United States
Environmental Protection
Agency

Emergency and
Remedial Response
(5204G)

9283.1-11
EPA540-K-96-008
PB96-963310
December 1996

EPA Ground Water Cleanup at Superfund Sites

157421

GROUND WATER CLEANUP AT SUPERFUND SITES

Introduction

Over 80 percent of the most serious hazardous waste sites in the U.S. have adversely impacted the quality of nearby ground water (the water present underground in tiny spaces in rocks and soil). Just as the ground water cleanup process is complex, so are the issues behind the methods and techniques EPA uses to determine the best approach for each site. This brochure explains some of the approaches EPA uses to clean up ground water contamination and, most importantly, offers information on how citizens can help reduce and prevent ground water contamination.

What is Superfund?

Responding to public concern about abandoned hazardous waste sites across the nation, Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund. Enacted in 1980, Superfund directs the U.S. Environmental Protection Agency (EPA) to administer the Superfund Program in cooperation with state and tribal governments. The program is designed to:

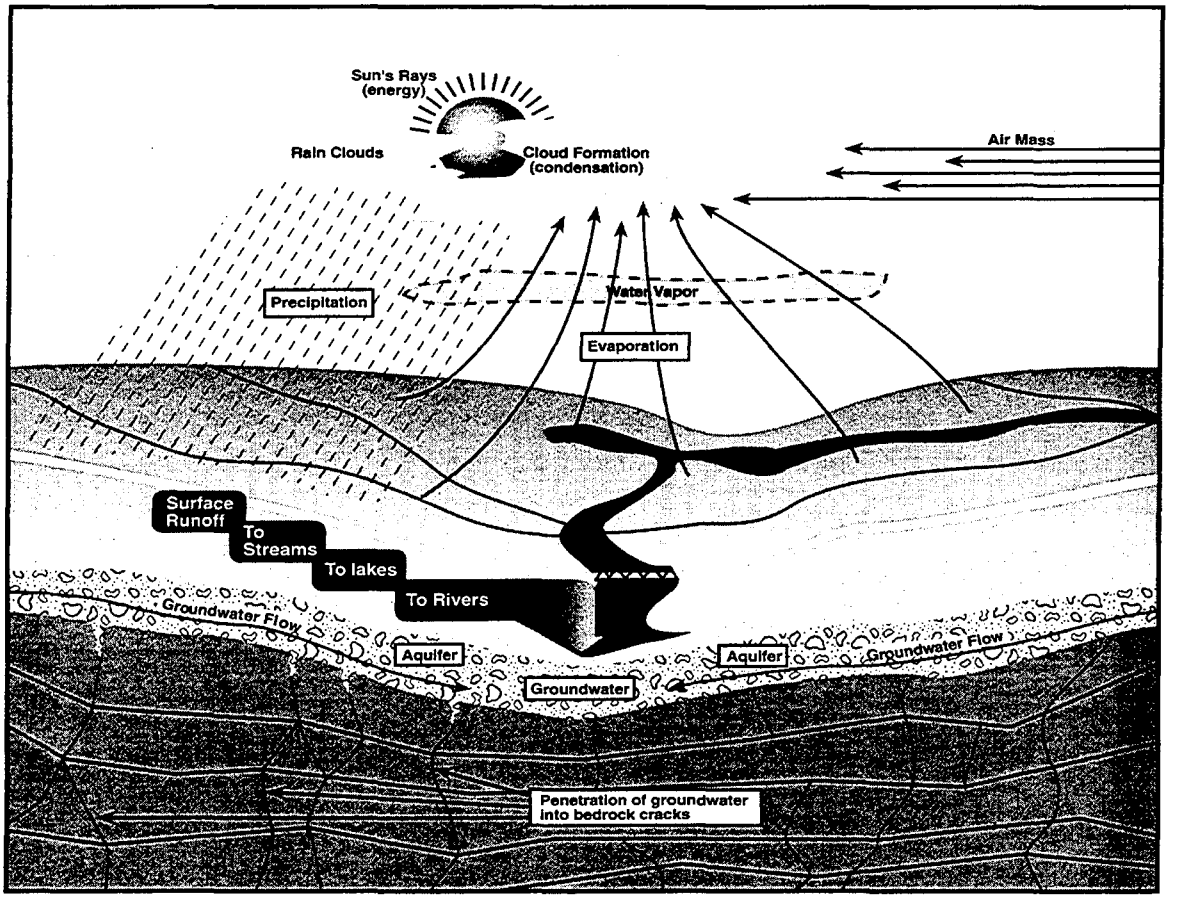
- Locate, study, and clean up the most serious hazardous waste sites in the nation (known as Superfund sites)
- Respond to chemical accidents and spills
- Pay for cleanup when parties who own or control a site cannot be found or cannot afford to pay. (Money for Superfund cleanups comes mostly from taxes on industries that make hazardous chemicals or petroleum products.)

Protecting and cleaning up contaminated ground water are two of the main concerns of the Superfund Program. Over 80 percent of Superfund sites have ground water that is contaminated to some degree.

What is Ground Water?

Ground water is the water present underground in the tiny spaces in rocks and soil. Underground areas where ground water accumulates in large amounts are called aquifers. Aquifers are layers of rock or soil that can store and supply enough water to wells and springs to be economically useful. Most ground water moves slowly—usually no more than a few feet a day. Ground water in aquifers will eventually discharge to or be replenished by springs, rivers, wells, precipitation, lakes, wetlands, and the oceans as part of the Earth's water cycle.

Hydrologic Cycle



Who Uses Ground Water?

Ground water accounts for over 95 percent of the nation's available fresh water resources, and is the drinking water source for half the people in this country. Many households, towns, cities, farms, and industries use ground water every day, or depend on lakes and rivers that receive part of their water supplies from ground water. Ground water wells near Superfund sites supply public and private drinking water wells, irrigation, and other agricultural needs, and commercial and industrial businesses. Ground water quality is very important.

What is Hazardous Waste?

More than 70,000 chemicals are used regularly around the world. Improper use and disposal can have harmful effects on humans, plants, and animals. But even when used properly, many chemicals still have the potential to harm human health and the environment. When these hazardous substances are thrown away, they can become hazardous waste. Hazardous wastes are most often a by-product of a manufacturing process, but there are many sources, including wastes we throw away at home.

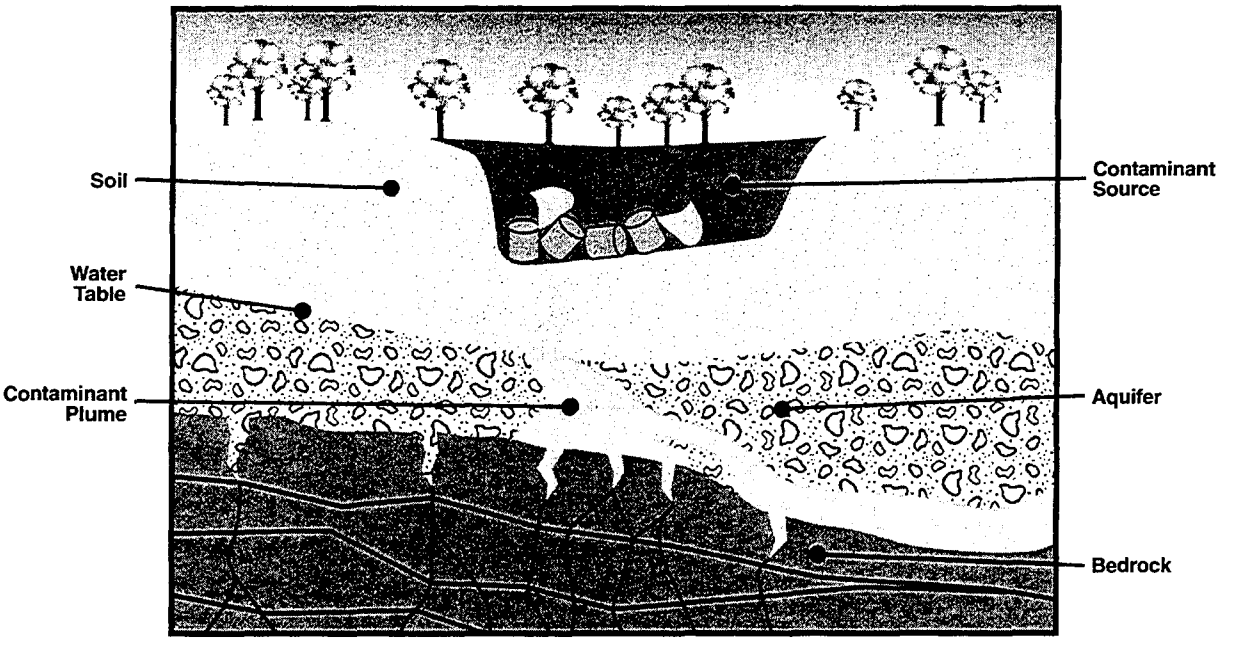
Regardless of the source, unless we dispose of hazardous waste properly, it can create health risks for people and damage the environment. When hazardous waste is released into the air, water, or on the land it can spread, contaminating a broad area and exposing more people to health risks. Proper management and control can greatly reduce the dangers of hazardous waste. Improper management and disposal of hazardous waste in the past created the hazardous waste sites that are now in the Superfund program.

How Does Hazardous Waste Affect Ground Water?

Hazardous wastes from a variety of sources have contaminated the ground water at many Superfund sites. Typically rainfall seeps through the soil, comes in contact with buried waste or other sources of contamination, picks up chemicals, and carries them into the ground water. Some pollutants spread quickly, contaminating ground water several miles from the site.

Polluted ground water may affect drinking water, surface waters, and the people, plants, and animals near the site. Often the first clue that ground water is contaminated is when pollutants from a nearby site are found in local drinking water or monitoring wells. If left unchecked, ground water contamination can continue to spread, increasing the cost of future cleanup, reducing useful water resources, and potentially affecting more people.

Contaminated Ground Water



What Does Superfund Do About Contaminated Ground Water?

The Superfund Program strives to restore ground water to beneficial use and prevent any further human exposure to contaminants. This is done by removing or containing the source of the contamination and cleaning up the affected ground water. Since many aquifers are a current or potential source of drinking water, most Superfund site cleanups try to ensure that ground water quality meets federal and state drinking water standards.

Experience has shown that this cleanup process can take anywhere from several years to many decades, depending on the conditions at the site. Sometimes, however, depending on the type of contamination, the ground water cannot be restored. When this happens, the ground water is prevented from moving to uncontaminated areas. At every site, the Superfund Program acts to protect human health and the environment from the effects of hazardous waste contamination.

Why Can Ground Water Cleanup Take So Long?

Once ground water is contaminated, making it clean enough to drink can be extremely difficult for several reasons:

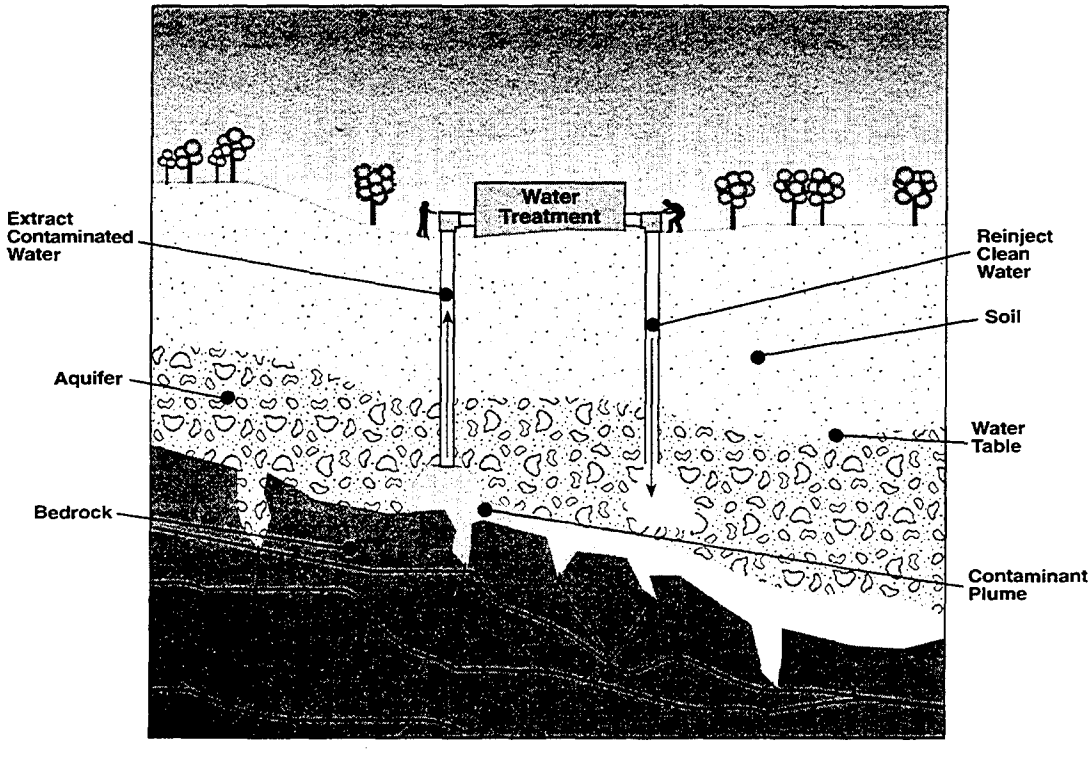
- **Aquifers are complex structures.** Aquifers can contain cracked and fractured rocks and other geological variations. These variations can act as nooks and crannies that hold contaminants or create additional pathways for contaminants to follow. This makes removing contaminants difficult.
- **Not all contaminants behave in the same way.** Different contaminants behave differently in ground water. This makes them hard to locate and remove, complicating cleanup. Some do not mix with or dissolve readily in water. Some are heavier than water and sink to the bottom of an aquifer, such as dry-cleaning solvents. Other contaminants are lighter than water and float on top, such as petroleum products like jet fuel and gasoline.
- **Locating the contamination can be difficult.** The ability of technology to find contaminants in ground water is limited. Samples from ground water wells do not always provide enough information about the extent of ground water contamination. Other devices for detecting contaminants and identifying variations in the underground rock and soil can also help, but only to a certain degree.
- **Technology has limitations.** Treatment technologies are limited in their ability to clean up an aquifer, even if the location of the contaminants is known. Frequently, ground water is cleaned by pumping it to the surface for treatment. After contaminants have been removed, the water is discharged back into the ground or to a stream or river. Even then, some contamination remains in the aquifer, which can continue to contaminate the ground water. Contaminants that cannot be pumped to the surface with the water must be treated underground, making cleanup more difficult, expensive, and time consuming.

What We Have Learned About Ground Water Cleanup

Ground water treatment systems are in place and working well at hundreds of Superfund sites. The diagram below shows a common ground water cleanup technology called "pump-and-treat." Here, wells are installed to pump contaminated ground water to the surface for treatment. As contaminants are removed, the clean ground water is discharged back into the ground or to a stream or river. Sometimes pump-and-treat is used with other methods to remove contaminants. These technologies generally prevent contaminants from spreading beyond the site.

Due to the complexity of aquifers and the types of contamination, not all ground water can be restored to a safe drinking quality. In particular, contamination by common solvents and oily waste pose a common, major hurdle for Superfund ground water cleanups. In such cases, current strategies rely on reducing and containing ground water contamination. As we gain a better understanding of site characteristics and the nature of ground water contamination, we can clean up more ground water to meet drinking water standards and contain only the most difficult problems.

Pumping and Treating Contaminated Ground Water



Despite the challenges, ground water has been and is being restored for beneficial uses, including drinking water. Advances in scientific and technical knowledge have made ground water cleanup faster and more effective. For example:

- Progress has been made in techniques used to study Superfund sites. This includes the development of new sampling and testing devices that make studies of ground water faster and cheaper. A thorough study is important in determining the extent of contamination, and in designing the plan for how a site will be cleaned up.
- Knowledge of how contaminants move in ground water has advanced, helping to predict where contamination might move and who might be exposed. This knowledge is crucial in designing the cleanup.
- There is better understanding of the limits of available cleanup technologies. For example, it is now easier to predict which portions of an aquifer can be cleaned up to drinking water standards using pump-and-treat technology, and which portions must be contained or addressed by another treatment method.
- In some cases, microscopic organisms that live underground can digest or break down harmful contaminants into harmless elements. This process is called "bioremediation." By adding nutrients or oxygen, this process can be enhanced and used to clean up contaminated ground water. Bioremediation relies mostly on nature, involves minimal construction or disturbance, and is comparatively inexpensive. It has been studied at many Superfund sites and is formally a part of the cleanup remedy at some sites.
- Use of soaps, solutions, steam, and hot water to remove contaminants from aquifers has improved. These and other innovative technologies can increase the effectiveness of a pump-and-treat cleanup.

WHAT YOU CAN DO!

There are many things you can do to gain a basic understanding of ground water as a resource and to support efforts to protect ground water quality in your community.

Prevent Ground Water Contamination

The difficulty and costs of cleanups are proof that every effort should be made to prevent ground water from becoming contaminated. Here are some steps you can take to protect your ground water.

Ask public works personnel in your local government for information on how to handle and reduce the use of household chemicals. Investigate whether there is a program in your area to collect household hazardous wastes, such as solvents, used paint cans, used motor oil, and pesticides and fertilizers. These programs are helping to prevent the chemicals we use in our homes from getting into our ground water! For more information about household hazardous waste, call EPA's RCRA/ UST, Superfund, & EPCRA Hotline at (800) 424-9346.

Report spills, suspicious dumping, or other signs of contamination to your local health board, state environmental department, or EPA Regional Office. Accidents, spills and other releases can also be reported to the National Response Center Hotline at (800) 424-8802.

Keep Informed

Citizens can get information about ground water in their communities by contacting:

- Local water authority or other local natural resource authorities
- Service agencies, such as the County Cooperative Extension Service, and the Soil and Water Conservation District
- Civic and environmental organizations
- Universities and colleges
- Trade associations of environmental engineers or well drillers.

The local telephone directory or elected officials can help you find information on:

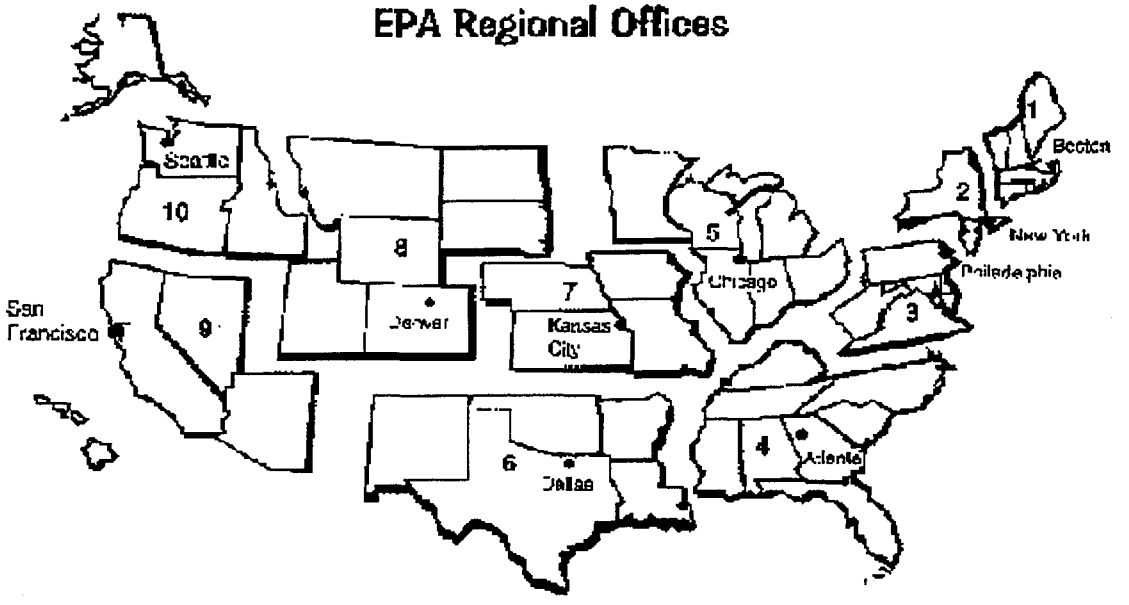
- Where your community gets its drinking water and what state, tribal, or local efforts are being made to protect water quality
- What possible sources of ground water contamination are in your area and what government or community programs are in place to monitor these sources
- Whether your community's water well has been tested in the past year
- Where your solid waste goes, and how ground water is protected there.

For information about releases of toxic chemicals in your area, call the RCRA/UST, Superfund, & EPCRA Hotline at (800)424-9346.

Get Involved

Ask and read about any Superfund sites or other hazardous waste sites in your area. Attend public meetings, and offer any information you have regarding the history, natural features, or community activity related to the site. Participate in community work groups about the site, and give your comments and concerns to state and federal government staff. Local groups may apply for an EPA Technical Assistance Grant (TAG) to get independent expert advice on cleanup plans at Superfund sites. In addition, state and local governments often seek input from citizens and community groups when developing plans for managing ground water resources.

For further information about the Superfund Program, call EPA's RCRA/UST, Superfund & EPCRA Hotline at (800)424-9346. To speak to the EPA Community Involvement Coordinator or a ground water specialist in your EPA Regional Office, contact:



Region 1	(617) 565-3420	Region 6	(214) 665-6444
Region 2	(212) 637-3000	Region 7	(913) 551-7000
Region 3	(215) 566-5000	Region 8	(303) 312-6312
Region 4	(404) 562-8357	Region 9	(415) 744-1305
Region 5	(312) 353-2000	Region 10	(206) 553-1200

GROUND WATER IS A VITAL RESOURCE

- As of 1990, over half of the people in the United States get their drinking water from ground water (more than 140 million people).
- Across the country, 95% of rural households and 35% of urban households use ground water as their drinking water source.
- In the United States, 34 of the largest 100 cities rely completely or partially on ground water as their source of water.
- New Mexico, Mississippi, and Florida rely on ground water for 90% or more of their drinking water supply.
- From 1970 to 1990, seven states or territories more than doubled their use of ground water for public water supply: Alaska, Arizona, California, Florida, Kentucky, Missouri, and Puerto Rico.
- More than one-third of the water used in agriculture is ground water. In Arkansas, Nebraska, Colorado, and Kansas, more than 90% of ground water withdrawals are for agricultural activities.
- As many as 91% of Superfund sites have one or more operable wells within a one-mile radius.
- Contamination from Superfund sites has already shut down supply wells in 344 communities.
- There is a threat of ground water contamination at 500 other Superfund sites where wells are located nearby, but are as yet unaffected.
- Contaminated ground water at Superfund sites discharges into other water resources: 62% to surface water, 38% to drinking water aquifers, and 19% to ecologically sensitive areas.

Printed on recycled paper