EPA (U.S. Environmental Protection Agency), 1993b, Approval of Petition for a Treatability Variance from the Land Disposal Restrictions (LDR) Treatment Standards for In-Tank Precipitation Filters Submitted by the U.S. Department of Energy (DOE) Field Office, Savannah River, October 1.

Harvey, S. A., 1994a, Bechtel Savannah River Incorporated, Aiken, South Carolina, Interoffice Memorandum to M. N. Hoganson, Halliburton NUS Corporation, Aiken, South Carolina, "EIS Information," September 19.

Harvey, S. A., 1994b, Bechtel Savannah River Incorporated, Aiken, South Carolina, Interoffice Memorandum to M. N. Hoganson, Halliburton NUS Corporation, Aiken, South Carolina, "Waste Management EIS Information (Partial)," September 19.

Hess, M. L., 1994a, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to H. L. Pope, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "Draft In-depth Option Analysis for Review and Comments," ESH-NEP-94-0099, July 29.

Hess, M. L., 1994b, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to H. L. Pope, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "Waste Min/Decon Systems," ESH-NEP-94-0155, September 29.

Hess, M. L., 1994c, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to H. L. Pope, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "Tank Farm Volume Waste Forecast," ESH-NEP-94-0147, September 27.

Hess M. L., 1994d, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to H. L. Pope, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "NMPD Liquid Waste Forecast," ESH-NEP-94-0150, September 28.

Hess, M. L., 1994e, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to H. L. Pope, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "Complete Set of Flow Sheets," ESH-NEP-94-0241, November 15.

Hess, M. L., 1994f, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to H. L. Pope, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "Storage & Disposal Capabilities," ESH-NEP-94-0226, October 28.

Hess, M. L., 1994g, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to H. L. Pope, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "WSRC Data Transmittal - Revised Options Analysis Executive Summary," ESH-NEP-94-0214, October 21.

Hess, M. L., 1994h, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to H. L. Pope, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "Operational Scenarios for Experimental Transuranic Waste Assay Facility for Waste Management Spreadsheets," ESH-NEP-994-0218, October 26.

Hess, M. L., 1994i, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to H. L. Pope, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "Selection of Soil Technology," ESH-NEP-94-0220, October 26.

Hess, M. L., 1994j, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to H. L. Pope, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "WSRC Data Transmittal - Use of TRUPACT-II to Transport Untreated Pu-238 Wastes (U)," ESH-NEP-95-0002, January 5.

Hess, M. L., 1994k, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to H. L. Pope, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "Smelter Volume Reduction Factors," ESH-NEP-94-0185, Westinghouse Savannah River Company, Aiken, South Carolina, October 10.

Hess, M. L., 1995a, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to H. L. Pope, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "WSRC Data Transmittal - Summary of Changes Between Draft and Final WMEIS Forecasts and Alternatives," ESH-NEP-95-0084, May 15.

Hess, M. L., 1995b, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to H. L. Pope, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "WSRC Data Transmittal - Responses to BRE Questions on Vaults and CIF Fuel Oil Utilization," ESH-NEP-95-0076, May 4.

Hess, M. L., 1995c, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to H. L. Pope, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "WSRC Data Transmittal - Spreadsheets for Final EIS," ESH-NEP-95-0090, May 17.

Hess, M. L., 1995d, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to H. L. Pope, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "WSRC Data Transmittal - Table 2.3-6 WMEIS Ranking of Various Facilities/Technologies," ESH-NEP-95-0079, May 5.

Hess, M. L., 1995e, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to H. L. Pope, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "WSRC Data Transmittal - Revised Facility Costs for the No-Action Alternative and Revised Employees for Alternative A, Minimum Forecast (U)," ESH-NEP-95-0085, May 16.

Hess, M. L., 1995f, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to H. L. Pope, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "WSRC Data Transmittal - Complete Copy of Cost Model for WMEIS," ESH-NEP-95-0078, May 5.

Larkin, G. F., 1994, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to M. N. Hoganson, Halliburton NUS Corporation, Aiken, South Carolina, "1994 ALD/Special Projects Waste Minimization," September 21.

Martin Marietta (Martin Marietta Energy Systems), EG&G (EG&G - Idaho), and WSRC (Westinghouse Savannah River Company), 1994, *Radiological Performance Assessment for the E-Area Vaults Disposal Facility*, WSRC-RP-94-218, Westinghouse Savannah River Company, Aiken, South Carolina.

Miller, J. A., 1994, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to M. N. Hoganson, Halliburton NUS Corporation, Aiken, South Carolina, "Waste Management EIS," September 27.

Roberts, J. S., 1985, Westinghouse Savannah River Company, Aiken, South Carolina, Letter to S. R. Wright, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "Hazardous Waste Minimization Program," August 28.

Stone, K. A., 1994a, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to M. N. Hoganson, Halliburton NUS Corporation, Aiken, South Carolina, "Information Needs for the Waste Management EIS," September 15.

Stone, K. A., 1994b, Westinghouse Savannah River Company, Aiken, South Carolina, Memorandum to L. C. Thomas, Westinghouse Savannah River Company, Aiken, South Carolina, "Waste Minimization Initiatives," SWE-WGS-94-0211, September 16.

Stone, K. A., 1994c, Westinghouse Savannah River Company, Aiken, South Carolina, Memorandum to Distribution, "Savannah River Site Pollution Prevention and Waste Minimization Second Quarter CY 1994 Report," SWE-WGS-94-1062, August 4.

Stone, K. A., 1994d, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to M. N. Hoganson, Halliburton NUS Corporation, Aiken, South Carolina, October 5.

Swygert, R., 1994, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to E. M. Rollins, Halliburton NUS Corporation, Aiken, South Carolina, "Savannah River Site Truck Traffic," September 30.

Tuthill, B. J., 1994, Westinghouse Savannah River Company, Aiken, South Carolina, Letter to A. Harris, Continental Industrial Chemicals, Inc., Greenville, South Carolina, "Contract DE-AC09-89SR18035," July 28.

Ucak, M., and D. Noller, 1994, *Feasibility Study for a Solid Waste Treatment Complex*, WSRC-TR-90-353, Westinghouse Savannah River Company, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1990, *Savannah River Site Waste Minimization Plan*, WSRC-RP-90-263, Revision 2, Aiken, South Carolina, May 8.

WSRC (Westinghouse Savannah River Company), 1991, *Treatability Variance for In-Tank Precipitation Filters*, WSRC-RP-91-777, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1993a, *Savannah River Site Decontamination and Decommissioning Program Facilities Plan*, WSRC-IM-93-10, Revision 0, Aiken, South Carolina, February 25.

WSRC (Westinghouse Savannah River Company), 1993b, *Savannah River Site Solid Waste Management Program Plan - FY93*, WSRC-RP-93-89, Aiken, South Carolina, June.

WSRC (Westinghouse Savannah River Company), 1993c, *1992 RCRA Part B Permit Renewal Application - Savannah River Site*, Volume II, Book 1 of 1, Hazardous Waste Storage Facility, WSRC-IM-91-53, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1993d, *RCRA Part A Application for a Hazardous Waste Permit*, Tab AH, Liquid Waste Solvent Tanks S33-S36, Revision 9, Aiken, South Carolina. February 16.

WSRC (Westinghouse Savannah River Company), 1994a, *Thirty Year Solid Waste Generation Forecast for Facilities at SRS*, WSRC-RP-94-532, Revision 4, Aiken, South Carolina, July.

WSRC (Westinghouse Savannah River Company), 1994b, *Thirty Year Decontamination and Decommissioning Waste Generation Forecast for Facilities at SRS (U)*, WSRC-RP-94-496, Revision 0, Aiken, South Carolina, May 9.

WSRC (Westinghouse Savannah River Company), 1994c, *Thirty-Year Solid Waste Generation Forecast by Treatability Group (U)*, WSRC-RP-94-584, Revision 1, Aiken, South Carolina, June 14.

WSRC (Westinghouse Savannah River Company), 1994d, *Thirty-Year Solid Waste Generation Maximum and Minimum Forecast for SRS*, WSRC-RP-94-585, Revision 0, Aiken, South Carolina, July 29.

WSRC (Westinghouse Savannah River Company), 1994e, *Department of Energy, Savannah River Site Waste Minimization and Pollution Prevention Awareness Plan*, FY 1995, WSRC-RP-93-1494, Savannah River Site, Aiken, South Carolina, June 27.

WSRC (Westinghouse Savannah River Company), 1994f, *High Level Waste System Plan*, HLW-OVP-94-0077, Revision 3 (U), WSRC High Level Waste Management Division, Savannah River Site, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1994g, *DOE Directive Compliance Assessment and Implementation Report*, WSRC-RP-93-668-044, Revision 1, Aiken, South Carolina, September 20.

WSRC (Westinghouse Savannah River Company), 1994h, *RCRA Part A Application for a Hazardous Waste Permit,* Tab AF, Mixed Waste Storage Building 316-M, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1994i, *Solvent Storage Tanks (S23-S30) Interim Closure Plan*, SWE-SWE-94-0279, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1994j, *Strategy Proposal for Interim Storage of Hazardous, Mixed, and Non-Mixed TRU and Low-Level Mixed Wastes (U)*, WSRC-RP-94-767, Revision 0, Aiken, South Carolina, August.

WSRC (Westinghouse Savannah River Company), 1994k, *Technology Selection Methodology for the Waste Management EIS (U)*, WSRC-RP-94-1215, Revision 0, Aiken, South Carolina, December.

WSRC (Westinghouse Savannah River Company), 1995, *SRS Proposed Site Treatment Plan*, WSRC-TR-94-0608, Aiken, South Carolina.

CHAPTER 3. AFFECTED ENVIRONMENT

This chapter describes the existing environmental and socioeconomic characteristics of the Savannah River Site (SRS) and nearby region that could be affected by the proposed action or its alternatives. The data presented in this chapter are required to assess the consequences of the proposed action and its alternatives.

3.1 Introduction

SRS is located in southwestern South Carolina adjacent to the Savannah River, which forms the boundary between South Carolina and Georgia. It encompasses approximately 800 square kilometers (300 square miles) within the Atlantic Coastal Plain physiographic province. SRS is approximately 40 kilometers (25 miles) southeast of Augusta, Georgia, and 32 kilometers (20 miles) south of Aiken, South Carolina. Figure 3-1 shows the location of SRS within the South Carolina-Georgia region.

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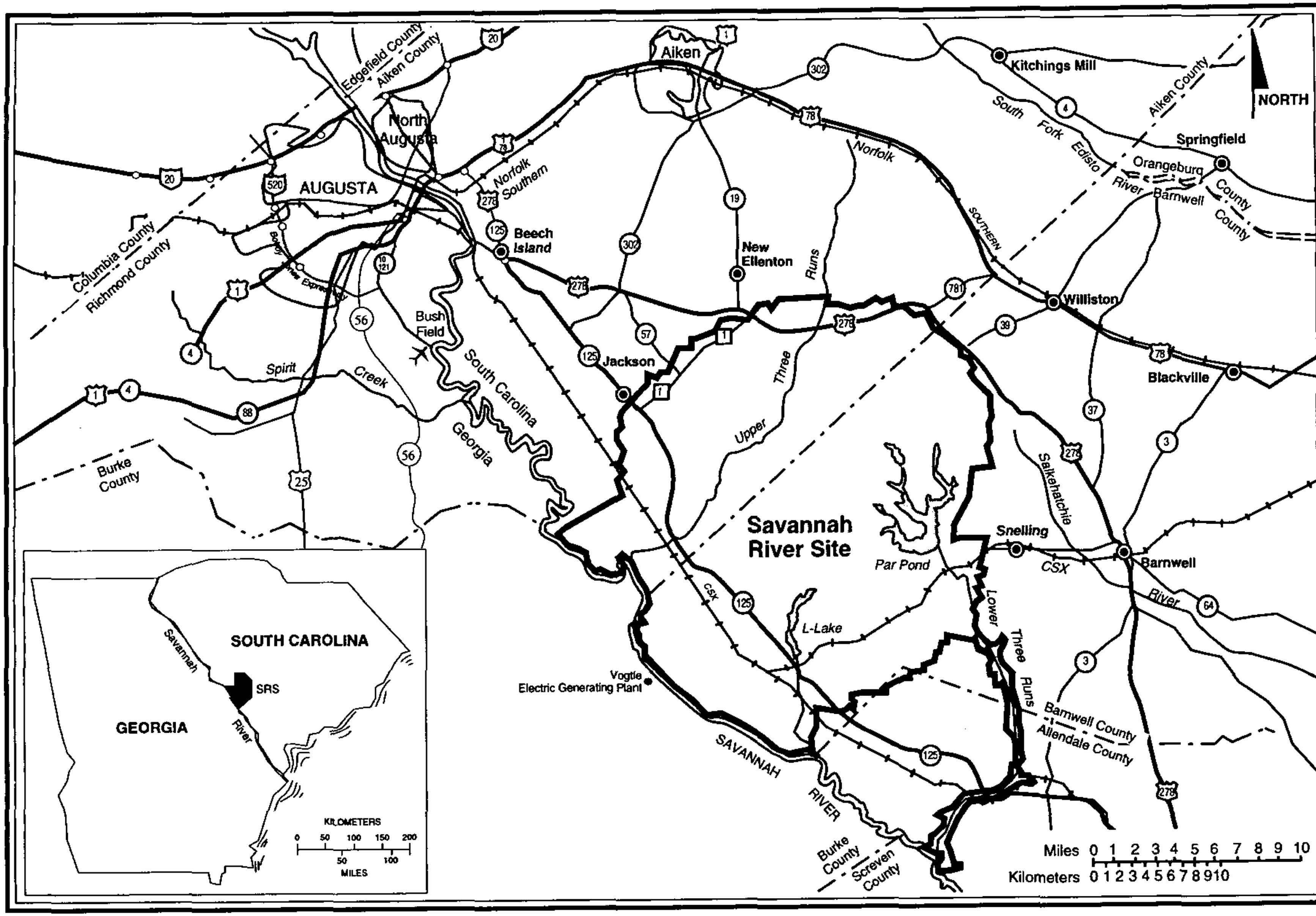
SRS is a controlled area with limited public access. Through traffic is allowed only on SC Highway 125, U.S. Highway 278, SRS Road 1, and CSX railroad corridors (Figure 3-1). Figure 3-2 shows SRS areas and facilities, which include five nuclear production reactors (C-, K-, L-, P-, and R-Reactors); a nuclear target and fuel fabrication facility (M-Area), which assembled the targets and fuel that went into the reactors; two chemical separations areas (F- and H-Areas), which processed irradiated targets and fuel assemblies to separate and recover various isotopes and which contain the liquid high-level radioactive waste tank farms; a waste vitrification facility (S-Area), which vitrifies liquid high-level radioactive waste; a saltstone facility (Z-Area), which solidifies low-level radioactive sludge into a cement-like matrix; N-Area, where some wastes are stored; E-Area, which includes waste treatment, storage, and disposal facilities; and various administrative, support, and research facilities. These facilities have generated a variety of liquid high-level radioactive, low-level radioactive, hazardous, mixed (hazardous and radioactive), and transuranic wastes. Section 3.13 provides photographs and descriptions of specific waste management facilities. Section 4.4.15 and Appendix B also describe facilities at SRS.



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TE | **Figure 3-1.** Savannah River Site (SRS).

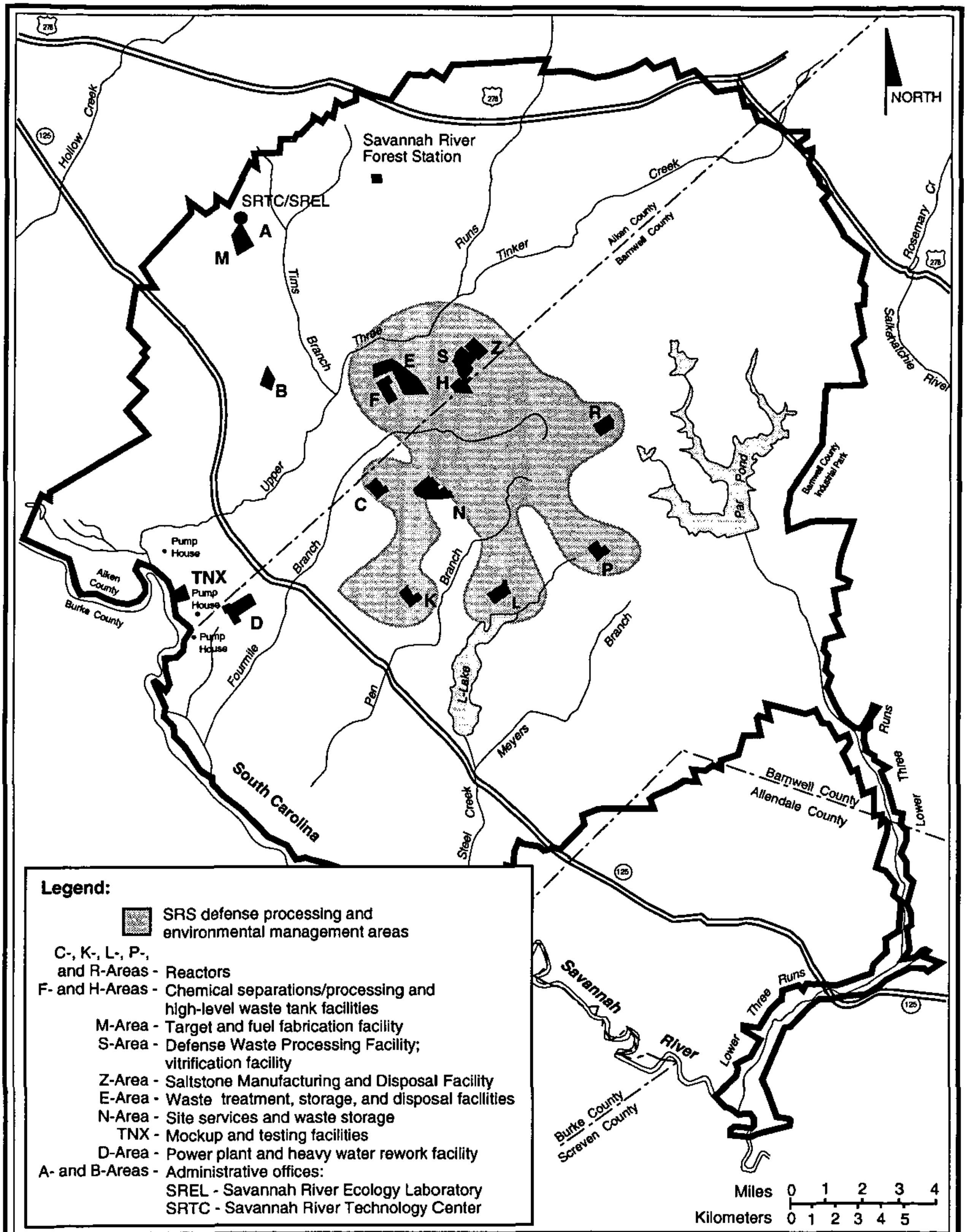

Figure 3-2. SRS areas and facilities.

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3.2 Geologic Resources

3.2.1 SOILS AND TOPOGRAPHY

SRS is located on the Aiken Plateau of the Upper Atlantic Coastal Plain physiographic province about 40 kilometers (25 miles) southeast of the Fall Line that separates the Atlantic Coastal Plain from the TE Piedmont physiographic province (Figure 3-3). The Aiken Plateau is highly dissected and consists of broad, flat areas between streams and narrow, steep-sided valleys. It slopes from an elevation of approximately 200 meters (650 feet) at the Fall Line to an elevation of about 75 meters (250 feet) on the southeast edge of the plateau. Because of SRS's proximity to the Piedmont province, it is somewhat more hilly than the near-coastal areas, with onsite elevations ranging from 27 to 128 meters (90 to 420 feet) above sea level. Relief on the Aiken Plateau is as much as 90 meters (300 feet) locally. The TE plateau is generally well drained, although small poorly drained depressions do occur. The *Final Environmental Impact Statement, Continued Operation of K-, L-, and P-Reactors, Savannah River Site, Aiken, South Carolina* (DOE 1990) contains a complete description of the geologic setting and the stratigraphic sequences at SRS.

Previously disturbed soils are mostly well drained and were taken from excavated areas, borrow pits, and other areas where major land-shaping or grading activities have occurred. These soils are found beside and under streets, sidewalks, buildings, parking lots, and other structures. Much of the soil in the existing waste management areas has been moved, so soil properties can vary within a few meters. Slopes of soils generally range from 0 to 10 percent and have a moderate erosion hazard. These disturbed soils range from a consistency of sand to clay, depending on the source of the soil material (USDA 1990).

Undisturbed soils at SRS generally consist of sandy surface layers above a subsoil containing a mixture of sand, silt, and clay. These soils are gently sloping to moderately steep (0 to 10 percent grade) and have a slight erosion hazard (USDA 1990). Some soils on uplands are nearly level, and those on bottomlands along the major streams are level. Soils in small, narrow drainage valleys are steep. Most of the upland soils are well drained to excessively drained. The well-drained soils have a thick, sandy surface layer that extends to a depth of 2 meters (7 feet) or more in some areas. The soils on bottomlands range from well drained to very poorly drained. Some soils on the abrupt slope breaks have a dense, brittle subsoil.

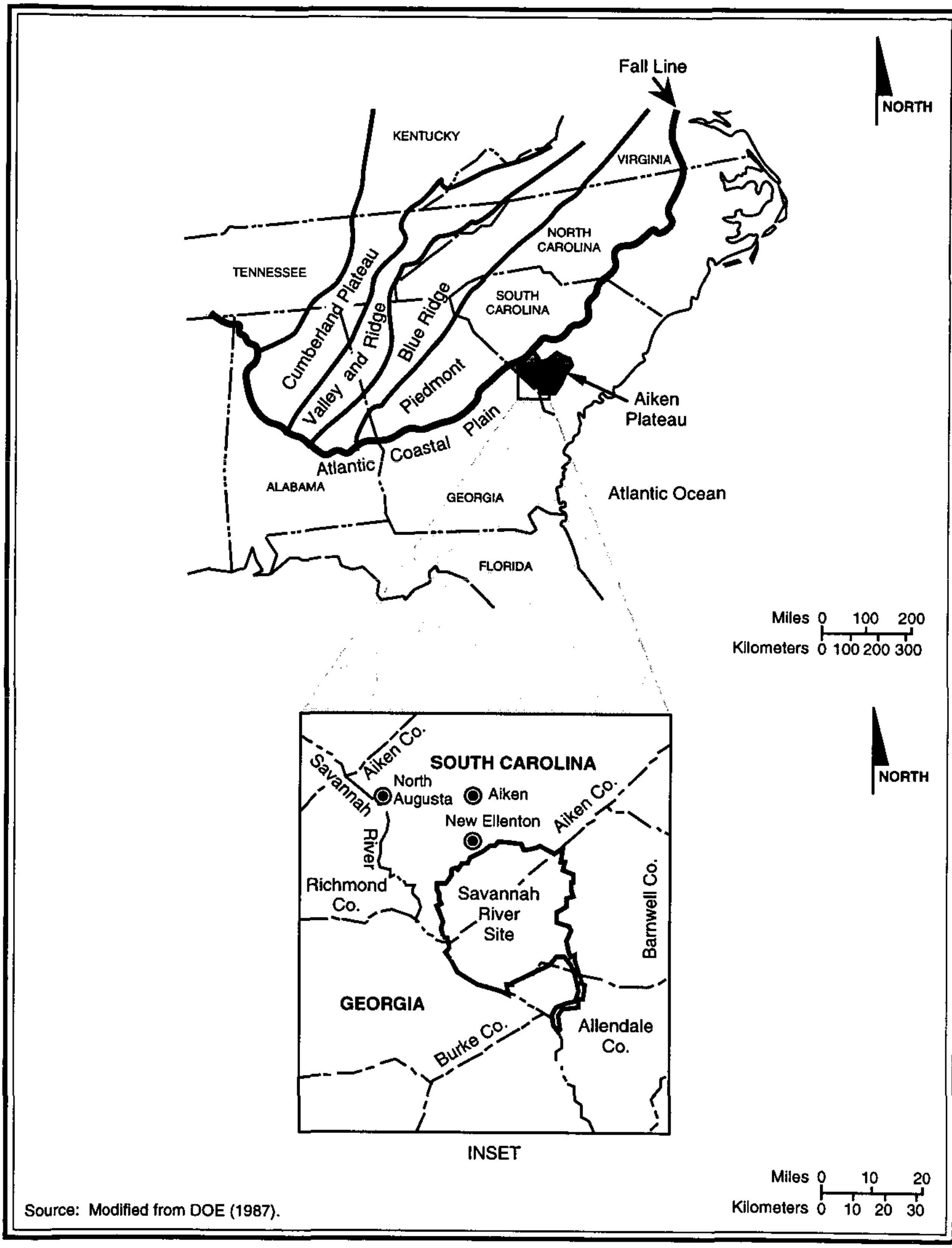

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Figure 3-3. General location of SRS and its relationship to physiographic provinces of the southeastern United States. | TE

3.2.2 GEOLOGIC STRUCTURES

Several fault systems occur offsite, northwest of the Fall Line. DOE (1990) contains a detailed discussion of these offsite geologic features. A recent study (Stephenson and Stieve 1992) identified six faults under SRS: Pen Branch, Steel Creek, Advanced Tactical Training Area (ATTA), Crackerneck, TE | Ellenton, and Upper Three Runs Faults. Identification of faults is important because earthquakes can occur along these faults. The location of faults must be considered when siting hazardous waste management facilities. South Carolina Department of Health and Environmental Control (SCDHEC) regulations specify a setback distance of at least 61 meters (200 feet) from a fault where displacement during the Holocene Epoch (approximately 35,000 years ago to the present) has occurred. None of the waste management areas occur within 61 meters (200 feet) of any faults, nor is there evidence that any of the identified faults have moved in the last 35,000 years. Based on information developed to date, none of the faults discussed in this section are considered "capable," as defined by the Nuclear Regulatory Commission in 10 CFR 100, Appendix A. The capability of a fault is determined by several criteria, one TE | of which is whether the fault has moved at or near the ground surface within the past 35,000 years.

Several subsurface investigations conducted on SRS waste management areas encountered soft sediments classified as calcareous sands. These sands contain calcium carbonate (calcite), which can be dissolved by water. The calcareous sands were encountered in borings in S-, H-, and Z-Areas between 33 and 45 meters (110 to 150 feet) below ground surface. Preliminary information indicates that these calcareous zones are not continuous over large areas, nor are they very thick. If the calcareous material TE | dissolved, possible underground subsidence could result in settling at the ground surface. No such settling has been reported at any of the waste management facilities; however, the U.S. Department of Energy (DOE) is currently investigating potential impacts of subsidence.

3.2.3 SEISMICITY

Two major earthquakes have occurred within 300 kilometers (186 miles) of SRS. The first was the Charleston, South Carolina, earthquake of 1886, which had an estimated Richter scale magnitude of 6.8 and occurred approximately 145 kilometers (90 miles) from SRS. The SRS area experienced an estimated peak horizontal acceleration of 10 percent of gravity (0.10*g*) during this earthquake (URS/Blume 1982). The second major earthquake was the Union County, South Carolina, earthquake of 1913, which had an estimated Richter scale magnitude of 6.0 and occurred about 160 kilometers (99 miles) from SRS (Bollinger 1973). Because these earthquakes have not been conclusively associated with a specific fault, researchers cannot determine the amount of displacement resulting from them.

Two earthquakes occurred during recent years inside the SRS boundary. On June 8, 1985, an earthquake with a local Richter scale magnitude of 2.6 and a focal depth of 0.96 kilometer (0.59 mile) occurred at SRS. The epicenter was west of C- and K-Areas (Figure 3-4). The acceleration produced by the earthquake did not activate seismic monitoring instruments in the reactor areas (which have detection limits of 0.002*g*). On August 5, 1988, an earthquake with a local Richter scale magnitude of 2.0 and a focal depth of 2.68 kilometers (1.66 miles) occurred at SRS. Its epicenter was northeast of K-Area (Figure 3-4). The seismic alarms in SRS facilities were not triggered. Existing information does not conclusively correlate the two earthquakes with any of the known faults on the site. TE TE

A report on the August 1988 earthquake (Stephenson 1988) reviewed the latest earthquake history. The report predicts a recurrence rate of 1 earthquake per year at a Richter scale magnitude of 2.0 in the southeast Coastal Plain. However, the report also notes that historic data that can be used to accurately calculate recurrence rates are sparse.

A Richter scale magnitude 3.2 earthquake occurred on August 8, 1993, approximately 16 kilometers (10 miles) east of the city of Aiken near Couchton, South Carolina. Residents reported feeling this earthquake in Aiken, New Ellenton (immediately north of SRS), and North Augusta, South Carolina [approximately 40 kilometers (25 miles) northwest of SRS]. Although detected by SRS instruments, no seismic alarms were triggered.

The current design basis earthquake that nuclear safety-related facilities are engineered to withstand is one that would produce a horizontal peak ground acceleration of 20 percent of gravity (0.2g). Based on current estimates, an earthquake of this magnitude or greater can be expected to occur about once every 5,000 years.

3.3 Groundwater

This section updates the detailed water resources information provided in the *Final Environmental Impact Statement, Waste Management Activities for Groundwater Protection, Savannah River Plant, Aiken, South Carolina* (DOE 1987) and in DOE (1990), and incorporates the latest aquifer terminology used at SRS.

3.3.1 AQUIFER UNITS

The most important hydrologic system underlying SRS occurs above the Piedmont hydrogeologic province in the Coastal Plain sediments, in which groundwater flows through porous sands and clays.

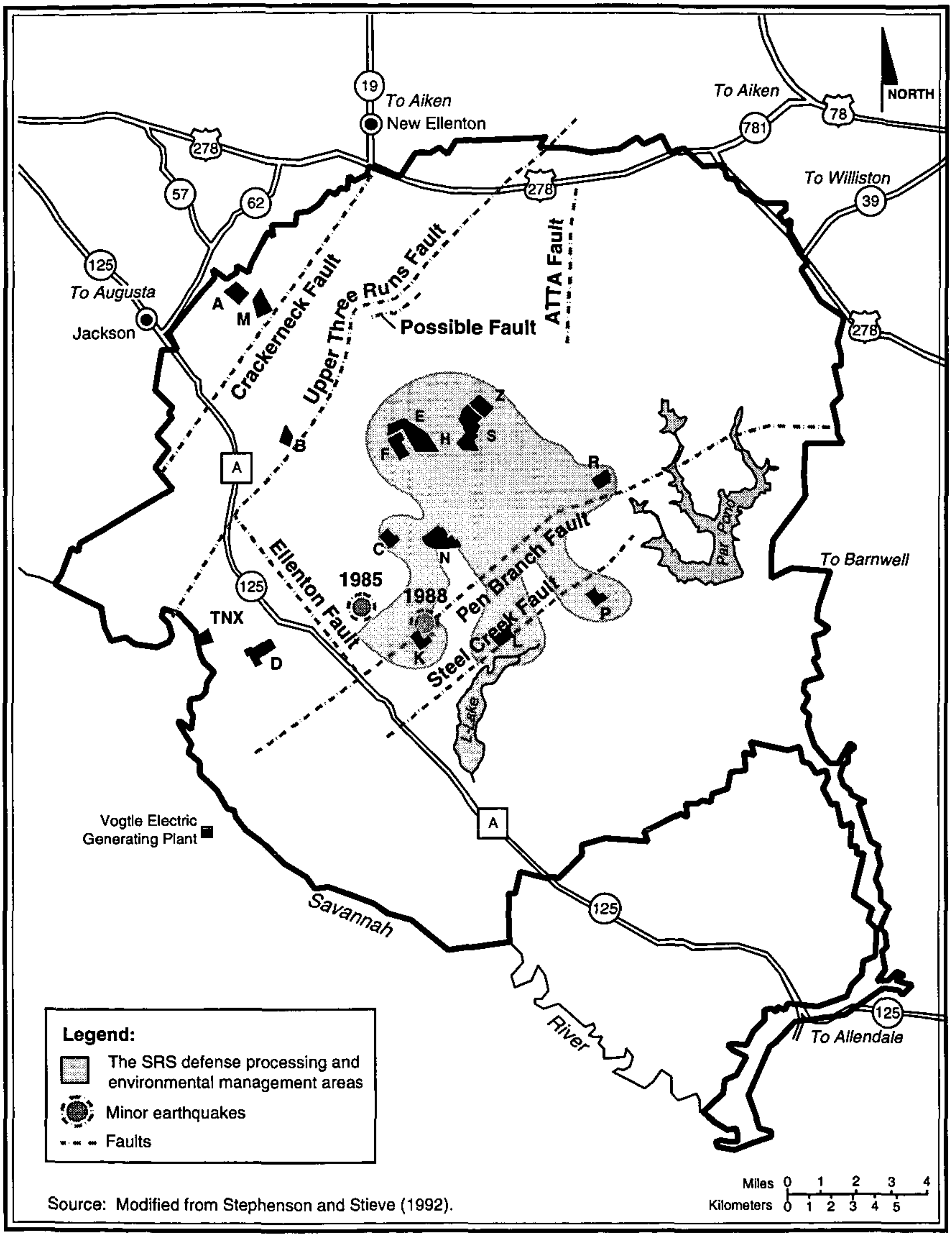

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Figure 3-4. Geologic faults of SRS. | TE

Figure 3-5 names the geologic formations based on the physical character of the rocks (lithostratigraphy) and the corresponding names used to identify their water-bearing properties (hydrostratigraphy); this figure also identifies the shallow, intermediate, and deep aquifers. This EIS uses depth-based identification to simplify discussions of groundwater resources and consequences. More detailed discussions of SRS groundwater features are available in DOE (1987) and DOE (1990).

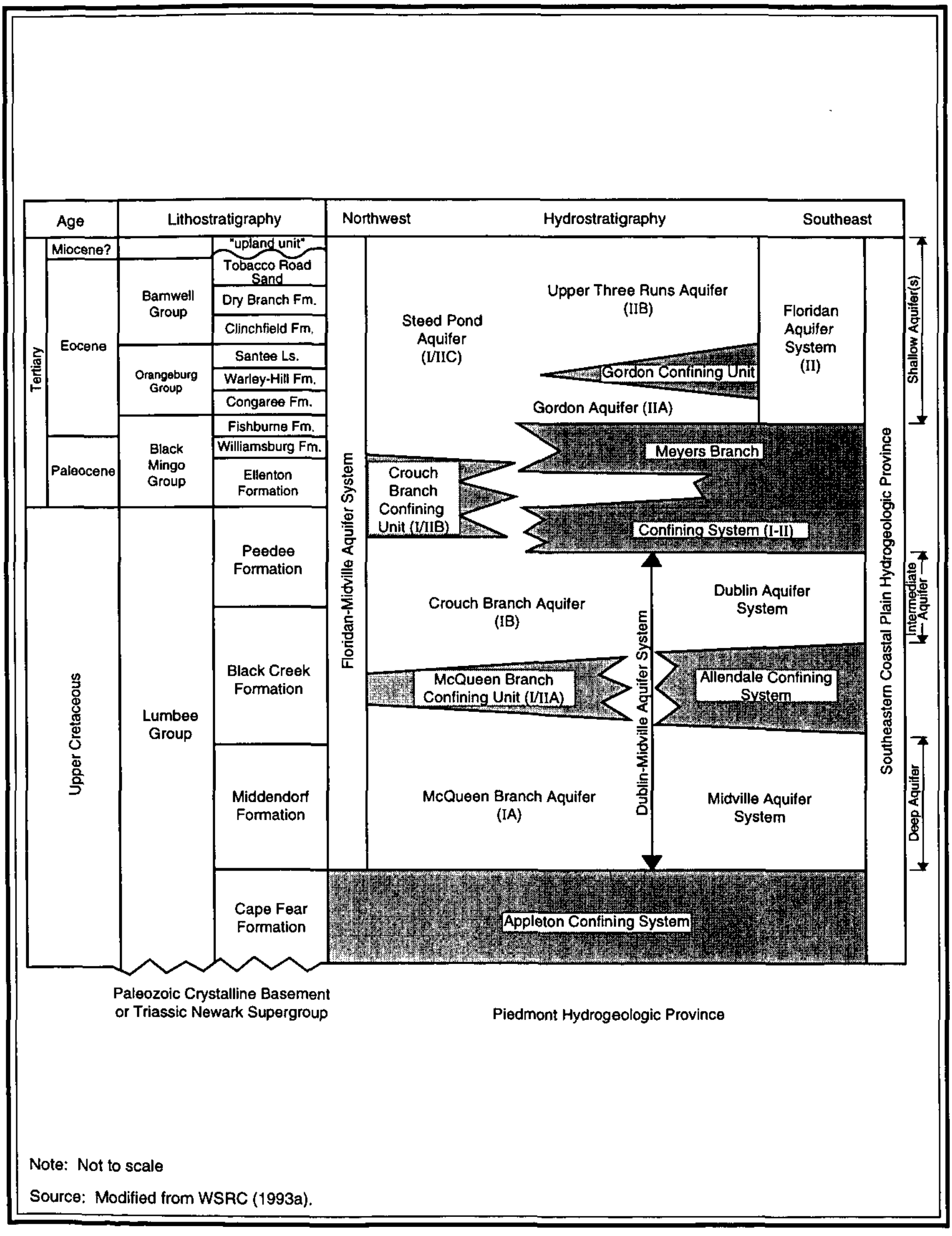
3.3.2 GROUNDWATER FLOW

Groundwater beneath SRS flows at rates ranging from a few centimeters (inches) per year to several hundred meters (feet) per year toward streams and swamps on the site and into the Savannah River.

At SRS, groundwater movement is controlled by the depths of the incisions of creeks and streams where water discharges to the surface. The valleys of the smaller perennial streams collect discharge from the shallow aquifers. Groundwater in the intermediate aquifer flows to Upper Three Runs or to the Savannah River. Water in the deep aquifer beneath SRS flows toward the Savannah River or southeast toward the coast. Beneath some of SRS, groundwater flow is predominantly downward from the upper to the lower parts of the shallow aquifer. This downward flow occurs under A-, M-, L-, and P-Areas. In other areas, groundwater flow is upward, from the lower to the upper parts of the shallow aquifer and from the deep aquifer to the lower part of the shallow aquifer. This upward flow occurs, for example, in the separations (F and H) areas and around C-Area. The upward flow increases near Upper Three Runs. | TE

This section and Section 3.3.3 present groundwater flow and quality, respectively, associated with waste units with known or potential releases to the subsurface. Waste units discussed in these sections are listed in the SRS Federal Facility Agreement (EPA 1993a); Appendix G.1 of this EIS (Resource Conservation and Recovery Act (RCRA)/Comprehensive Environmental Response, Compensation and Liability Act Units List) - sites with known releases; Appendix G.2 of this EIS (RCRA Regulated Units) or Appendix G.3 of this EIS (Site Evaluation List) - sites with potential releases to be investigated. Table 3-1 lists these waste units by area and the known contaminants for each area (or group of waste units). Refer to Figure 3-6 for the location of these units. | TE

Some SRS facilities that will be investigated in the future for potential groundwater remediation (and the horizontal flow directions of the groundwater beneath them) include the M-Area Metallurgical Laboratory (horizontal flow to the west-northwest in the shallow aquifer and to the south toward Upper Three Runs in the intermediate aquifer); K-Area seepage basin (flow to the southwest toward Indian



TE **Figure 3-5.** Comparison of lithostratigraphy and hydrostratigraphy for the SRS region.

Table 3-1. Waste units associated with known or potential releases to the groundwater at SRS.[a]

Area	Waste Units	Contaminants
A- and M-Areas	• M-Area Hazardous Waste Management Facility • Metallurgical Laboratory Seepage Basin • Savannah River Technology Center (SRTC) Seepage Basins	Volatile organic compounds (VOCs), radionuclides, metals, nitrates
Reactor Areas	• Reactor Seepage Basins • Acid/Caustic Basins • K-Area Retention Basin • L-Area Oil/Chemical Basin	C-, K-, L-, and P-Areas: tritium, other radionuclides, metals, VOCs R-Area: radionuclides, cadmium
E-Area, Separations (F and H) Areas	• Burial Ground Complex • Mixed Waste Storage • F/H Seepage Basins • F/H Tank Farms • H-Area Retention Basin	Tritium, other radionuclides, metals, nitrate, sulfate, VOCs
G-Area	• Sanitary Landfill	Tritium, lead, VOCs
TNX	• Seepage Basins • Burying Ground	Radionuclides, VOCs, nitrate
D-Area	• Oil Disposal Basin	Metals, radionuclides, VOCs, sulfate

a. Source: Modified from Arnett, Karapatakis, and Mamatey (1993).

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Grave Branch); L-Area seepage basin (flow toward Pen Branch and L-Lake); and the P-Area seepage basin (flow toward Steel Creek). F- and H-Areas and vicinity are on a surface and groundwater divide; shallow groundwater flows toward either Upper Three Runs or Fourmile Branch.

For further technical discussions of groundwater flow beneath waste units of interest for this EIS, as well as beneath SRS in general, for the relationships of groundwater flow between the three main aquifers, and for values for aquifer properties that are useful in analysis of groundwater flow and consequences, see DOE (1987, 1990). TE

3.3.3 GROUNDWATER QUALITY

Groundwater of excellent quality is abundant in this region of South Carolina from many local aquifers. The water in Coastal Plain sediments is generally of good quality and suitable for municipal and industrial use with minimum treatment. The water is generally soft, slightly acidic (pH of 4.9 to 7.7),

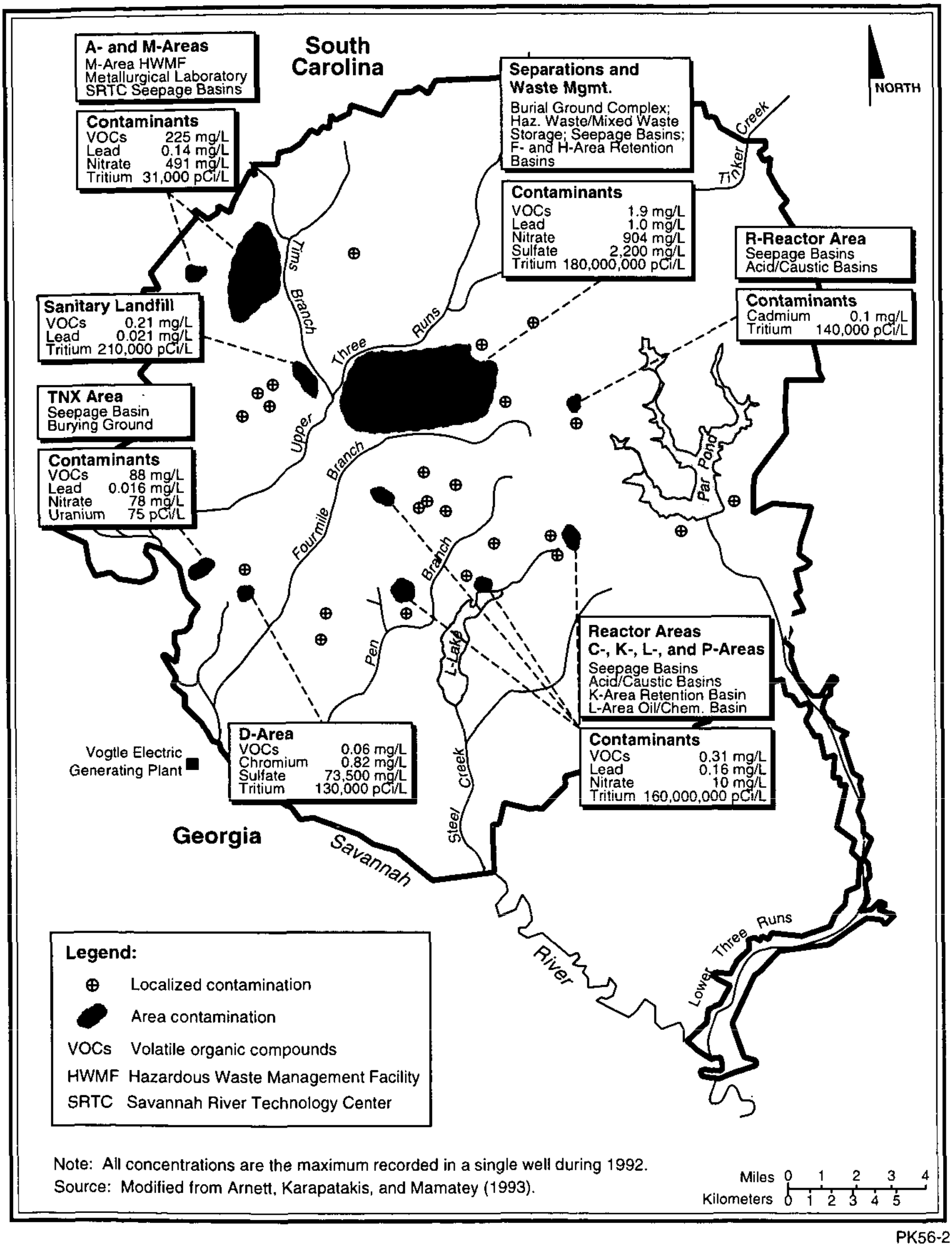

Figure 3-6. Groundwater contamination at SRS. | TE

and low in dissolved and suspended solids. High dissolved iron concentrations occur in some aquifers. Groundwater is the only source of domestic water at SRS and where necessary, it is treated to raise the pH and remove the iron.

Industrial solvents, metals, tritium, and other constituents used or generated at SRS have contaminated the shallow aquifers beneath 5 to 10 percent of SRS (Arnett, Karapatakis, Mamatey 1993). Localized contamination of groundwater in the deep aquifer was found in the early 1980s beneath M-Area. Low concentrations of trichloroethylene (11.7 milligrams per liter) have been detected in water from a production well in M-Area. Similarly, low trichloroethylene values have been detected in a few other wells used for process water (du Pont 1983). Groundwater contamination has not been detected outside SRS boundaries. Figure 3-6 shows (1) the locations of facilities where SRS monitors groundwater, (2) areas with constituents that exceeded drinking water standards (40 CFR Part 141) in 1992, and (3) waste units associated with known or potential releases that may require groundwater remediation. Most contaminated groundwater at SRS occurs beneath a few facilities; contaminants reflect the operations and chemical processes performed at those facilities. For example, contaminants in the groundwater beneath A- and M-Areas include chlorinated volatile organic compounds, radionuclides, metals, and nitrate. At F- and H-Areas, contaminants in the groundwater include tritium and other radionuclides, metals, nitrate, chlorinated volatile organic compounds, and sulfate. At the reactors (C-, K-, L-, and P-Areas), tritium, other radionuclides, and lead are present in the groundwater. At D-Area, contaminants in the groundwater include volatile organic compounds, chromium, nickel, lead, zinc, iron, sulfate, and tritium. A recent SRS annual environmental report (Arnett, Karapatakis, and Mamatey 1993) presents specific groundwater data from more than 1,600 monitoring wells at SRS, including approximately 120 wells in A- and M-Areas, 218 plume-definition wells in these areas, 8 wells in the areas of the reactors of interest, and more than 350 wells in F- and H-Areas. TE

After the discovery in 1981 that groundwater beneath A- and M-Areas was contaminated with volatile organic compounds, SRS established an assessment program to define the extent and migration rate of the contamination. A groundwater extraction system was installed in 1983 and modified in 1985. It consists of 11 wells which pump more than 1,890 liters (500 gallons) per minute from the lower section of the shallow aquifer and an air stripper process which removes the volatile organic compounds. The treated waste is discharged to Tims Branch and Upper Three Runs through permitted outfalls.

3.3.4 GROUNDWATER USE

Groundwater is a domestic, municipal, and industrial water source throughout the Upper Coastal Plain. Most municipal and industrial water supplies in Aiken County are from the deep aquifers. Domestic water supplies are primarily from the intermediate and shallow aquifers. In Barnwell and Allendale Counties, the intermediate zone and overlying units that thicken to the southeast supply some municipal users. At SRS, most groundwater production is from the deep aquifer, with a few lower-capacity wells pumping from the intermediate zone. Every major operating area at SRS has groundwater-producing wells. Total groundwater production at SRS is from 34,000 to 45,000 cubic meters (9 to 12 million gallons) per day, similar to the volume pumped for industrial and municipal production within 16 kilometers (10 miles) of SRS.

DOE has identified 56 major municipal, industrial, and agricultural groundwater users within 32 kilometers (20 miles) of the center of SRS (DOE 1987). The total amount pumped by these users, excluding SRS, is about 135,000 cubic meters (36 million gallons) per day.

3.4 Surface Water

3.4.1 SAVANNAH RIVER

The Savannah River is the southwestern border of SRS for about 32 kilometers (20 miles). SRS is approximately 260 river kilometers (160 river miles) from the Atlantic Ocean. At SRS, river flow averages about 283 cubic meters (10,000 cubic feet) per second. Three large upstream reservoirs, Hartwell, Richard B. Russell, and Strom Thurmond/Clarks Hill, moderate the effects of droughts and the impacts of low flows on downstream water quality and fish and wildlife resources in the river.

The Savannah River, which forms the boundary between Georgia and South Carolina, supplies potable water to several municipal users. Immediately upstream of SRS, the river supplies domestic and industrial water to Augusta, Georgia, and North Augusta, South Carolina. The river also receives sewage treatment plant effluents from Augusta, Georgia; North Augusta, Aiken, and Horse Creek Valley, South Carolina; and from a variety of SRS operations through permitted stream discharges. Approximately 203 river kilometers (126 river miles) downstream of SRS, the river supplies domestic and industrial water for the Port Wentworth (Savannah, Georgia) water treatment plant at river kilometer 47 (river mile 29) and for Beaufort and Jasper Counties in South Carolina at river kilometer 63 (river mile 39.2). In addition, Georgia Power's Vogtle Electric Generating Plant withdraws an average of 1.3 cubic meters (46 cubic feet) per second for cooling and returns an average of 0.35 cubic meters (12 cubic feet) per second. Also, the South Carolina Electric and Gas Company's Urquhart Steam Generating Station at Beech Island, South Carolina, withdraws approximately 7.4 cubic meters (261 cubic feet) per second of once-through cooling water.

In 1992, SCDHEC changed the classification of the Savannah River and the SRS streams from "Class B waters" to "Freshwaters." The definitions of Class B waters and Freshwaters are the same, but the Freshwaters classification imposes a more stringent set of water quality standards. Table 3-2 provides data on water quality in the Savannah River upstream and downstream of SRS during 1992. Comparison of the upstream and downstream concentrations shows little impact from SRS discharges on the water quality of the Savannah River, except for an increase in the tritium concentration. Constituents of SRS discharges are within the guidelines for drinking water established by the U.S. Environmental Protection Agency (EPA), SCDHEC, and DOE. TE

3.4.2 SRS STREAMS TE

This section describes the pertinent physical and hydrological properties of the six SRS tributaries that drain to the Savannah River.

The five tributaries which discharge directly to the river from SRS are Upper Three Runs, Beaver Dam Creek, Fourmile Branch, Steel Creek, and Lower Three Runs (Figure 3-7). A sixth stream, Pen Branch, does not flow directly into the Savannah River but joins Steel Creek in the Savannah River floodplain swamp. These tributaries drain all of SRS with the exception of a small area on the northeast side. No development occurs in this area of SRS, which drains to an unnamed tributary of Rosemary Branch, a tributary of the Salkehatchie River. Each of these six streams originates on the Aiken Plateau in the Coastal Plain and descends 15 to 60 meters (50 to 200 feet) before discharging into the river. The streams, which historically have received varying amounts of effluent from SRS operations, are not commercial sources of water. The natural flow of SRS streams ranges from 0.3 cubic meter (11 cubic feet) per second in smaller streams such as Indian Grave Branch, a tributary to Pen Branch, to 6.8 cubic meters (240 cubic feet) per second in Upper Three Runs (Wike et al. 1994). TE

Upper Three Runs is a large, cool [annual maximum temperature of 26.1°C (79°F)] blackwater stream that discharges to the Savannah River in the northern part of SRS. It drains an area approximately 545 square kilometers (210 square miles), and during water year 1991 (a water year is October through September) had a mean discharge of 6.8 cubic meters (239 cubic feet) per second at the mouth of the creek (Wike et al. 1994). The 7-day, 10-year low flow (the lowest flow expected in any consecutive 7 days in any 10 years) is 2.8 cubic meters (100 cubic feet) per second. Upper Three Runs is approximately 40 kilometers (25 miles) long, with its lower 28 kilometers (17 miles) within the boundaries of the SRS. This creek receives more water from underground sources than other SRS streams and, therefore, has lower dissolved solids, hardness, and pH values. Upper Three Runs is the only major tributary on SRS that has not received thermal discharges. It receives surface water runoff

Table 3-2. Water quality in the Savannah River upstream and downstream from SRS (calendar year 1993).[a,b]

Parameter	Unit of measure[c]	MCL[d,e] or DCG[f]	Upstream Minimum[g]	Upstream Maximum[g]	Downstream Minimum	Downstream Maximum
Aluminum	mg/L	0.05-0.2[h]	0.174	0.946	0.182	0.838
Ammonia	mg/L	NA[i,j]	0.04	0.13	0.02	0.11
Cadmium	mg/L	0.005[d]	ND[k]	ND	ND	ND
Calcium	mg/L	NA	3.1	4.24	3.25	5.09
Chemical oxygen demand	mg/L	NA	ND	ND	ND	ND
Chloride	mg/L	250[h]	4	13	4	12
Chromium	mg/L	0.1[d]	ND	ND	ND	ND
Copper	mg/L	1.3[l]	ND	ND	ND	ND
Dissolved oxygen	mg/L	>5.0[m]	8.0	11.5	6.2	10.5
Fecal coliform	Colonies per 100 ml	1,000[m]	13	1,960	5	854
Gross alpha radioactivity	pCi/L	15[d]	<DL[n]	0.586	<DL	0.325
Iron	mg/L	0.3[h]	0.41	1.39	0.516	1.15
Lead	mg/L	0.015[l]	ND	0.002	ND	0.003
Magnesium	mg/L	NA	1.08	1.38	1.11	1.34
Manganese	mg/L	0.05[h]	0.067	0.088	0.04	0.064
Mercury	mg/L	0.002[d,e]	ND	ND	ND	ND
Nickel	mg/L	0.1[d]	ND	ND	ND	ND
Nitrite/Nitrate (as nitrogen)	mg/L	10[d]	0.17	0.31	0.18	0.31
Nonvolatile (dissolved) beta radioactivity	pCi/L	50[d]	0.393	3.17	0.959	3.12
pH	pH units	6.5-8.5[h]	6.0	6.8	6.0	6.7
Phosphate	mg/L	NA	ND	ND	ND	ND
Plutonium-238	pCi/L	1.6[f]	<DL	0.00086	<DL	0.00174
Plutonium-239	pCi/L	1.2[f]	<DL	0.000985	<DL	0.0012
Sodium	mg/L	NA	4.87	11.6	5.28	12.7
Strontium-90	pCi/L	8[f]	<DL	0.174	0.009	0.22
Sulfate	mg/L	250[h]	4.0	8.0	4.0	9.0
Suspended solids	mg/L	NA	5	17	5	16
Temperature	°C	32.2[o]	9.0	24.8	9.1	25.7
Total dissolved solids	mg/L	500[h]	48	75	49	90
Tritium	pCi/L	20,000[d,e]	<DL	726	66	1,920
Zinc	mg/L	5[h]	ND	ND	ND	0.012

a. Source: Arnett (1994).
b. Parameters are those DOE routinely measures as a regulatory requirement or as part of ongoing monitoring programs.
c. mg/L = milligrams per liter; a measure of concentration equivalent to the weight/volume ratio.
pCi/L = picocuries per liter; a picocurie is a unit of radioactivity; one trillionth of a curie.
d. Maximum Contaminant Level (MCL), EPA National Primary Drinking Water Standards (40 CFR Part 141). See glossary.
e. Maximum Contaminant Level (MCL): SCDHEC (1976a). See glossary.
f. DOE Derived Concentration Guides (DCGs) for water (DOE Order 5400.5, "Radiation Protection for the Public and the Environment"). DCG values are based on committed effective dose of 100 millirem per year for consistency with drinking water MCL of 4 millirem per year. See glossary.
g. Minimum concentrations of samples. The maximum listed concentration is the highest single result found during one sampling event.
h. Secondary Maximum Contaminant Level (SMCL). EPA National Secondary Drinking Water Regulations (40 CFR Part 143).
i. NA = none applicable.
j. Dependent upon pH and temperature.
k. ND = none detected.
l. Action level for lead and copper.
m. WQS = water quality standard. See glossary.
n. Less than (<) indicates concentration below analyses detection limit (DL).
o. Shall not exceed weekly average of 32.2°C (90°F) after mixing nor rise more than 2.8°C (5°F) in 1 week unless appropriate temperature criterion mixing zone has been established.

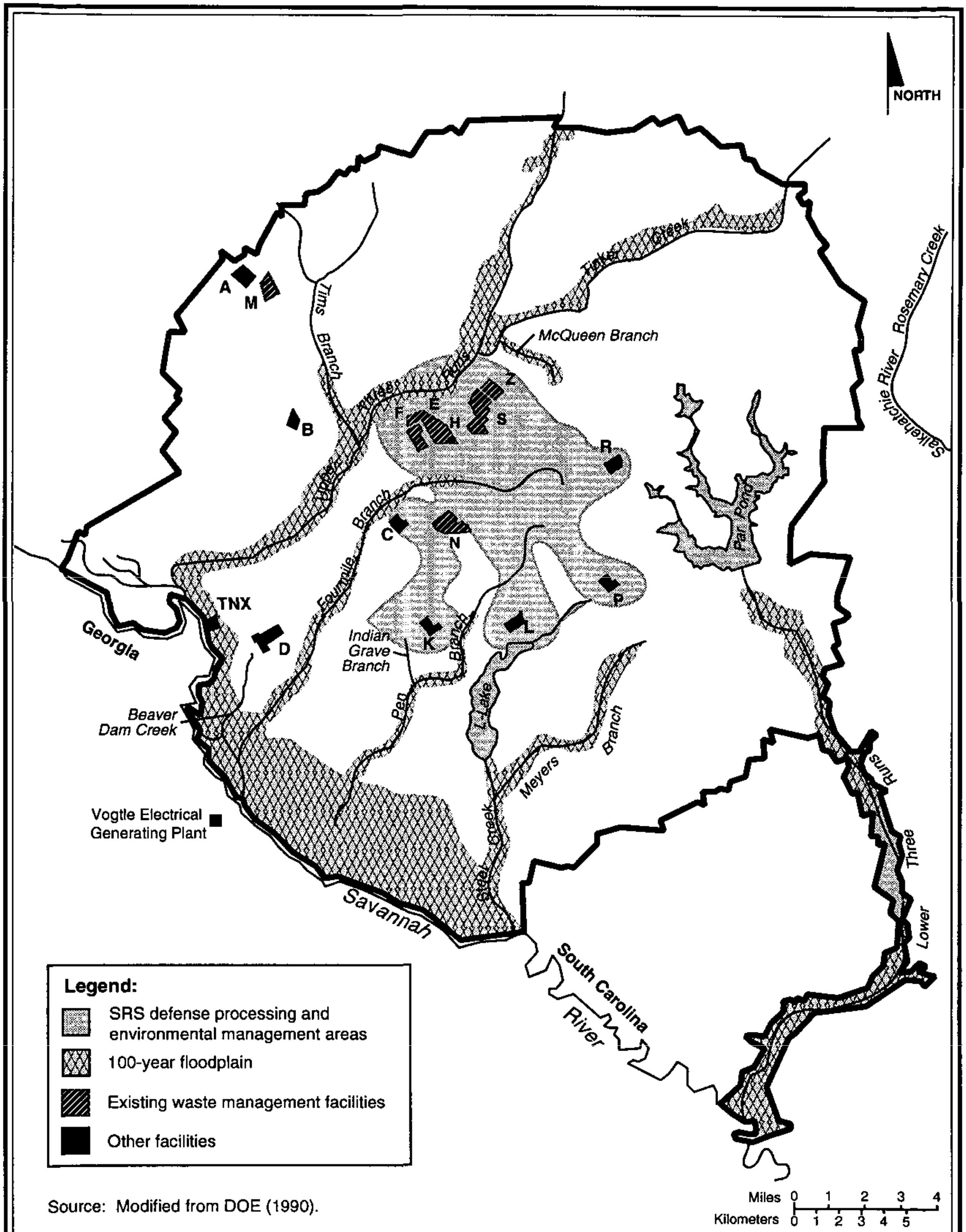

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Figure 3-7. Major stream systems and facilities at SRS.

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TE and water from permitted discharges in A-, E-, F-, H-, M-, S-, and Z-Areas. Table 3-3 presents maximum and minimum values for water quality parameters for Upper Three Runs for 1993. Water quality parameters for other onsite streams are presented in Appendix E.

Table 3-3. Water quality in Upper Three Runs downstream from SRS discharges (calendar year 1993).[a,b]

Parameter	Unit of measure[c]	MCL[d,e] or DCG[f]	Minimum[g]	Maximum[g]
Aluminum	mg/L	0.05-0.2[h]	0.018	0.261
Ammonia	mg/L	NA[i,j]	ND[k]	0.04
Cadmium	mg/L	0.005[d]	ND	ND
Calcium	mg/L	NA	ND	ND
Chemical oxygen demand	mg/L	NA	ND	ND
Chloride	mg/L	250[h]	2	3
Chromium	mg/L	0.1[d]	ND	ND
Copper	mg/L	1.3[l]	ND	ND
Dissolved oxygen	mg/L	>5[m]	5.0	12.5
Fecal coliform	Colonies per 100 ml	1,000[m]	52	1,495
Gross alpha radioactivity	pCi/L	15[d]	<DL[n]	3.57
Iron	mg/L	0.3[h]	0.363	0.709
Lead	mg/L	0.015[l]	ND	0.002
Magnesium	mg/L	NA	0.034	0.356
Manganese	mg/L	0.05[h]	0.012	0.034
Mercury	mg/L	0.002[d,e]	ND	ND
Nickel	mg/L	0.1[d]	ND	ND
Nitrite/Nitrate (as nitrogen)	mg/L	10[d]	0.10	0.19
Nonvolatile (dissolved) beta radioactivity	pCi/L	50[d]	0.205	3.94
pH	pH units	6.5-8.5[h]	5.2	8.0
Phosphate	mg/L	NA	ND	ND
Sodium	mg/L	NA	1.44	2.01
Strontium-89/90	pCi/L	-	<DL	0.783
Sulfate	mg/L	250[h]	1	3
Suspended solids	mg/L	NA	1	20
Temperature	°C	32.2[o]	9.7	24.4
Total dissolved solids	mg/L	500[h]	19	47
Tritium	pCi/L	20,000[d,e]	<DL	17,900
Zinc	mg/L	5[h]	ND	ND

a. Source: Arnett (1994).
b. Parameters are those DOE routinely measures as a regulatory requirement or as a part of ongoing monitoring programs.
c. mg/L = milligrams per liter; a measure of concentration equivalent to the weight/volume ratio.
pCi/L = picocuries per liter; a picocurie is a unit of radioactivity; a trillionth of a curie.
d. Maximum Contaminant Level (MCL), EPA National Primary Drinking Water Standards (40 CFR Part 141). See glossary.
e. Maximum Contaminant Level; SCDHEC (1976a). See glossary.
f. DOE Derived Concentration Guides (DCGs) for water (DOE Order 5400.5). DCG values are based on committed effective doses of 4 millirem per year for consistency with drinking water MCL of 4 millirem per year. See glossary.
g. Minimum concentrations of samples taken at the downstream monitoring station. The maximum listed concentration is the highest single result during one sampling event.
h. Secondary Maximum Contaminant Level (SMCL), EPA National Secondary Drinking Water Regulations (40 CFR Part 143).
i. NA = none applicable.
j. Depends on pH and temperature.
k. ND = none detected.
l. Action level for lead and copper.
m. WQS = water quality standard. See glossary.
n. Less than (<) indicates concentration below analysis detection limit (DL).
o. Shall not exceed weekly average of 32.2°C (90°F) after mixing nor rise more than 2.8°C (5°F) in 1 week unless appropriate temperature criterion mixing zone has been established.

Beaver Dam Creek is approximately 5 kilometers (3.1 miles) long and drains approximately 2.2 square kilometers (approximately 1 square mile). Beaver Dam Creek originates at the effluent canal of D-Area and flows south, parallel to Fourmile Branch. Some of the discharges of Fourmile Branch and Beaver Dam Creek mix in the Savannah River floodplain swamp before entering the Savannah River. Prior to SRS operations, Beaver Dam Creek had only intermittent or low flow. It has received thermal effluents since 1952 as a result of the cooling water operations from the heavy water production facility (shut down in 1982) and a coal-fired power plant in D-Area. Currently, Beaver Dam Creek receives condenser cooling water from the coal-fired power plant, neutralization wastewater, sanitary wastewater treatment effluent, ash basin effluent waters, and various laboratory wastewaters. In water year 1991, the mean flow rate for Beaver Dam Creek taken approximately 1 kilometer (0.6 miles) south of D-Area was 2.6 cubic meters (93 cubic feet) per second. The mean temperature found during the comprehensive cooling water study (conducted between 1983 and 1985) (Gladden et al. 1985) was 25°C (77°F), with a maximum temperature of 34°C (93°F) (Wike et al. 1994). As required by a Record of Decision (DOE 1988), water from the Savannah River is added to the D-Area powerhouse condenser discharges during the summer months to maintain the temperature of the stream below 32.2°C (90°F) (DOE 1987).

Fourmile Branch is a blackwater stream that previous SRS operations have affected. It originates near the center of SRS and follows a southwesterly route for approximately 24 kilometers (15 miles). It drains an area of about 57 square kilometers (21 square miles), receiving effluents from F- and H-Areas. It received C-Reactor effluent until C-Reactor was placed on shutdown status in 1987; however, thermal discharges ceased in 1985. When C-Reactor was operating, its discharge resulted in water temperatures in excess of 60°C (140°F). Since the shutdown of C-Reactor, the maximum recorded water temperature has been 31°C (89°F), with a mean temperature of 18.5°C (65°F). With C-Reactor discharge, the flow in Fourmile Branch measured about 11.3 cubic meters (400 cubic feet) per second. The average flow at SRS Road A-12.2 (southwest of SC Highway 125) in water year 1991 was 1.8 cubic meters (63 cubic feet) per second (Wike et al. 1994). In its lower reaches, Fourmile Branch broadens and flows via braided channels through a delta formed by the deposition of sediments eroded from upstream during high flows. Downstream of the delta, the channels rejoin into one main channel. Most of the flow discharges into the Savannah River at river kilometer 245 (river mile 152.1), while a small portion of the creek flows west and enters Beaver Dam Creek. When the Savannah River floods, water from Fourmile Branch flows along the northern boundary of the floodplain swamp and joins with Pen Branch and Steel Creek, exiting the swamp via Steel Creek instead of flowing directly into the river.

Pen Branch and Indian Grave Branch drain an area of about 55 square kilometers (21 square miles). Pen Branch is approximately 24 kilometers (15 miles) long and follows a southwesterly path from its headwaters about 3.2 kilometers (2 miles) east of K-Area to the Savannah River Swamp. At the swamp, it flows parallel to the Savannah River for about 8 kilometers (5 miles) before it enters and mixes with the waters of Steel Creek. In its headwaters, Pen Branch is a largely undisturbed blackwater stream. Until K-Reactor shut down in 1988, Indian Grave Branch, a tributary of Pen Branch, received the thermal effluent from the reactor. When K-Reactor operated, Indian Grave Branch's average natural flow of 0.3 cubic meters (10 cubic feet) per second increased to about 11.3 cubic meters (400 cubic feet) per second. As required by a Record of Decision (DOE 1988), a recirculating cooling tower was completed in 1992 to cool water for K-Reactor. This system has not operated because K-Reactor was placed in cold standby in 1992. However, if it were to operate, the flow in Indian Grave Branch would be reduced to 1.6 cubic meters (55 cubic feet) per second with 1.3 cubic meters (45 cubic feet) per second coming from cooling tower blowdown (DOE 1987). This change would alter the water quality and temperature and flow regimes in Pen Branch. Currently, the Pen Branch system receives non-thermal effluents (e.g., non-process cooling water, ash basin effluent waters, powerhouse wastewater, and sanitary wastewater) from K-Area and sanitary effluent from the Central Shops (N-) Area. In water year 1991, the mean flow of Pen Branch at SRS Road A (SC 125) was 4.1 cubic meters (145 cubic feet) per second. During reactor operation, the mean water temperatures of Pen Branch ranged from 33.5 to 48°C (92 to 119°F). Since the shutdown of K-Reactor, the mean temperature of Pen Branch has been 22°C (72°F) (Wike et al. 1994).

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The headwaters of Steel Creek originate near P-Reactor. The creek flows southwesterly about 3 kilometers (approximately 2 miles) before it enters the headwaters of L-Lake. The lake is 6.5 kilometers (4 miles) long and relatively narrow, with an area of about 4.2 square kilometers (1,034 acres). Flow from the outfall of L-Lake travels about 5 kilometers (3 miles) before entering the Savannah River swamp and then another 3 kilometers (approximately 2 miles) before entering the Savannah River. Meyers Branch, the main tributary of Steel Creek, flows approximately 10 kilometers (6.2 miles) before entering Steel Creek downstream of the L-Lake dam and upstream of SRS Road A. The total area drained by the Steel Creek-Meyers Branch system is about 91 square kilometers (35 square miles). In 1954 (before the construction of L-Lake or Par Pond), Steel Creek started to receive effluents from L- and P-Reactors. By 1961, a total of 24 cubic meters (850 cubic feet) per second of thermal effluents was being released to Steel Creek. From 1961 to 1964 P-Reactor partially used the Par Pond recirculating system. In 1964, all P-Reactor effluent was diverted to Par Pond, and in 1968 L-Reactor was put on standby. In 1981, DOE initiated activities to restart L-Reactor. L-Lake was constructed in 1985 along the upper reaches of Steel Creek to cool the heated effluent from L-Reactor, and it received these effluents for several years until L-Reactor was shut down in 1988. In addition to receiving the cooling water from L-Reactor, Steel Creek also received ash basins runoff, nonprocess cooling water, powerhouse wastewater, reactor process effluents, sanitary treatment plant effluents, and vehicle wash waters. From October 1990 to September 1991, the mean flow rate of Steel Creek at SRS

Road A was 4.7 cubic meters (185 cubic feet) per second, with an average temperature of 19°C (66°F) (Wike et al. 1994).

Lower Three Runs is a large blackwater creek draining about 460 square kilometers (286 square miles), with a 10-square kilometer (2,500-acre) impoundment, Par Pond, on its upper reaches. From the Par Pond dam, Lower Three Runs flows about 39 kilometers (24 miles) before entering the Savannah River. The SRS property includes Lower Three Runs and its floodplain from Par Pond to the river. The mean flow rate of Lower Three Runs in water year 1991 at Patterson Mill [8 kilometers (5 miles) below Par Pond] was 1.8 cubic meters (65 cubic feet) per second. The mean temperature at the Patterson Mill location during the period 1987 to 1991 was 18°C (64°F) (Wike et al. 1994).

Tables E.1-3 through E.1-7 present maximum and minimum values for water quality parameters for each of the remaining five major SRS tributaries that discharge to the Savannah River for 1993 (1992 for Beaver Dam Creek). The analytical results indicate that the water quality of SRS streams is generally acceptable, with the exception of the tritium concentrations. SCDHEC regulates the physical properties and concentrations of chemicals and metals in SRS effluents under the National Pollutant Discharge Elimination System program. SCDHEC also regulates chemical and biological water quality standards for SRS waters. TE

3.5 Air Resources

3.5.1 CLIMATE AND METEOROLOGY

The climate at SRS is temperate, with short, mild winters and long, humid summers. Throughout the year, the weather is affected by warm, moist maritime air masses (DOE 1991).

Summer weather usually lasts from May through September, when the area is strongly influenced by the western extension of the semi-permanent Atlantic subtropical "Bermuda" high pressure system. Winds are relatively light, and migratory low pressure systems and fronts usually remain well to the north of the area. The Bermuda high is a relatively persistent feature, resulting in few breaks in the summer heat. Climatological records for the Augusta, Georgia, area indicate that during the summer months, high temperatures were greater than 32.2°C (90°F) on more than half of all days. The relatively hot and humid conditions often result in scattered afternoon and evening thunderstorms (Hunter 1990).

The influence of the Bermuda high begins to diminish during the fall, resulting in relatively dry weather and moderate temperatures. Fall days are frequently characterized by cool, clear mornings and warm, sunny afternoons (Hunter 1990).

During the winter, low pressure systems and associated fronts frequently affect the weather of the SRS area. Conditions often alternate between warm, moist subtropical air from the Gulf of Mexico region and cool, dry polar air. The Appalachian Mountains to the north and northwest of SRS moderate the extremely cold temperatures associated with occasional outbreaks of arctic air. Consequently, less than one-third of all winter days have minimum temperatures below freezing, and temperatures below -7°C (20°F) occur infrequently. Snow and sleet occur on average less than once per year (Hunter 1990).

Outbreaks of severe thunderstorms and tornadoes occur more frequently during the spring than during the other seasons. Although spring weather is variable and relatively windy, temperatures are usually mild (Hunter 1990).

Data on severe weather conditions are important considerations in the selection of design criteria for buildings and structures at SRS. Information on the frequency and severity of past incidents provides a basis for predicting the probabilities and consequences of releases of airborne pollutants.

3.5.1.1 Occurrence of Violent Weather

The SRS area experiences an average of 55 thunderstorms per year, half of which occur during the summer months of June, July, and August (Shedrow 1993). On average, lightning flashes will strike six times per year on a square kilometer (0.39 square mile) of ground (Hunter 1990). Thunderstorms can
TE | generate wind speeds as high as 64 kilometers (40 miles) per hour and even stronger gusts. The highest 1-minute wind speed recorded at Bush Field in Augusta, Georgia, between 1950 and 1990 was
TE | 100 kilometers (62 miles) per hour (NOAA 1990).

TE | Since SRS operations began, nine confirmed tornadoes have occurred on or close to SRS. Eight caused light to moderate damage. The tornado of October 1, 1989, caused considerable damage to timber resources on about 4.4 square kilometers (1,097 acres) and lighter damage on about 6 square kilometers (1,497 acres) over southern and eastern areas of the site. Winds produced by this tornado were estimated to have been as high as 240 kilometers per hour (150 miles per hour) (Parker and Kurzeja 1990). No tornado-related damage has occurred to SRS production facilities.

Based on tornado statistics for the SRS area, the average frequency of a tornado striking any given location in South Carolina was estimated to be 7.11×10^{-5} per year. This means that a tornado could strike any given location about once every 14,000 years (Bauer et al. 1989).

The nuclear materials processing facilities at SRS were built to withstand a maximum tornado wind speed of 451 kilometers per hour (280 miles per hour) (Bauer et al. 1989). The estimated probability of any location on SRS experiencing wind speeds equal to or greater than this is 1.2×10^{-7} per year. Such a tornado would occur about once every 10 million years (Bauer et al. 1989). TE

A total of 36 hurricanes have caused damage in South Carolina between 1700 and 1989. The average frequency of occurrence of a hurricane in the state is once every 8 years; however, the observed interval between hurricanes has ranged from as short as 2 months to as long as 27 years. Eighty percent of hurricanes have occurred in August and September.

Winds produced by Hurricane Gracie, which passed to the north of SRS on September 29, 1959, were as high as 121 kilometers (75 miles) per hour in F-Area. No other hurricane-force wind has been measured on SRS. Heavy rainfall and tornadoes, which frequently accompany tropical weather systems, usually have the greatest hurricane-related impact on SRS operations (Bauer et al. 1989). TE

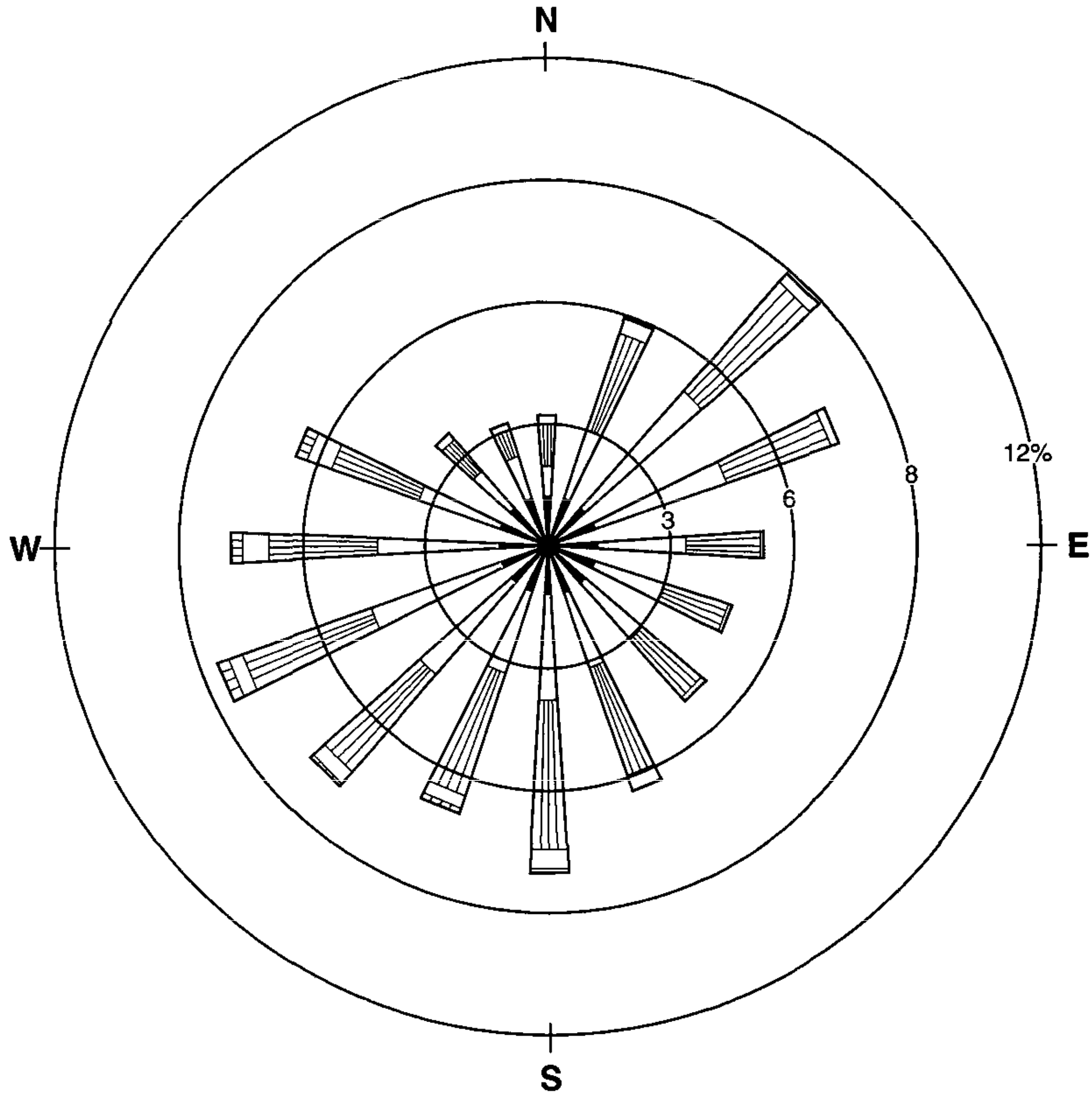
3.5.1.2 Wind Speed and Direction

A joint frequency summary (wind rose) of hourly averaged wind speeds and directions collected from the H-Area meteorological tower at a height of 61 meters (200 feet) during the 5-year period 1987 through 1991 is shown in Figure 3-8. This figure indicates that the prevailing wind directions are from the south, southwest, west, and northeast. Winds from the south, southwest, and west directions occurred during about 35 percent of the monitoring period (Shedrow 1993). TE

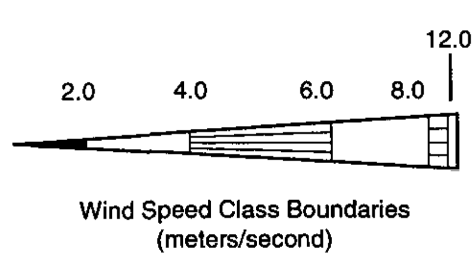
The average wind speed for the 5-year period was 13.7 kilometers (8.5 miles) per hour. Hourly averaged wind speeds less than 7.2 kilometers (4.5 miles) per hour occurred about 10 percent of the time. Seasonally averaged wind speeds were highest during the winter [14.8 kilometers (9.2 miles) per hour] and lowest during the summer [12.2 kilometers (7.6 miles) per hour] (Shedrow 1993). TE TE

3.5.1.3 Atmospheric Stability

Air dispersion models that predict downwind ground-level concentrations of an air pollutant released from a source are based on specific parameters such as stack height, wind speed, pollutant emission rate,



TE | This wind rose plot shows percent occurrence frequencies of wind direction and speed at SRS. It is based on a composite of hourly averaged wind data from the H-Area meteorological tower for the
TE | 5-year period 1987 through 1991. Measurements were taken from 200 feet above ground. Directions indicated are *from* which the wind blows.



Source: Arnett, Karapatakis, Mamatey (1993).

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TE | **Figure 3-8.** Wind rose for SRS, 1987 through 1991.

and air dispersion coefficients. The air dispersion coefficients used in modeling are determined by atmospheric stability.

The ability of the atmosphere to disperse air pollutants is frequently expressed in terms of the seven Pasquill-Gifford atmospheric turbulence (stability) classes A through G. Occurrence frequencies for each of the stability classes at SRS have been determined using turbulence data collected from the SRS meteorological towers during the 5-year period 1987 through 1991. Relatively turbulent atmospheric conditions that increase atmospheric dispersion, represented by the unstable classes A, B, and C, occurred approximately 56 percent of the time. Stability class D, which represents conditions that are moderately favorable for atmospheric dispersion, occurred approximately 23 percent of the time. Relatively stable conditions that minimize atmospheric dispersion, represented by classes E, F, and G, occurred about 21 percent of the time (Shedrow 1993).

In the southeastern United States, high air pollution levels typically occur when the air is stagnant and there is little dispersion of pollutants. Stagnant episodes generally occur when atmospheric pressure is high (i.e., the area is under a high-pressure system). Under a stagnating high-pressure system, the maximum height of air mixing is less than 1,524 meters (5,000 feet), and the average wind speed is less than 4.0 meters per second (9 miles per hour). According to upper air data, episodes of poor dispersion in the vicinity of SRS lasted for at least 2 days on 12 occasions over a 5-year period (1960 through 1964). Episodes lasting at least 5 days occurred on two occasions. A stagnation episode is defined as limited dispersion lasting 4 or more days. Two stagnation episodes have occurred in the SRS area each year over the 40-year period from 1936 through 1975. The total number of stagnant days averaged about 10 per year (Bauer et al. 1989). TE

3.5.2 EXISTING RADIOLOGICAL CONDITIONS

3.5.2.1 <u>Background and Baseline Radiological Conditions</u>

Ambient air concentrations of radionuclides at SRS include nuclides of natural origins, such as radon from uranium in soils; man-made radionuclides, such as fallout from testing of nuclear weapons; and emissions from coal-fired and nuclear power plants. SRS operates a 35-station atmospheric surveillance program. Stations are located inside the SRS perimeter, on the SRS perimeter, and at distances up to 161 kilometers (100 miles) from SRS (Arnett, Karapatakis, and Mamatey 1994).

Routine SRS operations release quantities of alpha- and beta-gamma-emitting radioactive materials in the form of gases and particulates. Gross alpha and nonvolatile beta measurements are used as a screening method for determining the concentration of all radionuclides in the air.

The average 1990 to 1993 gross alpha radioactivity and nonvolatile beta radioactivity measured at SRS and at distances of 40 kilometers (25 miles) to 161 kilometers (100 miles) from SRS are shown in Table 3-4. The maximum levels of onsite gross alpha and gross beta radioactivity were found near production/processing areas. For each year, average onsite gross alpha and nonvolatile beta radioactivity concentrations were similar to the average concentrations measured in offsite air (Arnett, Karapatakis, and Mamatey 1994). Nonvolatile beta concentrations do not include tritium (which accounts for more than 99 percent of the airborne radioactivity released from SRS) or carbon-14.

Table 3-4. Average concentrations of gross alpha and nonvolatile beta radioactivity measured in air (1991 to 1993) (microcuries per milliliter of air).[a]

Location	Number of Locations	Average gross alpha radioactivity			Average nonvolatile beta radioactivity		
		1991	1992	1993	1991	1992	1993
Onsite	5	2.5×10^{-15}	1.8×10^{-15}	1.9×10^{-15}	1.8×10^{-14}	1.9×10^{-14}	1.8×10^{-14}
SRS perimeter	14	2.6×10^{-15}	1.8×10^{-15}	1.8×10^{-15}	1.8×10^{-14}	1.9×10^{-14}	1.9×10^{-14}
40-km[b] radius	12	2.5×10^{-15}	1.7×10^{-15}	1.8×10^{-15}	1.8×10^{-14}	1.8×10^{-14}	1.8×10^{-14}
161-km radius	4	2.6×10^{-15}	1.7×10^{-15}	2.0×10^{-15}	1.8×10^{-14}	1.7×10^{-14}	2.0×10^{-14}

a. Source: Arnett, Karapatakis, and Mamatey (1994).
b. Kilometer; to convert to miles, multiply by 0.621.

Tritium levels in 1993 are not directly comparable to those observed in previous years because the sampling protocol for atmospheric tritium oxide was changed in 1993. For 1993, the highest annual average concentration of tritium in air over SRS was 1.06×10^{-9} microcuries per milliliter. The maximum offsite tritium concentration was slightly higher than the 1992 level of 5.3×10^{-11} microcuries per milliliter (Arnett, Karapatakis, and Mamatey 1994).

3.5.2.2 Sources of Radiological Emissions

The major SRS production facilities and the types and quantities of radionuclides released during 1993 are presented in Table 3-5. The dose to a member of the public from these releases, calculated by the MAXIGASP computer model, was 0.11 millirem. This dose is 1.1 percent of the 10-millirem-per-year EPA limit (see 40 CFR 52.21). Tritium (H-3), in both elemental and oxide forms, constitutes more than 99 percent of the radioactivity released to the atmosphere from SRS operations (Arnett, Karapatakis, and Mamatey 1994).

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Table 3-5. Atmospheric releases by source facility in 1993.[a]

Radionuclide[b]	Half-life	Reactors	Separations	Reactor materials	Heavy water	SRTC[d]	Diffuse and fugitive[e]	Total
		Curies[c]						
Gases and Vapors								
H-3 (oxide)	12.3 yrs	3.85×10^{4}	9.39×10^{4}	NR[f]	448	NR	43.1	1.33×10^{5}
H-3 (elem.)	12.3 yrs	NR	5.82×10^{4}	NR	NR	NR	NR	5.82×10^{4}
H-3 Total	12.3 yrs	3.85×10^{4}	1.52×10^{5}	NR	448	NR	43.1	1.91×10^{5}
Carbon-14	5.7×10^{3} yrs	NR	0.0169	NR	NR	NR	4.00×10^{-6}	0.0169
Iodine-129	1.6×10^{7} yrs	NR	0.00496	NR	NR	NR	6.88×10^{-7}	0.00496
Iodine-131	8 days	NR	8.89×10^{-5}	NR	NR	5.92×10^{-5}	NR	1.48×10^{-4}
Iodine-133	20.8 hrs	NR	NR	NR	NR	0.00196	NR	0.00196
Xenon-135	9.1 hrs	NR	NR	NR	NR	0.0319	NR	0.0319
Particulates								
S-35	87.2 days	NR	NR	NR	NR	NR	2.00×10^{-6}	2.00×10^{-6}
Cobalt-60	5.3 yrs	NR	5.89×10^{-9}	NR	NR	NR	3.34×10^{-17}	5.89×10^{-9}
Ni-63	100 yrs	NR	NR	NR	NR	NR	2.00×10^{-7}	2.00×10^{-7}
Sr-89,90[g]	29.1 yrs	1.81×10^{-4}	0.00188	8.32×10^{-5}	7.19×10^{-5}	1.19×10^{-5}	1.11×10^{-4}	0.00227
Zr-95 (Nb-95)	64 days	NR	NR	NR	NR	NR	2.39×10^{-14}	2.39×10^{-14}
Ru-106	1.0 yrs	3.99×10^{-6}	5.76×10^{-9}	NR	NR	NR	4.96×10^{-12}	4.00×10^{-6}
Sb-125	2.8 yrs	NR	NR	NR	NR	NR	7.27×10^{-15}	7.27×10^{-15}
Cesium-134	2.1 yrs	NR	1.49×10^{-6}	NR	NR	NR	1.40×10^{-17}	1.49×10^{-6}
Cesium-137	30.2 yrs	1.04×10^{-4}	5.28×10^{-4}	NR	NR	1.51×10^{-6}	4.33×10^{-11}	6.34×10^{-4}
Cesium-144	285 days	NR	NR	NR	NR	NR	1.13×10^{-13}	1.13×10^{-13}
Eu-154	8.6 yrs	NR	NR	NR	NR	NR	3.44×10^{-13}	3.44×10^{-13}
Eu-155	4.7 yrs	NR	NR	NR	NR	NR	1.63×10^{-13}	1.63×10^{-13}
U-235,238	4.5×10^{9} yrs	NR	0.00186	1.55×10^{-5}	NR	2.89×10^{-8}	4.74×10^{-5}	0.00192
Pu-238	87.7 yrs	NR	0.00121	NR	NR	1.00×10^{-8}	4.63×10^{-12}	0.00121
Pu-239[h]	2.4×10^{4} yrs	4.11×10^{-6}	0.00106	3.50×10^{-6}	8.42×10^{-7}	9.41×10^{-6}	4.70×10^{-7}	0.00108
Am-241,243	7.4×10^{3} yrs	NR	1.42×10^{-4}	NR	NR	1.34×10^{-6}	8.86×10^{-13}	1.43×10^{-4}
Cm-242,244	18.1 yrs	NR	4.96×10^{-5}	NR	NR	6.83×10^{-6}	7.33×10^{-12}	5.64×10^{-5}

a. Source: Arnett, Karapatakis, and Mamatey (1994).

b. H-3 = tritium; S = sulfur; Ni = nickel; Sr = strontium; Zr = zirconium; Nb = niobium; Ru = rubidium; Sb = antimony; Eu = europium; U = uranium; Pu = plutonium; Am = americium; Cm = curium

c. One curie equals 3.7×10^{10} becquerels.

d. Savannah River Technology Center.

e. Estimated releases from minor unmonitored diffuse and fugitive sources (i.e., sources other than stacks or vents such as windows and doors).

f. NR = not reported.

g. Includes unidentified beta-gamma emissions.

h. Includes unidentified alpha emissions.

3.5.3 NONRADIOLOGICAL CONDITIONS

3.5.3.1 Background Air Quality

SRS is in an area that is designated an attainment area because it complies with National Ambient Air Quality Standards for criteria pollutants, including sulfur dioxide, nitrogen oxides (reported as nitrogen dioxide), particulate matter (less than or equal to 10 microns in diameter), carbon monoxide, ozone, and lead (see 40 CFR 81). The closest nonattainment area (an area that does not meet National Ambient Air Quality Standards) to SRS is the Atlanta, Georgia, air quality region, which is 233 kilometers (145 miles) to the west.

Sources in attainment areas must comply with Prevention of Significant Deterioration regulations. The regulations apply to new and modified sources of air pollution if the net increase in emissions from the new or modified source is determined to exceed the Prevention of Significant Deterioration annual threshold limit (see 40 CFR 52.21). Development at SRS has not triggered Prevention of Significant Deterioration permitting requirements, nor is it expected to trigger such requirements in the future.

3.5.3.2 Air Pollutant Source Emissions

DOE has demonstrated compliance with state and Federal air quality standards by modeling ambient air concentrations that would result from maximum potential emission rates using the calendar year 1990 (most recent available) air emissions inventory data as the baseline year. The compliance demonstration also included sources forecast for construction or operation through 1995 and permitted sources supporting the Defense Waste Processing Facility (WSRC 1993b). SRS based its calculated emission rates for the compliance demonstration sources on process knowledge, source testing, permitted operating capacity, material balance, and EPA air pollution emission factors (EPA 1985).

3.5.3.3 Ambient Air Monitoring

At present, SRS does not perform onsite ambient air quality monitoring. State agencies operate ambient air quality monitoring sites in Barnwell and Aiken Counties in South Carolina, and Richmond County in Georgia. These counties, which are near SRS, are in compliance with National Ambient Air Quality Standards for particulate matter, lead, ozone, sulfur dioxide, nitrogen oxides, and carbon monoxide (see 40 CFR 50).

3.5.3.4 Atmospheric Dispersion Modeling

SRS has modeled atmospheric dispersion of both maximum potential and actual emissions of criteria and toxic air pollutants using EPA's Industrial Source Complex Short Term Model (EPA 1992). This modeling was performed using the most recent (1991) quality-assured onsite meteorological data. The maximum potential emissions data included sources of air pollution at SRS that either existed or were permitted to operate as of December 1992. Emissions data for 1990 were used for the modeling of actual emissions (WSRC 1993b; Hunter and Stewart 1994). The results of this modeling are summarized in Tables 3-6 and 3-7, which list the maximum concentrations occurring at or beyond the SRS boundary. Actual SRS boundary concentrations are probably lower than values reported in these tables.

3.5.3.5 Summary of Nonradiological Air Quality

SCDHEC has air quality regulatory authority over SRS and determines compliance based on pollutant emission rates and estimates of ambient concentrations at the SRS perimeter based on modeling. SRS complies with National Ambient Air Quality Standards and the gaseous fluoride and total suspended particulate standards, as required by SCDHEC Regulation R.61-62.5, Standard 2 ("Ambient Air Quality Standards"). These standards are shown in Table 3-6. SRS complies with SCDHEC Regulation R.61-62.5, Standard 8 ("Toxic Air Pollutants"), which regulates the emission of 257 toxic air pollutants (EPA 1992). SRS has identified emission sources for 139 of the 257 regulated air toxics; the modeling results indicate that SRS complies with SCDHEC air quality standards. Table 3-7 lists concentrations of air toxics at the SRS boundary which exceed 1 percent of SCDHEC standards. Concentrations of all other air toxics are less than 1 percent of SCDHEC standards and are shown in Table E.2-1 in Appendix E.

3.6 Ecological Resources

The United States acquired the SRS property in 1951. At that time, the site was approximately 60 percent forest and 40 percent cropland and pasture (Wike et al. 1994). At present, more than 90 percent of SRS is forested. An extensive forest management program conducted by the Savannah River Forest Station, which is operated by the U.S. Forest Service under an interagency agreement with DOE, has converted many former pastures and fields to pine plantations. Except for SRS production and support areas, natural succession has reclaimed many previously disturbed areas.

TE | **Table 3-6.** Estimated ambient concentration contributions of criteria air pollutants from existing SRS sources and sources planned for construction or operation through 1995 (micrograms per cubic meter of air).[a,b]

Pollutant[c]	Averaging time	SRS maximum potential concentration (μg/m³)	Concentrations based on actual emissions (μg/m³)	Most stringent AAQS[d] (Federal or state) (μg/m³)	Maximum potential concentration as a percent of AAQS[e]
SO_2	3 hours	1,514 (1,245)[f]	823	1,300[g,h]	96
	24 hours	449 (300)	196	365[g,h]	82
	Annual	22.9	14.5	80[g]	29
NO_x	Annual	14.8	5.7	100[g]	15
CO	1 hour	434	171	40,000[g]	1
	8 hours	57.8	22	10,000[g]	0.6
TC Gaseous fluorides (as HF)	12 hours	2.22	1.99	3.7[e]	60
	24 hours	1.16	1.04	2.9[e]	40
	1 week	0.44	0.39	1.6[e]	28
	1 month	0.11	0.09	0.8[e]	14
PM_{10}	24 hours	80.4	50.6	150[g]	54
	Annual	5.2	2.9	50[g]	10
O_3	1 hour	NA[i]	NA	235[g]	NA
TSP	Annual geometric mean	16.1	12.6	75[e]	21
Lead	Calendar quarter mean	0.001	0.0004	1.5[e]	0.07

a. Source: Stewart (1994).
b. The concentrations are the maximum values at the SRS boundary.
c. SO_2 = sulfur dioxide; NO_x = nitrogen oxides; CO = carbon monoxide; HF = hydrogen fluoride; PM_{10} = particulate matter ≤ 10 microns in diameter; O_3 = ozone; TSP = total suspended particulates.
d. AAQS = Ambient Air Quality Standard.
e. Source: SCDHEC (1976b).
f. The value in parentheses is the second highest maximum potential value.
g. Source: 40 CFR Part 50.
h. Concentration not to be exceeded more than once a year.
i. NA = not available.

SRS land management practices have maintained the biodiversity in the region. Satellite imagery reveals that SRS is a circle of wooded habitat surrounded by a matrix of cleared uplands and narrow forested wetland corridors. SRS provides more than 730 square kilometers (280 square miles) of contiguous

Table 3-7. SRS modeling results for toxic air pollutants that exceed 1 percent of SCDHEC air quality standards (micrograms per cubic meter of air).[a,b,c] | TE

Pollutant	Maximum allowable concentration ($\mu g/m^3$)	Concentration at SRS boundary ($\mu g/m^3$)	Percent of standard[d]
Chlorine	75.00	7.63023	10.17
Formic Acid	225.00	2.41990	1.08
Nitric Acid	125.00	50.95952	40.77
Phosphoric Acid	25.00	0.46236	1.85
Acrolein	1.25	0.01585	1.27
Benzene	150.00	31.71134	21.14
Bis (chloromethyl) Ether	0.03	0.00180	6.00
Cadmium Oxide	0.25	0.02136	8.54
Chloroform	250.00	4.95658	1.98
Cobalt	0.25	0.20628	82.51
3,3-Dichlorobenzidine	0.15	0.00180	1.20
Manganese	25.00	0.82129	3.29
Mercury	0.25	0.01393	5.57
Nickel	0.50	0.27106	54.21
Parathion	0.50	0.00737	1.47

a. Source: WSRC (1993b).
b. Concentrations are based on maximum potential emissions.
c. See Table E.2-1 for a complete list of toxic pollutant results.
d. Percent of standard = $\frac{\text{Concentration at SRS boundary}}{\text{Maximum allowable concentration}} \times 100$

forest that supports plant communities in various stages of succession. Carolina bay depressional wetlands, the Savannah River swamp, and several relatively intact longleaf pine-wiregrass (*Pinus palustris-Aristida stricta)* communities contribute to the biodiversity of SRS and the region. Table 3-8 lists land cover in undeveloped areas of SRS. | TE

The land used for production and support facilities is heavily industrialized and has little natural vegetation inside the fenced areas. These areas consist of buildings, paved parking lots, graveled construction areas, and laydown yards. While there is some landscaping around the buildings and some vegetation along the surrounding drainage ditches, most of these areas have little or no vegetation. Wildlife species common to the vegetated habitat surrounding the facilities often frequent the developed areas.

TE **Table 3-8.** Land cover of undeveloped areas of SRS.[a]

Types of land cover	Square kilometers	Square miles	Percent of total
Longleaf pine	150	58	20
Loblolly pine	258	100	35
Slash pine	117	45	16
Mixed pine/hardwood	23	9	3
Upland hardwood	20	8	3
Bottomland hardwood	117	45	16
Savannah River swamp	49	19	7
Total[b]	734	284	100

a. Source: USDA (1991a).
b. Excludes production areas; total reflects undeveloped land only.

Most new development needed to support waste management would be within previously disturbed areas and would occur on existing graveled or paved areas. Undeveloped land required for expanded waste management facilities is located in E-Area near the center of SRS and approximately 1.6 kilometers (1 mile) southeast of Upper Three Runs (Figure 3-2).

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Figure 3-9 shows the existing land cover of the area where most new waste management facilities would be located. The undeveloped land is comprised of 0.2 square kilometer (49 acres) of longleaf pine planted in 1988; 0.4 square kilometer (99 acres) of slash pine (*P. elliotti*) planted in 1959; 0.36 square kilometer (88 acres) of loblolly pine planted in 1946; 0.73 square kilometer (180 acres) of white oak (*Quercus alba*), red oak (*Q. rubra*), and hickory (*Carya sp.*) regenerated in 1922; 0.64 square kilometer (158 acres) of longleaf pine regenerated in 1922, 1931, or 1936; 0.32 square kilometer (79 acres) of loblolly pine planted in 1987; and 0.12 square kilometer (30 acres) of recently harvested mixed pine hardwood (see Figure 3-9). TC TE

3.6.1 TERRESTRIAL ECOLOGY

TE SRS is near the transition between northern oak-hickory-pine forest and southern mixed forest. Thus, species typical of both associations are found on SRS (Dukes 1984). Farming, fire, soil, and topography have strongly influenced SRS vegetation patterns.

A variety of plant communities occurs in the upland areas (Dukes 1984). Typically, scrub oak communities are found on the drier, sandier areas. Longleaf pine, turkey oak (*Quercus laevis*), bluejack oak (*Q. incana*), and blackjack oak (*Q. marilandica*) dominate these communities, which typically have understories of wire grass and huckleberry (*Vaccinium* spp.). Oak-hickory communities are usually located on more fertile, dry uplands; characteristic species are white oak, post oak (*Q. stellata*), red oak, mockernut hickory (*Carya tomentosa*), pignut hickory (*C. glabra*), and loblolly pine, with an understory of sparkleberry (*Vaccinium arboreum*), holly (*Ilex* spp.), greenbriar (*Smilax* spp.), and poison ivy (*Toxicodendron radicans*) (Dukes 1984; Wike et al. 1994).

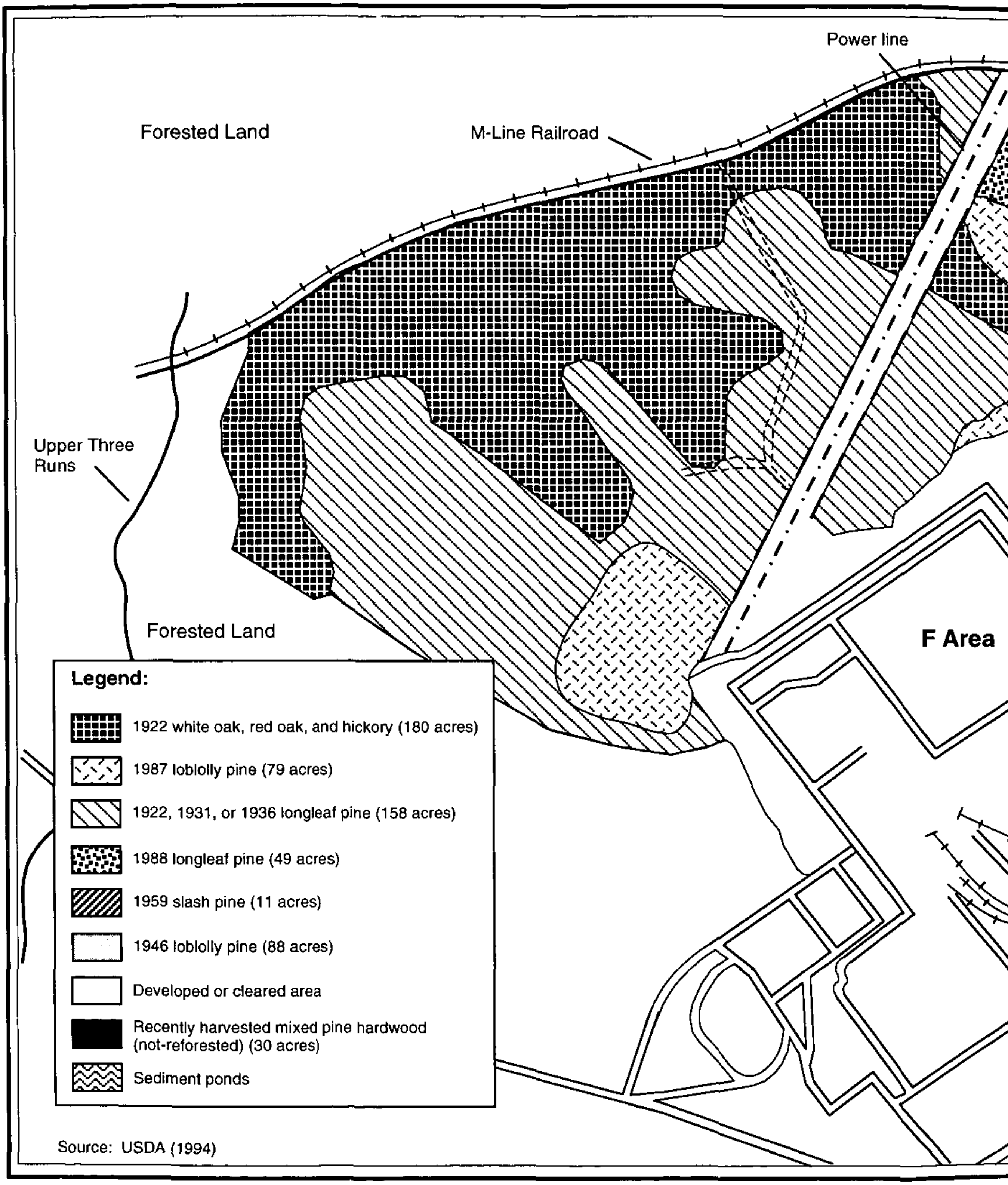
The departure of residents in 1951 and the subsequent reforestation have provided the wildlife of SRS with excellent habitat. Furbearers such as gray fox (*Urocyon cinereoargenteus*), opossum (*Didelphis virginiana*), and bobcat (*Felis rufus*) are relatively common throughout the site. Game species such as gray squirrel (*Sciurus carolinensis*), fox squirrel (*S. niger*), white-tailed deer (*Odocoileus virginianus*), eastern cottontail (*Sylvilagus floridanus*), mourning dove (*Zenaida macroura*), northern bobwhite (*Colinus virginianus*), and eastern wild turkey (*Meleagris gallopavo*) are also common (Cothran et al. 1991; Wike et al. 1994). Waterfowl are common on most SRS wetlands, ponds, reservoirs, and in the Savannah River swamp and have been studied extensively (Mayer, Kennamer, and Hoppe 1986a; Wike et al. 1994). The reptiles and amphibian species of SRS include 17 salamanders, 26 frogs and toads, 1 crocodilian, 12 turtles, 9 lizards, and 36 snakes. Gibbons and Semlitsch (1991) provides an overview, description, and identification keys to the reptiles and amphibians of SRS.

Undeveloped land in E-Area contains suitable habitat for white-tailed deer and feral hogs (*Sus scrofa*), as well as other animal species common to the mixed pine/hardwood forests of South Carolina.

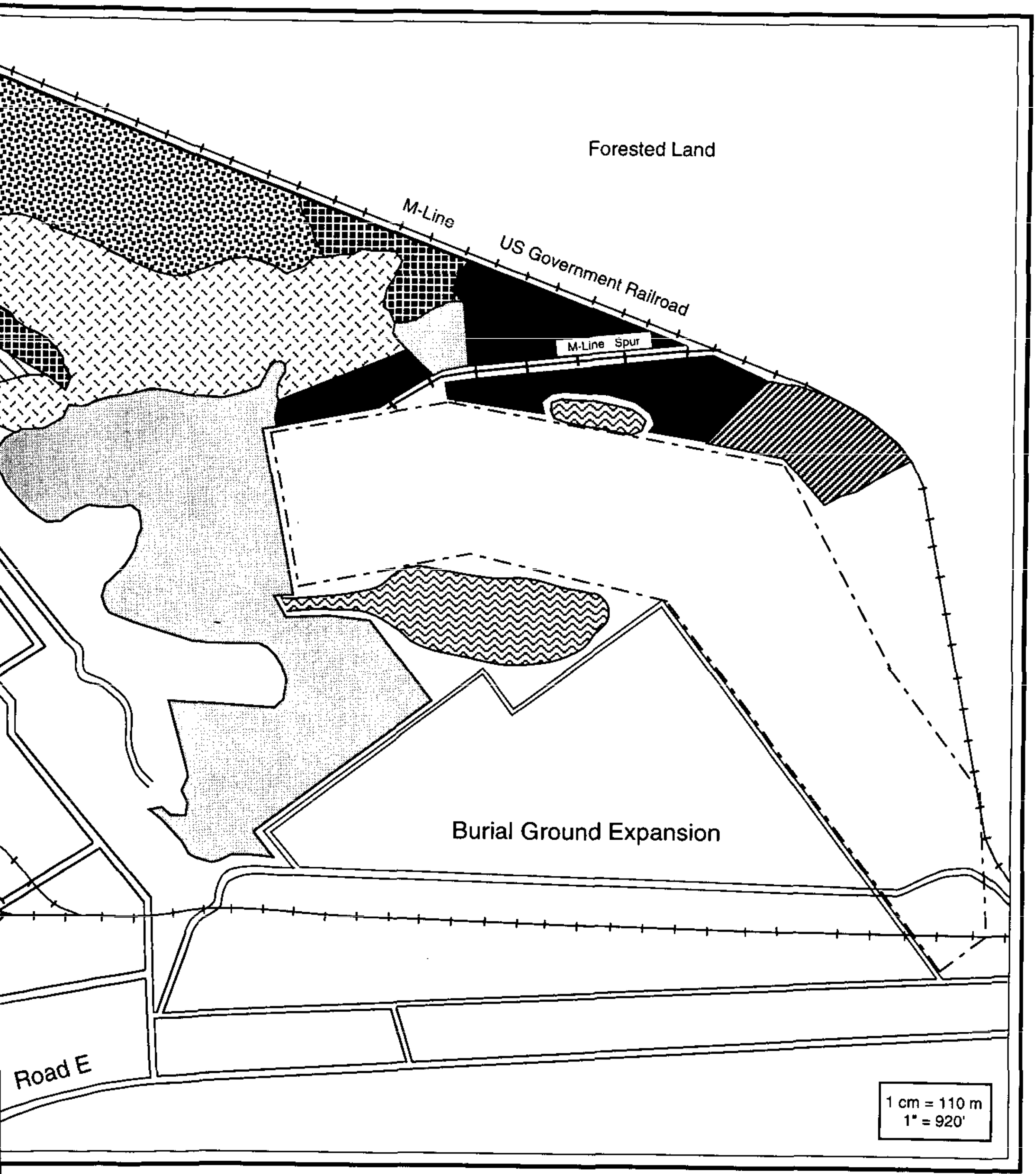
3.6.2 WETLANDS

SRS has extensive, widely distributed wetlands, most of which are associated with floodplains, creeks, or impoundments. In addition, approximately 200 Carolina bays occur on SRS (Shields et al. 1982; Schalles et al. 1989). Carolina bays are unique wetland features of the southeastern United States. They are isolated wetland habitats dispersed throughout the uplands of SRS. The more than 200 bays on SRS exhibit extremely variable hydrology and a range of plant communities from herbaceous marsh to forested wetland (Shields et al. 1982; Schalles et al. 1989).

The Savannah River bounds SRS to the southwest for approximately 32 kilometers (20 miles). The river floodplain supports an extensive swamp, covering about 49 square kilometers (19 square miles) of SRS; a natural levee separates the swamp from the river. Timber was cut in the swamp in the late 1800s. At present, the swamp forest consists of second-growth bald cypress (*Taxodium distichum*), black gum (*Nyssa sylvatica*), and other hardwood species (Sharitz, Irwin, and Christy 1974; USDA 1991a; Wike et al. 1994). TE



TE | **Figure 3-9.** Existing land cover of SRS area considered for expansion of waste management facilities.


Forested Land
M-Line
US Government Railroad
M-Line Spur
Burial Ground Expansion
Road E
1 cm = 110 m
1" = 920'

PK56-18

Six streams drain SRS and eventually flow into the Savannah River. Each stream has floodplains with bottomland hardwood forests or scrub-shrub wetlands in varying stages of succession. Dominant species include red maple (*Acer rubrum*), box elder (*A. negundo*), bald cypress, water tupelo (*Nyssa aquatica*), sweetgum (*Liquidambar styraciflua*), and black willow (*Salix nigra*) (Workman and McLeod 1990).

Raccoon (*Procyon lotor*), beaver (*Castor canadensis*), and otter (*Lutra canadensis*) are relatively common throughout the wetlands of SRS. The Savannah River Ecology Laboratory has conducted extensive studies of reptile and amphibian use of the wetlands of SRS (Schalles et al. 1989).

Bottomland hardwood forest wetlands are located north of E-Area along Upper Three Runs. These wetlands, dominated by sweetgum and yellow poplar (*Liriodendron tulipifera*), are flooded during most winters.

3.6.3 AQUATIC ECOLOGY

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The aquatic resources of SRS have been the subject of intensive study for more than 30 years. Research has focused on the flora and fauna of the Savannah River, the tributaries of the river that drain SRS, and the artificial impoundments on two of the tributary systems. Section 3.3.3 describes the water quality of those aquatic systems. In addition, several monographs (Patrick, Cairns, and Roback 1967; Dahlberg and Scott 1971; Bennett and McFarlane 1983), the eight-volume comprehensive cooling water study (du Pont 1987), and three EISs (DOE 1984, 1987, 1990) describe the aquatic biota (fish and macroinvertebrates) and aquatic systems of SRS.

Based on studies by the Academy of Natural Sciences of Philadelphia and others (Floyd, Morse, and McArthur 1993), Upper Three Runs has one of the richest aquatic insect faunas of any stream in North America. At least 551 species of aquatic insects, including at least 52 species and 2 genera new to science, have been identified (Wike et al. 1994). A recent study identified 93 species of caddisflies, including three species that had not previously been found in South Carolina and two species that are new to science (Floyd, Morse, and McArthur 1993). Other insect species found in the creek are considered endemic, rare, or of limited distribution (Floyd, Morse, and McArthur 1993). Between 1987 and 1991, the density and variety of insects collected from Upper Three Runs decreased for unknown reasons. Data from 1991 indicate that the insect communities may be recovering from this disturbance (Wike et al. 1994).

The American sandburrowing mayfly (*Dolania americana*), a relatively common mayfly in Upper Three Runs, is listed by the Federal government as a candidate species for protection under the Endangered Species Act. The species is sensitive to siltation, organic loading, and toxic releases (Wike et al. 1994). TE

A recent study (Davis and Mulvey 1993) has identified an extremely rare clam species (*Elliptio hepatica*) in the Upper Three Runs drainage.

3.6.4 THREATENED AND ENDANGERED SPECIES

Several threatened, endangered, or candidate plant and animal species are known to occur on SRS. Table 3-9 lists those species (Wike et al. 1994). SRS contains no designated critical habitat for any listed threatened or endangered species. TE

The smooth coneflower (*Echinacea laevigata*) is the only endangered plant species found on SRS. One colony is located on Burma Road approximately 5 kilometers (3 miles) south of the waste management sites. A second colony is located near the junctions of SRS Roads 9 and B (LeMaster 1994a). The habitat of smooth coneflower is open woods, cedar barrens, roadsides, clearcuts, and powerline rights-of-way. Optimum sites are characterized by abundant sunlight and little competition in the herbaceous layer (USFWS 1992). Suitable habitat for this species occurs throughout SRS, including undeveloped land near E-Area. TE

Botanical surveys performed during 1992 and 1994 by the Savannah River Forest Station located four populations of rare plants in the area northwest of F-Area (Figure 4-4). One population of *Nestronia* and three populations of Oconee azalea (*Rhododendron flammeum*) were located on the steep slopes adjacent to the Upper Three Runs floodplain (LeMaster 1994b). The Oconee azalea is a state-listed rare species. *Nestronia* was a Federally-listed Category 2 species that was found to be more abundant than previously believed; consequently, it was determined that listing as threatened or endangered was not warranted (USFWS 1993). TE

Wood storks (*Mycteria americana*) feed in the Savannah River Swamp and the lower reaches of Steel Creek, Pen Branch, Beaver Dam Creek, and Fourmile Branch. They foraged at Par Pond during the drawdown in 1991 (Bryan 1992). The undeveloped land in E-Area contains no suitable foraging habitat, and wood storks have not been reported in this area (Coulter 1993). Bald eagles (*Haliaeetus leucocephalus*) nest near Par Pond and L-Lake and forage on these reservoirs (USDA 1988; Brooks 1994). One bald eagle was reported flying near the junction of SRS Roads E and 4, south of H-Area, on November 15, 1985 (Mayer, Kennamer, and Hoppe 1986b). However, E-Area does not contain suitable

TE | **Table 3-9.** Threatened, endangered, and candidate plant and animal species of SRS.[a]

Common Name (Scientific Name)	Status[b]
Animals	
American sandburrowing mayfly (*Dolania americana*)	FC2
Shortnose sturgeon (*Acipenser brevirostrum*)	E
American alligator (*Alligator mississippiensis*)	T/SA
Southern hognose snake (*Heterodon simus*)	FC2
Northern pine snake (*Pituophis melanoleucus melanoleucus*)	FC2
Carolina crawfish (= gopher) frog (*Rana areolata capito*)	FC2
Loggerhead shrike (*Lanius ludovicianus*)	FC2
Bachman's sparrow (*Aimophila aestivalis*)	FC2
Bald eagle (*Haliaeetus leucocephalus*)	E
Wood stork (*Mycteria americana*)	E
Red-cockaded woodpecker (*Picoides borealis*)	E
Peregrine falcon (*Falco peregrinus*)	E
Kirtland's warbler (*Dendroica kirtlandii*)	E
Bewick's wren (*Thyromanes bewickii*)	FC2
Rafinesques (= southeastern) big-eared bat (*Plecotus rafinesquii*)	FC2
Plants	
Smooth coneflower (*Echinacea laevigata*)	E
Bog spice bush (*Lindera subcoriacea*)	FC2
Boykin's lobelia (*Lobelia boykinii*)	FC2
Loose watermilfoil (*Myriophyllum laxum*)	FC2
TE | Nestronia (*Nestronia umbellula*)	FC3
Awned meadowbeauty (*Rhexia aristosa*)	FC2
Cypress knee sedge (*Carex decomposita*)	FC2
Elliott's croton (*Croton elliottii*)	FC2

a. Source: Wike et al. (1994).
b. FC2 = under review (a candidate species) for listing by the Federal Government.
FC3 = found to be more abundant than previously believed.
E = Federal endangered species.
T/SA = threatened due to similarity of appearance.

nesting or foraging habitat for bald eagles. Peregrine falcons (*Falco peregrinus*) have been reported in the past as rare winter visitors to SRS near Par Pond. Kirtland's warbler (*Dendroica kirtlandii*) is also a rare temporary visitor (Wike et al. 1994). Shortnose sturgeon (*Acipenser brevirostrum*), typically residents of large coastal rivers and estuaries, have not been collected in the tributaries of the Savannah River that drain SRS. Sturgeon ichthyoplankton have been collected in the Savannah River near SRS (Wike et al. 1994).

The *Red-Cockaded Woodpecker Standards and Guidelines, Savannah River Site* (USDA 1991b) describes SRS management strategy for the red-cockaded woodpecker (*Picoides borealis*). The most important element of this management strategy is the conversion of slash (*P. elliottii*) (and some loblolly) pine in a designated red-cockaded woodpecker management area to longleaf pine, with a harvest rotation of 120 years. These birds inhabit and use open pine forests with mature trees (older than 70 years for nesting and 30 years for foraging) (Wike et al. 1994). While the undeveloped land surrounding E-Area contains no red-cockaded woodpecker nesting or foraging areas currently used by the species, it does contain unoccupied habitat of a suitable age (LeMaster 1994c). TE

As presented in Appendix J, DOE has consulted with the U.S. Fish and Wildlife Service to determine the potential for endangered species to be affected, as required by the Endangered Species Act. TC

3.7 Land Use

SRS occupies approximately 800 square kilometers (300 square miles) in a generally rural area in western South Carolina. Administrative, production, and support facilities make up about 5 percent of the total SRS area. Of the remaining land, approximately 70 percent is planted pine forest managed by the U.S. Forest Service (under an interagency agreement with DOE), which harvests about 7.3 square kilometers (2.8 square miles) of timber from SRS each year (DOE 1993a). Approximately 57 square TE kilometers (22 square miles) of SRS have been set aside exclusively for nondestructive environmental research (DOE 1993a) in accordance with SRS's designation as a National Environmental Research Park. TE Research in the set-aside areas is coordinated by the University of Georgia's Savannah River Ecology Laboratory.

A number of factors will determine the future development and use of SRS. Primary among these are:

- funding and priority of DOE defense programs and environmental management activities
- decisions on the disposition of nuclear materials at SRS and other sites, which DOE is currently evaluating under the National Environmental Policy Act (NEPA)
- the role of SRS in the reconfigured DOE weapons complex, which is also being evaluated through the NEPA process
- possible alternative uses of SRS land, facilities, and human resources
- compliance with regulatory requirements concerning environmental protection, worker safety and health, and nuclear facility safety

- public input and participation

- community support (DOE 1994a)

Decisions on future land uses at SRS will be made by DOE through the site development, land-use, and future-use planning processes. There will be a study of each DOE site to determine possible uses. The study will address DOE missions and the public's perspectives and interests; and it will aid in deciding the most appropriate use for each site (DOE 1994a). SRS has established a Land Use Technical Committee composed of representatives from DOE, Westinghouse Savannah River Company, and other SRS organizations. The committee is evaluating potential uses for SRS. DOE prepared an *FY 1994 Draft Site Development Plan* (DOE 1994a), which describes the current SRS mission and facilities, evaluates possible future missions of SRS and their requirements, and outlines a master development plan now being prepared. In addition, DOE has projected requirements for land and other SRS resource needs for the next 20 years. This planning process must consider activities that will involve all DOE sites (e.g., reconfiguration of the nuclear weapons complex and strategies for spent nuclear fuel management) and SRS-specific actions (e.g., waste management and environmental restoration activities). The plan will take into account risks, benefits, possible final disposition of nuclear materials, potential facility decontamination and decommissioning, land-use strategies, cleanup standards, and facilities required for potential future missions. Once decisions on the future use of SRS have been made, appropriate cleanup levels will be determined and remediation techniques will be selected and submitted for regulatory approval.

3.8 Socioeconomics

This section discusses existing socioeconomic conditions within the "region of influence" where TE approximately 90 percent of the SRS workforce lived in 1992 (Figure 3-10). The SRS region of influence includes Aiken, Allendale, Bamberg, and Barnwell Counties in South Carolina, and Columbia and Richmond Counties in Georgia.

3.8.1 EMPLOYMENT

Between 1980 and 1990, total employment in the SRS region of influence increased from 139,504 to 199,161, an average annual growth rate of approximately 4 percent. The unemployment rates for 1980

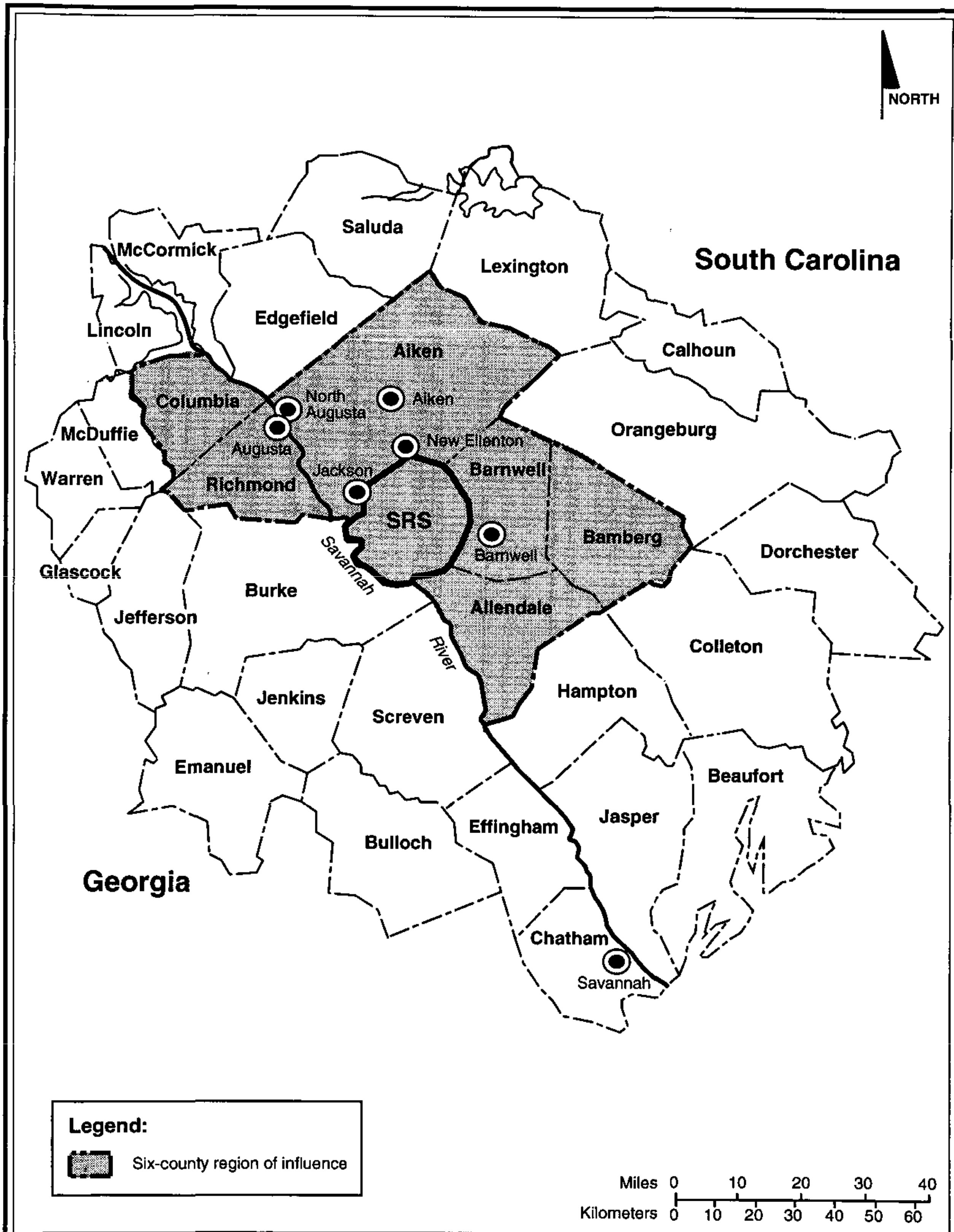

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Figure 3-10. Counties and cities within the SRS vicinity. TE

TE and 1990 were 7.3 percent and 4.7 percent, respectively (HNUS 1992). Table 3-10 lists projected employment data for the six-county region of influence. By 2025, regional employment is forecast to increase to approximately 269,000 (HNUS 1994).

TE **Table 3-10.** Forecast employment, population, and personal income data for the SRS six-county region of influence.[a]

Year	Employment	Population	Personal Income (Billions)
1994	239,785	456,892	$8.259
1995	242,033	461,705	$8.770
2000	252,861	474,820	$11.645
2005	267,138	479,663	$15.608
2010	273,187	486,727	$21.297
2015	274,541	497,226	$28.771
2020	271,186	508,205	$37.927
2025	268,659	517,080	$50.194

a. Source: HNUS (1994).

In fiscal year 1992, employment at SRS was 23,351, approximately 10 percent of regional employment, TE with an associated payroll of more than $1.1 billion. SRS employment in 2000 is expected to decrease to approximately 15,800, representing 6 percent of regional employment, and it is expected to continue to decrease as a percent of regional employment in subsequent years.

3.8.2 INCOME

TE Personal income in the six-county region of influence increased from almost $2.9 billion in 1980 to approximately $6.9 billion in 1990. Together, Richmond and Aiken Counties accounted for 78 percent of personal income in the region of influence during 1991; these two counties provided most of the TE employment opportunities in the region. As listed in Table 3-10, personal income in the region is projected to increase 27 percent to almost $8.8 billion in 1995 and to approximately $50.2 billion by TE 2025 (HNUS 1994).

3.8.3 POPULATION

Between 1980 and 1990, population in the region of influence increased 13 percent, from 376,058 to 425,607. More than 88 percent of the 1990 population lived in Aiken (28.4 percent), Columbia

(15.5 percent), or Richmond (44.6 percent) counties. Table 3-10 also presents population forecasts for the region of influence to 2025 (HNUS 1994). According to census data, the average number of persons TE per household in the six-county region of influence was 2.72 in 1990, and the median age was 31.2 years (HNUS 1992).

3.8.4 COMMUNITY INFRASTRUCTURE AND SERVICES

Public education facilities in the six-county region of influence include 95 elementary or intermediate TE schools and 25 high schools. In addition to the public schools, there are 42 private and 16 post-secondary schools in the region (HNUS 1992).

The average number of students per teacher in 1988 was 16, based on a combined average daily attendance for elementary and high school students in the region of influence. The highest ratio was in Columbia County high schools, where there were 19 students per teacher (1987/1988 academic year). The lowest ratio occurred in Barnwell County's district 29 high school, which had 12 students per teacher (1988/1989 academic year) (HNUS 1992).

The six-county region of influence has 14 major public sewage treatment facilities with a combined TE design capacity of 302.2 million liters (79.8 million gallons) per day. In 1989, these systems were operating at approximately 56 percent of capacity, with an average daily flow of 170 million liters (44.9 million gallons) per day. Capacity utilization ranged from 45 percent in Aiken County to 80 percent in Barnwell County (HNUS 1992).

There are approximately 120 public water systems in the region of influence. About 40 of these county and municipal systems are major facilities, while the remainder serve individual subdivisions, water districts, trailer parks, or miscellaneous facilities. In 1989, the 40 major facilities had a combined total flow of 576.3 million liters (152.2 million gallons) per day. With an average daily flow rate of approximately 268.8 million liters (71 million gallons) per day, these systems were operating at 47 percent of total capacity in 1989. Facility utilization rates ranged from 13 percent in Allendale County to 84 percent in the City of Aiken (HNUS 1992).

Eight general hospitals operate in the six-county region of influence, with a combined capacity in 1987 TE of 2,433 beds (5.7 beds per 1,000 population). Four of the eight general hospitals are in Richmond County; Aiken, Allendale, Bamberg, and Barnwell Counties each have one general hospital. Columbia County has no hospital. In 1989, there were approximately 1,295 physicians serving the regional population, which represents a physician-to-population ratio of 3 to 1,000. This ratio ranged from 0.8

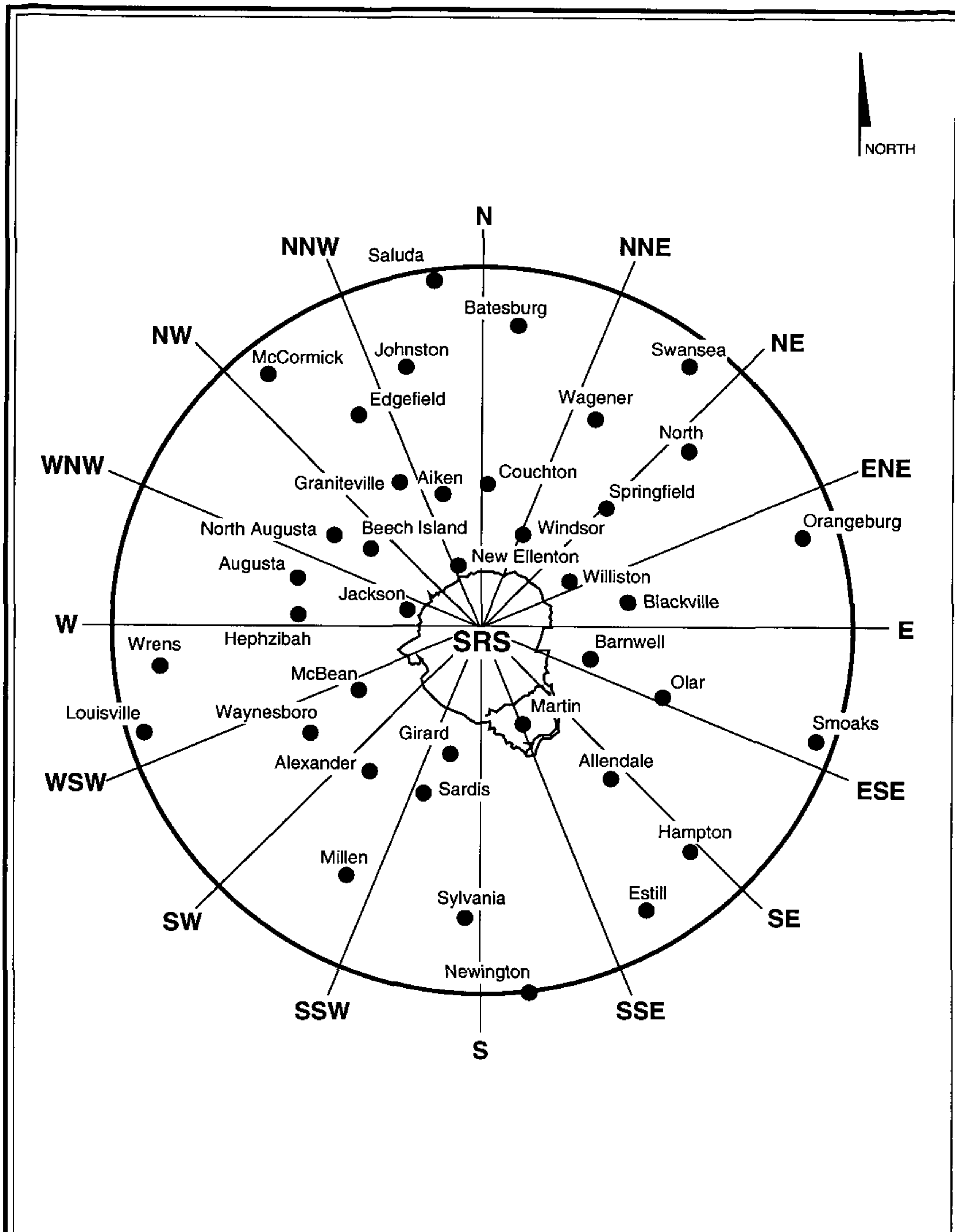
physician per 1,000 people in Aiken and Allendale counties to 5.4 physicians per 1,000 people in Richmond County (HNUS 1992).

Fifty-six fire departments provide fire protection in the region of influence. Twenty-seven of these are classified as municipal fire departments, but many provide protection to rural areas outside municipal limits. The average number of firefighters in the region in 1988 was 3.8 per 1,000 people, ranging from 1.6 per 1,000 in Richmond County to 10.2 per 1,000 in Barnwell County (HNUS 1992).

TE | County sheriff and municipal police departments provide most law enforcement in the region of influence. In addition, state law enforcement agents and state troopers assigned to each county provide protection and assist county and municipal officers. In 1988, the average ratio in the region of influence of full-time police officers employed by state, county, and local agencies per 1,000 population was 2.0. This ratio ranged from 1.4 per 1,000 in Columbia County to 2.5 per 1,000 in Richmond County (HNUS 1992).

3.8.5 DEMOGRAPHIC CHARACTERISTICS

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires that Federal agencies identify and address, as appropriate, disproportionate adverse human health or environmental effects of their programs and activities on people of color and the poor. DOE is developing official guidance on the implementation of the Executive Order. This EIS's approach to implementing the Order is to identify the potential effects of waste management activities at SRS on people of color or those with low incomes. The following describes the analysis of environmental justice issues for the alternatives considered in this EIS. Potential offsite health impacts would result from releases to the air and to the Savannah River. For air releases, standard population dose analyses are based on an 80-kilometer (50-mile) radius from SRS
TE
L004-01 | because expected dose levels beyond that distance are very small. Table 3-11 and Figure 3-11 provide data on the 1990 population distribution within a 80-kilometer (50-mile) radius of SRS. For releases to
TE | water, the region of analysis includes areas along the Savannah River that draw on it for drinking water [Beaufort and Jasper Counties in South Carolina and Port Wentworth (Savannah), Georgia]. Therefore, the analysis examines populations in all census tracts that have at least 20 percent of their area within the 80-kilometer (50-mile) radius of SRS and all tracts from Beaufort and Jasper Counties in South Carolina and Effingham and Chatham Counties in Georgia. It should be noted that offsite health effects are based on the population within an 80-kilometer (50-mile) radius of SRS and those people who use the
L004-01 | Savannah River for drinking water. The population considered in estimating drinking water dose is beyond the 80-kilometer (50-mile) radius. DOE used data from each census tract in this combined



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TC

L004-01

Figure 3-11. Cities and towns within an 80-kilometer (50-mile) radius of SRS.

TE

TE | **Table 3-11.** Population distribution in 1990 within an 80-kilometer (50-mile) radius of SRS.[a]

	Kilometers[b]						
Direction	0-8	8-16	16-32	32-48	48-64	64-80	Total
N	0	26	5,321	10,020	5,067	12,210	32,620
NNE	0	6	1,320	2,066	4,445	14,370	22,200
NE	0	1	2,945	2,928	5,269	10,200	21,340
ENE	0	27	3,126	4,483	5,337	40,770	53,740
E	0	155	6,743	5,305	8,812	4,334	25,350
ESE	0	36	1,556	1,931	2,711	3,253	9,487
SE	0	26	547	6,511	6,685	8,577	22,350
SSE	0	40	391	769	1,356	2,539	5,095
S	0	1	558	1,332	7,251	3,335	12,480
SSW	0	2	897	2,008	4,181	2,944	10,030
SW	0	17	944	2,240	2,606	2,660	8,467
WSW	0	60	1,103	7,112	2,285	5,818	16,380
W	0	55	3,314	7,941	7,994	6,780	26,080
WNW	0	449	3,342	106,900	50,310	11,550	172,500
NW	0	271	5,899	87,930	26,570	3,025	123,700
NNW	0	363	18,030	27,160	6,665	6,079	58,300
Total	0	1,535	56,040	276,600	147,500	138,400	620,100

a. Source: Arnett (1993).
b. To convert to miles, multiply by 0.6214.

region to identify the racial composition of communities and the number of persons characterized by the U.S. Bureau of the Census as living in poverty. The combined region of analysis contains 247 census tracts, 99 in South Carolina and 148 in Georgia.

TE | Tables 3-12 and 3-13 list racial and economic characteristics of the population within the combined region. The total population in the combined area is more than 993,000. Of that total population, TE | approximately 618,000 (62.2 percent) are white. Within the population of people of color (375,000), approximately 94 percent are African American; the remainder are Asian, Hispanic, or Native American. TE | Figure 3-12 gives the distribution of people of color by census tract areas within the region of analysis.

TE | **Table 3-12.** General racial characteristics of the population in the region of analysis.[a]

State	Total population	White	African American	Hispanic	Asian	Native American	Other	People of color	Percent people of color[b]
SC	418,685	267,639	144,147	3,899	1,734	911	335	151,046	36.08%
GA	574,982	350,233	208,017	7,245	7,463	1,546	478	224,749	39.09%
Total	993,667	617,872	352,164	11,144	9,197	2,457	833	375,795	37.82%

a. Source: U.S. Bureau of the Census (1990a).
b. Methodologies used to collect census data result in situations in which the total population does not equal the sum of the populations of the identified racial groups. In this table, people of color is calculated by subtracting the white population from the total population.

Table 3-13. Percentage of the population living in poverty in the region of analysis.[a] | TE

Area	Total population	Persons living in poverty[b]	Percent living in poverty
SC	418,685	72,345	17.28%
GA	574,982	96,672	16.81%
Total	993,667	169,017	17.01%

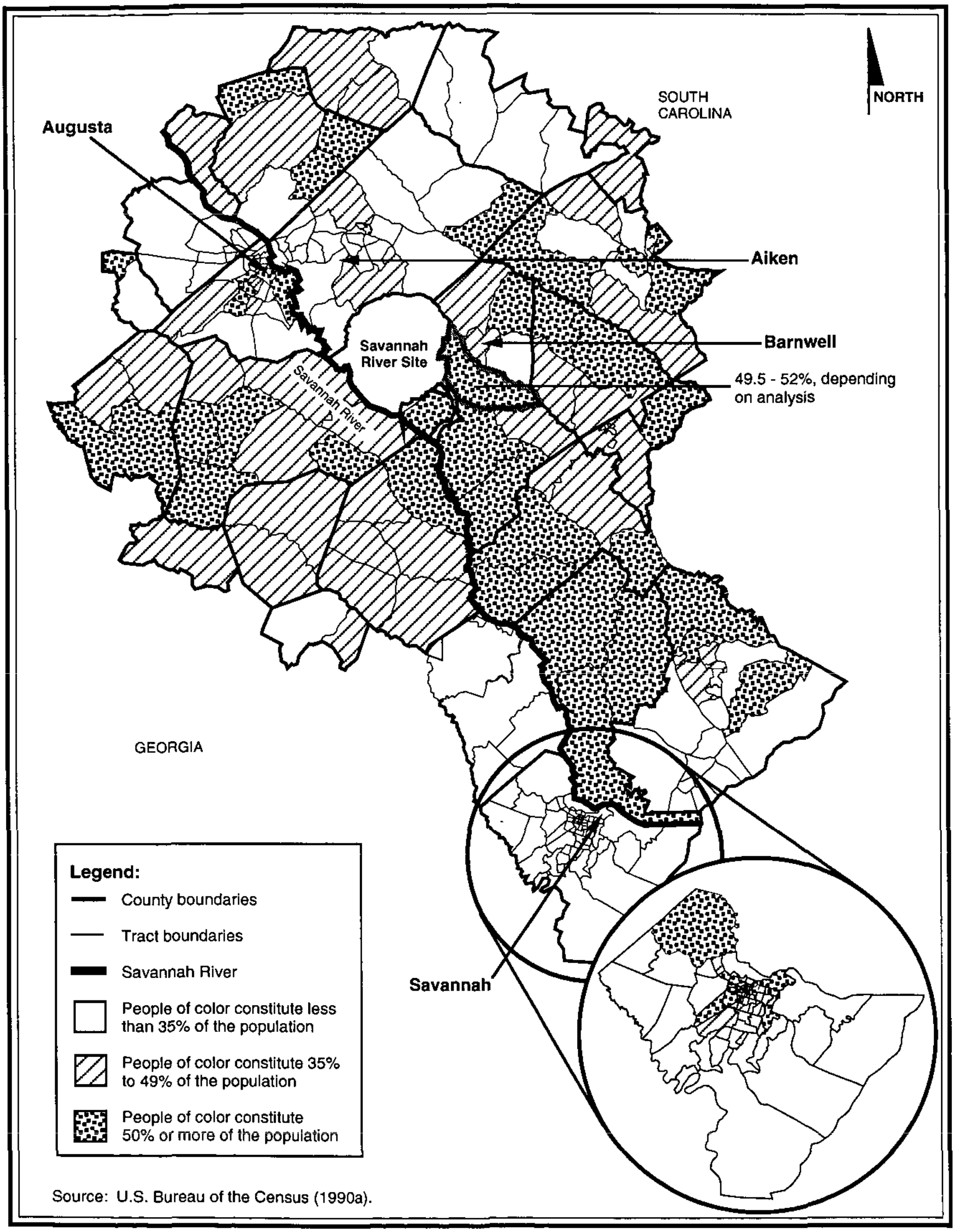
a. Source: U.S. Bureau of the Census (1990b).
b. Families with incomes less than $8,076 in 1989 for a family of two.

Executive Order 12898 does not define minority populations. However, one approach is to identify communities that contain a simple majority of people of color (greater than or equal to 50 percent of the total population of the community). A second approach, proposed by EPA, defines communities of people of color as those that have higher-than-average (over the region of analysis) percentages of people of color (EPA 1994). In Figure 3-12, two different shadings indicate census tracts where (1) people of color constitute 50 percent or more of the total population in the tract, or (2) people of color constitute between 35 percent and 50 percent of the total population in the tract. For purposes of this analysis, DOE adopted the second, more expansive, approach to identifying minority populations. | TE | TE | TE

In the combined region, there are 80 tracts (32.4 percent) where the number of people of color are equal to or greater than 50 percent of the total population. In an additional 50 tracts (20.2 percent), people of color comprise between 35 and 49 percent of the population. These tracts are well distributed throughout the region, although there are more of them toward the south and in the immediate vicinities of Augusta and Savannah, Georgia. | TE

Low-income communities are defined as those in which 25 percent or more of the population live in poverty (EPA 1993b). The U.S. Bureau of the Census defines persons in poverty as those with incomes less than a "statistical poverty threshold." This threshold is a weighted average based on family size and the age of the persons in the family. The baseline threshold for the 1990 census was an income of $8,076 for a family of two during the previous year, 1989. | TC

In the region of analysis, more than 169,000 persons (17.0 percent of the total population) live in poverty (Table 3-13). In Figure 3-13, shaded census tracts identify low-income communities. In the region, 72 tracts (29.1 percent) are low-income communities. These tracts are distributed throughout the region of analysis, but are primarily to the south and west of SRS. | TE



TE | **Figure 3-12.** Distribution of people of color by census tracts in the SRS region of analysis.

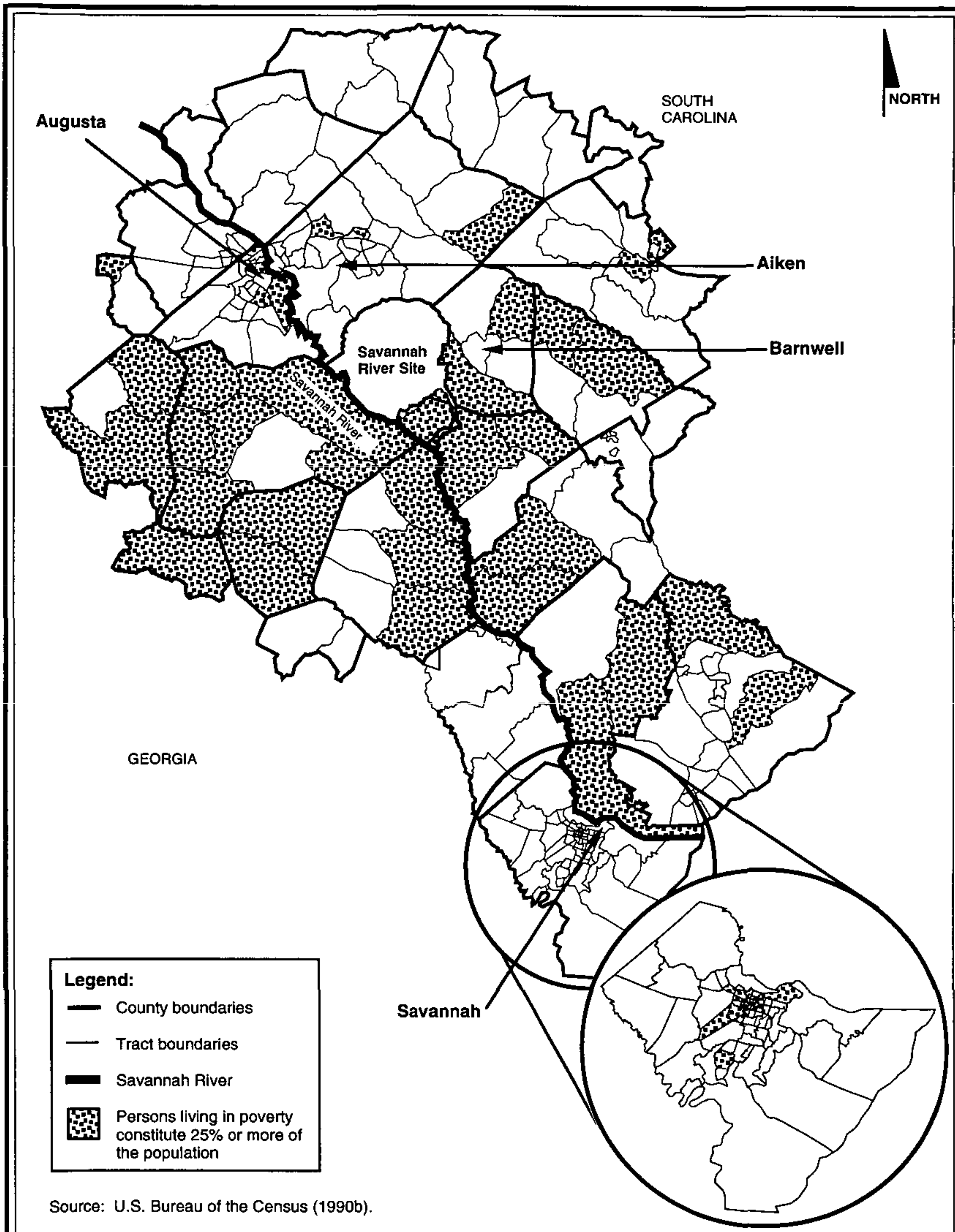


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Figure 3-13. Low-income census tracts in the SRS region of analysis. TE

3.9 Cultural Resources

3.9.1 ARCHAEOLOGICAL SITES AND HISTORIC STRUCTURES

Field studies conducted over the past two decades by the South Carolina Institute of Archaeology and Anthropology of the University of South Carolina, under contract to DOE and in consultation with the South Carolina State Historic Preservation Officer, have provided considerable information about the distribution and content of archaeological and historic sites on SRS. By the end of September 1992, approximately 60 percent of SRS had been examined, and 858 archaeological (historic and prehistoric) sites had been identified. Of these, 53 have been determined to be eligible for the National Register of Historic Places; 650 have not been evaluated. No SRS facilities have been nominated for the National Register of Historic Places, and there are no plans for nominations at this time. The existing SRS nuclear production facilities are not likely to be eligible for the National Register of Historic Places, either because they lack architectural integrity, do not represent a particular style, or do not contribute to the broad historic theme of the Manhattan Project and the production of initial nuclear materials (Brooks 1993, 1994).

Archaeologists have divided SRS into three zones related to their potential for containing sites with multiple archaeological components or dense or diverse artifacts, and their potential for nomination to the National Register of Historic Places (SRARP 1989).

- Zone 1 is the zone of the highest archaeological site density, with a high probability of encountering large archaeological sites with dense and diverse artifacts, and a high potential for nomination to the National Register of Historic Places.

- Zone 2 includes areas of moderate archaeological site density. Activities in this zone have a moderate probability of encountering large sites with more than three prehistoric components or that would be eligible for nomination to the National Register of Historic Places.

- Zone 3 includes areas of low archaeological site density. Activities in this zone have a low probability of encountering archaeological sites and virtually no chance of encountering large sites with more than three prehistoric components; the need for site preservation is low. Some exceptions to this definition have been discovered in Zone 3; some sites in the zone could be considered eligible for nomination to the National Register of Historic Places.

S- and Z-Areas were extensively surveyed prior to construction of the Defense Waste Processing Facility. No archaeological or historic artifacts were found (DOE 1982). The construction of F- and H-Areas during the 1950's is likely to have destroyed any historic or archaeological resources in those areas (Brooks 1993).

3.9.2 NATIVE AMERICAN CULTURAL RESOURCES AND CONCERNS

In conjunction with studies in 1991 related to the New Production Reactor, DOE solicited the concerns of Native Americans about religious rights in the Central Savannah River Valley. During this study, three Native American groups, the Yuchi Tribal Organization, the National Council of Muskogee Creek, and the Indian People's Muskogee Tribal Town Confederacy, expressed general concerns about SRS and the Central Savannah River Area, but did not identify specific sites as possessing religious significance. The Yuchi Tribal Organization and the National Council of Muskogee Creek are interested in several plant species traditionally used in tribal ceremonies, such as redroot (*Lachnanthes carolinianum*), button snakeroot (*Eryngium yuccifolium*), and American ginseng (*Panax quinquefolium*) that may occur on SRS (NUS 1991a). Redroot and button snakeroot are known to occur on SRS (Batson, Angerman, and Jones 1985). DOE included all three tribal organizations on its mailing lists and sends them documents about SRS environmental activities. TE

3.10 Aesthetics and Scenic Resources

The dominant aesthetic settings in the vicinity of SRS are agricultural land and forest, with some limited residential and industrial areas. The reactors and most of the large facilities are located in the interior of SRS (Figure 3-2). Because of the distance to the SRS boundary, the rolling terrain, normally hazy atmospheric conditions, and heavy vegetation, SRS facilities are not usually visible from outside SRS or from roads with public access. The few locations that have views of some SRS structures (other than the administrative area) are distant from the structures [8 kilometers (5 miles) or more]; these views have low visual sensitivity levels because most of these structures were built as many as 40 years ago and are well established in the viewer's expectations. TE

SRS land is heavily wooded (predominantly pine forest, which minimizes seasonal differences), and developed areas occupy approximately 5 percent of the total land area. The facilities are scattered across SRS and are brightly lit at night. Typically, the reactors and principal processing facilities are large concrete structures as much as 30 meters (100 feet) tall adjacent to shorter administrative and support buildings and parking lots. These facilities are visible in the direct line-of-sight when approaching them on SRS access roads. The only structure visible from a distance is the recently completed K-Reactor TE

Cooling Tower. Since this tower will not be operated, the absence of a steam plume ensures no further visual impact. Otherwise, heavily wooded areas that border the SRS road system and public highways crossing the Site limit views of the facilities.

3.11 Traffic and Transportation

3.11.1 REGIONAL INFRASTRUCTURE

SRS is surrounded by a system of interstate highways, U.S. highways, state highways, and railroads. Barge traffic is possible on the Savannah River; however, neither SRS nor commercial shippers routinely use barges (DOE 1991). Figure 3-14 shows the regional transportation infrastructure. TE

3.11.2 SRS TRANSPORTATION INFRASTRUCTURE

The SRS transportation infrastructure consists of more than 230 kilometers (143 miles) of primary roads, 1,931 kilometers (1,200 miles) of unpaved secondary roads, and 103 kilometers (64 miles) of railroad track (WSRC 1993c). These roads and railroads provide connections among the various SRS facilities and links to offsite transportation. Figure 3-15 shows the SRS network of primary roadways, access points, and the SRS railroad system.

3.11.2.1 SRS Roads

In general, heavy traffic occurs in the early morning and late afternoon when workers commute to and from SRS. Table 3-14 provides data on SRS roads during peak travel times, and Table 3-15 provides peak baseline traffic for the primary offsite access roads and Road E. During working hours, official vehicles and logging trucks constitute most of the traffic. As many as 30 logging trucks, which can impede traffic, may be operating simultaneously on SRS, with an annual average of 15 trucks per day (WSRC 1992a). A total of 785 trucks longer than about 8 meters (25 feet) enter and exit SRS daily (Swygert 1994a). TE

3.11.2.2 SRS Railroads

The SRS rail yard is east of P-Reactor. This eight-track facility sorts and redirects rail cars. Deliveries of shipments to SRS occur at two rail stations in the former towns of Ellenton and Dunbarton. From these stations, an SRS engine moves the railcars to the appropriate facility. The Ellenton station, which is on the main Augusta-Yemassee line, receives coal for the large powerhouse located in D-Area. The

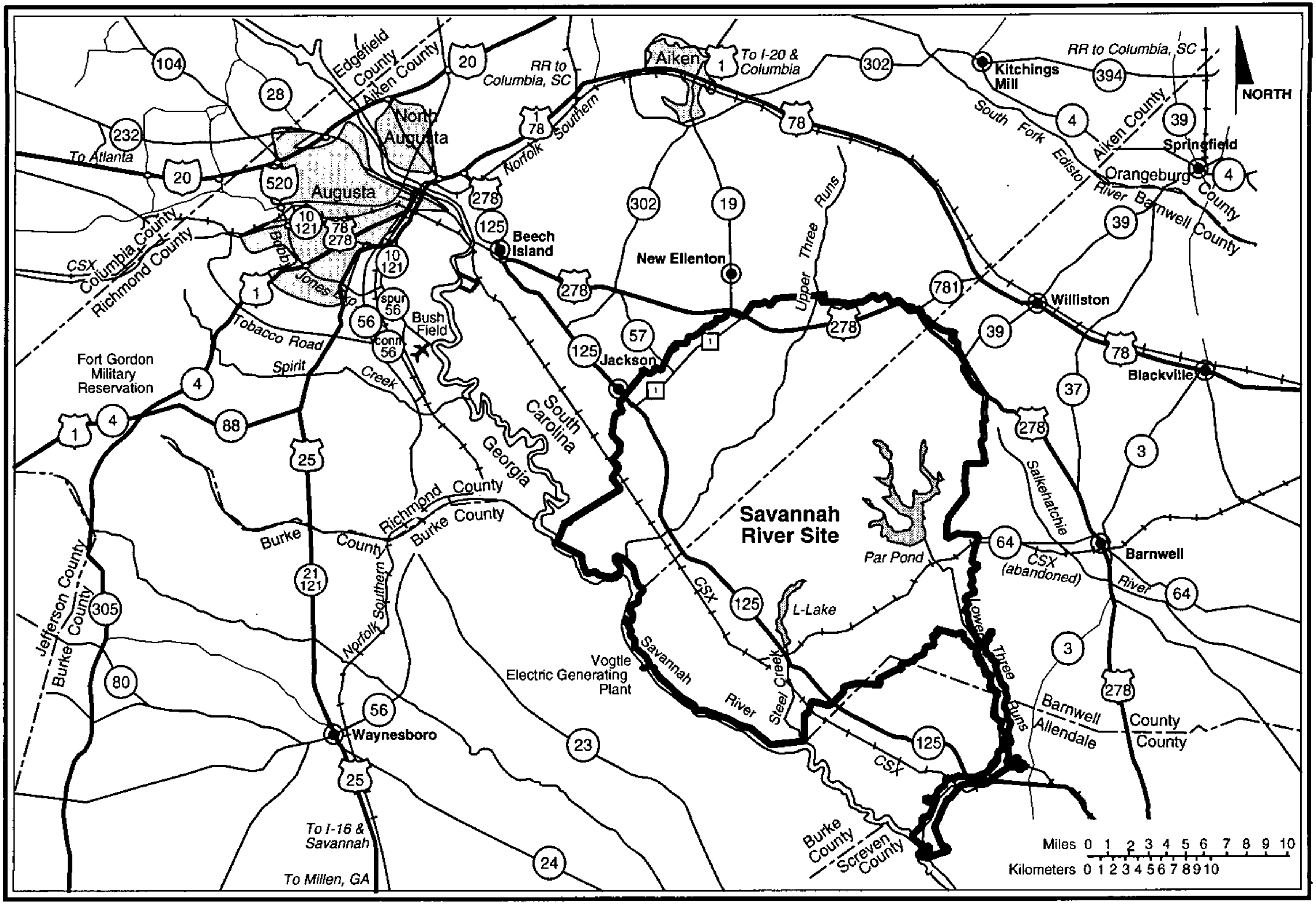

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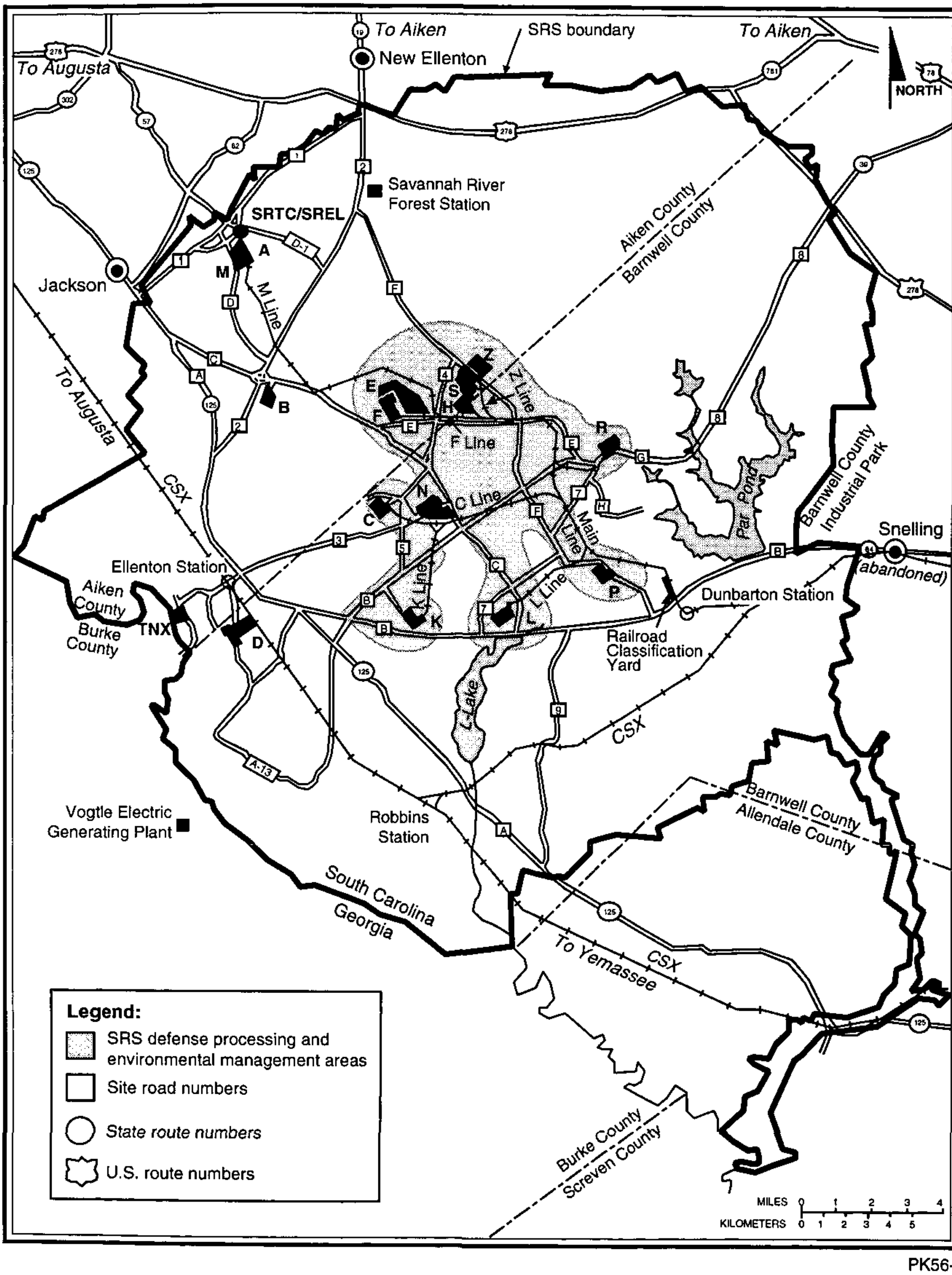
Figure 3-14. SRS regional transportation infrastructure.



TE | **Figure 3-15.** Location of principal SRS facilities, roads, and railroads.

Table 3-14. Traffic counts on major SRS roads.[a]

TE

Measurement point	Date	Direction	Daily total	Peak[b]	Peak time[c]	Average speed (mph)[d]
Road 2 between Roads C and D	9-29-93	East	3,224	794	1530	52
	9-29-93	West	3,225	897	0630	47
Road 4 between Roads E and C	12-9-92	East	1,624	352	1530	NA[e]
	12-9-92	West	1,553	306	0615	NA
Road 8 at Pond C	2-23-92	East	634	274	1530	58
	2-23-92	West	662	331	0615	56
Road C between landfill and Road 2	12-16-92	North	6,931	2,435	1530	53
	12-16-92	South	6,873	2,701	0630	58
Road C north of Road 7	1-20-93	North	742	288	0630	45
	1-20-93	South	763	223	1530	47
Road D at old gunsite	9-29-93	North	1,779	218	1500	43
	9-29-93	South	1,813	220	0845	52
Road E at E-Area	8-25-93	North	3,099	669	1530	35
	8-25-93	South	3,054	804	0630	38
Road F at Upper Three Runs	2-2-93	North	3,239	1,438	1530	53
	2-2-93	South	3,192	1,483	0630	51
Road F north of Road 4	8-25-93	North	3,097	1,239	1530	NA
	8-25-93	South	255	75	0645	39
Road F south of Road 4	8-25-93	North	126	41	0645	29
	8-25-93	South	290	68	0645	35

a. Source: Swygert (1994b).
b. Number of vehicles in peak hour.
c. Start of peak hour.
d. mph = miles per hour; to convert to kilometers per hour, multiply by 1.6093.
e. NA = not available.

Table 3-15. Traffic counts on major SRS arteries during peak hours (vehicles per hour).

TE

Road	Design capacity	1994 baseline traffic[a]	Percent of capacity
		Offsite[a]	
SC 19	3,000[b]	2,800[b]	93
SC 125	3,200[b]	2,700[b]	84
SC 57	2,100[b]	700[c]	33
		Onsite[a,d]	
Road E at E-Area	2,300[c]	741[e]	32

a. Baseline traffic for 1994 was estimated from actual traffic counts measured in 1989 (offsite) and 1992/1993 (onsite) by adjusting total vehicles by the percent of change in SRS employment between the measured years and 1994.
b. Adapted from Smith (1989).
c. Adapted from TRB (1985).
d. Source: Swygert (1994b).
e. Morning traffic traveling to E-Area.

Dunbarton station receives the other rail shipments and coal for the smaller powerhouses located throughout SRS (McLain 1994).

Under normal conditions, about 13 trains per day use the CSX tracks through SRS (Burns 1993). Movement of coal and casks containing radioactive material constitutes the bulk of rail traffic (DOE 1991).

3.11.3 NOISE

Previous studies have assessed noise impacts of existing SRS operational activities (NUS 1991b; DOE
TE | 1990, 1991). These studies concluded that, because of the remote locations of the SRS operational areas, there are no known conditions associated with existing sources of noise at SRS that adversely affect individuals at offsite locations.

3.12 Occupational and Public Radiological Health and Safety

3.12.1 PUBLIC RADIOLOGICAL HEALTH

A release of radioactivity to the environment from a nuclear facility is an important issue for both SRS workers and the public. However, the environment contains many sources of radiation, and it is important to understand all the sources of ionizing radiation to which people are routinely exposed.

3.12.1.1 Sources of Environmental Radiation

Environmental radiation consists of natural background radiation from cosmic, terrestrial, and internal body sources; radiation from medical diagnostic and therapeutic practices; radiation from weapons tests fallout; radiation from consumer and industrial products; and radiation from nuclear facilities. All radiation doses mentioned in this EIS are "effective dose equivalents" (i.e., organ doses are weighted for biological effect to yield equivalent whole-body doses) unless specifically identified otherwise (e.g., "absorbed dose," "thyroid dose," "bone dose").

Releases of radioactivity to the environment from SRS account for less than 0.1 percent of the total
TE | annual average environmental radiation dose to individuals within 80 kilometers (50 miles) of SRS (Arnett, Karapatakis, and Mamatey 1994). Standard population dose analyses for air releases are based on an 80-kilometer (50-mile) radius because expected dose levels beyond that distance are very small.

Natural background radiation contributes about 82 percent of the annual dose of 357 millirem received by an average member of the population within 80 kilometers (50 miles) of SRS (Figure 3-16). Based on national averages, medical exposure accounts for an additional 15 percent of the annual dose, and the combined doses from weapons tests fallout, consumer and industrial products, and air travel account for about 3 percent of the total dose (NCRP 1987a). | TE

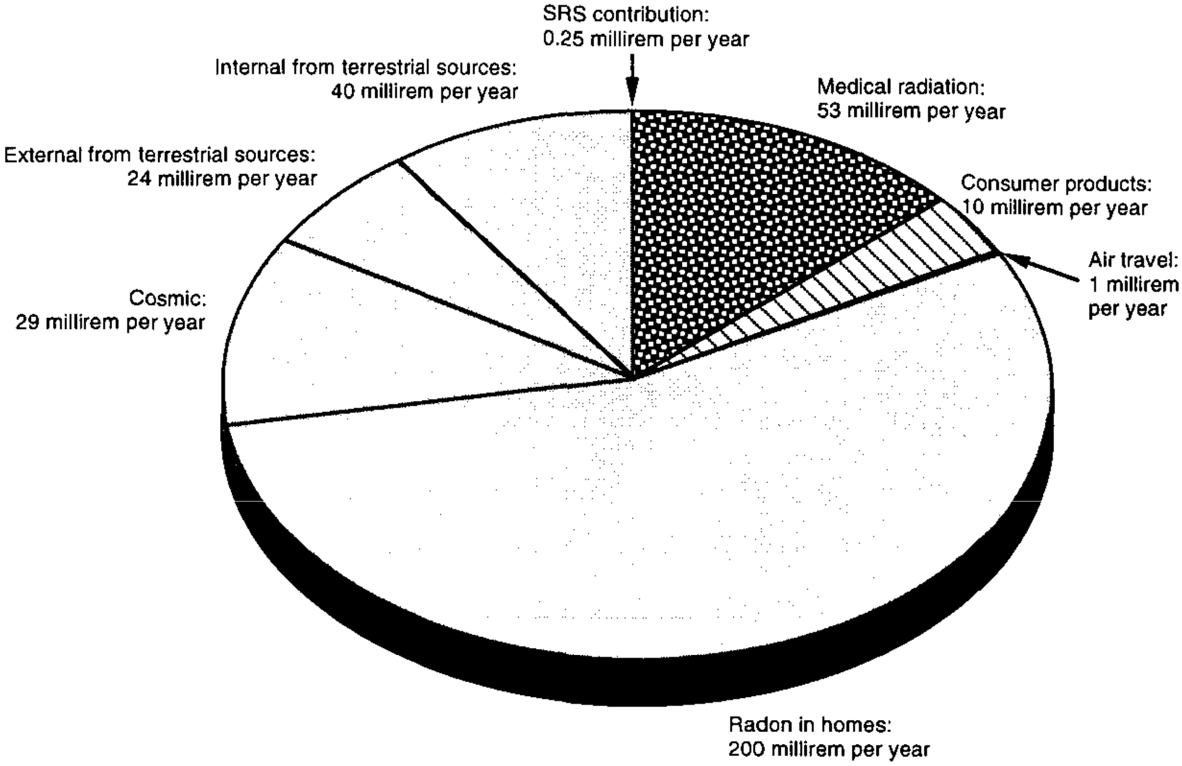
External radiation from natural sources comes from cosmic rays and emissions from natural radioactive materials in the ground. The radiation dose from external radiation varies with location and altitude.

Internal radiation from natural terrestrial sources consists primarily of potassium-40, carbon-14, rubidium-87, and daughter products of radium-226 that are consumed in food grown with fertilizers containing these radionuclides. The estimated average internal radiation exposure in the United States from natural radioactivity (primarily indoor radon daughter products) is 240 millirem per year (NCRP 1987b).

Medical radiation is the largest source of man-made radiation to which the population of the United States is exposed. The average dose to an individual from medical and dental x-rays, prorated over the entire population, is 39 millirem per year (NCRP 1987a). In addition, radiopharmaceuticals administered to patients for diagnostic and therapeutic purposes account for an average annual dose of 14 millirem when prorated over the population. Thus, the average medical radiation dose in the U.S. population is about 53 millirem per year. Prorating the dose over the population determines an average dose that, when multiplied by the population size, produces an estimate of population exposure. It does not mean that every member of the population receives a radiation exposure from these sources.

In 1980, the estimated average annual dose from fallout from nuclear weapons tests was 4.6 millirem (0.9 millirem from external gamma radiation and 3.7 millirem from ingested radioactivity). Because atmospheric nuclear weapons tests have not been conducted since 1980, the average annual dose from fallout is now less than 1 millirem. This decline is due principally to radioactive decay.

A variety of consumer and industrial products yield ionizing radiation or contain radioactive materials and, therefore, result in radiation exposure to the general population. Some of these sources are televisions, luminous dial watches, airport x-ray inspection systems, smoke detectors, tobacco products, fossil fuels, and building materials. The estimated average annual dose for the U.S. population from these sources is 10 millirem per year (NCRP 1987a). About one-third of this dose is from external exposure to naturally occurring radionuclides in building materials.



Notes:
1. Values are effective dose equivalent from NCRP (1987a) unless otherwise noted.
2. External terrestrial: NCRP (1987a) reports 26 millirem per year for sea level. Multiplying that value by 1.1 to correct for the altitude of 300 meters above sea level gives 29 millirem per year.
3. Internal terrestrial: NCRP (1987b) reports an absorbed dose rate for Augusta, Georgia, of 4 microrad/hr, which is 35 millirad per year. NCRP (1987b) uses a factor of 0.7 to convert absorbed dose in air to effective dose equivalent, so 35 x 0.7 = 24 millirem per year.
4. Value for SRS contribution is from Arnett, Karapatakis, and Mamatey (1994).

Legend:

☐ Natural Background

PK56-3

TE | **Figure 3-16.** Major sources of radiation exposure in the vicinity of SRS.

People who travel by aircraft receive additional exposure from cosmic radiation because at high altitudes the atmosphere provides less shielding from this source of radiation. The average annual airline passenger dose, when prorated over the entire U.S. population, amounts to 1 millirem (NCRP 1987b).

3.12.1.2 Radiation Levels in the Vicinity of SRS

Figure 3-16 summarizes the major sources of exposure for the population within 80 kilometers (50 miles) of SRS and for populations in Beaufort and Jasper Counties, South Carolina, and in Chatham County, Georgia, that drink water from the Savannah River. Many factors, such as natural background dose and medical dose, are independent of SRS. TE

Atmospheric testing of nuclear weapons deposited approximately 25,600,000 curies of cesium-137 on the earth's surface (United Nations 1977). About 104 millicuries of cesium-137 per square kilometer were deposited in the latitude band where South Carolina is located (30°N to 40°N). The total resulting deposition was 2,850 curies on the 27,400 square kilometers (10,580 square miles) of the Savannah River watershed and 80 curies on SRS. The cesium-137 attached to soil particles and has slowly been transported from the watershed. Results from routine health protection monitoring programs indicate that since 1963 about 1 percent of the 2,850 curies of cesium-137 deposited on the total Savannah River watershed has been transported down the Savannah River (du Pont 1983).

Onsite monitoring shows that an average of 50 millicuries of cesium-137 per square kilometer (1976 to 1982 average) are in the upper 5 centimeters (2 inches) of the soil column. This is one-half the original amount. Some of the cesium has moved down in the soil column, and some has been transported in surface water to the Savannah River.

Other nuclear facilities within 80 kilometers (50 miles) of SRS include a low-level waste burial facility operated by Chem-Nuclear Systems, Inc., near the eastern SRS boundary, and Georgia Power Company's Vogtle Electric Generating Plant, located directly across the Savannah River from SRS. In addition, Carolina Metals, Inc., which is northwest of Boiling Springs in Barnwell County, South Carolina, processes depleted uranium. The Chem-Nuclear facility, which began operating in 1971, releases essentially no radioactivity to the environment (Chem-Nuclear Systems, Inc. 1980), and the population dose from normal operations is very small. The 80-kilometer (50-mile) radius population receives an immeasurably small radiation dose from transportation of low-level radioactive waste to the burial site. Plant Vogtle began commercial operation in 1987, and its releases to date have been far below DOE guidance levels and Nuclear Regulatory Commission regulatory requirements (Davis, Martin, and Todd 1989). TE

In 1993, releases of radioactive material to the environment from SRS operations resulted in a site perimeter maximum dose from all pathways from atmospheric releases of 0.11 millirem per year (in the north-northwest sector), and a maximum dose from releases into water of 0.14 millirem per year, for a maximum total annual dose at the SRS perimeter of 0.25 millirem (Arnett, Karapatakis, and Mamatey 1994). The maximum dose to downstream consumers of Savannah River water was to users of the Port Wentworth public water supply, and was 0.05 millirem per year (Arnett, Karapatakis, and Mamatey 1994).

TE In 1990, the population within 80 kilometers (50 miles) of SRS was 620,100 (Arnett, Karapatakis, and Mamatey 1993 and Table 3-11). The collective effective dose equivalent to the 80-kilometer (50-mile) population in 1993 was 7.6 person-rem from atmospheric releases (Arnett, Karapatakis, and Mamatey 1994). The 1990 population of 65,000 people using water from Port Wentworth (Savannah), Georgia, and from Beaufort and Jasper Counties, South Carolina, received a collective dose equivalent of 1.5 person-rem (Arnett, Karapatakis, and Mamatey 1994).

Controlled deer and hog hunts are conducted annually at SRS to control their populations. Field measurements performed on each animal prior to release to the hunter determine the levels of cesium-137 present in the animal. Field measurements are subsequently verified by laboratory analysis, and dose calculations are performed to estimate dose to the maximally exposed individual among the hunters. In 1993, the maximally exposed individual hunter killed four deer and three hogs. The dose to this hunter was estimated based on the cesium-137 measurements of the deer and hog muscle taken from these animals and the conservative assumption that the hunter consumed all of the edible portions of these animals (337 pounds of meat). The dose to this maximally exposed individual was estimated to be 57 millirem (Arnett, Karapatakis, and Mamatey 1994), which represents 57 percent of the DOE annual limit of 100 millirem (DOE Order 5400.5).

In 1993, the maximally exposed individual fisherman was assumed to eat 19 kilograms (42 pounds) of fish per year. The dose to the fisherman was based on consumption of fish taken only from the mouth of
TE
L004-04 Steel Creek on SRS. The dose to this individual was estimated to be 1.30 millirem (WSRC 1994a) or 1.3 percent of the DOE annual limit (DOE 1993a).

The hunter population dose was estimated based on the fact that 1,553 deer and 147 hogs were killed in 1993. These deer and hogs contained average cesium-137 concentrations of 4.69 picocuries per gram and 5.64 picocuries per gram, respectively. The regional average of cesium-137 concentration in deer is 0.7 picocuries per gram (Fledderman 1994). The population dose due to the consumption of SRS animals is estimated to be 8.3 person-rem. The portion of this dose attributable to the presence of cesium-137 above the regional average concentration is 7.1 person-rem (Rollins 1994).

Gamma radiation levels, including natural background terrestrial, and cosmic radiation measured at 179 locations around the SRS perimeter during 1993, yielded a maximum dose rate of 102 millirem per year (Arnett, Karapatakis, and Mamatey 1994). This level is typical of normal background gamma levels measured in the general area (84 millirem per year measured by the EPA at Augusta, Georgia, in 1992). The maximum gamma radiation level measured onsite (N-Area) was 460 millirem per year (Arnett, Karapatakis, and Mamatey 1994). TE TC L004-05

Detailed summaries of releases to the air and water from SRS are provided in a series of annual environmental reports (e.g., Arnett, Karapatakis, and Mamatey 1994 for the year 1993). Each of these environmental reports also summarizes radiological and nonradiological monitoring and the results of the analyses of environmental samples. These reports also summarize the results of the extensive groundwater monitoring at SRS, which uses more than 1,600 wells to detect and monitor both radioactive and nonradioactive contaminants in the groundwater and drinking water in and around process operations, burial grounds, and seepage basins.

3.12.1.3 Radiation Levels in E-, F-, H-, N-, S-, and Z-Areas TE

Table 3-16 presents gamma radiation levels measured in E-, F-, H-, N-, S-, and Z-Areas in 1993. These values can be compared to the average dose rate of 35 millirem per year measured at the SRS perimeter. This difference is attributable to differences in geologic composition, as well as facility operations. TE

Table 3-16. External radiation levels (milliRoentgen per year) at SRS facilities.[a,b] TE

Location	Average	Maximum
E-Area	158	345
F-Area	91	126
H-Area	103	146
N-Area	178	460
S-Area	101	117
Z-Area	72	80

L004-05

a. Source: Arnett (1994).
b. One milliRoentgen is approximately 1 millirem.

Analyses of soil samples from uncultivated areas measure the amount of particulate radioactivity deposited from the atmosphere. Table 3-17 lists maximum measurements of radionuclides in the soil for 1993 at E-, F-, H-, S-, and Z-Areas, the SRS perimeter, and at background [160-kilometer (100-mile)] TE monitoring locations. Measured elevated concentrations of strontium-90 and plutonium-239 around F- and H-Areas reflect releases from these areas.

TE | **Table 3-17.** Maximum measurements of radionuclides in soil for 1993 [picocuries per gram; 0 to 8 centimeters (0 to 3 inches) depth].[a]

Location	Strontium-90	Cesium-137	Plutonium-238	Plutonium-239
F-Area	0.133	1.26	0.0784	0.360
H-Area	0.0863	1.57	0.0262	0.178
S-Area	0.0331	0.353	0.0355	0.0540
Z-Area	0.0825	0.820	0.00663	0.0504
E-Area	0.0264	0.271	(b)	(b)
Site perimeter	0.0095	0.652	0.00187	0.0201
Background [160-kilometer (100-mile) radius]	0.0772	0.352	0.00105	0.00835

a. Source: Arnett (1994).
b. No data available.

3.12.2 WORKER RADIATION EXPOSURE

The major goals of the SRS Health Protection Program are to keep the exposure of workers to radiation and radioactive material within safe limits and, within those limits, as low as reasonably achievable. An effective radiation protection program must minimize doses to individual workers and the collective dose to all workers in a given work group.

3.12.2.1 Sources of Radiation Exposure to Workers at SRS

Worker dose comes from exposure to external radiation or from internal exposure when radioactive material enters the body. In most SRS facilities, the predominant source of worker exposure is from external radiation. In the SRS facilities that process tritium, the predominant source of worker exposure is the internal dose from tritium that has been inhaled or absorbed into internal body fluids. On rare occasions, other radionuclides can contribute to internal dose if they have accidentally been inhaled or ingested.

External exposure comes mostly from gamma radiation emitted from radioactive material in storage containers or process systems (tanks and pipes). Neutron radiation, which is emitted by a few special radionuclides, also contributes to worker external radiation in a few facilities. Beta radiation, a form of external radiation, has a lesser impact than gamma and neutron radiation because it has lower penetrating energy and, therefore, produces a dose only to the skin, rather than to critical organs within the body. Alpha radiation from external sources does not have an impact because it has no penetrating power.

Internal exposure occurs when radioactive material is inhaled, ingested, or absorbed through the skin. Once the radioactive material is inside the body, low-energy beta and non-penetrating alpha radiation emitted by the radioactive material in close proximity to organ tissue can produce dose to that tissue. If this same radioactive material were outside the body, the low penetrating ability of the radiation emitted would prevent it from reaching the critical organs. For purposes of determining health hazards, organ dose can be converted to effective dose equivalents. The mode of exposure (internal versus external) is irrelevant when comparing effective dose equivalents.

3.12.2.2 Radiation Protection Regulations and Guidelines

The current SRS radiological control program implements Presidential Guidance issued to all Federal agencies on January 20, 1987. This guidance was subsequently codified (10 CFR 835) as a federal regulation governing all DOE activities (58 FR 238). Policies and program requirements, formulated to ensure the protection of SRS workers and visitors, are documented in the *SRS Radiological Control Procedure Manual, WSRC 5Q* (WSRC 1993d). DOE performs regular assessments to ensure the continuing quality and effectiveness of the SRS radiological control program by monitoring radiological performance indicators and by making periodic independent internal appraisals as required by 10 CFR 835.102. External appraisals are also conducted periodically by DOE and the Defense Nuclear Facilities Safety Board to provide additional assurance of continuing program effectiveness. TE

Appropriate control procedures, engineered safety systems, and worker training programs are established and implemented to ensure compliance with applicable regulations before beginning radioactive operation of any facility at the SRS.

3.12.2.3 SRS Worker Dose

The purpose of the radiation protection program is to minimize dose from external and internal exposure; it must consider both individual and collective dose. It would be possible to reduce individual worker dose to very low levels by using numerous workers to perform extremely small portions of the work task. However, frequent changing of workers would be inefficient and would result in a higher total dose received by all the workers than if fewer workers were used and each worker were allowed to receive a slightly higher dose. TE

Worker doses at SRS have consistently been well below the DOE worker exposure limits. Administrative exposure guidelines are set at a fraction of the exposure limits to help ensure doses are as low as reasonably achievable. For example, the current DOE worker exposure limit is 5 rem per year, TE | and the SRS administrative exposure guideline was 1.5 rem per year in 1993. Table 3-18 shows the maximum and average individual doses and the SRS collective doses for 1988 through 1993.

TE | **Table 3-18.** SRS annual individual and collective radiation doses.[a]

Year	Individual dose (rem)		SRS collective dose (person-rem)
	Maximum	Average[b]	
1988	2.040	0.070	864
1989	1.645	0.056	754
1990	1.470	0.056	661
1991	1.025	0.038	392
1992	1.360	0.049	316
1993	0.878	0.051	263

a. Adapted from: du Pont (1989), WSRC (1991, 1992b, 1993d, 1994a), Petty (1993).
TE | b. The average dose is calculated only for workers who received a measurable dose during the year.

3.12.2.4 Worker Risk

In the United States, 23.5 percent of human deaths each year are caused by some form of cancer (CDC 1993). Any population of 5,000 people is expected to contract approximately 1,200 fatal cancers from non-occupational causes during their lifetimes, depending on the age and sex distribution of the population. Workers who are exposed to radiation have an additional risk of 0.0004 latent fatal cancers TE | per person-rem of radiation exposure (NCRP 1993).

In 1993, 5,157 SRS workers received a measurable dose of radiation amounting to 263 person-rem TE | (Table 3-18). Therefore, this group may experience up to 0.1 (0.0004×263) additional cancer death due to its 1993 occupational radiation exposure. Continuing operation of SRS could result in up to 0.1 additional cancer death each year of operation, assuming future annual worker exposure continues at the 1993 level. In other words, for each 10 years of operation, there could be one additional death from cancer among the work force that receives a measurable dose at the 1993 level.

3.12.3 WORKER NONRADIOLOGICAL SAFETY AND HEALTH

Industrial safety, industrial hygiene, medical monitoring, and fire protection programs have been TE | implemented at SRS to ensure the nonradiological health and safety of SRS workers.

TE | The Occupational Safety and Health Administration requires the use of incidence rates to measure worker safety and health (DOL 1986). Incidence rates relate the number of injuries and illnesses and the resulting days lost from work to exposure (i.e., the number of hours worked) of workers to workplace conditions that could result in injuries or illnesses. Incidence rates, which are based on the exposure of 100 full-time workers working 200,000 hours (100 workers times 40 hours per week times 50 weeks per year), automatically adjust for differences in the hours of worker exposure. The Occupational Safety and Health Administration also specifies the types of injuries and illnesses that must be recorded for inclusion in incidence rate calculations. Incidence rates are generally calculated for total number of recordable cases, total number of lost workday cases, and total number of lost workdays.

Each year, the Bureau of Labor Statistics reports the results of its annual survey of job-related injuries and illnesses in private industry. The injury and illness data supplied by the Bureau of Labor Statistics provide the most comprehensive survey data available on work-related injuries and illnesses in private industry. The Bureau of Labor Statistics estimates that in 1991, private industry employers experienced 8.4 work-related injuries and illnesses per 100 full-time workers (DOE 1993b). TE

Incidence rates provide an objective measure of the performance of SRS safety programs. The data in Table 3-19 compare the performance of SRS operations to that of general industry, the manufacturing industry, and the chemical industry (DOE 1993a). SRS safety programs have produced incidence rates that are far below comparable rates for general industry, the manufacturing industry, and the chemical industry. The numbers reported in Table 3-19 for SRS include only management and operating contractor employers because these are the only ones that would be involved in waste management. TE TE

Table 3-19. Comparison of 1992 illness and injury incidence rates for SRS operations to 1991 illness and injury incidence rates for general industry, the manufacturing industry, and the chemical industry (number of illnesses and injuries per 100 full-time workers). TE

Incidence rate	SRS M&O[a] operations	General industry	Manufacturing industry	Chemical industry
Total recordable cases	0.5	8.4	12.7	6.4
Lost workday cases	0.1	3.9	5.6	3.1
Lost workdays	2.0	86.5	121.5	62.4

a. M&O = management and operating contractor. TE

Occupational exposure to noise is controlled through the management and operating contractor hearing conservation program outlined in Industrial Hygiene Manual 4Q, Procedure 501. This program implements the contractor requirements for identifying, evaluating, and controlling noise exposures to meet the requirements of 29 CFR 1910.95, Occupational Noise Exposure. TE TE

3.13 Waste and Materials

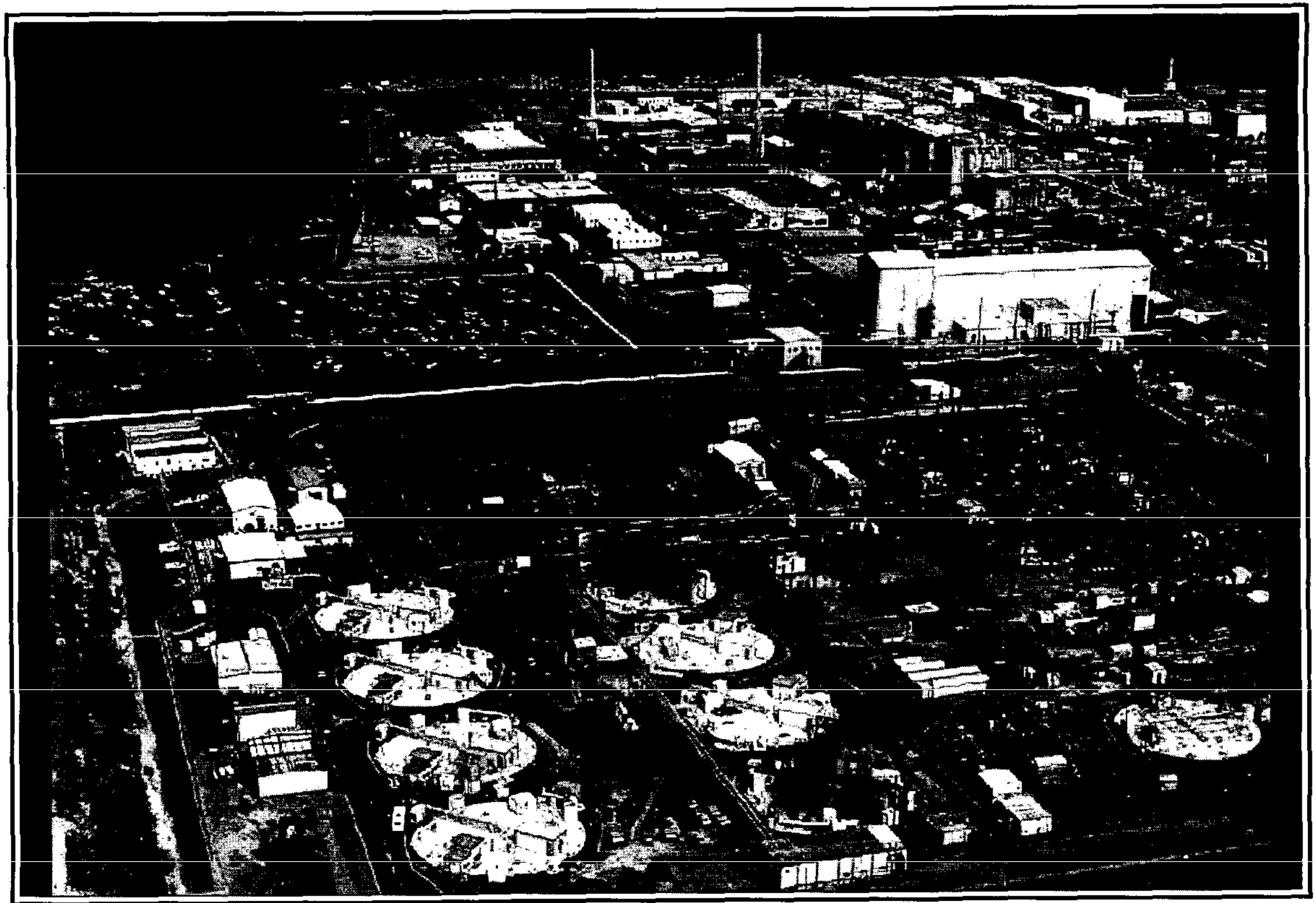
SRS activities in support of the national defense mission produced liquid high-level radioactive waste, low-level (low- and intermediate-activity) radioactive waste, hazardous waste, mixed waste (radioactive and hazardous combined), and transuranic waste. This section discusses current treatment, storage, and disposal of these wastes at SRS and management of wastes generated from facility operations discussed in Chapter 2.

Wastes at SRS were and continue to be generated both by facility operations and environmental restoration, with facility operations generating most of the waste. Facility operations include nuclear and non-nuclear research; material testing; laboratory analysis; high-level waste processing and nuclear fuel storage; manufacturing, repair, and maintenance; and general office work. Facility operations also include operating all waste management facilities for treatment, storage, and disposal of SRS-generated wastes.

DOE treats, stores, and disposes of wastes generated from all onsite operations in waste management facilities, most of which are located in E-, F-, H-, N-, S-, and Z-areas (Figure 3-2). Major facilities include the high-level waste tank farms; the Low-Level Radioactive Waste Disposal Facility; the F- and H-Area Effluent Treatment Facility; the Defense Waste Processing Facility (undergoing startup testing); and the Consolidated Incineration Facility (under construction).

The environmental restoration mission has increased in recent years and includes two programs: (1) the decontamination and decommissioning of surplus facilities (see Section 3.14) and (2) the remediation program, which identifies and, where necessary, arranges for cleanup of potential releases from inactive waste sites (see Section 3.15).

DOE stores liquid and solid wastes at SRS. Liquid high-level radioactive waste is stored in underground storage tanks in accordance with an SCDHEC wastewater treatment permit (Figures 3-17 and 3-18). The tanks are managed in accordance with federal laws, SCDHEC regulations, and DOE Orders. Figure 3-19 shows the management process for liquid high-level radioactive waste at SRS. Transuranic mixed waste is stored on interim-status storage pads in accordance with SCDHEC requirements and DOE Orders (Figure 3-20). Wastewater contaminated with low-level radioactivity is stored and treated at the F/H-Area Effluent Treatment Facility, a SCDHEC permitted facility (Figure 3-21). Hazardous and mixed wastes are stored in permitted or interim-status facilities, such as the hazardous waste storage facilities (buildings and pads) and in the mixed waste storage buildings (Figures 3-22 and 3-23, respectively). Figure 3-24 shows the process for handling other forms of waste at SRS.



PK56-27

Figure 3-17. F-Area liquid high-level waste tank farm.

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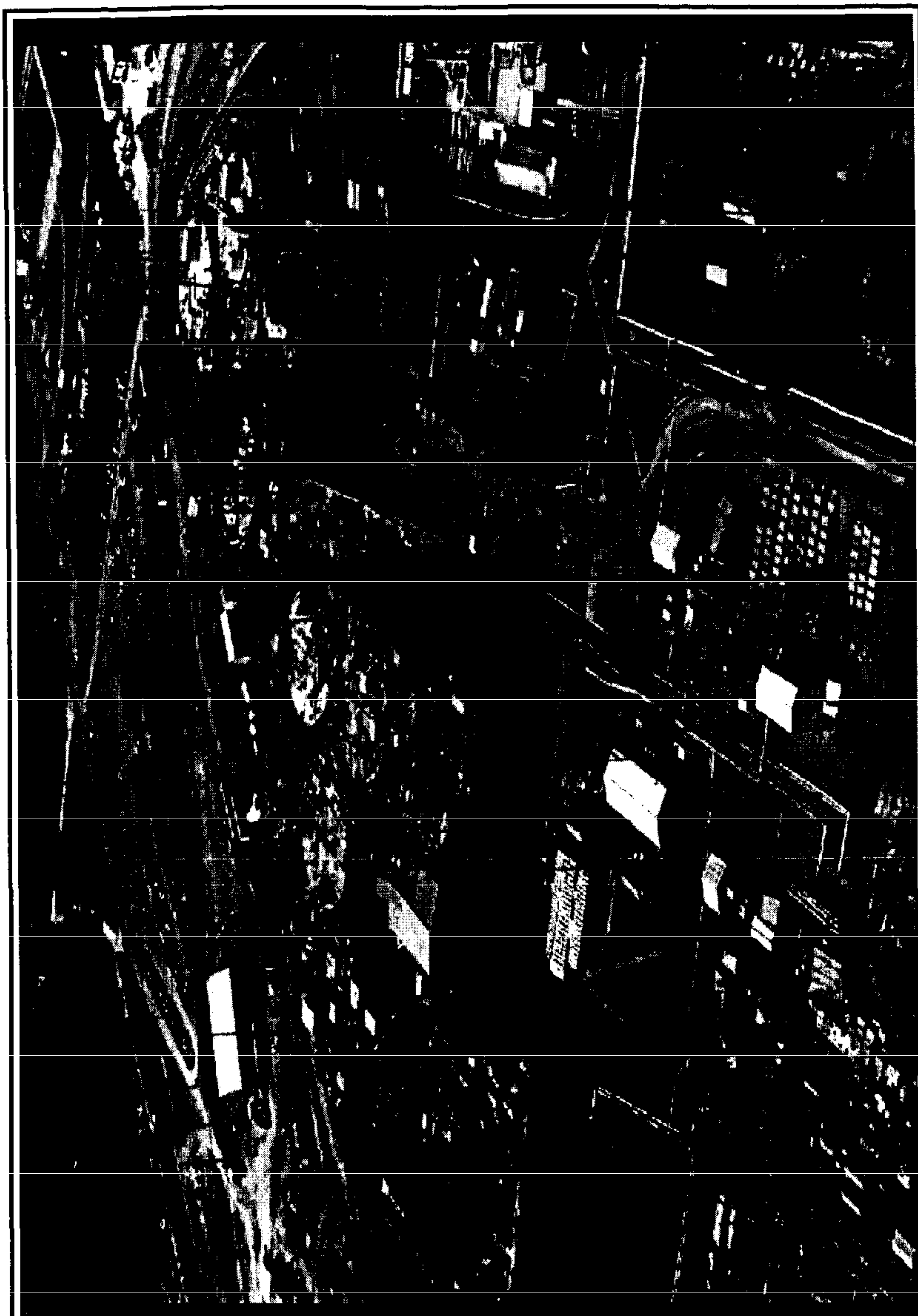


PK56-24

TE | **Figure 3-18.** H-Area liquid high-level waste tank farm.

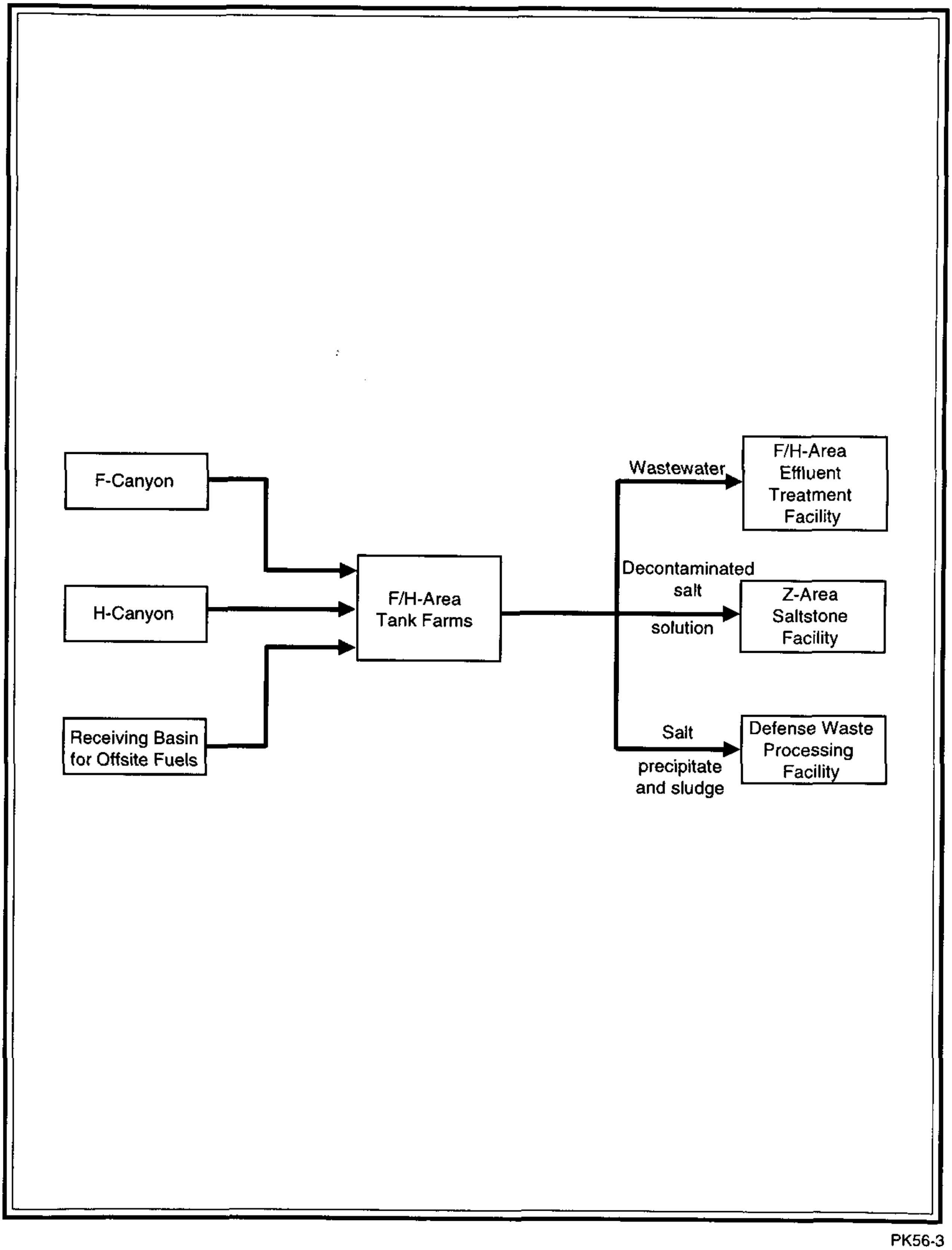
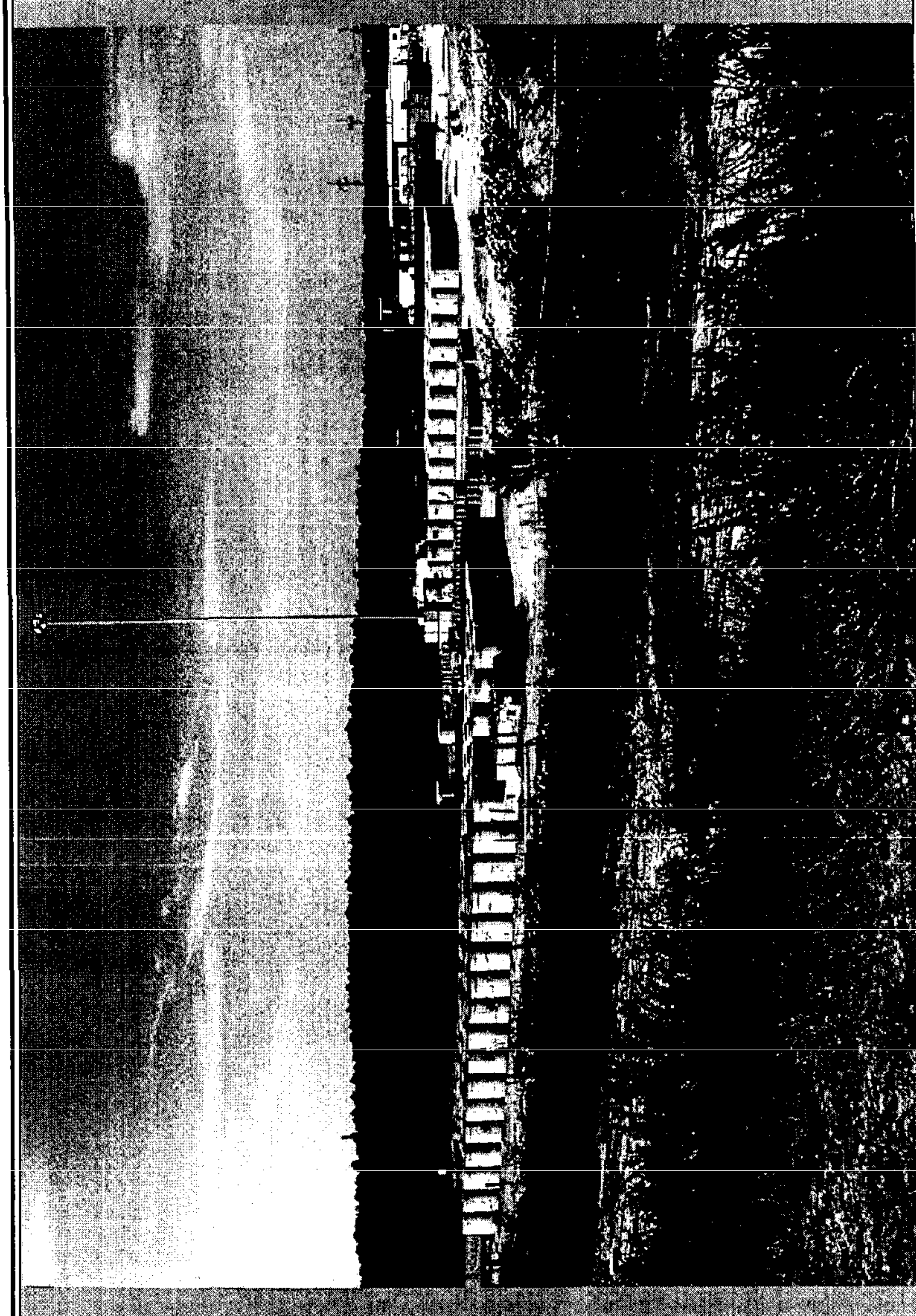


Figure 3-19. Management process for liquid high-level radioactive waste at SRS. TE



PK56-26

TE | **Figure 3-20.** Transuranic mixed waste storage pads (E-Area).

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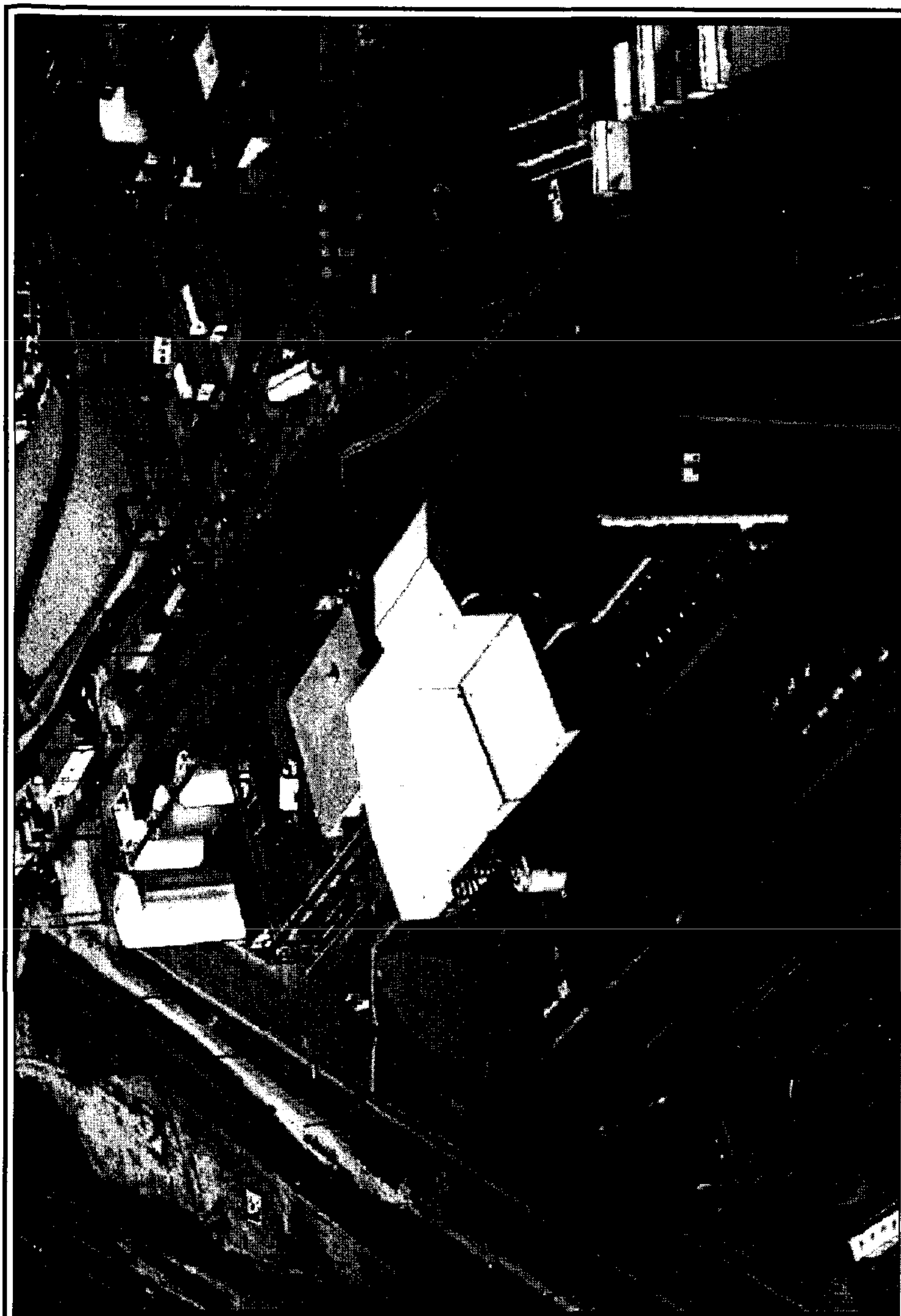
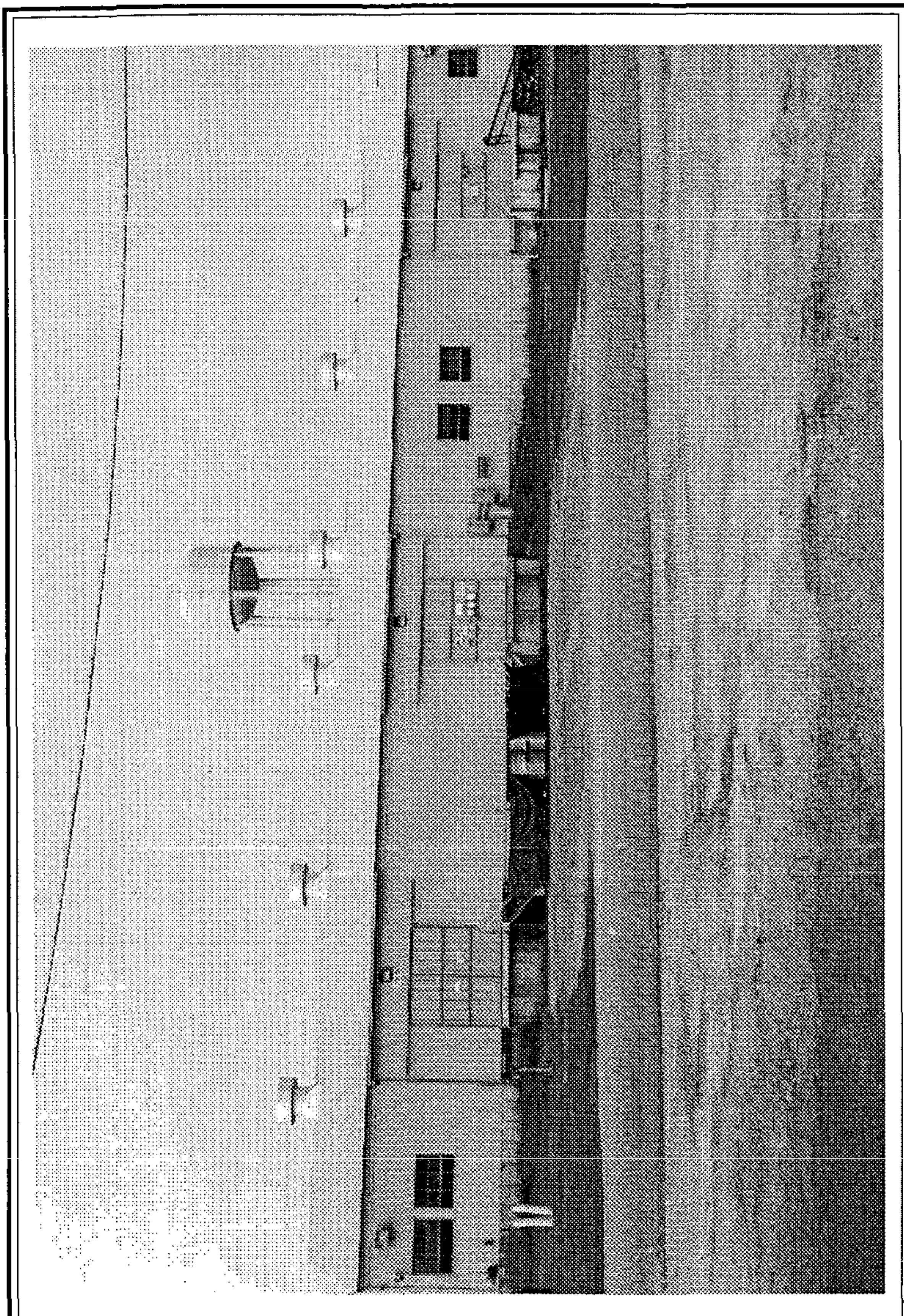


PK56-30

Figure 3-21. F/H-Area Effluent Treatment Facility (H-Area).



PK56-7

TE | **Figure 3-22.** Hazardous waste storage facility (B-Area).

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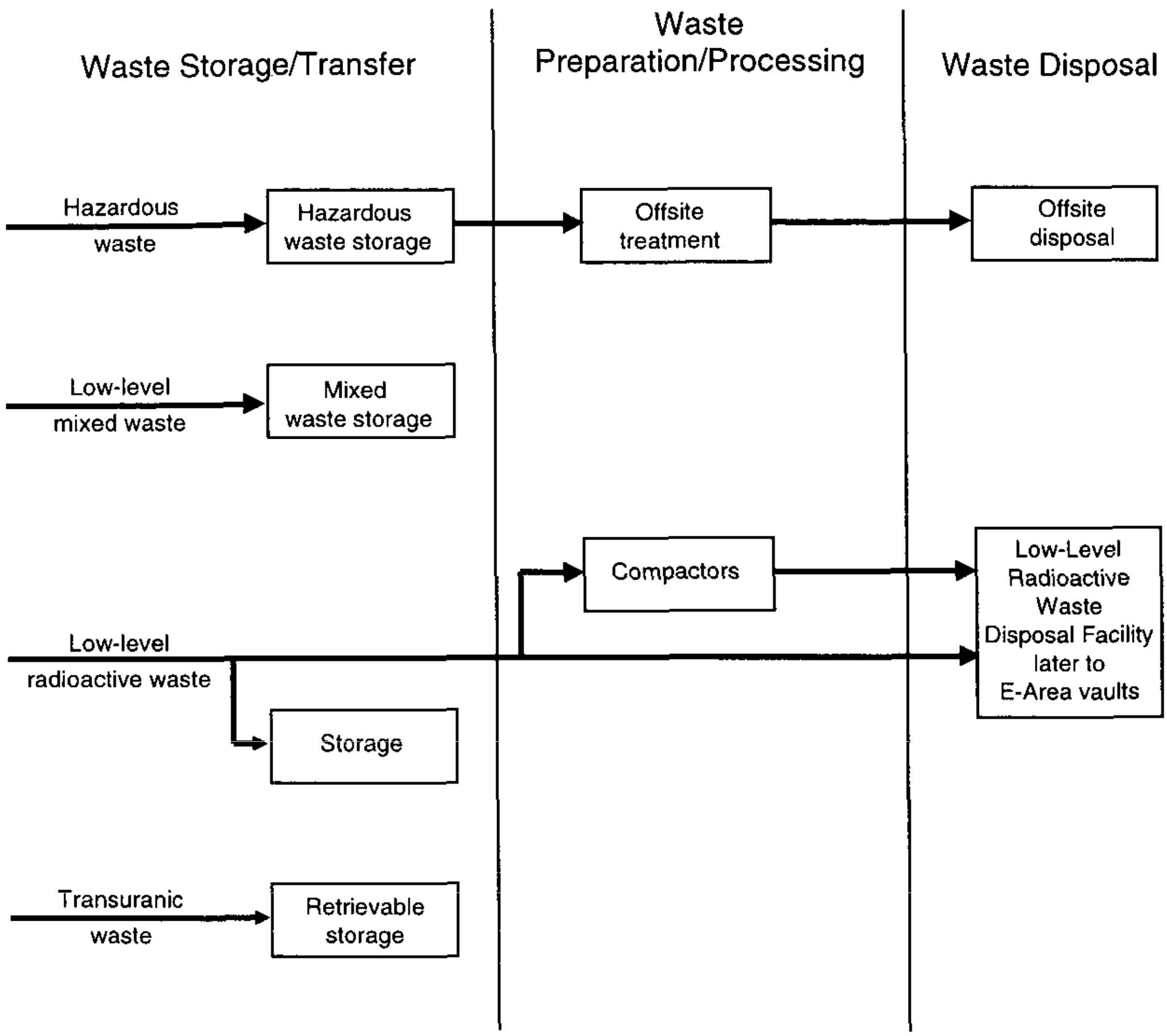
PK56-26

Figure 3-23. Mixed waste storage facility (E-Area).



Source: WSRC (1994b)

PK56-3

TE **Figure 3-24.** Flow diagram for waste management at SRS.

Through waste minimization and treatment programs, DOE continues to reduce the amount of waste generated, stored, and disposed of at SRS. DOE minimizes waste by reducing its volume, toxicity, or mobility before storage and disposal. Waste reduction includes intensive surveys, waste segregation, and the use of administrative and engineering controls.

3.13.1 LOW-LEVEL RADIOACTIVE WASTE

Low-level radioactive waste is defined as waste that contains radioactivity and is not classified as high-level waste, transuranic waste, spent nuclear fuel, or byproduct material.

SRS packages low-level waste for disposal onsite in the Low-Level Radioactive Waste Disposal Facility (Figure 3-25) according to its waste category and its estimated surface dose. DOE places low-activity wastes in carbon steel boxes and deposits them in low-activity waste vaults in E-Area. The vaults are concrete structures approximately 200 meters (643 feet) long by 44 meters (145 feet) wide by 8 meters (27 feet) deep.

DOE packages intermediate-activity waste according to its form and disposes of it in intermediate-level waste vaults in E-Area. Some intermediate-activity waste, such as contaminated pieces of equipment, is wrapped in canvas before disposal. TE

DOE will store long-lived wastes, such as resins, in the Long-Lived Waste Storage Building in E-Area until DOE develops treatment and disposal technologies for them (Figure 3-26).

The E-Area vaults began receiving low-level radioactive waste in September 1994. This facility includes low-activity, intermediate-level nontritium, and intermediate-level tritium vaults (Figures 3-27 and 3-28).

3.13.2 LIQUID HIGH-LEVEL RADIOACTIVE WASTE

Liquid high-level radioactive waste is highly radioactive material from the reprocessing of spent nuclear fuel that contains a combination of transuranic waste and fission products in concentrations requiring permanent isolation. It includes both the liquid waste produced by reprocessing and any solid waste derived from that liquid. The solid waste is also classified as liquid high-level radioactive waste.

PK56-25

TE | **Figure 3-25.** Low-Level Radioactive Waste Disposal Facility (E-Area).

TE

PK56-24

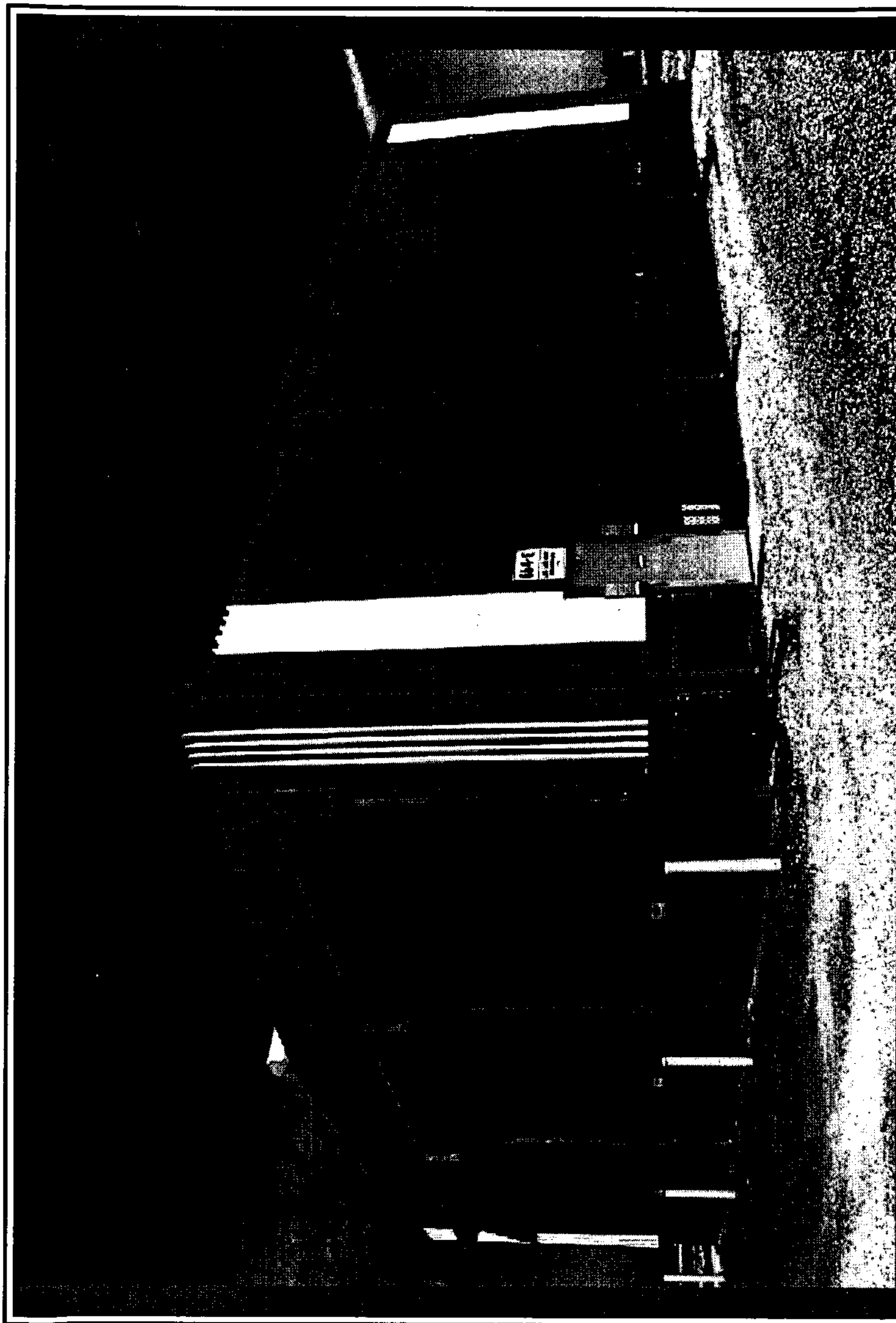


Figure 3-26. Long-lived waste storage facility (E-Area).

PK48-28

TE | **Figure 3-27.** Low-activity waste vault (E-Area).

TE

PK56-28

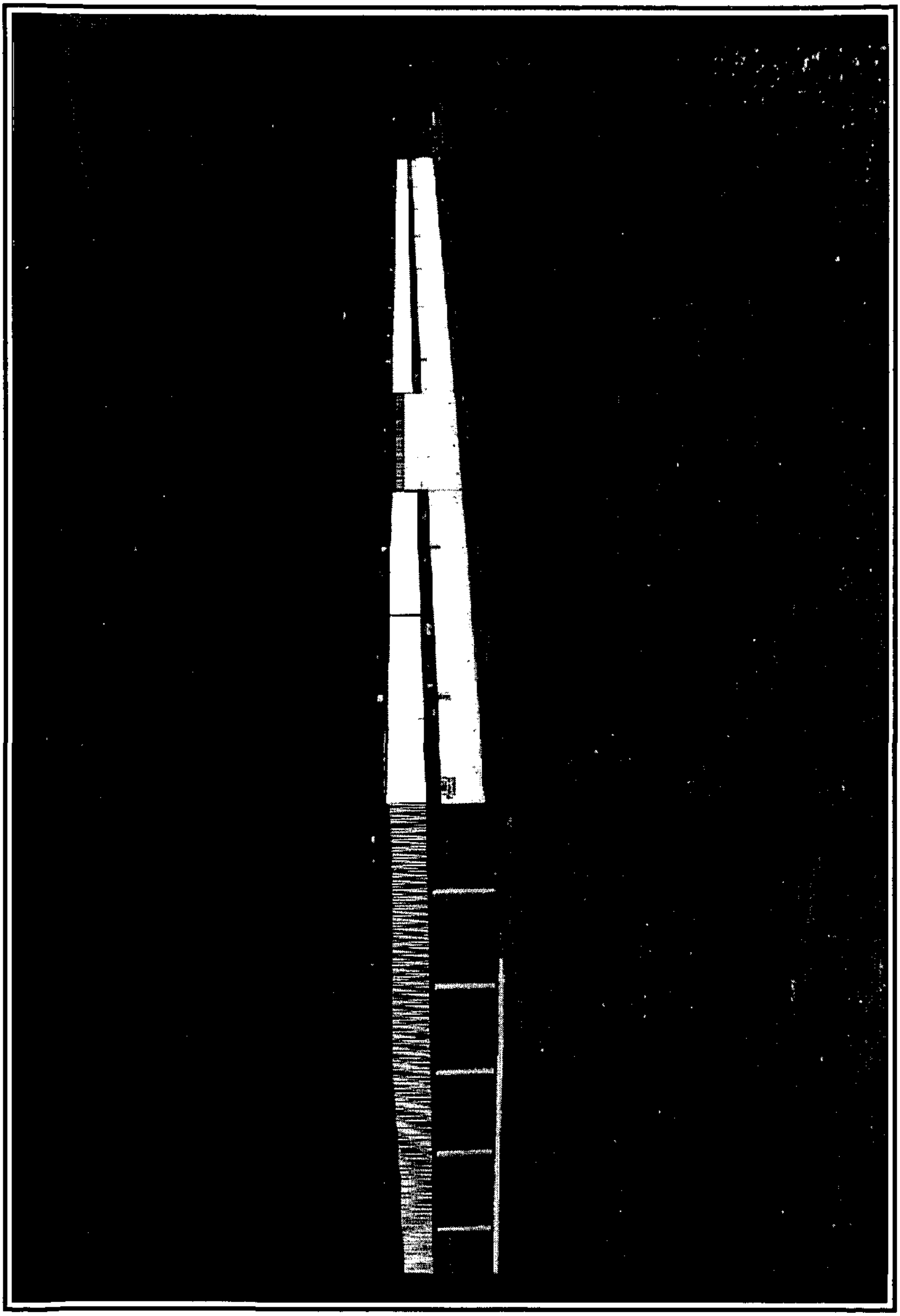


Figure 3-28. Intermediate-level nontritium and tritium waste vaults (E-Area).

SRS generates liquid high-level radioactive waste during the recovery of nuclear materials from spent fuel and targets in F- and H-Areas, and stores it in 50 underground tanks. Waste was previously stored in an additional tank; however, waste in that tank has been removed, and the tank is no longer in service. These tanks also contain other radioactive effluents (primarily low-level radioactive waste such as liquid process waste and purge water from storage basins for irradiated reactor fuel or fuel elements). The liquid high-level waste is neutralized and then stored in these tanks until short-lived radionuclides have decayed to inconsequential levels and insoluble components of the waste (about 5 to 10 percent) have settled out to form a sludge layer on the tank bottom. The liquid waste is then heated to evaporate the water, thereby reducing its volume and crystallizing the solids as salt. The *Final Supplemental Environmental Impact Statement Defense Waste Processing Facility* (DOE 1994b) provides details on this process. The evaporated liquid is transferred to the F/H-Area Effluent Treatment Facility, which is designed to decontaminate routine process effluents from F- and H-Areas. The salt fraction is further processed by in-tank precipitation to separate it into a highly radioactive portion for vitrification at the Defense Waste Processing Facility (when it becomes operational) and a low radioactive salt solution that is stabilized and disposed of at the Z-Area Saltstone Facility.

3.13.3 TRANSURANIC WASTE

Transuranic waste contains alpha-emitting radionuclides that have an atomic weight greater than uranium (92), half-lives greater than 20 years, and concentrations greater than 100 nanocuries per gram of waste. Before 1982, transuranic waste was defined as any waste containing transuranic radionuclides with concentrations in excess of 10 nanocuries per gram. Buried and stored wastes containing concentrations of transuranic radionuclides between 10 and 100 nanocuries per gram are now referred to as alpha-contaminated low-level waste (or "alpha waste" in this EIS). Alpha waste is managed like transuranic waste because its physical and chemical characteristics are similar and because similar procedures will be used to determine its final disposition. SRS stores waste containing 10 to 100 nanocuries of alpha activity per gram with transuranic wastes until disposal requirements can be determined. Currently, there are no treatment facilities or disposal capacities for transuranic waste; however, DOE plans to retrieve, repackage, certify, and ship all transuranic wastes offsite for final disposition.

Historically, DOE used three types of retrievable storage for transuranic waste at SRS. Transuranic waste generated before 1974 is buried in approximately 120 below-grade concrete culverts in the Low-Level Radioactive Waste Disposal Facility. Transuranic waste generated between 1974 and 1986 is stored on five concrete pads and one asphalt pad that have been covered with approximately 1.2 meters (4 feet) of native soil. DOE stores waste generated since 1986 on 13 concrete pads that are not covered with soil. Transuranic waste includes waste mixed with hazardous waste which is stored on Pads 1 through 17 that operate under interim status approved by SCDHEC (Figures 3-20 and 3-29). DOE currently uses Pads 18 and 19 to manage nonhazardous transuranic wastes only. DOE filed for approval under a RCRA Part A permit application (to describe the waste and facilities) for additional storage of transuranic mixed waste on Pads 20 through 22, which are currently empty. All of these pads are located in the Low-Level Radioactive Waste Disposal Facility. TE

3.13.4 HAZARDOUS WASTE

Hazardous waste is defined as any discarded materials that are either characteristically hazardous or are listed as hazardous under RCRA. Characteristically hazardous materials are corrosive, ignitable, reactive, or toxic. Wastes listed as hazardous include certain process wastes, solvents, and discarded commercial chemicals.

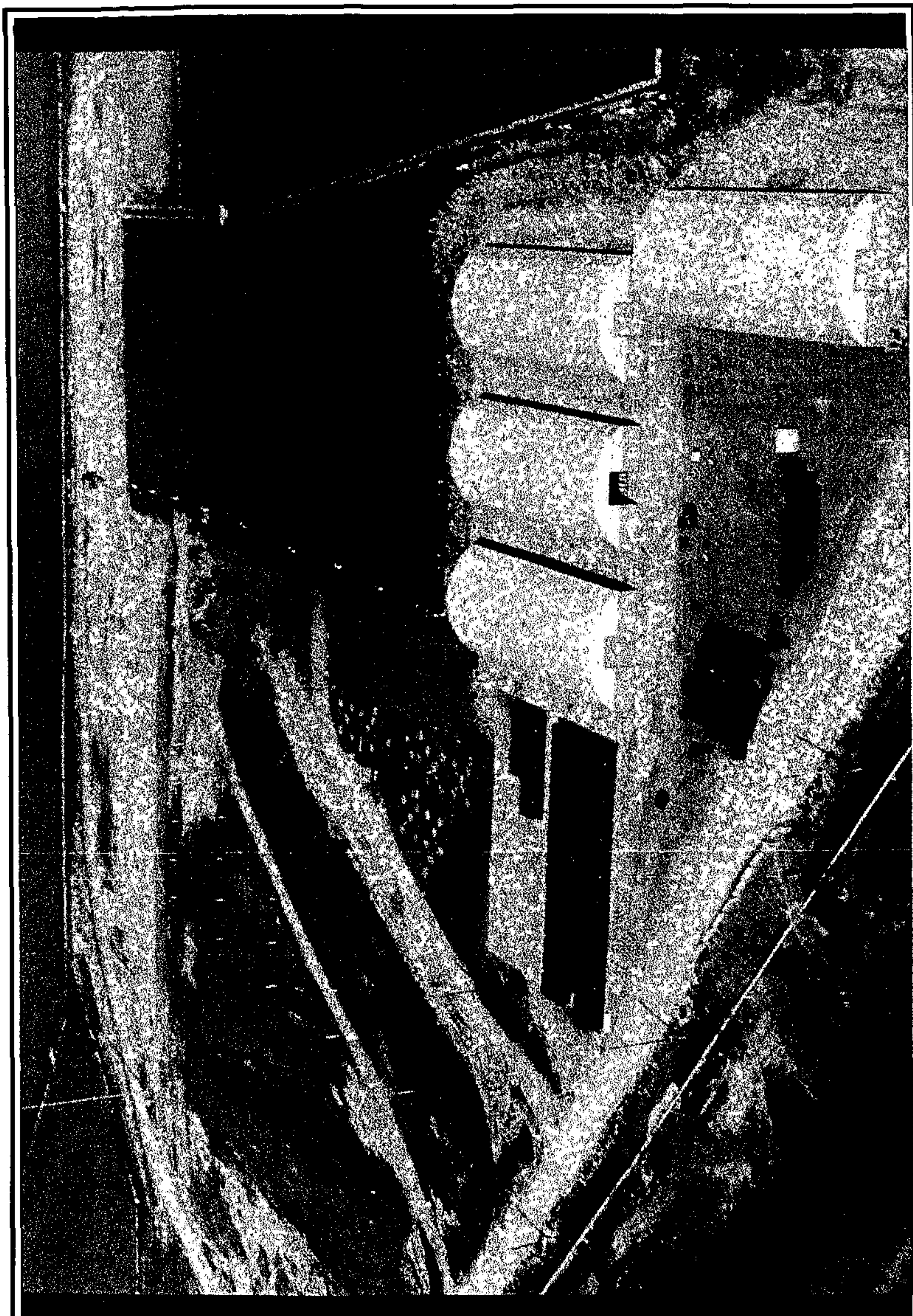
At SRS, hazardous waste is generated by routine facility operations and environmental restoration projects. Hazardous waste is temporarily stored at storage facilities (Figure 3-22) located in new buildings in B- and N-Areas, prior to shipment to permitted treatment, storage, and disposal facilities. TE

DOE began offsite shipments of hazardous wastes to treatment and disposal facilities in 1987. In 1990, DOE imposed a moratorium on shipments of hazardous waste that came from radiological materials areas or that had not been proven to be nonradioactive. SRS continues to send hazardous waste that is confirmed as not subject to the moratorium (e.g., recyclable solvents) offsite for recycling, treatment, or disposal.

3.13.5 MIXED WASTE

Mixed waste contains both hazardous waste (subject to RCRA), and source, special nuclear, or byproduct material (subject to the Atomic Energy Act of 1954). Mixed waste is classified according to its radioactive component. Low-level mixed waste is managed with its hazardous components as its primary consideration, while high-level and transuranic mixed wastes are managed with their radioactive component as the primary consideration.

The SRS mixed waste program consists primarily of safely storing mixed wastes until treatment and disposal facilities are available. Mixed waste storage facilities are located in E-Area (Figure 3-23), N-Area, M-Area, S-Area, and A-Area. These facilities include Burial Ground Solvent Tanks S23 through S30, M-Area Process Waste Interim Treatment/Storage Facility (Figure 3-30), Savannah River Technology Center Mixed Waste Storage Tanks, and the Organic Waste Storage Tank (Figure 3-31). TE



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TE | **Figure 3-29.** Transuranic waste storage pads (E-Area).

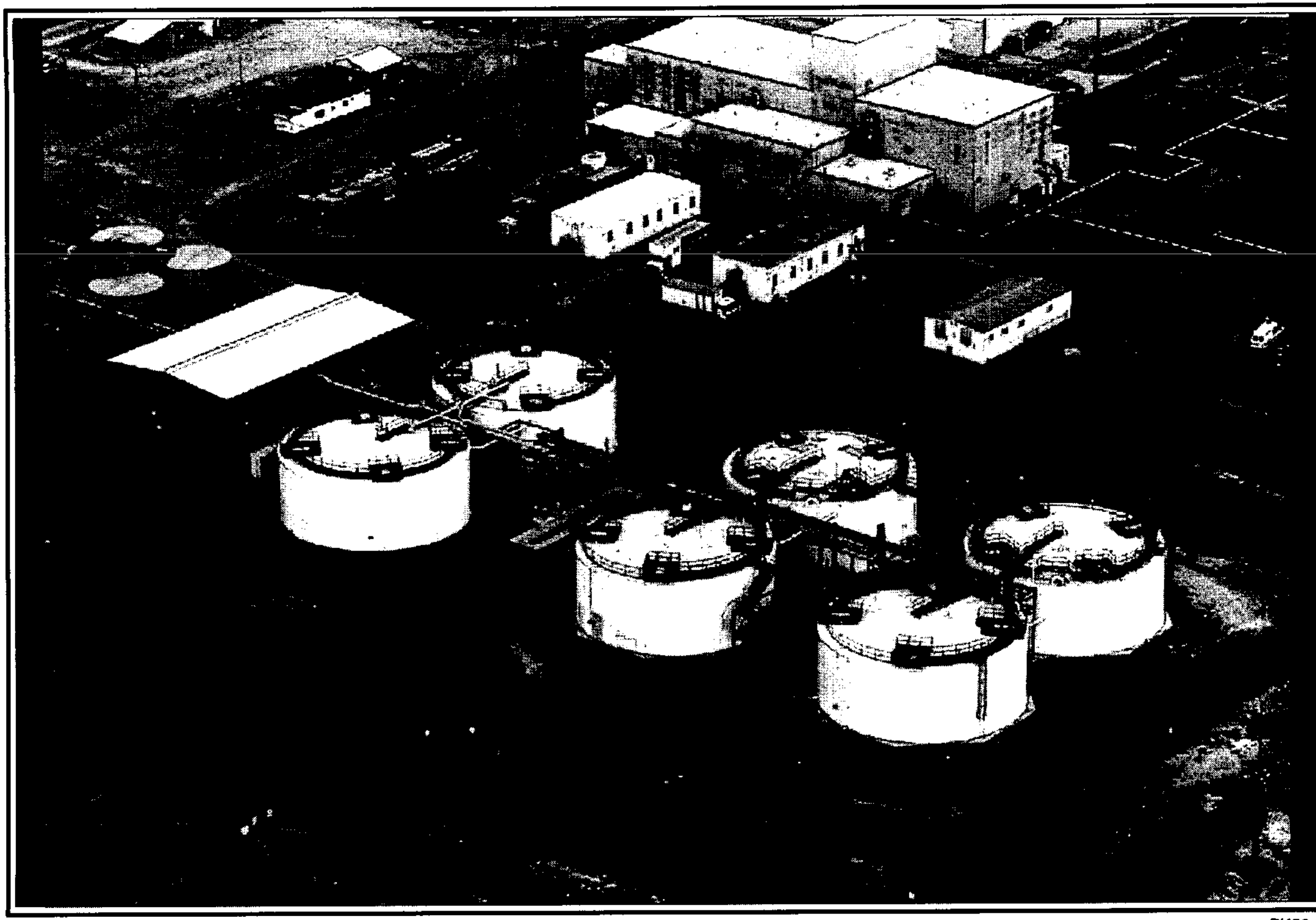

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Figure 3-30. M-Area Process Waste Interim Treatment/Storage Facility.

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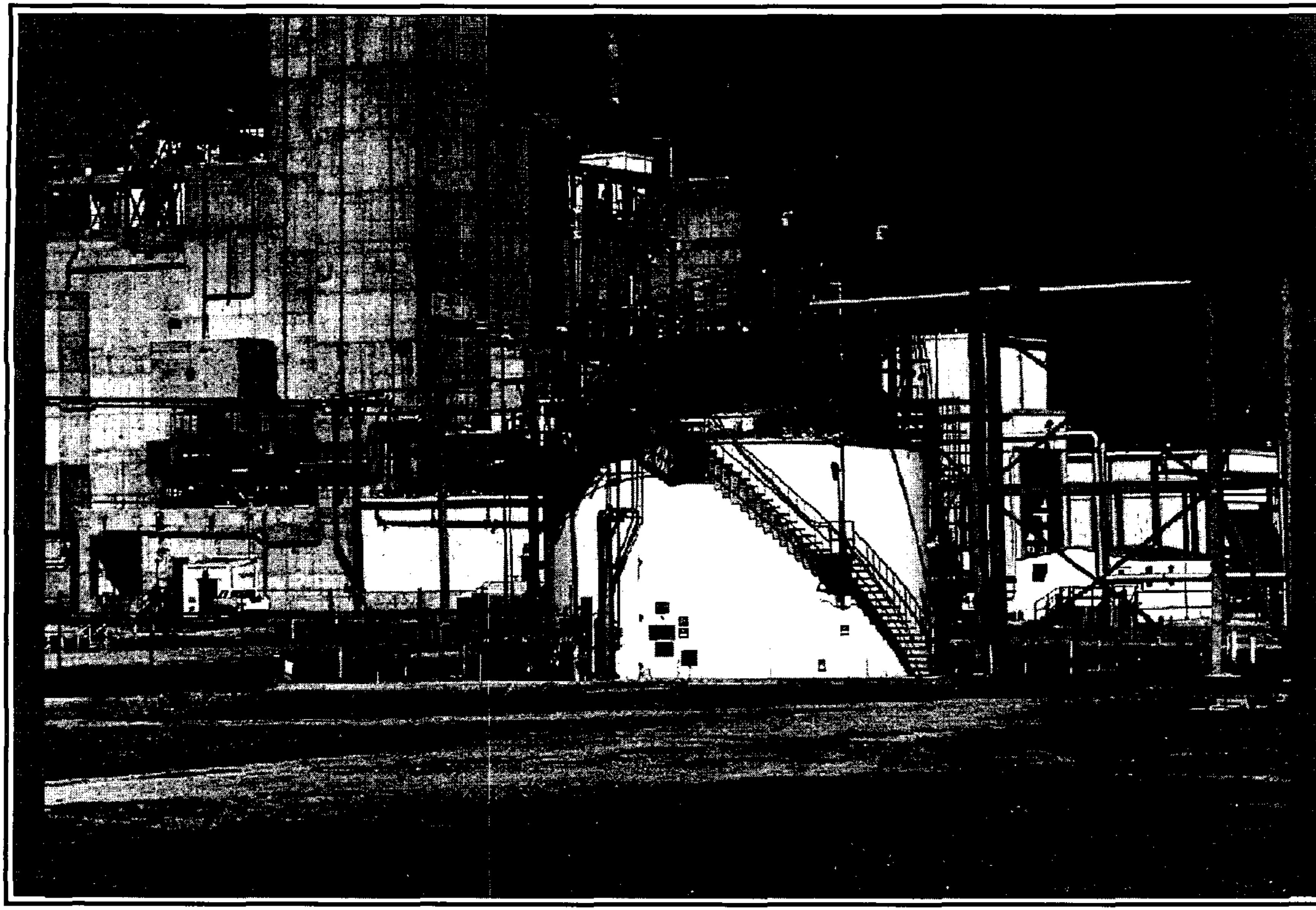

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TE | **Figure 3-31.** Organic Waste Storage Tank (S-Area).

DOE has also requested approval under RCRA for interim storage capacity at a pad in M-Area for treated M-Area sludge and stabilized ash and blowdown waste from the Consolidated Incineration Facility.

DOE is constructing the Consolidated Incineration Facility in H-Area to treat mixed, low-level, and hazardous waste. The Consolidated Incineration Facility is designed to annually process approximately 17,830 cubic meters (630,000 cubic feet) of solid waste (e.g., boxed mixed, low-level, or hazardous waste) at 50 percent utility and approximately 4,630 cubic meters (163,610 cubic feet) of liquid waste (e.g., liquid hazardous, mixed, and low-level waste) at 70 percent utility (Figure 3-32). TE TE

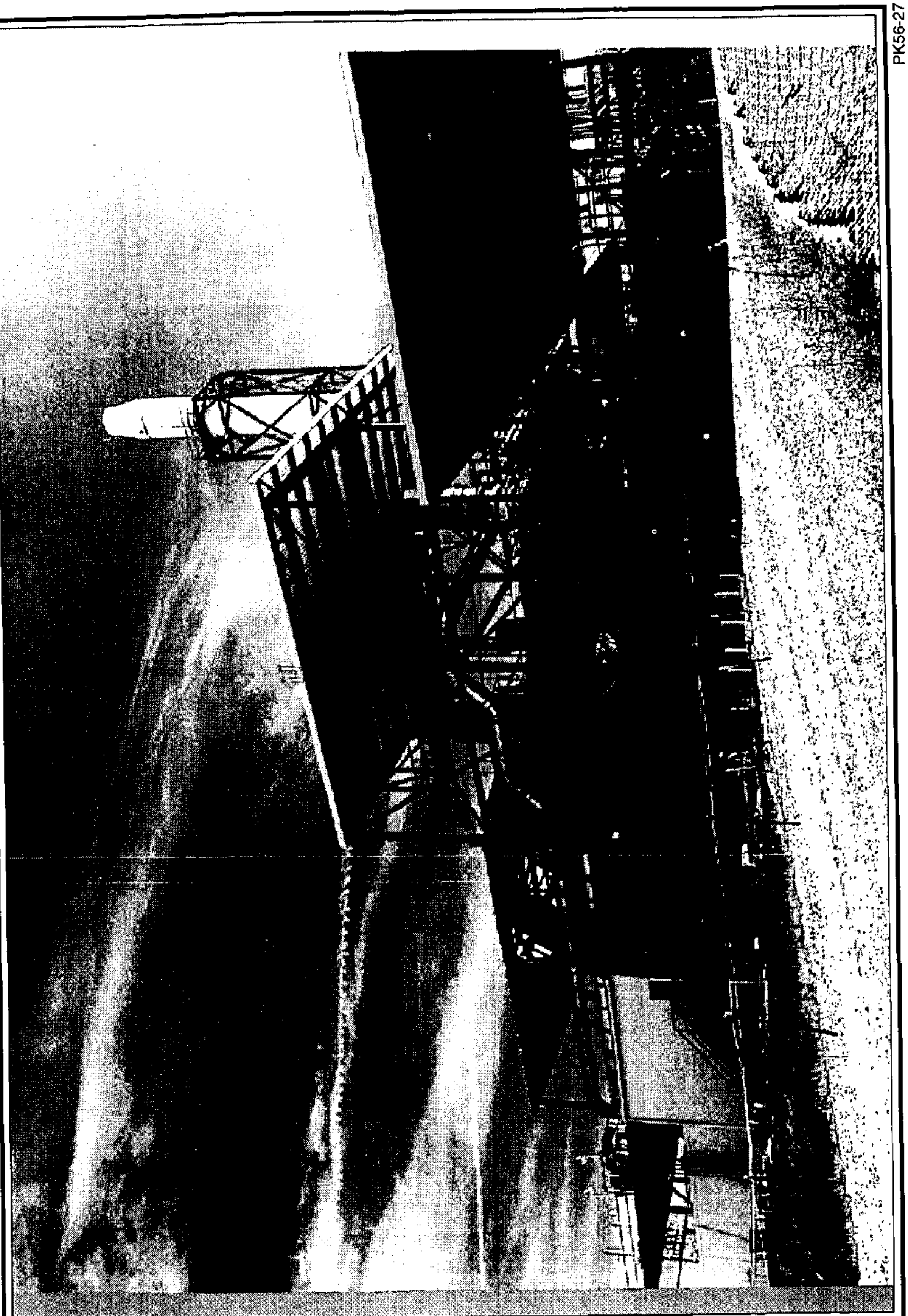
3.13.6 HAZARDOUS MATERIALS

The *SRS Tier Two Emergency and Hazardous Chemical Inventory Report* (WSRC 1994b) for 1993 lists more than 225 hazardous chemicals that were present at some time during the year in excess of their respective minimum threshold level (10,000 pounds for hazardous chemicals and 500 pounds or less for extremely hazardous substances). Ten of these hazardous chemicals are designated as extremely hazardous substances under the Emergency Planning and Community Right-to-Know Act of 1986. The actual number and quantity of hazardous chemicals present on SRS, as well as at individual facilities, change daily as inventories are used and replenished. The annual reports filed under the Superfund Amendments and Reauthorization Act for the SRS facilities include year-to-year inventories of these chemicals.

3.14 Decontamination and Decommissioning

3.14.1 DECONTAMINATION AND DECOMMISSIONING PROGRAMS

The objective of the decontamination and decommissioning programs at SRS is to plan and implement the surveillance, maintenance, and cleanup of contaminated areas that are no longer needed by DOE. The program's goal is to ensure that risks to human health and safety and to the environment posed by these areas are eliminated or reduced to safe levels in a timely and cost-effective manner. This goal will be accomplished by cleaning up and reusing facilities, returning sites to greenfield conditions (in which the facility, its foundation, and the contaminated soil would be removed), or entombing facilities in concrete. The methods selected will determine the quantities of waste materials needing disposal. Decontamination and decommissioning methods have not been identified for most SRS facilities; the selection process would be subject to separate NEPA review. This section describes the surplus areas TE TE



TE | **Figure 3-32.** Consolidated Incineration Facility (H-Area).

that will eventually be decontaminated and decommissioned and estimates the amount of waste that will be generated by decontamination and decommissioning.

There are more than 6,000 buildings at SRS that will eventually be declared surplus and will need to be decommissioned. As of April 1994, 2,862 of these facilities had been identified as surplus (WSRC 1994c). Two-hundred-thirty-four of the buildings are now surplus or will be within 5 years. Some of these facilities may be used in new missions, but others pose risks unless they are properly maintained and decommissioned.

SRS prepared a 30-year forecast of the amounts of wastes that would be generated by decontamination and decommissioning (WSRC 1994d). This forecast was based on a 5-year forecast that identified 53 facilities to be decontaminated and decommissioned between 1995 and 1999. Both forecasts relied on the Surplus Facility Inventory and Assessment Database dated March 4, 1994, which contains information on SRS facilities such as building size, type of construction, radiological characterization, and hazardous material characterization. The database is continuously updated as new information becomes available.

Facilities that need to be decontaminated and decommissioned have been categorized according to the types of work required (WSRC 1994e). These categories will ensure incorporation of on-the-job lessons learned and assignment of specialized work crews to similar projects across SRS. The following sections describe some tentative categories of facilities with common traits or factors. TE

3.14.1.1 Asbestos Abatement Program

Two-hundred-eleven buildings contain asbestos, including 142 buildings for which asbestos is the only contaminant present. The R-Area surplus buildings are the first ones scheduled for asbestos removal. Experience at these facilities will improve asbestos abatement at other SRS facilities.

3.14.1.2 Decommissioning Program for Higher-Risk Facilities

Most of the surplus buildings have only small amounts of contamination. However, a few surplus facilities have more contamination, pose risks of releasing contaminants under special circumstances, or are located near large numbers of employees or near the SRS boundary. These facilities have been given a priority for immediate decontamination and decommissioning and are assigned to the higher risk facilities decommissioning program. Facilities in this program include the Separations Equipment

Development Facility, the 235-F Plutonium Fabrication Facility, and the 232-F Tritium Manufacturing Building.

3.14.1.3 Decommissioning Program for Nuclear Reactor Facilities

The buildings associated with nuclear reactors are included in the nuclear reactor facilities decommissioning program. The Heavy Water Component Test Reactor is the prototype for this program. By starting with a small facility, DOE can learn from experience and develop methods and procedures which will then be applied to the larger reactors.

TE

3.14.1.4 Decommissioning Program for High-Level Waste Storage Tanks

Fifty-one high-level waste storage tanks and their ancillary equipment will eventually be decommissioned. Type I, II, and IV tanks will be closed in place once the waste (supernatant, saltcake, and sludge) stored in the tanks has been removed, prior to decontamination and decommissioning. Decontamination and decommissioning activities will include stabilizing residual waste, removing associated equipment and small buildings, and abandoning in place underground transfer lines and diversion boxes. Type III tanks, which have secondary containment, will be used during the waste vitrification process at the Defense Waste Processing Facility, which is expected to continue for 24 years. To date, waste has been removed from one high-level waste storage tank.

TE

3.14.1.5 Decommissioning Program for Separations Facilities

The separations facilities present the greatest challenge for decontamination and decommissioning because of their size, high levels of contamination, need for security, and process complexity. The transition of these facilities from operational status to one suitable for final disposition will require a long and expensive sequence of activities. The Separations Equipment Development facility (located within the Savannah River Technology Center) was shut down in 1978 and transferred to the DOE environmental restoration decontamination and decommissioning program in 1982 (see Section 3.14.1.2). Lessons learned from the decontamination and decommissioning of this facility will be used to develop procedures for the larger chemical separations facilities in F- and H-Areas.

3.14.1.6 Decommissioning Program for Waste Handling Facilities

Waste handling facilities will process waste generated by decontamination and decommissioning. The decontamination and decommissioning of these facilities cannot begin until this processing has been completed. However, there are a number of obsolete waste handling facilities that can be decommissioned sooner.

3.14.1.7 Decommissioning Program for Miscellaneous Facilities

Facilities that do not fit into other categories are included in the miscellaneous facilities category. At this time only a few facilities (in M-, N-, and Z-Areas) have been assigned to this category. Other unique facilities will probably be added to the miscellaneous facilities category. Decontamination and decommissioning of these areas is not scheduled to begin until 1998.

3.14.2 DECONTAMINATION AND DECOMMISSIONING WASTE GENERATION

Decontamination and decommissioning will generate large amounts of waste for a long period of time. These wastes will include equipment, rubble, contaminated clothing, and tools. Most of the quantitative data regarding waste generated by decontamination and decommissioning have been collected during the dismantling of plutonium production and processing facilities. The volumes of waste generated by decontaminating and decommissioning these facilities is expected to represent an upper estimate of the amount of waste generated because of the high contamination levels and special packaging requirements inherent in transuranic waste. TE

For plutonium-238 facilities, approximately 13 cubic meters (459 cubic feet) of solid waste per square meter (10.76 square feet) of contaminated floor area are generated by decontamination and decommissioning. Of this, approximately 50 percent is transuranic waste; the rest is low-level waste. Less than 0.03 cubic meters (1.05 cubic feet) is mixed waste (primarily lead shielding) per square meter of area (Smith and Hootman 1994; Hootman and Cook 1994).

For plutonium-239 processing facilities, approximately 4 cubic meters (141 cubic feet) of transuranic waste and 5 cubic meters (177 cubic feet) of low-level waste are generated per square meter (10.76 square feet) of contaminated floor during decontamination and decommissioning (Hootman and Cook 1994).

3.15 Environmental Restoration

The fundamental goal of environmental restoration at SRS is to ensure that the environment is protected from further degradation caused by past activities, and that the safety and health of people exposed to the environment are protected. This goal is met through the cleanup of inactive facilities. "Cleanup" refers to actions taken to prevent the release or potential release of hazardous substances to the environment. These actions may involve complete removal of the substances from the environment; or stabilizing, containing, or treating the substances so that they do not affect human health or the environment.

In accordance with Section 120 of the Comprehensive Environmental Response, Compensation and Liability Act, DOE negotiated a Federal Facility Agreement with EPA and SCDHEC that organizes remedial activities at SRS into one comprehensive strategy that fulfills both RCRA corrective action requirements, including closure and post-closure of RCRA-regulated units, and Comprehensive Environmental Response, Compensation, and Liability Act investigation and remedial action requirements. Environmental restoration of inactive waste sites at SRS is controlled by the Federal Facility Agreement. The number of sites to be assessed and considered for cleanup under the Federal Facility Agreement is estimated to be 420. Newly identified sites are still being added to Appendix G of the Federal Facility Agreement. Sites are listed in the following Federal Facility Agreement appendixes:

- Appendix C - Sites with known releases
- Appendix G - Sites with potential releases to be investigated
- Appendix H - Sites subject to RCRA

Each of these lists appears in Appendix G of this EIS.

To date, DOE has prepared approximately 55 work plans detailing the proposed investigations for RCRA/Comprehensive Environmental Response, Compensation, and Liability Act units identified in Appendix C of the Federal Facility Agreement. These work plans must be approved by EPA and SCDHEC prior to implementation. Eleven of the work plans have been approved. Additional site characterization and field sampling is underway at these units.

Of the 304 areas identified on the original Site Evaluation List (Appendix G of the Federal Facility Agreement), DOE has prepared site evaluation reports for 36 and received EPA and SCDHEC concurrence on 17 of the proposed response actions. Six closures of RCRA-regulated units (Appendix H of the Federal Facility Agreement) have been completed and approved by SCDHEC.

Each cleanup and closure will generate significantly different quantities of waste materials. Specific cleanup methods have not been identified for most of the SRS waste sites. The methods will be selected in accordance with procedures established by the Federal Facility Agreement and will be subject to separate NEPA review. The remainder of this section discusses the extent and type of site contamination in E-Area and hazardous and mixed waste sites.

3.15.1 SURFACE AND GROUNDWATER QUALITY

Contamination of the shallow groundwater aquifers beneath the SRS with industrial solvents, metals, tritium, and other constituents, and contamination of the surface waters with tritium are discussed in Sections 3.3 and 3.4, respectively.

3.15.2 HAZARDOUS AND MIXED WASTE SITES

Six types of waste units are common to SRS. The descriptions for these waste sites are derived from Arnett, Karapatakis, and Mamatey (1993).

3.15.2.1 Acid/Caustic Basins

The acid/caustic basins found in F-, H-, K-, L-, P-, and R-Areas are unlined earthen pits, approximately 15 meters by 15 meters by 2 meters (50 feet by 50 feet by 7 feet) deep, that received dilute sulfuric acid and sodium hydroxide solutions used to regenerate ion-exchange units. Other wastes discharged to the basins included water rinses from the ion-exchange units, steam condensate, and runoff from containment enclosures for storage tanks. The dilute solutions are mixed and neutralized in the basins before they are discharged to nearby streams. Constituents identified as exceeding standards in monitoring wells near the acid/caustic basins include lead, cadmium, sulfates, nitrates, tritium, gross alpha radioactivity, nonvolatile beta radioactivity, technetium-99, and total dissolved solids (Arnett, Karapatakis, and Mamatey 1993).

The basins were constructed between 1952 and 1954. The R-Area basin was abandoned in 1964, the L-Area basin in 1968, and the H-Area basin not until 1985. The other basins remained in service until new neutralization facilities became operational in 1982. The basins will be remediated in accordance with requirements of the Federal Facility Agreement; however, SRS and SCDHEC have not determined the level of cleanup that will be required.

3.15.2.2 Burning/Rubble Pits

From 1951 to 1973, wastes such as paper, wood, plastics, rubber, oil, degreasers, and drummed solvents were burned in one of the burning/rubble pits in A-, C-, D-, F-, K-, L-, N- (Central Shops), P-, or R-Areas. In 1973, the burning of waste stopped, and the bottoms of the pits were covered with soil. Rubble wastes including paper, wood, concrete, and empty galvanized-steel barrels and drums were then disposed of in the pits until they reached capacity and were covered with soil. All dumping into burning/rubble pits stopped by 1982, and all are covered except the R-Area pit, which has not been backfilled. These pits will be remediated in accordance with requirements of the Federal Facility Agreement. Work plans to fully characterize the extent of contamination at all of the pits have been submitted to EPA and SCDHEC. Constituents identified as exceeding standards in monitoring wells near the burning/rubble pits include lead and volatile organics (Arnett, Karapatakis, and Mamatey 1993).

3.15.2.3 Coal Pile Runoff Containment Basins

Electricity and steam at SRS are generated by burning coal, which is stored in open piles. The coal is generally moderate-to-low sulfur coal (1 to 2 percent), which is received by rail, placed on a hopper, sprayed with water to control dust, and loaded onto piles. Coal piles originally existed in A-, C-, D-, F-, H-, K-, L-, P-, and R-Areas. The coal pile in R-Area was removed in 1964, the L-Area coal pile was removed in 1968, and the coal piles in C- and F-Areas were removed in 1985. In 1991, the K-Area coal pile was reduced to a 2-inch base, and 75 percent of the P-Area coal pile was also removed. Constituents identified as exceeding standards in monitoring wells near the former coal piles include gross alpha radioactivity, nonvolatile beta radioactivity, volatile organics, sulfates, tritium, total dissolved solids, and lead (Arnett, Karapatakis, and Mamatey 1993).

The coal piles generally contained a 90-day reserve of coal, which was not rotated; this resulted in long-term exposure to the weather. Chemical and biological oxidation of sulfur compounds in the coal during this weathering resulted in the formation of sulfuric acid.

To comply with the National Pollutant Discharge Elimination System permit issued in 1977, DOE built runoff containment basins around the coal piles in A- and D-Areas in October 1978, and around the coal piles in the C-, F-, H-, K-, and P-Areas in March 1981.

Currently, rainwater runoff from the remaining coal piles in several areas (A, D, H, K, and P) flows into the coal pile runoff containment basins via ditches and sewers. The basins allow mixing of the water runoff with seepage below the surface, thus preventing the discharge of large surges of low pH (acidic) runoff into streams. All the basins are functional, including those in C- and F-Areas which still collect runoff, although no coal remains at either location. These basins will be remediated in accordance with requirements of the Federal Facility Agreement.

3.15.2.4 Disassembly Basins

Disassembly basins were constructed adjacent to each reactor to store irradiated reactor fuel and target rods prior to their shipment to the separations areas. The disassembly basins are concrete-lined tanks containing water. Although the irradiated assemblies were rinsed before being placed in the basins, some radioactivity was released to the water from the film of liquid on the irradiated components, the oxide corrosion film on the irradiated components, and infrequently, from leaks in porous components. Sand filters were used to remove radioactive particulates from the disassembly basin water. Filtered basin water was circulated through chemical filters (deionizers) to remove additional constituents and was periodically purged through regenerated deionizers to the reactor seepage basins. The disassembly basin then was filled with clean water.

Constituents identified as exceeding standards in monitoring wells near the disassembly basins include lead, tritium, and alkalinity (as calcium carbonate) (Arnett, Karapatakis, and Mamatey 1993). The disassembly basins will be remediated in accordance with the Federal Facility Agreement.

3.15.2.5 Reactor Seepage Basins

Since 1957, active reactor seepage basins have received purged water with low-level radioactivity from disassembly basins. This water purge is necessary to keep the tritium concentration in disassembly basin water within safe levels for operating personnel. Although many radionuclides have been discharged to the basins, almost all of the radioactivity is due to tritium and small amounts of strontium-90, cesium-137, and cobalt-60. Constituents identified as exceeding standards in monitoring wells near the reactor seepage basins include alkalinity (as calcium carbonate), lead, tritium, gross alpha radioactivity, nonvolatile beta radioactivity, nitrates, volatile organics, mercury, potassium-40, and strontium-90 (Arnett, Karapatakis, and Mamatey 1993).

Before the use of sand filters began in the 1960s (see Section 3.15.2.4), purge water was pumped directly from the disassembly basins to the seepage basins. From 1970 to 1978, the seepage basins for active reactors were bypassed, and the filtered, deionized purge water was discharged directly into nearby streams. In 1978, the seepage basins for C-, L-, and P-Reactors were reactivated. The K-Reactor Seepage Basin was used from 1957 to 1960 only. The R-Area seepage basins have been filled and covered with asphalt. The K- and R-Area Reactor seepage basins will be remediated in accordance with the Federal Facility Agreement.

3.15.2.6 Sewage Sludge Application Sites

Beginning in 1980, the sewage sludge application sites were the subject of a research program using domestic sewage sludge to reclaim borrow pits and to enhance forest productivity. After sludge was applied to the sites according to the provisions of a SCDHEC permit, hardwoods and pines were planted to determine whether sludge could be used as a fertilizer and soil amendment to increase wood production. Constituents identified as exceeding standards in monitoring wells near these sites include gross alpha radioactivity, nonvolatile beta radioactivity, radium-226, radium-228, and lead (Arnett, Karapatakis, and Mamatey 1993). These sludge application sites will be remediated in accordance with the Federal Facility Agreement. Work plans to fully characterize the extent of contamination at the K-Area and Par Pond sites have been submitted to EPA and SCDHEC.

3.15.3 BURIAL GROUND COMPLEX

The Burial Ground Complex (E-Area) occupies about 1.3 square kilometers (330 acres) in the central part of SRS between F- and H-Areas. The Burial Ground Complex is divided into a northern area containing 1 square kilometer (254 acres) and a southern area containing 0.3 square kilometer (76 acres). The southern area is known as the Old Radioactive Waste Burial Ground; it was a trench disposal area that began receiving waste in 1952 and was filled in 1972. After 1973, wastes were disposed of in the northern disposal area (Figure 3-33). TE

Disposal in the northern area of the Burial Ground Complex, referred to as the Low-Level Radioactive Waste Disposal Facility, continues. In 1986, it was determined that hazardous wastes may have been placed in certain areas of the Low-Level Radioactive Waste Disposal Facility. These areas were designated as the Mixed Waste Management Facility (Figure 3-33). TE Since that time, DOE has determined that additional areas of the Low-Level Radioactive Waste Disposal Facility contain solvent rags; these areas have been added to the Mixed Waste Management Facility. The Mixed Waste Management Facility includes shallow, unlined trenches in which various low-level radioactive wastes containing solvents and metals were placed. A RCRA Closure Plan was approved by SCDHEC for the original Mixed Waste Management Facility in 1987; closure was completed in December 1990, and SCDHEC issued the closure certification in April 1991. Closure of the portions of the Mixed Waste Management Facility that contain the solvent rags is pending.

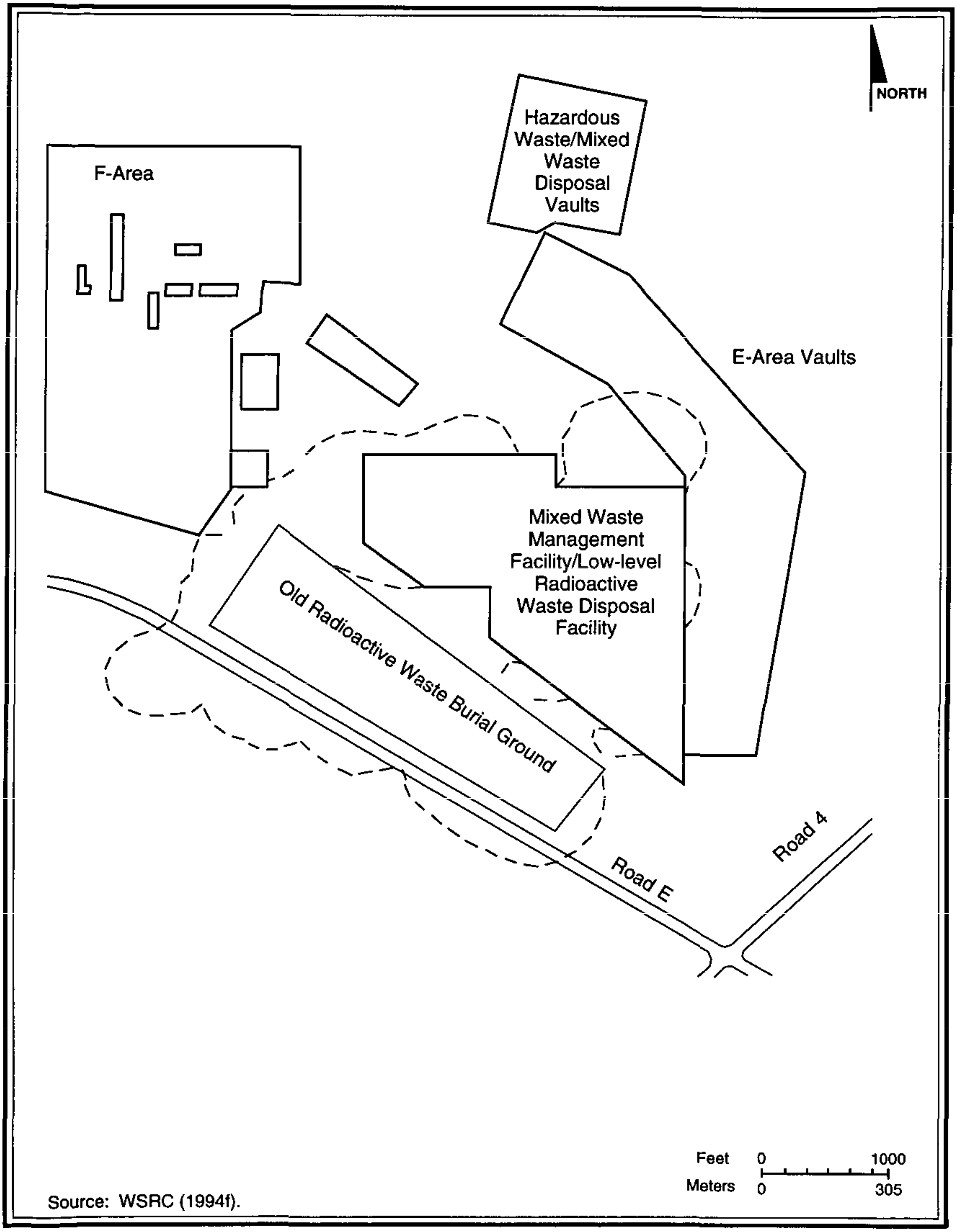


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Figure 3-33. Tritium contamination in the shallow aquifer under the E-Area complex. TE

Hazardous substances, including cadmium, lead, mercury, tritium, and volatile organic compounds, have been detected in groundwater beneath the Mixed Waste Management Facility. The shallow aquifer contains levels of tritium, trichloroethylene, and tetrachloroethylene that exceed EPA's primary drinking water standards (Figures 3-33 and 3-34).

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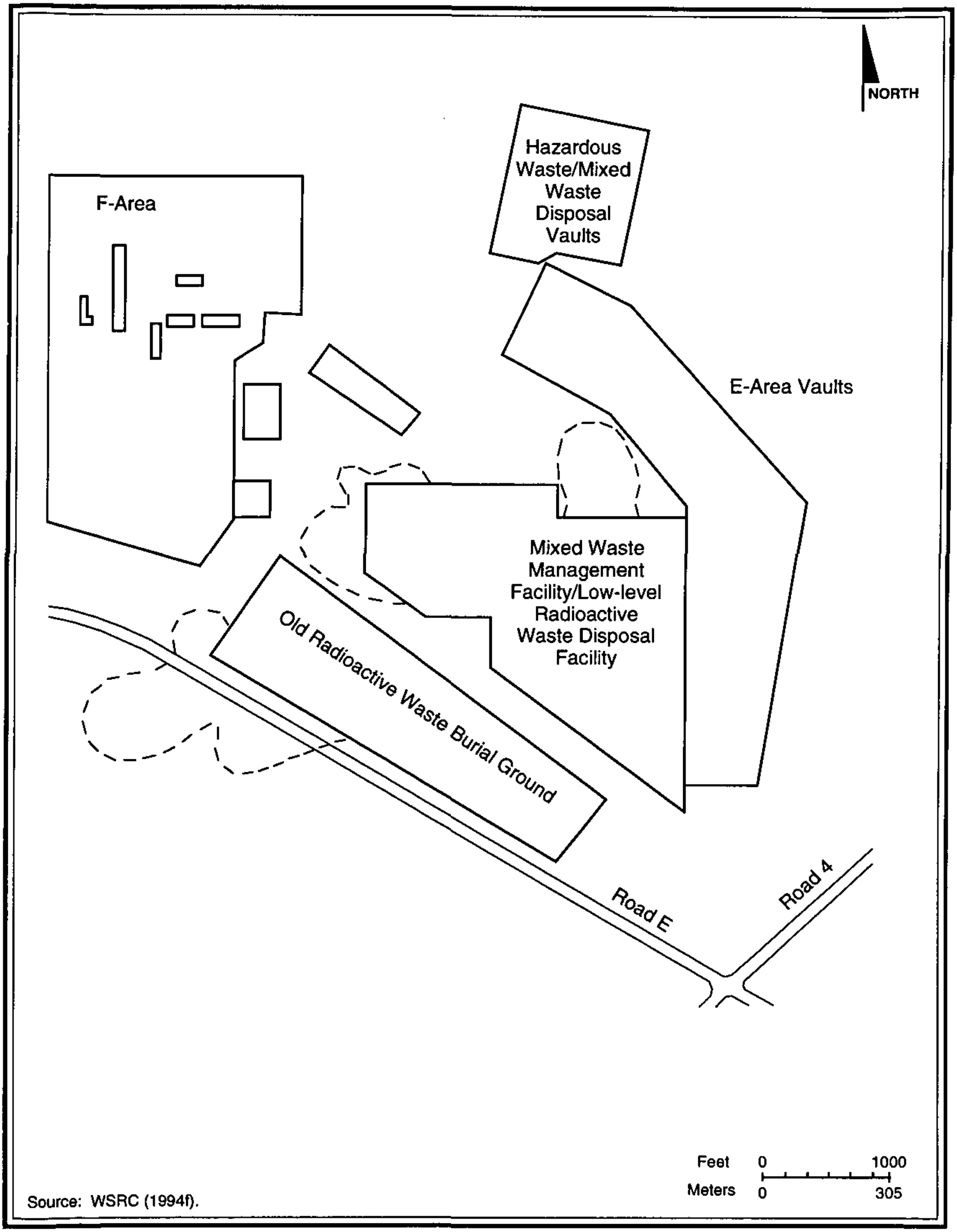

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Figure 3-34. Trichloroethylene and tetrachloroethylene contamination in the shallow aquifer under the E-Area complex. TE

3.16 References

Arnett, M. W., 1993, *Savannah River Site Environmental Data for 1992*, WSRC-TR-93-077, Westinghouse Savannah River Company, Aiken, South Carolina.

Arnett, M. W., 1994, *Savannah River Site Environmental Data for 1993*, WSRC-TR-94-077, Westinghouse Savannah River Company, Aiken, South Carolina.

Arnett, M. W., L. K. Karapatakis, and A. R. Mamatey, 1993, *Savannah River Site Environmental Report for 1992*, WSRC-TR-93-075, Westinghouse Savannah River Company, Aiken, South Carolina.

Arnett, M. W., L. K. Karapatakis, and A. R. Mamatey, 1994, *Savannah River Site Environmental Report for 1993*, WSRC-TR-94-075, Westinghouse Savannah River Company, Aiken, South Carolina.

Batson, W. T., J. S. Angerman, and J. T. Jones, 1985, *Flora of the Savannah River Plant: An Inventory of the Vascular Plants on the Savannah River Plant, South Carolina*, Savannah River Plant National Environmental Research Park Program, Aiken, South Carolina.

Bauer, L. R., D. W. Hayes, C. H. Hunter, W. L. Marter, and R. A. Moyer, 1989, *Reactor Operation Environmental Information Document - Meteorology, Surface Hydrology, Transport and Impacts*, WSRC-RP-89-817, Volume III, Westinghouse Savannah River Company, Aiken, South Carolina.

Bennett, D. H. and R. W. McFarlane, 1983, *The Fishes of the Savannah River Plant: National Environmental Research Park*, SRO-NERP-12, Savannah River Ecology Laboratory, Aiken, South Carolina.

Bollinger, G. A., 1973, "Seismicity of the Southeastern United States," *Bulletin of the Seismological Society of America, 63*, 5, pp. 1785-1808.

Brooks, F., 1994, Savannah River Forest Station, Aiken, South Carolina, personal communication with R. K. Abernethy, Halliburton NUS Corporation, Aiken, South Carolina, "Bald Eagle Nests on SRS," May 17.

Brooks, R. D., 1993, Savannah River Archaeology Research Program, South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, South Carolina, personal communication with L. S. Moore, Halliburton NUS Corporation, Aiken, South Carolina, "SRS Sites Eligible for Historical Register of Historic Places," November 15.

Brooks, R. D., 1994, Savannah River Archaeology Research Program, South Carolina Institute of Archaeology and Anthropology, University of South Carolina, Columbia, South Carolina, personal communication with L. S. Moore, Halliburton NUS Corporation, Aiken, South Carolina, "SRS Archeological Sites and National Register of Historic Places Status," January 24.

Bryan, L., 1992, Savannah River Ecology Laboratory, Aiken, South Carolina, personal communication with R. K. Abernethy, Halliburton NUS Corporation, Aiken, South Carolina, "Recent Work with Natural Resource Trusteeship Concerning Wood Storks," October 27.

Burns, C., 1993, CSX Transportation, Jacksonville, Florida, personal communication with S. J. Connor, Halliburton NUS Corporation, Aiken, South Carolina, "Train Movement through Millet, SC."

CDC (Centers for Disease Control and Prevention), 1993, "Advance Report of Final Mortality Statistics, 1990," *Monthly Vital Statistics Report, 41,* No. 7 Supplement, U.S. Public Health Service, Department of Health and Human Services, Washington, D.C., January 7.

Chem-Nuclear Systems, Inc., 1980, *Environmental Assessment for Barnwell Low-Level Radioactive Waste Disposal Facility,* Columbia, South Carolina.

Cothran, E. G., M. H. Smith, J. O. Wolff, and J. B. Gentry, 1991, *Mammals of the Savannah River Site*, SRO-NERP-21, Savannah River Site National Environmental Research Park, Aiken, South Carolina.

Coulter M. C., 1993, *Wood Storks of the Birdsville Colony and Swamps of the Savannah River Site*, SREL-42, Savannah River Ecology Laboratory, Aiken, South Carolina.

Dahlberg, M. D. and D. C. Scott, 1971, "The Freshwater Fishes of Georgia," *Bulletin of the Georgia Academy of Science, 29*, 1, pp. 1-64.

Davis, G. M. and M. Mulvey, 1993, *Species Status of Mill Creek Elliptio,* SRO-NERP-22, Savannah River Site National Environmental Research Park, Savannah River Ecology Laboratory, Aiken, South Carolina.

Davis, H. A., D. K. Martin, and J. L. Todd, 1989, *Savannah River Site Environmental Report for 1988,* WSRC-RP-89-59-1, Westinghouse Savannah River Company, Aiken, South Carolina.

DOE (U.S. Department of Energy), 1982, *Final Environmental Impact Statement, Defense Waste Processing Facility, Savannah River Plant, Aiken, South Carolina*, DOE/EIS-0082, Savannah River Operations Office, Aiken, South Carolina.

DOE (U.S. Department of Energy), 1984, *Final Environmental Impact Statement, L-Reactor Operation, Savannah River Plant, Aiken, South Carolina*, DOE/EIS-0108, Savannah River Operations Office, Aiken, South Carolina.

DOE (U.S. Department of Energy), 1987, *Final Environmental Impact Statement, Waste Management Activities for Groundwater Protection, Savannah River Plant, Aiken, South Carolina,* DOE/EIS-0120, Savannah River Operations Office, Aiken, South Carolina.

DOE (U.S. Department of Energy), 1988, 53 FR 29, "Alternative Cooling Water Systems, Savannah River Plant, Aiken, South Carolina, Record of Decision," p. 4203, February 12.

DOE (U.S. Department of Energy), 1990, *Final Environmental Impact Statement, Continued Operation of K-, L-, and P-Reactors, Savannah River Site, Aiken, South Carolina,* DOE/EIS-0147, Savannah River Operations Office, Aiken, South Carolina.

DOE (U.S. Department of Energy), 1991, *Draft Environmental Impact Statement for the Siting, Construction, and Operation of New Production Reactor Capacity*, DOE/EIS-0144D, Office of New Production Reactors, Washington, D.C.

DOE (U.S. Department of Energy), 1993a, *Introduction to Natural Resources Management at the Savannah River Site,* Savannah River Operations Office, Aiken, South Carolina.

DOE (U.S. Department of Energy), 1993b, *Occupational Injury and Property Damage Summary, January - December 1992,* DOE/EH/10570-H1, SPMS Maintenance and Operations, EG&G Idaho, Inc., Idaho Falls, Idaho.

DOE (U.S. Department of Energy), 1994a, *FY 1994 Draft Site Development Plan,* Savannah River Operations Office, Aiken, South Carolina.

DOE (U.S. Department of Energy), 1994b, *Final Supplemental Environmental Impact Statement for the Defense Waste Processing Facility*, DOE/EIS-0082-S, Savannah River Operations Office, Aiken, South Carolina.

DOL (U.S. Department of Labor), 1986, *Recordkeeping Guidelines for Occupational Injuries and Illnesses,* Bureau of Labor Statistics, Washington, D.C.

du Pont (E. I. du Pont de Nemours and Company, Inc.), 1983, *Technical Summary of Groundwater Quality Protection Program at Savannah River Plant,* DPST-83-829, Aiken, South Carolina.

du Pont (E. I. du Pont de Nemours and Company, Inc.), 1987, *Comprehensive Cooling Water Study - Final Report, Volumes I-VIII,* DP-1739, Aiken, South Carolina.

du Pont (E. I. du Pont de Nemours and Company, Inc.), 1989, *Radiation Exposure Report, Annual Report for 1988,* DPSPU-89-11-1, Aiken, South Carolina.

Dukes, E. K., 1984, *The Savannah River Plant Environment*, DP-1642, E. I. du Pont de Nemours and Company, Inc., Aiken, South Carolina.

EPA (U.S. Environmental Protection Agency), 1985, *Compilation of Air Pollutant Factors - Stationary Point and Area Sources, Volume 1,* Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

EPA (U.S. Environmental Protection Agency), 1992, *Industrial Source Complex (ISC) Dispersion Mode 1 User's Guide*, Second Edition (Revised), Volume I, II, National Technical Information Service, Springfield, Virginia.

EPA (U.S. Environmental Protection Agency), 1993a, Federal Facility Agreement between the U.S. Environmental Protection Agency, Region IV, the U.S. Department of Energy, and the South Carolina Department of Health and Environmental Control, Docket No. 89-05-FF, August 16.

EPA (U.S. Environmental Protection Agency), 1993b, "Office of Environmental Equity Grants Program; Solicitation Notice for Fiscal Year (FY) 1994, Environmental Justice Grants to Community Groups," 58 FR 63955, December 8.

EPA (U.S. Environmental Protection Agency), 1994, *Environmental Justice Initiatives 1993,* EPA 200-R-93-001, Washington, D.C.

Fledderman, P. D., 1994, Westinghouse Savannah River Company, Aiken, South Carolina, personal communication with E. M. Rollins, Halliburton NUS, Corporation, Aiken, South Carolina, "Wildlife Data."

Floyd, M. A., J. C. Morse, and J. V. McArthur, 1993, "Aquatic Insects of Upper Three Runs Savannah River Site, South Carolina - Part IV: Caddisflies (Trichoptera) of the Lower Reaches," *Journal of Entomological Science 28*, 1, pp. 85-95.

Gibbons, J. W. and R. D. Semlitsch, 1991, *Guide to the Reptiles and Amphibians of the Savannah River Site,* University of Georgia Press, Athens, Georgia.

Gladden, J. B., M. W. Lower, H. E. Mackey, W. L. Specht, and E. W. Wilde, 1985, *Comprehensive Cooling Water Study Annual Report*, DP-1697, E. I. du Pont de Nemours and Company, Aiken, South Carolina.

HNUS (Halliburton NUS Environmental Corporation), 1992, *Socioeconomic Characteristics of Selected Counties and Communities Adjacent to the Savannah River Site*, Aiken, South Carolina.

HNUS (Halliburton NUS Corporation), 1994, *Computer printouts generated from the Regional Economic Models, Inc. (REMI), Economic and Demographic Forecasting and Simulation Model for the SRS Region of Influence*, Aiken, South Carolina.

Hootman, H. E. and J. R. Cook, 1994, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to T. H. Gould, Westinghouse Savannah River Company, Aiken, South Carolina, "Transuranic Waste Projections at SRS for Long Range Planning (U)," EDD-MPS-94-0018, Aiken, South Carolina.

Hunter, C. H., 1990, *A Climatological Description of the Savannah River Site*, WSRC-RP-89-313, Westinghouse Savannah River Company, Aiken, South Carolina.

Hunter, C. H. and J. Stewart, 1994, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice Memorandum to C. B. Shedrow, Westinghouse Savannah River Company, Aiken, South Carolina, "Air Quality Calculations for DWPF Supplemental Environmental Impact Statement," SRT-ETS-940891, Aiken, South Carolina, June 17.

LeMaster, E. T., 1994a, Savannah River Forest Station, Aiken, South Carolina, personal communication with R. K. Abernethy, Halliburton NUS Corporation, Aiken, South Carolina, Location of a second colony of "Smooth Coneflower," on SRS, June 21.

LeMaster, E. T., 1994b, Savannah River Forest Station, Aiken, South Carolina, personal communication with R. K. Abernethy, Halliburton NUS Corporation, Aiken, South Carolina, "Locations of rare plants located during 1992 and 1994 surveys of E-Area," September 27.

LeMaster, E. T., 1994c, Savannah River Forest Station, Aiken, South Carolina, personal communication with R. K. Abernethy, Halliburton NUS Corporation, Aiken, South Carolina, "Red-cockaded woodpecker survey of compartment 49 stands 6 and 8," November 3.

Mayer, J. J., R. A. Kennamer, and R. T. Hoppe, 1986a, *Waterfowl of the Savannah River Plant, Comprehensive Cooling Water Study, Final Report*, SREL-22, Savannah River Ecology Laboratory, Aiken, South Carolina.

Mayer, J. J., R. A. Kennamer, and R. T. Hoppe, 1986b, *Bald and Golden Eagles of the SRP,* SREL-21, Savannah River Ecology Laboratory, Aiken, South Carolina.

McLain, A. R., 1994, Westinghouse Savannah River Company, personal communication with E. M. Rollins, Halliburton NUS Corporation, Aiken South Carolina, "SRS Railroad Information," May 12.

NCRP (National Council on Radiation Protection and Measurements), 1987a, *Ionizing Radiation Exposure of the Population of the United States, Report Number 93,* Washington, D.C.

NCRP (National Council on Radiation Protection and Measurements), 1987b, *Exposure of the Population in the United States and Canada from Natural Background Radiation, Report Number 94,* Washington, D.C.

NCRP (National Council on Radiation Protection and Measurements), 1993, *Limitation of Exposure to Ionizing Radiation, Report No. 116,* Washington, D.C.

NOAA (National Oceanic and Atmospheric Administration), 1990, *Local Climatological Data Annual Summary for Augusta, Georgia*, National Climatic Data Center, Asheville, North Carolina.

NUS (NUS Corporation), 1991a, *American Indian Religious Freedom Act (AIRFA) Compliance at the Savannah River Site*, Aiken, South Carolina.

NUS (NUS Corporation), 1991b, Update to the *Air Quality, Cooling Tower, and Noise Impact Analyses in Support of The New Production Reactor Environmental Impact Statement*, Aiken, South Carolina.

Parker, M. J. and R. J. Kurzeja, 1990, *The October 1, 1989 Tornado at the Savannah River Site*, WSRC-RP-90-1288, Westinghouse Savannah River Company, Aiken, South Carolina.

Patrick, R., J. Cairns, Jr., and S. S. Roback, 1967, "An ecosystematic study of the fauna and flora of the Savannah River Plant," *Proceedings of the Academy of Natural Sciences of Philadelphia, 118,* 5, pp. 109-407.

Petty, K. R., 1993, Westinghouse Savannah River Company, Interoffice Memorandum to Distribution, "Health Protection Department 1992 Annual Report," WSRC-ESH-HPD-9200035, Aiken, South Carolina.

Rollins, E. M., 1994, Calculation Worksheet WMEIS-001, "Sportsman Dose," Halliburton NUS Corporation, Aiken, South Carolina.

SCDHEC (South Carolina Department of Health and Environmental Control), 1976a, "State Safe Drinking Water Act of 1976," South Carolina Code of Laws, Section 61-58.

SCDHEC (South Carolina Department of Health and Environmental Control), 1976b, "Air Pollution Control Regulations and Standards," South Carolina Code of Laws, Regulations 61-62.

Schalles, J. F., R. R. Sharitz, J. W. Gibbons, G. J. Leversee, and J. N. Knox, 1989, *Carolina Bays of the Savannah River Plant,* SRO-NERP-18, Savannah River Ecology Laboratory, Aiken, South Carolina.

Sharitz, R. R., J. E. Irwin, and E. J. Christy, 1974, "Vegetation of swamps receiving reactor effluents," *Oikos*, *25*, pp. 7-13.

Shedrow, C. B., 1993, *SRS Affected Environment*, WSRC-TR-93-667, Westinghouse Savannah River Company, Aiken, South Carolina.

Shields, J. D., N. D. Woody, A. S. Dicks, G. J. Hollod, J. Schalles, and G. J. Leversee, 1982, *Locations and Areas of Ponds and Carolina Bays at the Savannah River Plant,* DP-1525, Revision 1, E. I. du Pont de Nemours and Company, Inc., Aiken, South Carolina.

Smith, R. H. and H. E. Hootman, 1994, *Dismantlement and Decontamination of a Plutonium-238 Facility at SRS (U)*, WSRC-RP-93-1376, Westinghouse Savannah River Company, Aiken, South Carolina.

Smith, W. B., 1989, *Draft Traffic Services Report, Savannah River Plant*, Wilbur B. Smith Associates, Columbia, South Carolina, March 24.

SRARP (Savannah River Archaeological Research Program), 1989, *Archaeological Resource Management Plan of the Savannah River Archaeological Research Program*, Savannah River Archaeological Research Program, South Carolina Institute of Archaeology and Anthropology, University of South Carolina, December 1989.

Stephenson, D. E., 1988, *August 1988 Savannah River Plant Earthquake,* DPST-88-841, E. I. du Pont de Nemours and Company, Inc., Aiken, South Carolina.

Stephenson, D. E. and A. L. Stieve, 1992, Structural Model of the Basement in the Central Savannah River Area, South Carolina and Georgia, WSRC-TR-92-120, Westinghouse Savannah River Company, Aiken, South Carolina.

Stewart, J., 1994, *Air Dispersion Modeling for Waste Management Environmental Impact Statement (U)*, WSRC-RP-94-1271, Westinghouse Savannah River Company, Aiken, South Carolina.

Swygert, R. W., 1994a, Westinghouse Savannah River Company, Aiken, South Carolina, personal communication with E. M. Rollins, Halliburton NUS Corporation, Aiken, South Carolina, "SRS Truck Traffic," September 30.

Swygert, R. W., 1994b, Westinghouse Savannah River Company, Aiken, South Carolina, personal communication with E. M. Rollins, Halliburton NUS Corporation, Aiken, South Carolina, "Site Traffic Counts," March 21.

TRB (Transportation Research Board), 1985, "High Capacity Manual," *National Research Council Special Report 209*, Washington, D.C.

URS/Blume (URS/John Blume and Associates, Engineers), 1982, *Update of Seismic Criteria for the Savannah River Plant, Volume I: Geotechnical,* DPE-3699, prepared for E. I. du Pont de Nemours and Company, Inc., Aiken, South Carolina.

U.S. Bureau of the Census, 1990a, *Summary Tape File 1B*, Table P8, Washington, D.C.

U.S. Bureau of the Census, 1990b, *Summary Tape File 1B*, Table 117, Washington, D.C.

USDA (U.S. Department of Agriculture), 1988, *Eagle Bay Management Plan,* Savannah River Forest Station, New Ellenton, South Carolina.

USDA (U.S. Department of Agriculture), 1990, *Soil Survey of Savannah River Plant Area, Parts of Aiken, Barnwell, and Allendale Counties, South Carolina,* Soil Conservation Service, Washington, D.C.

USDA (U.S. Department of Agriculture), 1991a, *Savannah River Site Wildlife, Fisheries, and Botany Operation Plan,* Savannah River Forest Station, New Ellenton, South Carolina.

USDA (Forest Service), 1991b, *Red-cockaded Woodpecker Management Standards and Guidelines, Savannah River Site*, Savannah River Forest Station, New Ellenton, South Carolina.

USDA (U.S. Department of Agriculture), 1994, "Stand Prescription Summary Data for Compartment 49," U.S. Department of Agriculture, Forest Service, Savannah River Forest Station, New Ellenton, South Carolina.

USFWS (U.S. Fish and Wildlife Service), 1992, 57 FR 196, "50 CFR Part 17, Endangered and Threatened Wildlife and Plants; *Echinacea laevigata* (Smooth Coneflower) Determined to be Endangered," p. 46340.

USFWS (U.S. Fish and Wildlife Service), 1993, 58 FR 188, "50 CFR Part 17, Endangered and Threatened Wildlife and Plants; Review of Plant Taxa for Listing as Endangered or Threatened Species," p. 51144-51190.

United Nations, 1977, "Sources and Effects of Ionizing Radiation," United Nations Scientific Committee on the Effects of Atomic Radiation, Report to the General Assembly, with Annexes, United Nations Sales Section, New York, New York.

Wike, L. D., R. W. Shipley, J. A. Bowers, A. L. Bryan, C. L. Cummins, B. R. del Carmen, G. P. Friday, J. E. Irwin, H. E. Mackey, J. J. Mayer, E. A. Nelson, M. H. Paller, V. A. Rogers, W. L. Specht, and E. W. Wilde, 1994, *SRS Ecology Environmental Information Document*, WSRC-TR-93-496, Westinghouse Savannah River Company, Aiken, South Carolina.

Workman, S. W. and K. W. McLeod, 1990, *Vegetation of the Savannah River Site: Major Community Types*, SRO-NERP-19, Savannah River Ecology Laboratory, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1991, *Radiation Protection and Industrial Hygiene Annual Report 1989*, ESH-QIS-910027, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1992a, *Evaluation of Accident Risks in the Transportation of Hazardous Materials by Truck and Rail at the Savannah River Site (U)*, WSRC-RP-89-715, Revision 1, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1992b, *1990 Health Protection Annual Report,* ESH-HPD-92-0072, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1993a, *Draft Environmental Information Document: Geology and Hydrogeology of the Savannah River Site,* WSRC-TR-93-147, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1993b, *SCDHEC Regulation No. 62.5 Standard No. 2 and Standard No. 8, Compliance Modeling Input/Output Data,* ESH-ESS-93-0531, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1993c, *Savannah River Site Development Plan,* Revision 1, WSRC-RP-93-477, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1993d, *Savannah River Site Radiological Control Procedure Manual 5Q,* Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1994a, *Savannah River Site Radiological Performance, 4th Quarter 1993,* ESH-PAS-94-0018, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1994b, *Savannah River Site Tier Two Emergency and Hazardous Chemical Inventory Report (U),* Aiken, South Carolina, March.

WSRC (Westinghouse Savannah River Company), 1994c, *Savannah River Surplus Facility Inventory and Assessment Project - Phase 2 (U),* SWE-TDD-940074, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1994d, *Thirty Year Decontamination and Decommissioning Waste Generation Forecast for Facilities at SRS,* WSRC-RP-94-496, Revision 0, Aiken, South Carolina, May 9.

WSRC (Westinghouse Savannah River Company), 1994e, *Westinghouse Savannah River Company Decontamination and Decommissioning Program Facilities Plan,* WSRC-IM-93-10, Aiken, South Carolina.

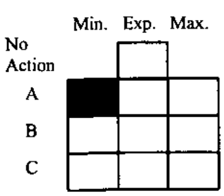
WSRC (Westinghouse Savannah River Company), 1994f, *Solid Waste Management Plan,* Predecisional Draft, WSRC-RP-93-1448, Revision 2, Aiken, South Carolina, March 29.

CHAPTER 4. ENVIRONMENTAL CONSEQUENCES

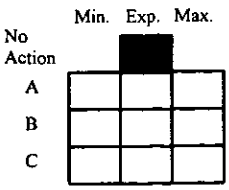
This chapter describes the impacts of waste management activities on the environment (described in Chapter 3) at the Savannah River Site (SRS), including the construction and operation of new facilities (described in Chapter 2). As described in Chapter 2, 10 scenarios are evaluated. The no-action alternative (see Section 2.2) is evaluated first (Section 4.1). In Section 4.2, alternative A (limited treatment configuration; see Section 2.4) is evaluated for the expected, minimum, and maximum amounts of waste forecast for SRS. In Section 4.3, alternative C (extensive treatment configuration; see Section 2.5) is evaluated for the same three forecasts. Section 4.4 analyzes alternative B (moderate treatment configuration; see Section 2.6), which incorporates a mix of technologies being considered by the U.S. Department of Energy (DOE) for the different waste types. The three alternatives place different degrees of emphasis on the objectives of the proposed action. DOE believes that these alternatives represent the full range of reasonable alternatives and has identified alternative B as the preferred alternative. TE

This chapter also discusses potential cumulative impacts from alternative B when it is added to impacts from past, present, and reasonably foreseeable actions and presents the unavoidable adverse impacts and irreversible or irretrievable commitment of resources under alternative B. Cumulative impacts were assessed only for the moderate treatment configuration alternative B – expected waste forecast because the impacts for it generally fall between those for the other alternatives, and because impacts do not vary greatly between alternatives. Despite some variation in impacts, this approach allowed for an assessment of the likely magnitudes of the cumulative impacts of the other alternatives based on the cumulative impacts of alternative B. Appendix B.5 examines the impacts of processing low-level, hazardous, and mixed wastes in the Consolidated Incineration Facility under alternatives A, B, and C. TE TE TE

Impacts are assessed in terms of direct physical disturbance or consumption of affected resources and as the effects of effluents and emissions on the chemical and physical quality of the environment. When annual data (such as annual doses) are presented, they are based on the calendar year rather than the fiscal year. Assessments focus on impacts to such natural resources as air, water, and plants and animals, as well as on human resources, including the health of workers and the public, and socioeconomics. TE



To aid the reader, the same stacked-box symbol used in Chapter 2 is used in Chapter 4. For example, a section that begins with the symbol shown at left is discussing alternative A – minimum waste forecast.



4.1 No Action

This section discusses the effects of the no-action alternative described in Section 2.2.

4.1.1 INTRODUCTION

Under the no-action alternative, which continues current practices to manage waste, DOE would:

- Continue waste minimization activities as described in Section 2.2.1.
- Continue receiving and storing liquid high-level waste in the F- and H-Area tank farms and begin removing it for treatment at the Defense Waste Processing Facility and associated facilities.
- Continue operating the existing liquid high-level waste evaporators and operate the Replacement High-Level Waste Evaporator presently under construction.
- Operate the Defense Waste Processing Facility and associated liquid high-level waste management facilities as described in *Final Supplemental Environmental Impact Statement,* TC *Defense Waste Processing Facility* (DOE/EIS-0082S) and its Record of Decision (60 FR 18589).
- Continue to compact some low-level waste using the three existing compactors.
- Continue to dispose of low-level wastes in vaults and by shallow land disposal.
- Store certain low-level wastes in long-lived waste storage buildings.
- Continue to store naval hardware on pads in E-Area with possible shallow land disposal.
- Continue to store hazardous wastes until they are sent for offsite treatment and disposal.
- Continue to treat aqueous hazardous wastes collected from groundwater monitoring well operations (investigation-derived wastes) in the M-Area Air Stripper.

- Continue offsite treatment and disposal of PCB wastes.
- Continue to store mixed wastes and construct additional storage for them.
- Continue to treat mixed wastes by ion exchange in the tanks at the Savannah River Technology Center.
- Construct and operate the M-Area Vendor Treatment Facility and use it to vitrify mixed wastes from M-Area electroplating operations, as discussed in the *Environmental Assessment, Treatment of M-Area Mixed Wastes at the Savannah River Site* (DOE/EA-0918).
- Continue to treat aqueous mixed wastes collected from groundwater monitoring wells (investigation-derived waste) in the F/H-Area Effluent Treatment Facility.
- Continue to store radioactive PCB wastes with planned offsite treatment of the PCB fraction and onsite shallow land disposal of the radioactive residuals.
- Construct and operate Resource Conservation and Recovery Act (RCRA)-permitted disposal vaults for disposal of residuals from the treatment of mixed waste, as evaluated in *Final Environmental Impact Statement, Waste Management Activities for Groundwater Protection, Savannah River Plant* (DOE/EIS-0120).
- Continue to store transuranic and alpha wastes on transuranic waste storage pads, retrieve waste drums from mounded storage pads, and construct additional waste storage capacity.
- Perform facility upgrades and continue to operate the Experimental Transuranic Waste Assay Facility/Waste Certification Facility to characterize transuranic and alpha wastes.
- Dispose of newly-generated nonmixed alpha waste in low-activity waste vaults.
- Continue to construct the Consolidated Incineration Facility.

The locations of these waste management facilities are identified in Figure 4-1.

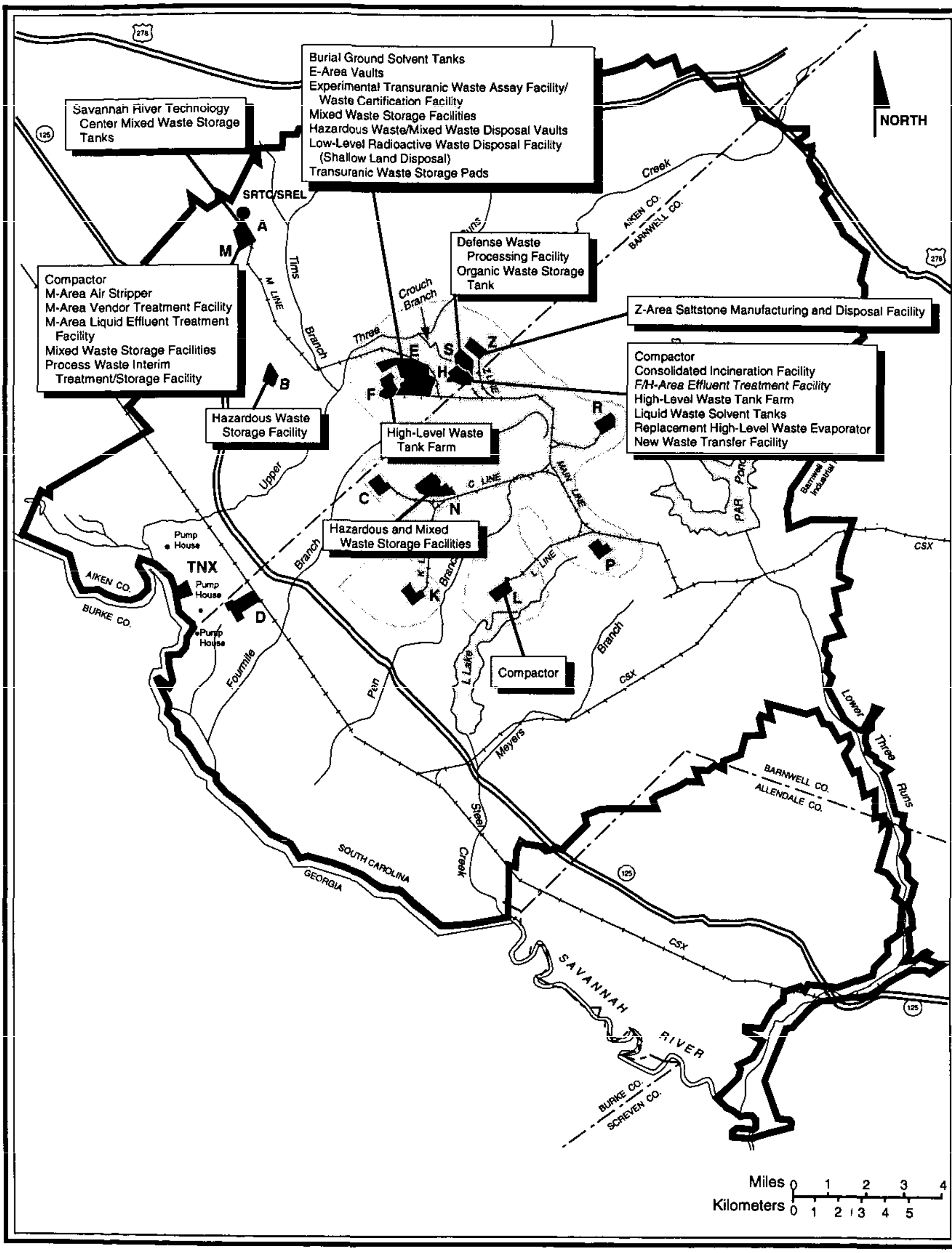


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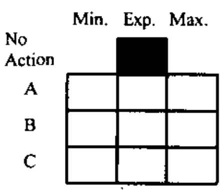
Figure 4-1. Location of SRS waste management facilities under the no-action alternative.

The no-action alternative requires additional storage facilities for transuranic and alpha waste and additional disposal areas for low-level radioactive waste and mixed waste in the vicinity of the existing vaults in E-Area. New mixed waste storage facilities would be constructed in the area between the Low-Level Radioactive Waste Disposal Facility and the M-Line railroad. A portion of this area has been cleared, graded, and stabilized with vegetation to prevent erosion. Additional undisturbed lands located (1) adjacent to and south of the M-Line railroad and (2) northwest of F-Area would be required for the remainder of the mixed waste storage facilities (Figure 4-2).

Construction for the no-action alternative would require 0.35 square kilometer (86 acres) of undeveloped TC
land northwest of F-Area and 0.30 square kilometer (74 acres) of undeveloped land between the Low-Level Radioactive Waste Disposal Facility and M-Line railroad. Other construction would be on previously cleared and developed land in the eastern part of E-Area.

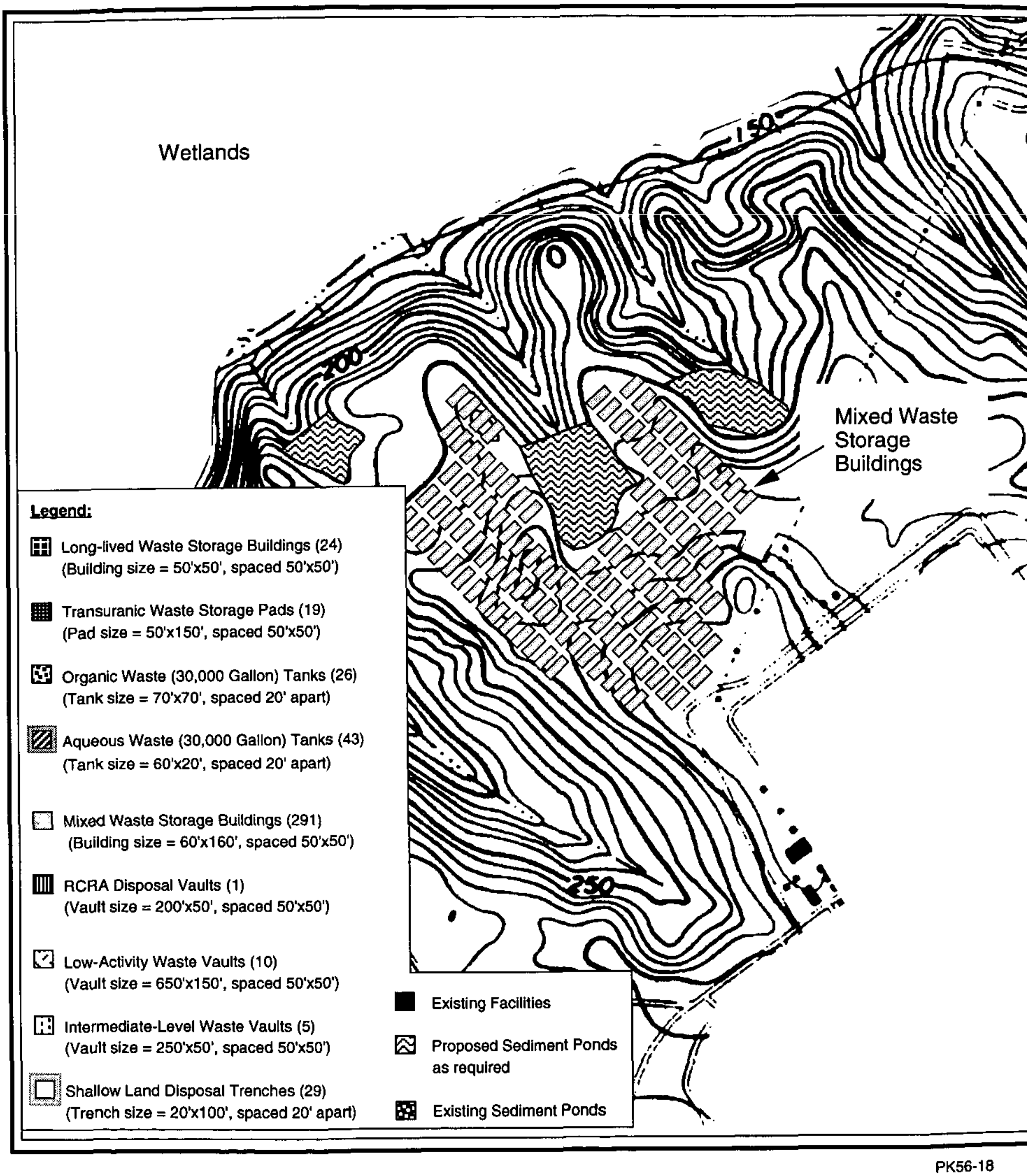


4.1.2 GEOLOGIC RESOURCES

Under the no-action alternative, impacts to geologic resources can be evaluated by comparing the amounts of land needed to build the facilities for this alternative. The more land required for the facilities, the greater the impacts, namely soil erosion, on these resources. TE

Except for some small gravel deposits, there are no economically valuable minerals or unique geologic features located in the vicinity of the waste management areas considered in this alternative, or any of the other alternatives. Waste management activities in the no-action alternative would mainly impact soils in the uncleared parts of E-Area. Construction would have less impact on soils in those parts of E-Area where the land has been cleared of trees and already disturbed by the construction of existing buildings. In E-Area, approximately 0.33 square kilometer (81 acres) has been cleared and developed, TC
and approximately 0.65 square kilometer (160 acres) would be cleared to build additional vaults, storage pads, tanks, and buildings (Figure 4-2).

The undisturbed soils in E-Area have a slight to moderate erosion hazard rating (USDA 1990). That is, erosion could occur if site preparation activities, such as grading, expose these soils and no precautions are taken to prevent erosion. Most of the soils in the cleared parts of E-Area consist of spoil from excavated areas, borrow pits, and previous grading activities; these soils also have a slight to moderate



TC
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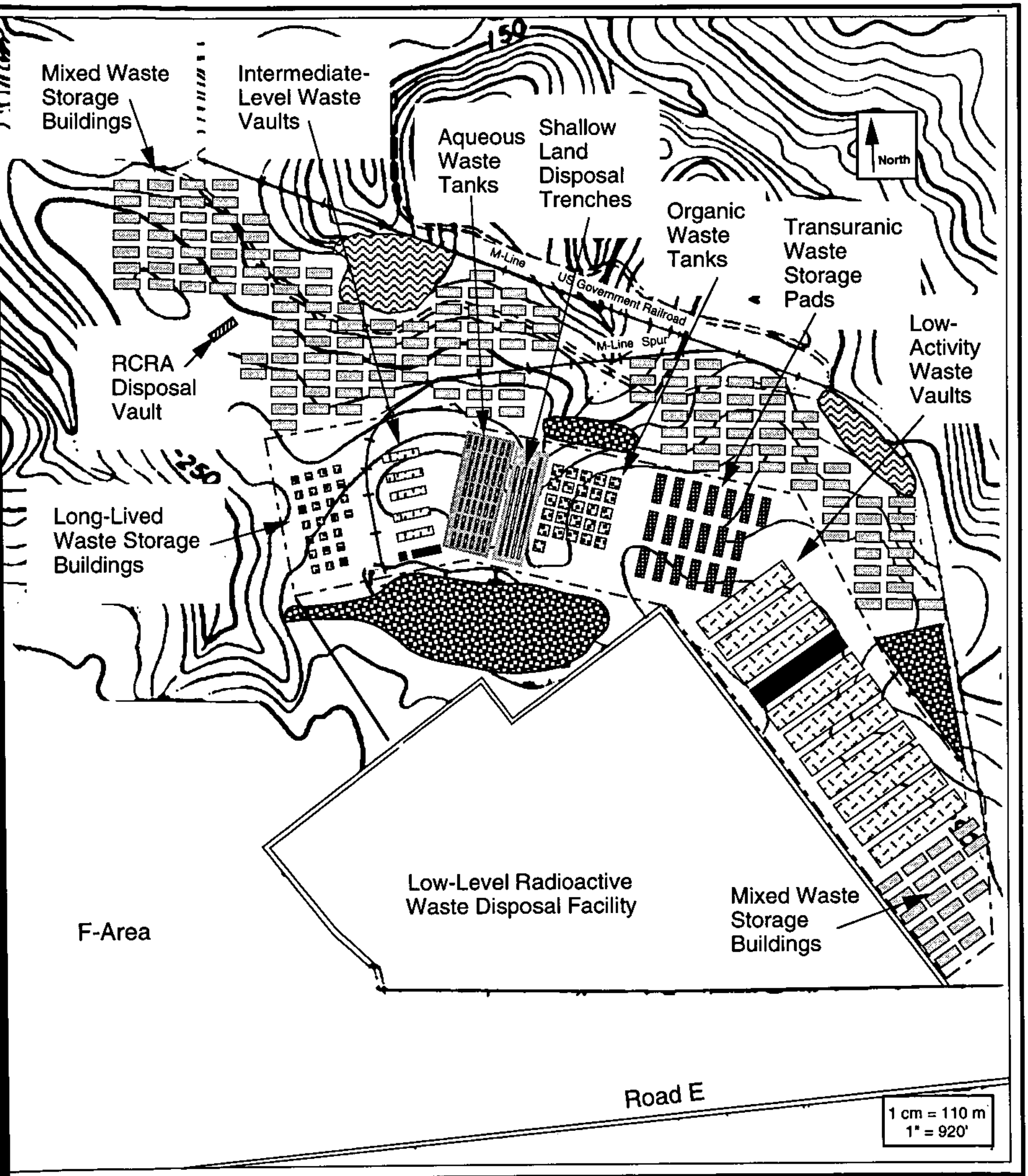
Figure 4-2. Configuration of treatment, storage, and disposal facilities in E-Area under the no-action alternative by 2024.


Mixed Waste Storage Buildings
Intermediate-Level Waste Vaults
Aqueous Waste Tanks
Shallow Land Disposal Trenches
North
Organic Waste Tanks
Transuranic Waste Storage Pads
M-Line
US Government Railroad
M-Line Spur
Low-Activity Waste Vaults
RCRA Disposal Vault
250
150
Long-Lived Waste Storage Buildings
Low-Level Radioactive Waste Disposal Facility
F-Area
Mixed Waste Storage Buildings
Road E
1 cm = 110 m
1" = 920'

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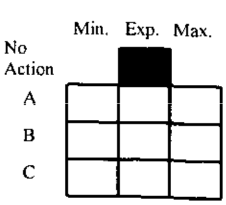
erosion hazard rating. The potential for erosion and sedimentation effects increases as the amount of land needed for construction increases, especially undeveloped land.

Potential adverse effects to geologic resources would be very small and could be mitigated by installing sediment and erosion control devices, properly grading slopes, and stabilizing the site. All new construction activities at SRS must comply with state regulations to prevent erosion. As a condition of the South Carolina Department of Health and Environmental Control (SCDHEC) National Pollutant Discharge Elimination System general permit for stormwater discharges from construction activities at SRS, a stormwater pollution prevention plan (WSRC 1993a) must be developed for each construction site covered by the permit, and each plan must provide for erosion and sediment controls. E-Area erosion and sediment control activities are addressed in the *Solid Waste Operations Erosion and Sedimentation Control Maintenance Program Plan - E-Area* (WSRC 1992a). For those areas already cleared and ready for construction of new facilities and those areas already operating, proper construction and maintenance of sediment ponds, stormwater basins, and other erosion and sediment control devices would mitigate adverse effects to soils during operation of waste management facilities.

TE Construction and operation activities might produce accidental occasional spills (e.g., oil, fuel, and process chemicals) on the soil. SRS has formal spill prevention, control, and countermeasures plans to prevent, identify, and mitigate spills of petroleum products (WSRC 1991a, b). Both the *Savannah River Site Best Management Practices Plan* (WSRC 1991a) and the *Savannah River Site Spill Prevention, Control, and Countermeasures Plan* (WSRC 1991b) are updated as conditions warrant or at least every 3 years. In addition, SRS is obligated under the Federal Facility Agreement (EPA 1993) to identify, evaluate, and, if necessary, remediate spills of hazardous substances, including radionuclides (e.g., high-level liquid radioactive waste leaks). This remediation could include removing, storing, or disposing of contaminated soil. Because SRS has controls to prevent spills, large spills of waste requiring remediation of extensive areas of soil are not expected; therefore, impacts to soils would be very small.



4.1.3 GROUNDWATER RESOURCES

Facilities and activities that are part of the no-action alternative which could affect groundwater quantity or quality include the M-Area Air Stripper, additional mixed waste storage buildings, intermediate-level, low-activity, and RCRA-permitted waste disposal vaults, long-lived waste storage buildings, shallow land disposal units, transuranic and alpha waste storage pads, and the Defense Waste Processing Facility.

Since these facilities do not withdraw groundwater in quantities that would materially affect the availability of this resource, the focus of these assessments was on their potential to impact groundwater quality.

The M-Area Air Stripper (see Appendix B.14 for description) removes volatile organic compounds from contaminated groundwater beneath A- and M-Areas. Based on current data, DOE anticipates that it would need to operate the M-Area Air Stripper for the remainder of its 30-year post-closure period (1987 to 2017) to meet the groundwater protection standard (40 CFR 264.92) for the contaminants trichloroethylene and tetrachloroethylene. The air stripper would also treat investigation-derived hazardous wastes generated from groundwater monitoring wells. Effects of the continued operation of the M-Area Air Stripper on groundwater quality at SRS would be beneficial because of the continued removal of volatile organic compounds from groundwater beneath A- and M-Areas.

For the remaining storage and disposal facilities, the most important impact to the groundwater resources of SRS is the potential for the leaching of radioactive and hazardous constituents by rainfall infiltration. There is also a potential for groundwater contamination during construction as a consequence of leaks and spills of oil, fuel, or other chemicals from construction equipment. However, the potential impacts of such spills or leaks would be mitigated by using spill prevention plans and best management practices, as described in Section 4.1.2.

DOE would design and construct waste storage facilities and engineered disposal vaults to prevent releases, as described for the individual facility types in Appendix B, and would inspect and monitor them to ensure their continued integrity. Their operation, therefore, is very unlikely to adversely affect groundwater quality during the 30-year period considered in this EIS. Releases to groundwater could occur, however, whenever active maintenance is discontinued. For shallow land disposal facilities (i.e., slit trenches), releases could occur sooner. For purposes of assessment, it is assumed that institutional controls, including active maintenance, would be continued for 100 years. The potential impacts of releases from both disposal vaults and slit trenches were evaluated by calculating the effects of infiltration and the leaching of radionuclides from wastes on the concentration of radionuclides in groundwater beneath these facilities at a compliance point defined as a hypothetical well 100 meters (328 feet) away (Toblin 1995). The predicted groundwater concentrations were derived from information provided in the *Radiological Performance Assessment for the E-Area Vaults Disposal Facility* (Martin Marietta, EG&G, and WSRC 1994). The Radiological Performance Assessment evaluated disposal of unstabilized waste forms in the intermediate-level waste vaults, low-activity waste vaults, as well as suspect soil in slit trenches. This evaluation calculated the groundwater concentrations for each nuclide per curie of that nuclide in each of the waste disposal facilities (intermediate-level waste vaults, low-activity waste vaults, and slit trenches). The groundwater concentrations predicted in this environmental impact statement (EIS) were derived by applying these Radiological Performance Assessment-determined unit dilution factors to the anticipated inventories in each type of facility for each alternative and waste forecast.

After the draft EIS was issued, DOE reevaluated the isotopic inventory of wastes and modified the inventories assumed in this EIS to better reflect waste composition. Because curium-247 and -248 are not present at detectable concentrations in the current wastes and are not expected to occur at detectable concentrations in any future waste, these isotopes were removed from the inventories considered in analysis. Therefore, the curium-247 and -248 exceedances discussed in the draft EIS do not occur under any alternative.

Thus, the groundwater concentrations were predicted for the alternatives in this EIS by scaling from the Radiological Performance Assessment based on the number and type of facilities required, the radionuclide inventories, and the characteristics of the unstabilized waste forms. Factors such as retardation of radionuclide movement in groundwater by sorption processes, which differ between nuclides, were considered, as were the characteristics of the shallow aquifer (through which migration to surface water would occur). These concentrations were not added to existing groundwater contamination levels since, as noted below, they would not occur until a century or more in the future, after current groundwater concentrations would have been reduced by natural means (decay) or remediation activities. Potential contamination of the deep Middendorf aquifer (formerly known as the Tuscaloosa) was determined in an earlier EIS (DOE 1987) not to be a concern because of the isolation of that aquifer from the shallow aquifer affected by these facilities.

The disposal of stabilized waste forms (ashcrete, glass) in slit trenches was not evaluated in the Radiological Performance Assessment and is subject to completion of performance assessments and demonstration of compliance with performance objectives required by DOE Order 5820.2A ("Radioactive Waste Management"). Therefore, DOE was unable to base an analysis of stabilized waste in slit trenches on the Radiological Performance Assessment. The analysis presented in the draft EIS did not account for the reduced mobility of stabilized waste forms in slit trenches. The final EIS assumes that releases from these wastes in slit trenches would not exceed the performance objectives specified by DOE Order 5820.2A. As a result of the modified assessment approach, exceedances for uranium and plutonium isotopes identified in the draft EIS under some alternatives and waste forecasts are no longer predicted to occur. DOE would re-evaluate the performance assessment and, if necessary, adjust either the waste acceptance criteria or the inventory limit for the storage or disposal units to ensure compliance with these criteria, or standards which may become applicable in the future. The results of applying this assessment methodology to the different storage and disposal facilities are presented below. TE

The performance objectives required by DOE Order 5820.2A include ensuring that groundwater resources are protected as required by federal, state, and local requirements. Additionally, public drinking water standards promulgated in 40 CFR 141 which limit dose to 4 millirem per year were adopted by DOE in Order 5400.5 ("Radiation Protection of the Public and the Environment"). TC

Compliance with the performance objectives required by DOE is determined by comparing the annual dose resulting from drinking 2 liters per day of the contaminated groundwater. This annual dose was compared with the 4 millirem per year effective dose equivalent criterion specified in DOE Order 5400.5. The factors used to convert from groundwater concentrations to dose are specified in DOE Order 5400.5. Assessment of compliance with this dose criterion was based on the potential additive effects of new units contaminating the same groundwater. The concentration values do not, however, include the groundwater contamination from prior waste disposal activities at SRS, as presented in Chapter 3. Groundwater contamination resulting from the waste disposal under this EIS would be in addition to existing contamination from past waste disposal. By the time that concentrations resulting from waste disposal activities evaluated in this EIS reached their peak (at least 97 to 130 years in the future), the concentrations of contaminants introduced by past disposal will have been substantially reduced below present concentrations as a result of natural decay processes and any environmental restoration programs. TE TC

Three types of vaults – RCRA-permitted disposal vaults, intermediate-level waste vaults, and low-activity waste vaults – would be used in E-Area. The existing vaults are subsurface structures designed to comply with the performance objectives of DOE Order 5820.2A. The performance assessment described above considered intact vaults operating as designed and a worst-case scenario of a fractured protective cap and fractured vaults (Martin Marietta, EG&G, and WSRC 1994). The groundwater analysis (Toblin 1995) determined that during the 30-year period of this EIS (1995 through 2024), releases of radionuclides from intermediate-level waste vaults or low-activity waste vaults are not expected to reach the 100-meter (328-foot) compliance point, even conservatively assuming an infiltration rate of 40 centimeters per year. The analysis also assumes that failure and collapse of either type of vault would be expected to occur as a result of normal deterioration within a period ranging from 570 years for the development of cracks in a vault's roof to over 1,000 years for a roof's collapse. TE TC

Under normal conditions vaults are slightly permeable, so some easily-leachable constituents will move through them and into the groundwater. The modeling results from this groundwater analysis indicate TC that tritium would be the first radionuclide detected at the compliance point. Assuming infiltration at a rate of 40 centimeters per year, the peak concentration of tritium in groundwater at the compliance point would occur after 130 years for the intermediate-level waste vaults and after 97 years for the low-activity waste vaults. Peak concentrations of tritium in groundwater from these facilities would be 7.3×10^{-4} and

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1.0×10^{-6} picocuries per liter, respectively, which are very small fractions of the 20,000 picocuries per liter limit specified in the EPA drinking water standard for this nuclide, and are not measurable by current instrumentation. In addition, during the 100-year institutional control period, periodic site inspections would discover any visible degradation of the cover and drainage system constructed over the vaults after the vaults are closed, and corrective actions would be taken.

The modeling results of the groundwater analysis for both types of low-level waste vaults beyond the institutional control period predicts that no dose of any constituent placed in these vaults under the

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no-action alternative would exceed the 4 millirem per year drinking water dose criterion at any time after disposal. The disposal of wastes in the RCRA-permitted vaults was not evaluated quantitatively. It would be subject to completion of performance assessments and demonstration of compliance with the performance objectives required by DOE Order 5820.2A. Therefore, DOE has conservatively assumed that groundwater concentrations as a result of radioactive releases from the RCRA-permitted vaults and all other low-level waste disposal facilities (vaults and slit trenches) would remain within the DOE performance objective of 4 millirem per year adopted by DOE in Order 5400.5.

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Releases of nonradioactive constituents from the RCRA-permitted vaults were not evaluated in this EIS. Hazardous constituent releases to groundwater could occur as a result of vault failure after loss of institutional control. The hazardous constituents in these vaults would consist primarily of metals, such as mercury and lead. These do not decay over time as do radioactive constituents such as tritium. Potential groundwater concentrations of hazardous constituents have not been evaluated, but some hazardous metals might enter groundwater following degradation of the vaults and waste forms.

Under the no-action alternative, shallow land disposal of radioactive waste would also continue. DOE Order 5820.2A as now implemented requires that performance assessments for radioactive waste management at DOE facilities be conducted prior to disposal of wastes. Recently issued guidance for

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management of low-level waste at SRS (WSRC 1994a) prohibited shallow land disposal of wastes without a radiological performance assessment after March 31, 1995 (see Appendix B.27). The performance assessment referred to above (Martin Marietta, EG&G, and WSRC 1994) evaluated the impact of shallow land disposal of suspect soils on groundwater quality near the center of SRS (west of the E-Area vaults). Modeling results for suspect soils under the no-action alternative (Toblin 1995)

TC

indicate that none of the radionuclides analyzed would exceed the 4 millirem per year drinking water dose criterion at any time. The projected impacts on groundwater resources at SRS from E-Area disposal facilities do not consider existing groundwater contamination beneath the Burial Ground Complex, because of the time displacements of the impacts, as discussed earlier. TC

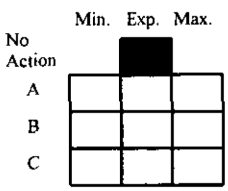
Under the no-action alternative, DOE would store packaged mixed wastes on concrete pads within each of the mixed waste storage buildings; each pad would include a concrete sump to collect and contain leaks per RCRA requirements (see Appendix B.18). Therefore, it is not anticipated that operation of these mixed waste storage buildings through the year 2024 would affect the quality of groundwater in the area. Shallow groundwater in this area flows to Upper Three Runs and Crouch Branch to the north and northeast and to Fourmile Branch to the south. Mixed waste storage buildings would be located a short distance from two of these streams (see Figures 4-1 and 4-2). However, these buildings would be above-grade, zero-release facilities and, as discussed above, releases would not be expected to soils, streams, or groundwater. If, however, releases did occur, groundwater monitoring around such facilities would detect contaminants in groundwater and mitigation by containment, removal, and proper disposal of contaminated media would be implemented.

The no-action alternative also calls for construction of 24 long-lived radioactive waste storage buildings, 19 transuranic and alpha waste storage pads, 26 114-cubic-meter (30,000-gallon) organic waste storage tanks, and 43 114-cubic-meter (30,000-gallon) aqueous waste tanks in E-Area (see Figure 4-2). These storage facilities would be designed and constructed to meet regulatory requirements to protect human health and the environment, including maintenance of zero releases as noted above. The long-lived waste storage buildings and the transuranic and alpha waste storage pads would include sumps to collect and contain leaks. Below-grade organic waste tanks would be constructed with secondary containment and leak detection and leachate collection systems, as required by the Resource Conservation and Recovery Act (RCRA). Neither the low-level waste and transuranic and alpha waste storage facilities nor the above- and below-grade mixed waste tanks are expected to adversely affect the quality of groundwater at SRS under normal circumstances. TC TE

Because DOE would not intend to release the areas containing these storage facilities to unrestricted access, the facilities would not be designed to function for extended time intervals without institutional control and maintenance. Accordingly, no assessment of potential releases from long-term unattended operation of these facilities and their contents has been performed.

The Defense Waste Processing Facility and the Z-Area Saltstone Facility would operate under the no-action alternative for this EIS. High-level waste stored in the F- and H-Area tank farms would be gradually removed for vitrification, storage and permanent disposal. As the high-level waste is removed

from the tanks and vitrified, the potential for inadvertent releases to groundwater would decrease. Possible effects on groundwater would be minimized with the treatment and ultimate disposal of the high-level waste. In case of accidental spills of salt solution (e.g., from transfer pipes in the tank farms) during Defense Waste Processing Facility operations, the soil would be expected to slow the migration of contaminants in the subsurface, and remedial actions would be undertaken to recover as much of the spilled material as is feasible and to minimize the dispersal of the residual material. The effects on groundwater of the operation of the Defense Waste Processing Facility and the Saltstone Facility were
TE presented in the *Final Supplemental Environmental Impact Statement Defense Waste Processing Facility*.



4.1.4 SURFACE WATER RESOURCES

This section examines the no-action alternative activities (described in Section 2.2) that would produce wastewater discharges to surface waters and presents the potential effects on the environment from both radiological and nonradiological constituents contained in treated wastewater. The evaluation of these consequences is based on Section 4.1.3. Evaluation of these consequences assumed that existing regulatory limits would continue to apply for the various nonradiological constituents. The radiological
TE criterion used as the basis for this evaluation comply with DOE Order 5400.5 and 40 CFR 141, the U.S. Environmental Protection Agency (EPA) national primary drinking water regulations.

Spills or leaks could occur from various tanks and equipment. Sumps and secondary containment around tanks and vulnerable equipment would capture and collect spills or leaks if they were to occur. Material that accumulates in sumps and secondary containment would be sampled to determine if contaminants were present. If contaminated, the wastewater would be treated in the appropriate treatment facility, such as the F/H-Area Effluent Treatment Facility or the M-Area Dilute Effluent Treatment Facility. Uncontaminated wastewater would be discharged via a permitted outfall to surface waters. SRS has and would maintain a best management practices plan, a spill prevention control and countermeasures plan, and administrative procedures for monitoring and cleaning up spills to prevent them from reaching a surface stream.

In construction of the various storage facilities needed under the no-action alternative in E-Area, DOE would prepare sedimentation and erosion control plans in compliance with state regulations on stormwater discharges, which became effective in 1992 as part of the Clean Water Act. SRS was issued a permit by SCDHEC (Permit SCR100000) that applies to stormwater runoff during construction activities. If a project requires disturbing more than 0.02 square kilometer (5 acres) of land, SCDHEC must approve the sediment and erosion control plan. Facilities or measures taken to control erosion during the construction phase would be regularly inspected by SCDHEC; the Management and Operating Contractor's Environmental Protection Department; the U.S. Natural Resources Conservation Service (formerly the Soil Conservation Service); and the U.S. Forest Service to monitor the effectiveness of the erosion control measures (particularly following a storm). Corrective measures, if needed, would be taken by DOE. After facilities begin operating, they would be included in the *SRS Stormwater Pollution Prevention Plan*, which details the required stormwater control measures and is one of the criteria of the stormwater general permit issued to SRS by SCDHEC (Permit SCR000000) for operating facilities. Also, as required by the National Pollutant Discharge Elimination System permit, the facilities would be included in the *SRS Best Management Practices Plan.* TE

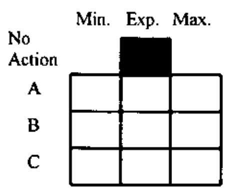
Studies have been performed to determine the effect of stormwater that might infiltrate waste in the disposal facilities in E-Area and then enter the groundwater. As noted in Section 4.1.3, the incremental increase in groundwater concentrations of the radionuclides present in the waste would be small. Most of the radionuclides would not reach peak concentrations in the river until at least 10,000 years beyond the present. The tritium would peak in 70 to 237 years at a concentration below 10^{-5} picocuries per liter, which is one billion times below the regulatory limits; iodine-129, selenium-79 and technetium-99 would peak in 150 to 9,700 years at concentrations below 10^{-6}, 10^{-6}, and 10^{-4} picocuries per liter, respectively, which are also well below regulatory limits (Toblin 1995). Thus, the impact on the Savannah River from groundwater which reaches the surface and eventually enters the river would be very small. TC TC TE

The M-Area Vendor Treatment Facility (see Appendix B.15) would not discharge wastewater directly to a surface stream. However, the wastewater discharged from the scrubber system [an average flow of approximately 0.5 liter (0.13 gallon) per minute] would be directed to the M-Area Dilute Effluent Treatment Facility (DOE 1993a), which can adjust the wastewater pH, add alum as a coagulant, settle the resulting suspended solids, and dewater the solids. Since the wastewater from the scrubber system would be similar in composition to the wastewater already being treated, the surface water would receive little, if any, impact from the discharge of this additional treated water. The water resources section in Appendix E lists the minimum and maximum chemical concentrations found in the effluent from the M-Area Liquid Effluent Treatment Facility, which includes the Dilute Effluent Treatment Facility (outfall M-004). The treatment facility has been meeting the discharge criteria. The M-Area Liquid Effluent Treatment Facility has been processing approximately 53 liters (14 gallons) per minute for the last several years (Arnett 1994), but it is designed to treat 100 liters (26 gallons) per minute. Thus, the additional flow of 0.5 liter (0.13 gallon) per minute from the M-Area Vendor Treatment Facility would TE TE have a very small effect on the flow rate of the water being treated and the effectiveness of the treatment facility. The treated water would be discharged to Tims Branch via National Pollutant Discharge Elimination System permitted outfall M-004. A DOE environmental assessment (DOE 1993a) concluded that water quality and indigenous biota within the receiving stream (Tims Branch) would not be adversely impacted by this discharge of treated water.

Additional wastewater streams would be treated in existing SRS wastewater treatment facilities. The M-Area Air Stripper removes volatile organic compounds from the groundwater beneath A- and M-Areas. The air stripper is permitted by SCDHEC to treat 2,270 liters (600 gallons) per minute of contaminated groundwater and operates at approximately 1,900 liters (500 gallons) per minute. Purge water containing volatile organic compounds from the monitoring wells would be treated by the air stripper. An additional 2 liters (0.53 gallon) per minute average flow of purge water would be treated by the air stripper. The operation of the air stripper would not be compromised, and the quality of the effluent would not change.

Additional wastewater would be sent to the F/H-Area Effluent Treatment Facility, either directly or after being treated in one of the high-level waste evaporator systems. The F/H-Area Effluent Treatment Facility has a design flow rate of 1,135 liters (300 gallons) per minute. The projected additional wastewater stream for the no-action alternative (based on the expected waste forecast) is estimated to be 1.8 liters (0.48 gallon) per minute. There would also be 26 liters (6.9 gallons) per minute of recycle water from the Defense Waste Processing Facility being sent to the F/H-Area Effluent Treatment Facility. Thus, the additional flow of wastewater to be treated would be 27.8 liters (7.3 gallons) per
TE | minute. Since the facility processes approximately 114 liters (30 gallons) per minute, this additional flow would be within its design capability. The *Final Supplemental Environmental Impact Statement Defense Waste Processing Facility* discusses the effects of this wastewater on the treatment processes. This release, on an annual basis, represents approximately 15 percent of the total dose to the offsite maximally exposed individual from liquid releases from SRS in 1993. The water resources section in Appendix E lists the minimum and maximum chemical concentrations which were reported for the F/H-Area Effluent Treatment Facility outfall (outfall H-016) for 1993. The effluent concentrations have been in compliance with the permit limits. Since the additional wastewater is of similar composition to the wastewater already being treated by this system, the quality of the effluent from the F/H-Area Effluent Treatment Facility is not likely to change. The calculated dose of the various radionuclides is included in
TC | the tables in Appendix E. Two radionuclides account for more than 99 percent of the calculated dose: tritium and cesium-137 together account for 0.0206 millirem of the total dose of 0.0208 millirem to the offsite maximally exposed individual over the 30-year period (1995 through 2024). The impact on Upper Three Runs from radionuclides would be very small.

The Replacement High-Level Waste Evaporator would eventually replace existing evaporators and would produce distillate of the same quality as produced by the present evaporators and which would be treated in the F/H-Area Effluent Treatment Facility. Concentrated waste from the evaporator would be sent to the Defense Waste Processing Facility (WSRC 1994b). Operation of the replacement evaporator would not change the quality of the wastewater discharges. The wastewater flow would be approximately the same because the older evaporators would be retired. TE



4.1.5 AIR RESOURCES

The no-action alternative would result in additional nonradiological and radiological emissions from SRS. In both cases, the resulting incremental increase in air concentrations at and beyond the SRS boundary would be very small compared to existing concentrations at and beyond the SRS boundary. Operations under the no-action alternative would not exceed state or Federal air quality standards. TE

4.1.5.1 Construction

Potential impacts to air quality from construction activities under the no-action alternative would include fugitive dust and emissions from construction equipment. Fugitive dust results from soil transportation activities, moving and maintenance of soil piles, and clearing and excavation of soil. Approximately 182,500 cubic meters (239,000 cubic yards) of soil would be displaced in E-Area for the construction of the treatment, storage, and disposal facilities listed in Section 2.2.7.

The amount of fugitive dust produced was assumed to be proportional to the land area disturbed. Amounts of fugitive dust for the no-action alternative were calculated from the estimated annual average amount of soil excavated during construction activities over the 30-year analysis period. Fugitive soil emissions are based on U.S. Environmental Protection Agency (EPA) AP-42 emission factors and the number of cubic meters of soil excavated (EPA 1985; Hess 1994a). Maximum downwind concentrations at the SRS boundary for total suspended particulates and particulate matter less than 10 microns in diameter were calculated using EPA's TSCREEN model (EPA 1988).

Exhaust emissions from construction equipment were calculated from estimates of the types and number of earth-moving equipment required and from EPA AP-42 emission factors. Maximum downwind concentrations for criteria pollutants at the SRS boundary were calculated using EPA's TSCREEN model (EPA 1988).

The 30-year average annual concentrations due to construction activities are shown in Table 4-1. The increases in SRS-boundary concentrations due to construction activities would be less than state and Federal ambient air quality standards for all air contaminants.

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Table 4-1. Average increase over baseline[a] of criteria pollutants at the SRS boundary from construction-related activities under the no-action alternative.

Pollutant	Averaging time	No-action alternative Baseline (mg/m^3)[b,c]	No-action alternative Increase[d] (mg/m^3)	SCDHEC standard[e] (mg/m^3)	Existing + increase as percent of standard (%)[f]
Nitrogen oxides	1 year	14	0.01	100	14
Sulfur dioxide	3 hours	857	65.65	1,300	71
	24 hours	213	1.27	365	59
	1 year	17	<0.01[g]	80	21
Carbon monoxide	1 hour	171	1,919	40,000	5
	8 hours	22	302	10,000	3
Total suspended particulates	1 year	43	0.01	75	57
Particulate matter less than 10 microns in diameter	24 hours	85	5.24	150	60
	1 year	25	0.01	50	50

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a. Baseline includes background concentrations and the contributions from existing sources.
b. Micrograms per cubic meter.
c. Source: Stewart (1994).
d. Source: Hess (1994a).
e. Source SCDHEC (1976).
f. Percent of standard = 100 × (existing sources + baseline + increase) divided by regulatory standard.
g. < is read as "less than."

4.1.5.2 Operations

The following facilities were included in the no-action alternative air dispersion modeling analysis: the Defense Waste Processing Facility, including In-Tank Precipitation; additional organic waste storage tanks; the M-Area Vendor Treatment Facility; additional mixed waste storage tanks (E-Area); and hazardous and mixed waste storage facilities.

Air emissions from disposal vaults in E-Area are very small because solvents and solvent-contaminated rags are not disposed of in the vaults. Solvents and solvent-contaminated rags are stored in drums, with pressure relief valves that release with pressures greater than 280 grams per square centimeter (4 pounds per square inch), located in the hazardous waste and mixed waste storage buildings. Emissions are very small under routine operating conditions because pressure changes greater than 280 grams per square centimeter (4 pounds per square inch) would occur only during emergency conditions, such as a fire. TE

To determine which facility source terms should be revised to accurately reflect the structure of operations of the no-action alternative, a thorough review of facilities was performed. The following summarizes facility source terms that were not changed and the rationale for not modifying them.

Changes in impacts to maximum boundary-line concentrations would not be expected to result from the continued operation of the F- and H-Area evaporators, the F/H-Area Effluent Treatment Facility, the lead melter, solvent reclamation units, the silver recovery unit, the Organic Waste Storage Tank, Savannah River Technology Center ion exchange process, the low-level waste compactors, or the M-Area Air Stripper, because these facilities are currently operating. Additional organic emissions from the M-Area Air Stripper due to the treatment of investigation-derived waste from groundwater monitoring well operations would be less than 13 kilograms (29 pounds) per year; the incremental contribution to maximum boundary-line concentrations would be very small [less than 0.005 micrograms per cubic meter, based on TSCREEN modeling and Hess (1995a)]. Additional organic emissions from the F/H-Area Effluent Treatment Facility would be 2.7 kilograms (6 pounds) per year; the incremental impact would be very small (Hess 1994b). TC

4.1.5.2.1 Nonradiological Air Emissions Impacts

Table 4-2 shows maximum ground-level concentrations at the SRS boundary for nonradiological air pollutants emitted under the no-action alternative. Air dispersion modeling was performed with calculated emission rates for facilities not yet operating and actual 1990 emission levels for facilities currently operating (Stewart 1994). For proposed facilities for which permit limits have not yet been established, emissions were estimated based on operational processes (see Appendix B) and data obtained from similar activities at SRS and other waste management facilities. The dispersion calculations for criteria pollutants were performed with 1991 meteorological data from H-Area. DOE used periods ranging from 1 hour to 1 year to model criteria pollutant concentrations, which correspond to the averaging periods found in South Carolina's "Ambient Air Quality Standards" (SCDHEC 1976). TC

Table 4-2. Changes in maximum ground-level concentrations of criteria pollutants at the SRS boundary from operation activities under the no-action alternative.

Pollutant	Averaging time	Existing sources (μ/m^3)[a,b]	Regulatory standards (μ/m^3)[c]	Background concentration (μ/m^3)[d]	Increase in concentration (μ/m^3)	Existing + background + increase as percent of standard (%)[e]
Nitrogen oxides	1 year	6	100	8	0.11	14[f]
Sulfur dioxide	3 hour	823	1300	34	15.36	67
	24 hour	196	365	17	2.8	59
	1 year	14	80	3	0.08	21
Carbon monoxide	1 hour	171	40,000	NA[g]	24.2	0.5
	8 hour	22	10,000	NA	4.03	0.3
Total suspended particulates	1 year	13	75	30	2.02	60
Particulate matter < 10 microns in diameter	24 hour	51	150	34	5.20	60
	1 year	3	50	22	0.13	50
Lead	3 months	4×10^{-4}	1.5	0.011	0	0.8
Gaseous fluorides (as hydrogen fluoride)	12 hour	2	3.7	NA	0.0019	54
	24 hour	1	2.9	NA	9×10^{-4}	35
	1 week	0.4	1.6	NA	3.5×10^{-4}	25
	1 month	0.1	0.8	NA	9×10^{-5}	13

a. Micrograms per cubic meter.
b. Source: Stewart (1994).
c. Source: SCDHEC (1976).
d. Source: SCDHEC (1992).
TE e. Percent of standard = 100 × (existing sources + background + increase in concentration) divided by regulatory standard.
f. For example, 6 + 8 + 0.11 divided by 100 would equal 14.11 percent, rounded to the nearest whole number, 14 percent.
g. NA = not applicable.

Maximum ground-level concentrations for nonradiological air pollutants were determined from the Industrial Source Complex Version 2 Dispersion Model using maximum potential emissions from all the facilities proposed in the no-action alternative (Stewart 1994). The calculations for the dispersion of carcinogenic toxic substances were performed with 1991 meteorological data from H-Area. Modeled air toxic concentrations for carcinogens were based on an annual averaging period and are presented in Section 4.1.12.2.2. To get a 30-year exposure period, annual averages were calculated by adding all emissions occurring in an annual period, and then proportioning the emissions on a unit-time basis (e.g., grams per second). Under the no-action alternative, emissions of noncarcinogenic air toxics are very small. Maximum boundary-line concentrations for all SCDHEC air toxics are very small and are below SCDHEC regulatory standards. They are presented in the *SCDHEC Regulation No. 62.5 Standard*

No. 2 and Standard No. 8 Compliance Modeling Report Input/Output Data (WSRC 1993b) and in Section 3.5 of this EIS.

4.1.5.2.2 Radiological Air Emissions Impacts

Offsite maximally exposed individual and population doses are presented for atmospheric releases resulting from routine operations under the no-action alternative. The largest sources of radionuclides would be from activities at the transuranic and alpha waste storage pads, the F- and H-Area tank farms, M-Area Vendor Treatment Facility, and the F/H-Area Effluent Treatment Facility. L004-13

SRS-specific computer models MAXIGASP and POPGASP (Hamby 1992) were used to determine the maximum individual dose at the SRS boundary and the 80-kilometer (50-mile) population dose, respectively, resulting from routine atmospheric releases. See Appendix E for detailed facility-specific isotopic and dose data. L004-13

Table 4-3 shows the doses to the offsite maximally exposed individual and the population as a consequence of the normal radiological emissions from the no-action alternative activities. The calculated incremental committed effective annual dose equivalent to the hypothetical offsite maximally exposed individual would be 1.2×10^{-4} millirem [doses were calculated using dose factors provided by Simpkins (1994a)], which is well within the annual dose limit of 10 millirem for SRS atmospheric releases. In comparison, an individual living near SRS receives a dose of 0.25 millirem from all current releases of radioactivity at SRS (Arnett 1994). TC

Table 4-3. Annual radiological doses to individuals and the population within 80 kilometers (50 miles) of SRS from atmospheric releases under the no-action alternative.[a] TE

	Offsite maximally exposed individual	Population
Release Pathway	Dose (millirem)	Dose (person-rem)
Atmospheric	1.2×10^{-4}	2.9×10^{-4}

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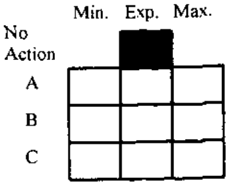
a. Source: Simpkins (1994a). TE

The annual incremental dose to the population within 80 kilometers (50 miles) of SRS from the no-action alternative would be 2.9×10^{-4} person-rem. In comparison, the collective dose received from natural sources of radiation is approximately 1.95×10^{5} person-rem (Arnett, Karapatakis, Mamatey 1994). Sections 4.1.12.1 and 4.1.12.2 describe the potential health effects of these releases on the workers and public, respectively.



4.1.6 ECOLOGICAL RESOURCES

Under the no-action alternative, disturbed areas would be cleared and graded to build new waste storage
TE and disposal facilities. (Areas are given in acres; to convert to square kilometers, multiply by 0.004047.)
TC Approximately 160 acres of the following types of woodlands would be cleared and graded by 2024:

- 7 acres of slash pine planted in 1959
- 42 acres of loblolly pine planted in 1987
- 26 acres of white oak, red oak, and hickory regenerated in 1922
- TC 44 acres of longleaf pine planted in 1922, 1931, or 1936
- 3 acres of loblolly pine planted in 1946
- 20 acres of longleaf pine planted in 1988
- 18 acres from which mixed pine/hardwood was recently harvested

Larger, more mobile animal species inhabiting the undeveloped portions of the site, such as fox, raccoon, bobcat, gray squirrel, and white-tailed deer would be able to avoid the clearing and grading equipment and escape; smaller, less mobile species such as reptiles, amphibians, and small mammals could be killed or displaced by the logging and earth-moving equipment. Although the animals displaced by construction will likely survive for some time in newly established home ranges, these individuals or
TE those whose home ranges they infringe on may die or experience decreased reproduction. The net result of the construction would be less habitat and therefore fewer individuals. If the clearing were done in the spring and summer, birds' nests, including nestlings and eggs, would be destroyed. Hardwood-
TE dominated sites on steep slopes and in wetlands would be avoided whenever possible. Approximately 15 percent of the total acreage of mature hardwoods in or near E-Area would be cleared (Figure 3-9). The clearing of hardwoods would be restricted to some upland areas required for sediment ponds (Figures 3-9 and 4-2).

Construction and operation of storage and disposal facilities within the previously cleared and graded portions of E-Area would have little effect on terrestrial wildlife. Wildlife habitat in these areas is poor and characterized by mowed grassy areas with few animals. Birds and mammals that use these areas, mostly for feeding, would be displaced by construction activities, but it is unlikely that they would be physically harmed or killed.

The undeveloped land between the M-Line railroad and the E-Area expansion and extending northwest of F-Area is described in Section 3.6. Animal species common to these areas are typical of the mixed pine/hardwood forests of South Carolina and are described in Section 3.6.1. TE

Wetlands would not be affected by construction on the developed or undeveloped lands (Ebasco 1992). Potential adverse effects to the downstream wetlands, aquatic macroinvertebrate, and fish species of Crouch Branch and five small unnamed tributaries to Upper Three Runs would be minimized during construction by installing sediment and erosion control devices before clearing begins, maintaining the sediment and erosion control devices, properly grading the slopes, and stabilizing the site. By state law, construction activities on SRS must have an approved sediment and erosion control plan (see Section 4.1.2). Proper construction and maintenance of sediment ponds and stormwater basins would mitigate adverse effects to the wetlands during operation of waste storage and disposal facilities. Additional sediments are not likely to reach the wetlands adjacent to Upper Three Runs.

The effect of additional wastewater discharges to surface waters for the no-action alternative are presented in Section 4.1.4. Small changes would occur to discharge rates, but the wastewater discharges would remain within permit limits. The aquatic biota in the receiving streams would not be affected because the water quality would not change.

Suitable habitat for the red-cockaded woodpecker exists in the area adjacent to E-Area. Red-cockaded woodpeckers prefer to nest in living pine trees over 70 years of age and forage in pine stands over 30 years of age (Wike et al. 1994). Trees suitable for nesting and foraging are found throughout SRS. In 1986, DOE and the U.S. Fish and Wildlife Service agreed on a red-cockaded woodpecker management plan at SRS, which is based on dividing SRS into two management areas (Henry 1986) (Figure 4-3). TE

One management area (112,000 acres; Management Area Two) forms a natural buffer just within the SRS boundary. This management area contains most of the suitable red-cockaded woodpecker habitat on SRS and all the active colonies. Timber in this area is managed to produce a viable population of red-cockaded woodpeckers. The red-cockaded woodpecker population has increased from 5 in 1985 to 77 in 1994 (LeMaster 1994a). TC

The other management area (69,000 acres; Management Area One; Figure 4-3) includes developed areas of SRS and adjacent woodland. E-Area and the area of proposed expansion are located within this management area. While potential red-cockaded woodpecker habitat occurs within this area, no active colonies or birds have been identified. By agreement between DOE and the U.S. Fish and Wildlife Service, Management Area Two, the outer ring of the SRS, has been dedicated to enhancement of

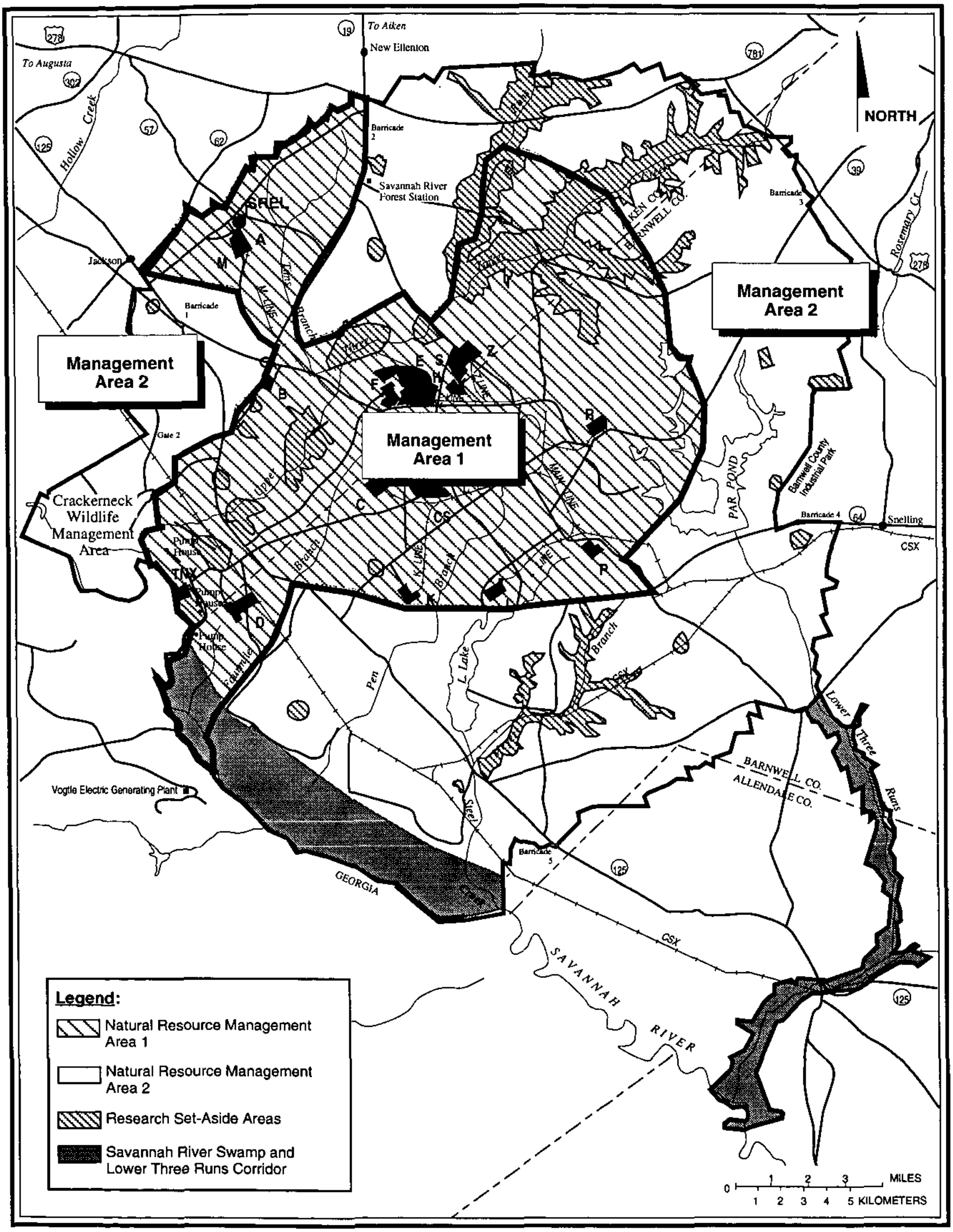


Figure 4-3. SRS natural resource management areas, Savannah River Swamp, Lower Three Runs corridor, and research set-aside areas.

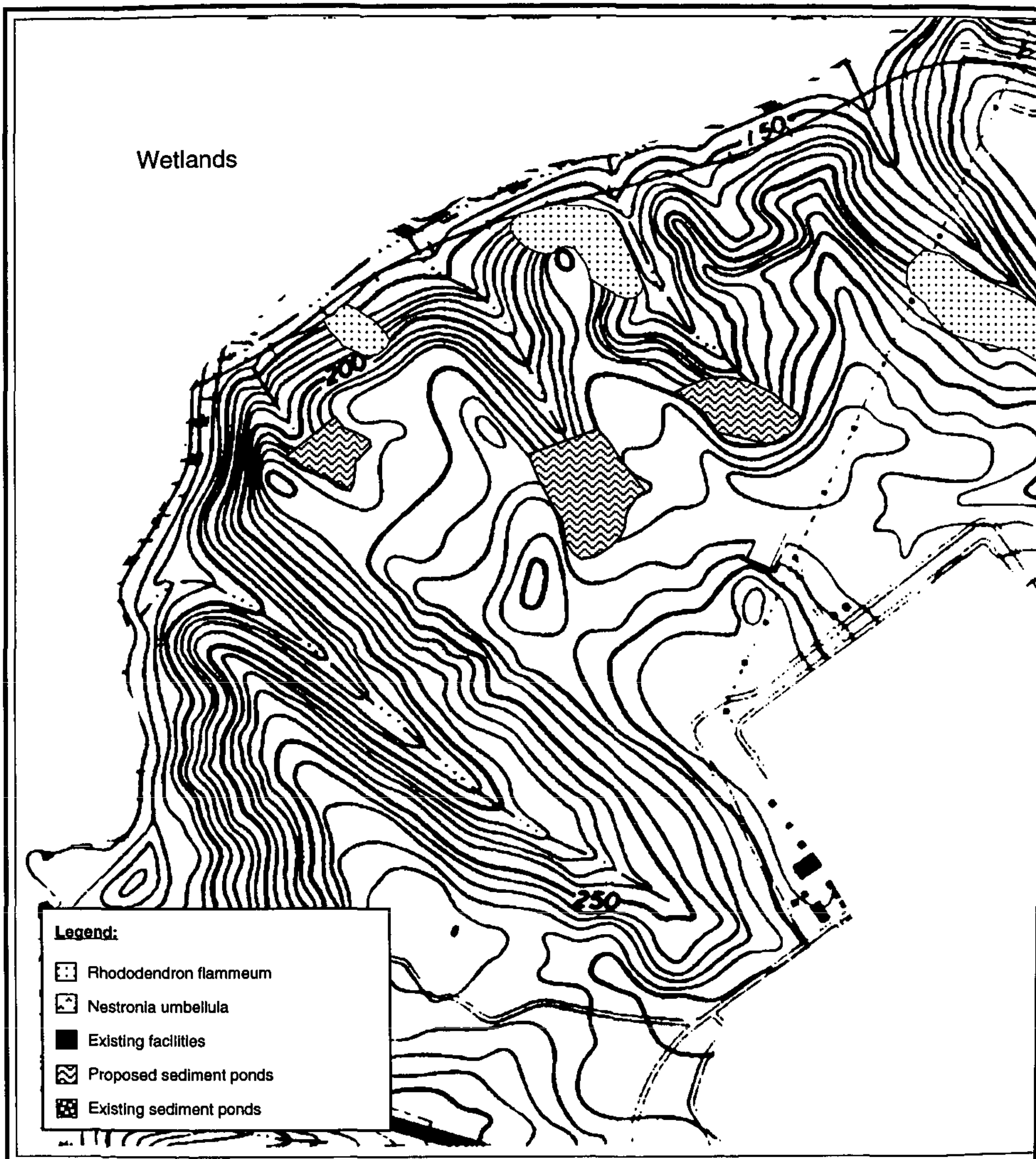
red-cockaded woodpecker populations and habitat, and reserved for timber management activities compatible with this goal. In the same agreement, Management Area One, the central core of SRS that includes E-Area, has been dedicated to DOE mission requirements and intensive timber management. The area northwest of F-Area contains suitable nesting and foraging habitat. This area was surveyed for red-cockaded woodpeckers in 1993 and no colonies or foraging birds were located (LeMaster 1994a). Because of the intensive red-cockaded woodpecker management conducted on most of SRS, clearing of this land would not affect red-cockaded woodpeckers.

The smooth coneflower is another Federally protected species on SRS. It grows in open woods, in cedar barrens, along roadsides, in clearcuts, and in powerline rights-of-way – habitat which is available in the area. However, the species was not found in or near E-Area during 1992 or 1994 botanical surveys (LeMaster 1994b).

One Federally listed Category 2 species, the American sandburrowing mayfly, is known to occur in Upper Three Runs. Several Federally listed Category 2 animal species could occur on the site proposed for new construction. These species include the southern hognose snake, northern pine snake, loggerhead shrike, and Bachman's sparrow.

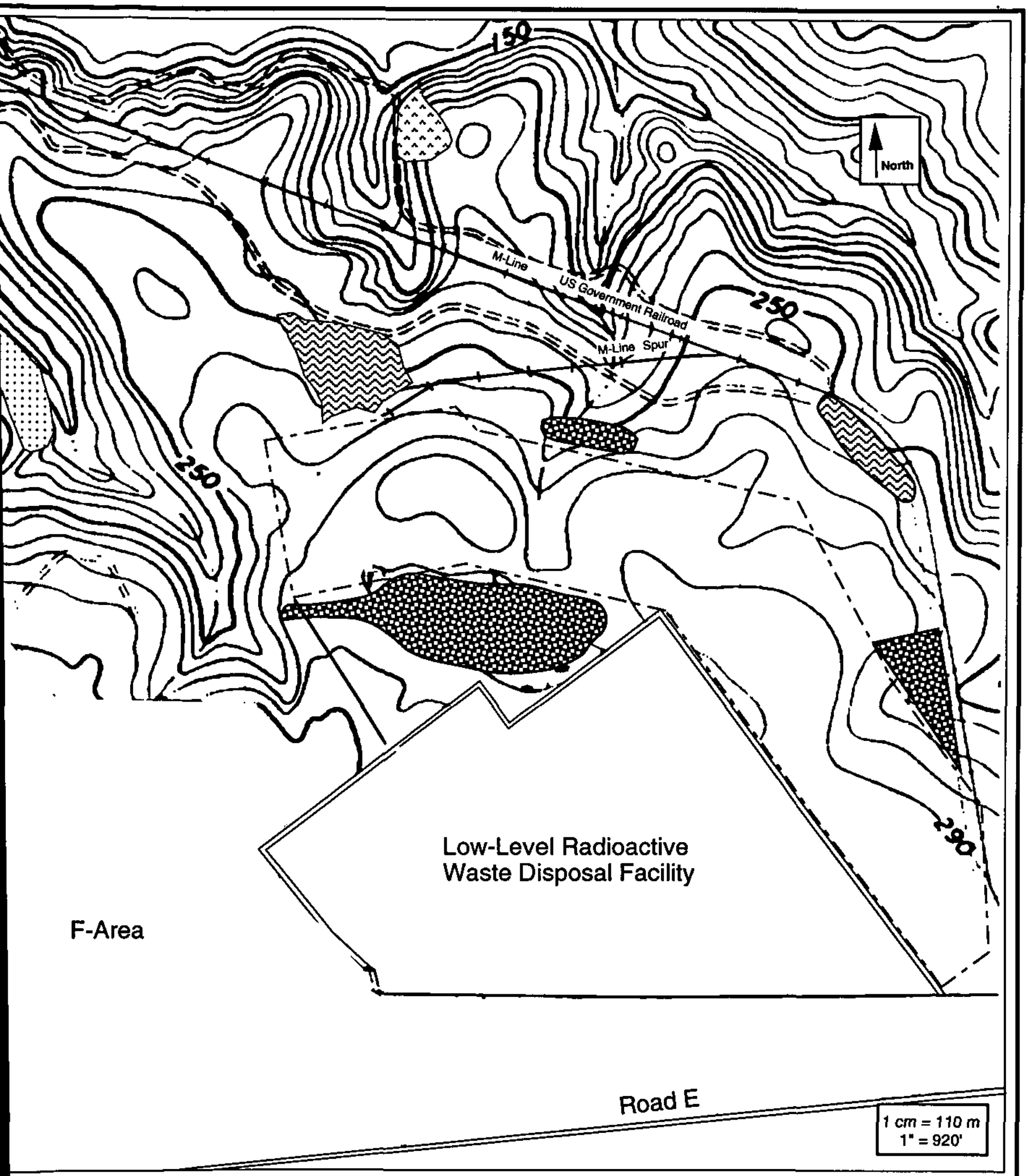
Botanical surveys performed during 1992 and 1994 by the Savannah River Forest Station located four populations of rare plants in or adjacent to E-Area (see Figure 4-4). One population of *Nestronia umbellula* (a shrub) and three populations of Oconee azalea (*Rhododendron flammeum*) were located on the steep slopes adjacent to the Upper Three Runs floodplain (LeMaster 1994b). The Oconee azalea is a South Carolina-listed rare species. *Nestronia umbellula* was a Federally listed Category 2 species that was found to be more abundant than previously believed; consequently, it is no longer listed (USFWS 1993). These species would not be adversely impacted by the no-action alternative. TE

DOE prepared a Protected Species Survey (April 1995) based on information presented in the draft EIS and submitted it to the U.S. Fish and Wildlife Service and the National Marine Fisheries Service as part of the formal consultation process in compliance with the Endangered Species Act of 1973. The survey is included as Appendix J of this EIS. Both the U.S. Fish and Wildlife Service and the National Marine Fisheries Service concur with DOE's determination of no jeopardy (i.e., no impact to endangered species) for the proposed project in the no-jeopardy opinions contained in Appendix J. However, both agencies stated that additional consultation would be necessary as siting for new facilities proceeds. DOE has committed to conduct additional protected species surveys as needed, and to consult with these agencies should changes occur in the proposed project and as new waste management facilities are planned. TC L003-02



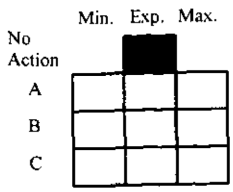
PK56-22

Figure 4-4. Rare plants located near E-Area during Savannah River Forest Station 1992 and 1994 botanical surveys.



150
North
M-Line
US Government Railroad
250
M-Line Spur
250
290
Low-Level Radioactive
Waste Disposal Facility
F-Area
Road E
1 cm = 110 m
1" = 920'

PK56-22

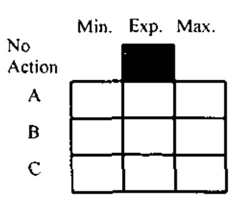


4.1.7 LAND USE

Land use impacts were evaluated on the basis of the amount of land that would be cleared to build facilities that otherwise would be available for non-industrial uses such as natural resource conservation or research, or future, but unidentified, land options.

TC DOE would use approximately 0.98 square kilometer (160 acres of undeveloped; 81 acres of developed) of land in E-Area for activities associated with the no-action alternative. SRS has about 181,000 acres of undeveloped land, which includes wetlands and other areas that cannot be developed, and 17,000 acres of developed land.

Activities associated with the no-action alternative would not affect current SRS land-use plans; E-Area was designed as an area for nuclear facilities in the *Draft 1994 Land-Use Baseline Report* (WSRC
TE 1994c). Furthermore, no part of E-Area has been identified as a potential site for future new missions. According to the *FY 1994 Draft Site Development Plan* (DOE 1994a), proposed future land management plans specify that E-Area be characterized and remediated for environmental contamination in its entirety, if necessary. Decisions on future SRS land uses will be made by DOE through the site development, land-use, and future-use planning processes, including public input through avenues such as the Citizens Advisory Board as required by DOE Order 4320.1B.



4.1.8 SOCIOECONOMICS

This section describes the potential effects of the no-action alternative on the socioeconomic resources in the region of influence. This assessment is based on the estimated construction and operations personnel required to implement this alternative (Table 4-4). Impacts to socioeconomic resources can be evaluated by examining the potential effects from both the construction and operation of each waste management alternative on factors such as employment, income, population, and community resources in the region of influence.

Table 4-4. Estimated construction and operations employment under the no-action alternative.[a]

Year	Construction employment	Operations employment
1995	30	1,880
1996	50	1,880
1997	50	2,000
1998	40	2,210
1999	40	2,310
2000	40	2,420
2001	40	2,420
2002	40	2,420
2003	40	2,450
2004	40	2,450
2005	40	2,450
2006	40	2,450
2007	40	2,450
2008	40	2,450
2009	40	2,450
2010	40	2,450
2011	40	2,450
2012	40	2,450
2013	40	2,450
2014	40	2,450
2015	40	2,450
2016	40	2,450
2017	40	2,450
2018	40	2,450
2019	40	2,450
2020	40	2,450
2021	40	2,450
2022	40	2,450
2023	40	2,450
2024	40	2,450

a. Source: Hess (1995a, b).

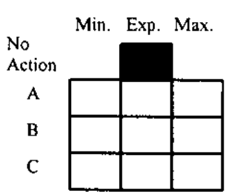
TC

4.1.8.1 Construction

TC Construction employment associated with the no-action alternative is expected to peak in 1996 and 1997 with approximately 50 jobs (Table 4-4). Given the normal fluctuation of employment in the construction industry, DOE does not expect a net change in regional construction employment from implementation of the no-action alternative. Therefore, DOE does not expect socioeconomic resources in the region to be affected.

4.1.8.2 Operations

TC Operations employment associated with implementation of the no-action alternative would peak during 2003 through 2024 with an estimated 2,450 jobs (Table 4-4), which represents approximately 12 percent of the 1992 SRS employment. DOE expects that these jobs would be filled through the reassignment of existing workers. Thus, DOE anticipates that socioeconomic resources would not be affected by changes in operations employment.



4.1.9 CULTURAL RESOURCES

Potential impacts on cultural resources can be evaluated by identifying the known or expected important resources in the areas of potential impact and activities that could directly or indirectly affect those significant resources. Potential impacts would vary by alternative relative to the amount of land disturbed for construction, modification, and/or operation of waste management facilities. No areas of religious importance to Native American tribes have been identified within areas to be disturbed by construction and operation of facilities associated with the no-action alternative. While several tribes have indicated general concerns about SRS (see Section 3.9.2), no tribe has specifically identified SRS or specific portions of SRS as possessing religious importance.

A Programmatic Memorandum of Agreement between the DOE Savannah River Operations Office, the South Carolina State Historic Preservation Office, and the Advisory Council on Historic Preservation (SRARP 1989), which was ratified on August 24, 1990, is the instrument for the management of cultural resources at SRS. DOE uses this memorandum to identify cultural resources, assess them in terms of eligibility for the National Register of Historic Places, and develop mitigation plans for affected resources in consultation with the State Historic Preservation Officer. DOE will comply with the terms of the memorandum for activities required to support waste management activities.

Construction within the developed and fenced portion of E-Area would not affect archaeological resources because this area has been disturbed. Most of the construction activities that would take place to the north of the currently developed portion of E-Area would be within an area that was surveyed in 1986 as a potential site for waste disposal facilities (Figure 4-5) (Brooks, Hanson, and Brooks 1986). No important cultural resources were discovered during that survey, and further archaeological work would not be required prior to construction in this area. TE

As shown in Figure 4-5, there are two small areas of unsurveyed land to the east and northeast of the currently developed portion of E-Area that would be used to support the no-action alternative. In compliance with the Programmatic Memorandum of Agreement (SRARP 1989), DOE would survey these areas before beginning construction. If important resources were discovered, DOE would avoid them or remove them.

The Savannah River Archaeological Research Program has recently completed an archaeological survey of a 4-square-kilometer (1,000-acre) parcel of undeveloped land within E-Area to the north and northwest of F-Area (Figure 4-5). During this survey, 33 archaeological sites were identified, 12 of which may be eligible for listing on the National Register of Historic Places. However, recommendations on eligibility made by the Savannah River Archaeological Research Program are not binding until the South Carolina State Historic Preservation Officer concurs with the recommendations. DOE expects to receive concurrence in 1995. One of the 12 sites that may be eligible for listing on the National Register of Historic Places would be disturbed by construction of a sediment pond. Some TE potential exists that other important archaeological sites in the vicinity of new waste management facilities could be indirectly affected if the introduction of contamination were to make the area unsuitable for additional research activities or if operation of the new facilities were to bring a larger permanent workforce closer to the sites. Before beginning construction in this area, the Savannah River Archaeological Research Program and DOE would complete the consultation process with the State Historic Preservation Officer and develop mitigation action plans to ensure that important archaeological resources would be protected and preserved (Sassaman 1994).

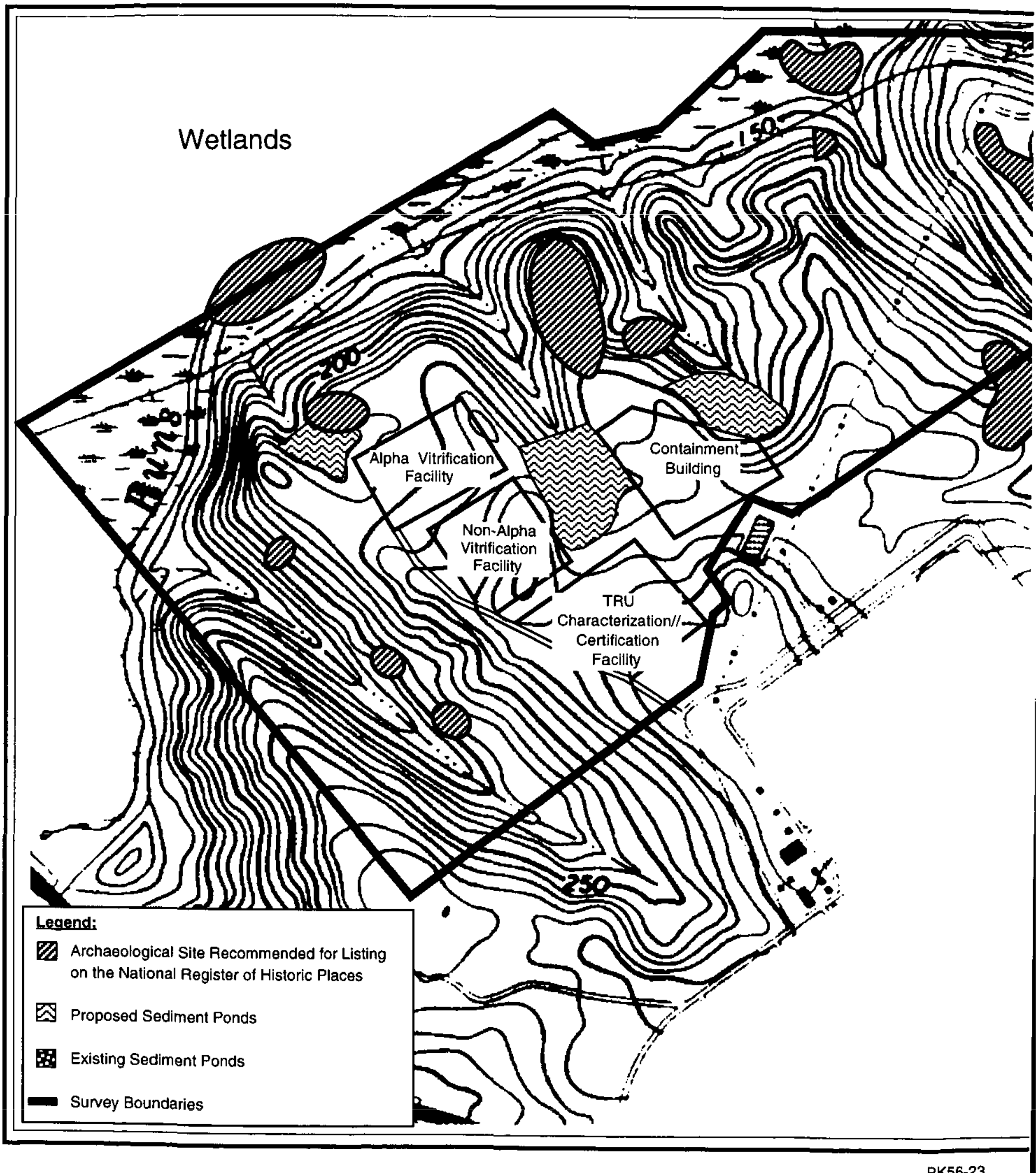
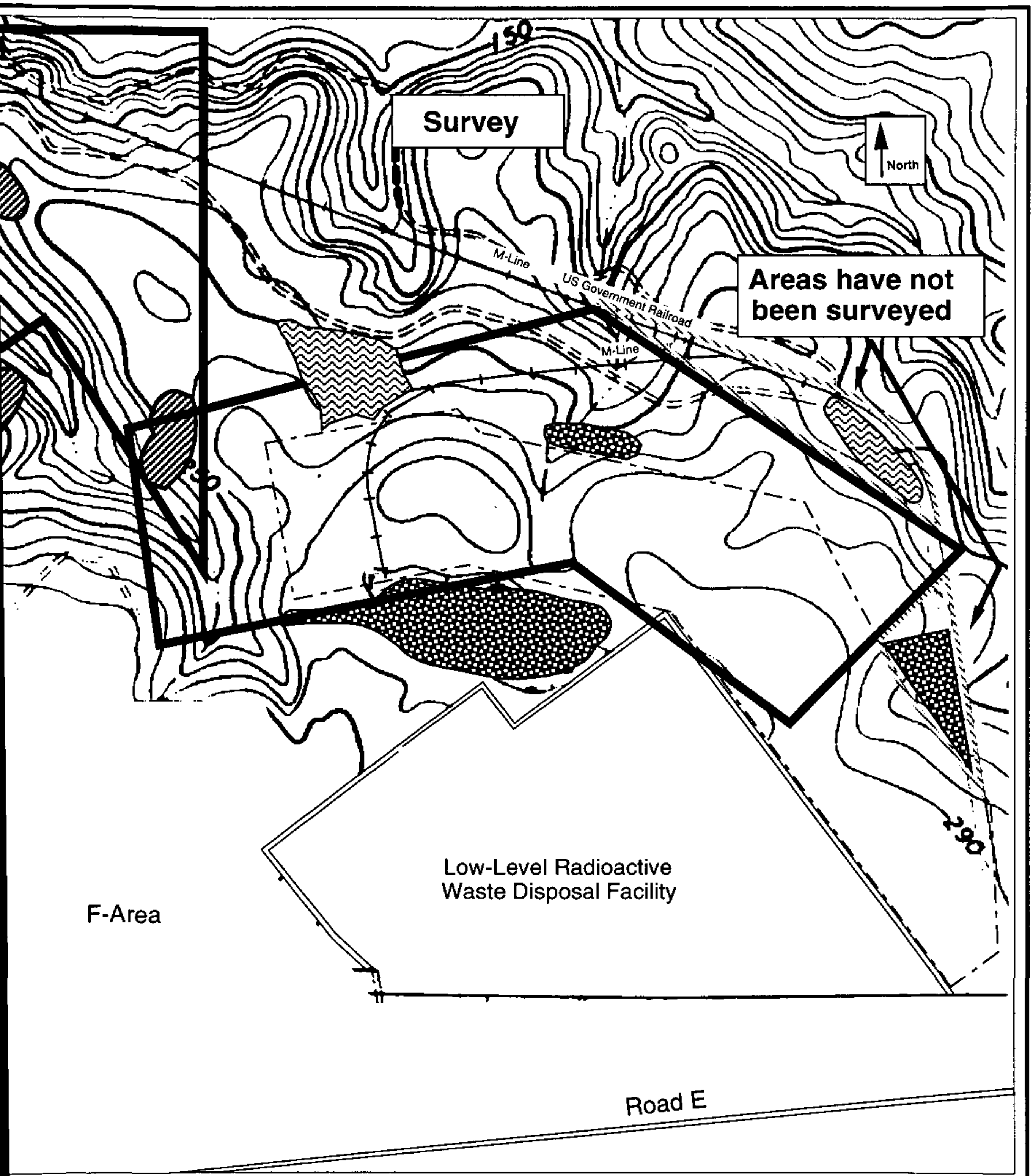
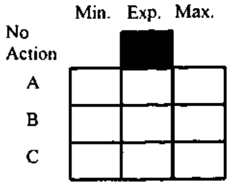


Figure 4-5. Location of previous archaeological survey areas and significant archaeological sites in E-Area.

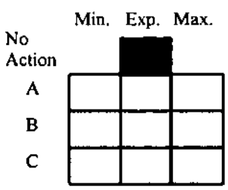

150
Survey
North
M-Line
US Government Railroad
M-Line
Areas have not
been surveyed
290
Low-Level Radioactive
Waste Disposal Facility
F-Area
Road E

PK56-23



4.1.10 AESTHETICS AND SCENIC RESOURCES

Impacts were evaluated on the basis of visibility of new facilities from offsite. Under the no-action alternative, the facilities DOE plans to construct in E-Area would not adversely affect scenic resources or aesthetics. E-Area is already dedicated to industrial use. New construction would not be visible off SRS or from public access roads on SRS. The new facilities would not produce emissions to the atmosphere that would be visible or that would indirectly reduce visibility.



4.1.11 TRAFFIC AND TRANSPORTATION

DOE analyzed impacts under each alternative that would result from changes in daily commuter and truck traffic. Traffic impacts are expressed as increases in vehicles per hour and in the number of hazardous and radioactive waste shipments by truck. As a road's carrying capacity is approached, the likelihood of traffic accidents increases. Similarly, the more truck shipments on a given road, the greater the probability of a traffic accident involving a truck. Increases in either condition could cause an increase in traffic fatalities.

DOE also evaluated the impacts that transportation of low-level, mixed, transuranic, and hazardous wastes would have on individuals located onsite and offsite. These impacts were determined by the
TE calculation of dose and expressed as health effects (i.e., the number of excess fatal cancers resulting from exposure to radioactive waste shipments). High-level waste was excluded from the analyses because it is not transported by vehicle.

Impacts from incident-free (normal) transport and postulated transportation accidents involving onsite shipment of radioactive waste over 30 years were calculated for the no-action alternative. Offsite transportation impacts were also calculated. The only traffic increases considered were from construction workers traveling to and from the site.

4.1.11.1 Traffic

Vehicle counts were estimated from current and projected levels of SRS employment (Turner 1994) and waste shipments. The baseline number of vehicles per hour was estimated from values in Smith (1989) and Swygert (1994). Table 4-5 shows estimated peak vehicles per hour for representative onsite and offsite roads. The table also shows the design carrying capacity for the roads (vehicles per hour) and the percentage of this design carrying capacity that the expected traffic represents. Vehicles per hour on offsite roads represent daily maximum values, while vehicles per hour onsite represent peak morning traffic. For the no-action alternative, the year when the most people would be employed was used to determine the change from the baseline. These traffic analyses conservatively assume that each worker drives a vehicle and arrives at E-Area during the peak commuter traffic hour.

Table 4-5. Number of vehicles per hour during peak hours under the no-action alternative.

Road	Design capacity (vehicles per hour)	1994 baseline traffic[a] (percentage of design capacity)[b]	No-action alternative change (percentage of design capacity)[c]	
		Offsite		
SC 19	3,000[d]	2,800[d](93)	21(94)	TC
SC 125	3,200[d]	2,700[d](84)	20(85)	
SC 57	2,100[d]	700[e](33)	6(34)	
		Onsite		
Road E at E-Area	2,300[e]	741[f,g](32)	47[h](34)	TC TE

a. Vehicles per hour baseline traffic for 1994 was estimated from actual counts measured in 1989 (offsite) and 1992/1993 (onsite) (Smith 1989) by adjusting vehicle counts by the change in SRS employment between measured years and 1994.
b. Numbers in parentheses indicate percentage of carrying capacity.
c. Percentage of design capacity changed between the draft and final EIS because the manpower numbers are based on construction costs which were modified after the draft was issued to better reflect actual costs.
d. Adapted from Smith (1989).
e. Adapted from TRB (1985).
f. Source: Swygert (1994).
g. Morning traffic traveling to E-Area.
h. Maximum number of construction workers (Hess 1995a, b). TE

For the no-action alternative, the roads' carrying capacities would not be exceeded by the workforce increase of 47 vehicles per hour. DOE would not expect adverse impacts from traffic associated with the no-action alternative. TC

Impacts of daily truck traffic associated with onsite shipments of hazardous and radioactive waste were analyzed for the no-action alternative. These shipments, presented in Table 4-6, are assumed to occur TE during normal working hours (versus commuter hours), and therefore, would have very little effect on the roadway carrying capacity. Hazardous waste shipments include shipments from accumulation areas to the RCRA-permitted storage buildings and from the storage buildings to offsite treatment and disposal facilities. Shipments of radioactive waste include those from the generators to the treatment, storage, or disposal facilities.

Table 4-6. Projected SRS hazardous and radioactive waste shipments by truck.[a]

	Waste Type	Destination	Total Shipments	No-action alternative (1994 baseline traffic)[b]
	Hazardous	Onsite/offsite	101,437	14
TE	Low-level	Onsite	1,559	7
TC	Mixed	Onsite/offsite	58,349	8
	Transuranic[c]	Onsite	3,790	1
			Total Shipments per day	30

a. To arrive at shipments per day, the total number of waste shipments estimated for the 30 years considered in this EIS was divided by 30 to determine estimated shipments per year. These numbers were divided by 250, which represents working days in a calendar year, to determine shipments per day.

TE

b. Shipments per day. 1994 baseline traffic is assumed to equal the no-action alternative using expected waste volumes.

c. Includes mixed and nonmixed transuranic waste shipments.

Under the no-action alternative, daily truck shipments would be the same as for the baseline. This assumption was based on transportation data (Hess 1994c) developed from historical shipping configurations for each waste. Baseline waste volumes were estimated from the 30-year expected waste forecast. DOE expects that impacts from waste shipments under the no-action alternative would be the TE same as for baseline waste management activities. Numbers of shipments assumed under the no-action alternative are given in Tables E.3-1 through E.3-3.

In 1992, South Carolina had a highway fatality rate of 2.3 per 100 million miles driven (SCDOT 1992). At this rate, an estimated 5.5 fatalities would be expected to occur annually within the commuter population for the baseline case based on a 40-mile round-trip commute 250 times a year (see TC Section 3.11.2.1). For the no-action alternative, an additional 47 workers would be expected to drive an additional one-half million miles per year, which is predicted to result in less than one additional traffic fatality.

The occurrence of highway injuries and prompt fatalities for truck accidents can be estimated from data reported by the National Highway Safety Council (DOT 1982). Injuries occur in 24 percent of all single truck accidents. The estimated injury- and fatality-causing accident rates are 3.2×10^{-7} and 1.2×10^{-7} per mile traveled, respectively.

Trucks carrying hazardous waste have an accident rate of 1.4×10^{-6} accidents per mile traveled for all road types. An estimated 20 percent of these truck accidents will result in a release of hazardous materials (EPA 1984).

Based on these statistics, an analysis (Rollins 1995) was performed to determine impacts from shipments of hazardous and radioactive materials for the 30-year period of interest for this EIS. For the no-action alternative, 7,200 annual (onsite and offsite) hazardous and radioactive waste shipments would travel approximately 600,000 miles and would result in slightly less than 1 accident with 0.074 prompt fatality. Accidents involving the release of hazardous material would be expected to occur, on average, once in 6 years. TC TE

The analysis determined that the largest impacts would occur for alternative B – maximum waste forecast. For this case, 22,000 annual (onsite and offsite) hazardous and radioactive waste shipments would travel approximately 1.9 million miles, leading to an expectation of less than 3 accidents with 0.23 prompt fatality. Accidents involving the release of hazardous material would be expected to occur, on average, once in 4 years. Impacts for all other alternatives and waste forecasts would be lower. These impacts are considered very small and are not discussed further in this EIS. TC TE TE

4.1.11.2 <u>Transportation</u>

DOE used the RADTRAN (Neuhauser and Kanipe 1992) computer codes to model the transportation of radioactive materials. These computer codes were configured with applicable SRS demographics and transportation accident rates (HNUS 1995a). The parameters for the RADTRAN analysis include the package dose rate, the number of packages per shipment, the number of shipments, the distance traveled, the fraction of travel in rural, suburban, and (for offsite transportation) urban population zones, traffic counts, travel speed, and type of highway traveled. Transport of radioactive material within a particular facility was excluded from this assessment because it involves operational transfers that are not defined as transportation and that would be included in facility accidents (e.g., Section 4.1.13). A more detailed breakdown of the transportation analysis by waste type is provided in Appendix E. Other model assumptions and input parameters are described in HNUS (1995a). TE

DOE analyzed the impacts that transportation of low-level, mixed, transuranic, and hazardous wastes would have on individuals located onsite and offsite. Doses from incident-free (normal) transport of waste over 30 years and from postulated transportation accidents involving radioactive waste were calculated for each alternative. Finally, health effects, expressed as the number of excess latent cancer fatalities associated with the estimated doses, were calculated by multiplying the resultant occupational and general public doses by the risk factors of 0.0004 (for occupational health) and 0.0005 (for the general public) excess latent cancer fatalities per person-rem (ICRP 1991). For individuals, the calculated value represents the additional probability of developing a latent fatal cancer. TE

The AXAIR89Q (Hess 1995c) computer code uses SRS-specific meteorological data to model releases offsite from postulated onsite accidents. AXAIR89Q conservatively calculates the offsite individual and population doses because it uses very conservative air quality parameters (99.5 percent of the time the actual meteorology at SRS is less severe than that used by the model). For the transportation analyses, seven hypothetical human receptor groups were identified:

- Uninvolved worker: The SRS employee who is not assigned to the transportation activity but is located along the normal transportation route at an assumed distance of 30 meters (98 feet) and would be exposed to radiation from the normal transport shipment. Doses are reported in units of rem. TE

- Uninvolved workers: The collective SRS employee population not assigned to the transportation activity that would receive external or internal radiation exposure from normal onsite shipments and accidents. About 7,000 SRS employees would be exposed to routine shipments and as many as 6,000 could be exposed to radiation in the event of an accident. Doses are reported in units of person-rem.

- Involved workers: The collective SRS employee population assigned to the transportation activity (i.e., two transport crew and six package handlers per shipment) that would receive external radiation exposure from normal transport of shipments. These workers are allowed to receive a greater radiation dose than the general public. Doses are reported in units of person-rem.

- Offsite maximally exposed individual: The member of the public located at the point along the SRS boundary that receives the highest ground-level radioactive material concentration and who would receive external or internal radiation exposure from an onsite transportation accident. Doses are reported in units of rem.

- Offsite population: The members of the public in the compass sector most likely to experience the maximum collective dose due to radioactive material released from an onsite transportation accident. Approximately 182,000 people are considered part of the offsite population. Doses are reported in units of person-rem.

- Remote maximally exposed individual: The member of the public located along the offsite transportation route who would receive radiation exposure from normal transport. Doses are reported in units of rem.

- Remote population: Members of the public (as many as 1,837 people per square kilometer) along the offsite transportation route who would receive external or internal radiation exposure from normal shipments and accidents. Members of the remote population who would be exposed to incident-free shipments by rail number about 200,000, and about 130,000 for truck shipments. As many as 3 million people have the potential to be exposed to offsite accidents involving the transport of radioactive wastes. TC

4.1.11.2.1 Incident-Free Radiological Impacts

The magnitude of incident-free impacts depends on the dose rate at the surface of the transport vehicle, the exposure time, and the number of people exposed. Radiological consequences of incident-free transport would result from external exposure to radiation by the vehicle crew and package handlers and by the uninvolved workers along the transportation route (including those in vehicles sharing the route at the time of transport). For each waste and package type, external dose rates at 1 meter (3.3 feet) from the transport vehicle were calculated and used to calculate incident-free consequences to onsite receptors (HNUS 1995a). Duration of exposure depends on the speed of the transport vehicle and the distance it travels. Additionally, occupational exposure time depends on the number of shipments and how long it takes to load each transport vehicle. TE

Annual incident-free doses for the no-action alternative are shown in Table 4-7. The uninvolved worker dose represents the maximum annual exposure from each waste type (shown in Appendix E). Using conservative assumptions, involved workers would experience the highest doses because they would be closest to the waste. Of the waste types handled by these workers, low-level waste would deliver the highest dose due to the types of radionuclides present. TE

Table 4-7. Annual dose and associated excess latent cancer fatalities from incident-free onsite transport of radioactive material under the no-action alternative.

Waste[a]	Uninvolved worker[b] (rem)	Uninvolved workers (person-rem)	Involved workers (person-rem)
Low-level	0.011	2.0	150
Mixed	5.5×10^{-5}	0.12	4.3
Transuranic	1.3×10^{-4}	0.0095	0.15
Total[c]	0.011[d]	2.1[e]	150[e]
Excess latent cancer fatalities	4.5×10^{-6}[f]	8.4×10^{-4}[g]	0.060[g]

TC TE

a. See Appendix E for a list of waste streams which make up each waste type. Dose is based on exposure to all waste streams of a particular waste type.
b. See Section 4.1.11.2 for descriptions of the receptors.
c. Totals are rounded to two significant figures.
d. Assumes the same individual has maximum exposure to each waste stream (Appendix E) for a single year.
e. Dose from 1 year of exposure to incident-free transportation of all waste streams (see Appendix E).
f. Represents additional probability of an excess latent cancer fatality.
g. Values equal the total dose × the risk factor (0.0004 excess latent fatal cancers per person-rem).

TE

The concepts of fractions of fatalities may be applied to estimate the effects of exposing a population to radiation. For example, in a population of 100,000 people exposed only to background radiation (0.3 rem per year), 15 latent cancer fatalities per year would be inferred to be caused by the radiation (100,000 persons × 0.3 rem per year × 0.0005 latent cancer fatalities per person-rem = 15 latent cancer fatalities per year).

Sometimes calculations of the number of latent cancer fatalities associated with radiation exposure do not yield whole numbers, and, especially in environmental applications, may yield numbers less than 1.0. For example, if a population of 100,000 were exposed as above, but to a total dose of only 0.001 rem, the collective dose would be 100 person-rem, and the corresponding estimated number of latent cancer fatalities would be 0.05 (100,000 persons × 0.001 rem × 0.0005 latent cancer fatalities per person-rem = 0.05 latent fatal cancers).

TE

In this instance, 0.05 is the average number of deaths that would result if the same exposure situation were applied to many different groups of 100,000 people. In most groups, no one (0 people) would incur a latent cancer fatality from the 0.001 rem dose each member would have received. In a small fraction of the groups, 1 latent fatal cancer would result; in exceptionally few groups, 2 or more latent fatal cancers would occur. The average number of deaths over all of the groups would be 0.05 latent fatal cancers (just as the average of 0, 0, 0, and 1 is 1/4, or 0.25). The most likely outcome is 0 latent cancer fatalities.

4.1.11.2.2 Radiological Transportation Accident Impacts

How great the consequences of an accident are depends on the amount of radioactive contamination to which the individual(s) are exposed, how long they are exposed, and the number of people exposed. DOE considered both the consequence and probability of vehicle accidents in the transportation impacts model. The joint probability of a given severity of accident occurring for each type of waste shipped was calculated based on the probability of a range of impact forces that a package could receive in a hypothetical accident (NRC 1977), vehicle accident rates, and number of miles traveled. The severity of an accident is determined by the amount of damage to the package and subsequent release of material. Joint probabilities of a given accident severity greater than approximately 1×10^{-7} were selected for further analysis to determine the magnitude of accident consequences. Dispersion of radioactive material from the damaged package, combined with assumed release fractions, the fraction of released material that becomes airborne, and the fraction of airborne material that is of a size capable of being breathed in, is modeled to calculate the amount of radioactive contamination to which the individuals(s) are exposed. Generally, the requirements for package integrity and transport vehicles for onsite waste shipments are not as stringent as for transportation on public highways where package and vehicle requirements are regulated by the Department of Transportation and the Nuclear Regulatory Commission. Consequently, impacts from onsite accidents would be much greater than those for offsite accidents, because it is assumed that larger fractions of material would be released in an onsite accident. TE

Accident probabilities are best understood by assuming that many trips occur for a given type of transportation event (i.e., shipping low-level waste to an offsite facility). The number of trips when an accident occurs for a given number of trips is the accident probability. For example, if on a single trip, there was an accident, the probability of having an accident would be 1. If there was a second trip without an accident, the number of trips with accidents which occurred overall (1 out of 2 possible) would be one-half (0.5). However, since the number of accidents can only be whole numbers (i.e., it is impossible to have half an accident), the probability of having an accident is now 1 out of 2 trips, or 0.5, or 50 percent probability. Note that the probability is a unitless number. TE

Over the 30-year analysis period, for all accidents resulting in any consequence, the total probability of an accident involving low-level waste would be 0.49; from mixed waste, it would be 0.52; and from transuranic waste, it would be 0.038. The most probable accidents would not result in a dose because radioactive material would not be released. Table 4-8 presents the consequences to both onsite and offsite receptors from high consequence (low probability) postulated accidents. The results indicate that the highest consequences would result from accidents involving the release of transuranic waste and occur through inhalation of high-energy alpha particles associated with transuranic nuclides. TC

Table 4-8. Annual accident probabilities, doses associated with those accidents, and associated excess latent cancer fatalities from high consequence (low probability) accidents involving the transport of radioactive materials under the no-action alternative.

TC

		Dose					
		Uninvolved workers[a]		Offsite population		Offsite MEI[b]	
Waste type	Annual accident probability	Dose (person-rem)	Excess latent cancer fatalities[c]	Dose (person-rem)	Excess latent cancer fatalities[c]	Dose (rem)	Excess latent cancer probability[d]
Low-level	5.6×10^{-7}	720	0.29	65	0.032	0.0092	4.6×10^{-6}
Mixed	7.1×10^{-5}	140	0.058	14	0.0071	0.0020	1.0×10^{-6}
Transuranic	4.8×10^{-8}	3.1×10^{5}	120	2.7×10^{4}	14	3.9	0.0019

TC

a. See Section 4.1.11.2 for descriptions of the receptors.
b. MEI = maximally exposed individual.
c. Excess latent cancer fatalities = risk factor (0.0004 excess latent fatal cancers per person-rem for uninvolved workers and 0.0005 per person-rem for the offsite population) × total dose.
d. Additional probability of an excess fatal cancer.

The greatest consequence from postulated transportation accidents involving radioactive materials would be to the uninvolved workers (with an estimated 120 latent cancer fatalities; Table 4-8) as the result of an accident in which it is assumed that all of the conservatively estimated transuranic nuclides in a transuranic waste container would be released over an area of about 3 square kilometers (1.1 square miles) in a single transportation accident. The number of cancers would be highest for the uninvolved workers due to the larger number of people that would be exposed and the greater amount of radioactive material to which they would potentially be exposed. Over the 30-year analysis period, the probability that an accident of this consequence would occur is 1.44×10^{-6}.

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TC

4.1.11.2.3 Nonradiological Transportation Accident Impacts

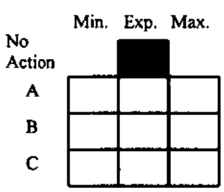
Since the actions evaluated in this EIS do not introduce new dispersible, nonradioactive, hazardous materials to the SRS transportation system, DOE reviewed the results of prior transportation accident analyses (WSRC 1991c, 1992b) for applicability to the waste management alternatives. These analyses were based on the facilities, equipment, and operations representative of SRS conditions between 1982 and mid-1985, when SRS's chemical inventory and the movement of chemicals were at their peak. Because the actions evaluated in this EIS involve the shipment of hazardous waste (rather than hazardous materials whose concentrations are generally much larger) and current and future site chemical inventories would be less than those previously analyzed (WSRC 1992b), this prior conclusion that there would be very small onsite and offsite impacts from onsite shipments of hazardous waste remains valid. This conclusion is further supported by recent analysis (see Section 4.1.11.1) which determined that

TE

accidents resulting in the release of hazardous material would occur, on average, only once in 6 years for the no-action alternative. This analysis also predicted that for the scenario with the largest impacts (alternative B – maximum waste forecast), accidents resulting in the release of hazardous material would occur, on average, only once in 4 years. Based on the waste forecasts (Appendix A) over the next 30 years, most hazardous waste shipments (91 percent) are expected to be soil and debris. These wastes do not contain high concentrations of toxic materials, and accidental release of these solid materials would not lead to an explosion hazard or atmospheric release of dangerous chemicals. Accident consequences are therefore expected to be localized and result in minimal impacts to human health or the environment. These impacts are considered very small and are not discussed further in this document. TC

4.1.11.3 Noise

As discussed in Section 3.11.3, studies have concluded that, because of the remote locations of the SRS operational areas, no known conditions are associated with existing onsite noise sources that adversely affect offsite individuals (NUS 1991; DOE 1990, 1991, 1993b). Since the vast majority of waste management activities occur onsite, adverse impacts due to noise are not expected for any of the alternatives or waste forecasts. Thus, noise impacts are not discussed further in this EIS. TE



4.1.12 OCCUPATIONAL AND PUBLIC HEALTH

This section discusses the radiological and nonradiological exposures due to normal operations under the no-action alternative and subsequent impacts to the public and workers. This analysis, further discussed in Section 4.1.12.1.1, shows that the health effects (specifically latent cancer fatalities) associated with the no-action alternative are themselves small and are small relative to those normally expected in the worker and regional area population groups from other causes.

The principal potential human health effect from exposure to low levels of radiation is cancer. Human health effects from exposure to chemicals may be toxic effects (e.g., nervous system disorders) or cancer. For the purpose of this analysis, radiological carcinogenic effects are expressed as the number of fatal cancers for populations and the maximum probability of death of a maximally exposed individual. Nonradiological carcinogenic effects are expressed as the total number of fatal and non-fatal cancers.

In addition to latent cancer fatalities, other health effects could result from environmental and occupational exposures to radiation. These effects include nonfatal cancers among the exposed population and genetic effects in subsequent generations. To enable comparisons with fatal cancer risk, the International Commission of Radiological Protection (ICRP 1991) suggested use of detriment weighting factors which take into consideration the curability rate of non-fatal cancers and the reduced quality of life associated with non-fatal cancer and heredity effect. The commission recommended probability coefficients (risk factors) for the general public of 0.0001 per person-rem for non-fatal cancers and 0.00013 per person-rem for hereditary effects. Both of these values are approximately a factor of four lower than the risk factors for fatal cancer. Therefore, this EIS presents estimated effects of radiation only in terms of latent cancer fatalities, because that is the major health effect from exposure to radiation.

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For nonradiological health effects, risks are estimated as the incremental probability of an individual developing cancer (either fatal or nonfatal) over a lifetime as a result of exposure to the potential carcinogen. The overall potential for cancer posed by exposure to multiple chemicals is calculated by summing the chemical-specific cancer risks to give a total individual lifetime cancer risk.

For radiological emissions from facilities considered under the no-action alternative, the largest occupational and public health effects were projected from the following facilities: (1) for involved workers, the transuranic and alpha waste storage pads and the F- and H-Area (high-level waste) tank farms; (2) for the public and uninvolved workers, the M-Area Vendor Treatment Facility; and (3) for the public only, the F/H-Area Effluent Treatment Facility. To simplify the calculation, 30-year process volumes were used to estimate occupational and public health effects.

Nonradiological air emissions are expected to produce very small health impacts for involved and uninvolved workers. Although overall public health impacts would be very small, the greatest contribution to these impacts would occur due to emissions from benzene waste generated from the Defense Waste Processing Facility, including In-Tank Precipitation.

4.1.12.1 <u>Occupational Health and Safety</u>

4.1.12.1.1 Radiological Impacts

Doses to involved workers were estimated based on a review of exposures resulting from waste management activities for the no-action alternative. Direct radiation and inhalation would be the largest exposure pathways. Doses to uninvolved workers were calculated using the MAXIGASP computer code (see Section 4.1.12.2). An uninvolved worker was conservatively assumed to be located 100 meters (328 feet) from the release point (of the affected facility) for 80 hours per week; another was conservatively assumed to be located 640 meters (2,100 feet) from the release point for 80 hours per week. The weekly exposure period was conservatively estimated to ensure that doses to overtime workers were not underestimated. Doses were estimated for the inhalation, ground contamination, and plume immersion exposure pathways. Data required to calculate doses to the uninvolved worker population are not currently available; however, dose to an individual uninvolved worker at 100 meters (328 feet) and 640 meters (2,100 feet) would bound the impact to the individual members of the population. TE

The incremental worker doses (the increase in dose due to activities under the no-action alternative) are given in Table 4-9. DOE regulations (10 CFR 835) require that annual doses to individual workers not exceed 5 rem per year. DOE assumes that exposure to the maximally exposed involved worker at SRS would not exceed 0.8 rem per year due to administrative controls (WSRC 1994d). TC

From these radiological doses, estimates of latent cancer fatalities were calculated using the conversion factor for workers of 0.0004 latent cancer fatality per rem (ICRP 1991). Based on this factor, the probability that the average involved worker would develop a fatal cancer sometime during his lifetime as the result of a single year's exposure to waste management-generated radiation would be 1.0×10^{-5}, or approximately 1 in 100,000. For the worker exposed to the administrative limit (0.8 rem), the probability of developing a fatal cancer sometime in his lifetime as a result of a single year's exposure would be 3.2×10^{-4}, or approximately 3 in 10,000. For the total involved workforce, the collective radiation dose could produce up to 0.022 additional fatal cancer as the result of a single year's exposure; over the 30-year period the involved workers could have 0.65 additional fatal cancer as a result of exposure. The probability of any individual uninvolved worker developing a fatal cancer as a result of the estimated exposure would be very small (Table 4-9). TE TC TC

The calculated numbers of fatal cancers due to worker exposure to radiation can be compared with the number of fatal cancers that would normally be expected among the workers during their lifetimes. Population statistics indicate that, of the U.S. population which died in 1990, 23.5 percent died of cancer (CDC 1993). If this percentage of deaths from cancer remains constant, 23.5 percent of the U.S. population will develop a fatal cancer during their lifetime. Therefore, in the group of 2,088 involved workers, about 491 would normally be expected to die of cancer.

The probability of developing a radiation-induced fatal cancer associated with the no-action alternative is much less than the probability of developing a fatal cancer from other causes.

Table 4-9. Worker radiological doses[a] and resulting health effects associated with the no-action alternative.

Receptor(s)	Individual: Dose (rem)	Individual: Probability of a fatal cancer	All workers: Dose (person-rem)	All workers: Number of fatal cancers
Average involved worker				
• Annual[b]	0.025	1.0×10^{-5}	NA[c]	NA
• 30-year	0.75	3.1×10^{-4}	NA	NA
All involved workers[d]				
• Annual[b]	NA	NA	52[e]	0.021
• 30-year	NA	NA	1,600	0.62
Uninvolved worker at 100 meters[f,g,h]				
• Annual[b]	1.0×10^{-5}	4.1×10^{-9}	NC[i]	NC
• 30-year	3.0×10^{-4}	1.2×10^{-7}	NC	NC
Uninvolved worker at 640 meters[f,g]				
• Annual[b]	2.9×10^{-7}	1.1×10^{-10}	NC	NC
• 30-year	8.6×10^{-6}	3.4×10^{-9}	NC	NC

a. Supplemental facility information is provided in Appendix E.
b. Annual individual worker doses can be compared with the regulatory dose limit of 5 rem (10 CFR 835) and with the SRS administrative exposure guideline of 0.8 rem. Operational procedures ensure that the dose to the maximally exposed worker will remain as far below the regulatory dose limit as is reasonably achievable. The 1993 average dose for all site workers who received a measurable dose was 0.051 rem (see Table 3-18).
c. NA = not applicable.
d. The number of involved workers is estimated to be 2,088.
e. Total for involved workers; 1993 SRS total for all workers was 263 person-rem (see Table 3-18).
f. M-Area Vendor Treatment Facility.
g. Doses conservatively assume 80 hours per week of exposure.
h. To convert to feet, multiply by 3.28.
i. NC = not calculated. Uninvolved worker population doses were not calculated because not all facilities have not been sited.

TC TC TC TC TE

4.1.12.1.2 Nonradiological Impacts

Potential nonradiological impacts to SRS workers were considered for air emissions emanating from the following facilities: Defense Waste Processing Facility, including In-Tank Precipitation; M-Area Vendor Treatment Facility; M-Area Air Stripper; hazardous and mixed waste storage buildings; and the E-Area organic waste storage tanks. Occupational health impacts to employees in the Defense Waste Processing Facility and In-Tank Precipitation are presented in the *Final Supplemental Environmental Impact Statement Defense Waste Processing Facility.* TC TC

Table 4-10 presents a comparison between Occupational Safety and Health Administration-permissible exposure limit values and potential exposures to employees at both 100 meters (328 feet) and 640 meters (2,100 feet) from each facility considered. Downwind concentrations were calculated using EPA's TSCREEN model. In all cases, employee exposure would be below Occupational Safety and Health Administration-permissible exposure limits, and health impacts would be expected to be very small.

4.1.12.1.3 Noise

Occupational exposures to noise are controlled through the contractor hearing conservation program activities in Industrial Hygiene Manual 4Q, Procedure 501. This program implements the contractor requirements for identifying, evaluating, and controlling noise exposures to meet the requirements of 29 CFR 1910.95, Occupational Noise Exposure. All personnel with 8-hour time weighted average exposures greater than 85 dBA are enrolled in the program. Significant aspects of the hearing conservation program include: routine noise exposure monitoring, audiometric testing, hearing protection, employee information and training, and recordkeeping. TC

4.1.12.2 <u>Public Health and Safety</u>

4.1.12.2.1 Radiological Impacts

To estimate the health effects associated with the no-action alternative on the public, it was necessary to calculate radiological doses to individuals and population groups. Estimates of latent cancer fatalities were then calculated using the conversion factor of 0.0005 latent cancer fatality per rem for the general population (ICRP 1991). This factor is slightly higher than that for workers (Section 4.1.12.1), because infants and children are part of the general population. L004-06

Table 4-10. Calculated maximum 8-hour average pollutant concentrations (micrograms per cubic meter of air).

Facility	Pollutant	OSHA PEL[a,b]	Receptor locations	
			100 meters[c]	640 meters[c]
M-Area Air Stripper	Trichloroethylene	2.7×10^5	0.0046	0.0092
	Tetrachloroethylene	1.7×10^5	0.0023	0.0047
	Methyl chloroform	1.9×10^6	0.0008	0.0016
M-Area Vendor Treatment Facility	Nitrogen dioxide	9,000	37.4	43.6
	Sulfur dioxide	1.3×10^4	1.6	1.9
	PM-10[d]	5,000	2.0	2.3
	Carbon monoxide	4×10^4	6.0	7.0
Hazardous waste storage building (645-N)	Total suspended solids	1.5×10^4	25.13	10.56
	PM-10[d]	5,000	8.79	3.70
TC Mixed waste storage building (645-2N)	Total suspended particulates	1.5×10^4	7.0	2.9
	PM-10[d]	5,000	2.5	1.1
E-Area facilities	Vinyl chloride	2,600	0.26	0.11
	1,1 Dichloroethene	NA[e]	0.020	0.0083
	Methyl ethyl ketone	5.9×10^5	1.13	0.48
	Chloroform	9,780	0.12	0.051
	Carbon tetrachloride	1.26×10^4	0.0098	0.004
	Benzene	3,250	0.16	0.067
	1,2 Dichloroethane	NA[e]	0.0065	0.0027
	Trichloroethene	2.7×10^5	0.0062	0.0026
	Tetrachloroethylene	1.7×10^5	0.0014	5.8×10^{-4}
	Chlorobenzene	3.5×10^5	8.6×10^{-4}	3.6×10^{-4}

a. Source: NIOSH (1990).
b. OSHA PEL is Occupational Safety and Health Administration Permissible Exposure Limit.
c. To convert to feet multiply by 3.281.
d. Particulate matter less than 10 microns in diameter.
e. NA = not applicable.

Effects are estimated for two separate population groups: (1) the 620,100 people living within 80 kilometers (50 miles) of SRS and the 871,000 people living within 80 kilometers (50 miles) of the offsite facility who would be exposed to atmospheric releases; and (2) the 65,000 people using the Savannah River who would be exposed to releases to the river (Arnett, Karapatakis, and Mamatey 1994). Impacts are estimated for the maximally exposed individual in each of these population groups.

To facilitate the prediction of the radiological doses associated with the no-action alternative, current and future waste management practices at SRS were assessed. Wastes were aggregated into treatability groups to estimate the radionuclide releases to air and water.

Airborne radiological releases were converted to doses using the MAXIGASP and POPGASP computer codes (Hamby 1992). Doses were calculated using dose factors provided in Simpkins (1994a). These codes calculate the dose to a hypothetical maximally exposed individual at the SRS boundary and the collective dose to the population within an 80-kilometer (50-mile) radius, respectively. The inhalation, food ingestion, ground contamination, and plume exposure pathways were evaluated. Both codes utilize the GASPAR (Eckerman et al. 1980) and XOQDOQ (Sagendorf, Croll, and Sandusky 1982) modules. GASPAR and XOQDOQ have been adapted for use at SRS (Hamby 1992 and Bauer 1991, respectively).

For the assessments, DOE assumed that the population would remain constant over the 30-year period of analysis. This assumption is justified because (1) current estimates indicate that the population will increase by less than 15 percent during this period (HNUS 1995b), (2) there are uncertainties in the determination of year-to-year population distributions, and (3) although the absolute impacts would increase proportionately with population growth, the relative impact comparison between alternatives would not be affected. TE

Calculated atmospheric doses are given in Table 4-11 (releases from operation of the Defense Waste Processing Facility are not included). The annual doses (0.00012 millirem to the offsite maximally exposed individual and 0.00029 person-rem to the offsite population) would be small fractions of the dose from total SRS airborne releases in 1993 [0.11 millirem to the offsite maximally exposed individual and 7.6 person-rem to the population within 80 kilometers (50 miles) of SRS (Arnett, Karapatakis, and Mamatey 1994)]. Doses from 1993 operations were well within the EPA requirements given in 40 CFR 161 and adopted by DOE in Order 5400.5, which allow an annual dose limit to the offsite maximally exposed individual of 10 millirem from all airborne releases. TC TC

Waterborne releases were converted to doses using the LADTAP XL computer code (Hamby 1991). This code calculates the dose to a hypothetical maximally exposed individual along the Savannah River just downstream of SRS, and to the population using the Savannah River from SRS to the Atlantic Ocean. Fish ingestion, water ingestion, and recreational exposure pathways were evaluated. The aqueous dose-producing-releases were discharges from the F/H-Area Effluent Treatment Facility; seeps from groundwater discharges were too small to affect the totals. TE

TE **Table 4-11.** Radiological doses[a] associated with the no-action alternative and resulting health effects to the public.

	Individual				Population			
	Dose (millirem)				Dose (person-rem)[b]			
Receptor(s)[c]	Atmospheric releases	Aqueous releases	Total	Probability of a fatal cancer	Atmospheric releases	Aqueous releases	Total	Number of fatal cancers
Offsite maximally exposed individual								
• Annual	1.2×10^{-4}	6.9×10^{-4}	8.1×10^{-4}	4.1×10^{-10}	NA[d]	NA	NA	NA
• 30-year	0.0037	0.021	0.025	1.2×10^{-8}	NA	NA	NA	NA
Population								
• Annual	NA	NA	NA	NA	2.9×10^{-4}	0.0068	0.0071	3.5×10^{-6}
• 30-year	NA	NA	NA	NA	0.0086	0.20	0.21	1.1×10^{-4}

a. Supplemental information is provided in Appendix E.
b. For atmospheric releases, the dose is to the population within 80 kilometers (50 miles) of SRS. For aqueous releases, the dose is to the people using the Savannah River from SRS to the Atlantic Ocean.
c The doses to the public from total SRS operations in 1993 were 0.25 millirem to the offsite maximally exposed individual (0.11 millirem from airborne releases and 0.14 millirem from aqueous releases) and 9.1 person-rem to the regional population (7.6 person-rem from airborne releases and 1.5 person-rem from aqueous releases). Source: Arnett, Karapatakis, and Mamatey (1994).
d. NA = not applicable.

As was done for the atmospheric assessments, the population was assumed to remain constant over the 30-year period of analysis. TE

Calculated doses from releases to water are given in Table 4-11. The annual doses (0.00069 millirem to the offsite maximally exposed individual and 0.0068 person-rem to the offsite population) would be small fractions of the doses from total SRS releases to water in 1993 [0.14 millirem to the maximally exposed member of the public and 1.5 person-rem to the population using the Savannah River from SRS to the Atlantic Ocean (Arnett, Karapatakis, and Mamatey 1994)]. Doses from 1993 operations were well within the regulatory requirements specified in DOE Order 5400.5 and by EPA in 40 CFR 141, which allow an annual dose limit to the offsite maximally exposed individual of 4 millirem from drinking water. TC

Using the fatal-cancer-per-rem dose factor given above, the probability of the maximally exposed individual developing a fatal cancer and the numbers of fatal cancers that could occur in the regional population under the no-action alternative were calculated (Table 4-11). The probability of the maximally exposed individual dying of cancer as a result of 30 years of exposure to radiation from activities under the no-action alternative is slightly more than 1 in 100 million; the number of additional fatal cancers that might occur in the regional population for this same exposure period would be 1.1×10^{-4}. TE TC

About 23.5 percent of the U.S. population die from cancer from all causes (Section 4.1.12.1); accordingly, the probability of an individual dying of cancer is 0.235, or approximately 1 in 4. In a population of 620,100 people (the number of people living within 80 kilometers [50 miles] of SRS), the number of people expected to die of cancer is 145,700. In a population of 65,000 (the number of people using the Savannah River as a source of drinking water), the number of people expected to die of cancer is 15,275. Thus, the incidence of radiation-induced fatal cancers associated with the no-action alternative (see Table 4-11) would be much smaller than the incidence of cancers from all causes. L004-08

4.1.12.2.2 Nonradiological Impacts

Potential nonradiological impacts to individuals residing offsite were considered for both criteria and carcinogenic pollutants. Maximum SRS boundary-line concentrations for criteria pollutants are discussed in Section 4.1.5.

For routine releases from operating facilities under the no-action alternative, criteria pollutant concentrations would be within both state and federal ambient air quality standards and are discussed in

Section 4.1.5. During periods of construction under normal operating conditions, the criteria pollutant concentrations at the SRS boundary would not exceed air quality standards, and very small health impacts would be expected from criteria pollutant emissions.

Offsite risks due to carcinogens were calculated using the Industrial Source Complex 2 model for the same facilities discussed in Section 4.1.12.1.2. The assumptions in the model are conservative. Emissions of carcinogenic compounds were estimated using permitted values for facilities not currently operating (e.g., the Defense Waste Processing Facility) and emission factors for facilities currently operating (e.g., aqueous and organic waste storage tanks) (EPA 1985). Table 4-12 shows estimated
TE latent cancers based on EPA's Integrated Risk Information System database (EPA 1994).

Table 4-12. Estimated probability of excess latent cancers in the SRS offsite population.

Pollutant	Unit risk factor (latent cancers per µg/m^3)[a]	Concentration[b] (µg/m^3)	Latent cancers[c]
Chloroform	2.3×10^{-5}	0.0029	2.9×10^{-8}
Carbon tetrachloride	1.5×10^{-5}	2.0×10^{-7}	1.3×10^{-12}
Benzene	8.3×10^{-6}	0.048	1.7×10^{-7}
1,1 Dichloroethene	5.0×10^{-5}	4.0×10^{-7}	8.6×10^{-12}
Total			2.0×10^{-7}

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a. Micrograms per cubic meter of air.
b. Source: Stewart (1994).
c. Latent cancer probability equals unit risk factor times concentration times 30 years divided by 70 years.

The unit risk (cancer risk per unit of air concentration) for a chemical is the highest lifetime risk (over 70 years) of developing cancer (either fatal or nonfatal) when continuously exposed to the chemical at an air concentration of 1 microgram per cubic meter. As shown in Table 4-12, the estimated lifetime risk associated with routine emissions from facilities included in the no-action alternative is approximately 2 in 1.0×10^7. Health impacts to the public would be very small.

4.1.12.2.3 Environmental Justice Assessment

Environmental justice has assumed an increasingly prominent role in the environmental movement over the past decade. In general, the term "environmental justice" refers to fair treatment of all races, cultures, and income levels with respect to laws, policies, and government actions. In February 1994, Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-
TE Income Populations," was released. This order directs federal agencies to identify and address, as
TC appropriate, disproportionately high and adverse effects of its programs, policies, and activities on

minority and low-income populations. Executive Order 12898 also directs the Administrator of EPA to convene an interagency federal working group on environmental justice (referred to below as the Working Group). The Working Group will provide guidance to federal agencies for identifying disproportionately high and adverse human health or environmental effects on minority and low-income populations. TE TC The Working Group has not yet issued this guidance. It has developed working draft definitions. Although the definitions are in draft form, DOE used them in the analysis for this EIS. In coordination with the Working Group, DOE is developing internal guidance on implementation of the executive order. DOE's internal guidance was used in preparing this EIS.

This EIS addresses environmental justice concerns in three areas: (1) potential air emissions, (2) potential impacts from transportation of wastes offsite, and (3) potential impacts from consuming fish and game. Based on these analyses, DOE concluded that none of the alternatives would have TE disproportionate adverse effects on minority populations or low-income communities.

Although adverse health effects are not expected under the no-action alternative, in the spirit of Executive Order 12898 an analysis was performed to determine whether any impacts would have been disproportionately distributed. Figures 3-12 and 3-13 identify census tracts with significant proportions TE of people of color or low income. This section presents the predicted average radiation doses that would be received under the no-action alternative by individuals in these census tracts and compares them to the predicted per capita doses received in the remaining tracts within the 80-kilometer (50-mile) radius of SRS. This section also discusses impacts of doses received in the downstream communities from liquid effluents from all alternatives and cases.

Figure 4-6 shows a wheel with 22.5-degree sectors and concentric rings from 16 to 80 kilometers (10 to 50 miles) radiating at 16-kilometer (10-mile) intervals from the center of SRS. A fraction of the total dose (see Appendix E) was calculated for each sector based on meteorological data (Simpkins 1994b), the sector wheel was laid over the census tract map, and each tract was assigned to a sector. For purposes of this analysis, if a tract fell in more than one sector, the tract was assigned to the sector with the highest dose.

DOE analyzed the effects by comparing the per capita dose received by each type of community to the other types of communities within a defined region. To eliminate the possibility that effects to a small community close to SRS would be diluted and masked by including it with a larger community located farther from SRS, comparisons were made within increasingly larger concentric circles, the radii of which increase in 16-kilometer (10-mile) increments.

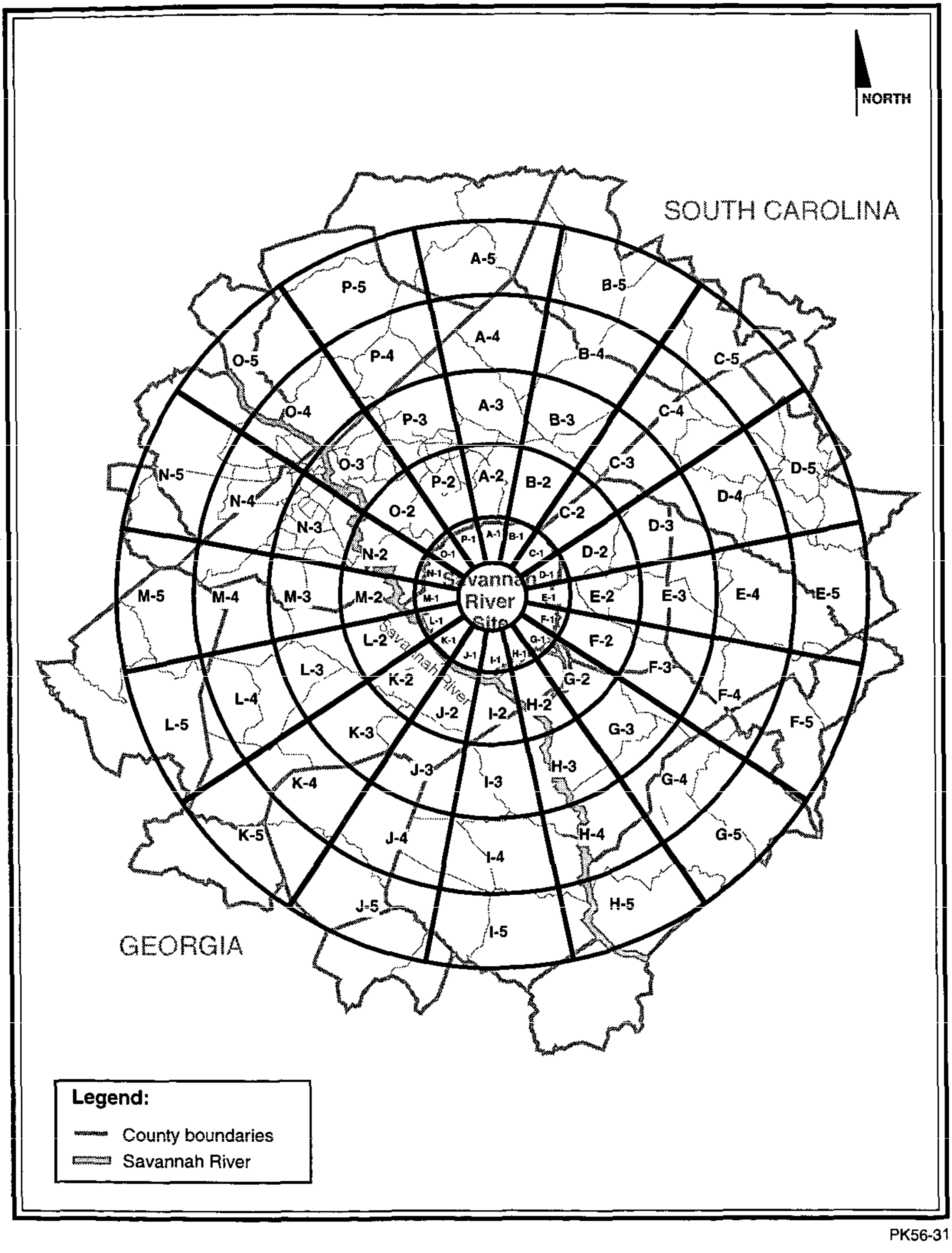

Figure 4-6. Identification of annular sectors around SRS. (See Appendix E for dose fractions by sector.)

To determine the per capita radiation dose in each census tract for the no-action alternative, the number of people in each tract was multiplied by that tract's dose value to obtain a total population dose for each tract. These population doses were summed over each concentric circle and divided by the total community population to obtain a mean per capita dose for each circular area. The dose determined for each tract was compared to this mean dose. Figure 4-7 illustrates these results for the no-action alternative. Appendix E provides the supporting data.

As shown, the per capita dose is extremely small for each community type. This analysis indicates that communities of people of color (in which the minority population is equal to or greater than 35 percent | TE of the total population) or low income (in which the number of low income persons is equal to or greater than 25 percent of the total population) would not be disproportionately affected by atmospheric releases.

Table 4-11 lists predicted doses to the offsite maximally exposed individual and to the downstream population from exposure to water resources. The doses reflect people using the Savannah River for drinking water, sports, and food (fish). Because the communities of people of color or low income living | TE in the areas downstream from SRS are well distributed and because persons in the downstream region would not be affected (the 30-year dose to the offsite maximally exposed individual for all alternatives and forecasts would be 0.021 millirem), there are no disparate adverse impacts on low-income or | TC TE minority communities in the downstream areas for any of the alternatives.

The distribution of carcinogen and criteria pollutant emissions due to routine operations, and of criteria pollutants from construction activities, would be essentially identical to those presented for airborne radiological emissions, so people of color and the poor would not be disproportionately affected by non-radiological emissions under any of the alternatives. Because non-radiological pollutant emissions have | TE only very small impacts in any of the alternatives, and are not disproportionately distributed among types of communities, there are no environmental justice concerns related to these pollutants for any of the alternatives.

Environmental justice concerns were also considered for the impacts associated with the offsite transportation of hazardous and radioactive waste that would occur under the alternatives. A recent | TE impact analysis (see Section 4.1.11.1) determined that for the no-action alternative, accidents resulting in the release of hazardous material would be expected to occur, on average, only once in 6 years (i.e., five | TE accidents resulting in hazardous material release over the 30-year period of this EIS). The impact analysis determined that for the scenario with largest impacts (alternative B – maximum waste forecast), | TC accidents involving the release of hazardous material would be expected to occur, on average, only once in 4 years. In addition to the expected frequency of such accidents, their impacts can be mitigated by

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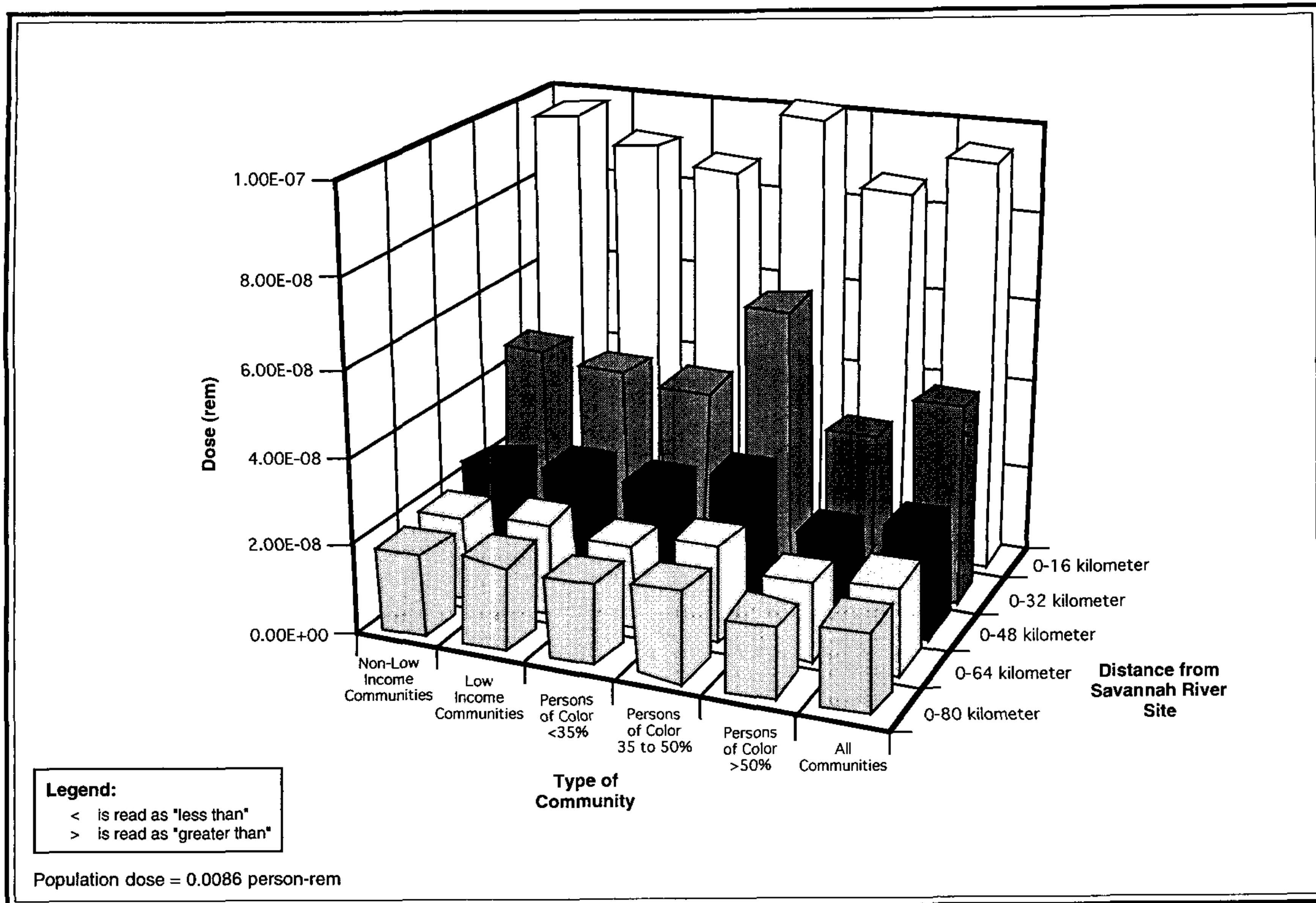

Figure 4-7. Dose to individuals in communities within 80 kilometers (50 miles) of SRS under the no-action alternative.

existing training and technology for controlling spills from vehicles. Because these rare events are expected to occur randomly in time with equal distribution throughout various types of communities, there are no disproportionate adverse impacts on poor or minority communities from transportation of hazardous and radioactive waste for any of the alternatives evaluated in this EIS.

DOE also considered impacts associated with consumption of wildlife from SRS and fish from the Savannah River from the perspective of environmental justice. Doses to the maximally exposed hunter and fisherman (see Section 3.12.1.2) have been determined to be 57 and 1.3 millirem, respectively. These analyses assumed that the hunter consumed 153 kilograms (337 pounds) of meat from deer and TC hogs taken from SRS and 19 kilograms (42 pounds) of fish from the Savannah River at the mouth of Steel Creek each year. If the rate of fish consumption, for conservatism, was doubled to 39 kilograms (84 pounds) per year, the total annual dose to an individual consuming both game and fish would be 59.6 millirem or 59.6 percent of the DOE annual limit (DOE 1993c). A dose of this magnitude would TE result in an annual probability of contracting a latent fatal cancer of 3.0×10^{-5} (approximately 3 in 100,000). It is highly unlikely that communities of people of color or low income consume game and fish at a rate greater than that calculated for the maximally exposed individual who both hunts and fishes, as that person is assumed to eat 421 pounds of fish and game each year. Because the doses received by this maximally exposed individual from fish and game are not significant, there would be no disproportionate adverse impacts from consumption of wildlife by people of color or low income.

4.1.13 FACILITY ACCIDENTS

This section summarizes the risks to workers and members of the public from potential accidents at facilities associated with the various waste types under the no-action alternative. An accident is a series of unexpected or undesirable events leading to a release of radioactive or hazardous material within a facility or to the environment. Appendix F provides further detail and discussion regarding the accident analysis.

4.1.13.1 Methodology

Accident assessment is based on potential accidents identified and described in safety documentation for SRS facilities and on material inventories at SRS facilities that support the no-action alternative. Accidents include events resulting from external initiators (e.g., vehicle crashes, nearby explosions), internal initiators (e.g., equipment failures, human error), and natural phenomena initiators (e.g., earthquakes, tornadoes). Radioactive and hazardous material releases resulting from accidents are considered in this analysis.

The accident scenarios selected for this evaluation were chosen to represent the full spectrum of events which could occur (i.e., both high- and low-frequency events and large- and small-consequence events). The frequency ranges, as presented in Table 4-13, are as follows: anticipated accidents, unlikely accidents, extremely unlikely accidents, and beyond-extremely-unlikely accidents. A more complete discussion on accident frequencies is given in Section F.2 of Appendix F. However, it should be noted that all frequency ranges may not have representative accident scenarios identified for them. Accident scenarios in the beyond-extremely-unlikely frequency range are so unlikely that they often are not analyzed in safety documentation.

Table 4-13. Accident frequency categories.[a]

Frequency category	Frequency range (accidents per year)[b]
Anticipated accidents	$10^{-1} \geq p \geq 10^{-2}$
Unlikely accidents	$10^{-2} \geq p \geq 10^{-4}$
Extremely unlikely accidents	$10^{-4} \geq p \geq 10^{-6}$
Beyond-extremely-unlikely accidents	$10^{-6} \geq p$

a. The frequencies for accidents are from DOE Standard 3009-94 (DOE 1994b).
b. $x \geq y$. The number "x" is greater than or equal to the number "y." Conversely, the number "y" is less than or equal to the number "x" (e.g., $5 \geq 4 \geq 3$).

Radiological consequences are defined in terms of (1) the dose to an individual and collective dose to a population; and (2) latent fatal cancers from a postulated accident. The human health effect of concern is the development of latent fatal cancers. The International Commission on Radiological Protection (ICRP) has made specific recommendations for quantifying these health effects (ICRP 1991). The results of these health effects are presented in terms of increased latent fatal cancers (i.e., number of additional fatal cancers expected in the population) calculated using ICRP-60 conversion factors of 0.0005 for the public and 0.0004 for onsite workers if the effective dose equivalent is less than 20 rem. For individual doses of 20 rem or more, the ICRP-60 conversion factors are doubled. For hazardous materials, consequences are defined in terms of airborne chemical concentrations.

Radiological doses for the postulated accident scenarios were extracted from information provided in the following technical reports: *Bounding Accident Determination for the Accident Input Analysis of the SRS Waste Management Environmental Impact Statement* (WSRC 1994e), *Solid Waste Accident Analysis in Support of the Savannah River Waste Management Environmental Impact Statement* (WSRC 1994f), and the *Liquid Waste Accident Analysis in Support of the Savannah River Waste Management Environmental Impact Statement* (WSRC 1994g). These technical reports compiled pre-existing safety

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documentation addressing the risks of operating waste management facilities. Figure 4-8 is a flowchart for the preparation of radiological accident analysis information. No new analyses were performed because existing documentation adequately supported a quantitative or qualitative estimation of potential impacts, as required by the National Environmental Policy Act (NEPA). As indicated by the last step of the flowchart (Figure 4-8), impacts resulting from the expected, minimum, and maximum forecast are evaluated and discussed for the representative bounding accidents. However, the no-action alternative only considers the expected waste forecast. TE TE

The figures presented in Section 4.1.13.2 reflect the increase in cancers estimated using the above conversion factors. The AXAIR89Q computer code (WSRC 1994h) predicted impacts in terms of dose for onsite and offsite receptor groups. The code then calculated the collective dose to the affected population living within 80 kilometers (50 miles) of SRS. This population exposure is given as person-rem dose equivalent, as if the accident occurred. Increases in latent fatal cancers as the result of an accident would be in addition to the number of cancers expected from all other causes.

The point estimate of increased risk is provided to allow consideration of accidents that may not have the highest consequence, but due to a higher estimated frequency, may pose a greater risk. An example of this concept for the no-action alternative can be seen in the representative bounding accidents selected for liquid high-level radioactive waste. An accidental release of radioactive material due to a pressurization and breach at the Replacement High-Level Waste Evaporator would result in the greatest consequence, which would be 6.8×10^{-1} latent fatal cancer per occurrence for the offsite population within 80 kilometers (50 miles). Because this accident is estimated to occur once every 20,000 years, a time-weighted average of these consequences over the accident frequency time span (i.e., consequences times frequency) results in an annualized point estimate of increased risk of 3.4×10^{-5} latent fatal cancer per year. A release due to a feed line break at the Replacement High-Level Waste Evaporator produces lower consequences than the pressurization and breach scenario: 9.1×10^{-3} latent fatal cancer per occurrence. However, this accident is estimated to occur every 14 years, resulting in a point estimate of increased risk of 6.3×10^{-4} latent fatal cancer per year. Thus, by factoring in the accident probability, a more accurate comparison of the resulting risks can be made.

To fully understand the hazards associated with SRS facilities under the alternatives considered in this EIS, it is necessary to evaluate potential accidents involving both hazardous and radiological materials. For chemically toxic materials, several government agencies recommend quantifying chemical concentrations that cause short-term effects as threshold values of concentrations in air.

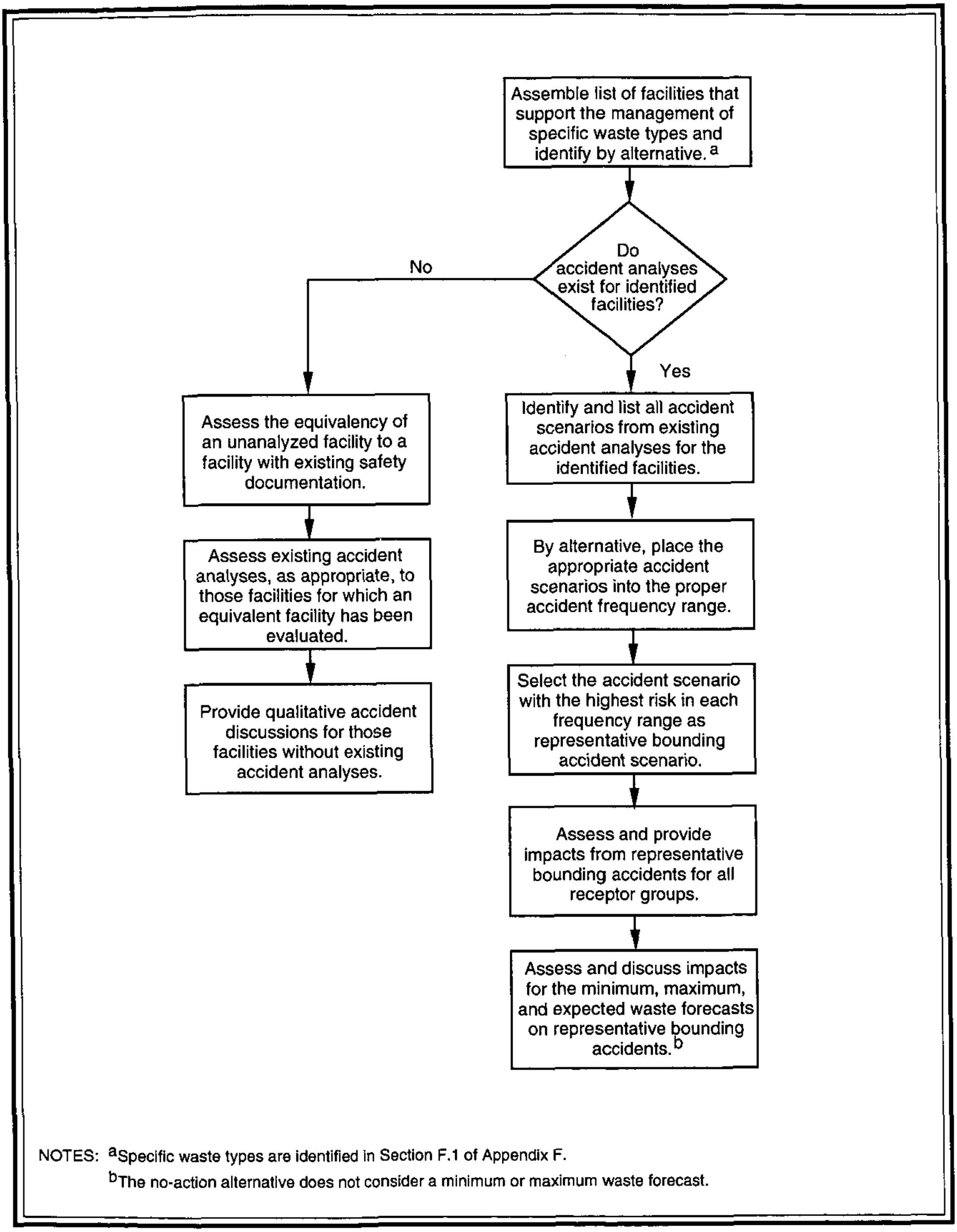

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Figure 4-8. Radiological accident analysis process flowchart.

Because the long-term health consequences of human exposure to hazardous materials are not as well understood as those related to radiation exposure, a determination of potential health effects from exposures to hazardous materials is more subjective than a determination of health effects from exposure to radiation. Therefore, the consequences from accidents involving hazardous materials are in terms of airborne concentrations at various distances from the accident location. Emergency Response Planning Guidelines (ERPG) values are the only well-documented parameters developed specifically for use in evaluating the health consequences of exposure of the general public to accidental releases of hazardous materials (WSRC 1992c). ERPG-3 values represent the threshold concentration for lethal effects, while ERPG-2 values represent the threshold concentration for severe or irreversible health effects in exposed populations (see Appendix F, Table F-3). The quantities and airborne concentrations of toxic chemicals at the various receptor locations were extracted from information provided in the technical reports (WSRC 1994g, h) supporting this EIS. The analysis presented in Appendix F presents facility-specific chemical hazards. TE

4.1.13.2 Summary of Accident Impacts

Figures 4-9 through 4-12 summarize the projected impacts of radiological accidents to the population, the offsite maximally exposed individual, and uninvolved workers at 100 and 640 meters (328 and 2,100 feet), respectively. Data required to calculate uninvolved worker population doses are not currently available; however, doses to uninvolved workers at 100 and 640 meters (328 and 2,100 feet) would bound impacts to the individual member of the population. For example, Figure 4-9 shows the estimated increase in latent fatal cancers resulting from the estimated population dose for the representative bounding accidents selected for each waste type. Representative bounding accidents are identified by each frequency range for each applicable waste type. An anticipated accident (i.e., one occurring between once every 10 years and once every 100 years) involving low-level and mixed waste is the accident scenario under the no-action alternative that would present the greatest risk to the population within 80 kilometers (50 miles) of SRS (see Figure 4-9). This accident scenario would increase the risk to the population within 80 kilometers (50 miles) by 1.7×10^{-2} latent fatal cancer per year. TE

Figures 4-10, 4-11, and 4-12 present similar information for the offsite maximally exposed individual, uninvolved workers at 640 meters (2,100 feet), and uninvolved workers at 100 meters (328 feet), respectively. An anticipated accident involving either mixed waste or low-level waste would pose the greatest risk to the offsite maximally exposed individual (Figure 4-10) and the uninvolved worker at 640 meters (2,100 feet) (Figure 4-11). The anticipated accident increases the risk to the offsite

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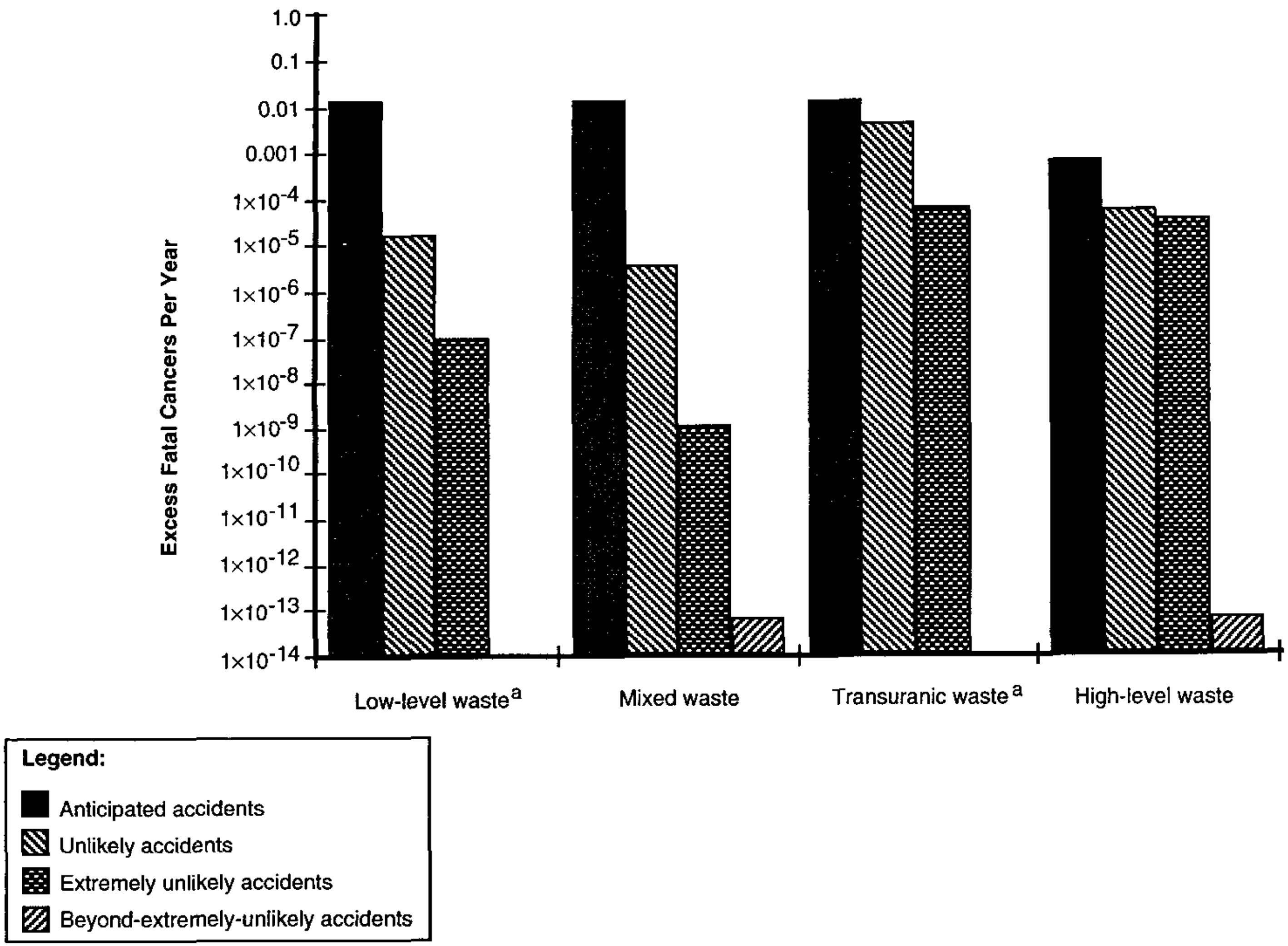
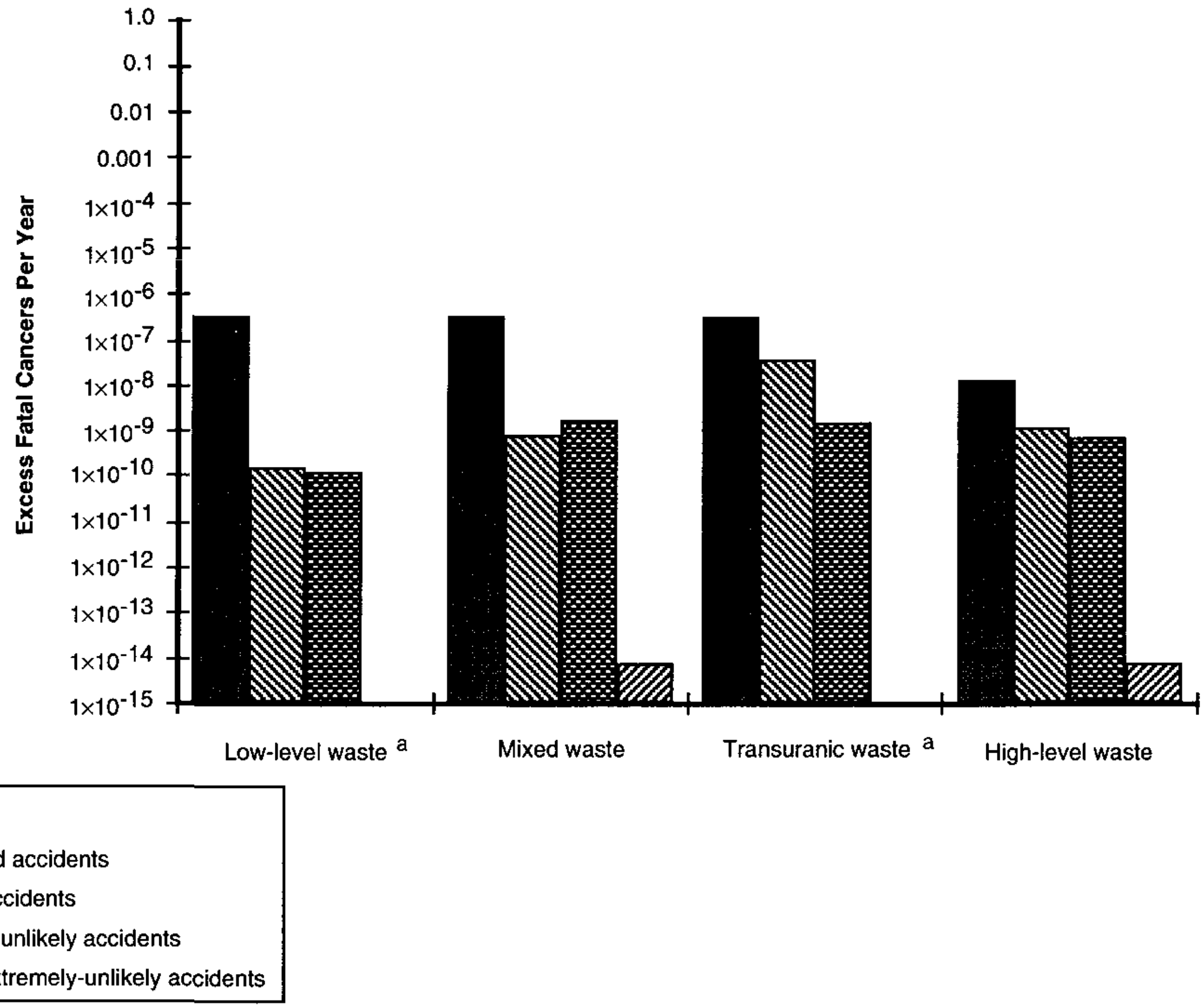


Notes:

a. No beyond-extremely-unlikely accidents were identified for low-level or transuranic wastes.

PK56-31

TE **Figure 4-9.** Summary of radiological impacts to the population within 80 kilometers (50 miles) of SRS under the no-action alternative.



Notes:

a. No beyond-extremely-unlikely accidents were identified for low-level or transuranic wastes.

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Figure 4-10. Summary of radiological accident impacts to the offsite maximally exposed individual under the no-action alternative. | TE

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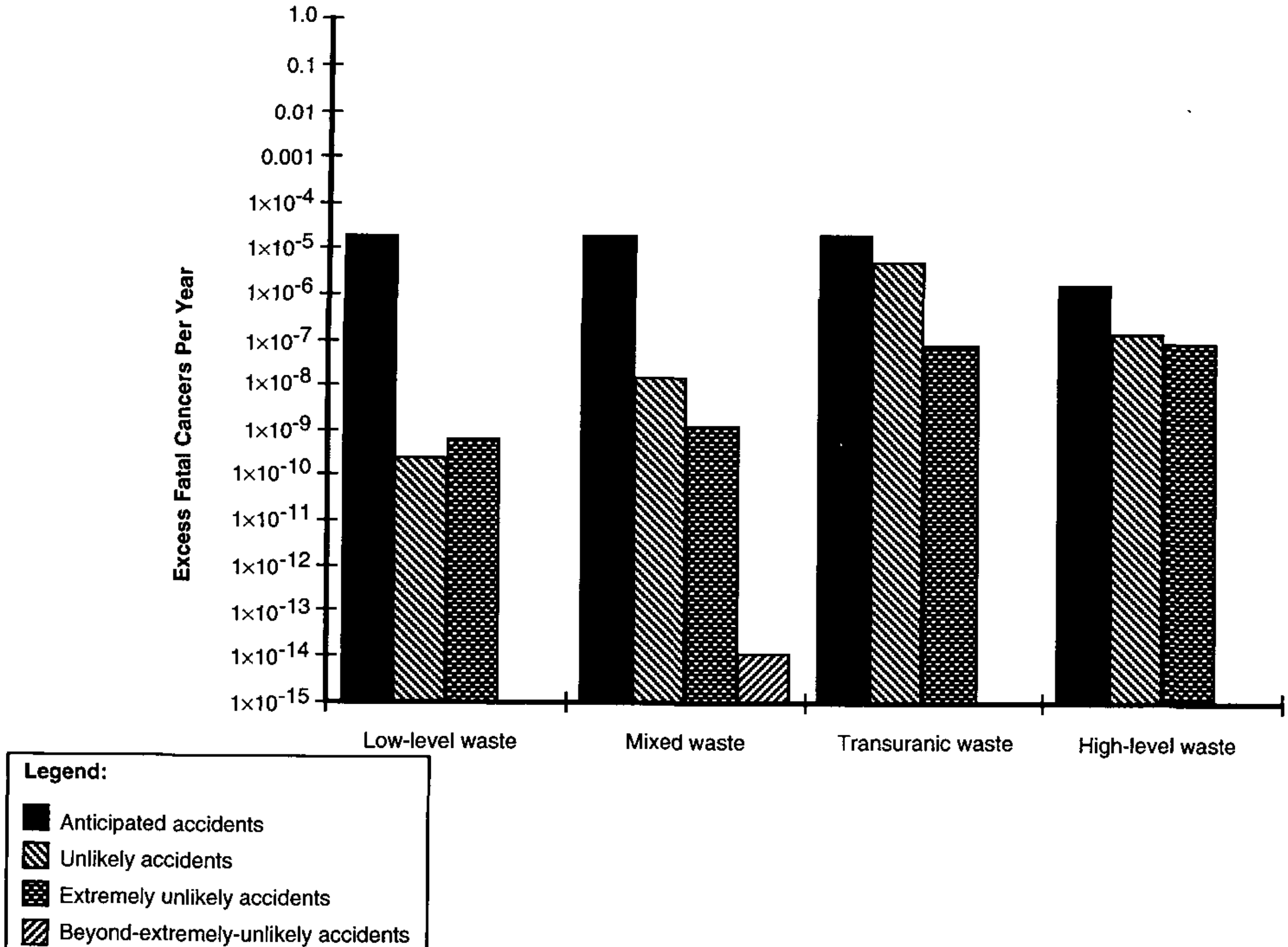
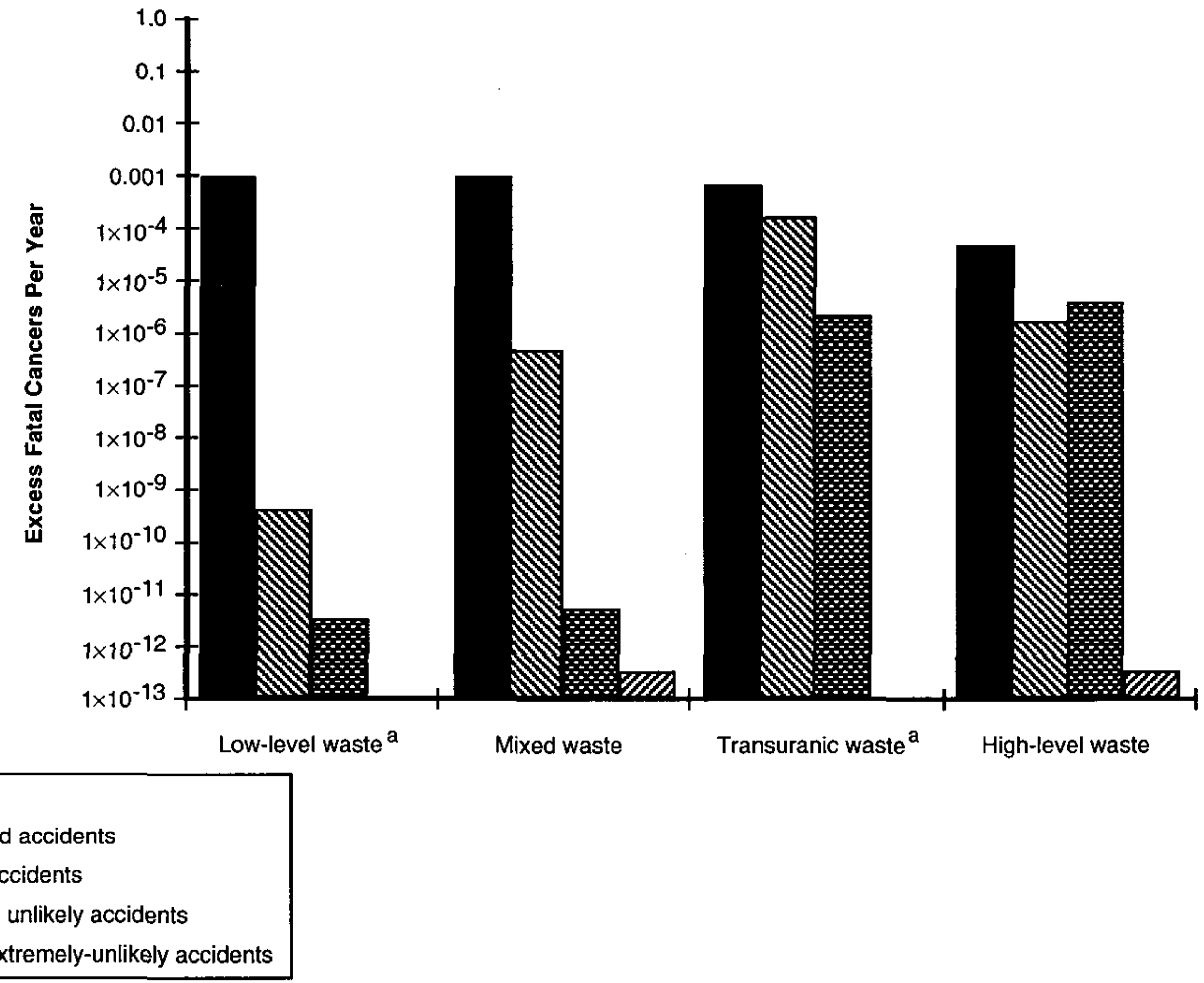


Notes:

a. No beyond-extremely-unlikely accidents were identified.

PK56-31

TE **Figure 4-11.** Summary of radiological accident impacts to the uninvolved worker within 640 meters (2,100 feet) under the no-action alternative.



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Notes:

a. No beyond-extremely-unlikely accidents were identified for low-level or transuranic wastes.

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Figure 4-12. Summary of radiological accident impacts to the uninvolved worker within 100 meters (328 feet) under the no-action alternative. TE maximally exposed individual by 3.3×10^{-7} latent fatal cancer per year and to the uninvolved worker at 640 meters (2,100 feet) by 1.8×10^{-5} latent fatal cancer per year.

TE An accident involving either mixed waste or low-level waste would also pose the greatest risk to the uninvolved worker at 100 meters (328 feet) (Figure 4-12). This accident scenario would increase the risk to the uninvolved worker at 100 meters (328 feet) by 1.0×10^{-3} latent fatal cancer per year.

Except for an accident in the transuranic waste characterization/certification facility (discussed under alternatives A, B, and C), radiological accidents considered in this EIS would not result in doses that would result in substantial acute or latent health effects.

A complete summary of all representative bounding accidents considered for the no-action alternative is presented in Table 4-14. This table provides accident descriptions, annual frequency of occurrence, accident scenario. Details regarding the individual postulated accident scenarios associated with the various waste types are provided in Appendix F.

For all the waste types considered, a summary of the chemical hazards associated with the no-action alternative estimated to exceed ERPG-2 values is presented in Table 4-15. For the uninvolved worker at 100 meters (328 feet), nine chemical-release scenarios are estimated to exceed ERPG-3 values. Moreover, another five chemical-release scenarios estimate airborne concentrations that exceed ERPG-2 values where equivalent ERPG-3 values were not identified. For the offsite maximally exposed individual, no chemical-release scenario identified airborne concentrations that exceeded ERPG-3 values. Only the lead-release scenario estimates airborne concentrations that exceed the ERPG-2 TE guidelines (Table F-25 in Appendix F).

Furthermore, the benzene-release scenarios (see Table F-19) result from an explosion and tornado at the Organic Waste Storage Tank, respectively. Under the no-action alternative, the Consolidated TC Incineration Facility is unavailable as a benzene treatment option. As a result, an additional four organic waste storage tanks would be required for the management of benzene mixed waste. Therefore, DOE assumes an increase in the likelihood that a catastrophic benzene release could occur (i.e., more organic waste storage tanks that could explode or be hit by a tornado).

In addition to the risk to human health, secondary impacts from postulated accidents on plant and animal TE resources, water resources, the economy, national defense, environmental contamination, threatened and endangered species, land use, and Native American treaty rights are considered. DOE believes secondary impacts from postulated accidents as assessed in Appendix F, Section F.7 to be minor.

Table 4-14. Summary of representative bounding accidents under the no-action alternative.[a]

Accident Description	Affected waste types[c]	Frequency (per year)	Increased risk of latent fatal cancers per year[b]: Uninvolved worker at 100 meters	Uninvolved worker at 640 meters	Maximally exposed offsite individual	Population within 80 kilometers
RHLWE[d] release due to a feed line break	High-level	0.07[e]	1.79×10^{-5}	6.38×10^{-8}	1.32×10^{-8}	6.34×10^{-4}
RHLWE release due to a design basis earthquake	High-level	2.00×10^{-4}[f]	1.54×10^{-6}	5.46×10^{-8}	1.12×10^{-9}	5.43×10^{-5}
RHLWE release due to evaporator pressurization and breech	High-level	5.09×10^{-5}[g]	1.95×10^{-6}	3.46×10^{-8}	7.13×10^{-10}	3.44×10^{-5}
Design basis ETF[h] airborne release due to tornado	High-level Mixed	3.69×10^{-7}[i]	3.20×10^{-13}	1.02×10^{-14}	7.20×10^{-15}	6.35×10^{-14}
Container breach at the ILNTV[j]	Low-level Mixed	0.02[e]	0.00104	1.84×10^{-5}	3.31×10^{-7}	0.0168
High wind at the ILNTV	Low-level	0.001[f]	4.04×10^{-10}	2.43×10^{-10}	1.52×10^{-10}	1.06×10^{-5}
Tornado at the ILNTV	Low-level	2.00×10^{-5}[g]	3.26×10^{-12}	6.18×10^{-10}	1.18×10^{-10}	1.18×10^{-7}
Earthquake at the SRTC[k] storage tanks	Mixed	2.00×10^{-4}[f]	4.80×10^{-7}	1.54×10^{-8}	8.06×10^{-10}	3.60×10^{-6}
F3 tornado[l] at Building 316-M	Mixed	2.80×10^{-5}[g]	5.35×10^{-12}	1.29×10^{-9}	1.65×10^{-9}	1.12×10^{-9}
Deflagration in culvert during TRU[m] drum retrieval activities	Transuranic	1.00×10^{-2}	8.96×10^{-4}	1.59×10^{-5}	2.86×10^{-7}	1.45×10^{-2}
Fire in culvert at the TRU waste storage pads (one drum in culvert)	Transuranic	8.10×10^{-4}[f]	3.07×10^{-4}	5.48×10^{-6}	9.84×10^{-8}	0.0498
Vehicle crash with resulting fire at the TRU waste storage pads	Transuranic	6.50×10^{-5}[g]	4.47×10^{-6}	7.96×10^{-8}	1.43×10^{-9}	7.25×10^{-5}

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a. A complete description and analysis of the representative bounding accidents are presented in Appendix F.
b. Increased risk of fatal cancers per year is calculated by multiplying the [consequence (dose) × latent cancer conversion factor] × annual frequency. For dose consequences and latent cancer fatalities per dose, see tables in Appendix F.
c. The waste type for which the accident scenario is identified as a representative bounding accident. A representative bounding accident may be identified for more than one waste type. These waste types are high-level, low-level, mixed, and transuranic.
d. Replacement High-Level Waste Evaporator.
e. The frequency of this accident scenario is within the anticipated accident range.
f. The frequency of this accident scenario is within the unlikely accident range.
g. The frequency of this accident scenario is within the extremely unlikely accident range.
h. F/H-Area Effluent Treatment Facility.
i. The frequency of this accident scenario is within the beyond-extremely-unlikely accident range.
j. Intermediate-Level Nontritium Vault.
k. Savannah River Technology Center.
l. F3 tornadoes have rotational wind speeds of 254 to 331 kilometers (158 to 206 miles) per hour.
m. Transuranic.

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Table 4-15. Summary of chemical hazards associated with the no-action alternative estimated to exceed ERPG-2[a] values.

Chemical name	Appendix F table reference[b]	100-meter concentration (mg/m^3)[c]	640-meter concentration (mg/m^3)	Offsite concentration (mg/m^3)	Reference concentrations	
					ERPG-2 (mg/m^3)	ERPG-3 (mg/m^3)
Nitric acid	F-6	830[d]	100	2	39	77
Nitrogen dioxide	F-7	79.6[d]	0.339	0.159	1.88	56.4
Oxalic acid	F-7	276	1.18	0.552	5	500
Nitric acid	F-7	181[d]	0.771	0.361	38.7	77.3
Benzene	F-18	670	(e)	0.42	160	9,600
Cadmium	F-18	2.7	(e)	0.0017	0.25	500
Chromium	F-18	2.7	(e)	0.0017	2.5	(f)
Lead	F-18	160	(e)	0.10	0.25	700
Mercury	F-18	15	(e)	0.0094	0.20	28
Methyl ethyl ketone	F-18	1,800	(e)	1.1	845	1.01×10^4
Benzene[g]	F-19	1.40×10^4[d]	610	5.7	160	9,600
Benzene[g]	F-19	1.02×10^4[d]	1,210	15.4	160	9,600
Beryllium	F-25	16.7[d]	(e)	0.00823	0.01	10
Cadmium	F-25	333[d]	(e)	0.165	0.25	50
Chloroform	F-25	8,330[d]	(e)	4.11	488	4,880
Chromium	F-25	16.7	(e)	0.00823	2.5	(f)
Copper	F-25	66.7	(e)	0.0329	5	(f)
Lead	F-25	66.7	(e)	0.329	0.25	700
Lead nitrate	F-25	16.7	(e)	0.00823	0.25	700
Mercuric nitrate	F-25	16.7	(e)	0.00823	0.2	28
Mercury	F-25	16.7	(e)	0.00823	0.2	28
Nickel nitrate	F-25	16.7	(e)	0.00823	5	(f)
Silver nitrate	F-25	16.7	(e)	0.00823	0.5	(f)
Sodium chromate	F-25	16.7	(e)	0.00823	0.25	30
Toluene	F-25	8,330[d]	(e)	4.11	754	7,450
Uranyl nitrate	F-25	16.7	(e)	0.00823	0.25	30

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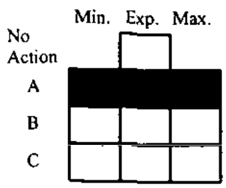
a. Emergency Response Planning Guidelines. (See glossary.)
b. Analyses regarding specific chemical releases are provided in the referenced Appendix F tables.
c. Milligrams per cubic meter of air.
d. Concentration at 100 meters (328 feet) exceeds ERPG-3 values.
e. Airborne concentrations at 640 meters (2,100 feet) were not available from existing safety documentation.
f. No equivalent value found.
g. Benzene appears twice under the F-19 category due to different accident initiators: explosion or tornado.



4.2 Alternative A - Limited Treatment Configuration

This section describes the effects alternative A (described in Section 2.4) would have on the existing environment (described in Chapter 3).

4.2.1 INTRODUCTION

Alternative A (limited treatment practices for waste at SRS) includes the continuation of ongoing activities listed under the no-action alternative (Section 4.1.1). In addition DOE would:

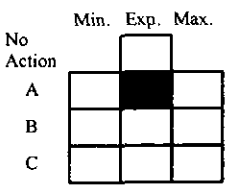
- Construct and operate a containment building to process mixed wastes. TE
- Operate a mobile soil sort facility. TE
- Treat small quantities of mixed and polychlorinated biphenyl (PCB) wastes offsite. TE
- Burn mixed and hazardous wastes in the Consolidated Incineration Facility.
- Construct and operate a transuranic waste characterization/certification facility.
- Store transuranic wastes until they can be sent to the Waste Isolation Pilot Plant. TE

Storage facilities would be constructed on previously cleared land in E-Area. The new waste treatment facilities for characterization/certification of transuranic and alpha wastes and for decontamination/macroencapsulation (containment) of mixed waste would be built on undeveloped land northwest of F-Area.

Construction related to this alternative would require 0.22 square kilometer (55 acres) of undeveloped land northwest of F-Area and 0.04 square kilometer (9 acres) of undeveloped land northeast of F-Area TC

TC by 2006 (Figure 4-13). An additional 0.13 square kilometer (32 acres) of undeveloped land would be required by 2024 for construction of disposal vaults northeast of F-Area (Figure 4-14). Other construction would be on previously cleared and developed land in the eastern portion of E-Area. The minimum waste forecast for this alternative would require 0.29 square kilometer (73 acres) of TC undeveloped land, and the maximum waste forecast would require 4.0 square kilometers (986 acres). Additional site-selection studies would be required to locate suitable land if the maximum waste forecast is realized.

4.2.2 GEOLOGIC RESOURCES

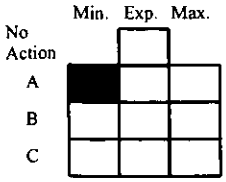


4.2.2.1 Geologic Resources – Expected Waste Forecast

Effects on geologic resources from alternative A – expected waste forecast would result primarily from the construction of new facilities. The effects discussed under the no-action alternative (Section 4.1.2) form the basis for comparison and are referenced in this section.

Although the number of facilities required for this case would be substantially fewer than for the no-action alternative because more waste would be treated and less would be stored, waste management activities associated with alternative A expected waste forecast would affect soils in E-Area. The fewer number of facilities and the corresponding decrease in the amount of land needed would result in smaller effects on soils under this alternative. Cleared and graded land required for this alternative totals approximately 0.26 square kilometer (65 acres) (by 2006). Approximately 0.26 square kilometer (65 acres) of undeveloped land in E-Area would be cleared and graded for the construction of new TC facilities through 2006. Later, an additional 0.13 square kilometer (32 acres) would be cleared for construction of additional RCRA-permitted disposal vaults. This total of 0.39 square kilometer (96 acres) is approximately 60 percent of the 0.65 square kilometer (160 acres) of undisturbed land that would be required for the no-action alternative.

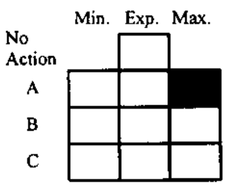
The potential for accidental oil, fuel, and chemical spills would be lower under this alternative than under the no-action alternative because of reduced construction and operation activities. Spill prevention, control, and countermeasures for this scenario would be the same as for the no-action alternative discussed in Section 4.1.2, and impacts to soils would be very small.



4.2.2.2 Geologic Resources – Minimum Waste Forecast

Effects from alternative A – minimum waste forecast would be slightly less than those for the expected waste forecast because less land would be disturbed during construction activities. Approximately 0.17 square kilometer (41 acres) of cleared land (by 2008) and 0.29 square kilometer (73 acres) of uncleared land (by 2024) would be used for construction of treatment, storage, and disposal facilities. TC

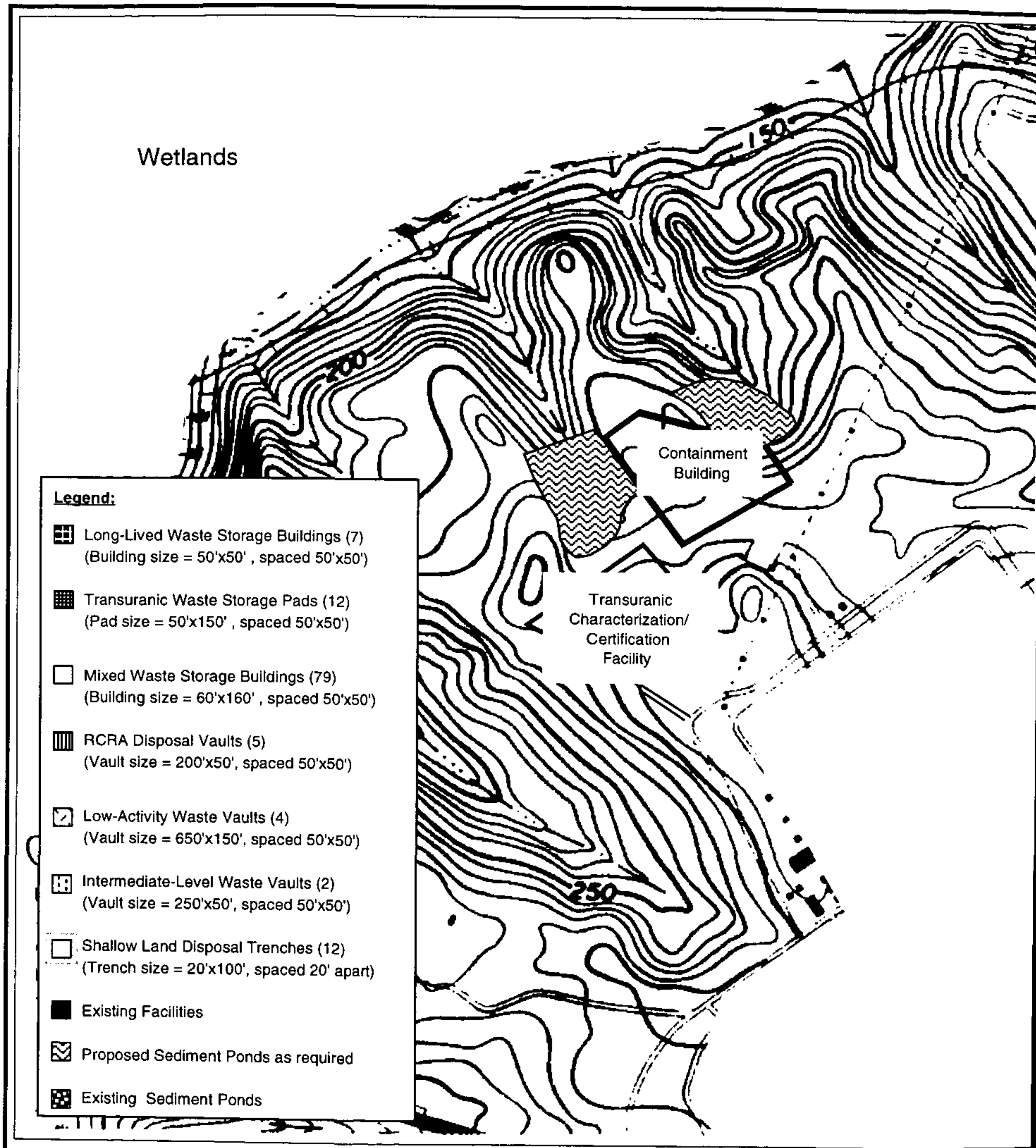
For operations activities, spill prevention, control, and countermeasures plans for this case would be the same as for the no-action alternative.



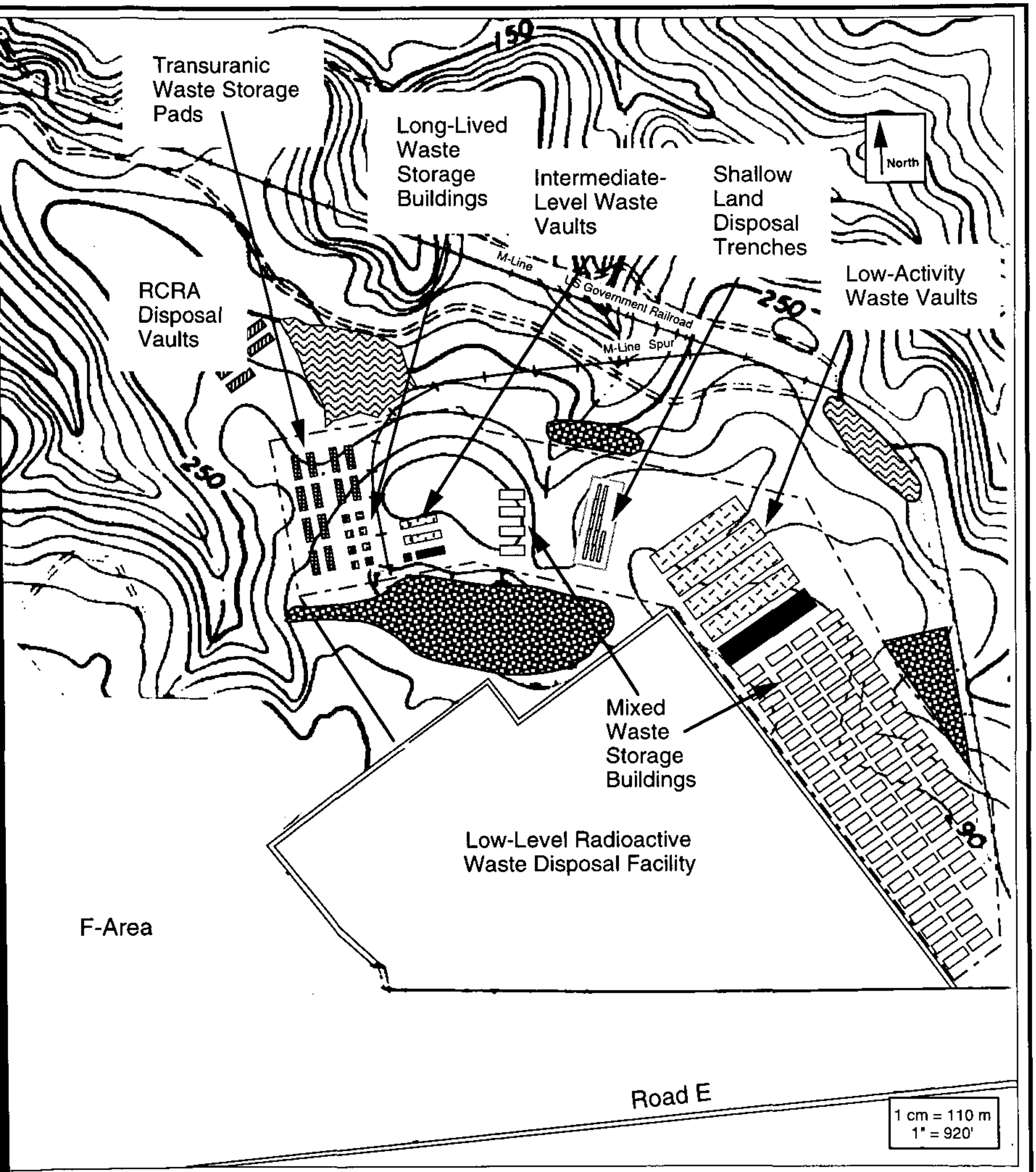
4.2.2.3 Geologic Resources – Maximum Waste Forecast

Effects from alternative A – maximum waste forecast would be greater than from the minimum or expected forecasts previously discussed, because more land would be disturbed during construction activities. Approximately 0.283 square kilometer (70 acres) of cleared land, 0.745 square kilometer (184 acres) of uncleared land in E-Area, and 3.25 square kilometers (802 acres) of land outside E-Area, TC approximately 7 times as much land as would be required for the expected waste forecast, would be used for construction of treatment, storage, and disposal facilities.

For operations activities, spill prevention, control, and countermeasures plans for this alternative would be the same as for the no-action alternative; the potential for spills would be greater because there would be more facilities, and larger amounts of wastes would be managed.

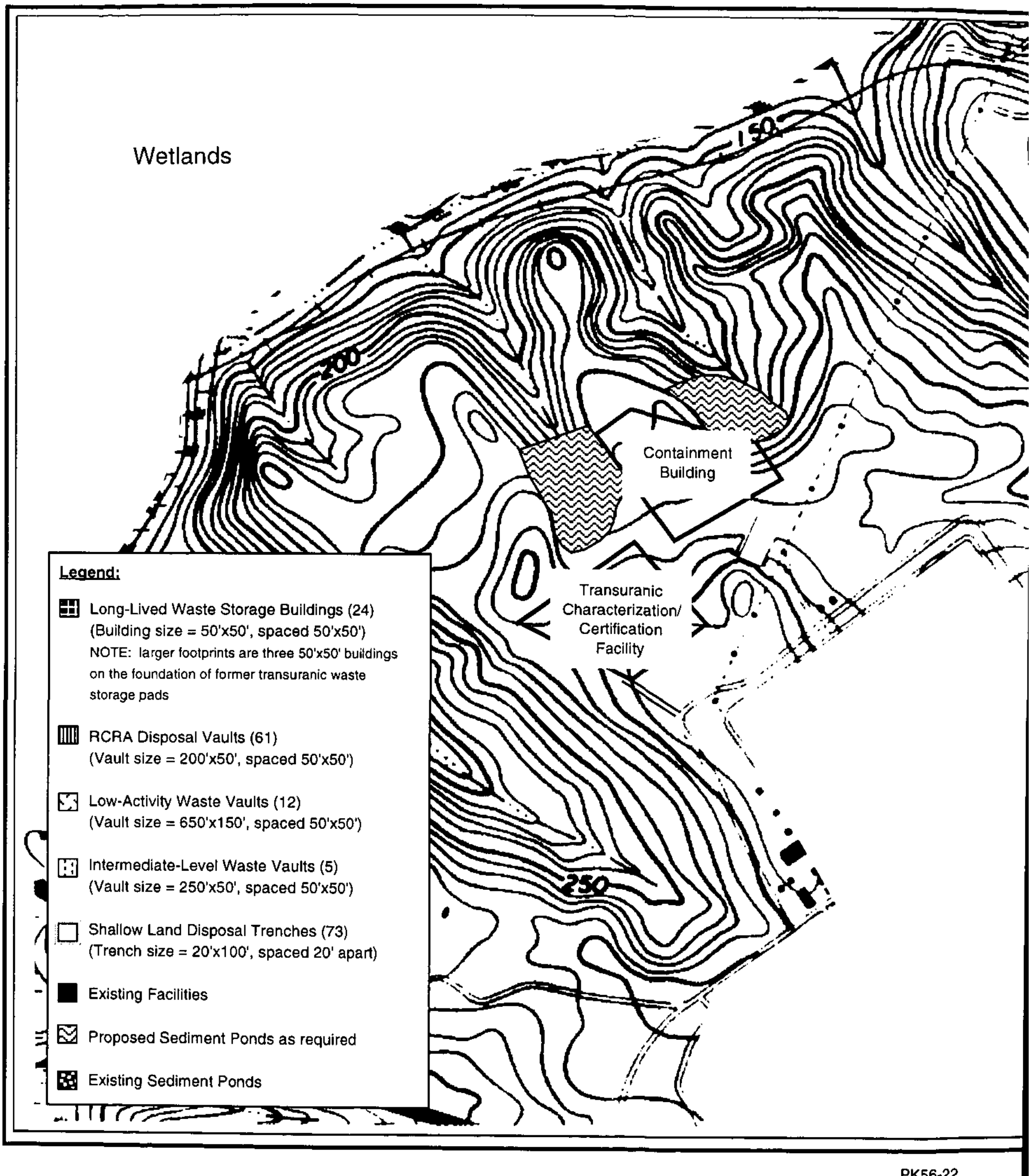


TC | **Figure 4-13.** Configuration of treatment, storage, and disposal facilities in E-Area for alternative A – expected waste forecast by 2006.

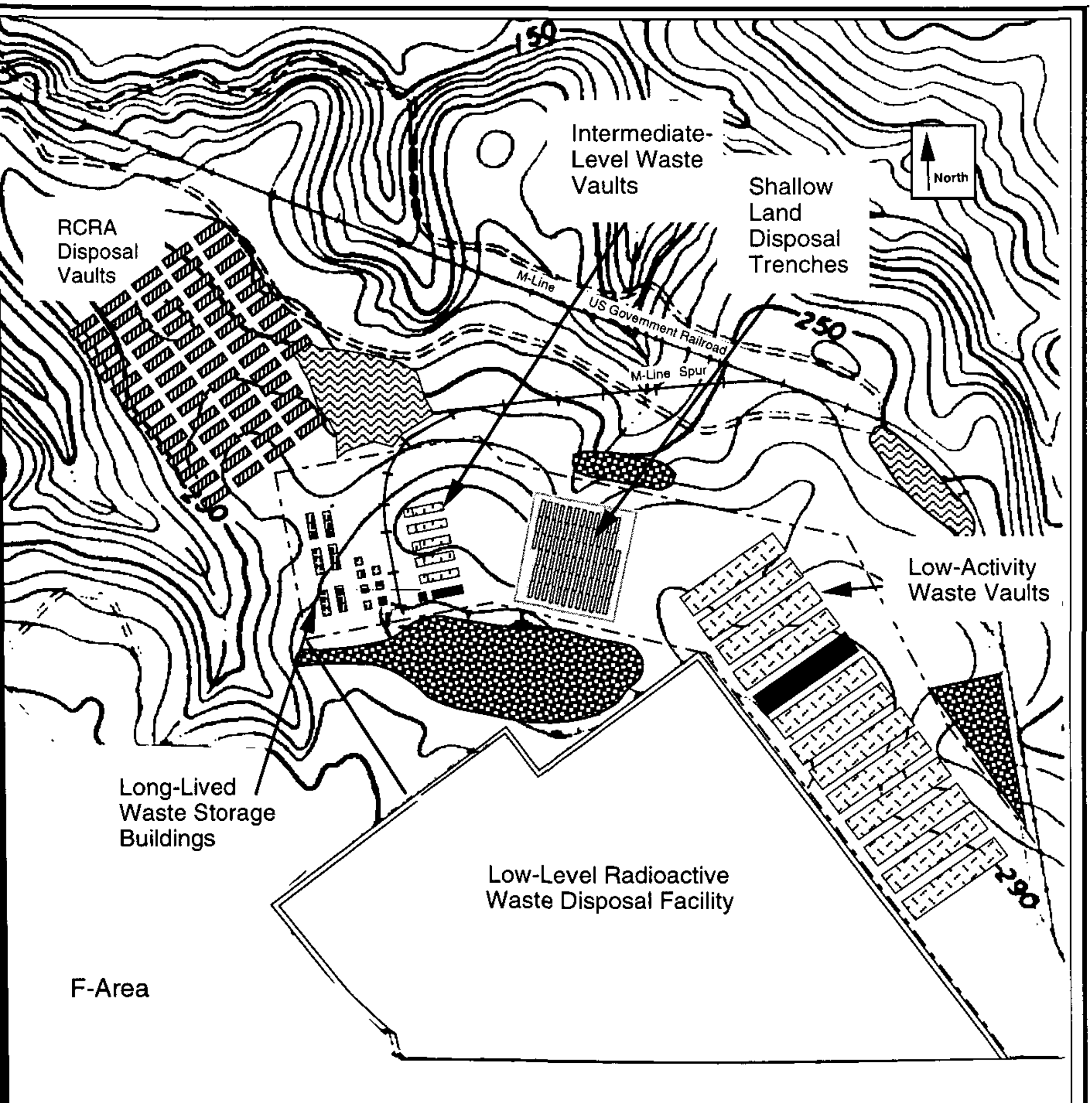


Transuranic Waste Storage Pads
Long-Lived Waste Storage Buildings
Intermediate-Level Waste Vaults
Shallow Land Disposal Trenches
North
Low-Activity Waste Vaults
RCRA Disposal Vaults
M-Line
US Government Railroad
M-Line Spur
150
250
250
250
Mixed Waste Storage Buildings
Low-Level Radioactive Waste Disposal Facility
F-Area
Road E
1 cm = 110 m
1" = 920'

PK56-22



TC | **Figure 4-14.** Configuration of treatment, storage, and disposal facilities in E-Area for alternative A – expected waste forecast by 2024.


150
Intermediate-
Level Waste
Vaults
Shallow
Land
Disposal
Trenches
North
RCRA
Disposal
Vaults
M-Line
US Government Railroad
250
M-Line Spur
Low-Activity
Waste Vaults
Long-Lived
Waste Storage
Buildings
Low-Level Radioactive
Waste Disposal Facility
290
F-Area
Road E
1 cm = 110 m
1" = 920'

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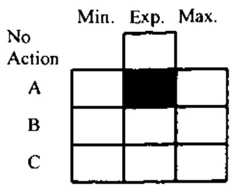
4.2.3 GROUNDWATER RESOURCES



4.2.3.1 Groundwater Resources – Expected Waste Forecast

This section discusses the effects of alternative A – expected waste forecast on groundwater resources at SRS. Effects can be evaluated by comparing the concentrations of contaminants predicted to enter the groundwater for each alternative and waste forecast. Effects on groundwater resources under the no-action alternative (Section 4.1.3) form the basis for comparison among the alternatives and are referenced in this section.

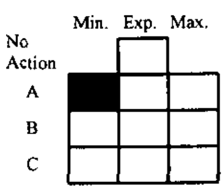
Operation and impacts of the M-Area Air Stripper and the F- and H-Area tank farms would be the same as under the no-action alternative.

TE For the expected forecast and as noted in Section 4.1.3, releases to groundwater from RCRA-permitted disposal vaults would be improbable during active maintenance; however, releases could eventually occur after loss of institutional control and degradation of the vaults. Impacts from the RCRA-permitted disposal vaults would be similar to the effects under the no-action alternative (Section 4.1.3).

There would be two more additional low-activity and intermediate-level radioactive waste disposal
TC vaults (17) than under the no-action alternative (15). Modeling has shown that releases from these vaults would not cause groundwater standards to be exceeded during the 30-year planning period or the
TC 100-year institutional control period. As in the no-action alternative, no radionuclide exceeded the
TE 4 millirem per year standard for a user of shallow groundwater from the hypothetical well 100 meters
TC (328 feet) from the waste disposal facility at any time after disposal (Toblin 1995). Also as in the no-action alternative, the predicted concentrations of tritium would be a very small fraction of the
TE drinking water standard. The discussion in Section 4.1.3 on the basis for the 4 millirem standard also applies to this case. Impacts under this forecast would be similar to the effects under the no-action alternative.

Under this waste forecast, 73 additional slit trenches would be constructed. Twenty-seven (27) of these slit trenches would be used for disposal of suspect soil and have been evaluated using results from the previous Radiological Performance Assessment (Martin Marietta, EG&G, and WSRC 1994). Under this waste forecast, modeling results indicate that none of the radionuclides analyzed would at any time TC exceed DOE's performance objective of 4 millirem per year for drinking water (Toblin 1995). The remaining trenches would be filled with stabilized waste forms (e.g., ashcrete) subject to completion of performance assessments and demonstration of compliance with the performance objectives required by DOE Order 5820.2A. Therefore, DOE has conservatively assumed that groundwater concentrations as a result of radioactive releases from the RCRA-permitted vaults and all other low-level waste disposal TE facilities (vaults and slit trenches) would remain within the DOE performance objective of 4 millirem per year adopted by DOE in Order 5400.5.

In summary, effects on groundwater for alternative A – expected waste forecast would be very small and TC similar to the effects discussed under the no-action alternative.



4.2.3.2 Groundwater Resources – Minimum Waste Forecast

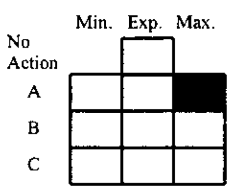
For the minimum forecast, and as discussed in Section 4.1.3, releases to groundwater from the disposal vaults would be improbable during active maintenance; however, releases could eventually occur after TE the loss of institutional control and degradation of the vaults. Impacts from the disposal vaults would be similar to the effects under the no-action alternative (Section 4.1.3).

There would be four fewer additional low-activity and intermediate-level radioactive waste disposal vaults (11) than under the no-action alternative (15). Impacts of disposal in these vaults are similar to the impacts discussed in Section 4.1.3. Exceedance of the 4 millirem per year drinking water standard does TC not occur for any radionuclide in shallow groundwater at any time after disposal (Toblin 1995).

For this forecast there would be limited direct disposal of radioactive waste by shallow land disposal (25 additional slit trenches). Eleven (11) of these slit trenches would be used for disposal of suspect soil and have been evaluated using results from the previous Radiological Performance Assessment (Martin TC Marietta, EG&G, and WSRC 1994). Under this waste forecast, modeling results indicate that none of

the radionuclides analyzed would at any time exceed DOE's performance objective of 4 millirem per
year for drinking water. The remaining trenches would be filled with stabilized waste forms
(e.g., ashcrete) subject to completion of performance assessments and demonstration of compliance with
TC the performance objectives required by DOE Order 5820.2A. Therefore, DOE has conservatively
TE assumed that groundwater concentrations as a result of radioactive releases from the RCRA-permitted
vaults and all other low-level waste disposal facilities (vaults and slit trenches) would remain within the
DOE performance objective of 4 millirem per year adopted by DOE in Order 5400.5.

In summary, effects on groundwater for alternative A – minimum waste forecast would be similar to the
TC effects under the no-action alternative (Section 4.1.3) and the effects for alternative A – expected waste
forecast.



4.2.3.3 Groundwater Resources – Maximum Waste Forecast

TC For the maximum forecast under alternative A, a total of 347 disposal vaults would have been
constructed by 2024. However, these vaults would have double liners and leak-detection and
leachate-collection systems, as required by RCRA (see Section 4.1.3). Therefore, despite the large
number of vaults required, releases to groundwater would be improbable during active maintenance;
TE however, releases could eventually occur after loss of institutional control and degradation of the vaults.
Impacts from the RCRA-permitted disposal vaults would be similar to the effects under the no-action
alternative (Section 4.1.3). Potential effects on groundwater resources due to the construction of RCRA-permitted disposal vaults would be similar to the potential effects due to the construction of mixed-waste
storage buildings under the no-action alternative discussed in Section 4.1.3.

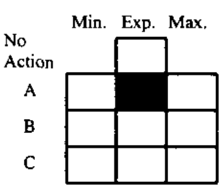
There would be more than four times the number of low-activity and intermediate-level radioactive
waste disposal vaults (62) than under the no-action alternative (15). Predicted effects on groundwater
resources from low-activity and intermediate-level radioactive waste disposal vaults would be similar to
TC those effects under the no-action alternative (Section 4.1.3); no radionuclide would exceed the 4 millirem
drinking water standard at any time after disposal (Toblin 1995).

For the maximum forecast, 644 additional slit trenches would be needed to support shallow land
TC disposal. Four hundred twenty six (426) of these slit would be used for disposal of suspect soil and have
been evaluated using results from the previous Radiological Performance Assessment (Martin Marietta,

EG&G, and WSRC 1994). Under this waste forecast, modeling results indicate that none of the radionuclides analyzed would at any time exceed DOE's performance objective of 4 millirem per year from drinking water (Toblin 1995). The remaining trenches would be filled with stabilized waste forms TC (e.g., ashcrete) subject to completion of performance assessments and demonstration of compliance with the performance objectives required by DOE Order 5820.2A. Therefore, DOE has conservatively assumed that groundwater concentrations as a result of radioactive releases from the RCRA-permitted vaults and all other low-level waste disposal facilities (vaults and slit trenches) would remain with the TE DOE performance objective of 4 millirem per year adopted by DOE in Order 5400.5.

In summary, predicted impacts to groundwater for alternative A – maximum waste forecast would be similar to those under the no-action alternative (Section 4.1.3) and alternative A – expected waste TC forecast (Section 4.2.3.1).

4.2.4 SURFACE WATER RESOURCES



4.2.4.1 <u>Surface Water Resources – Expected Waste Forecast</u>

The impacts of the alternatives can be compared by examining the pollutants that would be introduced to TE the surface waters. The effect of alternative A – expected waste forecast on SRS streams would not differ from present effects, except that flow rates of the discharged treated wastewater would increase slightly.

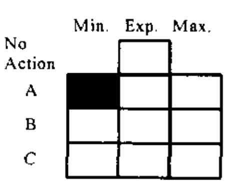
As discussed in Section 4.1.4, construction of facilities would require sedimentation and erosion control plans to prevent adverse effects to streams by silt, oil/grease, or other pollutants that could occur in runoff. Regular inspection of the implementation of these plans would be performed as outlined in Section 4.1.4. After facilities were operating, they would be included in the *SRS Stormwater Pollution Prevention Plan*, and erosion and pollution control measures would be implemented as indicated in this plan.

For alternative A – expected waste forecast, the M-Area Air Stripper, the M-Area Dilute Effluent Treatment Facility, and the F/H-Area Effluent Treatment Facility would receive the same additional wastewater flows for treatment as those received in the no-action alternative. Each of these facilities has TC the design capacity to treat the additional flows and maintain discharge levels in compliance with established permit conditions. The treated effluent from these facilities would, as explained in Section 4.1.4, continue to have little, if any, impact to receiving streams. Radionuclide concentrations would be the same as those reported for the no-action alternative. Drinking water doses due to stormwater infiltrating the vaults and trenches and draining to surface water would be many times lower TC than regulatory standards (Toblin 1995).

The Replacement High-Level Waste Evaporator (as noted under the no-action alternative) would evaporate the liquid waste from the high-level waste tanks in the F- and H-Area tank farms. It would be used in the same manner as the present F- and H-Area evaporators, with the distillate being sent to the F/H-Area Effluent Treatment Facility for treatment prior to being discharged to Upper Three Runs. The concentrate from the evaporator would be sent to the Defense Waste Processing Facility for vitrification. Since the Replacement High Level Waste Evaporator would be used in the same manner as the existing evaporators and would produce a distillate similar in composition to the present distillate, the effect of the F/H-Area Effluent Treatment Facility effluent on Upper Three Runs would be the same as it is now.

Wastewater from the containment building would be transferred to the Consolidated Incineration Facility for treatment. The containment building would not discharge to a stream.

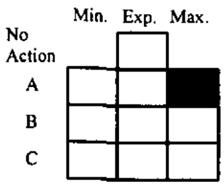
Wastewater discharges would not occur from the mobile soil sort facility under this alternative.



4.2.4.2 Surface Water Resources – Minimum Waste Forecast

The M-Area Dilute Effluent Treatment Facility would receive the same additional wastewater flow for treatment as under the no-action alternative. The M-Area Air Stripper and the F/H-Area Effluent Treatment Facility would each receive approximately 0.4 gallon (1.5 liters) per minute less than that sent to each facility under the no-action alternative. As explained in Section 4.1.4, the treated effluent from these facilities would continue to have little, if any, impact on receiving streams. Each facility has the necessary capacity to treat the additional wastewater and maintain discharges in compliance with established permit conditions. Also, because of less waste disposal, groundwater discharging to surface water would have a very small impact (Toblin 1995). Drinking water doses due to stormwater TC infiltrating waste disposal vaults and trenches and draining to surface waters would be many times lower than regulatory standards.

As discussed in Section 4.1.4, erosion and sedimentation control plans would be prepared and implemented for the construction projects, and the operators of the facilities would be required to abide by the *SRS Pollution Prevention Plan*.



4.2.4.3 Surface Water Resources – Maximum Waste Forecast

Storage and disposal facilities would be as described in Section 4.2.4.1. Surface waters would not be affected by operation of these facilities.

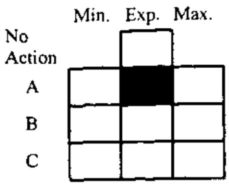
For the maximum waste forecast, wastewater from the containment building would not be transferred to the Consolidated Incineration Facility because that facility could not handle the increased volume. A new wastewater treatment facility would be installed to treat this wastewater to meet outfall discharge limits established by SCDHEC. The average flow rate for this discharge would be approximately 11 liters (2.9 gallons) per minute. The dose to the offsite maximally exposed individual would be 2.1×10^{-5} millirem (Appendix E). The flow of properly treated water would not affect the water quality of the receiving stream.

The M-Area Air Stripper and the M-Area Dilute Effluent Treatment Facility would receive approximately the same additional wastewater flows as under the no-action alternative. The F/H-Area Effluent Treatment Facility would receive additional wastewater flow of 0.28 gallon (1.1 liter) per minute above that for the no-action alternative. The facilities have the capacity to treat the additional flow.

Stormwater infiltrating the disposal vaults and trenches would drain to surface water at concentrations many times less than regulatory standards (Toblin 1995). TC

Erosion and sediment control during construction projects and pollution prevention plans after operations begin would be required, as discussed in Section 4.1.4.

4.2.5 AIR RESOURCES



4.2.5.1 Air Resources – Expected Waste Forecast

Impacts to air can be compared among the alternatives by evaluating the pollutants introduced to the air. Under alternative A expected waste forecast, DOE would continue ongoing and planned waste treatment activities and construct and operate the additional facilities identified in Section 4.2.1. Additional nonradiological and radiological emissions would come from these facilities. The resulting increases of
TE pollutant concentrations at and beyond the SRS boundary would be very small compared to existing concentrations. Operations for alternative A – expected waste forecast would not exceed state or Federal air quality standards.

4.2.5.1.1 Construction

Potential impacts to air quality from construction activities would include fugitive dust (particulate matter) and exhaust from earth-moving equipment. For this case, approximately 5.73×10^5 cubic meters (7.50×10^5 cubic yards) of soil in E-Area would be moved. Fugitive dust emissions for alternative A –
TE expected waste forecast were estimated using the calculations described in Section 4.1.5.1.

Maximum SRS boundary-line concentrations of air pollutants from a year of average construction activity are shown in Table 4-16. The sum of the incremental increases of pollutant concentrations due to construction and the existing baseline concentrations would be within both state and Federal air quality standards.

4.2.5.1.2 Operations

In addition to the current emissions from SRS, nonradiological and radiological emissions would occur due to the operation of new facilities such as the Defense Waste Processing Facility, including In-Tank Precipitation; the M-Area Vendor Treatment Facility; the Consolidated Incineration Facility; the mixed waste containment building; mixed waste soil sort facility; and the transuranic waste characterization/ certification facility. Air emissions from facilities such as disposal vaults and mixed waste storage buildings would be very small.

Table 4-16. Maximum SRS boundary-line concentrations resulting from a year of construction activities under alternative A (in micrograms per cubic meter of air).

Pollutant	Averaging time	Baseline[a] (µg/m³)	Average increase[b] (µg/m³) Expected	Average increase[b] (µg/m³) Minimum	Average increase[b] (µg/m³) Maximum	SCDHEC[c] standard (µg/m³)	Baseline + increase as percent of standard Expected	Baseline + increase as percent of standard Minimum	Baseline + increase as percent of standard Maximum
Nitrogen oxides	1 year	14	0.01	<0.01[d]	0.02	100	14	14	14
Sulfur dioxide	3 hours	857	37.06	17.61	414	1,300	69	67	98
	24 hours	213	0.70	0.34	7.82	365	59	58	60
	1 year	17	<0.01	<0.01	<0.01	80	21	21	21
Carbon monoxide	1 hour	171	769	394	7,751	4.0×10^4	2	1	20
	8 hours	22	54	62	1,177	1.0×10^4	1	1	12
Total suspended particulates	1 year	43	0.01	0.01	0.06	75	57	57	57
Particulate matter less than 10 microns in diameter	24 hours	85	2.71	1.30	28.00	150	59	58	75
	1 year	25	0.02	0.01	0.09	50	50	50	50

a. Source: Stewart (1994).
b. Source: Hess (1994a).
c. Source: SCDHEC (1976).
d. < is read as "less than."

TC

According to the rationale provided about similar facilities contained in Section 4.1.5.2, increases in maximum boundary-line concentrations of pollutants would not result from the continued operation of the F- and H-Area tank farm evaporators, the F/H-Area Effluent Treatment Facility, the scrap-lead melter, solvent distillation units, the silver recovery unit, the Organic Waste Storage Tank, Savannah River Technology Center ion exchange process, low-level waste compactors, or the M-Area Air Stripper. Additional emissions from the M-Area Air Stripper and the F/H-Area Effluent Treatment Facility would be very small, as addressed in Section 4.1.5.2.

Nonradiological Air Emissions Impacts

Maximum ground-level concentrations for nonradiological air pollutants were determined from the Industrial Source Complex Version 2 Dispersion Model using maximum potential emissions from all the facilities included in alternative A (Stewart 1994). The bases for calculating the dispersion of toxic substances that are carcinogenic are presented in Section 4.1.5.2. Modeled air toxic concentrations for carcinogens are based on an annual averaging period and are presented in Section 4.2.12.2.2. The methodology for calculating an annual averaging period is presented in Section 4.1.5.2.1. Air dispersion modeling was performed using calculated emission rates for facilities not yet operating and actual 1990 emission levels for facilities currently operating (Stewart 1994).

The following facilities were incorporated in the modeling analysis for alternative A air dispersion: the Consolidated Incineration Facility, including the ashcrete storage silo, the ashcrete hopper duct, and the TC ashcrete mixer; four new solvent tanks at the Consolidated Incineration Facility; the Defense Waste Processing Facility, including In-Tank Precipitation; the M-Area Vendor Treatment Facility; the mixed waste containment building; the transuranic waste characterization/certification facility; hazardous waste storage facilities; and mixed waste storage facilities.

Emissions of air toxics would be very small. Maximum boundary-line concentrations for air toxics emanating from SRS sources, including the Consolidated Incineration Facility and the Defense Waste Processing Facility, would be well below regulatory standards and are presented in the *SCDHEC Regulation No. 62.5 Standard No. 2 and Standard No. 8 Compliance Modeling Input/Output Data.*

The Savannah River Technology Center laboratory's liquid waste and the E-Area vaults would have very small air emissions, as described in Section 4.1.5.2.

Table 4-17 shows the increase in maximum ground-level concentrations at the SRS boundary for nonradiological air pollutants due to treating the expected, minimum, and maximum waste forecasts under alternative A.

Concentrations at the SRS boundary would be within both state and Federal ambient air quality regulations. Minimal health effects would occur to the public due to routine emissions.

Offsite lead decontamination operations (described in Appendix B.21) would result in a maximum ground-level 3-month concentration of 0.008 micrograms per cubic meter for all alternatives and forecasts, less than the 0.011 micrograms per cubic meter background concentrations of lead in the SRS area (EPA 1990). Both the concentrations at the offsite facility and at SRS are less than 1 percent of the SCDHEC regulatory standard (SCDHEC 1976). Impacts would be very small. TC

Radiological Air Emissions Impacts TE

Offsite maximally exposed individual and population doses were determined for atmospheric releases resulting from routine operations under alternative A. The major sources of radionuclides would be the Consolidated Incineration Facility (mixed waste only), the transuranic waste characterization/ certification facility, and the F/H-Area Effluent Treatment Facility. Other facilities with radiological releases would be the M-Area Vendor Treatment Facility, the mixed waste containment building, and the soil sort facility.

SRS-specific computer codes MAXIGASP and POPGASP were used to determine the maximum individual dose and the dose to the population within an 80-kilometer (50-mile) radius of SRS respectively, from routine atmospheric releases. See Appendix E for detailed facility-specific isotopic and dose data. TE L004-01

Table 4-18 shows the dose to the offsite maximally exposed individual and the population from atmospheric pathways. The calculated maximum committed effective annual dose equivalent (see glossary for definitions of dose, dose equivalent, effective dose, and committed effective dose equivalent) to a hypothetical individual would be 0.011 millirem (Chesney 1995), which is 1,000 times less than the annual dose limit of 10 millirem from SRS atmospheric releases. In comparison, an individual living near SRS receives a dose of 0.25 millirem from all current SRS releases of radioactivity (Arnett 1994). The 0.011 millirem annual dose is greater than the 1.3×10^{-4} millirem dose shown for the no-action alternative. TE TC TC

Table 4-17. Changes in maximum ground-level concentrations of air pollutants at the SRS boundary for alternative A – expected, minimum, and maximum waste forecasts (micrograms per cubic meter of air).

Pollutant	Averaging time	Existing sources (μg/m³)[a,b]	Regulatory standards (μg/m³)[c]	Background concentration (μg/m³)[d]	Increase in concentration (μg/m³) Expected[b]	Minimum	Maximum	Percent of standard[e] Expected	Minimum	Maximum
Nitrogen oxides	1 year	6	100	8	0.46	0.46	0.47	14	14	14
Sulfur dioxides	3 hours	823	1,300	34	3.78	3.78	3.79	66	66	66
	24 hours	196	365	17	0.69	0.69	0.69	59	59	59
	1 year	14	80	3	0.23	0.23	0.23	22	22	22
Carbon monoxide	1 hour	171	40,000	NA[f]	22.93	22.93	22.93	0.5	0.5	0.5
	8 hours	22	10,000	NA	5.37	5.37	5.37	0.3	0.3	0.3
Total suspended particulates	1 year	13	75	30	2.01	2.01	2.01	60	60	60
Particulate matter less than 10 microns in diameter	24 hours	51	150	34	4.61	4.61	4.61	60	60	60
	1 year	3	50	22	0.10	0.10	0.10	50	50	50
Lead	3 months	4.0×10^{-4}	1.50	0.01	8.0×10^{-6}	4.9×10^{-6}	6.2×10^{-6}	0.8	0.8	0.8
Gaseous fluorides (as hydrogen fluoride)	12 hours	2	3.70	NA	0.00187	0.00187	0.00187	54	54	54
	24 hours	1	2.90	NA	9.3×10^{-4}	9.3×10^{-4}	9.3×10^{-4}	35	35	35
	1 week	0.4	1.60	NA	3.5×10^{-4}	3.5×10^{-4}	3.5×10^{-4}	25	25	25
	1 month	0.1	0.80	NA	9.0×10^{-5}	9.0×10^{-5}	9.0×10^{-5}	13	13	13

a. Micrograms per cubic meter of air.
b. Source: Stewart (1994).
c. Source: SCDHEC (1976).
d. Source: SCDHEC (1992).
TE e. Percent of standard = 100 × (existing + background + increase) divided by the regulatory standard.
f. NA = not applicable.

TC

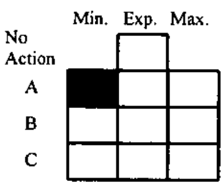
The annual dose to the population within 80 kilometers (50 miles) of SRS from treatment of the expected amount of waste would be 0.56 person-rem. This dose is greater than the population dose of 2.9×10^{-4} for the no-action alternative. In comparison, the collective dose received by the same population from natural sources of radiation is approximately 195,000 person-rem (Arnett, Karapatakis, and Mamatey 1994). Section 4.2.12.1.2 describes the potential health effects of these releases. TC

Table 4-18. Annual radiological doses to individuals and the population within 80 kilometers (50 miles) of SRS from atmospheric pathways under alternative A.[a]

Waste forecast	Offsite maximally exposed individual dose (millirem)	Population[b] dose (person-rem)
Expected waste forecast	0.011	0.56
Minimum waste forecast	0.0057	0.27
Maximum waste forecast	0.080	3.4

TC

a. Source: Chesney (1995). TC
b. For atmospheric releases, the dose is to the population within 80 kilometers (50 miles) of SRS.



4.2.5.2 Air Resources – Minimum Waste Forecast

4.2.5.2.1 Construction

Impacts were evaluated for the construction of storage, treatment, and disposal facilities listed in Section 2.4.7. Maximum concentrations at the SRS boundary resulting from a year of average construction activity are shown in Table 4-16 for alternative A – minimum waste forecast. Construction-related emissions would yield SRS boundary-line concentrations less than both state and Federal air quality standards.

4.2.5.2.2 Operations

Both radiological and nonradiological emission changes were determined for the same facilities listed in Section 4.2.5.1.2. Air emissions would be less than those for the expected waste forecast.

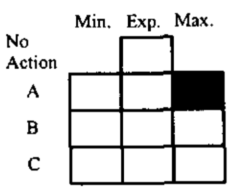
Nonradiological Air Emission Impacts

Nonradiological air emissions would be only slightly less than those for the expected waste forecast. Maximum SRS boundary-line concentrations are presented in Table 4-17. Modeled concentrations are similar to those shown for the expected waste forecast and under the no-action alternative (Table 4-17). Total concentrations would be less than applicable state and Federal ambient air quality standards.

Radiological Air Emission Impacts

Table 4-18 presents the dose to the offsite maximally exposed individual and the population due to atmospheric releases. The calculated maximum committed annual dose equivalent to a hypothetical
TC individual is 0.0057 millirem (Chesney 1995), which is less than the dose for the expected waste forecast and well below the annual dose limit of 10 millirem from SRS atmospheric releases.

The annual dose to the population within 80 kilometers (50 miles) of SRS would be 0.27 person-rem, which is less than the population dose calculated for the expected waste forecast.



4.2.5.3 Air Resources – Maximum Waste Forecast

Alternative A – maximum waste forecast would have greater air quality impacts than the expected waste forecast.

4.2.5.3.1 Construction

Impacts were evaluated for the construction of storage, treatment, and disposal facilities listed in Section 2.4.7. Maximum concentrations at the SRS boundary resulting from a year of average construction activity are presented in Table 4-16 for the maximum waste forecast. Construction-related concentrations would yield SRS boundary concentrations less than both state and Federal air quality standards.

4.2.5.3.2 Operations

Both radiological and nonradiological emissions increases were determined for the same facilities listed in Section 4.2.5.1.2. Air emissions would be greater than in the expected waste forecast; therefore,
TC impacts to air quality would be greater. However, they would remain within state and Federal ambient air quality standards.

Nonradiological Air Emissions Impacts TE

Nonradiological air emissions would be slightly higher than those associated with the expected waste forecast. Maximum concentrations at the SRS boundary are presented in Table 4-17. Modeled concentrations are similar to those for the expected waste forecast. Cumulative concentrations would be below applicable state and Federal ambient air quality standards.

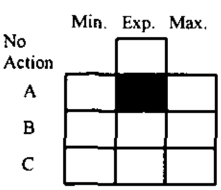
Radiological Air Emissions Impacts TE

Offsite maximally exposed individual and population doses were determined for atmospheric releases resulting from routine operations at the facilities identified in Section 4.2.5.1.2.

Table 4-18 shows the dose to the offsite maximally exposed individual and to the population due to atmospheric releases. The calculated maximum committed annual dose equivalent to a hypothetical individual is 0.080 millirem (Chesney 1995), which would be greater than the dose from the expected TC waste forecast but well below the annual dose limit of 10 millirem from SRS atmospheric releases.

The annual dose to the population within 80 kilometers (50 miles) of SRS would be 3.4 person-rem, which would be greater than the population dose calculated for the expected waste forecast. Section 4.2.12.1.2 describes the potential health effects of these releases.

4.2.6 ECOLOGICAL RESOURCES



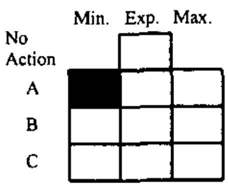
4.2.6.1 Ecological Resources – Expected Waste Forecast

Construction of new waste treatment, storage, and disposal facilities for alternative A – expected waste forecast would result in the clearing and grading of undisturbed areas. (These areas are given in acres; to convert to square kilometers, multiply by 0.004047.) Sixty-four acres of woodland would be cleared TC and graded by 2006 and an additional 32 acres would be needed by 2024, as follows:

- 27 acres of loblolly pine planted in 1987 TC
- 15 acres of white oak, red oak, and hickory regenerated in 1922
- 18 acres of longleaf pine regenerated in 1922, 1931, or 1936

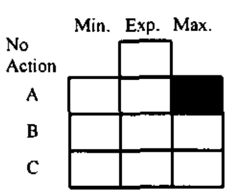
- 4 acres from which mixed pine/hardwood was recently harvested
- 20 acres of loblolly pine planted in 1987 would be cleared between 2007 and 2024
- TC 3 acres of loblolly pine planted in 1946 would be cleared between 2007 and 2024
- 9 acres of longleaf pine planted in 1988 would be cleared between 2007 and 2024

Effects on the ecological resources are described in Section 4.1.6; however, because less land would be TC required for this case (96 acres versus 160 under the no-action alternative), the overall impact due to loss of habitat would be less. For example, fewer animals would be displaced or destroyed.



4.2.6.2 Ecological Resources – Minimum Waste Forecast

TC Approximately 73 acres of undeveloped land located between the M-Line railroad and the E-Area expansion and extending northwest of F-Area would be required. Because less undeveloped land would be required under this waste forecast, impacts to the ecological resources of the area would be slightly less than for the expected waste forecast.

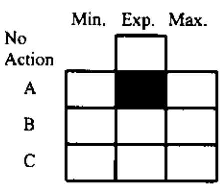


4.2.6.3 Ecological Resources – Maximum Waste Forecast

Approximately 184 acres of undeveloped land located between the M-Line railroad and the developed portion of E-Area and extending northwest of F-Area would be required for the maximum waste TC forecast. By 2006, an additional 802 acres of undeveloped land in an undetermined location would also be required. Impacts to the ecological resources of SRS under this forecast would be approximately 7 times greater than the impacts described in Section 4.1.6 due to the greater acreage required. For example, many more animals would be destroyed or displaced during clearing of this much land. Loss of cover from several hundred acres in a watershed can alter the water chemistry of the creeks in the drainage, which in turn could influence the kinds of organisms that live in the streams.

TE TC Wetlands constitute nearly 21 percent of SRS (DOE 1991). Should the maximum amount of waste be treated, and 802 acres of additional land be required, it is probable that some sites needed for the expansion could contain wetlands. Additionally, a large portion of SRS soils are on steep slopes and highly erodible, with conditions so difficult to overcome that special facility designs, substantial increases in construction costs, and increased maintenance costs would be required (WSRC 1994c). Soils on the steep slopes adjacent to E-Area would be avoided under all alternatives due to these construction and maintenance problems. It is likely that a portion of a site selected for additional waste management construction would contain some unsuitable soils. Threatened and endangered species and significant historic and pre-historic cultural resources are also found throughout SRS and could occur on portions of any site selected for additional waste management facilities. Because of these considerations, it is likely that a tract of land substantially larger than 802 acres would be needed to provide the required acreage. Threatened and endangered species surveys and floodplains and wetland assessments would be required before final site selection. TC

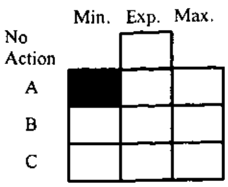
4.2.7 LAND USE



4.2.7.1 <u>Land Use – Expected Waste Forecast</u>

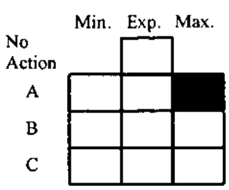
DOE would use approximately 0.52 square kilometer (64 acres of undeveloped; 65 acres of developed) land in E-Area through 2006 for activities associated with alternative A – expected waste forecast. By 2024, 0.61 square kilometer (152 acres) would be required, about 89 acres less than under the no-action alternative. SRS has about 181,000 acres of undeveloped land, which includes wetlands and other areas that cannot be developed, and 17,000 acres of developed land. TC

Activities associated with alternative A would not affect current SRS land-use plans; E-Area was designated as an area for nuclear facilities in the draft *1994 Land-Use Baseline Report.* Furthermore, no part of E-Area has been identified as a potential site for future new missions. According to the *FY 1994 Draft Site Development Plan*, proposed future land management plans specify that E-Area should be characterized and remediated for environmental contamination in its entirety, if necessary. Decisions on future SRS land uses will be made by DOE through the site development, land-use, and future-use planning processes, including public input through avenues such as the Citizens Advisory Board.



4.2.7.2 Land Use – Minimum Waste Forecast

Activities associated with alternative A – minimum waste forecast would not affect current SRS land TC uses. By 2024, approximately 0.44 square kilometer (108 acres; slightly less acreage than would be required in the expected waste forecast) in E-Area would be used for the facilities described in Section 4.2.1.

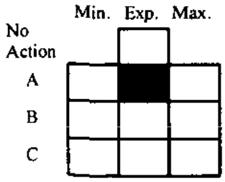


4.2.7.3 Land Use – Maximum Waste Forecast

Activities associated with alternative A – maximum waste forecast would not affect current SRS land TC uses. By 2006, DOE would need a total of 1.03 square kilometers (254 acres) in E-Area and 3.24 square kilometers (802 acres) elsewhere for the facilities described in Section 4.2.1. This acreage is nearly 10 times the land that would be required for the expected or minimum waste forecast, but less than 1 percent of the total undeveloped land on SRS (DOE 1993d). However, considerably more acreage than this may be affected (see Section 4.2.6.3). Current land uses in E-Area would not be impacted. The TC location of the 3.24 square kilometers (802 acres) outside of E-Area has not been identified and the site selection would involve further impact analyses. However, DOE would minimize the impact of clearing TC 3.24 square kilometers (802 acres) by locating these facilities within the central industrialized portion of SRS, as described in Section 2.1.2 and shown in Figure 2-1.

4.2.8 SOCIOECONOMICS

This section describes the potential effects of implementing alternative A on the socioeconomic resources in the region of influence discussed in Section 3.8. This assessment is based on the estimated construction and operations employment required to implement this alternative.



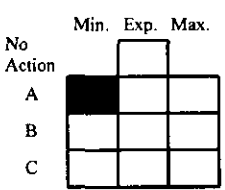
4.2.8.1 Socioeconomics – Expected Waste Forecast

4.2.8.1.1 Construction

Table 4-19 shows the estimated construction employment associated with the expected waste forecast for this alternative. DOE anticipates that construction employment would peak during 2003 through 2005 with approximately 80 jobs, 30 more jobs than during peak employment under the no-action alternative. TC This employment demand represents much less than 1 percent of the forecast employment in 2005. Given the normal fluctuation of employment in the construction industry, DOE does not expect a net change in regional construction employment from implementation of this forecast. Given no net change in employment, neither the population nor personal income in the region would change. As a result, socioeconomic resources would not be affected.

4.2.8.1.2 Operations

Operations employment associated with implementation of the expected waste forecast under this alternative is expected to peak from 2008 through 2018 with an estimated 2,560 jobs, 110 more jobs than during peak employment under the no-action alternative. This employment demand represents less than TC 1 percent of the forecast employment in 2015 (see Chapter 3) and approximately 12 percent of 1995 SRS employment. DOE believes these jobs would be filled from the existing SRS workforce. Thus, DOE anticipates that socioeconomic resources would not be affected by changes in operations employment.



4.2.8.2 Socioeconomics – Minimum Waste Forecast

4.2.8.2.1 Construction

Construction employment associated with the minimum waste forecast under this alternative would be slightly less than that for the expected waste forecast and would peak during 2003 through 2005 with approximately 70 jobs, which represents much less than 1 percent of the forecast employment in 2005. TC Socioeconomic resources in the region would not be affected.

Table 4-19. Estimated construction and operations employment for alternative A – expected, minimum, and maximum waste forecasts.[a]

	Waste Forecast				
	Minimum		Expected		Maximum[b]
Year	Construction	Operations	Construction	Operations	Construction
1995	20	920	50	1,650	290
1996	20	1,150	30	1,920	80
1997	20	1,150	30	1,920	80
1998	20	1,150	40	2,060	190
1999	20	1,150	40	2,170	190
2000	20	1,230	40	2,280	190
2001	20	1,230	40	2,280	190
2002	30	1,310	60	2,330	230
2003	70	1,350	80	2,330	260
2004	70	1,350	80	2,330	260
2005	70	1,350	80	2,330	260
2006	40	1,430	60	2,270	210
2007	20	1,390	40	2,190	80
2008	20	1,680	40	2,560	160
2009	20	1,610	40	2,560	160
2010	20	1,610	40	2,560	160
2011	20	1,610	40	2,560	160
2012	20	1,610	40	2,560	160
2013	20	1,610	40	2,560	160
2014	20	1,610	40	2,560	160
2015	20	1,610	40	2,560	160
2016	20	1,610	40	2,560	160
2017	20	1,610	40	2,560	160
2018	20	1,610	40	2,560	160
2019	20	1,310	40	2,190	80
2020	20	1,310	40	2,190	80
2021	20	1,310	40	2,190	80
2022	20	1,310	40	2,190	80
2023	20	1,310	40	2,190	80
2024	20	1,310	40	2,190	80

TC

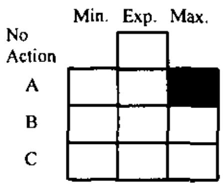
TE

a. Source: Hess (1995a, b).
b. Operations employment for the maximum waste forecast is provided in Table 4-20.

4.2.8.2.2 Operations

TC

Operations employment associated with implementation of the minimum waste forecast is expected to peak in the year 2008 with an estimated 1,680 jobs, 880 fewer jobs than for the expected waste forecast. This employment demand represents less than 1 percent of the forecast employment in 2008 and approximately 8 percent of 1995 SRS employment. DOE believes these jobs would be filled from the existing SRS workforce and anticipates that socioeconomic resources from changes in operations employment would not be affected.



4.2.8.3 Socioeconomics – Maximum Waste Forecast

4.2.8.3.1 Construction

Construction employment associated with alternative A – maximum waste forecast would be greater than that for the expected waste forecast and would peak during 2003 through 2005 with approximately 260 jobs, which represents much less than 1 percent of the forecast employment in 2005. DOE does not expect a net change in regional construction employment from implementation of this case. As a result, socioeconomic resources in the region would not be affected. TC

4.2.8.3.2 Operations

Operations employment associated with implementation of alternative A – maximum waste forecast is expected to peak during 2002 through 2005 with an estimated 11,200 jobs (Table 4-20), which represents 4 percent of the forecast employment in 2005 and approximately 56 percent of 1995 SRS employment. DOE assumes that approximately 50 percent of the total SRS workforce would be available to support the implementation of this case. If DOE transfers 50 percent of the SRS workforce, an additional 3,300 new employees would still be required during the peak years. Based on the number of new jobs predicted, DOE calculated changes in regional employment, population, and personal income using the Economic-Demographic Forecasting and Simulation Model developed for the six-county region of influence (Treyz, Rickman, and Shao 1992). TC

Results of the modeling indicate that the peak regional employment change would occur in 2002 with a total of approximately 7,540 new jobs (Table 4-21) (HNUS 1995b). This would represent a 3 percent increase in baseline regional employment and would have a substantial positive impact on the regional economy. TC

Potential changes in regional population would lag behind the peak change in employment because of migration lags and also because in-migrants may have children after they move into the area. As a result, the maximum change in population would occur in 2005 with an estimated 12,900 additional people in TC

TC the six-county region (HNUS 1995b). This increase is approximately 2.7 percent above the baseline regional population forecast (Table 4-21) and could affect the demand for community resources and services such as housing, schools, police, health care, and fire protection.

Table 4-20. Estimated new operations jobs required to support the alternative A – maximum waste forecast.[a]

Year	Projected total SRS employment	SRS employment available for waste management activities[b]	Total operations employment for the alternative A– maximum waste forecast	New hires[c]
1995	20,000	10,000	2,620	0
1996	15,800	7,900	4,420	0
1997	15,800	7,900	4,730	0
1998	15,800	7,900	10,200	2,300
1999	15,800	7,900	10,490	2,590
2000	15,800	7,900	10,510	2,610
2001	15,800	7,900	10,510	2,610
2002	15,800	7,900	11,200	3,300
2003	15,800	7,900	11,200	3,300
2004	15,800	7,900	11,200	3,300
2005	15,800	7,900	11,200	3,300
2006	15,800	7,900	10,040	2,140
2007	15,800	7,900	4,600	0
2008	15,800	7,900	9,060	1,160
2009	15,800	7,900	9,060	1,160
TC 2010	15,800	7,900	9,060	1,160
2011	15,800	7,900	9,060	1,160
2012	15,800	7,900	9,060	1,160
2013	15,800	7,900	9,060	1,160
2014	15,800	7,900	9,060	1,160
2015	15,800	7,900	9,060	1,160
2016	15,800	7,900	9,060	1,160
2017	15,800	7,900	9,060	1,160
2018	15,800	7,900	9,060	1,160
2019	15,800	7,900	4,600	0
2020	15,800	7,900	4,600	0
2021	15,800	7,900	4,600	0
2022	15,800	7,900	4,600	0
2023	15,800	7,900	4,600	0
2024	15,800	7,900	4,600	0

a. Source: Hess (1995a, b).
b. DOE assumed that approximately 50 percent of the total SRS workforce would be available to support waste management activities.
c. New hires are calculated by comparing the required employment (column 4) to available employment (column 3); new hires would be needed only in those years when required employment exceeds available employees.

Table 4-21. Changes in employment, population, and personal income for alternative A – maximum waste forecast.[a]

Year	New hires[b]	Change in indirect regional employment[c]	Net change in total regional employment	Percent change in regional employment	Change in regional population	Percent change in regional population	Change in regional personal income (millions)	Percent change in regional personal income
1998	2,300	3,300	5,600	2.26	1,960	0.42	270	2.60
1999	2,590	3,640	6,230	2.49	4,600	0.97	340	3.09
2000	2,610	3,490	6,100	2.41	6,380	1.34	370	3.18
2001	2,610	3,330	5,940	2.32	7,770	1.63	390	3.16
2002	3,300	4,240	7,540	2.92	9,460	1.98	520	3.98
2003	3,300	4,100	7,400	2.83	11,020	2.30	550	3.96
2004	3,300	3,990	7,290	2.76	12,080	2.52	580	3.94
2005	3,300	3,920	7,220	2.70	12,900	2.69	610	3.91
2006	2,140	2,170	4,310	1.60	12,490	2.60	430	2.59
2007	0	3,060	3,060	1.13	11,270	2.34	340	1.92
2008	1,160	760	1,920	0.71	9,880	2.04	240	1.27
2009	1,160	910	2,070	0.76	8,690	1.79	240	1.20
2010	1,160	1,070	2,230	0.82	7,850	1.61	250	1.17
2011	1,160	1,220	2,380	0.87	7,170	1.47	260	1.15
2012	1,160	1,340	2,500	0.91	6,630	1.35	280	1.17
2013	1,160	1,450	2,610	0.95	6,200	1.26	310	1.22
2014	1,160	1,530	2,690	0.98	5,850	1.18	330	1.22
2015	1,160	1,600	2,760	1.01	5,560	1.12	360	1.25
2016	1,160	1,650	2,810	1.03	5,310	1.06	380	1.25
2017	1,160	1,680	2,840	1.04	5,100	1.02	410	1.27
2018	1,160	1,710	2,870	1.05	4,920	0.98	440	1.29

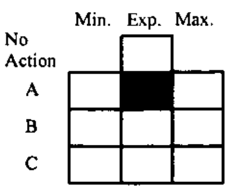
a. Source: Hess (1995a, b); HNUS (1995b).
b. From Table 4-20.
c. Change in employment related to changes in population.

TC

TC Potential changes in total personal income would peak in 2005 with a $610 million increase over forecast income levels for that year (HNUS 1995b). This would be a 4 percent increase over baseline income levels (Table 4-21) and would have a substantial, positive effect on the regional economy.

4.2.9 CULTURAL RESOURCES

This section discusses the effect of alternative A on cultural resources.



4.2.9.1 Cultural Resources – Expected Waste Forecast

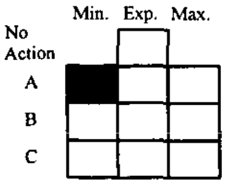
Waste treatment, storage, and disposal facilities would be constructed within the currently developed portion of E-Area, to the north and northwest of this area, and to the northwest of F-Area (see Figures 4-13 and 4-14).

Construction within the developed and fenced portion of E-Area would not affect cultural or archaeological resources because this area has been previously disturbed.

Two small areas of unsurveyed land to the east and northeast of the currently developed portion of E-Area that would be used for the construction of sediment ponds (see Figure 4-5) would be surveyed before beginning construction. If important resources were discovered, DOE would avoid them or remove them.

Construction of the RCRA-permitted disposal vaults to the northwest of the currently developed portion of E-Area (see Figure 4-13) would not affect archaeological resources because when this area was surveyed important sites were not discovered.

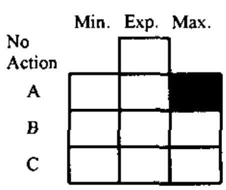
Archaeological sites in the area of expansion could be impacted as described in Section 4.1.9. If this occurred, DOE would protect these resources as described in Section 4.1.9.



4.2.9.2 Cultural Resources – Minimum Waste Forecast

Construction of new waste management storage facilities for this forecast would require approximately 0.18 fewer square kilometer (44 fewer acres) than that for the expected waste forecast. Although the precise configuration of facilities is currently undetermined, construction would take place within previously disturbed parts of E-Area. TC

As discussed in Section 4.2.9.1, construction within the developed and fenced portion of E-Area or to the northwest of this area would not have an effect on archaeological resources. Before construction would begin in the undeveloped area northwest of F-Area, the Savannah River Archaeology Research Program and DOE would complete the consultation process with the State Historic Preservation Officer and develop mitigation action plans to ensure that important archaeological resources would be protected and preserved (Sassaman 1994).



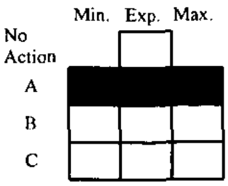
4.2.9.3 Cultural Resources – Maximum Waste Forecast

Construction of new waste management storage, treatment, and disposal facilities for this forecast would require approximately 4.27 square kilometers (1,056 acres), 3.66 kilometers (904 acres) more than for the expected waste forecast. Some of the new facilities would be sited within E-Area; however, DOE would need an estimated additional 3.24 square kilometers (802 acres) outside of E-Area. TC TC

Construction within the developed and fenced portion of E-Area or to the northwest of this area would be preceded by consultation with the State Historic Preservation Officer and the development of a mitigation plan to ensure that archaeological resources would be protected.

Until DOE determines the precise location of the additional 3.24 square kilometers (802 acres) that would be used outside of E-Area, effects on cultural resources cannot be predicted. The potential disturbance of important cultural resources would be proportional to the amount of land disturbed. However, in compliance with the Programmatic Memorandum of Agreement, DOE would survey areas TC proposed for new facilities prior to disturbance. If important resources were discovered, DOE would avoid or remove them.

TE

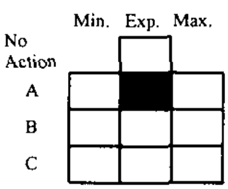


4.2.10 AESTHETICS AND SCENIC RESOURCES – EXPECTED, MINIMUM, AND MAXIMUM WASTE FORECASTS

TE Activities associated with alternative A – expected, minimum, and maximum waste forecasts would not adversely affect scenic resources or aesthetics. E-Area is already dedicated to industrial use. In all cases, new construction would not be visible from off SRS or from public access roads on SRS. The new facilities would not produce emissions that would be visible or that would indirectly reduce visibility.

4.2.11 TRAFFIC AND TRANSPORTATION

4.2.11.1 Traffic



4.2.11.1.1 Traffic – Expected Waste Forecast

The additional traffic under alternative A – expected waste forecast (Table 4-22) would result from construction activities. The increase would be greatest in 2003, when the greatest number of people would be employed. In the table, the additional traffic is distributed among offsite roads based on the percentage of baseline traffic each road carries. Traffic on all roads would remain within design capacity, and the effects of increased traffic would be very small.

Additional truck traffic due to increased construction activities was estimated to be fewer than 10 trucks per day for all alternatives (Hess 1994d). DOE would not expect this increase in construction-related truck traffic during normal working hours to adversely affect traffic; therefore, it will not be discussed in subsequent sections.

TC For the expected waste forecast, there would be two additional waste shipments per day over the no-action estimates (Table 4-23). This would be due to shipments of stabilized ash and blowdown from the Consolidated Incineration Facility to disposal facilities. DOE would not expect the additional truck traffic during normal working hours to adversely affect traffic. Numbers of shipments assumed under each alternative are given in Tables E.3-1 through E.3-3. TE

Table 4-22. Number of vehicles per hour during peak hours under alternative A.

Road	Design capacity (vehicles per hour)	No-action alternative (Percentage of design capacity)	Waste Forecast		
			Minimum	Expected	Maximum
Offsite			(percentage of design capacity)		
SC 19	3,000[b]	2,821(94)	2,831(94)	2,837(95)	2,917(97)
SC 125	3,200[b]	2,720(85)	2,730(85)	2,736(85)	2,812(88)
SC 57	2,100[b]	706(33)	707(34)	709(34)	729(35)
Onsite					
Road E at E-Area	2,300[c]	788[d](34)	809[e](35)	824[e](36)	999[e](43)

TC

a. Number in parentheses represents percentage of design capacity.
b. Adapted from Smith (1989).
c. Adapted from TRB (1985).
d. Includes baseline plus the maximum number (47) of construction workers (Hess 1995a, b).
e. Includes baseline plus the maximum number (68 for the minimum, 83 for the expected, and 258 for the maximum waste forecast) of construction workers (Hess 1995a, b).

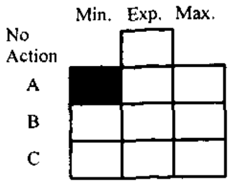
TC

Table 4-23. SRS daily hazardous and radioactive waste shipments by truck under alternative A.[a]

Waste type	1994 no-action traffic[a]	Change from no-action		
		Minimum	Expected	Maximum
Hazardous	14	-6	<1[b]	6
Low-level	7	-3	0	12
Mixed	8	-4	2	25
Transuranic[c]	1	<1	<1	15
Total change	NA[d]	-13	2	58
Total shipments per day	30	17	32	88

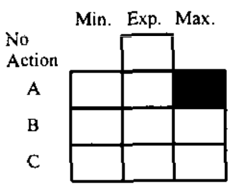
TC

a. Shipments per day: To arrive at shipments per day, the total number of waste shipments estimated for the 30 years considered in this EIS was divided by 30 to determine estimated shipments per year. These numbers were divided by 250, which represents working days in a calendar year, to determine shipments per day. Supplemental data are provided in the traffic and transportation section of Appendix E.
b. Values less than 1 are treated as zero for purposes of comparison.
c. Includes mixed and nonmixed transuranic waste shipments.
d. NA = not applicable.



4.2.11.1.2 Traffic – Minimum Waste Forecast

TC For the minimum waste forecast, there would be 21 more vehicles than in the no-action alternative during peak commuter hours (Table 4-22). Traffic on all roads would remain within design capacity. The effects of traffic under this case would be very small. There would be 13 fewer waste shipments per day compared to no-action estimates (Table 4-23). This decrease is due to smaller volumes of all types of waste. The lower volume of truck traffic would result in a slightly positive effect on traffic.



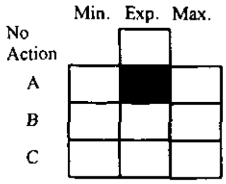
4.2.11.1.3 Traffic – Maximum Waste Forecast

As discussed in Section 4.1.11.1, the 1992 highway fatality rate of 2.3 per 100 million miles driven in South Carolina provides a baseline estimate of 5.5 traffic fatalities annually. Under alternative A, the largest increase in construction workers would occur for the maximum waste forecast (211 more workers TC than under the no-action alternative). These workers would be expected to drive 2.6 million miles annually (2.1 million miles more than under the no-action alternative), which would result in less than one additional traffic fatality per year.

TC TE Even with the addition of 211 vehicles above the estimates under the no-action alternative, traffic on all roads would remain within design carrying capacity; therefore, effects on traffic would be very small. Depending on the areas to which these employees were assigned and the shifts they worked, DOE would need to examine the design capacity of the affected roads.

Daily waste shipments would increase by 58 (Table 4-23), primarily due to overall increases in waste volumes and shipment of stabilized ash and blowdown to disposal facilities. The shipments would originate at various SRS locations (primarily F- and H-Areas) and terminate at the E-Area treatment and disposal facilities. Shipments from the transuranic waste characterization/certification facility and containment building would not affect traffic because these shipments would occur on a dedicated road that would be upgraded to accommodate expected traffic flows. The addition of 58 trucks during normal working hours is expected to have very small adverse effects on traffic.

4.2.11.2 Transportation



4.2.11.2.1 Transportation – Expected Waste Forecast

Consequences from incident-free onsite transportation over 30 years under alternative A were based on those under the no-action alternative, adjusted by the changes in the number of waste shipments (as a result of changes in volumes of waste shipped). The percent change in dose from the no-action alternative and corresponding health effects are shown in Table 4-24 for incident-free transportation. Consequences of onsite transportation accidents for any given shipment are independent of the number of shipments and are, therefore, the same as for the no-action alternative (Table 4-8).

Table 4-24. Annual dose (percent change from the no-action alternative) and associated excess latent cancer fatalities from incident-free onsite transport of radioactive material for alternative A – expected waste forecast.

Waste[a]	Uninvolved worker[b] (rem)		Uninvolved workers (person-rem)		Involved workers (person-rem)	
Low-level	0.011	(0%)	2.0	(2%)	280	(94%)
Mixed	8.4×10^{-5}	(52%)	0.17	(36%)	5.3	(23%)
Transuranic	1.3×10^{-4}	(0%)	9.5×10^{-3}	(0%)	0.15	(0%)
Totals[c]	0.011[d]		2.2[e]		290[e]	
Excess latent cancer fatalities	4.6×10^{-6}[f]		8.8×10^{-4}[g]		0.1[g]	

TC

a. See Appendix E for a list of waste streams which make up each waste type. Dose is based on exposure to all waste streams of a particular waste type. TC
b. See Section 4.1.11.2 for descriptions of the receptors.
c. Totals were rounded to two significant figures.
d. Assumes the same individual has maximal exposure to each waste type (Appendix E) for a single year.
e. Dose from 1 year of exposure to incident-free transportation of treatability groups (see Appendix E).
f. Additional probability of an excess latent cancer fatality.
g. Value equals the total dose × the risk factor (0.0004 excess latent fatal cancers per person-rem).

Doses from incident-free offsite shipments of mixed wastes were calculated as in Section 4.1.11.2 using calculated external dose rates 1 meter (3.3 feet) from the transport vehicle for each waste and package type (HNUS 1995a). Additionally, occupational exposure time depends on the number of shipments and how long it takes to load each transport vehicle. The results are shown in Table 4-25. TE

Table 4-25. Annual dose and excess latent cancer fatalities from incident-free offsite transport of mixed waste under alternative A – expected waste forecast.

Waste	Involved workers[a] (person-rem)	Remote MEI[b] (rem)	Remote population (person-rem)
Mixed	0.012[c]	3.2×10^{-8}[c]	2.5×10^{-3}[c]
Excess latent cancer fatalities	4.8×10^{-6}	1.6×10^{-11}[d]	1.3×10^{-6}

a. See Section 4.1.11.2 for descriptions of the receptors.
b. MEI = maximally exposed individual.
TC | c. Dose for the remote MEI assumes exposure to each waste in a single year; for the population, dose is the result of exposure to 1 year of incident-free transportation of each waste (see Appendix E).
d. Additional probability of an excess latent fatal cancer.

Incident-Free Radiological Impacts

For the expected waste forecast, there would be increases in dose to all onsite receptors and in the associated number of excess fatal cancers compared to the no-action alternative (Table 4-24) due to the increased volume of mixed waste. Additionally, involved workers' exposures would increase due to their exposure to the increased volume of low-level equipment shipped.

Transportation Accident Impacts

Refer to Sections 4.1.11.2.2 and 4.1.11.2.3 for radiological and nonradiological accident impacts, respectively. The probability of an onsite accident involving low-level or mixed wastes would increase or decrease compared to the no-action alternative depending on the volumes of wastes being shipped; however, the consequences due to a particular accident would be the same as described in Section 4.1.11.2.2. Accident probabilities for onsite shipments remain the same under all alternatives and are summarized in Table 4-26. Impacts of accidents involving offsite shipments were calculated as described in Section 4.1.11.2.2. The results are summarized in Table 4-27.

Table 4-26. Annual accident probabilities for onsite shipments for all alternatives and waste forecasts.[a]

	Waste forecast		
Waste type	Expected	Minimum	Maximum
Low-level	5.62×10^{-7}	2.19×10^{-7}	7.70×10^{-7}
Mixed	7.08×10^{-5}	1.78×10^{-5}	3.53×10^{-4}
Transuranic	2.57×10^{-6}	1.79×10^{-6}	4.24×10^{-5}

a. The accident probabilities under the no-action alternative are the same as for the expected waste forecast. See Appendix E for numbers of shipments.

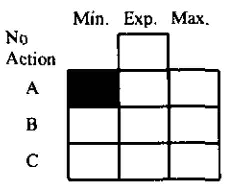
Table 4-27. Annual accident probability, doses associated with an accident, and excess latent cancer fatalities from an accident during offsite transport of mixed waste under alternative A.

Waste	Accident probabilities: Minimum forecast	Accident probabilities: Expected forecast	Accident probabilities: Maximum forecast	Remote population dose[a] (person-rem)	Number of latent cancer fatalities
Mixed	4.6×10^{-4}	1.1×10^{-3}	2.7×10^{-3}	0.0047	2.4×10^{-6}

a. See Section 4.1.11.2 for description of receptor.

TC

The consequences and associated excess latent cancer fatalities from offsite shipments of mixed waste under this alternative (Table 4-27) would be similar to the consequences to uninvolved workers under the no-action alternative (Table 4-8). However, because of the small volume of waste shipped offsite, a high consequence offsite accident would have less severe impacts than an onsite shipment.



4.2.11.2.2 Transportation – Minimum Waste Forecast

Incident-Free Radiological Impacts

For the minimum waste forecast, there would be decreases in dose (Table 4-28) to all onsite receptors compared to those from the expected waste forecast due to the smaller volumes of all wastes shipped onsite.

Table 4-28. Annual dose (percent change from the expected waste forecast) and associated excess latent cancer fatalities from incident-free onsite transport of radioactive material for alternative A –minimum waste forecast.

Waste[a]	Uninvolved worker[b] (rem)		Uninvolved workers (person-rem)		Involved workers (person-rem)	
Low-level	0.0057	(49%)	0.98	(52%)	140	(51%)
Mixed	3.2×10^{-5}	(62%)	0.067	(62%)	2.0	(62%)
Transuranic	9.0×10^{-5}	(30%)	6.6×10^{-3}	(30%)	0.10	(30%)
Totals[c]	5.8×10^{-3}[d]		1.0[e]		140[e]	
Excess latent cancer fatalities	2.3×10^{-6}[f]		4.2×10^{-4}[g]		0.057[g]	

a. *See Appendix E for a list of waste streams which make up each waste type. Dose is based on exposure to all* waste streams of a particular waste type.
b. See Section 4.1.11.2 for descriptions of receptors.
c. Totals rounded to two significant figures.
d. Assumes the same individual has maximal exposure to each waste type (Appendix E) for a single year..
e. Dose from 1 year of exposure to incident-free transportation of treatability groups (see Appendix E).
f. Additional probability of an excess fatal cancer.
g. Value equals the total dose × the risk factor (0.0004 excess latent fatal cancers per person-rem).

TC
TE
TE

For the minimum waste forecast, impacts from incident-free offsite transportation of radioactive materials (Table 4-29) would be very small.

Table 4-29. Annual dose and excess latent cancer fatalities from incident-free offsite transport of mixed waste for alternative A – minimum waste forecast.

TC

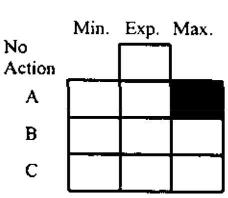
Waste	Involved workers[a] (person-rem)	Remote MEI[b] (rem)	Remote population (person-rem)
Mixed	5.2×10^{-3}[c]	1.4×10^{-8}[c]	1.1×10^{-3}[c]
Excess latent cancer fatalities	2.1×10^{-6}	7.0×10^{-12}[d]	5.5×10^{-7}

a. See Section 4.1.11.2 for descriptions of receptors.
b. MEI = maximally exposed individual.
TE c. Dose for the remote MEI assumes exposure to each waste in a year; for the population, dose is the result of exposure to 1 year of incident-free transportation of treatability groups (see Appendix E).
d. Additional probability of an excess latent fatal cancer.

Transportation Accident Impacts

The probability of an onsite accident involving radioactive wastes would decrease slightly for the minimum waste forecast (Table 4-26) because less waste would be shipped compared to the expected waste forecast; however, the consequences due to an accident would be the same as described in Section 4.1.11.2.2.

Effects of offsite accidents would be the same as for the expected waste forecast; however, the probability of an offsite accident would decrease by about one-third compared to the expected waste forecast because of the smaller volumes of wastes shipped (Table 4-27).



4.2.11.2.3 Transportation – Maximum Waste Forecast

Incident-Free Radiological Impacts

For the maximum waste forecast, there would be large increases in dose to all receptors (Table 4-30) due to the increases in volumes of all wastes shipped. Impacts from incident-free offsite transportation of mixed waste (Table 4-31) would be very small.

Table 4-30. Annual dose (percent change from the expected waste forecast) and associated excess latent cancer fatalities from incident-free onsite transport of radioactive material for alternative A – maximum waste forecast.

Waste[a]	Uninvolved worker[b] (rem)		Uninvolved workers (person-rem)		Involved workers (person-rem)	
Low-level	0.014	(27%)	2.8	(32%)	7.3×10-	(155%)
Mixed	3.3×10^{-4}	(291%)	0.70	(300%)	24	(342%)
Transuranic	0.0021	(1,550%)	0.16	(1,550%)	2.4	(1,550%)
Total[c]	0.017[d]		3.7[e]		750[e]	
Excess latent cancer	6.7×10^{-6}[f]		1.4×10^{-3}[g]		0.30[g]	

TC

a. See Appendix E for a list of waste streams which make up each waste type. Dose is based on exposure to all waste streams of a particular waste type.
b. See Section 4.1.11.2 for descriptions of receptors.
c. Totals rounded to two significant figures.
d. Assumes the same individual has maximum exposure to each waste type (Appendix E) for a single year.
e. Dose from 1 year of exposure to incident-free transportation of waste (see Appendix E).
f. Additional probability of an excess fatal cancer.
g. Value equals the total dose × the risk factor (0.0004 excess latent fatal cancers per person-rem).

TE

Table 4-31. Annual dose and excess latent cancer fatalities from incident-free offsite transport of mixed waste for alternative A – maximum waste forecast.

Waste	Involved workers[a] (person-rem)	Remote MEI[b] (rem)	Remote population (person-rem)
Mixed	0.031[c]	8.2×10^{-8}[c]	6.3×10^{-3}[c]
Excess latent cancer fatalities	1.2×10^{-5}	4.1×10^{-11}[d]	3.2×10^{-6}

L004-10

a. See Section 4.1.11.2 for descriptions of receptors.
b. MEI = maximally exposed individual.
c. Dose for the remote MEI assumes exposure to each waste in a year; for the population, dose is the result of exposure to 1 year of incident-free transportation of waste (see Appendix E). TE
d. Additional probability of an excess latent fatal cancer.

Transportation Accident Impacts

The probability of an onsite accident involving radioactive wastes would increase for the maximum waste forecast (Table 4-26) because more waste would be shipped compared to the expected waste forecast; however, the consequences due to an accident would be the same as described in Section 4.1.11.2.2. Effects of offsite accidents would be the same as for the expected waste; however, the probability of an offsite accident would be three times greater than that in the expected waste forecast because of the larger volumes of wastes shipped (Table 4-27).

4.2.12 OCCUPATIONAL AND PUBLIC HEALTH

Radiological and nonradiological impacts to workers and the public are presented in this section for the three waste forecasts. As expected, the impacts are smallest for the minimum waste forecast and largest for the maximum waste forecast.

Under this alternative, the Consolidated Incineration Facility, the transuranic waste characterization/certification facility, the mixed waste containment building, compaction facilities, and the mobile soil sort facility would operate. These facilities and changes in waste management would result in an increase in adverse health effects over the no-action alternative for the three waste forecasts. However, the effects would be small overall, except to involved workers under the maximum waste forecast.

The waste management operations that produce most of the occupational and public health effects are as follows:

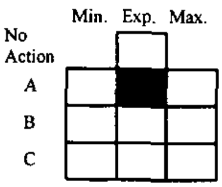
- For the involved workers, the sources of largest exposure would be the transuranic waste storage pads, the H-Area high-level waste tank farm, and the transuranic waste characterization/certification facility.

- For the public and uninvolved workers, the sources of largest exposure would be the Consolidated Incineration Facility and the transuranic waste characterization/certification facility. (Doses and health effects for the Consolidated Incineration Facility are presented in Appendix B.5.)

- For the public only, the F/H-Area Effluent Treatment Facility would be the source of greatest exposure.

For radiological assessments, the same general methodology was used as under the no-action alternative (see Section 4.1.12). The same risk estimators were used to convert doses to fatal cancers, and wastes were classified into treatability groups to facilitate the evaluations. However, the development of radiological source terms and worker exposures was much more involved. The releases of radioactivity to the environment and the radiation exposures of workers were determined for each waste forecast. The expected performance of new facilities was based on actual design information, augmented as necessary by operating experience with similar facilities.

Radiological impacts of facility operations were estimated for the 30-year period of analysis based on total material throughput. Annual impacts to workers and the offsite population were estimated by dividing the total 30-year impact by 30. TE



4.2.12.1 <u>Occupational and Public Health – Expected Waste Forecast</u>

For alternative A – expected waste forecast, the volumes of wastes to be treated would be the same as under the no-action alternative.

4.2.12.1.1 Occupational Health and Safety

Radiological Impacts

Table 4-32 presents the worker doses and resulting health effects associated with the expected waste forecast. Doses would remain well within the SRS administrative guideline of 0.8 rem per year. The probabilities and projected numbers of fatal cancers from 30 years of waste management operations under this alternative would be much lower than those expected from all causes during the workers' lifetimes. It is expected that there could be 0.86 additional fatal cancer in the workforce of 2,123. In comparison, the lifetime fatal cancer risk from all causes is 23.5 percent (refer to Section 4.1.12.1), which translates to a 1 in 4 chance of any individual (including a worker) contracting a fatal cancer, or 499 fatal cancers in the workforce of 2,123. TC

Nonradiological Impacts

DOE considered potential nonradiological impacts to SRS workers from air emissions from the following facilities: the Defense Waste Processing Facility, including In-Tank Precipitation; the M-Area Vendor Treatment Facility; the Consolidated Incineration Facility; Building 645-N, hazardous waste storage; Building 645-2N, mixed waste storage; the mobile soil sort facility; four new solvent tanks; the transuranic waste characterization/certification facility; and the mixed waste containment building. Occupational health impacts to employees at the Defense Waste Processing Facility and In-Tank Precipitation were discussed in the *Final Supplemental Environmental Impact Statement Defense Waste Processing Facility*. Occupational health impacts to employees associated with the Consolidated

Table 4-32. Worker radiological doses and resulting health effects associated with implementation of alternative A.[a]

Receptor(s)	No-action alternative	Waste forecast: Expected	Waste forecast: Minimum	Waste forecast: Maximum
Individual involved worker				
• Average annual dose (rem)[b]	0.025	0.033	0.032	0.047
• Associated probability of a fatal cancer	1.0×10^{-5}	1.3×10^{-5}	1.3×10^{-5}	1.9×10^{-5}
• 30-year dose to average worker (rem)	0.75	0.99	0.96	1.4
• Associated probability of a fatal cancer	3.0×10^{-4}	4.0×10^{-4}	3.9×10^{-4}	5.7×10^{-4}
All involved workers[c]				
• Annual dose[b] (person-rem)	52	70	67	113
• Associated number of fatal cancers	0.021	0.028	0.027	0.045
• 30-year dose (person-rem)	1,600	2,100	2,000	3,400
• Associated number of fatal cancers	0.62	0.84	0.81	1.4
Individual uninvolved worker[b,d]				
• Annual dose at 100 meter[e] (rem) (associated probability of a fatal cancer)	1.0×10^{-5} (4.1×10^{-9})	0.0054 (2.1×10^{-6})	3.7×10^{-3} (1.5×10^{-6})	0.088 (3.5×10^{-5})
• Annual dose at 640 meters (rem) (associated probability of a fatal cancer)	2.9×10^{-7} (1.1×10^{-10})	1.6×10^{-4} (6.2×10^{-8})	1.1×10^{-4} (4.3×10^{-8})	0.0026 (1.0×10^{-6})
• 30-year dose at 100 meters (rem) (associated probability of a fatal cancer)	3.0×10^{-4} (1.2×10^{-7})	0.16 (6.4×10^{-5})	0.11 (4.5×10^{-5})	2.7 0.0011
• 30-year dose at 640 meters (rem) (associated probability of a fatal cancer)	8.6×10^{-6} (3.4×10^{-9})	0.0047 (1.9×10^{-6})	0.0033 (1.3×10^{-6})	0.077 (3.1×10^{-5})

a. Supplemental facility information is provided in Appendix E.
b. Annual individual worker doses can be compared with the regulatory dose limit of 5 rem (10 CFR 835) and with the SRS administrative exposure guideline of 0.8 rem. Operational procedures ensure that the dose to the maximally exposed worker remains as far below the regulatory dose limit as is reasonably achievable.
c. The number of involved workers is estimated to be 2,123 for the expected waste forecast; 2,104 for the minimum waste forecast; and 2,379 for the maximum waste forecast.
d. Dose is due to emissions from the transuranic waste characterization/certification facility except for the no-action alternative. Doses conservatively assume 80 hours per week of exposure. Exposures for a typical 40-hour work week would be approximately 50 percent of doses given in the table.
e. To convert to feet, multiply by 3.28.

Incineration Facility were discussed in the *Environmental Assessment, Consolidated Incineration Facility* (DOE 1992).

Table E.2-2 in Appendix E presents a comparison between Occupational Safety and Health Administration permissible exposure limit values and potential exposures to uninvolved workers at both 100 meters (328 feet) and 640 meters (2,100 feet) from each facility for the expected, minimum, and maximum waste forecasts. Downwind concentrations were calculated using EPA's TSCREEN model (EPA 1988). For each facility's emissions, based on the expected waste forecast, uninvolved workers occupational exposure would be less than Occupational Safety and Health Administration permissible exposure limits. In most instances, downwind concentrations would be less than 1 microgram per cubic meter, whereas the Occupational Safety and Health Administration limits are greater than 2,000 micrograms per cubic meter. TE TE

4.2.12.1.2 Public Health and Safety

Radiological Impacts

Table 4-33 presents the radiological doses to the public and the resulting health effects associated with the expected waste forecast. The annual doses to the offsite maximally exposed individual (0.012 millirem) and to the regional population (0.57 person-rem) surrounding SRS are small fractions of the doses that resulted from SRS operations in 1993, which were well within regulatory limits (Arnett, Karapatakis, and Mamatey 1994). For the offsite facility (assumed to be located in Oak Ridge, Tennessee, for the purposes of this assessment) under this forecast, the annual doses to the offsite maximally exposed individual (5.1×10^{-7} millirem) and to the regional population (2.3×10^{-7} person-rem) surrounding Oak Ridge, Tennessee, represent a very small fraction (less than 0.01 percent) of the comparable doses to the SRS regional population. These doses remain less than 0.01 percent of the comparable SRS doses for all waste forecasts under this alternative (see Appendix E for facility-specific data). For this waste forecast, radiologically induced health effects to the public would be very small (Table 4-33). TC

Nonradiological Impacts

Potential nonradiological impacts to individuals residing offsite were considered for both criteria and carcinogenic pollutants. Maximum SRS boundary-line concentrations for criteria pollutants are discussed in Section 4.2.5.1.2.

Table 4-33. Radiological doses associated with implementation of alternative A and resulting health effects to the public.[a]

Waste forecast/receptor(s)[c]	No-action alternative: Dose[b] Atmospheric releases	No-action alternative: Dose[b] Aqueous releases	No-action alternative: Total	No-action alternative: Probability[d] or number of fatal cancers	Alternative A: Dose Atmospheric releases [g]	Alternative A: Dose Aqueous releases	Alternative A: Total	Alternative A: Probability[d] or number of fatal cancers
Expected waste forecast								
Offsite MEI[e]								
• Annual, millirem	1.2×10^{-4}	6.9×10^{-4}	8.1×10^{-4}	4.1×10^{-10}	0.011	6.9×10^{-4}	0.012	5.8×10^{-9}
• 30 years, millirem	0.0037	0.021	0.025	1.2×10^{-8}	0.33	0.021	0.35	1.7×10^{-7}
Population								
• Annual, person-rem	2.9×10^{-4}	0.0068	0.0071	3.5×10^{-6}	0.56	0.0068	0.57	2.8×10^{-4}
• 30 years, person-rem	0.0086	0.20	0.21	1.1×10^{-4}	17	0.20	17	0.0085
Minimum waste forecast								
Offsite MEI								
• Annual, millirem	NA[f]	NA	NA	NA	0.0057	6.9×10^{-4}	0.0064	3.2×10^{-9}
• 30 years, millirem	NA	NA	NA	NA	0.17	0.021	0.19	9.6×10^{-8}
Population								
• Annual, person-rem	NA	NA	NA	NA	0.27	0.0068	0.28	1.4×10^{-4}
• 30 years, person-rem	NA	NA	NA	NA	8.2	0.20	8.4	0.0042
Maximum waste forecast								
Offsite MEI								
• Annual, millirem	NA	NA	NA	NA	0.08	6.9×10^{-4}	0.081	4.1×10^{-8}
• 30 years, millirem	NA	NA	NA	NA	2.4	0.021	2.4	1.2×10^{-6}
Population								
• Annual, person-rem	NA	NA	NA	NA	3.4	0.0068	3.4	0.0017
• 30 years, person-rem	NA	NA	NA	NA	100	0.20	100	0.052

TC

a. Supplemental facility information is provided in Appendix E.
b. For atmospheric releases, the dose is to the population within 80 kilometers (50 miles) of SRS. For aqueous releases, the dose is to the people using the Savannah River from SRS to the Atlantic Ocean.
c. The doses to the public from total SRS operations in 1993 were 0.25 millirem to the offsite maximally exposed individual and 9.1 person-rem to the regional population. These doses, when added to the incremental doses associated with the waste management alternative given in this table, are assumed to equal total SRS doses. Source: Arnett, Karapatakis, and Mamatey (1994).
d. For the offsite maximally exposed individual, probability of a latent fatal cancer; for the population, number of fatal cancers.
e. MEI = maximally exposed individual.

TC g. Atmospheric releases for MEI and population include contribution from off-site facilities, which contribute less than 0.01% to the atmospheric releases reported here.

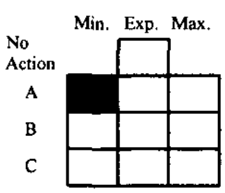
For routine releases from operating facilities under the expected waste forecast, criteria pollutant concentrations would be within state and federal ambient air quality standards, as discussed in Section 4.2.5.1.2, and health impacts to the public would be very small.

Offsite risks due to carcinogens were calculated using the Industrial Source Complex 2 model (Stewart 1994) for the same facilities listed in Section 4.2.12.1.1. Emissions of carcinogenic compounds were based on the types and quantities of waste being processed at each facility. Table 4-34 shows the excess individual lifetime cancer risks calculated from unit risk factors (see Section 4.1.12.2.2) derived from EPA's Integrated Risk Information System database (EPA 1994). As shown in Table 4-34, the estimated incremental lifetime cancer risk associated with routine emissions under the expected waste forecast is 2 in ten million. This is the same as that for the no-action alternative and represents a small overall increase in risk.

4.2.12.1.3 Environmental Justice Assessment

Section 4.1.12.2.3 described DOE's methodology for analyzing radiological dose to determine if there might be adverse and disproportionate impacts on people of color low income. Figure 4-15 illustrates the results of the analysis for alternative A – expected waste forecast for the 80-kilometer (50-mile) region of interest in this EIS. Supporting data for the analysis can be found in Appendix E. TE

The predicted per capita dose differs very little between types of communities at a given distance from SRS, and the per capita dose is extremely small in each type of community. This analysis indicates that people of color or with low incomes in the 80-kilometer (50-mile) region would be neither disproportionately nor adversely affected. TC



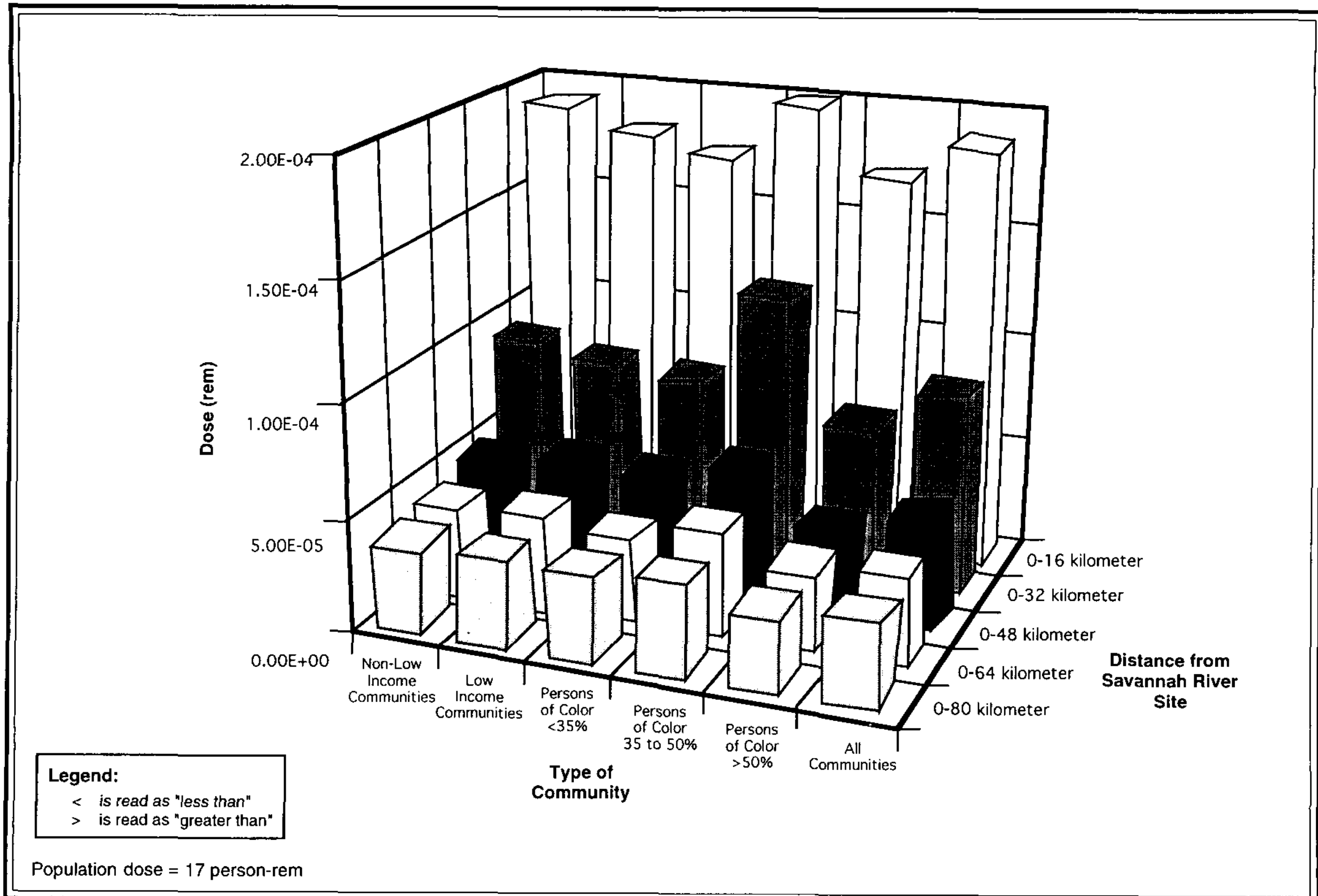
4.2.12.2 <u>Occupational and Public Health – Minimum Waste Forecast</u>

Because the waste amounts for alternative A – minimum waste forecast would be smaller than for the expected waste forecast and the treatment operations would be the same, the impacts to workers and the public would be smaller than described for the expected waste forecast.

Table 4-34. Estimated number of excess latent cancers in the offsite population from nonradiological carcinogens emitted under alternative A.

Pollutant	Unit risk factor[a] (latent cancers/ (μg/m³)[e]	Concentration[b,c] Expected waste forecast (μg/m³)	Concentration[b,c] Minimum waste forecast (μg/m³)	Concentration[b,c] Maximum waste forecast (μg/m³)	Latent cancers[d] Expected waste forecast[f]	Latent cancers[d] Minimum waste forecast	Latent cancers[d] Maximum waste forecast
Acetaldehyde	2.2×10^{-6}	1.5×10^{-7}	2.7×10^{-8}	9.1×10^{-8}	1.4×10^{-13}	2.5×10^{-14}	8.6×10^{-14}
Acrylamide	0.001	1.5×10^{-7}	2.7×10^{-8}	9.1×10^{-8}	8.2×10^{-11}	1.5×10^{-11}	5.1×10^{-11}
Acrylonitrile	6.8×10^{-5}	1.5×10^{-7}	2.7×10^{-8}	9.1×10^{-8}	4.3×10^{-12}	7.9×10^{-13}	2.7×10^{-12}
Arsenic Pentoxide	0.004	8.1×10^{-7}	5.0×10^{-7}	6.3×10^{-7}	1.5×10^{-9}	9.1×10^{-10}	1.2×10^{-9}
Asbestos	0.23	3.5×10^{-9}	4.1×10^{-10}	2.2×10^{-8}	3.5×10^{-10}	4.0×10^{-11}	2.2×10^{-9}
Benzene	8.3×10^{-6}	0.044	0.044	0.044	1.6×10^{-7}	1.6×10^{-7}	1.6×10^{-7}
Benzidine	0.067	1.5×10^{-7}	2.7×10^{-8}	9.1×10^{-8}	4.2×10^{-9}	7.8×10^{-10}	2.6×10^{-9}
Bis(chloromethyl)ether	0.062	1.5×10^{-7}	2.7×10^{-8}	9.1×10^{-8}	3.9×10^{-9}	7.2×10^{-9}	2.4×10^{-9}
Bromoform	1.1×10^{-6}	1.5×10^{-7}	2.7×10^{-8}	9.1×10^{-8}	7.0×10^{-14}	1.3×10^{-14}	4.3×10^{-14}
Carbon Tetrachloride	1.5×10^{-5}	1.5×10^{-7}	2.7×10^{-8}	9.1×10^{-8}	9.5×10^{-13}	1.7×10^{-13}	5.9×10^{-13}
Chlordane	3.7×10^{-4}	1.5×10^{-7}	2.7×10^{-8}	9.1×10^{-8}	2.3×10^{-11}	4.3×10^{-12}	1.4×10^{-11}
Chloroform	2.3×10^{-5}	0.003	0.003	0.003	3.0×10^{-8}	3.0×10^{-8}	3.0×10^{-8}
Cr(+6) Compounds	0.012	4.2×10^{-9}	4.5×10^{-11}	2.3×10^{-9}	2.2×10^{-11}	4.9×10^{-13}	1.2×10^{-11}
Formaldehyde	1.3×10^{-5}	1.5×10^{-7}	2.7×10^{-8}	9.1×10^{-8}	8.2×10^{-13}	1.5×10^{-13}	5.1×10^{-13}
Heptachlor	0.0013	9.7×10^{-7}	6.7×10^{-7}	8.3×10^{-7}	5.4×10^{-10}	3.7×10^{-10}	4.6×10^{-10}
Hexachlorobenzene	4.6×10^{-4}	1.5×10^{-7}	2.7×10^{-8}	9.1×10^{-8}	2.9×10^{-11}	5.3×10^{-12}	1.8×10^{-11}
Hexachlorobutadiene	2.2×10^{-5}	1.5×10^{-7}	2.7×10^{-8}	9.1×10^{-8}	1.4×10^{-12}	2.5×10^{-13}	8.6×10^{-13}
Hydrazine	0.0049	1.5×10^{-7}	2.7×10^{-8}	9.1×10^{-8}	3.1×10^{-10}	5.7×10^{-11}	1.9×10^{-10}
1,1,2,2-Tetrachloroethane	5.8×10^{-5}	2.9×10^{-6}	4.9×10^{-7}	1.8×10^{-6}	7.2×10^{-11}	1.2×10^{-11}	4.4×10^{-11}
1,1,2-Trichloroethane	1.6×10^{-5}	1.5×10^{-7}	2.7×10^{-8}	9.1×10^{-8}	1.0×10^{-12}	1.9×10^{-13}	6.2×10^{-13}
Toxaphene	3.2×10^{-4}	9.7×10^{-7}	6.7×10^{-7}	8.3×10^{-7}	1.3×10^{-10}	9.2×10^{-11}	1.1×10^{-10}
1,1-Dichloroethene	5.0×10^{-5}	2.9×10^{-5}	4.8×10^{-5}	5.6×10^{-5}	6.3×10^{-10}	1.0×10^{-9}	1.2×10^{-9}
Methylene Chloride	4.7×10^{-7}	1.5×10^{-7}	2.7×10^{-8}	9.1×10^{-8}	3.0×10^{-14}	5.4×10^{-15}	1.8×10^{-14}
				TOTAL	2.0×10^{-7}	1.9×10^{-7}	2.0×10^{-7}

a. Source: EPA (1994).
b. Maximum annual boundary-line concentration.
c. Source: Stewart (1994).
d. Latent cancer probability equals unit risk factor times concentration times 30 years divided by 70 years.
e. Micrograms per cubic meter of air.
f. Under the maximum waste forecast, wastewater would be treated in the containment building, which would lower the amount of wastewater going to the Consolidated Incineration Facility. Therefore, slightly higher impacts may occur in the expected waste forecast than in the maximum waste forecast.



PK56-4

TC

Figure 4-15. Dose to individuals in communities within 80 kilometers (50 miles) of SRS for alternative A – expected waste forecast. TE

4.2.12.2.1 Occupational Health and Safety

Radiological Impacts

Table 4-32 includes the worker doses and resulting health effects associated with the minimum waste forecast. Doses and health effects associated with this case would be smaller than those associated with the expected waste forecast.

Nonradiological Impacts

Table E.2-2 in Appendix E presents a comparison of the nonradiological air concentrations to SRS workers for the minimum waste forecast to permissible exposure limits under the Occupational Safety and Health Administration. Exposures to SRS workers are either equal to or less than those that would occur in the expected waste forecast. For each facility, employee occupational exposure would be less than Occupational Safety and Health Administration permissible exposure limits.

4.2.12.2.2 Public Health and Safety

Radiological Impacts

Table 4-33 includes the doses to the public and the resulting health effects associated with the minimum waste forecast. Doses and health effects associated with this case would be smaller than those associated with the expected waste forecast.

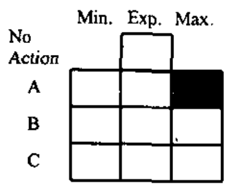
Nonradiological Impacts

Potential nonradiological impacts to individuals residing offsite are considered for both criteria and carcinogenic pollutants under the minimum waste forecast. For routine releases from operating facilities, criteria pollutant concentrations would be within state and Federal ambient air quality standards, as discussed in Section 4.2.5.2.

Offsite risks due to carcinogens are presented in Table 4-34. The overall incremental lifetime cancer risk TC is approximately 1.9 in ten million. This latent cancer risk is slightly less than that expected from the no-action alternative. DOE expects very small health impacts to the public from emissions from facilities under alternative A minimum waste forecast.

4.2.12.2.3 Environmental Justice Assessment

Figure 4-16 illustrates the results of the analysis for alternative A – minimum waste forecast for the 80-kilometer (50-mile) region of interest in this EIS. Supporting data for the analysis can be found in the environmental justice section of Appendix E. No community within 80 kilometers (50 miles) would be disproportionately affected by emissions under this case.



4.2.12.3 Occupational and Public Health – Maximum Waste Forecast

The volumes of wastes to be treated for alternative A – maximum waste forecast would be larger than for the minimum and expected waste forecasts, but the treatment operations would be the same. Therefore, the maximum waste forecast would result in the greatest health impacts to workers and the public for this alternative.

4.2.12.3.1 Occupational Health and Safety

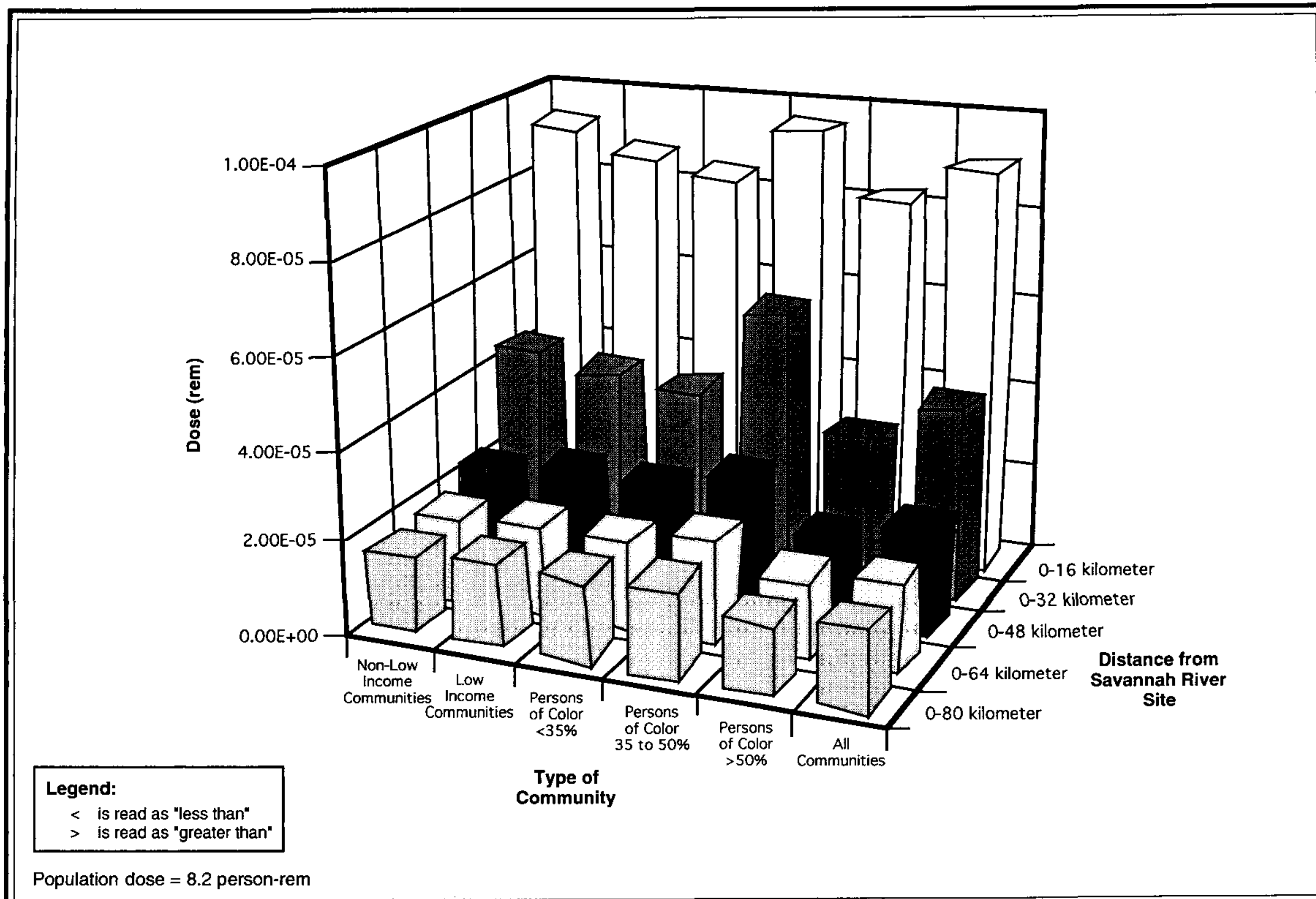
Radiological Impacts

Table 4-32 includes the worker doses and resulting health effects associated with the maximum waste forecast. The doses would remain well within the SRS administrative guideline of 0.8 rem per year. However, it is projected that less than 2 people in the involved workforce of 2,379 could develop a fatal cancer sometime during their lifetimes as the result of exposure to radiation during the 30-year period of analysis. TC

Nonradiological Impacts

DOE assessed concentrations for exposure to SRS workers. Table E.2-2 in Appendix E presents a comparison between the nonradiological air concentrations SRS workers would be exposed to for the maximum waste forecast with Occupational Safety and Health Administration permissible exposure limits values. Exposures to SRS workers are either equal to or greater than those occurring in the expected waste forecast. However, for all facilities, employee occupational exposure would be less than Occupational Safety and Health Administration permissible exposure limits.

TC



PK56-4

Figure 4-16. Dose to individuals in communities within 80 kilometers (50 miles) of SRS for alternative A – minimum waste forecast.

4.2.12.3.2 Public Health and Safety

Radiological Impacts

Table 4-33 includes the doses and resulting health effects to the public associated with the maximum waste forecast. The annual doses to the offsite maximally exposed individual (0.08 millirem) and to the SRS regional population (3.4 person-rem) would be about one-third of the doses that resulted from SRS operations in 1993, which were well within regulatory limits (Arnett, Karapatakis, and Mamatey 1994). For alternative A – maximum waste forecast, radiologically induced health effects to the public would be very small.

Nonradiological Impacts

Potential nonradiological impacts to individuals residing offsite are considered for both criteria and carcinogenic pollutants under the maximum waste forecast. For routine releases from operating facilities, criteria pollutant concentrations would be within state and Federal ambient air quality standards, as discussed in Section 4.2.5.3. During periods of construction, the criteria pollutant concentrations at the SRS boundary would not exceed air quality standards under normal operating conditions. With good construction management practices, such as wetting dirt roads twice a day, particulate concentrations would be approximately 50 percent of those shown in Section 4.2.5.3.

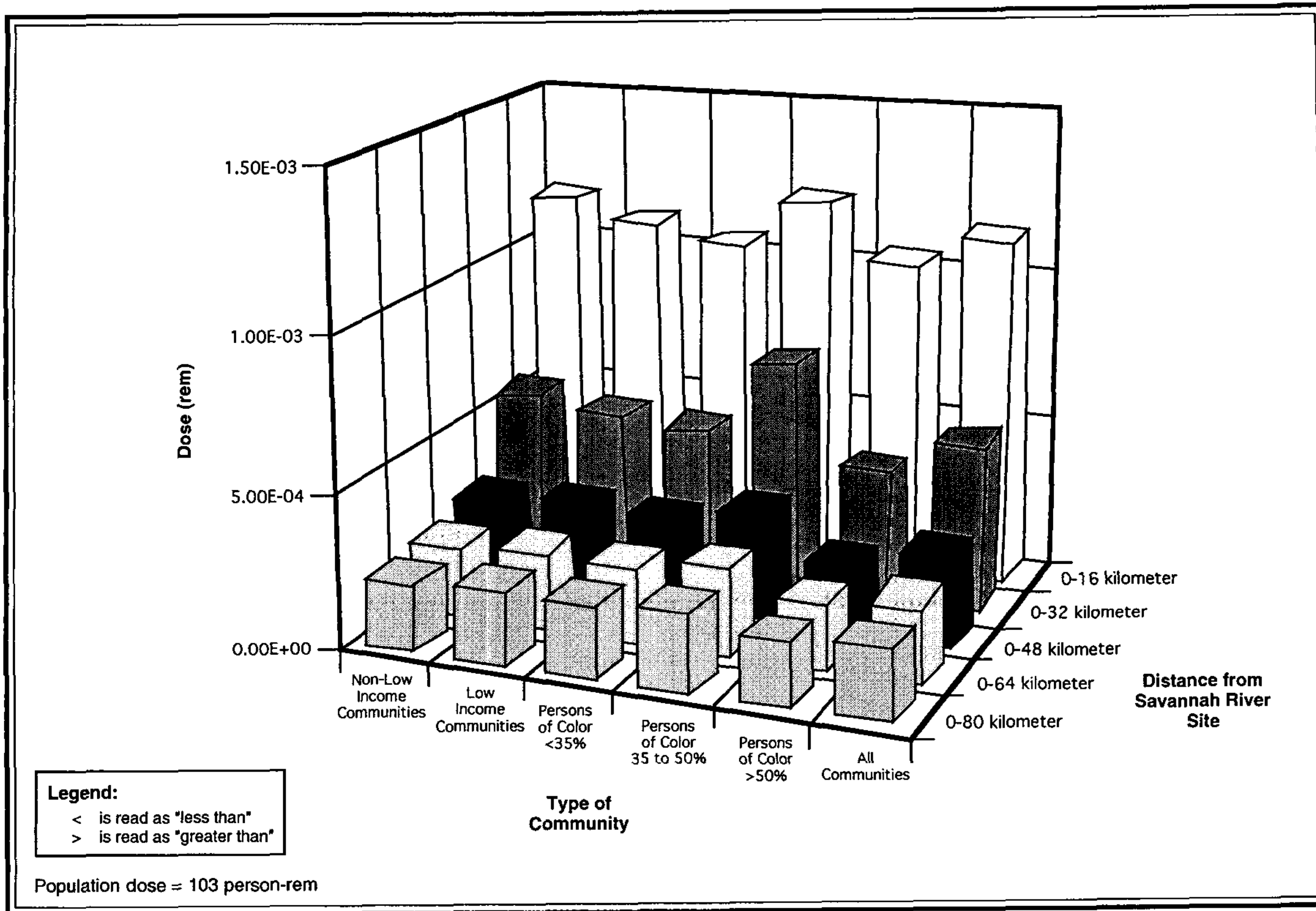
Table 4-34 presents offsite risks from carcinogens. The overall incremental lifetime cancer risk is approximately 2 in 10 million. This latent cancer risk is the same as expected under the no-action alternative. DOE expects very small health impacts to the public from emissions from facilities in the maximum waste forecast.

4.2.12.3.3 Environmental Justice Assessment

No community within 80 kilometers (50 miles) would be disproportionately affected by emissions under this scenario (Figure 4-17).

4.2.13 FACILITY ACCIDENTS

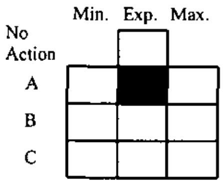
This section summarizes the risks to workers and members of the public from potential facility accidents associated with the various amounts of wastes that might be managed under alternative A. The



PK56-4

TC

Figure 4-17. Dose to individuals in communities within 80 kilometers (50 miles) of SRS for alternative A – maximum forecast. | TE methodologies used to develop the radiological and hazardous material accident scenarios are the same as those discussed in Section 4.1.13.1 under the no-action alternative.



4.2.13.1 Facility Accidents – Expected Waste Forecast

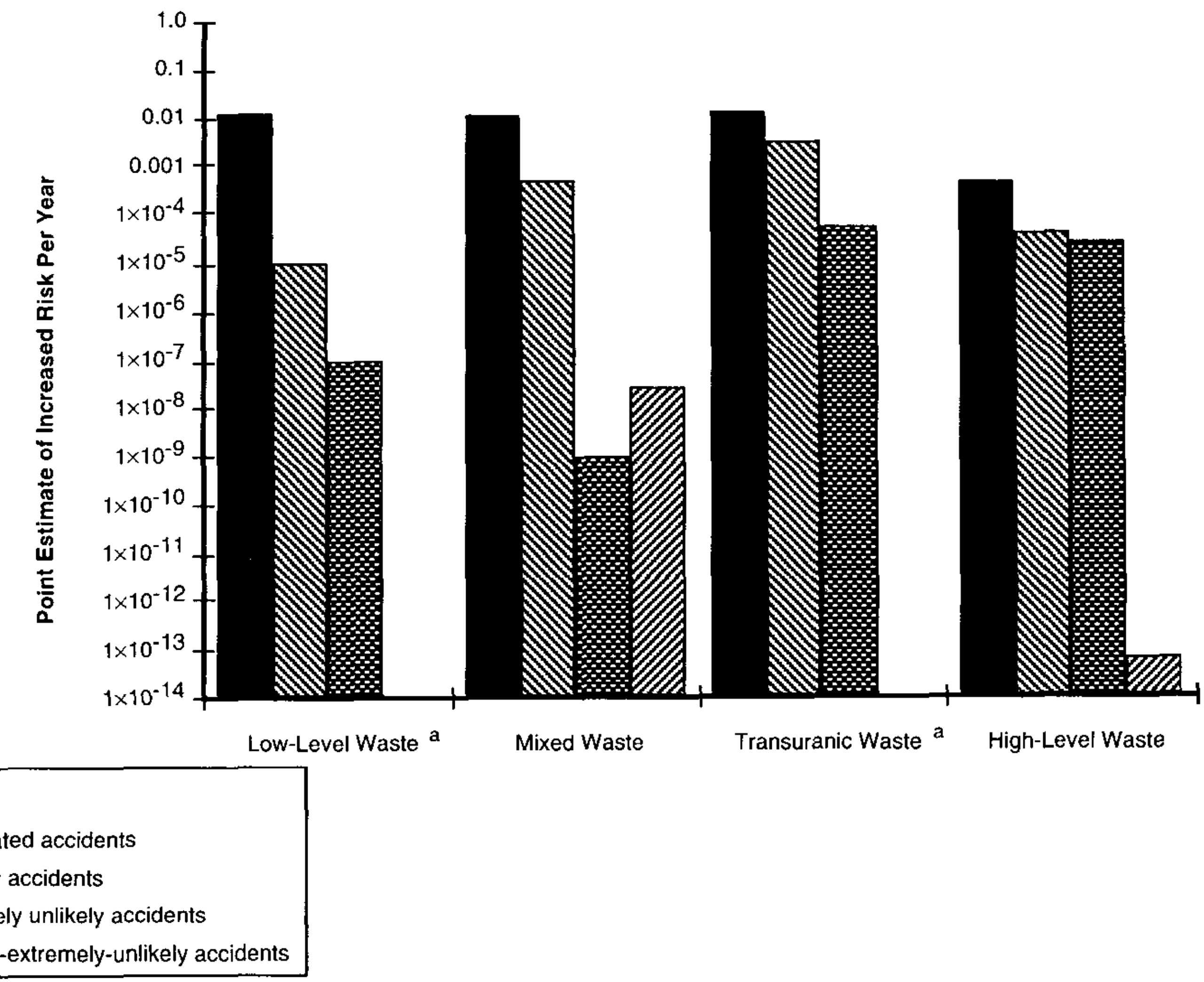
Figures 4-18 through 4-21 summarize the estimated increases in latent fatal cancers from radiological accidents involving the various waste types on the population, offsite maximally exposed individual, and uninvolved workers at 640 meters (2,100 feet) and 100 meters (328 feet) for alternative A expected waste forecast. Analyses are based on dose from the estimated bounding accident. The accident presenting the greatest overall risk to the population within 80 kilometers (50 miles) of SRS under this case is an anticipated accident (i.e., one occurring between once every 10 years and once every 100 years) involving either mixed waste or low-level waste, which would increase the risk to the population within 80 kilometers (50 miles) by 1.7×10^{-2} latent fatal cancer per year (Figure 4-18).

An anticipated accident involving either mixed waste or low-level waste would pose the greatest risk to the offsite maximally exposed individual (Figure 4-19) and the uninvolved worker at 640 meters (2,100 feet) (Figure 4-20). The anticipated accident scenario would increase the risk to the offsite maximally exposed individual by 3.3×10^{-7} latent fatal cancer per year and to the uninvolved worker at 640 meters (2,100 feet) by 1.8×10^{-5} latent fatal cancer per year.

An anticipated accident involving either mixed wastes or low-level wastes would also pose the greatest risk to the uninvolved worker at 100 meters (328 feet) (Figure 4-21). The anticipated accident scenario would increase the risk to the uninvolved worker at 100 meters (328 feet) by 1.0×10^{-3} latent fatal cancer per year.

For each receptor group, regardless of waste type, the greatest estimated risks associated with alternative A are identical to the no-action alternative. However, there could be differences in the overall risk to each receptor group for specific waste types. For example, the overall risks for transuranic waste increase approximately 100 times between the no-action alternative and alternative A. Table 4-35 provides a comparison of overall risk for specific waste types between the no-action alternative and alternative A. A multiplicative change factor is used to illustrate differences between no-action and alternative A risks. If the risks presented are identical, the multiplication factor is one. However, if the

TC

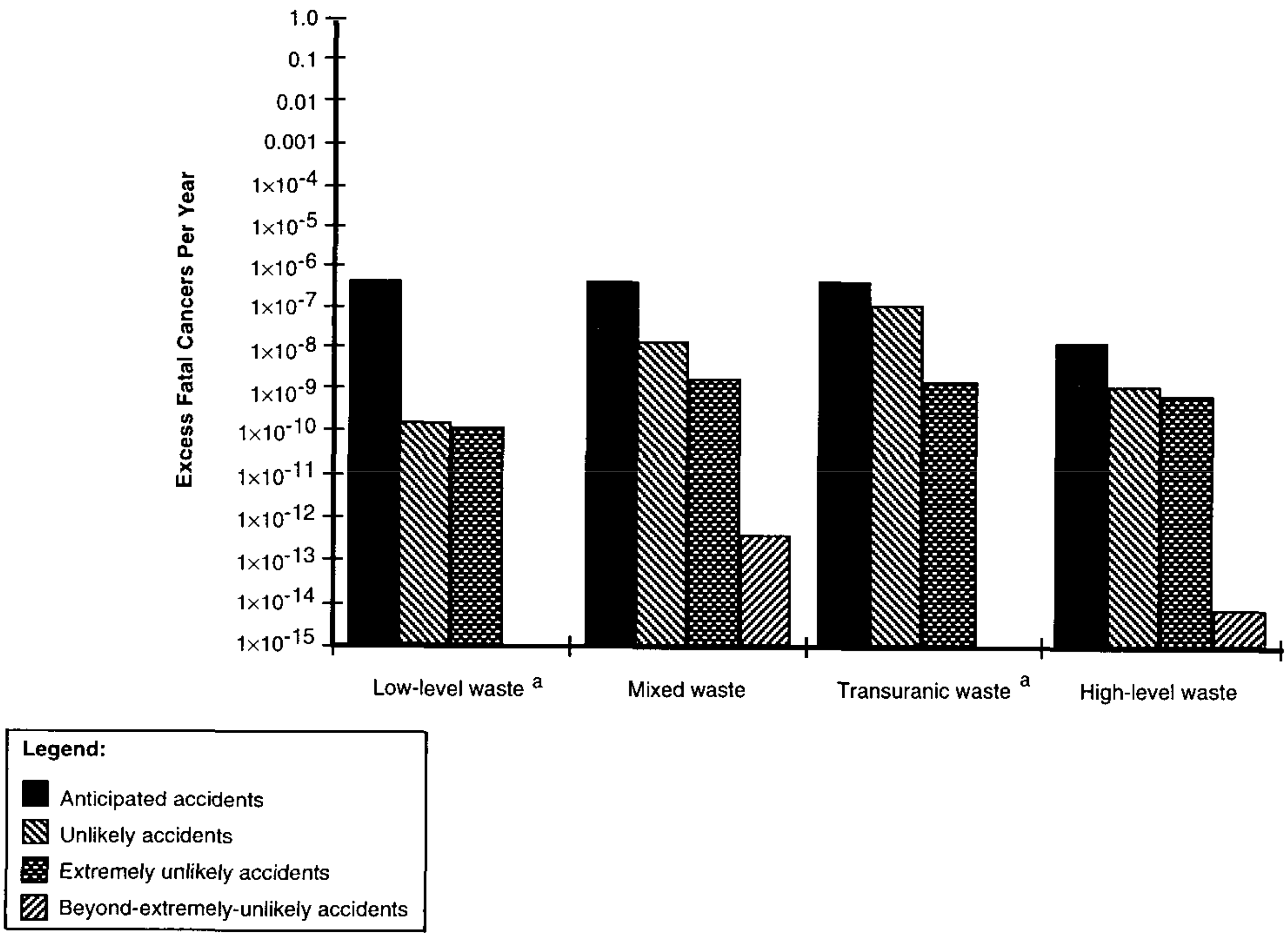


Notes:

a. No beyond-extremely-unlikely accidents were identified for low-level or transuranic wastes.

PK56-31

TE **Figure 4-18.** Summary of radiological accident impacts to population within 80 kilometers (50 miles) for alternative A – expected waste forecast.



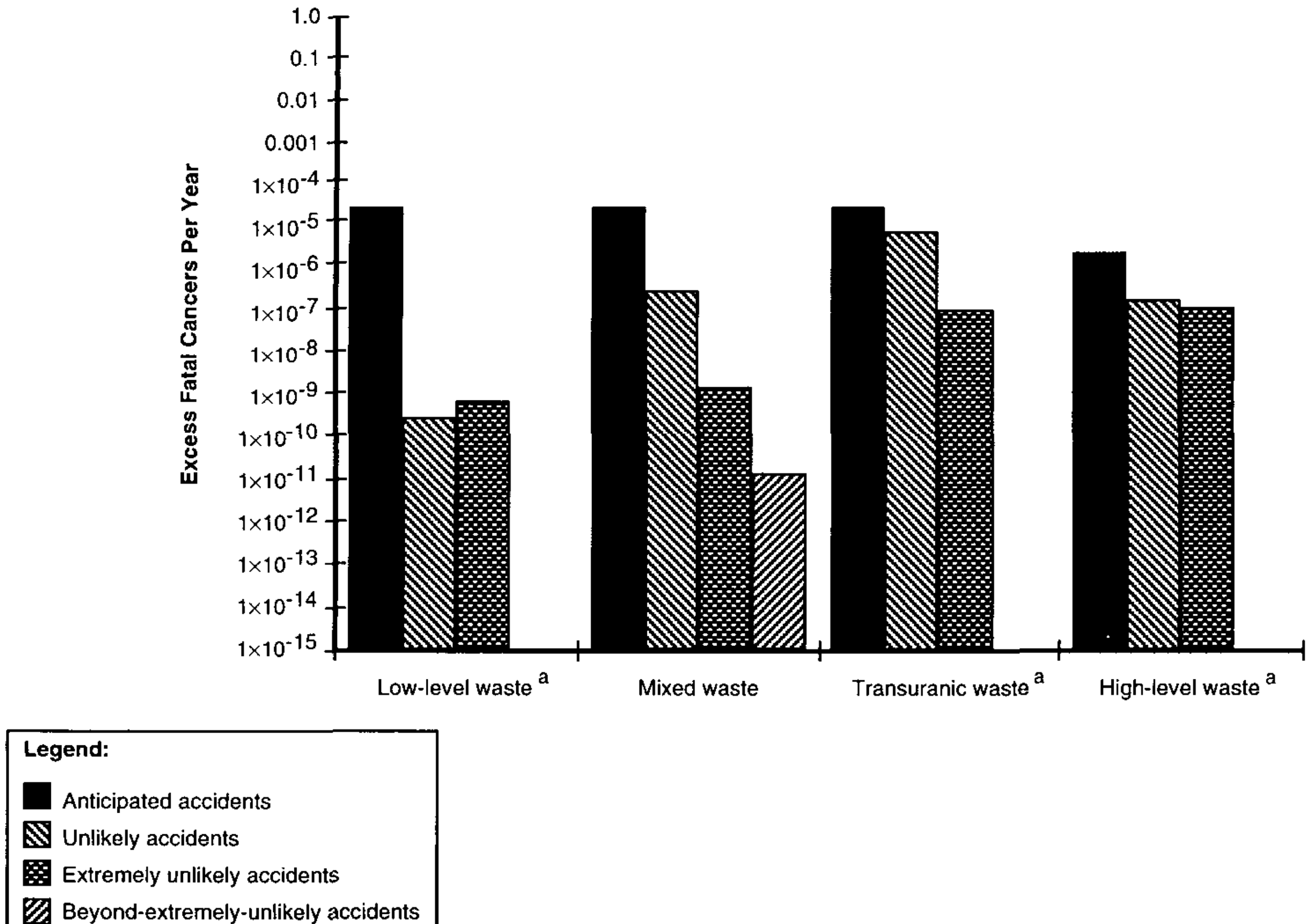
Notes:

a. No beyond-extremely-unlikely accidents were identified for low-level or transuranic wastes.

PK56-31

TC

Figure 4-19. Summary of radiological accident impacts to the offsite maximally exposed individual for alternative A – expected waste forecast. TE

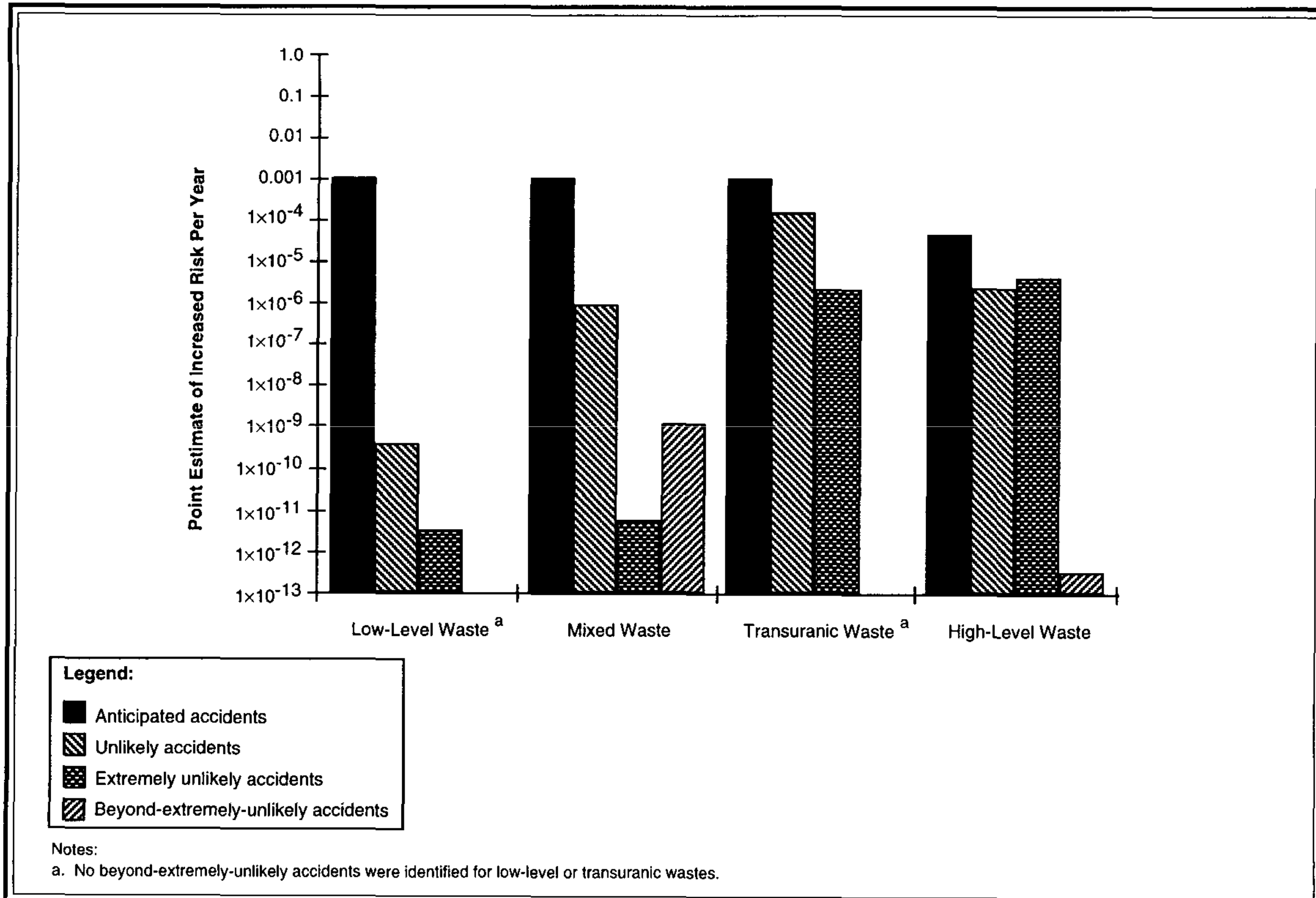


Notes:

a. No beyond-extremely-unlikely accidents were identified for low-level, transuranic, or high-level wastes.

PK56-31

Figure 4-20. Summary of radiological accident impacts to the uninvolved worker within 640 meters (2,100 feet) for alternative A – expected waste forecast.



PK56-31

Figure 4-21. *Summary of radiological accident impacts to the uninvolved worker within 100 meters (328 feet) for alternative A – expected waste forecast.* TE risks presented are different, the multiplication factor is the ratio of the two values (i.e., higher estimated TC risk divided by smaller estimated risk). Arrows indicate the alternative A risks that are larger than the no-action risks.

TE **Table 4-35.** Comparison of risks from accidents under the no-action alternative and alternative A.

Receptor	Waste type[b]	Estimated risk[a] No-action alternative	Estimated risk[a] Alternative A	Change factor[c]
Population within 80 kilometers	Low-level waste	0.017	0.017	1.0
	Mixed waste	0.017	0.017	1.0
	Transuranic waste	0.005	0.015	↑3.0
	High-level waste	6.3×10^{-4}	6.3×10^{-4}	1.0
Offsite maximally exposed individual	Low-level waste	3.3×10^{-7}	3.3×10^{-7}	1.0
	Mixed waste	3.3×10^{-7}	3.3×10^{-7}	1.0
	Transuranic waste	9.8×10^{-8}	2.9×10^{-7}	↑3.0
	High-level waste	1.3×10^{-8}	1.3×10^{-8}	1.0
Uninvolved worker to 640 meters	Low-level waste	1.8×10^{-5}	1.8×10^{-5}	1.0
	Mixed waste	1.8×10^{-5}	1.8×10^{-5}	1.0
	Transuranic waste	5.5×10^{-6}	1.6×10^{-5}	↑2.9
	High-level waste	6.4×10^{-7}	6.4×10^{-7}	1.0
Uninvolved worker to 100 meters	Low-level waste	0.001	0.001	1.0
	Mixed waste	1.0×10^{-7}	0.001	1.0
	Transuranic waste	3.1×10^{-4}	9.0×10^{-4}	↑2.9
	High-level waste	1.8×10^{-5}	1.8×10^{-5}	1.0

a. Increased risk of latent fatal cancers per year.
b. Waste types are described in Appendix F.
c. Change factors represent the multiplication factor required to equate no-action alternative risks to alternative A risks (e.g., no-action risk times change factor equals alternative A risk). The up arrow (↑) indicates that the alternative A risk is greater.

A complete summary of all representative bounding accidents considered for alternative A is presented in Table 4-36. This table provides accident descriptions, annual frequency of occurrence, increased risk of latent fatal cancers for all receptor groups, and the waste type associated with the accident scenario. Details regarding the individual postulated accident scenarios associated with the various waste types are provided in Appendix F.

Table 4-37 presents for each waste considered a summary of the chemical hazards estimated to exceed ERPG-2 values for the uninvolved worker at 100 meters (328 feet). For this worker, seven chemical release scenarios would exceed ERPG-3 values. Moreover, another five chemical release scenarios would have estimated airborne concentrations that exceed ERPG-2 values where equivalent ERPG-3 values were not identified. For the offsite maximally exposed individual, no chemical release scenario

Table 4-36. Summary of representative bounding accidents under alternative A.[a]

Accident Description	Affected waste types[c]	Frequency (per year)	Increased risk of latent fatal cancers per year[b]: Uninvolved worker at 100 meters	Uninvolved worker at 640 meters	Maximally exposed offsite individual	Population within 80 kilometers
RHLWE[d] release due to a feed line break	High-level	0.07[e]	1.79×10^{-5}	6.38×10^{-7}	1.32×10^{-7}	6.34×10^{-4}
RHLWE release due to a design basis earthquake	High-level	2.00×10^{-4}[f]	1.54×10^{-6}	5.46×10^{-8}	1.12×10^{-9}	5.43×10^{-5}
RHLWE release due to evaporator pressurization and breech	High-level	5.09×10^{-5}[g]	1.95×10^{-6}	3.46×10^{-8}	7.13×10^{-10}	3.44×10^{-5}
Design basis ETF[h] airborne release due to tornado	High-level	3.69×10^{-7}[i]	3.20×10^{-13}	1.02×10^{-14}	7.20×10^{-15}	6.35×10^{-14}
Container breach at the ILNTV[j]	Low-level Mixed	0.02[e]	0.00104	1.84×10^{-5}	3.31×10^{-7}	0.0168
High wind at the ILNTV	Low-level	0.001[f]	4.04×10^{-10}	2.43×10^{-10}	1.52×10^{-10}	1.06×10^{-5}
Tornado at the ILNTV	Low-level	2.00×10^{-5}[g]	3.26×10^{-12}	6.18×10^{-10}	1.18×10^{-10}	1.18×10^{-7}
Release due to multiple open containers at the containment building	Mixed	0.003[f]	4.69×10^{-7}	6.91×10^{-7}	1.22×10^{-8}	5.70×10^{-4}
F3 tornado[k] at Building 316-M	Mixed	2.80×10^{-5}[g]	5.35×10^{-12}	1.29×10^{-9}	1.65×10^{-9}	1.12×10^{-9}
Aircraft crash at the containment building	Mixed	1.60×10^{-7}[i]	9.73×10^{-10}	3.46×10^{-11}	6.66×10^{-13}	3.19×10^{-8}
Deflagration in culvert during TRU[l] retrieval activities	Transuranic	0.01[e]	8.96×10^{-4}	1.59×10^{-5}	2.86×10^{-7}	1.45×10^{-2}
Fire in culvert at the TRU[l] waste storage pads (one drum in culvert)	Transuranic	8.10×10^{-4}[f]	3.07×10^{-4}	5.48×10^{-6}	9.84×10^{-8}	0.00498
Vehicle crash with resulting fire at the TRU[l] waste storage pads	Transuranic	6.50×10^{-5}[g]	4.47×10^{-6}	7.96×10^{-8}	1.43×10^{-9}	7.25×10^{-5}

a. A complete description and analysis of the representative bounding accidents are presented in Appendix F.
b. Increased risk of fatal cancers per year is calculated by multiplying the [consequence (dose) × latent cancer conversion factor] × annual frequency. For dose consequences and latent cancer fatalities per dose, see tables in Appendix F.
c. The waste type for which the accident scenario is identified as a representative bounding accident. A representative bounding accident may be identified for more than one waste type. These waste types are high-level, low-level, mixed, and transuranic.
d. Replacement High-Level Waste Evaporator.
e. The frequency of this accident scenario is within the anticipated accident range.
f. The frequency of this accident scenario is within the unlikely accident range.
g. The frequency of this accident scenario is within the extremely unlikely accident range.
h. F/H-Area Effluent Treatment Facility.
i. The frequency of this accident scenario is within beyond extremely unlikely accident range.
j. Intermediate-Level Nontritium Vault.
k. F3 tornadoes have rotational wind speeds of 254 to 331 kilometers (158 to 206 miles) per hour.
l. Transuranic.

Table 4-37. Summary of chemical hazards associated with alternative A estimated to exceed ERPG-2 values.

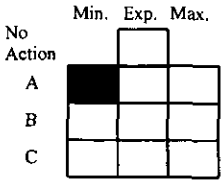
Chemical name	Appendix F table reference[a]	100-meter concentration (mg/m^3)[b]	640-meter concentration (mg/m^3)	Offsite concentration (mg/m^3)	ERPG-2[c] (mg/m^3)	ERPG-3 (mg/m^3)
Nitric acid	F-6	830[d]	100[e]	2	39	77
Nitrogen dioxide	F-7	79.6[f]	0.339	0.159	1.88	54.6
Oxalic acid	F-7	276	1.18	0.552	5.00	500
Nitric acid	F-7	181[d]	0.771	0.361	38.7	77.3
Benzene	F-17	670	(f)	0.42	160	9,600
Cadmium	F-17	2.7	(f)	0.0017	0.25	500
Chromium	F-17	2.7	(f)	0.0017	2.5	(g)
Lead	F-17	160	(f)	0.10	0.25	700
Mercury	F-17	15	(f)	0.0094	0.20	28
Methyl ethyl ketone	F-17	1,800[d]	(f)	1.1	845	1.01×10^4
Beryllium	F-25	16.7[d]	(f)	0.00823	0.01	10
Cadmium	F-25	333[d]	(f)	0.165	0.25	50
Chloroform	F-25	8,330[d]	(f)	4.11	488	4,880
Chromium	F-25	16.7	(f)	0.00823	2.5	(g)
Copper	F-25	66.7	(f)	0.0329	5.0	(g)
Lead	F-25	667	(f)	0.329	0.25	700
Lead nitrate	F-25	16.7	(f)	0.00823	0.25	700
Mercuric nitrate	F-25	16.7	(f)	0.00823	0.2	28
Mercury	F-25	16.7	(f)	0.00823	0.2	28
Nickel nitrate	F-25	16.7	(f)	0.00823	5	(g)
Silver nitrate	F-25	16.7	(f)	0.00823	0.5	(g)
Sodium chromate	F-25	16.7	(f)	0.00823	0.25	30
Toluene	F-25	8,330[d]	(f)	4.11	754	7,450
Uranyl nitrate	F-25	16.7	(f)	0.00823	0.25	30

a. Analyses regarding specific chemical releases are provided in the referenced Appendix F tables.
b. Milligrams per cubic meter of air.
c. Emergency Response Planning Guidelines.
d. Concentration at 100 meters exceeds ERPG-3 concentration.
e. Concentration at 640 meters exceeds ERPG-3 concentration.
f. Airborne concentrations at 640 meters (2,100 feet) were not available from existing safety documentation.
g. No equivalent value found.

would have airborne concentrations that exceed ERPG-3 values. In fact, in only one instance would a chemical release scenario have an airborne concentration that exceeds an ERPG-2 value for the offsite
TE maximally exposed individual (release of lead; see Table F-25 in Appendix F). Appendix F provides further detail and discussion regarding chemical hazards associated with each waste type.

In addition to the risk to human health from accidents, secondary impacts from postulated accidents on
TE plant and animal resources, water resources, the economy, national defense, contamination, threatened and endangered species, land use, and Native American treaty rights are considered. This qualitative

assessment (see Appendix F) determined that no substantial impacts would result from accidents for alternative A – expected waste forecast.

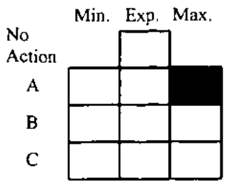


4.2.13.2 Facility Accidents – Minimum Waste Forecast

DOE assumes that conclusions regarding representative bounding accident scenarios could change with the amount of waste generated. Since accident analyses in this EIS are based on a conservative assumption of peak utilization of facilities, the various waste forecasts would only affect how long a facility (e.g., the Consolidated Incineration Facility) would operate. Therefore, while consequence or frequency for the postulated accidents would not change, the time the risk from a facility-specific accident would exist could be the same, more, or less, depending on the waste forecast. Alternative A – minimum waste forecast would not be expected to increase or decrease the duration of risk associated with the representative bounding accidents (see Appendix F).

The size and number of new facilities needed to meet waste management requirements would be affected by the amount of waste generated. Thus, the consequences or frequencies for specific accident scenarios TE could increase or decrease with the addition or subtraction of facilities, depending on the waste forecast. DOE expects that a slight decrease in risk would occur for alternative A – minimum waste forecast. A comparison of the number and type of facilities needed for the minimum and expected waste forecasts is provided in Section 2.4.7.

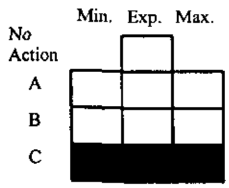
Transuranic waste provides the most dramatic example of why the risk would increase or decrease. It should be noted that the risk remains constant for an alternative and waste forecast, regardless of the waste type evaluated. For example, while alternative A – expected waste forecast calls for 12 transuranic TE waste storage pads, the minimum waste forecast estimates only 3 additional transuranic waste storage pads. Since the number of drums would be reduced, a resultant decrease in the overall risk is assumed TC between the two waste forecasts.



4.2.13.3 Facility Accidents – Maximum Waste Forecast

The maximum waste forecast would not be expected to increase or decrease the duration of risk for the facilities associated with the representative bounding accidents identified under alternative A (see Appendix F).

While the expected waste forecast calls for 12 transuranic waste storage pads, the maximum waste
TC forecast estimates that 1,168 additional transuranic waste storage pads would be needed to store the maximum amount of waste SRS could receive. Since the number of drums would increase, an increase in risk over the expected waste forecast would occur.



4.3 Alternative C – Extensive Treatment Configuration

This section describes the effects of implementing alternative C (described in Section 2.5) on the existing environment (described in Chapter 3).

4.3.1 INTRODUCTION

Alternative C would use an extensive treatment configuration, which would minimize the long-term impacts of waste storage and disposal at SRS. This alternative includes continuing ongoing activities TE listed for the no-action alternative (Section 4.1.1). In addition, DOE would:

- Construct and operate a containment building to treat mixed and hazardous wastes.
- Roast and retort contaminated process equipment to remove mercury and treat mercury by amalgamation at the containment building.
- Oxidize a small quantity of reactive metal at the containment building.
- Construct and operate a non-alpha vitrification facility for hazardous, mixed, and low-level wastes to replace the Consolidated Incineration Facility in 2006. The facility would include low-level and mixed waste soil sort capability to separate soil with nondetectable amounts of contamination from contaminated soil.

TE

- Decontaminate and recycle low-activity equipment waste (metals) offsite. Treatment residues would be returned to SRS for shallow land disposal.
- Treat small quantities of radioactive PCB wastes offsite; residuals would be returned to SRS for shallow land disposal.
- Operate the Consolidated Incineration Facility for mixed, hazardous, low-level, and alpha wastes until the vitrification facilities become operational.
- Construct and operate a transuranic waste characterization/certification facility.

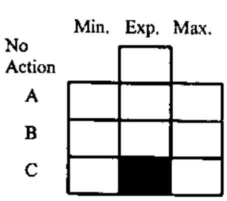
- Dispose of transuranic waste at the Waste Isolation Pilot Plant.

- Construct an alpha vitrification facility.

Alternative C would also require additional disposal areas for low-level radioactive wastes and mixed wastes. Four of six new waste treatment facilities [for characterization/certification of transuranic and alpha waste; for vitrification of transuranic and alpha wastes; for vitrification of mixed, hazardous, and low-level wastes; and for decontamination/macroencapsulation (containment) of mixed and hazardous waste] would be built in E-Area on undeveloped land northwest of F-Area.

Construction related to this alternative would require 0.40 square kilometer (99 acres) of undeveloped land northwest of F-Area and 0.036 square kilometer (9 acres) of undeveloped land northeast of F-Area TC by 2006 (Figure 4-22). An additional 0.081 square kilometer (20 acres) of undeveloped land would be required by 2024 for construction of RCRA-permitted disposal vaults northeast of F-Area (Figure 4-23). Other construction would be on previously cleared and developed land in the eastern portion of E-Area. The amount of undeveloped land required for the minimum waste forecast would be 0.45 square TC kilometer (111 acres), and the maximum waste forecast would require 3.9 square kilometers (959 acres). If alternative C were implemented, additional site-selection studies would be required to locate suitable land.

4.3.2 GEOLOGIC RESOURCES



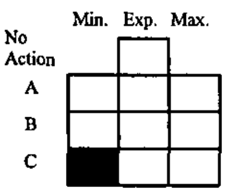
4.3.2.1 Geologic Resources – Expected Waste Forecast

Effects from alternative C – expected waste forecast would be mainly from the construction of new facilities. The effects discussed under the no-action alternative (Section 4.1.2) form the basis for comparison and are referenced in this section.

Although the number of facilities needed would be fewer for this forecast than under the no-action alternative, waste management activities associated with this case would affect soils in E-Area. Land that has been cleared and graded that would be required for this case totals approximately 0.239 square TC kilometer (59 acres). Approximately 0.44 square kilometer (108 acres) in E-Area would be cleared and graded for the construction of new facilities through 2006. Later, an additional 0.081 square kilometer

(20 acres) would be cleared for construction of RCRA-permitted disposal vaults. The total of 0.518 square kilometer (128 acres) is approximately 80 percent of the 0.65 square kilometer (160 acres) TC of undisturbed land that would be cleared and graded for the no-action alternative. Fewer facilities and the corresponding decrease in the amount of land needed would reduce the soils that would be affected under this case by about 15 percent.

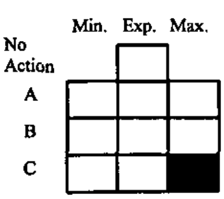
The potential for accidental oil, fuel, and chemical spills would be less for alternative C – expected waste forecast than under the no-action alternative because of reduced construction and operation activities. Spill prevention, control, and countermeasures for this alternative would be the same as for the no-action alternative discussed in Section 4.1.2; therefore, impacts to soils would be minimal.



4.3.2.2 Geologic Resources – Minimum Waste Forecast

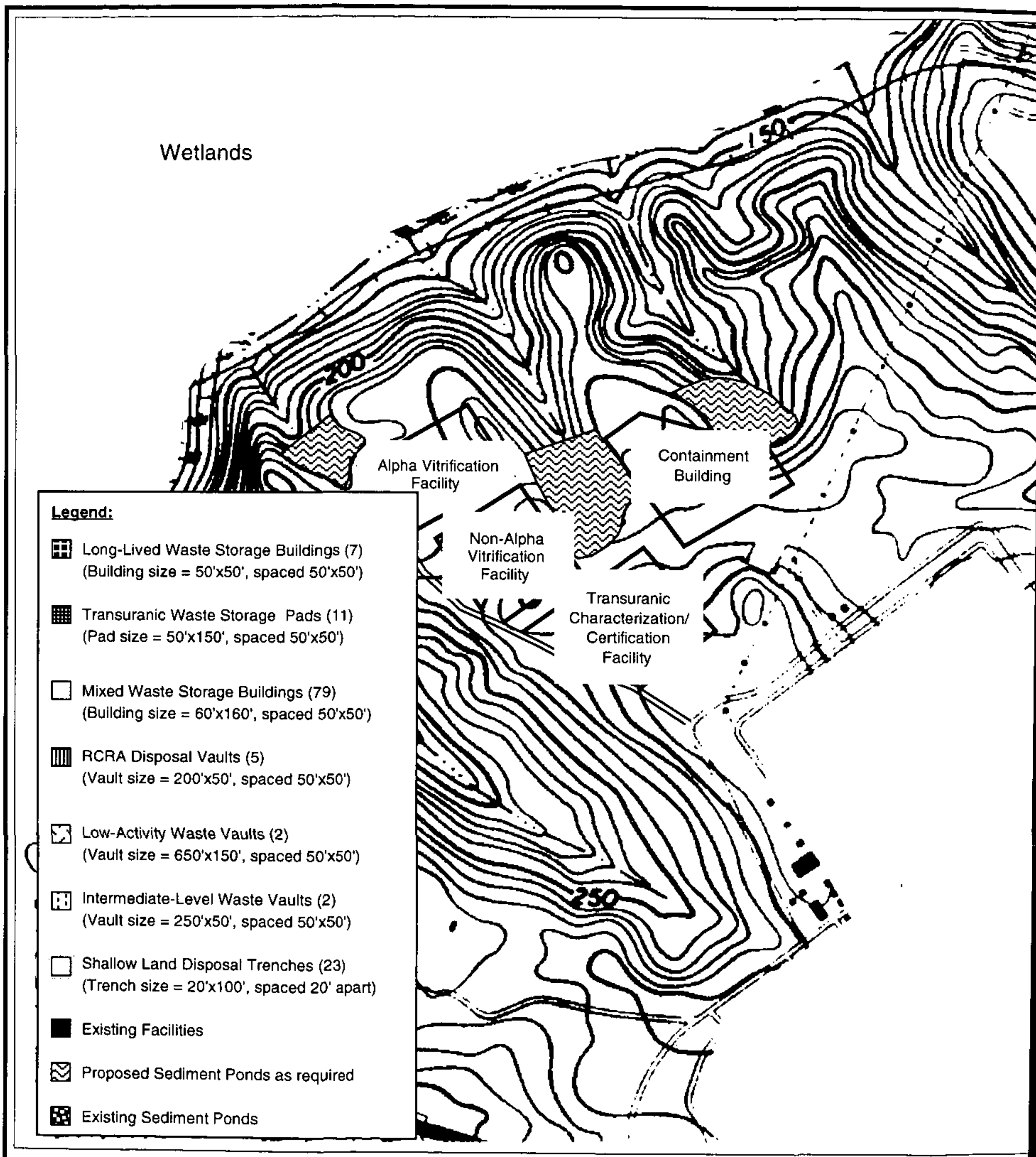
Effects from alternative C – minimum waste forecast would be slightly less than those from the expected waste forecast because less land would be disturbed during construction. Approximately 0.129 square kilometer (32 acres) of cleared land (by 2008) and 0.45 square kilometer (111 acres) (by 2024) of TC uncleared land would be used for new facilities.

For operations activities, spill prevention, control, and countermeasures for this scenario would be the same as for the no-action alternative.

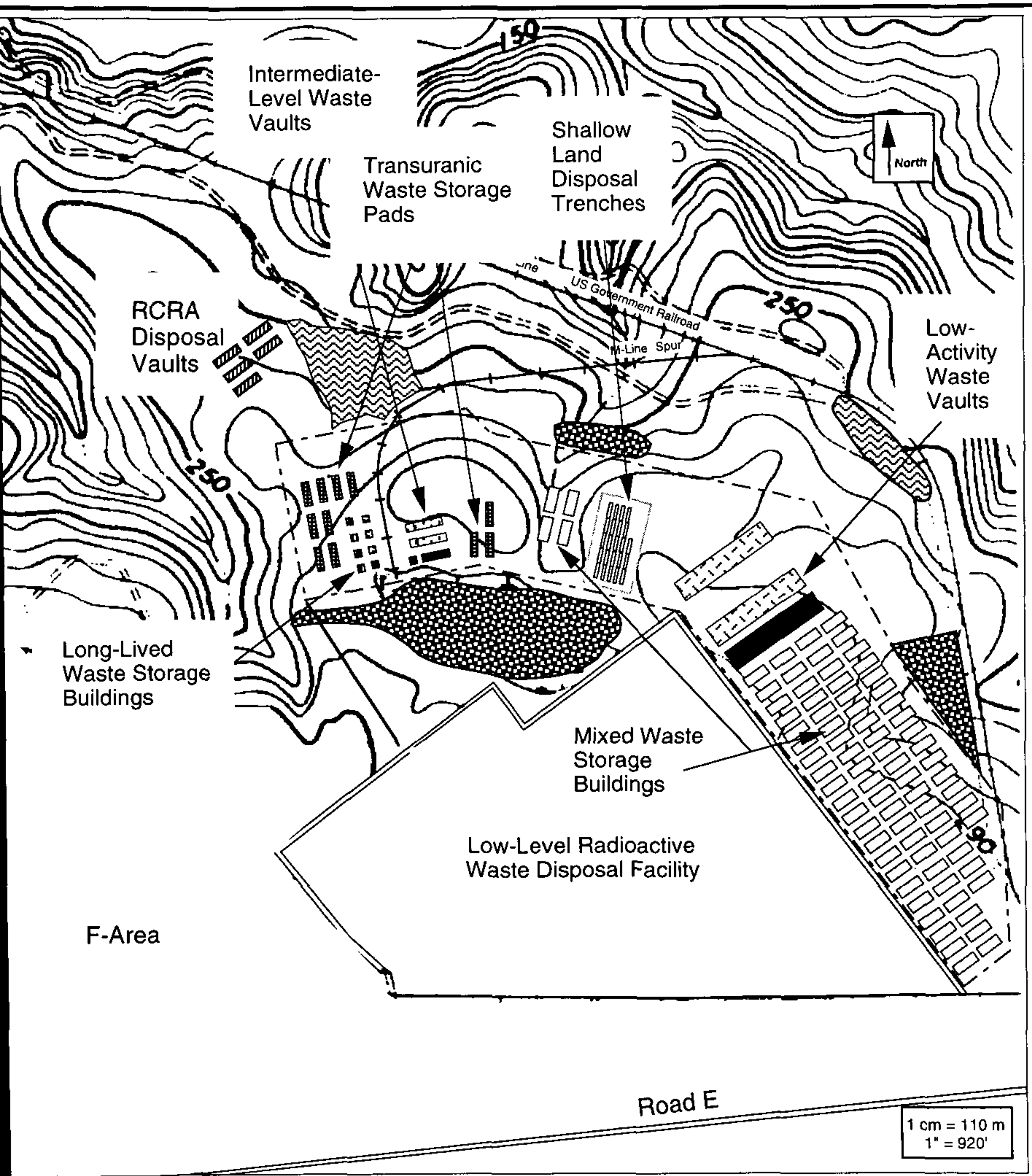


4.3.2.3 Geologic Resources – Maximum Waste Forecast

Effects from alternative C – maximum waste forecast would be greater than those from the minimum or expected waste forecasts because more land would be disturbed during construction. Approximately 0.283 square kilometer (70 acres) of cleared land and 0.745 square kilometer (184 acres) of uncleared land in E-Area, and 3.14 square kilometers (775 acres) of land outside E-Area would be used for new TC facilities.

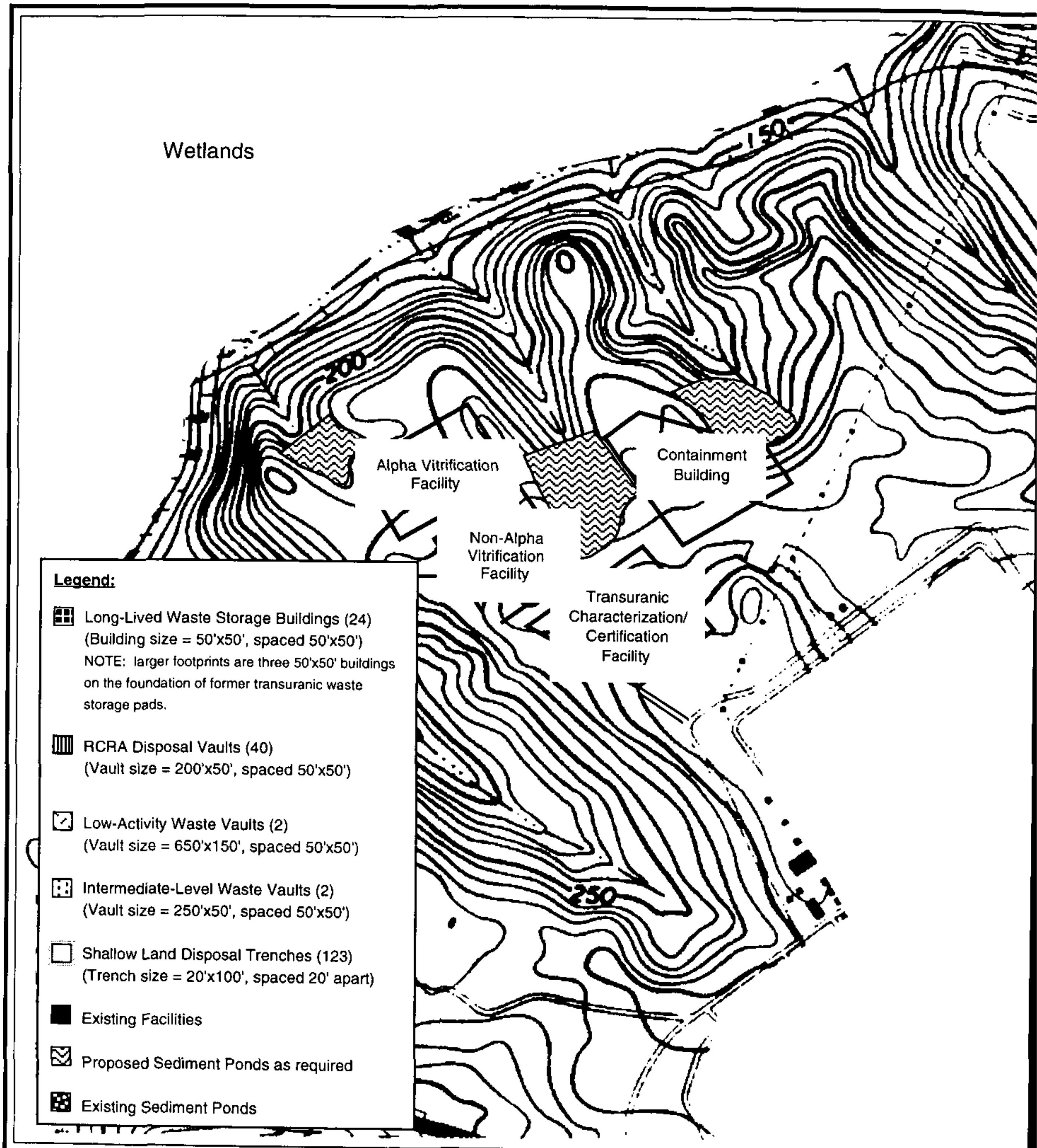


TC **Figure 4-22.** Configuration of treatment, storage, and disposal facilities in E-Area for alternative C – expected forecast by 2006.

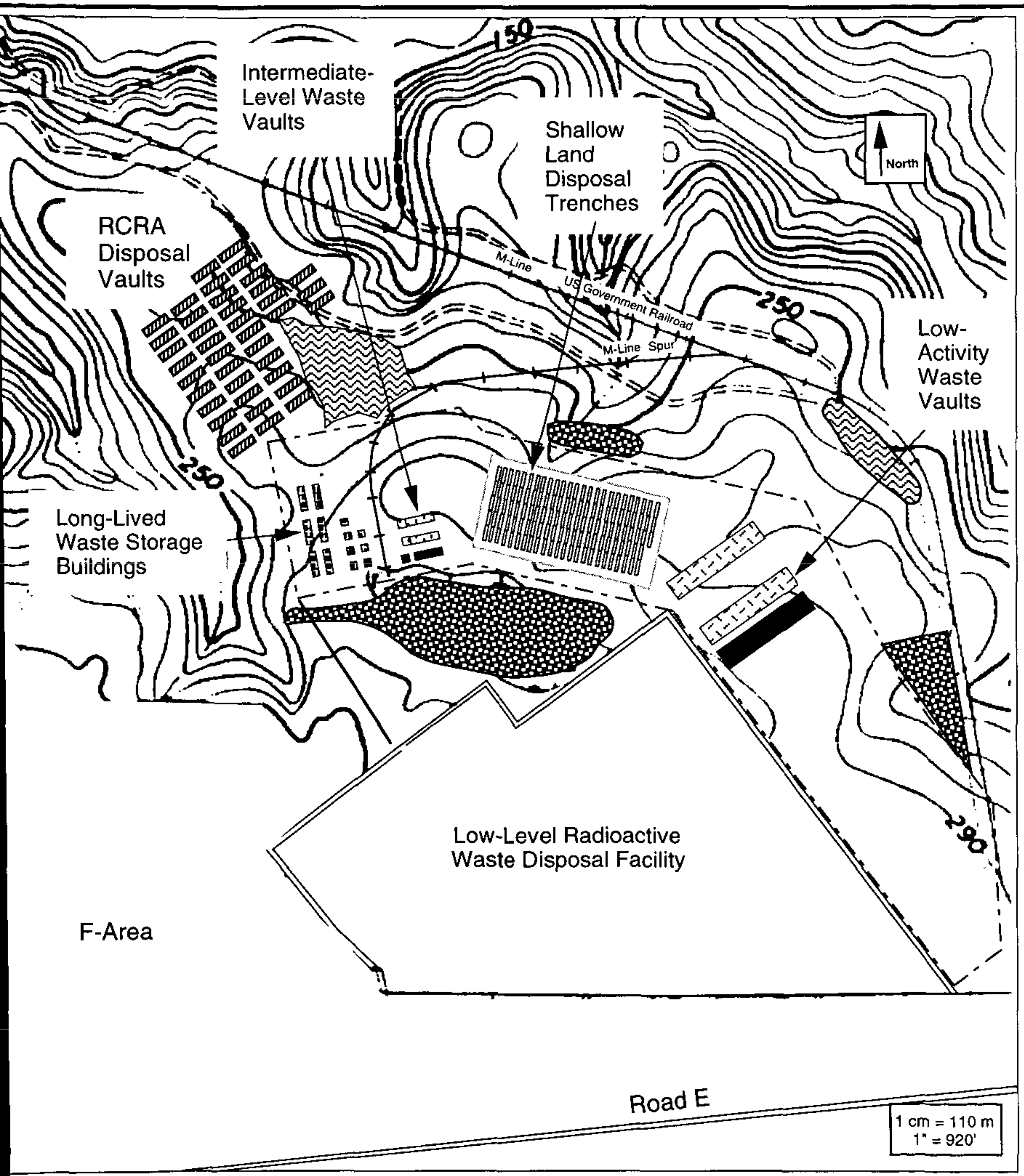


Intermediate-Level Waste Vaults
Transuranic Waste Storage Pads
Shallow Land Disposal Trenches
North
RCRA Disposal Vaults
US Government Railroad
M-Line Spur
250
150
Low-Activity Waste Vaults
Long-Lived Waste Storage Buildings
Mixed Waste Storage Buildings
Low-Level Radioactive Waste Disposal Facility
F-Area
90
Road E
1 cm = 110 m
1" = 920'

PK56-22



TC **Figure 4-23.** Configuration of treatment, storage, and disposal facilities in E-Area for alternative C – expected forecast by 2024.

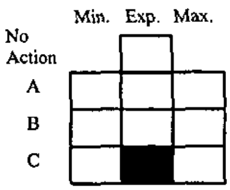


Intermediate-
Level Waste
Vaults
Shallow
Land
Disposal
Trenches
North
RCRA
Disposal
Vaults
M-Line
US Government Railroad
M-Line Spur
250
150
Low-
Activity
Waste
Vaults
Long-Lived
Waste Storage
Buildings
Low-Level Radioactive
Waste Disposal Facility
290
F-Area
Road E
1 cm = 110 m
1" = 920'

PK56-22

For operations activities, spill prevention, control, and countermeasures for this forecast would be the same as for the no-action alternative and the potential for spills would be greater than for the expected waste forecast because more facilities would be operated and larger volumes of wastes would be managed.

4.3.3 GROUNDWATER RESOURCES



4.3.3.1 Groundwater Resources – Expected Waste Forecast

This section discusses the effects of alternative C – expected waste forecast on groundwater resources at SRS. Effects can be evaluated by comparing the doses from contaminants predicted to enter the groundwater from each alternative and waste forecast. Effects on groundwater resources under the no-action alternative (Section 4.1.3) form the basis for comparison among the alternatives and are referenced in this section.

Operation and impacts of the M-Area Air Stripper and the F- and H-Area tank farms would be the same as for the no-action alternative.

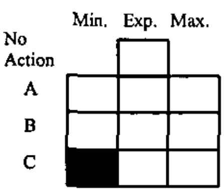
TE For this forecast, and as noted in Section 4.1.3, releases to the groundwater from RCRA-permitted disposal vaults would be improbable during active maintenance; however, releases could eventually occur after loss of institutional control and degradation of the vaults. Impacts from the RCRA-permitted disposal vaults would be similar to the effects under the no-action alternative (Section 4.1.3).

TC There would be 11 fewer additional low-activity and intermediate-level radioactive waste disposal vaults (4) than under the no-action alternative (15). Modeling has shown that any releases from these vaults would not cause groundwater standards to be exceeded during the 30-year planning period or the 100-year institutional control period or at any time after disposal (Toblin 1995). As in the no-action alternative, the predicted concentrations of tritium would be a very small fraction of the drinking water standard. The discussion in Section 4.1.3 on the basis of the 4 millirem standard is applicable to this case. For this waste forecast, impacts to groundwater resources from disposal vaults would be similar to the impacts under the no-action alternative.

TC
TE

For this waste forecast, 123 additional slit trenches would be constructed. Under this alternative, waste disposed in slit trenches would be stabilized (ashcrete, glass, smelter ingots). These disposal activities would be subject to completion of performance assessments and demonstration of compliance with the performance objectives required by DOE Order 5820.2A. Therefore, DOE has conservatively assumed that groundwater concentrations as a result of radioactive releases from the RCRA-permitted vaults and all other low-level waste disposal facilities (vaults and slit trenches) would remain within the DOE performance objective of 4 millirem per year adopted by DOE in Order 5400.5. TC

In summary, impacts to groundwater from alternative C – expected waste forecast would be similar to the impacts under the no-action alternative. TC TE



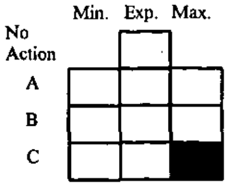
4.3.3.2 Groundwater Resources – Minimum Waste Forecast

For alternative C – minimum waste forecast, and as noted in Section 4.1.3, releases to the groundwater from RCRA-permitted disposal vaults would be improbable during active maintenance; however, releases could eventually occur after loss of institutional control and degradation of the vaults. Impacts from the RCRA-permitted disposal vaults would be similar to the effects under the no-action alternative (Section 4.1.3). TE

There would be 12 fewer additional low-activity and intermediate-level radioactive waste disposal vaults (3) than under the no-action alternative (15). Modeling has shown that the 4 millirem per year drinking water standard would not be exceeded by any radionuclide (Toblin 1995). Impacts to groundwater resources from disposal vaults, including minimal doses from tritium would be similar to those under the no-action alternative. TC TC

There would be less disposal of radioactive waste by shallow land disposal (45 additional slit trenches compared to 123 for the expected waste forecast). Under this alternative, waste disposed in slit trenches would be stabilized (ashcrete, glass, smelter ingots). These disposal activities would be subject to completion of performance assessments and demonstration of compliance with the performance objectives required by DOE Order 5820.2A. Therefore, DOE has conservatively assumed that groundwater concentrations as a result of radioactive releases from the RCRA-permitted vaults and all other low-level waste disposal facilities (vaults and slit trenches) would remain within the DOE performance objective of 4 millirem per year adopted by DOE in Order 5400.5. TC

TC TE In summary, impacts to groundwater from alternative C – minimum waste forecast would be similar to the impacts discussed under the no-action alternative (Section 4.1.3).



4.3.3.3 Groundwater Resources – Maximum Waste Forecast

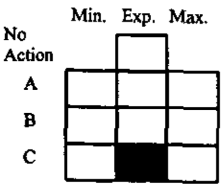
For this forecast, and as noted in Section 4.1.3, releases to the groundwater from RCRA-permitted disposal vaults would be improbable during active maintenance; however, releases could eventually TE occur after loss of institutional control and degradation of the vaults. Impacts from the RCRA-permitted disposal vaults would be similar to the effects under the no-action alternative (Section 4.1.3).

There would be seven fewer additional low-activity and intermediate-level radioactive waste disposal TC vaults (8) than under the no-action alternative (15). Modeling has predicted that the 4 millirem per year drinking water standard would not be exceeded for any radionuclide at any time after disposal (Toblin 1995). The impacts of the vaults in this case would be similar to those impacts in the no-action alternative (Section 4.1.3).

For alternative C – maximum waste forecast, there would be 576 additional slit trenches. Under this alternative, waste disposed in slit trenches would be stabilized (ashcrete, glass, smelter ingots). These disposal activities would be subject to completion of performance assessments and demonstration of TC compliance with the performance objectives required by DOE Order 5820.2A. Therefore, DOE has conservatively assumed that groundwater concentrations as a result of radioactive releases from the RCRA-permitted vaults and all other low-level waste disposal facilities (vaults and slit trenches) would remain within the DOE performance objective of 4 millirem per year adopted by DOE in Order 5400.5.

In summary, impacts to groundwater from alternative C – maximum waste forecast would be similar to TC the impacts under the no-action alternative (Section 4.1.3) and those for the expected waste forecast of this alternative (Section 4.3.3.1).

4.3.4 SURFACE WATER RESOURCES



4.3.4.1 Surface Water – Expected Waste Forecast

The extensive treatment configuration would use the treatment facilities presently available or being installed at SRS and several new facilities. Of the three alternatives, alternative C would treat waste most extensively prior to disposal. Impacts can be compared between the alternatives by evaluating the pollutants that would be introduced to the surface waters. The 4-millirem-per-year drinking water standard would not be exceeded for any radionuclide (Toblin 1995). TC

Under this alternative, the Consolidated Incineration Facility would operate until the non-alpha vitrification facility began operating. The incinerator would not discharge wastewater (blowdown) because it would be treated in the ashcrete process, and the stabilized ash and blowdown would be disposed of in RCRA-permitted disposal vaults or sent to shallow land disposal as discussed in Section 4.3.3.1. TE

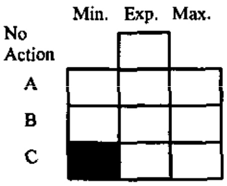
The Replacement High-Level Waste Evaporator would evaporate the liquid waste from the high-level waste tanks in the F- and H-Area tank farms (as noted in the no-action alternative). It would be used in the same manner as the present F- and H-Area evaporators, with the distillate being sent to the F/H-Area Effluent Treatment Facility for treatment prior to being discharged to Upper Three Runs. The concentrate from the evaporator would be sent to the Defense Waste Processing Facility for vitrification. Since the Replacement High-Level Waste Evaporator would be used in the same manner as the existing evaporators and would produce a distillate similar in composition to the present distillate, the effect of the effluent on Upper Three Runs would be the same as it is now. TE

DOE would also construct two vitrification facilities. The wastewater from both vitrification facilities would be treated at dedicated wastewater treatment facilities using an ion-exchange process, and the treated water would be recycled to each vitrification facility. Wastewater from the containment building would be transferred to the non-alpha vitrification facility for treatment and disposal. Wastewater would not be discharged to a surface stream.

Investigation-derived waste from groundwater wells that contained volatile organic compounds would be collected and treated by the M-Area Air Stripper. Since this water would be similar in composition to TE the groundwater presently being treated by the M-Area Air Stripper, surface waters would not be affected by the discharge of additional treated water.

As discussed in Section 4.2.4.1, additional wastewater would be treated in existing SRS facilities without exceeding the design capacity of any facility.

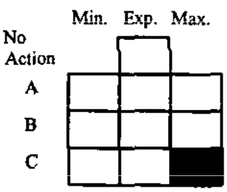
DOE would construct new facilities and additional storage buildings, pads, and vaults under this alternative. Erosion and sedimentation control plans would be developed and implemented for these projects, as noted in Section 4.1.4. After the facilities were operating, they would be included in the TE *Savannah River Site Stormwater Pollution Prevention Plan,* which details stormwater control measures.



4.3.4.2 Surface Water – Minimum Waste Forecast

TE As discussed in the other minimum waste forecasts (Sections 4.2.4.2 and 4.4.4.2), additional wastewater would be treated by the existing wastewater treatment facilities.

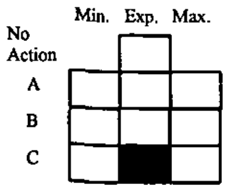
Erosion and sedimentation control plans for construction projects, and pollution prevention plans would be required as they are under the no-action alternative.



4.3.4.3 Surface Water – Maximum Waste Forecast

Facilities and discharges would be as described in Section 4.3.4.1. The previously described requirements for erosion and sedimentation control plans and pollution prevention plans would apply.

4.3.5 AIR RESOURCES



4.3.5.1 Air Resources – Expected Waste Forecast

Impacts to air resources can be evaluated by comparing pollutants introduced under the various alternatives. For alternative C – expected waste forecast, DOE would continue ongoing or planned waste treatment activities and construct and operate additional waste management facilities. Additional nonradiological and radiological emissions would occur. The resulting increases of pollutant concentrations at and beyond the SRS boundary would be minimal compared to existing concentrations. TE
Neither state nor Federal air quality standards would be exceeded by operations under alternative C.

4.3.5.1.1 Construction

Potential impacts to air quality from construction activities would include fugitive dust and earth-moving equipment exhaust. Approximately 6.19×10^5 cubic meters (8.10×10^5 cubic yards) of soil would be disturbed in E-Area for the construction of facilities for alternative C – expected waste forecast.

Maximum SRS boundary-line concentrations of air pollutants resulting from a year of average construction are shown in Table 4-38. These concentrations would be similar to those for the no-action alternative. During a year of average construction, the sum of the increase over baseline pollutant concentrations due to construction plus the existing baseline would be within both state and Federal air quality standards.

4.3.5.1.2 Operations

There would be additional radiological and nonradiological emissions at SRS due to the operation of new facilities such as the M-Area Vendor Treatment Facility, the mixed and hazardous waste containment building, the non-alpha waste vitrification facility, the transuranic waste characterization/certification facility, the alpha waste vitrification facility, and the Consolidated Incineration Facility (assuming it operates as scheduled until it is replaced by the vitrification facilities).

Table 4-38. Maximum SRS boundary-line concentrations resulting from a year of average construction activities under alternative C (in micrograms per cubic meter of air).

Pollutant	Averaging time	Existing baseline[a] (μg/m3)	Average change[b] (μg/m3)			SCDHEC standard[c] (μg/m3)	Existing baseline + change as percent of standard		
			Expected	Minimum	Maximum		Expected	Minimum	Maximum
Nitrogen oxides	1 year	14	<0.01[d]	<0.01	0.03	100	14	14	14
Sulfur dioxide	3 hours	857	38.71	15.94	362.25	1,300	69	67	94
	24 hours	213	0.72	0.30	6.83	365	59	58	60
	1 year	17	<0.01	<0.01	<0.01	80	21	21	21
Carbon monoxide	1 hour	171	737	330	6,793	40,000	2	1	17
	8 hours	22	115	52	1,030	10,000	1	1	11
Total suspended particulates	1 year	43	0.01	<0.01	0.03	75	57	57	57
Particulate matter less than 10 microns in diameter	24 hours	85	2.47	1.03	23.51	150	58	58	72
	1 year	25	0.01	<0.01	0.04	50	50	50	50

TC

a. Source: Stewart (1994).
b. Source: Hess (1994a).
c. Source: SCDHEC (1976).
d. < is read as "less than."

Emissions from new or proposed facilities are estimated from processes occurring in the facilities or similar facilities, annual average waste flow volumes, and air permit applications. Air emissions from facilities such as disposal vaults and mixed waste storage buildings would be very small.

Per the rationale provided in Section 4.1.5.2 regarding similar facilities, no increase in maximum boundary-line concentrations of pollutants would result from the continued operation of currently operating facilities. Additional emissions from the M-Area Air Stripper and the F/H-Area Effluent Treatment Facility due to the expected waste forecast would be very small and are discussed in Section 4.1.5.2. TE

Nonradiological Air Emissions Impacts

Maximum ground-level concentrations for nonradiological air pollutants are estimated from the Industrial Source Complex Version 2 Dispersion Model using maximum potential emissions from all facilities included in alternative C (Stewart 1994). Calculations for the annual averaging period and for the dispersion of toxic substances that are carcinogenic are presented in Section 4.1.5.2. Modeled air toxic concentrations for carcinogens are based on an annual averaging period and are presented in Section 4.3.12.1.2. Air dispersion modeling was performed with calculated emission rates for facilities not yet operating and actual 1990 emission levels for facilities currently operating (Stewart 1994).

The following facilities were included in the modeling analysis for alternative C air dispersion: the Consolidated Incineration Facility, including the ashcrete storage silo, the ashcrete hopper duct, and the ashcrete mixer; four new solvent tanks; the M-Area Vendor Treatment Facility; the hazardous and mixed waste containment building; the transuranic waste characterization/certification facility; hazardous waste storage facilities; mixed waste storage facilities; the non-alpha waste vitrification facility; and the alpha waste vitrification facility. TC

Emissions of air toxics would be negligible. Maximum boundary-line concentrations for air toxics emanating from existing SRS sources, including the Consolidated Incineration Facility and the Defense Waste Processing Facility, would be well below regulatory standards and are presented in the *SCDHEC Regulation No. 62.5 Standard No. 2 and Standard No. 8 Compliance Modeling Input/Output Data.* TE

The Savannah River Technology Center laboratory's liquid waste and E-Area vaults would have very small air emissions, as discussed in Section 4.1.5.2.

Table 4-39 shows the increase in maximum ground-level concentrations at the SRS boundary for nonradiological air pollutants due to routine releases for alternative C – expected, minimum, and maximum waste forecasts. Concentrations due to routine emissions resulting from alternative C – TC expected waste forecast are similar to those under the no-action alternative. Refer to Section 4.2.5.1.2 for a discussion of the emissions from offsite lead decontamination.

TE **Radiological Air Emissions Impacts**

Offsite maximally exposed individual and population doses were determined for atmospheric releases L004-13 resulting from routine operations. The major sources of radionuclides would be the Consolidated Incineration Facility, the alpha and non-alpha vitrification facilities, and the transuranic waste characterization/certification facility. Other facilities with radiological releases include the M-Area Vendor Treatment Facility and the mixed and hazardous waste containment building.

SRS-specific computer codes MAXIGASP and POPGASP were used to determine the maximum offsite individual dose and the 80-kilometer (50-mile) population dose, respectively, resulting from routine L004-13 atmospheric releases. See Appendix E for detailed facility specific isotopic and dose data.

Table 4-40 shows the dose to the offsite maximally exposed individual and the population. The calculated maximum committed effective annual dose equivalent to a hypothetical individual is TC 0.18 millirem (Chesney 1995), which is well within the annual dose limit of 10 millirem from SRS atmospheric releases. In comparison, an individual living near SRS receives a dose of 0.25 millirem from all current SRS routine releases (Arnett 1994).

For alternative C – expected waste forecast, the annual dose to the population within 80 kilometers TC (50 miles) of SRS would be 10 person-rem. In comparison, the collective dose received from natural sources of radiation is approximately 195,000 person-rem (Arnett, Karapatakis, and Mamatey 1994) to the same population. Section 4.3.12.1.2 describes the potential health effects of these releases on individuals residing offsite.

Table 4-39. Changes in maximum ground-level concentrations of air pollutants at the SRS boundary for alternative C – expected, minimum, and maximum waste forecasts. TE

Pollutant	Averaging time	Existing sources (μg/m3)[a,b]	Regulatory standards (μg/m3)[c]	Background concentration (μg/m3)[d]	Increase in concentration (μg/m3) Expected[b]	Minimum	Maximum	Percent of standard[e] Expected	Minimum	Maximum
Nitrogen oxides	1 year	6	100	8	0.28	0.28	0.32	14	14	14
Sulfur oxides	3 hours	823	1,300	34	2.70	2.69	2.74	66	66	66
	24 hours	196	365	17	0.39	0.39	0.40	58	58	58
	1 year	14	80	3	0.01	0.01	0.01	21	21	21
Carbon monoxide	1 hour	171	40,000	NA[f]	24.19	24.19	24.19	0.5	0.5	0.5
	8 hours	22	10,000	NA	4.02	4.02	4.02	0.3	0.3	0.3
Total suspended particulates	1 year	13	75	30	1.98	1.98	1.98	60	60	60
Particulate matter less than 10 microns in diameter	24 hours	51	150	34	3.20	3.18	3.52	59	59	59
	1 year	3	50	22	0.08	0.08	0.10	50	50	50
Lead	3 months	4.0×10^{-4}	1.5	0.011	2.50×10^{-5}	1.90×10^{-5}	6.60×10^{-5}	0.8	0.8	0.8
Gaseous fluorides (as hydrogen fluoride)	12 hours	2	3.7	NA	0.0012	0.0011	0.0012	54	54	54
	24 hours	1	2.9	NA	8.60×10^{-4}	8.60×10^{-4}	8.80×10^{-4}	35	35	35
	1 week	0.4	1.60	NA	3.40×10^{-4}	3.40×10^{-4}	3.50×10^{-4}	25	25	25
	1 month	0.01	0.80	NA	1.10×10^{-4}	1.10×10^{-4}	1.10×10^{-4}	13	13	13

TC

a. Micrograms per cubic meter of air.
b. Source: Stewart (1994).
c. Source: SCDHEC (1976).
d. Source: SCDHEC (1992).
e. Percent of standard = 100 × (actual + background + increment) divided by the regulatory standards.
f. NA = not applicable.

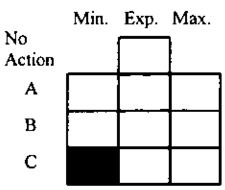
TE

Table 4-40. Annual radiological doses to individuals and the population within 80 kilometers (50 miles) of SRS under alternative C.[a]

TC

Waste forecast	Offsite maximally exposed individual Dose (millirem)	Population Dose (person-rem)
Expected	0.18	10
Minimum	0.09	4.9
Maximum	4.0	229

a. Source: Chesney (1995).



4.3.5.2 Air Resources – Minimum Waste Forecast

The alternative C – minimum waste forecast would have a smaller impact to air resources than the expected waste forecast.

4.3.5.2.1 Construction

Impacts were evaluated for the construction of facilities listed in Section 2.5.7. Maximum concentrations at the SRS boundary resulting from average annual emissions during the 30-year construction period are presented in Table 4-38. As discussed in Section 4.3.5.1.1, SRS would still be in compliance with both state and Federal air quality standards.

4.3.5.2.2 Operations

Both radiological and nonradiological impacts were determined for the same facilities listed in Section 2.5.7. Air emissions would be less than for the expected waste forecast.

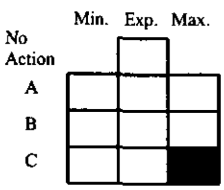
TE

Nonradiological Air Emissions Impacts

Nonradiological air emissions would be less than those estimated for the expected waste forecast. Maximum concentrations at the SRS boundary are presented in Table 4-39. Modeled concentrations are similar to the expected waste forecast. Total concentrations would be less than both state and Federal ambient air quality standards, and SRS would remain in compliance with both state and Federal standards.

Radiological Air Emissions Impacts TE

Table 4-40 shows the dose to the offsite maximally exposed individual and the population due to atmospheric releases. The calculated maximum committed annual dose equivalent to a hypothetical individual is 0.09 millirem (Chesney 1995), which is less than the dose from the expected waste forecast TC and below the annual dose limit of 10 millirem from SRS atmospheric releases. The annual dose to the population within 80 kilometers (50 miles) of SRS would be 4.9 person-rem, less than the population TC dose calculated for the expected waste forecast.



4.3.5.3 Air Resources – Maximum Waste Forecast

Alternative C – maximum waste forecast would have greater impacts than the expected waste forecast.

4.3.5.3.1 Construction

Maximum concentrations at the SRS boundary that would result from average annual emissions during the 30-year construction period are presented in Table 4-38.

During a year of average construction, the sum of concentrations of air pollutants resulting from construction activities plus the existing baseline would be below both state and Federal air quality standards. Good construction management procedures would require the wetting of roads to reduce particulate emissions.

4.3.5.3.2 Operations

Nonradiological Air Emissions Impacts TE

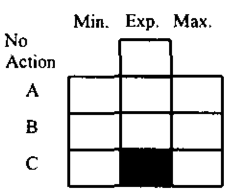
Nonradiological air emissions would be greater than those estimated for the expected waste forecast. Maximum concentrations at the SRS boundary are presented in Table 4-39. Cumulative concentrations would be within applicable state and federal ambient air quality standards.

TE **Radiological Air Emissions Impacts**

Table 4-40 shows the dose to the offsite maximally exposed individual and the population due to atmospheric releases from the facilities operating for the maximum waste forecast. The calculated TC maximum committed annual dose equivalent to a hypothetical individual is 4.0 millirem (Chesney 1995), which is greater than the dose calculated for the expected waste forecast but within the annual dose limit of 10 millirem from all SRS atmospheric releases.

TC The annual dose to the population within 80 kilometers (50 miles) of SRS would be 229 person-rem, which is greater than the population dose calculated for the expected waste forecast. The collective dose the same population receives from natural sources of radiation is approximately 195,000 person-rem (Arnett, Karapatakis, and Mamatey 1994). Section 4.3.12.1.2 describes the potential health effects of these releases.

4.3.6 ECOLOGICAL RESOURCES

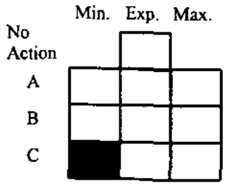


4.3.6.1 <u>Ecological Resources – Expected Waste Forecast</u>

Development of new facilities would result in the clearing and grading of undisturbed land. (These land areas are presented in acres; to convert from acres to square kilometers, multiply by 0.004047.) Clearing TC and grading would affect 108 acres of woodland by 2006 and an additional 20 acres by 2024, as follows:

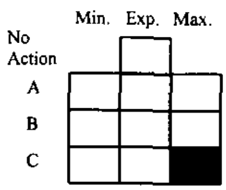
- TC 27 acres of loblolly pine planted in 1987
- 20 acres of white oak, red oak, and hickory regenerated in 1922
- 57 acres of longleaf pine regenerated in 1922, 1931, or 1936
- 4 acres from which mixed pine/hardwood was recently harvested
- TC 20 acres of loblolly pine planted in 1987 would be cleared between the years 2008 and 2024

TE Effects on the ecological resources would be the same as those described in Section 4.1.6 for the
TC no-action alternative; however, because slightly less land (i.e., 128 acres versus 160 under the no-action alternative) would be required, the overall impact would be slightly less.



4.3.6.2 Ecological Resources – Minimum Waste Forecast

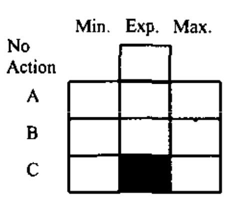
Approximately 111 acres of undeveloped land located between the M-Line railroad and the E-Area TC
expansion and extending northwest of F-Area would be required. Impacts to the ecological resources of the area would be slightly less than under the expected waste forecast due to the reduced area.



4.3.6.3 Ecological Resources – Maximum Waste Forecast

Approximately 184 acres of undeveloped land located between M-Line railroad and the E-Area expansion and extending northwest of F-Area would be required. By 2006, an additional 775 acres of TC
land in an undetermined location would also be required for alternative C – maximum waste forecast. Impacts to the ecological resources would be considerably greater than for the expected waste forecast due to the greater area, and similar to those described for alternative A – maximum forecast (see Section 4.2.6.3). Additional threatened and endangered species surveys and a floodplain/wetlands assessment would be required as part of the site-selection process.

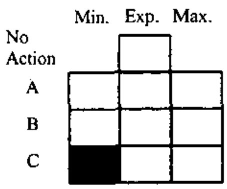
4.3.7 LAND USE



4.3.7.1 Land Use – Expected Waste Forecast

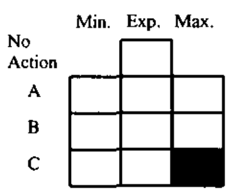
DOE would use approximately 167 acres (108 acres of undeveloped; 59 acres of developed) of land in E-Area through 2006 for activities associated with alternative C – expected waste forecast. By 2024, the TC
total would have been reduced to about 155 acres because as wastes would be treated and disposed, the storage buildings would be taken out of service and decontaminated and decommissioned; some would be demolished and the land converted back to a natural area. SRS has about 181,000 acres of undeveloped land which includes wetlands and other areas that cannot be developed, and 17,000 acres of developed land.

Activities associated with alternative C would not affect current SRS land-use plans; E-Area was designated as an area for nuclear facilities in the *Draft 1994 Land-Use Baseline Report*. Furthermore, no part of E-Area has been identified as a potential site for future new missions. And according to the *FY 1994 Draft Site Development Plan*, proposed future land management plans specify that E-Area be characterized and remediated for environmental contamination in its entirety, if necessary. DOE will make decisions on future SRS land uses through the site development, land-use, and future-use planning processes, including public input through avenues such as the Citizens Advisory Board.



4.3.7.2 Land Use – Minimum Waste Forecast

Activities associated with alternative C – minimum waste forecast would not affect current SRS land
TC uses. Approximately 0.57 square kilometer (141 acres) (slightly less than for the expected waste
forecast) in E-Area would be utilized.

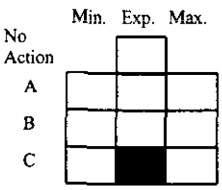


4.3.7.3 Land Use – Maximum Waste Forecast

Activities associated with alternative C – maximum waste forecast would not affect current SRS land
TC uses. By 2006, DOE would use a total of 1,029 acres (254 acres in E-Area and 775 acres elsewhere) for
the facilities listed in Section 4.3.1. This acreage is nearly 10 times the land that would be required
under the expected or minimum waste forecasts, but is less than 1 percent of the total undeveloped land
on SRS (DOE 1993d). However, considerably more acreage than this may be affected (see Section
TC 4.2.6.3). There would be no impact to current land uses in E-Area. The location of the 775 acres outside
of E-Area has not been identified and would be the subject of further impact analyses. However, DOE
TC would minimize the impact of clearing 775 acres by siting new facilities using the central industrialized
portion of SRS, as described in Section 2.1.2 and Figure 2-1.

4.3.8 SOCIOECONOMICS

This section describes the potential effects of alternative C on the socioeconomic resources in the region of influence discussed in Section 3.8. This assessment is based on the estimated construction and operations employment required to implement this alternative, as listed in Tables 4-41 and 4-42.



4.3.8.1 Socioeconomics – Expected Waste Forecast

4.3.8.1.1 Construction

DOE anticipates that for alternative C – expected waste forecast, construction employment would peak
during 2004 through 2005 with approximately 160 jobs (Table 4-41), 110 more than during peak TC
employment under the no-action alternative. This employment demand represents less than 1 percent of
the forecast employment in 2005. Given the normal fluctuation of employment in the construction
industry, DOE does not expect a net change in regional construction employment from implementation
of this case. Given no net change in employment, neither population nor personal income in the region TC
would change. As a result, socioeconomic resources would not be affected.

4.3.8.1.2 Operations

Operations employment associated with implementation of alternative C – expected waste forecast is
expected to peak from 2002 through 2005 with an estimated 2,160 jobs, 290 fewer than during peak
employment under the no-action alternative (Table 4-41). This employment demand represents less than TC
1 percent of the forecast employment in 2005 and approximately 10 percent of 1995 SRS employment.
DOE believes these jobs would be filled from the existing SRS workforce. Thus, DOE does not
anticipate impacts to socioeconomic resources from changes in operations employment.

Table 4-41. Estimated construction and operations employment for alternative C – minimum, expected, and maximum waste forecasts.[a]

TC

	Waste Forecast				
	Minimum		Expected		Maximum[b]
Year	Construction	Operations	Construction	Operations	Construction
1995	20	810	30	980	170
1996	20	970	20	1,250	40
1997	20	970	20	1,250	50
1998	20	970	20	1,360	140
1999	20	1,090	20	1,480	140
2000	20	1,100	20	1,610	140
2001	20	1,100	20	1,610	140
2002	60	1,230	90	2,160	270
2003	90	1,230	110	2,160	300
2004	130	1,470	160	2,160	350
2005	130	1,350	160	2,160	350
2006	90	1,300	100	1,940	230
2007	60	1,230	70	1,830	210
2008	20	1,330	30	1,910	80
2009	20	1,260	30	1,910	80
2010	20	1,260	30	1,910	80
2011	20	1,260	30	1,910	80
2012	20	1,260	30	1,910	80
2013	20	1,260	30	1,910	80
2014	20	1,260	30	1,910	80
2015	20	1,260	30	1,910	80
2016	20	1,260	30	1,910	80
2017	20	1,260	30	1,910	80
2018	20	1,260	30	1,910	80
2019	20	1,180	30	1,820	70
2020	20	1,180	30	1,820	70
2021	20	1,180	30	1,820	70
2022	20	1,180	30	1,820	70
2023	20	1,180	30	1,820	70
2024	20	1,180	30	1,820	70

a. Source: Hess (1995a).
b. Operations employment for the maximum waste forecast is provided in Table 4-42.

Table 4-42. Estimated new operations jobs required to support alternative C – maximum waste forecast.[a]

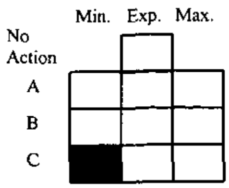
Year	Projected total site employment	Site employment available for WM activities[b]	Total operations employment for alternative C – maximum case	New hires[c]
1995	20,000	10,000	1,260	0
1996	15,800	7,900	2,620	0
1997	15,800	7,900	2,800	0
1998	15,800	7,900	7,720	0
1999	15,800	7,900	7,720	0
2000	15,800	7,900	7,880	0
2001	15,800	7,900	7,880	0
2002	15,800	7,900	10,060	2,160
2003	15,800	7,900	10,060	2,160
2004	15,800	7,900	10,060	2,160
2005	15,800	7,900	10,060	2,160
2006	15,800	7,900	8,870	970
2007	15,800	7,900	8,910	1,010
2008	15,800	7,900	4,540	0
2009	15,800	7,900	4,540	0
2010	15,800	7,900	4,540	0
2011	15,800	7,900	4,540	0
2012	15,800	7,900	4,540	0
2013	15,800	7,900	4,540	0
2014	15,800	7,900	4,540	0
2015	15,800	7,900	4,540	0
2016	15,800	7,900	4,540	0
2017	15,800	7,900	4,540	0
2018	15,800	7,900	4,540	0
2019	15,800	7,900	4,020	0
2020	15,800	7,900	4,020	0
2021	15,800	7,900	4,020	0
2022	15,800	7,900	4,020	0
2023	15,800	7,900	4,020	0
2024	15,800	7,900	4,020	0

TC

a. Source: Hess (1995a).

b. DOE assumed that approximately 50 percent of the total site workforce would be available to work on waste management activities.

c. New hires are calculated by comparing the required employment (column 4) to available employment (column 3); new hires would result only in those years when required employment exceeds available employment.



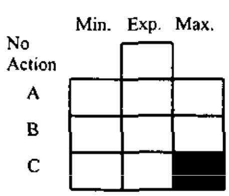
4.3.8.2 Socioeconomics – Minimum Waste Forecast

4.3.8.2.1 Construction

Construction employment associated with alternative C – minimum forecast would be slightly less than that for the expected waste forecast and would peak in 2004 and 2005 with approximately 130 jobs (Table 4-41), which represents much less than 1 percent of the forecast employment in 2005. DOE does not expect a net change in regional construction employment from implementation of this case. As a result, socioeconomic resources in the region would not be affected. TC

4.3.8.2.2 Operations

Operations employment associated with implementation of the minimum waste forecast is expected to peak in 2004 with an estimated 1,470 jobs, approximately 690 fewer jobs than under the expected waste forecast (Table 4-41). This employment demand represents less than 1 percent of the forecast employment in 2005 (see Chapter 3) and approximately 7 percent of 1995 SRS employment. DOE believes these jobs could be filled from the existing SRS workforce and, therefore, anticipates that socioeconomic resources would not be affected by changes in operations employment. TC



4.3.8.3 Socioeconomics – Maximum Waste Forecast

4.3.8.3.1 Construction

Construction employment associated with alternative C – maximum waste forecast would be greater than that for the expected waste forecast and would peak in 2004 and 2005 with approximately 350 jobs (Table 4-41), which represents less than 1 percent of forecast employment for 2005. DOE does not expect a net change in regional construction employment from implementation of this case. As a result, socioeconomic resources in the region would not be impacted. TE

4.3.8.3.2 Operations

Operations employment associated with the implementation of alternative C – maximum waste forecast is expected to peak during 2002 through 2005 with an estimated 10,060 jobs (Table 4-42), which represents 3.7 percent of the forecast regional employment in the year 2005 and approximately 50 percent of 1995 SRS employment. DOE assumes that approximately 50 percent of the total SRS workforce would be available to support implementation of this case. If DOE transfers 50 percent of the SRS workforce, an additional 2,160 new employees would still be required in the peak years. Based on the number of new jobs predicted, DOE calculated changes in regional employment, population, and personal income using the Economic-Demographic Forecasting and Simulation Model developed for the six-county region of influence (Treyz, Rickman, and Shao 1992). TC

Results of the modeling indicate that the peak regional employment change would occur in 2002 with a *total of approximately 5,320 new jobs (Table 4-43) (HNUS 1995b). This would represent a 2 percent* increase in baseline regional employment and would have a substantial positive impact on the regional economy.

Potential changes in regional population would lag behind the peak change in employment because of migration lags and because in-migrants may have children after they move into the area. As a result, the maximum change in population would occur in 2005 with an estimated 6,630 additional people in the six-county region (Table 4-43) (HNUS 1995b). This increase is approximately 1.4 percent above the baseline regional population forecast and could affect the demand for community resources and services such as housing, schools, police, health care, and fire protection. TC

Potential changes in total personal income would peak in 2005 with a $410 million increase over forecast regional income levels for that year (Table 4-43) (HNUS 1995b). This would be a 2.6 percent increase over baseline income levels and would have a substantial, positive effect on the regional economy.

4.3.9 CULTURAL RESOURCES

This section discusses the effect of alternative C on cultural resources.

TC

Table 4-43. Changes in employment, population, and personal income for alternative C – maximum waste forecast.[a]

Year	New hires[b]	Change in indirect regional employment[c]	Net change in total regional employment	Percent change in regional employment	Change in regional population	Percent change in regional population	Change in regional personal income (millions)	Percent change in regional personal income
2002	2,160	3,160	5,320	2.06	1,870	0.39	310	2.37
2003	2,160	3,110	5,270	2.02	4,130	0.86	350	2.52
2004	2,160	2,970	5,130	1.94	5,510	1.15	380	2.58
2005	2,160	2,860	5,020	1.88	6,630	1.38	410	2.63
2006	970	980	1,950	0.72	6,450	1.34	220	1.32
2007	1,010	980	1,990	0.74	5,900	1.23	220	1.32

a. Source: Hess (1995a); HNUS (1995b).
b. From Table 4-42.
c. Change in employment related to changes in population.