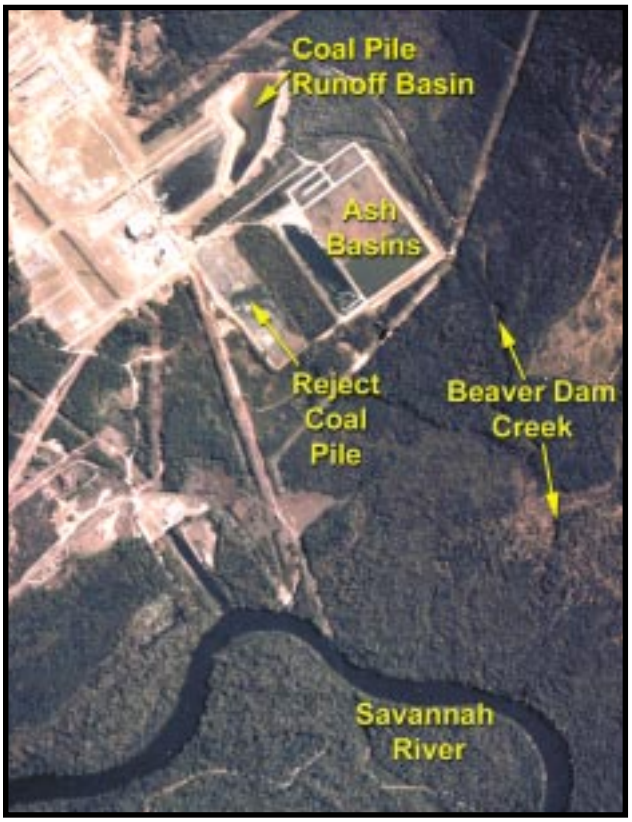
D-Area Ash Basins

the problem.....

Coal combustion accounts for 90% of fossil fuel-related wastes produced in the U.S. and coal combustion products constitute a major category of solid waste on the Savannah River Site. In D-Area, coal fly ash is discharged into open settling basins that are located approximately one quarter mile from the Savannah River. Effluent from these basins enters Beaver Dam Creek, which provides an aquatic corridor to the river. Coal fly ash contains trace elements, including arsenic, chromium, cadmium, and selenium. These contaminants are found at low levels in the water, at moderate to high levels in the sediments, and at high levels in the aquatic and semiaquatic biota of the settling basins and their downstream discharge channels. Body burdens of contaminants in some organisms in these areas are orders of magnitude greater than EPA limits for humans. Among organisms that have been documented to be contaminated by trace elements are alligators, softshell and slider turtles, water snakes, largemouth bass, several species of panfish, bullfrogs, toads, crayfish, cotton rats, raccoons, and freshwater clams. Considerable potential exists for pollutants to move from the D-Area settling basins into nearby terrestrial areas as a result of semiaquatic and terrestrial organisms feeding on prey items that are rich in trace elements.

A coal-fired power plant on the SRS.



The D-Area ash basins drain into Beaver Dam Creek and, ultimately, the Savannah River.

SREL research.....

SREL is conducting an integrated multidisciplinary research program aimed at identifying the extent of contamination at the D-Area ash basins and at providing less expensive remediation alternatives to address the environmental contamination resulting from the use of coal-fired power plants on the SRS. Because most organisms respond behaviorally, physiologically, and reproductively to contaminants at levels much lower than those that would cause death, one aspect of SREL's Ecotoxicology Program investigates impacts of ash basin contaminants on organisms that occupy these basins. Comparisons of animals from the ash basins to those from clean areas have documented that:

- more than 85% of bullfrog tadpoles raised in the ash basins had oral deformities that may have significantly impacted their ability to feed,
- metabolic rates in bullfrog tadpoles from the ash basins were 40-70% greater than tadpoles from control areas, indicating that ash basin tadpoles must use much more of their energy just to survive than do tadpoles from reference areas,
- adult male toads from the ash basins exhibited increased levels of circulating adrenal and sex hormones, which may be indicative of animals subjected to prolonged exposure to endocrine disrupting contaminants,
- adult toads from the ash basins contained significantly

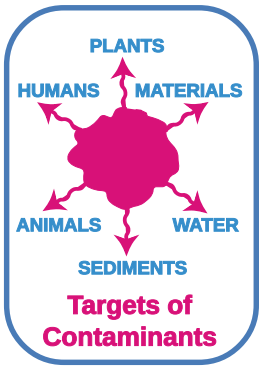
higher levels of arsenic, selenium, and vanadium than did toads from reference areas,

- chemical mapping studies have documented increased selenium concentrations in the deformed mouth parts of tadpoles from the ash basins, possibly as a result of selenium being incorporated into structural proteins that normally would contain sulfur,
- cotton rats from the ash basins had higher tissue concentrations of arsenic, nickel, and lead than did animals from a reference site,
- cotton rats from the ash basins exhibited a significantly higher proportion of double-stranded DNA, possibly due to DNA/DNA and DNA/protein crosslinking caused by arsenic and nickel in the ash basins.

Pilot project using constructed wetlands for effluent remediation.

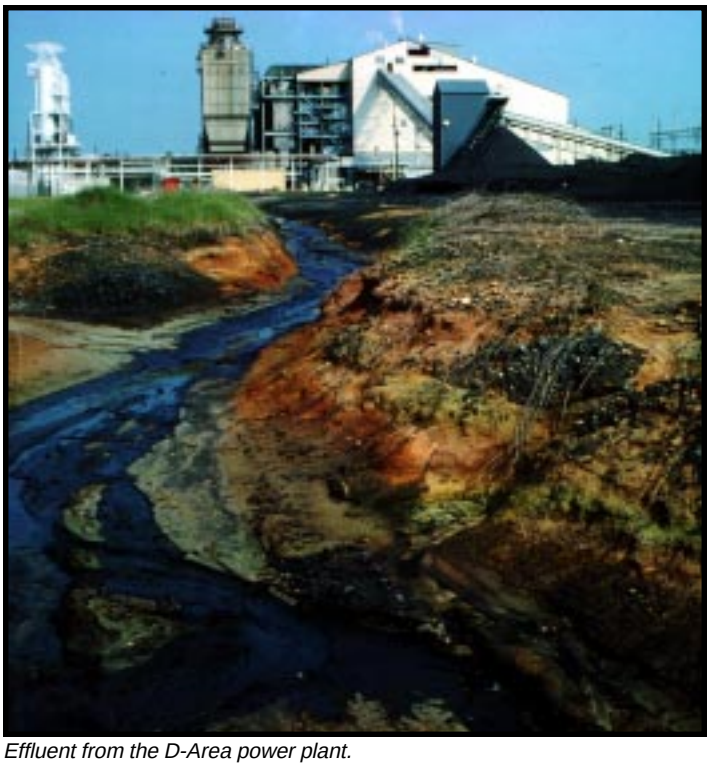
distinct stable isotope signatures of CPRB waters to trace and apportion water masses at the site. With this knowledge, the chemical kinetics of natural reactions can be defined to determine whether D-Area CPRB sediments have the capacity to sequester contaminants in benign forms as they are mobilized in groundwaters at the site.

At D-Area, where coal is stored in large piles that are exposed to the environment, minute amounts of sulfide minerals contained in this coal weather and dissolve in water to form an acidic metal-rich solution called acid-sulfate water. This water percolates directly into the subsurface or is directed as surface runoff to the D-Area Coal Pile Runoff Basin (CPRB), where additional seepage occurs. Because of the intense acid-sulfate contamination that occurs at the CPRB, this area currently is designated a RCRA/CERCLA site.



In addition, SREL researchers are developing methods to passively remediate CPRB surface waters by augmenting natural attenuation reactions, such as sulfate reduction, that occur at or near the sediment-water interface. Constructed wetlands are being evaluated to determine their potential as a low cost, effective method for improving the quality of contaminated surface waters in D-area. Various components of natural wetlands are being manipulated in a large field-scale experiment to determine the primary factors that control the form and availability of contaminants to wetland biota. Differing substrates, plants, and microbial communities are being tested to determine the appropriate combination that provides the most effective remedial design for improving the quality of CPRB waters.

SREL researchers are determining the factors that govern the changing chemistry of basin and subsurface waters at the CPRB and their relations to the contaminated aquifer at D-Area. These studies use the



Effluent from the D-Area power plant.

Using another approach, SREL's Waste Minimization Program seeks to find safe and innovative uses for coal combustion residues to alleviate potential environmental impacts that result from long-term accumulation of coal fly ash. Efforts include using coal fly ash to increase the water retention capacity of soils and the harvestability of sustainable biota such as "turf" grass species and non-food agricultural crops. This technique currently is being tested at the Columbia, SC Airport with funding from the Electric Power Research Institute and South Carolina Electric and Gas.

All of these efforts will result in the design of appropriate, cost-effective remediation strategies that reduce contamination to levels acceptable for human and ecological health and allow evaluation of existing and future technologies that are broadly applicable to the SRS and industrial sites across the U.S.