Assessment of Ground-Water Flow near the Savannah River Site, Georgia and South Carolina

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Problem

The U.S. Department of Energy (DOE) Savannah River Site (SRS) has manufactured nuclear materials for national defense since the early 1950s. A variety of hazardous materials—including radionuclides, volatile organic compounds, and trace metals—are either disposed of or stored at several locations at the SRS. As a result, contamination of ground water has been detected at several locations within the site and concern has been raised about the possible migration of waterborne contaminants off-site. Two issues have been raised: (1) is ground water flowing from the SRS and beneath the Savannah River into Georgia; and (2) under what pumping scenarios could such ground-water movement occur?

To address these concerns, the U.S. Geological Survey (USGS), in cooperation with the DOE, conducted a comprehensive study during 1991–97 that simulated ground-water flow and stream-aquifer relations near the SRS. Large increases in ground-water pumping in Burke and Screven Counties, Georgia, since 1992 and a pronounced drought during 1998–2002 may have changed hydraulic gradients near the river and affected the potential for trans-river flow. To provide a more accurate and up-to-date evaluation of trans-river flow near the SRS, the earlier model was updated to incorporate new data and simulate 2002 conditions.

Objectives

- Update the previously developed ground-water-flow model to better define present-day (2002) ground-water flowpaths near SRS.
- Use the 2002 calibrated model to identify ground-water flowpaths and quantitatively describe current ground-water flowpaths near SRS under a variety of hypothetical pumping scenarios.

Progress and Significant Results, 2004–2005

- The previous model (Clarke and West, 1998) was updated to simulate ground-water flow under 2002 hydrologic conditions and for four hypothetical pumping scenarios based on ground-water-use trends from 1980 to 2000 (Fanning, 2003).
- Four steady-state pumping scenarios were developed to simulate a range of pumping and climatic conditions affecting potential contaminant migration from the SRS:
  - 2002 observed pumping and boundary conditions for an average year.
  - 2002 observed pumping and boundary conditions for an average year with SRS pumping discontinued.
  - Projected 2020 pumping and boundary conditions for an average year.
  - Projected 2020 pumping and boundary conditions for a dry year.
- The USGS particle-tracking code MODPATH (Pollock, 1994) was used to generate advective water-particle path lines and time-of-travel based on MODFLOW simulations of the four scenarios. Results of model simulations and particle tracking were summarized in USGS Scientific Investigations Report 2006-5195 (Cherry, 2006). Major findings include:
  - Simulated ground-water flowpaths for each of the four pumping scenarios indicate that time-of-travel from recharge areas originating near central SRS (D and K Areas) westward into Georgia range from 110 years to 800 years (facing page).
  - Particle-tracking analysis indicates travel times and flowpaths are similar for the various pumping scenarios; however, the shutdown of the SRS production wells allows fewer particles to penetrate into deeper units (layers A3–A5), and median travel times are decreased by about 90 years.

References Cited

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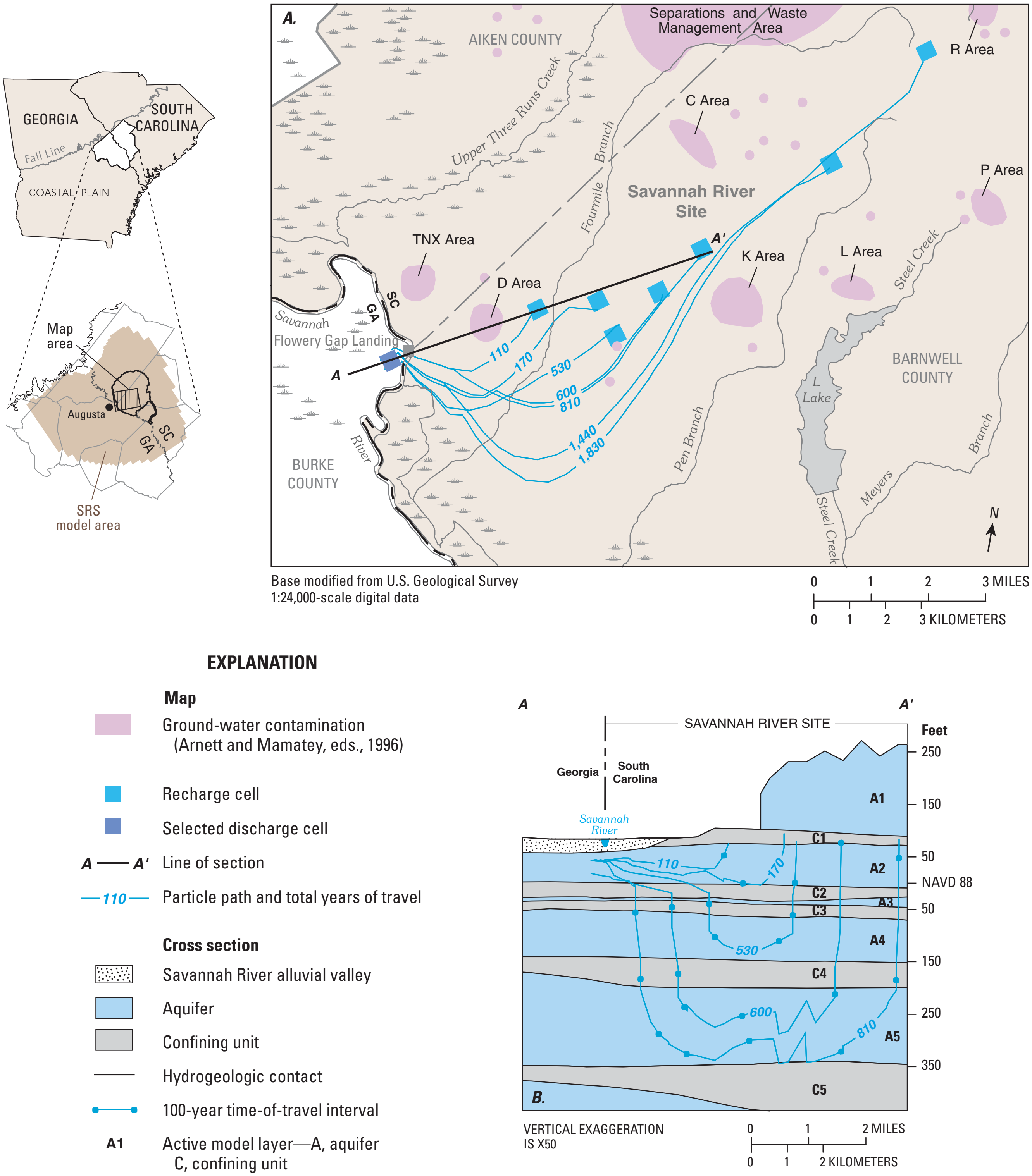

(A) *Map and* (B) *cross section showing simulated ground-water flowpaths near the Savannah River Site (SRS) for scenario* B, *representing average climatic conditions and the elimination of pumping at the SRS. Longer flowpaths originate in upland areas where head in the uppermost unit provides a driving force to allow flow to greater depths of penetration through aquifers and intervening confining units (see 810-year flowpath). Shorter flowpaths originate in lowland areas where head in the uppermost unit is low and there is less driving force for penetration into deeper units (see 110-year flowpath). Modified from Cherry (2006). (NAVD 88, North American Veritcal Datum of 1988)*