Chapter 11

Water

Section 1: Water Resources

DAY ONE
Water Resources

- Water is **essential** to life on Earth. Humans can live for more than a month without food, but we can live for only a few days without water.

- Two kinds of water found on Earth:
  - **Fresh water**, the water that people can drink, contains little salt.
  - **Salt water**, the water in oceans, contains a higher concentration of dissolved salts.

- Most human uses for water, such as drinking and agriculture, require fresh water.
The Water Cycle

- Water is a **renewable resource** because it is circulated in the water cycle.

- In the water cycle, water molecules travel between the Earth’s **surface and the atmosphere**.
  - Water **evaporates** at the Earth’s surface.

- Water vapor rises into the air.
  - As the vapor rises, it **condenses** to form clouds. Eventually the water in clouds falls back to the Earth.

- The oceans are important because **almost** all of the Earth’s water is in the ocean.
Bill Nye – Water Cycle
The Water Cycle

Condensation → Precipitation → Evaporation
Global Water Distribution

- Although 71 percent of the Earth’s surface is covered with water, nearly 97 percent of Earth’s water is salt water in oceans and seas.

- Of the fresh water on Earth, about 77 percent is frozen in glaciers and polar icecaps.

- Only a small percentage of the water on Earth is liquid fresh water that humans can use.
Global Water Distribution

- The fresh water we use comes mainly from **lakes and rivers** and from a relatively narrow zone beneath the Earth’s surface.
Surface Water

- **Surface water** is all the bodies of fresh water, salt water, ice, and snow, that are found above the ground.

- The distribution of surface water has played a vital role in the **development** of human societies.

- Throughout history, people have built cities and farms near reliable sources of water.

- Today, most large cities depend on surface water for drinking water, water to grow crops, food such as fish, power for industry, and transportation.
River Systems

• Streams form as water from falling rain and melting snow drains from mountains, hills, plateaus, and plains.

• As streams flow downhill, they combine with other streams and form rivers.

• A river system is a flowing network of rivers and streams draining a river basin.

• The Amazon River system is the largest river system in the world as it drains an area of land that is nearly the size of Europe.
Watersheds

- A **watershed** is the area of land that is drained by a water system.
- The amount of water that enters a watershed varies throughout the year.
- Rapidly melting snow as well as spring and summer rains can dramatically **increase** the amount of water in a watershed.
- At other times of the year, the river system that drains a watershed may be reduced to a trickle.
Watersheds
Groundwater

• Most of the fresh water that is available for human use cannot be seen, as it exists underground.

• When it rains, some of the water that falls onto the land flows into lakes and streams.

• But much of the water percolates through the soil and down into the rocks beneath.

• **Groundwater** is the water that is beneath the Earth’s surface.
Groundwater

- As water travels beneath the Earth’s surface, it eventually reaches a level where the rocks and soil are saturated with water.
  - This level is known as the water table.
- In wet regions, the water table may be at the Earth’s surface.
  - In deserts, the water table may be hundreds of meters beneath Earth’s surface.
- The water table has peaks and valleys that match the shape of the land above. Groundwater tends to flow slowly from the peaks to the valleys.
GroundWater Video
Aquifers

• An **aquifer** is a body or rock or sediment that stores groundwater and allows the flow of groundwater.

• They are an **important** water source for many cities.

• The water table forms the **upper boundary** of an aquifer, and most aquifers consist of materials such as **rock, sand, and gravel** that have a lot of spaces where water can accumulate.

• Groundwater can also **dissolve** rock formations, filling vast caves with water, creating underground lakes.
Porosity

- **Porosity** is the percentage of the total volume of a rock or sediment that consists of open spaces.
- Water in an aquifer is stored in the pore spaces and flows from one pore space to another.
- The more porous a rock is, the more water it can hold.
Permeability

- **Permeability** is the ability of a rock or sediment to let fluids pass through it open spaces or pores.
- Materials such as **gravel** that allow the flow of water are permeable. Materials such as clay or granite that stop the flow of water are impermeable.
- The most productive aquifers usually form in permeable materials, such as **sandstone, limestone, or layers of sand and gravel**.
The Recharge Zone

- To reach an aquifer, surface water must travel down through permeable layers of soil and rock.
- Water cannot reach an aquifer from places where the aquifer is covered by impermeable materials.
- The **recharge zone** is an area in which water travels downward to become part of an aquifer.
- Recharge zones are environmentally sensitive areas because any pollution in the recharge zone can also enter the aquifer.
The Recharge Zone
The Recharge Zone

• The size of an aquifer’s recharge zone is affected by the **permeability** of the surface above the aquifer.

• Structures such as **buildings and parking lots** can act as impermeable layers and reduce the amount of water entering an aquifer.

• Communities should carefully manage recharge zones, because surface water can take a very long time to refill an aquifer, even tens of thousands of years.
Wells

• A hole that is **dug or drilled** to reach groundwater is called a well.

• Humans have dug wells to reach groundwater for thousands of years.

• We dig wells because ground water may be a more reliable source of water than surface water and because water is filtered and purified as it travels underground.
Wells

• The height of the water table changes seasonally, so wells are drilled to **extend** below the water table.

• If the water tables falls below the bottom of the well during a drought, the well will dry up.

• In addition, if groundwater is removed faster than it is recharged, the water table may fall below the bottom of a well.

• To continue supplying water, the well must be drilled deeper.
Ticket out the Door

1. What is the difference between fresh and salt water?
2. What is the percentage of Earth that is covered with water?
3. What is a river system?
4. What is groundwater?
5. What is an aquifer?
6. What is the difference between permeability and porosity?
Chapter 11

Water

Section 2: Water Use and Management

DAY ONE
Water Use and Management

• When a water supply is polluted or overused, everyone living downstream can be affected.

• A shortage of clean, fresh water is one of the world’s most pressing environmental problems.

• According to the World Health Organization, more than 1 billion people lack access to a clean, reliable source of fresh water.
Global Water Use

There are three major uses for water: residential use, agricultural use, and industrial use.
Global Water Use

- Most of the fresh water used worldwide is used to **irrigate crops**.

- However, patterns of water use are not the same everywhere. The availability of fresh water, population sizes, and economic conditions affect how people use water.

- Industry accounts for about **19 percent** of the water used in the world, with the highest percent occurring in **North America and Europe**.

- About **8 percent** of water is used by households.
Residential Water Use

- There are striking differences in residential water use throughout the world.
  - For example, the average person in the United States uses about **300 L** of water a day.
  - But in India, the average person uses only **41 L** of water everyday.

- In the U.S., only about half of residential water use is for activities inside the home, such as drinking and cooking. The remainder of the water used residentially is used for activities outside the home such as watering lawns.
## Residential Water Use

**Daily Water Use in the United States (per Person)**

<table>
<thead>
<tr>
<th>Use</th>
<th>Water (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lawn watering and pools</td>
<td>95</td>
</tr>
<tr>
<td>Toilet flushing</td>
<td>90</td>
</tr>
<tr>
<td>Bathing</td>
<td>70</td>
</tr>
<tr>
<td>Brushing teeth*</td>
<td>10</td>
</tr>
<tr>
<td>Cleaning (inside and outside)</td>
<td>20</td>
</tr>
<tr>
<td>Cooking and drinking</td>
<td>10</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
</tr>
</tbody>
</table>
Water Treatment

• Most water must first be made potable.
  – **Potable** means suitable for drinking.

• Water treatment removes elements such as mercury, arsenic, and lead, which are poisonous to humans even in low concentrations.

• These elements are found in polluted water, but they can also occur naturally in groundwater.
Water Treatment

• A **pathogen** is a virus, microorganism, or other substance that causes disease.

• Pathogens are found in water contaminated by **sewage or animal feces**, but can be removed with water treatment.

• There are several methods of treating water to make it potable. A common method includes both **physical and chemical treatment**.
Drinking-Water Treatment

1. **First Filtration** The source water supply is filtered to remove large organisms and trash.

2. **Coagulation** Alum is rapidly mixed into the water and forms sticky globs called flocs. Bacteria and other impurities cling to the flocs, which settle to the bottom of a tank.

3. **Second Filtration** Layers of sand, gravel, and hard coal filter the remaining impurities.

4. **Additional Treatment** In some communities, fluoride may be added to prevent tooth decay. Sodium compounds or lime may also be added to soften hard water. Treated water is then pumped from storage tanks to homes and businesses.

5. **Chlorination** Chlorine is added to prevent bacteria from growing in the water.

6. **Aeration** Air is forced through the water to release unwanted gases, which reduces odor and improves taste.
Water Treatment Process
Industrial Water Use

- Industry accounts for **19 percent** of water used in the world. Water is used to manufacture goods, to dispose of wastes, and to generate power.
Industrial Water Use

• Most of the water that is used in industry is used to cool power plants.

• Power-plant cooling systems usually pump water from a surface water source such as a river or a lake, carry the water through pipes in a cooling tower, and then pump the water back into the source.

• The water that is returned is usually warmer than the source, but is generally clean and can be used again.
Agricultural Water Use

- Agriculture accounts for **67 percent** of the water used in the world. Plants require a lot of water to grow, and as much as 80 percent of the water used in agriculture evaporates.
Irrigation

• **Irrigation** is a method of providing plants with water from sources other than direct precipitation.

• Many different irrigation techniques are used today. For example, some crops are irrigated by shallow, water filled ditches.

• In the U.S., **high-pressured overhead** sprinklers are the most common form of irrigation.

• However, this method is **inefficient** because nearly half the water evaporates and never reaches the plant roots.
Water Management Projects

- People often prefer to live in areas where the natural distribution of surface water is inadequate.
- Water management projects, such as dams, are designed to meet these needs.
- Water management projects can have various goals, such as
  - bringing in water to make a dry area habitable
  - creating a reservoir for drinking water,
  - generating electric power, which then allows people to live and grow crops in desert areas.
Water Diversion Projects

- To supply dry regions with water, all or part of a river can be diverted into canals that carry water across great distances.
- The Colorado River begins as a glacial stream in the Rocky Mountains and quickly grows larger as other streams feed into it.
- As the river flows south, it is divided to meet the needs of 7 states.
- So much of the river’s water is diverted for irrigation and drinking water that the river runs dry before it reaches the Gulf of California.
Dams and Reservoirs

• A **dam** is a structure that is built across a river to control a river’s flow.

• A **reservoir** is an artificial body of water that usually forms behind a dam.
  – Water from a reservoir can be used for **flood control**, **drinking water**, **irrigation**, **recreation**, and **industry**.

• Hydroelectric dams use the power of flowing water to turn a **turbine** that generates electrical energy.

• About **20 percent** of the world electrical energy is generated using this method.
Dams and Reservoirs

• But, interrupting a river’s flow can have consequences.

• For example, when the land behind a dam is flooded, people are displaced, and entire ecosystems can be destroyed.

• Fertile sediment also builds up behind a dam instead of enriching the land farther down the river, and farmland below may be less productive.

• Dam failure can be another problem. If a dam bursts, the people living along the river below may be killed.
Water Conservation

• As water sources become depleted, water becomes more expensive.

• This is because wells must be dug deeper, water must be piped greater distances, and polluted water must be cleaned up before it can be used.

• **Water conservation** is one way that we can help ensure that everyone will have enough water at a reasonable price.
Water Conservation in Agriculture

- Most of the water loss in agriculture comes from **evaporation, seepage, and runoff**, so technologies that reduce these problems go a long way toward conserving water.

- **Drip irrigation systems** offer a promising step toward conservation.
  - They deliver small amounts of water directly to plant roots by using **perforated tubing**.
  - Water is released to plants as needed and at a controlled rate.
Water Conservation in Industry

- In industry today, the most widely used water conservation practices involve the *recycling of cooling water and wastewater*.  
- Instead of discharging used water into a nearby river, businesses often recycle water and use it again.  
- In an innovative program, Denver, Colorado pays small businesses to introduce water conservation measures.  
- This not only saves money for the city and the business but also makes more water available for agricultural and residential use.
Water Conservation at Home

- People can conserve water by changing a few everyday habits and by using only the water that they need.
- Water-saving technology, such as low-flow toilets, can also help reduce household water use.
- To conserve water, many people water their lawns at night to reduce the amount of evaporation.
- Another way some people conserve water outside the home is by xeriscaping, or designing a landscape that requires minimal water use.
Water Conservation at Home

What You Can Do to Conserve Water

- Take shorter showers, and avoid taking baths unless you keep the water level low.
- Install a low-flow shower head in your shower.
- Install inexpensive, low-flow aerators in your water faucets at home.
- Purchase a modern, low-flow toilet, install a water-saving device in your toilet, or simply place a water-filled bottle inside your toilet tank to reduce the water used for each flush.
- Do not let the water run while you are brushing your teeth.
- Fill up the sink basin rather than letting the water run when you are shaving, washing your hands or face, or washing dishes.
- Wash only full loads in your dishwasher and washing machine.
- Water your lawn sparingly.
Solutions for the Future

• In some places, conservation alone is not enough to prevent water shortages, and as populations grow, other sources of fresh water need to be developed.

• Two possible solutions are:
  • Desalination
  • Transporting Fresh Water
Desalination

- **Desalination** is the process of removing salt from ocean water.
- Some countries in drier parts of the world, such as the Middle East, have built desalination plants to provide fresh water.
- Most desalination plants heat salt water and collect the fresh water that evaporates.
- Because desalination consumes a lot of energy, the process is too expensive for many nations to consider.
Transporting Water

• In some areas of the world where freshwater resources are not adequate, water can be transported from other regions.

• For example, ships regularly travel from the mainland to the Greek islands towing enormous plastic bags full of fresh water.

• The ships anchor in port, and fresh water is then pumped onto the islands.
Transporting Water

• This bag solution is also being considered in the United States, where almost half of the available fresh water is in Alaska.

• Because **76 percent** of the Earth’s fresh water is frozen in icecaps, icebergs are another potential freshwater source.

• For years, people have considered towing icebergs to communities that lack fresh water. But an efficient way to tow icebergs is yet to be discovered.
Chapter 11, Water
Section 3, Water Pollution

DAY ONE
Water Pollution

- **Water pollution** is the introduction of waste matter or chemicals into water that is harmful to organisms living in the water or to those that drink or are exposed to the water.

- Almost all of the ways that we use water contribute to water pollution.

- However, the two underlying causes of water pollution are industrialization and rapid human population growth.
Water Pollution

• Developed countries have made great strides in cleaning up many polluted water supplies, but some water is still dangerously polluted.

• In developing parts of the world, water pollution is a big problem because often the only water available for drinking in the these countries is polluted with sewage and agriculture runoff, which can spread waterborne diseases.

• Water pollution comes from two types of sources: point and nonpoint sources.
Point-Source Pollution

- When you think of water pollution, you probably think of a single source, such as a factory, a wastewater treatment plant, or a leaking oil tanker.

- **Point-source pollution** is pollution that comes from a specific site.

- Although point-source pollution can often be identified and traced to a source, enforcing cleanup is sometimes difficult.
Nonpoint-Source Pollution

- **Non-point source pollution** is pollution that comes from many sources rather than from a single specific site.

- An example is pollution that reaches a body of water from **streets and storm sewers**.

- The accumulation of small amounts of water pollution from many sources is a major pollution problem.

- Controlling nonpoint-source pollution depends to a great extent on **public awareness** of the effects of activities such as spraying lawn chemicals.
Types of Pollution
Point and Nonpoint Sources of Pollution

**Sources of Point Pollution**
- leaking septic-tank systems
- leaking storage lagoons for polluted waste
- unlined landfills
- leaking underground storage tanks that contain chemicals or fuels such as gasoline
- polluted water from abandoned and active mines
- water discharged by industries
- public and industrial wastewater treatment plants

**Nonpoint Sources of Pollution**
- chemicals added to road surfaces (salt and other de-icing agents)
- water runoff from city and suburban streets that may contain oil, gasoline, animal feces, and litter
- pesticides, herbicides, and fertilizer from residential lawns, golf courses, and farmland
- feces and agricultural chemicals from livestock feedlots
- precipitation containing air pollutants
- soil runoff from farms and construction sites
- oil and gasoline from personal watercraft
# Principal Water Pollutants

<table>
<thead>
<tr>
<th>Type of pollutant</th>
<th>Agent</th>
<th>Major sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pathogens</td>
<td>disease-causing organisms, such as bacteria, viruses, protozoa, and parasitic worms</td>
<td>mostly nonpoint sources; sewage or animal feces, livestock feedlots, and poultry farms; sewage from overburdened wastewater treatment plants</td>
</tr>
<tr>
<td>Organic matter</td>
<td>animal and plant matter remains, feces, food waste, and debris from food-processing plants</td>
<td>mostly nonpoint sources</td>
</tr>
<tr>
<td>Organic chemicals</td>
<td>pesticides, fertilizers, plastics, detergents, gasoline and oil, and other materials made from petroleum</td>
<td>mostly nonpoint sources; farms, lawns, golf courses, roads, wastewater, unlined landfills, and leaking underground storage tanks</td>
</tr>
<tr>
<td>Inorganic chemicals</td>
<td>acids, bases, salts, and industrial chemicals</td>
<td>point sources and nonpoint sources; industrial waste, road surfaces, wastewater, and polluted precipitation</td>
</tr>
<tr>
<td>Heavy metals</td>
<td>lead, mercury, cadmium, and arsenic</td>
<td>point sources and nonpoint sources; industrial discharge, unlined landfills, some household chemicals, and mining processes; heavy metals also occur naturally in some groundwater</td>
</tr>
<tr>
<td>Physical agents</td>
<td>heat and suspended solids</td>
<td>point sources and nonpoint sources; heat from industrial processes and suspended solids from soil erosion</td>
</tr>
</tbody>
</table>
Wastewater

- After water flows down the drain in the sink, it usually flows through a series of sewage pipes that carry it, along with all the other wastewater in your community, to a wastewater treatment plant.
- **Wastewater** is water that contains wastes from homes or industry.
- At a wastewater treatment plant, water is **filtered and treated** to make the water clean enough to return to a river or lake.
Treating Wastewater

• Most of the wastewater from homes contains **biodegradable material** that can be broken down by living organisms.

• For example, wastewater from toilets and kitchen sinks contains animal and plant wastes, paper, and soap, all of which are biodegradable.

• But, some household and industrial water and some storm-water runoff contains toxic substances that cannot be removed by the standard treatment.
Sewage Sludge

• One of the products of wastewater treatment is sewage sludge, the solid material that remains after treatment.

• When sludge contains dangerous concentrations of toxic chemicals, it must be disposed of as hazardous waste.

• It is often incinerated, and then the ash is buried in a secure landfill.

• Sludge can be an expensive burden to cities as the volume of sludge that has to be disposed of every year is enormous.
Sewage Sludge

- The problem of sewage sludge disposal has prompted many communities to look for new uses for this waste.
- If the toxicity of sludge can be reduced to safe levels, it can be used as a fertilizer.
- In another process, sludge is combined with clay to make bricks that can be used in buildings.
Artificial Eutrophication

• Most nutrients in water come from **organic matter**, such as leaves and animal waste, that is broken down into mineral nutrients by decomposers such as bacteria and fungi.

• Nutrients are an essential part of any aquatic ecosystem, but when lakes and slow-moving streams contain an abundance of nutrients, they are **eutrophic**.
Artificial Eutrophication

- Eutrophication is a **natural process**
- When organic matter builds up in a body of water, it will begin to **decay and decompose**.
- The process of decomposition uses up oxygen, and as oxygen levels decrease, the types of organisms that live in the water change over time.
- For example, plants take root in the nutrient rich soil, and as more plants grow the shallow waters begin to fill in.
- Eventually the body of water becomes a swamp or marsh.
Artificial Eutrophication

• The natural process of eutrophication is accelerated when inorganic plant nutrients, such as phosphorus and nitrogen, enter the water from sewage and fertilizer runoff.

• Artificial eutrophication is a process that increases the amount of nutrients in a body of water through human activities, such as waste disposal and land drainage.

• The major causes of eutrophication are fertilizer and phosphates in some laundry detergents.
Artificial Eutrophication

- **Phosphorus** is a plant nutrient that can cause the excessive growth of algae.
- In bodies of water polluted by phosphorus, algae can form large floating mats, called **algal blooms**.
- As the algae die and decompose, most of the dissolved oxygen is used and fish and other organisms suffocate in the oxygen-depleted water.
Algal Blooms
Thermal Pollution

• **Thermal pollution** is a temperature **increase** in a body of water that is caused by **human activity** and that has harmful effect on water quality and on the ability of that body of water to support life.

• Thermal pollution can occur when **power plants** and other industries use water in their cooling systems and then discharge the warm water into a lake or river.
Thermal Pollution

• Thermal pollution can cause **large fish kills** if the discharged water is too warm for the fish to survive.

• If the temperature of a body of water rises even a few degrees, the amount of oxygen the water can hold decreases significantly.

• As oxygen levels **drop**, aquatic organisms may **suffocate and die**.

• If the flow of warm water into a lake or stream is constant, it may cause the total disruption of an aquatic ecosystem.
Groundwater Pollution

- Pollutants usually enter groundwater when polluted surface water *percolates* down from the Earth’s surface.
- Any pollution of the surface water in an area can affect the groundwater.
- *Pesticides, herbicides, chemical fertilizer, and petroleum* products are common groundwater pollutants.
- Other sources of pollution include septic tanks, unlined landfills, and industrial wastewater lagoons.
Groundwater Pollution

- **Leaking underground storage tanks** are another major source of groundwater pollution because as they age, they may develop leaks that allow pollutants to seep into the groundwater.
- Leaking tanks often cannot be repaired or replaced until after they have leaked enough pollutants to be located.
- Modern storage tanks are contained in concrete and have many other features to prevent leaks.
Cleaning Up Groundwater Pollution

• Groundwater pollution is one of the most challenging environmental problems in the world.

• Groundwater recharges very slowly, so the process for some aquifers to recycle water and purge contaminants can take hundreds of years.

• Also, pollution can cling to the materials that make up an aquifer, so even if all of the water in aquifer were pumped out and replaced with clean water, the groundwater could still become polluted.
Ocean Pollution

• Pollutants are often dumped directly into the ocean. For example, ships can legally dump wastewater and garbage overboard in some parts of the ocean.

• But at least 85 percent of ocean pollution, including pollutants such as oil, toxic wastes, and medical wastes, comes from activities on land, near the coasts.

• Sensitive coastal ecosystems, such as coral reefs, are the most effected by pollution.
Oil Spills

- Ocean water is also polluted by accidental oil spills. Each year, about **37 million gallons of oil** from tanker accidents are spilled into the ocean.

- Such oil spills have dramatic effects, but they are responsible for only about **5 percent of oil pollution** in the oceans.

- Most of the oil that pollutes the oceans comes from cities and towns.

- Limiting these nonpoint-sources of pollution would go a long way toward keeping the oceans clean.
Water Pollution and Ecosystems

• Water pollution can cause immediate damage to an ecosystem, but the effects can be far reaching as some pollutants build up in the environment because they do not decompose quickly.

• **Biomagnification** is the accumulation of pollutants at successive levels of the food chain.

• Biomagnification has alarming consequences for organisms at the top of the food chain, and is one reason why U.S. states limit the amount of fish people can eat from certain bodies of water.
Oceans and Oil Spills
Cleaning Up Water Pollution

- **The Clean Water Act of 1972** was designed to “restore and maintain the chemical, physical, and biological integrity of the nation’s waters.”

- The goal of making all surface water clean enough for fishing and swimming by 1983 was never achieved, but much progress has been made since the act was passed.

- The percentage of lakes that are fit for swimming has increased by **30 percent**, and many states have passed stricter water-quality standards.
Cleaning Up Water Pollution

• The Clean Water Act opened the door for other water-quality legislation.

• For example, the Marine, Protection, Research, and Sanctuaries Act of 1972 strengthened the laws against ocean dumping.

• Also, the Oil Pollution Act of 1990 requires all oil tankers traveling in U.S. waters to have double hulls by 2015 as an added protection against oil spills.
### Cleaning Up Water Pollution

#### Federal Laws Designed to Improve Water Quality in the United States

<table>
<thead>
<tr>
<th>Year</th>
<th>Law Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972</td>
<td>Clean Water Act (CWA)</td>
<td>The CWA set a national goal of making all natural surface water fit for fishing and swimming by 1983 and banned pollutant discharge into surface water after 1985. The act also required that metals be removed from wastewater.</td>
</tr>
<tr>
<td>1972</td>
<td>Marine Protection, Research, and Sanctuaries Act, amended 1988</td>
<td>This act empowered the EPA to control the dumping of sewage wastes and toxic chemicals in U.S. waters.</td>
</tr>
<tr>
<td>1975</td>
<td>Safe Drinking Water Act (SDWA), amended 1996</td>
<td>This act introduced programs to protect groundwater and surface water from pollution. The act emphasized sound science and risk-based standards for water quality. The act also empowered communities in the protection of source water, strengthened public right-to-know laws, and provided water system infrastructure assistance.</td>
</tr>
<tr>
<td>1980</td>
<td>Comprehensive Environmental Response Compensation and Liability Act (CERCLA)</td>
<td>This act is also known as the Superfund Act. The act makes owners, operators, and customers of hazardous waste sites responsible for the cleanup of the sites. The act has reduced the pollution of groundwater by toxic substances leached from hazardous waste dumps.</td>
</tr>
<tr>
<td>1987</td>
<td>Water Quality Act</td>
<td>This act was written to support state and local efforts to clean polluted runoff. It also established loan funds to pay for new wastewater treatment plants and created programs to protect major estuaries.</td>
</tr>
<tr>
<td>1990</td>
<td>Oil Pollution Act</td>
<td>This act attempts to protect U.S. waterways from oil pollution by requiring that oil tankers in U.S. waters be double-hulled by 2015.</td>
</tr>
</tbody>
</table>