

Water Resources Assessments and Research Subactivity

Program	FY 2000 Estimate	Uncontrol. & Related Changes	Program Changes	FY 2001 Budget Request	Change from FY 2000
Ground-Water Resources	2,800	+87	0	2,887	+87
National Water-Quality Assessment	61,883	+1,263	0	63,146	+1,263
Toxic Substances Hydrology	13,306	+331	⁽¹⁾ -1,240	12,397	-909
Hydrologic Research & Development	13,048	+331	-1,454	11,925	-1,123
Total Requirements \$000	91,037	+2,012	-2,694	90,355	-682

¹ See Program Change section for details on Amphibian Research and Monitoring (+\$500) and programmatic decrease (-\$1,740).

Toxic Substances Hydrology

Current Program Highlights

The USGS Toxic Substances Hydrology (Toxics) Program conducts research on the behavior of toxic substances in hydrologic environments. The information developed from this research is used by water resource managers, regulators, and industry to develop policies and action plans that help avoid exposure to toxic substances, provide cost-effective clean-up strategies, and reduce the risk of future contamination.

The contamination problems investigated by the Toxics Program are widespread and pose significant risk to human health and the environment. Field-based investigations are conducted at representative sites that focus on subsurface, point-source contamination or on watershed-scale and regional-scale contamination problems. As part of these investigations, new methods are developed to make environmental measurements (including methods to measure emerging contaminants in environmental samples), and new models are developed to predict the persistence and fate of contamination and to design waste-disposal and remediation strategies.

Information about the Toxics Program is available on the World Wide Web (WWW) at: <http://toxics.usgs.gov/toxics/>

The Toxics Program works in partnership with the U.S. Environmental Protection Agency (USEPA), the U.S. Department of Agriculture (USDA), Federal land management agencies, the Departments of Defense and Energy, and the Nuclear Regulatory Commission to ensure that research priorities are coordinated. Scientists from universities, other Federal agencies, and industry collaborate with USGS scientists in program activities. The results of studies are distributed at briefings for regulatory agencies and industry groups, at workshops, at national scientific meetings, in USGS reports, and in scientific journals and books.

Investigations of Subsurface, Point-Source Contamination -- Interdisciplinary USGS research teams conduct long-term intensive field investigations of common types of subsurface contamination in a variety of natural environments. The investigations at these "field laboratories" provide fundamental knowledge of the processes that control contamination. This

fundamental knowledge is generalized by testing at other sites so that lessons learned through these studies can be applied across the Nation.

- A "Tool Box" for Characterizing Contamination in Fractured-Rock Aquifers — Toxics Program scientists are developing a "tool box" of methods for characterizing contamination in fractured rock. Uncertainty in assessing the movement and transformation of contamination in fractured-rock aquifers makes this one of the toughest problems facing environmental professionals today. The "tool box" approach combines elements of chemistry, geology, geophysics, and hydrology to provide tools to characterize, monitor, and clean up contaminated fractured-rock sites. Tools developed at the program's uncontaminated field laboratory in Mirror Lake, New Hampshire, have been applied at numerous contaminated sites across the Nation. Currently, program activities are being extended to a contaminated fractured-rock site where a major emphasis will be to investigate how chemical reactions and biodegradation affect dispersal of contaminants differently in fractured-rock than in unconsolidated (granular) aquifers.

Additional subsurface point-source investigations and associated field laboratory

- Treated sewage-effluent releases - Cape Cod, Massachusetts
- Regular-gasoline spills - Galloway, New Jersey
- Oxygenated gasoline spills - Laurel Bay, South Carolina
- Landfill leachate - the Norman municipal landfill, Oklahoma
- Chlorinated solvents - Picatinny Arsenal, New Jersey
- Crude oil releases - a pipeline rupture near Bemidji, Minnesota

- Migration of Radionuclides and Mixed Wastes in Arid Environments, the Amargosa Desert Research Site, Nevada — USGS investigations have documented subsurface movement of radionuclides (radioactive carbon and hydrogen) and mixed wastes near a waste-isolation facility near Beatty, Nevada. The site was chosen because it was believed to provide ideal hydrologic conditions for waste isolation. Similar sites in the arid and semi-arid West increasingly are being sought for isolation of radioactive and other hazardous wastes. This investigation has improved understanding of movement of water, gas, and the associated contamination through thick arid unsaturated zones, including the effects of facility design features. Information gained from studies at this site is important to the design of waste-isolation facilities, their monitoring systems, and remedial strategies.

Investigations of Watershed-Scale and Regional-Scale Contamination -- Watershed-scale and regional-scale investigations address contamination problems typical of widespread land uses or human activities that may pose a threat to human and environmental health throughout a significant portion of the Nation. These investigations involve characterizing contaminant sources, the mechanisms by which non-point source contamination affects aquatic ecosystems, and the processes that transform contaminants into different and possibly more toxic forms.

- Mercury in Aquatic Ecosystems — Industrial activities have significantly increased mercury transport through the atmosphere, resulting in accumulation of a toxic form of mercury (methylmercury) even in remote wetlands, lakes, and streams. In some ecosystems, mercury is converted readily to methylmercury, which accumulates to dangerous levels in the food chain and threatens the health of fish-eating wildlife and humans. The USEPA and Department of Energy estimate that emission controls for mercury would cost about \$2 billion a year, yet current scientific understanding cannot provide reasonable assurance that significant environmental improvements would result from the decreased emissions. USGS is participating in two investigations that will provide the best scientific basis for

answering this difficult and relevant question. USGS scientists in the Toxics Program are conducting the first systematic national assessment of the different forms of mercury in water, sediment, and fish. This assessment will provide information needed to understand whether specific ecosystem types or specific regions of the Nation are more susceptible to mercury contamination. In addition, the USGS is participating in a new international study designed to address global-scale land management and regulatory issues. This study will define the response, in terms of reduced human and wildlife exposure, that could be expected if we reduce mercury emissions. More information on this international study is available at <http://www.biology.ualberta.ca/metaallicus/metaallicus.htm>.

- Amphibian Research and Monitoring – Scientists from the Toxics Program, together with USGS biologists and other DOI agencies, are undertaking a study to assess the scope and severity of amphibian declines across the U.S. This study intends to quantify changes in amphibian communities in priority ecosystems throughout the Nation, and to identify causes of declines. The USGS will conduct water-quality investigations and monitoring activities that focus on contaminants that cause and/or contribute to amphibian declines. Information from this national effort will assist in formulation of effective actions to arrest or reverse the declines.

Other regional investigations

- Agricultural chemicals in cotton-growing areas across the South
- The occurrence of herbicides in the Midwest (the corn-belt)
- Emerging contaminants (pharmaceuticals, hormones, new industrial chemicals) in the Nation's surface waters
- Mine drainage in arid southwest basins (Pinal Creek, Arizona), and Rocky Mountain watersheds (Upper Arkansas River, Colorado)

In addition to all the activities outlined above, the Toxics Program is a partner in the USGS Abandoned Mine Lands Initiative, where new methods to characterize and remediate mining contamination are being transferred to Federal land managers in two pilot watersheds--the Boulder River in Montana, and the Upper Animas River in Colorado. For more information on this initiative, see <http://amli.usgs.gov/amli>.

Recent Accomplishments

USGS Studies Form the Basis for Regulatory Guidance on Clean-up Options -- Toxics Program studies have helped form regulatory policy on the use of natural attenuation to clean up contaminated sites. Natural attenuation occurs when natural processes mitigate the harmful effects of subsurface contamination. USGS investigations of subsurface point-source contamination quantify natural processes and evaluate the long-term potential to maintain natural attenuation. Toxics Program scientists working at Laurel Bay, South Carolina, have developed a methodology to assess natural attenuation of MTBE at gasoline spill sites. The methodology developed by the USGS is being adopted by the South Carolina Department of Health and Environmental Control to integrate consideration of fuel oxygenates (such as MTBE) into the State Underground Petroleum Emergency Response Bank program. The USGS and USEPA scientists have offered a series of workshops on natural attenuation at 10 locations across the Nation. The workshops provided environmental scientists and engineers with guidance and methods for implementing monitored natural attenuation for cleaning up contaminated ground-water sites. Results from Toxics Program study sites on petroleum hydrocarbons, fuel oxygenates, and chlorinated solvents were used as a basis of current

knowledge. More information on the seminar can be found on the World Wide Web at <http://www.erg.com/erg/atten-info.htm>.

Silver Toxicity and Fish Reproduction -- Toxics Program scientists are studying the effects of silver on reproduction in marine life in the San Francisco Bay. Traditional lab-based assessments have shown little adverse effect from silver, especially on fish, at environmentally relevant levels. Field studies, however, indicate significant reproductive damage associated with silver exposure. These results raise a cautionary flag for traditional decision-making. The City of Palo Alto, California, is using these and other USGS results to encourage local dischargers of wastewater containing silver to maintain discharge-reduction efforts. The City of Palo Alto has received national awards for its source control program, part of which involves use of USGS data. Results also have been shared with the Silver Coalition, a coalition of silver users, and will assist industry decisions related to silver discharge reductions.

Hypoxia in the Gulf of Mexico -- Hypoxia is a condition whereby water becomes so low in dissolved oxygen that organisms (including fish and shrimp) flee the affected area or perish. Hypoxia is exacerbated by the flow of large quantities of nutrient-rich freshwater into the Gulf each year from the Mississippi River. At the request of the White House Office of Science and Technology Policy (Committee on Environment and Natural Resources), the USGS led a multi-agency team and prepared a report on the sources and discharge of nutrients to the Gulf of Mexico (<http://www.rcolka.cr.usgs.gov/midconherb/hypoxia.html>). Results indicate that on average about 1.6 million metric tons of nitrogen (a nutrient) enter the Gulf of Mexico from the Mississippi River each year. The largest sources of nitrogen to the Mississippi River are from streams draining the Midwest corn-growing States. The report documents the source areas for nutrients, such as nitrogen and phosphorus, and provides information on the human activities most responsible for these nutrients. The Mississippi River/Gulf of Mexico Watershed Nutrients Task Force will use this report to develop an action plan to improve water-quality conditions in the Mississippi River Basin and the Gulf of Mexico. (Note: the Hydrologic Research and Development Program also funds some work related to the hypoxia issue, and the National Stream Quality Accounting Network, which is funded by the Hydrologic Networks and Analysis Program, contributes to the hypoxia effort through nutrient monitoring in the Mississippi River.)