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Conrad Conero, Shawangunk Mountains, NY

Ground Water Quality

Ground water is a vital national resource. In many parts of the nation, ground water serves as the only reliable source of drinking and irrigation water. However, ground water is vulnerable to contamination, and problems caused by elevated levels of petroleum hydrocarbon compounds, volatile organic compounds (VOCs), nitrate, pesticides, and metals have been detected in ground water across the nation. The detection of some relatively new contaminants (e.g., methyl tertiary butyl ether or MTBE) in ground water is also increasing.

Ground Water Use in the United States

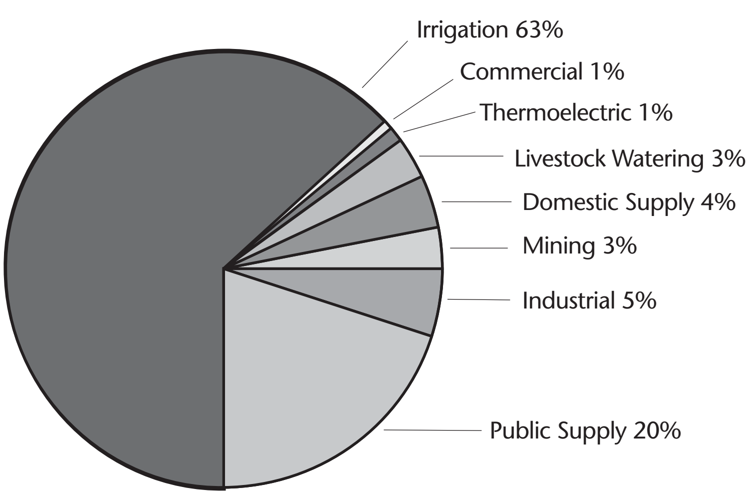
Ground water is an important component of our nation's freshwater resources. In 1995, the U.S. Geological Survey (USGS) reported that ground water supplied drinking water for 46% of the nation's overall population and 99% of the population in rural areas. Figure 6-1 illustrates how ground water is used nationwide. This figure indicates that irrigation (63%) and public water supply (20%) are the largest uses of ground water.

Ground Water Quality and Sources of Ground Water Contamination

Evaluating our nation's ground water quality is a complex task. Ground water quality can be adversely affected by human activities that introduce contaminants into the environment. It can also be affected by natural processes (such as leaching) that result in elevated concentrations of certain constituents. Ground water contamination can occur as relatively well-defined, localized plumes emanating from specific sources such as leaking underground storage tanks, spills, landfills, waste lagoons, and/or industrial facilities (Figure 6-2). Ground water quality degradation can also occur over a wide area due to diffuse nonpoint sources such as agricultural fertilizer and pesticide applications. Frequently, ground water contamination is discovered long after it has occurred. One reason for this is the slow movement of ground water through aquifers. In some cases, contaminants introduced into the subsurface decades ago are only now being discovered.

Figure 6-1

National Ground Water Use



Source: *Estimated Use of Water in the United States in 1995.* U.S. Geological Survey Circular 1200, 1998.

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Sources frequently cited by states as potential threats to ground water quality include leaking underground storage tanks, septic systems, landfills, industrial facilities, and fertilizer applications. If similar sources are combined, four broad categories emerge as the most important potential sources of ground water contamination:

■ **Fuel Storage Practices** – Leakage from storage tanks can be a significant source of ground water contamination (Figure 6-3). MTBE, added to some fuel products to improve performance, is highly water soluble; incidents of MTBE contamination in ground water are widely reported across the nation.

■ **Waste Disposal Practices** – Systems and practices that can contaminate ground water if not handled properly include septic systems, landfills, surface impoundments, deep and shallow injection wells, waste piles, waste tailings, and land application of waste.

■ **Agricultural Practices** – Ground water contamination can result from routine applications, spillage, or misuse of pesticides and fertilizers during handling and storage, manure storage/spreading, improper storage of chemicals, and irrigation return drains serving as a direct conduit to ground water.

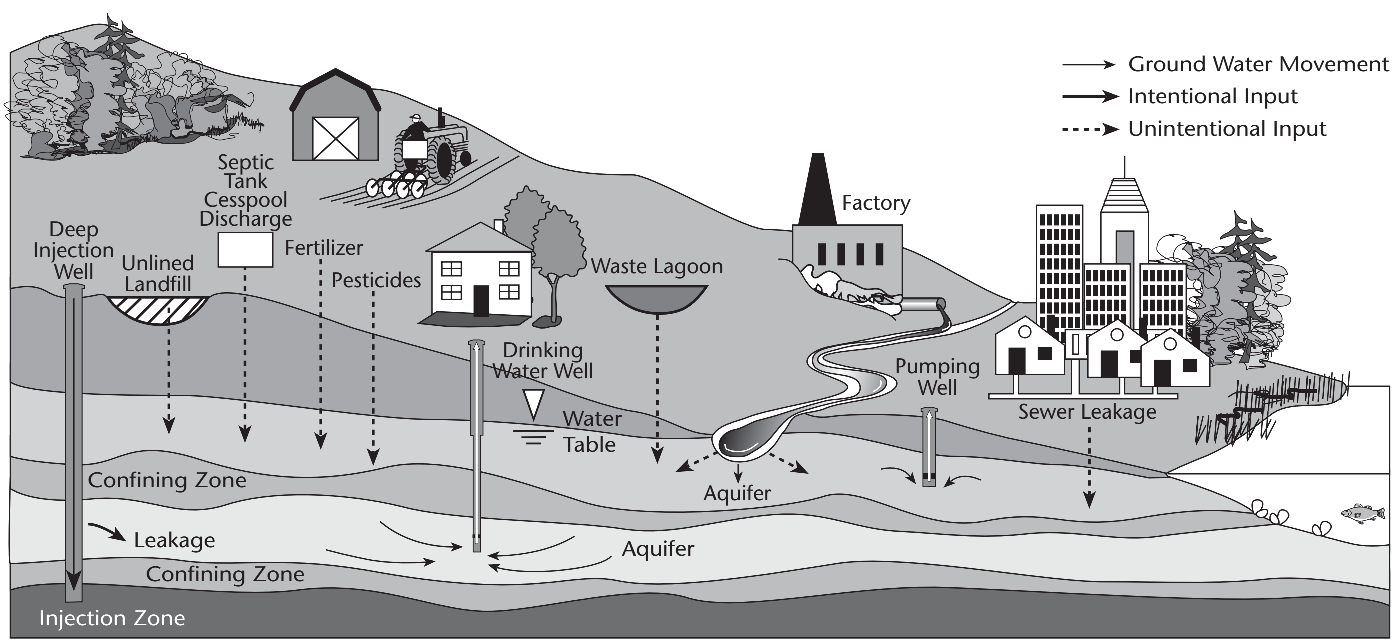
■ **Industrial Practices** – Raw materials and waste handling in industrial processes can pose a threat to ground water quality. Storage of raw materials at industrial sites can be a problem if the materials are stored improperly and leaks or spills occur.

Examples of State Assessments

Fifty-two states, tribes, and territories reported on ground water information in their 2000 reports (Figure 6-4). These states reported that the major sources of ground water contamination continue to be underground storage tanks, septic systems, and landfills (Figure 6-5). Of the six tribes

Figure 6-2

Sources of Ground Water Contamination



reporting on ground water, four identified septic systems as the major threat to ground water quality on tribal lands. Although positive strides were made in assessing ground water quality in 2000, ground water data collection under Section 305(b) is still too immature to provide comprehensive national assessments. Despite the lack of national coverage, many states have demonstrated strong ground water assessment programs. Two state ground water assessments are summarized below.

Massachusetts

In Massachusetts, 69% of the towns rely solely or partially on public ground water supply. The state currently has 2,648 ground water public supply sources, and due to increasing water demand there is a corresponding increase in the development of ground water sources. Because the number of ground water sources outnumbers surface water supplies by more than 13 to 1, the state is able to use public water supply (PWS) monitoring information to assess ground water quality across much of the state. Results of PWS monitoring show that the overwhelming majority of drinking water violations were due to coliform bacteria. However, VOCs were detected from sources across the state and with nitrates are currently the contaminants of greatest concern.

Protection of ground water from point sources of pollution (such as sanitary wastewater discharges and industrial discharges) is achieved through a Groundwater Discharge Permit Program in the state's Department of Environmental Protection. The permits require varying degrees of wastewater treatment based on the quality and use of the receiving ground water. However, additional controls are needed to eliminate contamination from septic systems and sludge disposal. Individual septic tanks serve about 30% of the state's population. Contamination of ground

Figure 6-3

Ground Water Contamination as a Result of Leaking Underground Storage Tanks

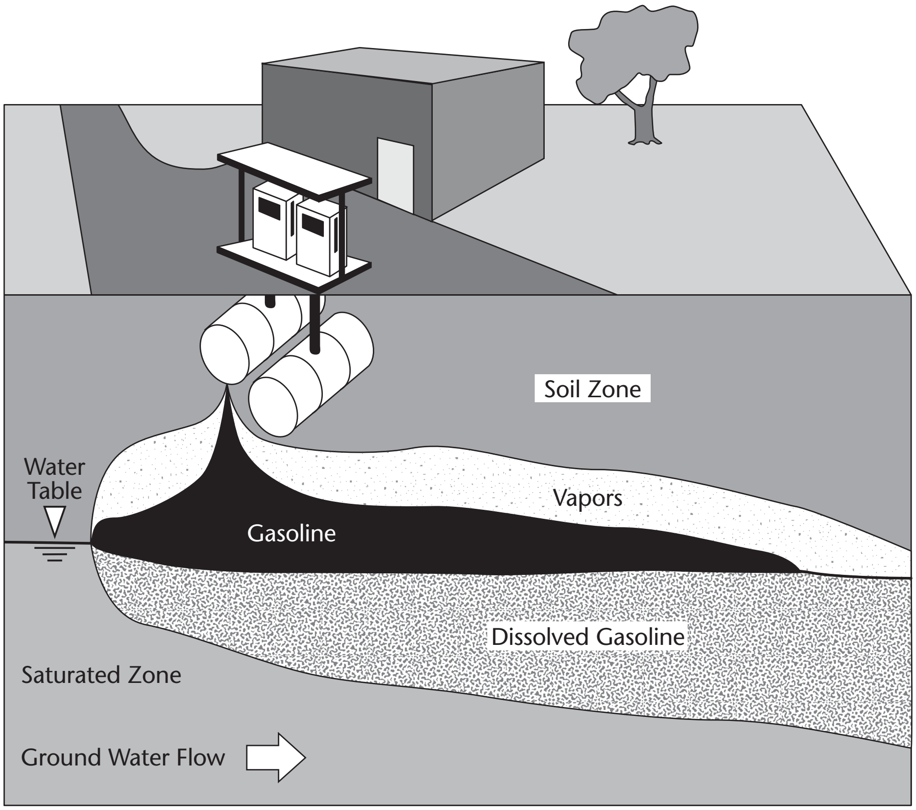
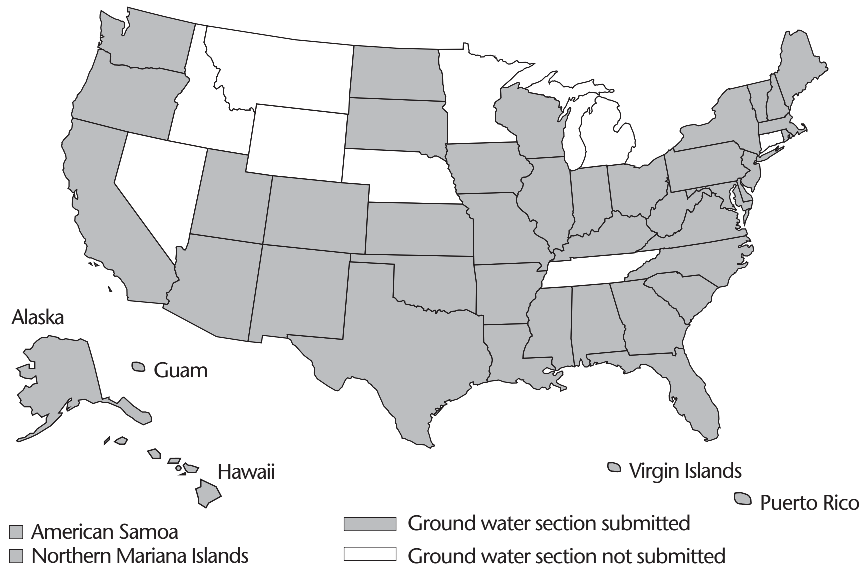


Figure 6-4

States Reporting Ground Water Data



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water supplies used for drinking water has been a problem in densely populated areas where septic systems are used. The state anticipates that new technologies and regulatory changes will be needed to reduce the level of contamination from septic systems.

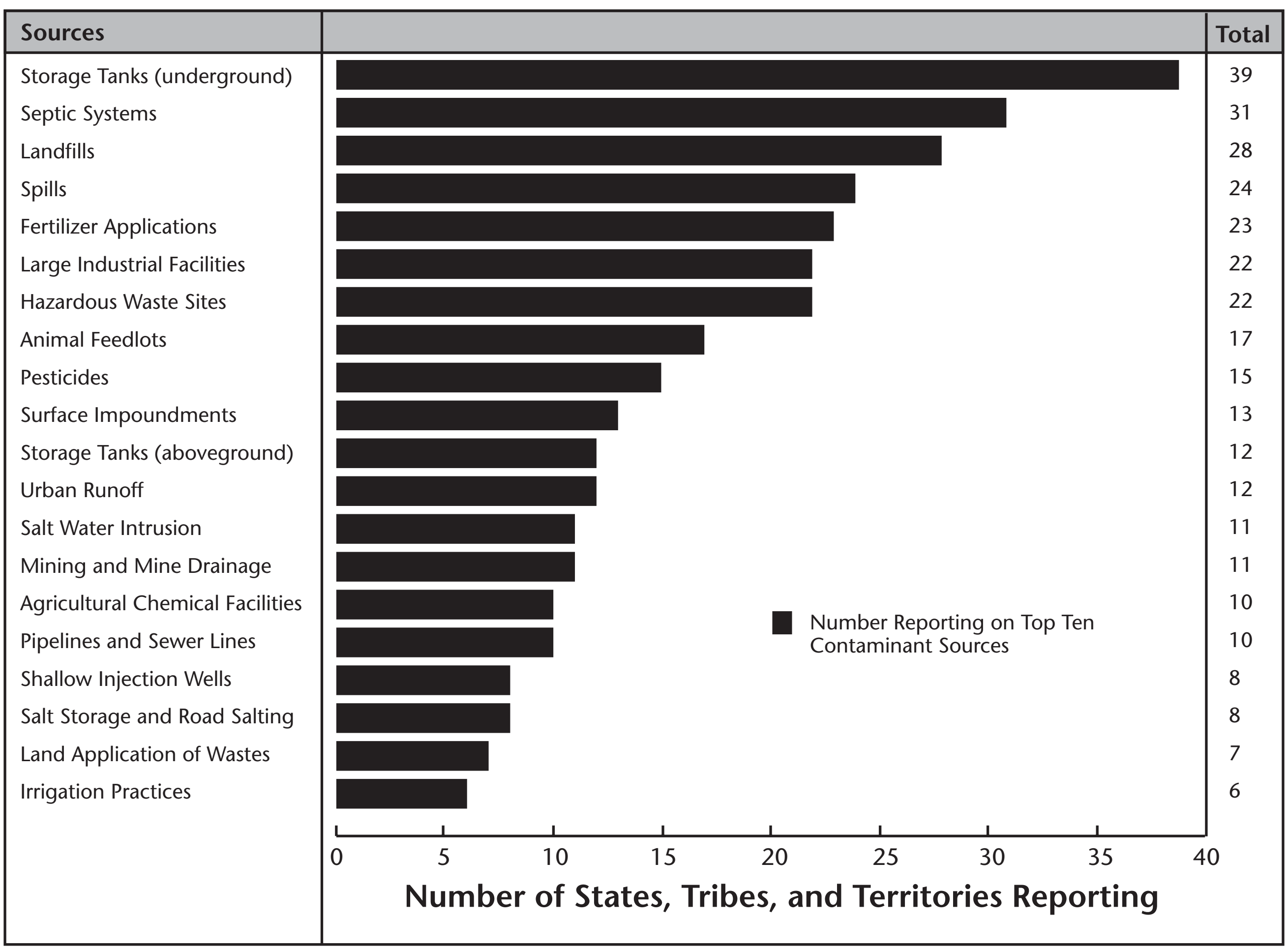
Recently, Massachusetts began work on its Source Water Assessment Program (SWAP), as required under Section 1453 of the Safe Drinking Water Act, and has established water supply protection areas for both ground water and surface water sources. Other regulatory requirements, such as the state's Underground Injection Control (UIC) Program, target the source water protection areas to implement controls preventing the migration of contaminants to ground water.

Arizona

Arizona assesses ground water quality using several different methods. The state monitors a network of ambient water quality index wells and compares these data to health-based Aquifer Water Quality Standards and to the Secondary Maximum Contaminant Level (SMCL) guidance (for contaminants that do not pose health risks). Data are also compiled from other monitoring programs, which are primarily targeted in areas of known or suspected contamination. To make water quality assess-

Figure 6-5

Major Sources of Ground Water Contamination



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ments, monitoring data from the index wells and targeted wells are pulled together from the state departments of Environmental Quality and Water Resources, from the USGS, and from specific watershed programs such as the Salt River Project. For the 2000 305(b) assessments, Arizona compared the last 8 years of ground water monitoring results to the aquifer standards and SMCL guidance. The state then summarized the percentage of wells exceeding each different standard. About 28% of wells exceeded the standards for VOCs and semivolatile organic compounds (SVOCs), and 12% exceeded nitrate standards over the past 8 years. Fluoride and radiochemicals occur naturally in the soil and water across Arizona, and in some locations the levels of these chemicals exceed drinking water standards.

Ground water contamination varies significantly across Arizona. In the metropolitan areas, VOCs and SVOCs contaminate ground water due to inadequate historic practices for disposing of industrial solvents and dry-cleaning chemicals. These contamination areas are being remediated by the federal and state Superfund Programs. In addition, the requirements of the state's Aquifer Protection Permit Program have greatly reduced the threat of ground water contamination from point source discharges. To protect ground water resources from nonpoint sources, the state relies on the application of Best Management Practices and other nonregulatory actions.

Conclusions

Assessing the quality of our nation's ground water resources is no easy task. Required source water assessments under Section 1453 of the Safe Drinking Water Act should prove helpful in generating good quality data that can be used to evaluate ground water quality over time. Monitoring data from wellhead protection delineations, source inventories, and other data collection efforts will increase and improve the information that is used to make determinations on the quality of ground water across the nation.

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