Chapter 7

Nonradiological Environmental Surveillance

Bill Littrell and Don Padgett
Environmental Protection Department

Robert Turner
Engineering Services Department

To Read About . . . **See Page . . .**

NONRADIOACTIVE environmental surveillance at the Savannah River Site (SRS) involves the sampling and analysis of surface water (six onsite streams and the Savannah River), drinking water, sediment, groundwater, and fish. Surface water, drinking water, sediment, and fish surveillance programs are discussed in this chapter. A description of the groundwater program can be found in chapter 8, "Groundwater."

The Environmental Protection Department's Environmental Monitoring Section (EMS) and the Savannah River Technology Center (SRTC) perform nonradiological surveillance activities. The Savannah River also is monitored by other groups, including the South Carolina Department of Health and Environmental Control (SCDHEC) and the Georgia Department of Natural Resources (GDNR). In addition, the Academy of Natural Sciences of Philadelphia (ANSP) conducts environmental surveys on the Savannah River through a program that began in 1951. A brief discussion of these surveys appears on page 106.

A complete description of the EMS sample collection and analytical procedures used for nonradiological surveillance can be found in section 1105 of the *Savannah River Site Environmental Monitoring Section Plans and Procedures*, WSRC–3Q1–2, Volume 1 (SRS EM Program). A summary of analytical results is presented in this chapter; however, more complete data can be found in *SRS Environmental Data for 2001* (WSRC–TR–2001–00475).

In 2001, approximately 6,300 nonradiological analyses for specific chemicals and metals were performed on about 1,200 samples, not including groundwater.

SRS currently does not conduct onsite surveillance for nonradiological ambient air quality. However, to ensure compliance with SCDHEC air quality regulations and standards, SRTC conducted air dispersion modeling for all site sources of criteria pollutants and toxic air pollutants in 1993. This modeling indicated that all SRS sources were in compliance with air quality regulations and standards. Since that time, additional modeling conducted for new sources of criteria pollutants and toxic air pollutants has demonstrated continued compliance by the site with these regulations and standards. The states of South Carolina and Georgia continue to monitor ambient air quality near the site as part of a network associated with the federal Clean Air Act. (See chapter 6 for more information about criteria pollutants and toxic air pollutants.)

Surface Water

SRS streams and the Savannah River are classified as "Freshwaters" by SCDHEC. Freshwaters are defined as surface water suitable for

- primary—and secondary—contact recreation and as a drinking water source after conventional treatment in accordance with SCDHEC requirements
- fishing and survival and propagation of a balanced indigenous aquatic community of fauna and flora
- industrial and agricultural uses

Appendix A, "Applicable Guidelines, Standards, and Regulations," provides some of the specific guides used in water quality surveillance, but because some of these guides are not quantifiable, they are not tracked.

Description of Surveillance Program

SRS stream and Savannah River nonradiological surveillance is conducted for any evident

degradation that could be attributed to the water discharges regulated by the site National Pollutant Discharge Elimination System (NPDES) permits and materials that may be released inadvertently from sources other than routine release points.

In addition, nonradiological surveillance is conducted to compare the SRS contribution of pollutants with background levels of chemicals from natural sources and from contaminants produced by municipal sewage plants, medical facilities, and other upriver industrial facilities.

Each SRS stream receives varying amounts of treated wastewater and rainwater runoff from site facilities. Stream locations are sampled for water quality at monthly and quarterly frequencies by the conventional grab-collection technique. Each grab sample shows the water quality at the time of sampling only.

River sampling sites are located upriver of, adjacent to, and downriver of the site. In the surveillance program, site streams and the Savannah River are sampled monthly for various physical and chemical properties. Surface water sampling locations are shown in figure 7–1.

To monitor the quality of water coming onto and leaving the site, field measurements for conductivity, dissolved oxygen, pH, and temperature are taken monthly and laboratory analyses are conducted for other water quality parameters, such as metals, pesticides/herbicides (quarterly), and other physical and chemical properties. Comparison of the results from upstream and downstream locations (locations that are below process areas or at points where the water leaves the site) indicates any impact the site may have had on the water.

The natural chemical and physical parameters measured monthly on each stream and in the river vary to some extent throughout the year. This natural variation can be trended on a month-to-month basis. When results diverge greatly from the historical norm, an abnormal discharge event or occurrence in the environment may be indicated. An investigation is held to determine if a release has occurred.

Surveillance Results

Comparison of the upstream and downstream locations where available (Upper Three Runs) and month-to-month trends for each of these stations indicated normal trends for a southern pine forest stream. The upstream pH varied within a range of 5.0 to 6.7 at Upper Three Runs–1A and between 5.7 and 6.9 at Tinker Creek–1. Conductivity ranged from a low of 12 µmhos/cm at the Upper Three Runs–1A location to a high of 39 µmhos/cm at Tinker Creek–1. The downstream station at Upper Three Runs–4 had a pH range of 6.0 to 6.7 and a conductivity range of 21 to 27 µmhos/cm.

Nitrate levels for most river and stream locations usually ranged below 0.50 mg/L. Steel Creek–4 had the highest nitrate concentration of all the streams at 1.3 mg/L—a one-time occurrence the cause of which is not known. Concentrations ranged downward to below the practical quantitation limit (PQL).

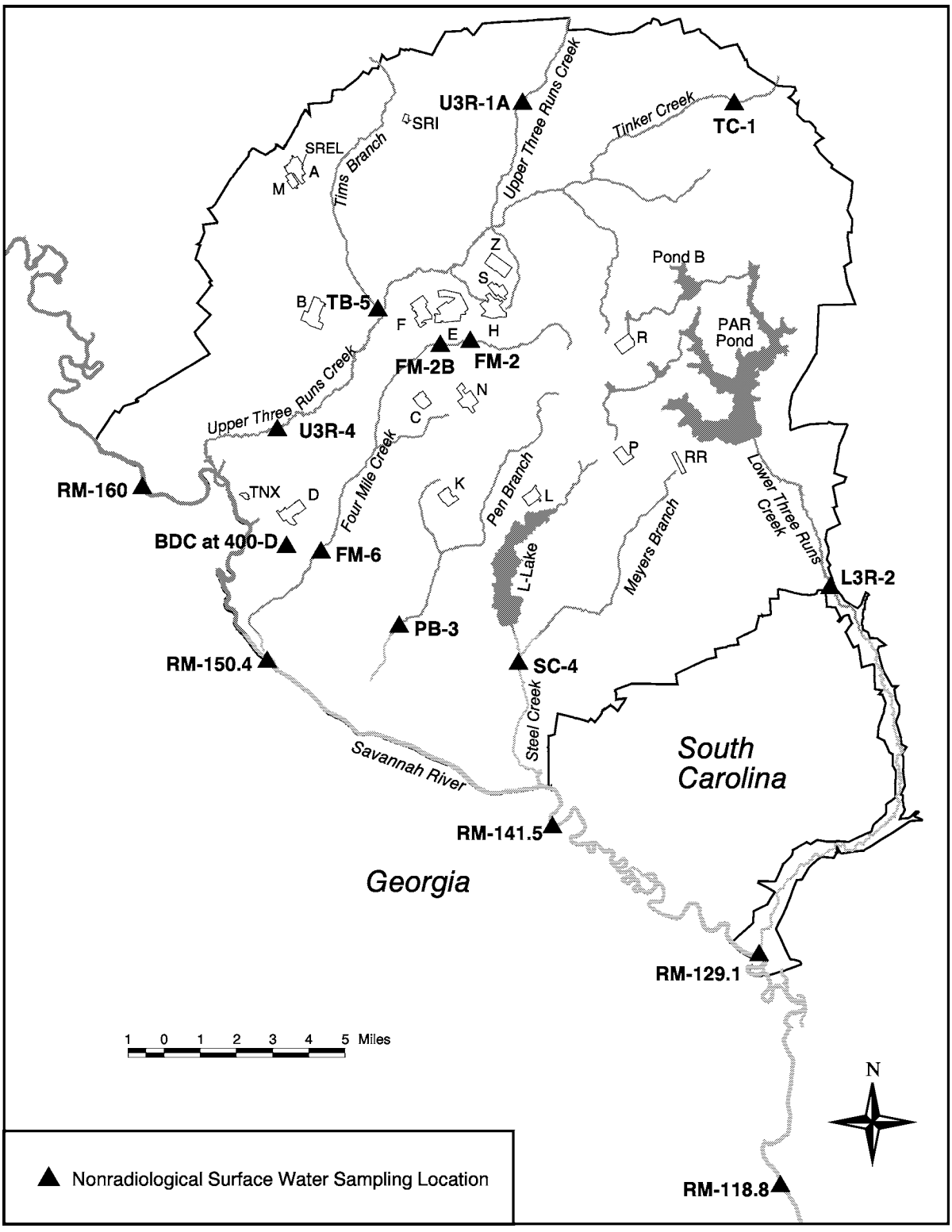
Average phosphate levels were typically higher in the Savannah River than in onsite streams. River levels ranged from an average of 0.105 mg/L at River Mile 118.8 to 0.151 mg/L at River Mile 150.4. The highest average on site was 0.129 mg/L on Beaver Dam Creek at 400–D. Lower Three Runs–2 was second, with approximately the same average.

With the exception of the 400–D location, total suspended solids averaged lower on site than in the river. The 400–D location had high total suspended solids during March (reason unknown), which raised the location's average to 8.9 mg/L. Excluding 400–D, onsite total suspended solids averages ranged from a low of 2.5 mg/L at Steel Creek–4 to a high of 6.5 mg/L at Four Mile Creek–2B. In the river, the low average was at River Mile 160 (7.5 mg/L), and the high average was at River Mile 129.1 (12.2 mg/L).

Hardness in the Savannah River ranged from a low below the PQL at River Mile 118.8 and River Mile 150.4 to a high of 37 mg/L—also at River Mile 118.8. On site, the low was below the PQL at two locations for the entire year (Upper Three Runs–4 and Upper Three Runs–1A), and the high was 41 mg/L at Lower Three Runs–2.

Aluminum, cadmium, chromium, copper, iron, manganese, nickel, and zinc were seen in surface waters at all river and stream locations. Mercury was seen above the quantitation limit in the Savannah River and in onsite streams. Levels ranged from a high of 0.05 mg/L at Four Mile–2 to below the PQL at several locations. Copper was found at various locations, both in the river and in site streams. All positive results were near the quantitation limit.

One pesticide, Beta BHC, was found in 2001 near the quantitation limit at Four Mile Creek–6, River Mile 150.4, River Mile 141.5, River Mile 129.1, and River Mile 118.8. No herbicides were detected during 2001.



EPD/GIS Map

Figure 7–1 Nonradiological Surface Water Sampling Locations

Surface water samples are collected from five Savannah River and eleven SRS stream locations and are analyzed for various chemical and physical properties.

Analyses of the data continue to indicate that SRS discharges are not significantly affecting the water quality of the streams or the river.

Drinking Water

Most of the drinking water at SRS is supplied by three systems that have treatment plants in A-Area, D-Area, and K-Area. The site also has 15 small drinking water facilities at remote security barricades, field laboratories, and field offices that serve populations of fewer than 25 persons (figure 7–2).

Well water from the McBean, Congaree, Black Creek, and Middendorf aquifers is utilized for the 18 drinking water systems. Many of these well water supplies require treatment to ensure that SCDHEC and U.S. Environmental Protection Agency (EPA) drinking water quality standards are maintained. Treatment processes include aeration to remove dissolved gases; filtration to remove iron; and addition of potable water treatment chemicals to adjust pH, prevent piping corrosion, and prevent bacterial growth.

Description of Surveillance Program

SRS drinking water supplies are tested routinely by site personnel and by SCDHEC to ensure compliance with SCDHEC and EPA drinking water standards (which can be found at http://www.epa.gov/safewater/mcl.html on the Internet) and monitoring requirements. This testing includes

- daily testing to monitor concentration of any potable water treatment chemicals added
- monthly or quarterly testing to confirm that bacteria are not present
- periodic testing for metals, organic and inorganic chemicals, and radionuclides

Surveillance Results

All samples collected from SRS drinking water systems during 2001 were in compliance with SCDHEC and EPA water quality limits (maximum contaminant levels).

Sediment

EMS's nonradiological sediment surveillance program provides a method of determining the deposition, movement, and accumulation of nonradiological contaminants in stream systems.

Description of Surveillance Program

The nonradiological sediment program consists of the collection of sediment samples at eight onsite stream locations and three Savannah River locations (figure 7–3). Collection is made by either a Ponar sediment sampler or an Emery pipe dredge sampler. The samples are analyzed for various inorganic contaminants (metals) and pesticides/herbicides by the Toxicity Characteristic Leaching Procedure (TCLP). This method analyzes for the soluble constituents in sediment. The program is designed to check for the existence and possible buildup of the inorganic contaminants as well as for pesticides/herbicides.

Surveillance Results

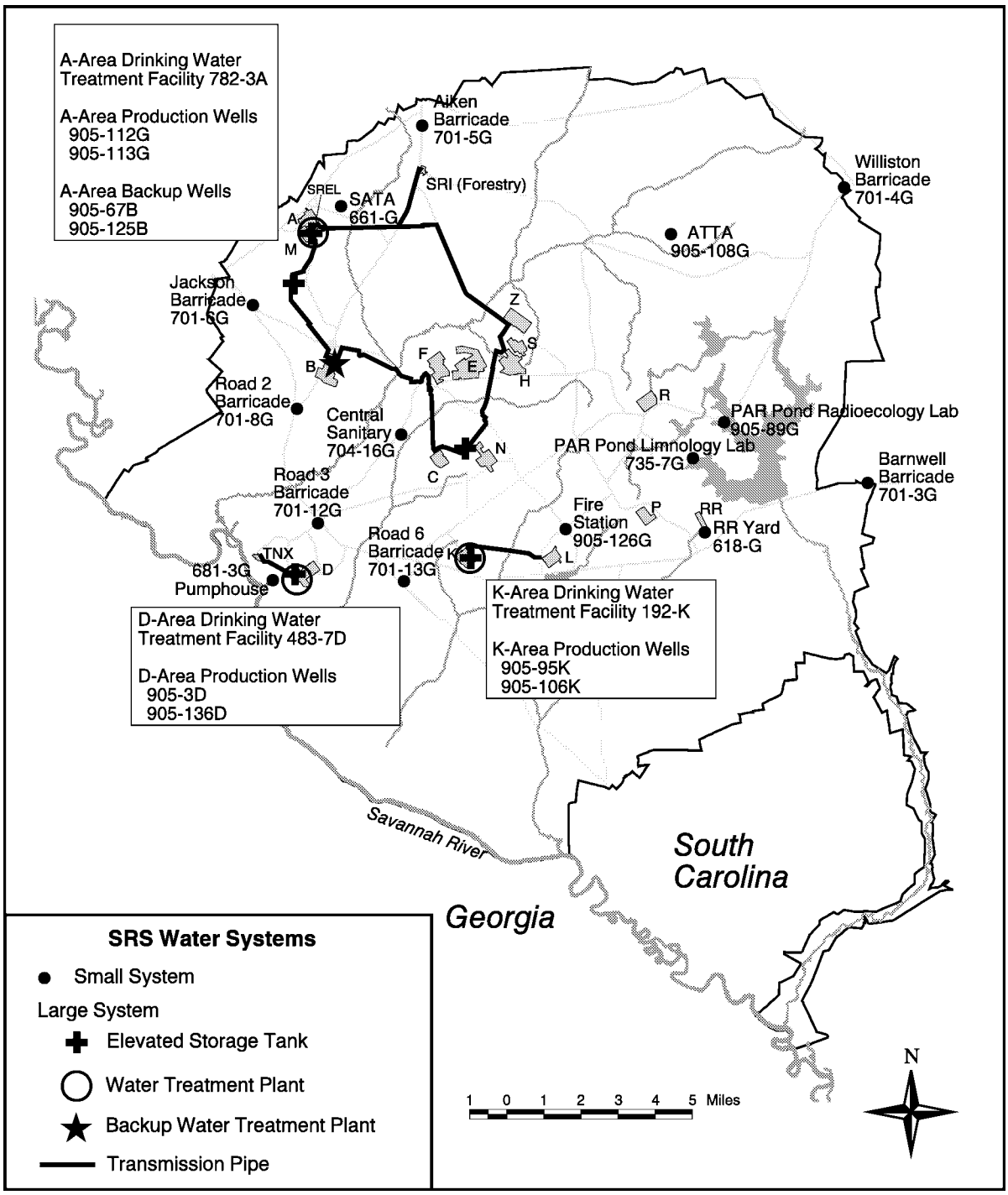
In 2001, as in the previous 5 years, no pesticides or herbicides were found to be above the quantitation limits in sediment samples. All pesticide/herbicide results were below the the PQL of the EPA analytical procedures used.

Barium, chromium, copper, lead, manganese, selenium, and zinc were seen in sediment at one or more river and/or stream locations. Levels for these metals were consistent with those seen in soil samples. From year to year, most metals vary from nondetectable levels to very low levels.

In 2001, copper was detected at Lower Three Runs–2 (0.065 mg/L) and Upper Three Runs–1A (0.056 mg/L). In recent years, it has ranged as high as 0.103 mg/L at Tinker Creek–1 (control location) to below the PQL at several locations, including Tinker Creek–1.

No mercury was detected in at any of the location sites in 2001, as was the case in 2000. In 1999, Upper Three Runs–4 showed 0.0001 mg/L of mercury, which is at the PQL. The 1998 level at Tinker Creek–1 was slightly above the PQL. No mercury was detected at any site in 1996 and 1997. In 2001, EMS completed an evaluation of mercury analysis at SRS using the new EPA 1631 method, which has a much lower PQL (0.006 ng/L) than the method used previously in the monitoring program. It was determined, however, that there would be no need to change the method used previously and adopt the new method.

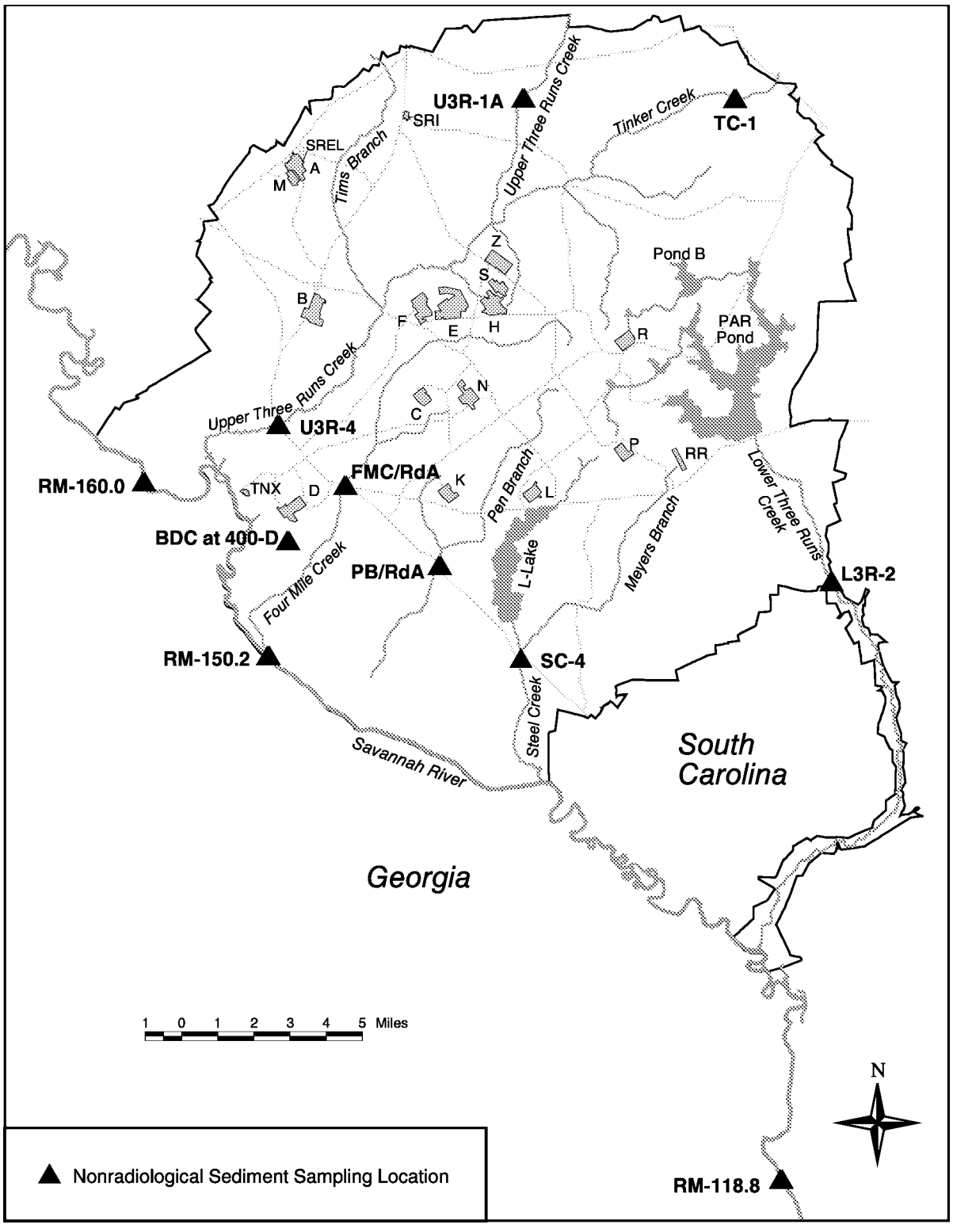
Cyanide was not detected at any location in 2001. No significant trends were observed for metals in the Savannah River or on site in 2001.



EPD/GIS Map

Figure 7–2 Drinking Water Systems

Most of the drinking water at SRS is supplied by three systems. The site also has 15 small drinking water facilities that serve populations of fewer than 25 persons. The three larger systems are depicted by transmission pipes, elevated storage tanks, water treatment plants, and a backup water treatment plant.



EPD/GIS Map

Figure 7–3 Nonradiological Sediment Sampling Locations

Sediment samples are collected at eight onsite stream locations and three Savannah River locations. The samples are analyzed for various inorganic contaminants (metals) and pesticides/herbicides.

Perspective on Mercury

Mercury in the environment can come from natural sources, such as volcanoes and venting of the earth's crust. Mercury also can come from manmade sources and processes, such as fungicides and fossil fuel combustion byproducts and the manufacture of chlorine, sodium hydroxide, plastics, textiles, and electrical apparatus. Testing by EPA during 2000 determined that 99 percent of the mercury in the Savannah River comes from atmospheric deposition [EPA, 2001b].

An important source of mercury in the SRS region may be in releases upriver of the site. Much of the mercury detected in SRS fish has been attributed to offsite sources, such as Savannah River water [Davis et al., 1989]. Savannah River water is pumped onto the site to support fire protection efforts and the sanitary waste treatment plant and to maintain L-Lake's water level. The water subsequently is released into site streams and lakes.

Naturally occurring mercury cycles between land, water, and air. As mercury enters streams and rivers through rainfall, runoff, and discharges, it is converted to the chemical compound methylmercury by bacterial and other processes. As part of the natural cycling, some methylmercury is absorbed by plants and animals into their tissues. Fish absorb methylmercury from food they ingest and from water as it passes over their gills; the methylmercury then is bound in their tissues. Consumption by people of fish containing methylmercury then completes the mercury pathway to humans. The amount of fish that can be eaten safely varies with (1) the concentration of methylmercury, (2) the amount consumed, and (3) the frequency of consumption. These factors are the basis of calculations performed during "risk analysis," a method to determine how much fish can be consumed safely.

State and federal regulatory agencies calculate the health risk associated with the consumption of fish, then recommend consumption guidelines based on that risk. Adherence to these guidelines can effectively control one's exposure to methylmercury. A list of fish advisories and/or recommended consumption limits can be obtained from state environmental agencies. EPA criteria taken from "Guidance For Assessing Chemical Contaminant Data For Use In Fish Advisories, Volume II Risk Assessment And Fish Consumption Limits" (EPA 823–B–94–004, June 1994), gives the monthly consumption limits for chronic systemic health endpoint for the general population.

Fish

Description of Surveillance Program

EMS analyzes the flesh of fish caught from onsite streams and ponds and from the Savannah River to determine concentrations of mercury in the fish [SRS EM Program, 2001]. The freshwater fish analyzed (bass, bream, and catfish) represent the most common edible species of fish in the Central Savannah River Area (CSRA), an 18-county area in Georgia and South Carolina that surrounds Augusta, Georgia, and includes SRS. Saltwater fish analyzed in 2001 included mullet, redfish, and sea trout. (Sampling locations for fish are depicted in a map on page 60 in chapter 4, "Radiological Environmental Surveillance.")

Surveillance Results

In 2001, 185 fish were caught from SRS streams and ponds and the Savannah River and analyzed for mercury. Because of low water, no fish were caught from the Pen Branch–3, Four Mile Creek–6, Steel Creek–4, Upper Three Runs–4, and Beaver Dam Creek locations.

The mercury concentrations in fish analyzed from onsite waters ranged from a high of 1.020 µg/g in a bass from Pond B to a low of 0.030 in a bream from L-Lake. Mercury concentrations in offsite fish ranged from a high of 1.530 µg/g in a bass from the Augusta Lock and Dam area to a low of 0.006 in mullet downstream of the Highway 17 Bridge area. The average quantitation limit for mercury in fish flesh is 0.008 µg/g.

Overall individual results of all samples indicated that bass contained the highest levels of mercury. After bass, the order of fish with the next highest levels of mercury was mixed, depending on location.

Table 3–57 in the EPA publication mentioned in the sidebar on page 105 indicates that the recommended monthly consumption limit for fish collected at the highest offsite location for 2001 (Augusta Lock and Dam) would be between one and two 8-ounce servings per month.

Academy of Natural Sciences of Philadelphia River Quality Surveys

Description of Surveys

The Patrick Center for Environmental Research of ANSP has conducted biological and water quality surveys of the Savannah River since 1951. The surveys are designed to assess potential effects of SRS contaminants and warm water discharges on the general health of the river and its tributaries. This is accomplished by looking for

- patterns of biological disturbance that are geographically associated with the site
- patterns of change over seasons or years that indicate improving or deteriorating conditions

Results of the 2000 comprehensive survey provide no compelling evidence of any SRS impact on water quality or on biological communities in the Savannah River. Complete results of this survey can be found in *2000 Savannah River Biological Surveys for Westinghouse Savannah River Company* (WSRC–TR–2002–00057).

Samples were collected for the 2001 survey, but could not be analyzed in time for the results to be published in this report.