

Test Document P01: Air Quality, Clean Water Act and Groundwater

Test document compiled from US federal public-domain sources for software testing.

Compiled in October 2026 from U.S. federal government web pages, which are in the public domain. This is not an official government publication and is not endorsed by any agency.

Contents

Air quality and the Air Quality Index (EPA)	4
Air Quality Index (AQI) Basics	4
What is the U.S. Air Quality Index (AQI)?	4
How does the AQI work?	4
AQI Basics for Ozone and Particle Pollution	4
Five major pollutants	5
Ground-level Ozone Basics	6
What is "good" vs. "bad" ozone?	6
How does ground-level ozone form?	6
What are the harmful effects of ozone?	6
What is being done to reduce ozone pollution?	7
Research on Health Effects from Air Pollution	7
Health Effects of Air Pollutants on Vulnerable Populations	8
Long-Term and Short-Term Effects from Exposure to Air Pollutants	9
Multipollutant Exposures and Changes in Environmental Conditions	9
Leveraging Big Data for Innovations in Health Science	10
Health Effects of Wildfire Smoke	10
Public Health Intervention and Communications Strategies	11
Integrated Science Assessments for Air Pollutants	11
Health and Environmental Effects of Particulate Matter (PM)	12
Health Effects	12
Environmental Effects	12
Further Reading	13
Clean Water Act basics and water quality (EPA)	14
Summary of the Clean Water Act	14
33 U.S.C. §1251 et seq. (1972)	14
Compliance and Enforcement	14
History of this Act	14
More Information	14
History of the Clean Water Act	15
Designated Uses	15

Designated Uses Overview	15
Designated Uses Resources	16
Designated Use Revision Infographics	16
Clean Water Act (CWA) and Federal Facilities	17
Summary:	17
Federal Facility Responsibilities under the CWA include:	17
Basics of Statute	18
Application of CWA to Federal Facilities	19
National Recommended Water Quality Criteria - Aquatic Life Criteria Table	22
National Recommended Aquatic Life Criteria table	22
Appendix A	29
Appendix B	29

Groundwater and aquifers (USGS) 31

Aquifers and Groundwater	31
Groundwater and aquifers	31
Visualizing groundwater	31
Pumping can affect the level of the water table	32
Water movement in aquifers	32
Visualizing artesian pressure	32
Groundwater Use in the United States	33
Groundwater serves many purposes	33
Groundwater withdrawals, by State, 2015	34
Groundwater Decline and Depletion	35
Groundwater Decline and Depletion	35
Excessive pumping can overdraw the groundwater "bank account"	35
What are some effects of groundwater depletion?	36
Where does groundwater depletion occur in the United States?	37

Sources 38

Air quality and the Air Quality Index (EPA)

Air Quality Index (AQI) Basics

What is the U.S. Air Quality Index (AQI)?

The U.S. AQI is EPA's index for reporting air quality.¹

How does the AQI work?

The U.S. Air Quality Index (AQI) is EPA's tool for communicating about outdoor air quality and health. The AQI includes six color-coded categories, each corresponding to a range of index values. The higher the AQI value, the greater the level of air pollution and the greater the health concern. For example, an AQI value of 50 or below represents good air quality, while an AQI value over 300 represents hazardous air quality.

For each pollutant an AQI value of 100 generally corresponds to an ambient air concentration that equals the level of the short-term national ambient air quality standard for protection of public health. AQI values at or below 100 are generally thought of as satisfactory. When AQI values are above 100, air quality is unhealthy: at first for certain sensitive groups of people, then for everyone as AQI values get higher.

The AQI is divided into six categories. Each category corresponds to a different level of health concern. Each category also has a specific color. The color makes it easy for people to quickly determine whether air quality is reaching unhealthy levels in their communities.

AQI Basics for Ozone and Particle Pollution

Daily AQI Color	Levels of Concern	Values of Index	Description of Air Quality
Green	Good	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Yellow	Moderate	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Orange	Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Red	Unhealthy	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Purple	Very Unhealthy	201 to 300	Health alert: The risk of health effects is increased for everyone.
Maroon	Hazardous	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

AQI Basics for Ozone and Particle Pollution Table print version (pdf, 163KB, 1p.)

See the Activity Guides to learn ways to protect your health when the AQI reaches unhealthy levels.

¹ Source: U.S. Environmental Protection Agency, "Air Quality Index (AQI) Basics", <https://www.airnow.gov/aqi/aqi-basics>.

Five major pollutants

EPA establishes an AQI for five major air pollutants regulated by the Clean Air Act. Each of these pollutants has a national air quality standard set by EPA to protect public health:

- ground-level ozone
- particle pollution (also known as particulate matter, including PM_{2.5} and PM₁₀)
- carbon monoxide
- sulfur dioxide
- nitrogen dioxide

Ground-level Ozone Basics

On this page:²

- What is "good" vs. "bad" ozone?
- How does ground-level ozone form?
- What are the harmful effects of ozone?
- What is being done to reduce ozone pollution?

What is "good" vs. "bad" ozone?

Ozone can be "good" or "bad" for health and the environment depending on where it's found in the atmosphere. Stratospheric ozone is "good" because it protects living things from ultraviolet radiation from the sun. Ground-level ozone, the topic of this website, is "bad" because it can trigger a variety of health problems, particularly for children, the elderly, and people of all ages who have lung diseases such as asthma. Learn more about ground-level ozone.

Ozone is a gas composed of three atoms of oxygen. Ozone occurs both in the Earth's upper atmosphere and at ground level. Ozone can be good or bad, depending on where it is found.

Called stratospheric ozone, good ozone occurs naturally in the upper atmosphere, where it forms a protective layer that shields us from the sun's harmful ultraviolet rays. This beneficial ozone has been partially destroyed by manmade chemicals, causing what is sometimes called a "hole in the ozone." The good news is, this hole is diminishing. Learn more about stratospheric, or "good" ozone.

Ozone at ground level is a harmful air pollutant, because of its effects on people and the environment, and it is the main ingredient in "smog." Learn more about air emission sources.

How does ground-level ozone form?

Tropospheric, or ground level ozone, is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC). This happens when pollutants emitted by cars, power plants, industrial boilers, refineries, chemical plants, and other sources chemically react in the presence of sunlight.

Ozone is most likely to reach unhealthy levels on hot sunny days in urban environments, but can still reach high levels during colder months. Ozone can also be transported long distances by wind, so even rural areas can experience high ozone levels.

What are the harmful effects of ozone?

What are the health effects of ozone?

Ozone in the air we breathe can harm our health, especially on hot sunny days when ozone can reach unhealthy levels. People at greatest risk of harm from breathing air containing ozone include people with asthma. Learn more about health effects.

What are the environmental effects of ozone?

Elevated exposures to ozone can affect sensitive vegetation and ecosystems, including forests, parks, wildlife refuges and wilderness areas. In particular, ozone can harm sensitive vegetation during the growing season. Learn more about how ozone harms ecosystems.

² Source: U.S. Environmental Protection Agency, "Ground-level Ozone Basics", <https://www.epa.gov/ground-level-ozone-pollution/ground-level-ozone-basics>, last updated February 18, 2026.

What are the ozone levels in my community?

Air quality forecasts are often given with weather forecasts on handheld devices, online or in the paper or television. You can check ozone levels and other daily air quality information by visiting www.airnow.gov and in many areas you can receive air quality notifications through www.enviroflash.info.

What can I do to reduce ozone?

There are actions every one of us can take to reduce air pollution and keep the air cleaner and precautionary measures you can take to protect your health. Visit AIRNow for tips on what you can do.

What is being done to reduce ozone pollution?***How is ozone pollution controlled?***

Ozone is one of the six common air pollutants identified in the Clean Air Act. EPA calls these "criteria air pollutants" because their levels in outdoor air need to be limited based on health criteria.

There are national ambient air quality standards (NAAQS) for each of the criteria pollutants. These standards apply to the concentration of a pollutant in outdoor air. Learn more about criteria air pollutants and NAAQS.

After working with the states and tribes and considering the information from air quality monitors, EPA "designates" an area as attainment or nonattainment with national ambient air quality standards. If the air quality in a geographic area meets or does better than the national standard, it is called an attainment area; areas that don't meet the national standard are called nonattainment areas. Learn more about ozone air quality designations.

In order to improve air quality, states must draft a plan known as a state implementation plan (SIP) to improve the air quality in nonattainment areas. The plan outlines the measures that the state will take in order to improve air quality. Once a nonattainment area meets the standards, EPA will designate the area as a "maintenance area."

What rules or regulations help reduce ozone pollution?

EPA's national and regional rules to reduce emissions of pollutants that form ground level ozone will help state and local governments meet the Agency's national air quality standards. Actions include vehicle and transportation standards, regional haze and visibility rules, and regular reviews of the NAAQS. Learn more about ozone standards.

Research on Health Effects from Air Pollution

Decades of research have shown that air pollutants such as ozone and particulate matter (PM) increase the amount and seriousness of lung and heart disease and other health problems. More investigation is needed to further understand the role poor air quality plays in causing detrimental effects to health and increased disease, especially in vulnerable populations. Children, the elderly, and people living in areas with high levels of air pollution are especially susceptible.³

Results from these investigations are used to support the nation's air quality standards under the Clean Air Act and contribute to improvements in public health.

On this page:

- Health Effects of Air Pollutants on Vulnerable Populations
- Long-Term and Short-Term Effects from Exposure to Air Pollutants

³ Source: U.S. Environmental Protection Agency, "Research on Health Effects from Air Pollution", <https://www.epa.gov/air-research/research-health-effects-air-pollution>, last updated May 21, 2026.

- Multipollutant Exposures and Changes in Environmental Conditions
- Leveraging Big Data for Innovations in Health Science
- Health Effects of Wildfire Smoke
- Public Health Intervention and Communications Strategies
- Integrated Science Assessments for Air Pollutants

Health Effects of Air Pollutants on Vulnerable Populations

Research has shown that some people are more susceptible than others to air pollutants. These groups include children, pregnant women, older adults, and individuals with pre-existing heart and lung disease. People in low socioeconomic neighborhoods and communities may be more vulnerable to air pollution because of many factors. Proximity to industrial sources of air pollution, underlying health problems, poor nutrition, stress, and other factors can contribute to increased health impacts in these communities.

There is a need for greater understanding of the factors that may influence whether a population or age group is at increased risk of health effects from air pollution. In addition, advances to analytical approaches used to study the health effects from air pollution will improve exposure estimates for healthy and at-risk groups.

The research by EPA scientists and others inform the required reviews of the primary National Ambient Air Quality Standards (NAAQS), which is done with the development of Integrated Science Assessments (ISAs). These ISAs are mandated by Congress every five years to assess the current state of the science on criteria air pollutants and determine if the standards provide adequate protection to

public health.

Research is focused on addressing four areas:

- Identifying and characterizing whether there are key reproductive factors and critical stages of development that are impacted by air pollution exposures;
- Determining the role of acute and chronic sociodemographic factors in air pollution health disparities;
- Understanding how diet modifies responses to air pollution;
- Evaluating long-term lifestyle and chronic disease effects on air pollution-induced respiratory and cardiovascular responses

A multi-disciplinary team of investigators is coordinating epidemiological, human observational, and basic toxicological research to assess the effects of air pollution in at-risk populations and develop strategies to protect these populations, particularly those with pre-existing disease. The results from these products will improve risk assessments by clarifying the role of modifying factors such as psychosocial stress (e.g. noise) and diet, and determining the impact of individual susceptibility on the relationship between air pollutant exposures and health.

Related Links

- [Healthy Heart Research](#)
- [Integrated Science Assessments](#)
- [Criteria Air Pollutants](#)

Long-Term and Short-Term Effects from Exposure to Air Pollutants

People can experience exposure to varying concentrations of air pollution. Poor air quality can impact individuals for a short period of time during the day, or more frequently during a given day. Exposure to pollutants can also occur over multiple days, weeks or months due to seasonal air pollution, such as increased ozone during the summer or particulate matter from woodstoves during the winter.

The health impact of air pollution exposure depends on the duration and concentrations, and the health status of the affected populations. Studies are needed to increase knowledge of the exposure duration and the possible cumulative increase in risk.

The research is focused on three main areas:

- Short-term peak exposures, such as wildfires, traffic-related sources, or other episodic events;
- Intermittent and cumulative exposures;
- Mechanisms underlying the exposure risks

Researchers are evaluating the health responses of intermittent multiple days versus one-day air pollution exposure in controlled human exposure, animal, and in vitro models and associated cellular and molecular mechanisms. They are employing population-based models and electronic health records to assess the health effects of short-term and long-term exposures and identifying populations at greatest risk of health effects. The work is improving our understanding of the possible cumulative effects of multiple short-term peak exposures and the relationship of these exposures to longer-term exposures and risks.

Multipollutant Exposures and Changes in Environmental Conditions

EPA research is providing information to understand how individuals may respond to two or more pollutants or mixtures and how environmental conditions may impact air quality. While risk estimates for exposure to individual criteria air pollutants such as PM and ozone are well established, the acute and cumulative effects of combinations of pollutants is not well understood. In addition, research is needed to determine how changes in the environment affect both pollutant formation and subsequent responsiveness to exposures in healthy and susceptible individuals.

The research is focused on three specific questions:

- What is the role of temperature and photochemical aging on the health impact of wildfire smoke and air pollution mixtures?
- What is the effect of changing environmental conditions (i.e., temperature and humidity) on responsiveness to air pollution?
- Does prior pollutant exposure modify responsiveness to subsequent exposures?

The integrated, multi-disciplinary research includes:

- Epidemiologic analyses of environmental influences on morbidity and mortality in populations,
- Simulations of changing environmental conditions in multi-pollutant formation in atmospheric chamber studies coupled with clinical and toxicological assessments in healthy and at-risk populations,
- Evaluation of pre-exposure as a modifying effect on subsequent exposures

The results are revealing how changes in environmental conditions affect pollutant formation and subsequent health impact in at-risk populations. The research findings are informing EPA's Integrated Science Assessments for criteria air pollutants and assisting with future regulatory decisions on the National Ambient Air Quality Standards (NAAQS).

Leveraging Big Data for Innovations in Health Science

EPA is at the cutting edge of health science, using electronic health records, novel data systems, tissue-like advanced cellular models, molecular approaches, and animal models to evaluate the health impacts of air pollution. Researchers are using these powerful new techniques to identify factors that may increase sensitivity and vulnerability to air pollution effects.

The research is building capacity for future risk assessment and regulatory analyses that go beyond traditional lines of evidence to more clearly define populations and lifestages at increased risk of health effects from air pollution.

To continue to protect public health from poor air quality, researchers must consider new epidemiological, toxicological and clinical approaches to understand the health risks of poor air quality and the biological mechanisms responsible for these risks. At the center of these new research approaches is an explosion of data availability and methodological approaches for handling large clinical and molecular datasets, also known as "big data."

While data of increasing size, depth, and complexity have accelerated research for many industries and scientific fields, big data is sometimes less recognized for the impacts it is having on environmental health studies. Increasingly, researchers are able to examine

vulnerable populations with unprecedented precision and detail while also evaluating hundreds of thousands of molecular biomarkers in order to understand biological mechanisms associated with exposure.

Health Effects of Wildfire Smoke

Larger and more intense wildfires are creating the potential for greater smoke production and chronic exposures in the United States, particularly in the West. Wildfires increase air pollution in surrounding areas and can affect regional air quality.

The health effects of wildfire smoke can range from eye and respiratory tract irritation to more serious disorders, including reduced lung function, exacerbation of asthma and heart failure, and premature death. Children, pregnant women, and the elderly are especially vulnerable to smoke exposure. Emissions from wildfires are known to cause increased visits to hospitals and clinics by those exposed to smoke.

It is important to more fully understand the human health effects associated with short- and long-term exposures to smoke from wildfires as well as prescribed fires, together referred to as wildland fires. EPA is conducting research to advance understanding of the health effects from different types of fires as well as combustion phases. Researchers want to know:

- What is the full extent of health effects from smoke exposure?
- Who is most at risk?
- Are there differences in health effects from different wildfire fuel types or combustion phases (burning versus flaming)?
- What strategies and approaches are most effective in protecting public health?
- What are the environmental, social and economic impacts of wildfire emissions?

Related Links

- Wildland Fire Research
- Smoke-Ready Toolbox for Wildfires
- Research on DIY Air Cleaners to Reduce Wildfire Smoke Indoors

Public Health Intervention and Communications Strategies

Many communities throughout the United States face challenges in providing advice to residents about how best to protect their health when they are exposed to elevated concentrations of air pollutants from motor vehicle and industrial emissions and other sources of combustion, including wildland fire smoke.

Researchers are studying intervention strategies to reduce the health impacts from exposure to air pollution as well as ways to effectively communicate these health risks. To translate the science for use in public health communication and community empowerment, EPA is collaborating with other federal agencies, such as the Centers for Disease Control and Prevention (CDC) and the National Heart, Lung, and Blood Institute (NHLBI), and state and local agencies and tribes. The objectives are to identify ways to lower air pollution exposure or mitigate the biological responses at individual, community or ecosystem levels, and ultimately evaluate whether such interventions have benefits as measured by indicators of health, well-being or economics.

Studies are evaluating the interactions between behavior and social and economic factors to more thoroughly understand how these factors may influence health and well-being outcomes, which can inform effective and consistent health risk messaging.

Related Links

- Healthy Heart Toolkit and Research

- Video: Air Quality Impacts on Public Health

Integrated Science Assessments for Air Pollutants

EPA sets National Ambient Air Quality Standards (NAAQS) for six principal criteria air pollutants—nitrogen oxides, sulfur oxides, particulate matter, carbon monoxide, ozone and lead—all of which have been shown to be harmful to public health and the environment.

The Agency's Integrated Science Assessments (ISAs) form the scientific foundation for the review of the NAAQS standards by providing the primary (human health-based) assessments and secondary (welfare-based, e.g. ecology, visibility, materials) assessments. The ISAs are assessments of the state of the science on the criteria pollutants. They are conducted as mandated under the Clean Air Act.

Health and Environmental Effects of Particulate Matter (PM)

Health Effects

The size of particles is directly linked to their potential for causing health problems. Small particles less than 10 micrometers in diameter pose the greatest problems, because they can get deep into your lungs, and some may even get into your bloodstream.

Exposure to such particles can affect both your lungs and your heart. Numerous scientific studies have linked particle pollution exposure to a variety of problems, including:

- premature death in people with heart or lung disease
- nonfatal heart attacks
- irregular heartbeat
- aggravated asthma
- decreased lung function
- increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing.

People with heart or lung diseases, children, older adults, minority populations, and low socioeconomic status populations are the most likely to be affected by particle pollution exposure, either because they are more sensitive or may have higher exposures.

- AirNow can help you monitor air quality near you, and protect yourself and your family from elevated PM levels.

Environmental Effects

Visibility impairment

Fine particles (PM_{2.5}) are the main cause of reduced visibility (haze) in parts of the United States, including many of our treasured national parks and wilderness areas. Learn more about visibility and haze

Environmental damage

Particles can be carried over long distances by wind and then settle on ground or water. Depending on their chemical composition, the effects of this settling may include:

- making lakes and streams acidic
- changing the nutrient balance in coastal waters and large river basins
- depleting the nutrients in soil
- damaging sensitive forests and farm crops
- affecting the diversity of ecosystems
- contributing to acid rain effects.

Materials damage

PM can stain and damage stone and other materials, including culturally important objects such as statues and monuments. Some of these effects are related to acid rain effects on materials.

Further Reading

Particle Pollution and Your Health (txt) (2 pp, 320 KB): Learn who is at risk from exposure to particle pollution, what health effects you may experience as a result of particle exposure, and simple measures you can take to reduce your risk.

How Smoke From Fires Can Affect Your Health: It is important to limit your exposure to smoke -- especially if you may be susceptible.

EPA research on airborne particulate matter: EPA supports research that provides the critical science on PM and other air pollutants to develop and implement Clean Air Act regulations that protect the quality of the air we breathe.

Source: U.S. Environmental Protection Agency, "Health and Environmental Effects of Particulate Matter (PM)", <https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm>.

Clean Water Act basics and water quality (EPA)

Summary of the Clean Water Act

33 U.S.C. §1251 et seq. (1972)

The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. The basis of the CWA was enacted in 1948 and was called the Federal Water Pollution Control Act, but the Act was significantly reorganized and expanded in 1972. "Clean Water Act" became the Act's common name with amendments in 1972.⁴

Under the CWA, EPA has implemented pollution control programs such as setting wastewater standards for industry. EPA has also developed national water quality criteria recommendations for pollutants in surface waters.

- EPA's National Pollutant Discharge Elimination System (NPDES) permit program controls discharges.
- Point sources are discrete conveyances such as pipes or man-made ditches.
 - Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need a NPDES permit;
 - Industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters.

Compliance and Enforcement

- Clean Water Act Compliance Monitoring: investigations and inspections
- Water Enforcement

History of this Act

- EPA History: Federal Water Pollution Control Act Amendments of 1972
- History of the Clean Water Act
- Archived EPA History: Clean Water Act

More Information

The Office of Water (OW) ensures drinking water is safe, and restores and maintains oceans, watersheds, and their aquatic ecosystems to protect human health, support economic and recreational activities, and provide healthy habitat for fish, plants, and wildlife.

- The EPA Watershed Academy provides training courses on statutes, watershed protection, and other key Clean Water Act resources.

⁴ Source: U.S. Environmental Protection Agency, "Summary of the Clean Water Act", <https://www.epa.gov/laws-regulations/summary-clean-water-act>, last updated February 23, 2026.

History of the Clean Water Act

The Federal Water Pollution Control Act of 1948 was the first major U.S. law to address water pollution. Growing public awareness and concern for controlling water pollution led to sweeping amendments in 1972. As amended in 1972, the law became commonly known as the Clean Water Act (CWA).⁵

The 1972 amendments:

- Established the basic structure for regulating pollutant discharges into the waters of the United States.
- Gave EPA the authority to implement pollution control programs such as setting wastewater standards for industry.
- Maintained existing requirements to set water quality standards for all contaminants in surface waters.
- Made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions.
- Funded the construction of sewage treatment plants under the construction grants program.
- Recognized the need for planning to address the critical problems posed by nonpoint source pollution.

Subsequent amendments modified some of the earlier CWA provisions. Revisions in 1981 streamlined the municipal construction grants process, improving the capabilities of treatment plants built under the program. Changes in 1987 phased out the construction grants program, replacing it with the State Water Pollution Control Revolving Fund, more commonly known as the Clean Water State Revolving Fund. This new funding strategy addressed water quality needs by building on EPA-state partnerships.

Over the years, many other laws have changed parts of the Clean Water Act. Title I of the Great Lakes Critical Programs Act of 1990, for example, put into place parts of the Great Lakes Water Quality Agreement of 1978, signed by the U.S. and Canada, where the two nations agreed to reduce certain toxic pollutants in the Great Lakes. That law required EPA to establish water quality criteria for the Great Lakes addressing 29 toxic pollutants with maximum levels that are safe for humans, wildlife, and aquatic life. It also required EPA to help the States implement the criteria on a specific schedule.

Read more: EPA's Summary of the Clean Water Act.

Designated Uses

Designated Uses Overview

Water quality standards consist of three core components. They include designated uses of a waterbody, criteria to protect designated uses, and antidegradation requirements to protect existing uses and high quality/high value waters. The WQS regulation requires states, territories and authorized Tribes to specify water quality goals and expectations for their surface waterbodies. Typical designated uses described in the Clean Water Act (CWA) include:⁶

- Protection and propagation of fish, shellfish and wildlife

⁵ Source: U.S. Environmental Protection Agency, "History of the Clean Water Act", <https://www.epa.gov/laws-regulations/history-clean-water-act>, last updated February 23, 2026.

⁶ Source: U.S. Environmental Protection Agency, "Designated Uses", <https://www.epa.gov/wqs-tech/designated-uses>, last updated April 6, 2026.

- Recreation in and on the water
- Public water supply
- Agriculture, industry, and navigation.

CWA Section 101(a)(2) states that it is a national goal that, wherever attainable, water quality provides for the protection and propagation of fish, shellfish and wildlife and recreation in and on the water. The EPA's WQS regulation at 40 CFR Part 131.10 interprets the CWA as requiring WQS to protect the uses specified in CWA Section 101(a)(2) unless such uses are shown to be unattainable through a use attainability analysis (UAA).

Diagram: What is a Use Attainability Analysis (UAA)? (pdf)

Designated Uses Resources

- WQS Handbook, Chapter 2: Designation of Uses
- Use Attainability Analysis (UAA)
- UAA Process Diagram with Tips for Combined Sewer Overflow (CSO) Receiving Waters

Designated Use Revision Infographics

The EPA has developed a series of infographics about the purpose and value of designated use revisions. These infographics identify opportunities for meaningful public engagement during the designated use revision process.

Your Input is Important to a Successful Designated Use Revision

These infographics describe how public stakeholder input can provide a state or authorized Tribe with critical information for making sound decisions early and throughout the designated use revision process. These infographics are geared toward public stakeholder audiences who are already familiar with WQS, such as members of environmental organizations and active community-based groups, to encourage meaningful collaboration and public engagement in the designated use revision process.

- Infographic: Your Input is Important to a Successful State Designated Use Revision (pdf)
- Infographic: Your Input is Important to a Successful Tribal Designated Use Revision (pdf)

Coordination with the Public is Key to a Successful Designated Use Revision

These infographics describe how coordination with public stakeholders can provide a state or authorized Tribe with critical information for making sound decisions early and throughout the designated use revision process. These infographics are geared toward state or Tribal WQS staff and explain the value of public engagement and where opportunities for meaningful collaboration with the public can result in a successful designated use revision process.

Clean Water Act (CWA) and Federal Facilities

Summary:

The Clean Water Act (CWA) is the primary Federal statute regulating the protection of the nation's water. The CWA aims to prevent, reduce, and eliminate pollution in the nation's water in order to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters", as described in CWA section 101(a). A stated goal of the CWA is to eliminate discharge of pollutants into navigable waters, as that term is defined in CWA § 502(7) and corresponding case law.⁷

Federal facilities have regulatory responsibilities under the Clean Water Act, including:

- preventing water pollution
- obtaining discharge permits
- meeting applicable water quality standards
- developing risk management plans, and
- maintaining records.

Part of EPA's mission is to ensure that Federal facilities (and Federal facility contractors) comply with these requirements.

Based on the Federal Water Pollution Control Act of 1948, the CWA underwent significant reorganization and expansion in 1972, with subsequent major amendments in 1977 and 1987. The CWA does not specifically address contamination of groundwater resources, a subject addressed by provisions in other laws including the Safe Drinking Water Act; the Resource Conservation and Recovery Act; and the Comprehensive Environmental Response, Compensation, and Liability Act.

The CWA can be found at 33 U.S.C. § 1251 et seq. The CWA regulations are in 40 C.F.R. Parts 104-108, 110-117, 122-140, 230-233, 401-471, and 501-503.

Federal Facility Responsibilities under the CWA include:

- Obtaining any applicable National Pollutant Discharge Elimination System (NPDES) permit and managing direct discharges in compliance with permit conditions
- Managing discharges to a Publicly-Owned Treatment Works (POTW) in accordance with established Federal, State, and local pretreatment standards
- Managing domestic treatment works in accordance with sludge requirements
- Applying for § 404 dredge and fill permits for construction and development projects
- Monitoring, recording, and reporting pollutant effluent concentrations
- Developing, implementing, and maintaining storm water pollution prevention plans and obtaining necessary permits
- Developing and implementing Spill Prevention, Control, and Countermeasure (SPCC) Plans
- Establishing and maintaining records, reports, monitoring equipment, and other information the EPA Administrator may require pursuant to Section 308, as well as allowing access to EPA to copy records, inspect monitoring equipment and sample effluent sources

⁷ Source: U.S. Environmental Protection Agency, "Clean Water Act (CWA) and Federal Facilities", <https://www.epa.gov/enforcement/clean-water-act-cwa-and-federal-facilities>, last updated March 5, 2026.

Basics of Statute

CWA is the primary Federal statute governing the restoration and maintenance of the “chemical, physical, and biological integrity of the Nation’s waters.” (CWA § 101). One of its principal objectives is to prohibit the discharge of pollutants into waters of the U.S., except in compliance with a permit.

The CWA establishes several major integrated regulatory programs, standards, and plans, which include the following:

- **National Pollutant Discharge Elimination System (NPDES) Program** - Establishes an effluent permit system for point source (e.g., pipe, ditch, sewer) discharges of pollutants into waters of the U.S. The NPDES permit system requires those permitted to maintain records and report on the amount and nature of discharged effluent waste components.
The stormwater program is a part of the NPDES program and is designed to reduce or eliminate the discharge of contaminated stormwater into waters of the U.S. The program requires the following stormwater discharges to be covered by an NPDES permit:
 - discharge associated with industrial activity
 - discharge from a large or medium municipal separate storm sewer system, or
 - discharge which EPA or the state/tribe determines contributes to a violation of a water quality standard or which is a significant contributor of pollutants to waters of the United States
- **National and Local Pretreatment Standards** - Requires new and existing industrial users to pre-treat wastewater discharged to Publicly-Owned Treatment Works (POTWs) to prevent pollutants in excess of certain limits from passing through POTWs, causing interference in the operation of the treatment works and to protect the quality of sludge generated by these plants (§ 307).
- **Dredge or Fill Discharge Permit Program** - Establishes a permit system, administered by the Army Corps of Engineers, for regulating the placement of dredge or fill material into waters of the U.S., including wetlands (§ 404).
- **Sewage Sludge Use and Disposal Program** - Establishes a permit system covering the use and disposal of sewage sludge by land application, surface disposal, incineration, and disposal in a municipal solid waste landfill. Requires generators, processors, users, and disposers of sewage sludge from privately - or Publicly-Owned Treatment Works to meet certain standards (§ 405).
- **Water Quality Management** - 40 C.F.R. Part 130 establishes policies and program requirements for water quality planning, management and implementation under sections 106, 205(j), non-construction management 205(g), 208, 303 and 305 of the CWA. Water quality standards are state or tribal goals for individual water bodies and provide the legal basis for control decisions under the CWA.

Application of CWA to Federal Facilities

Under CWA § 301, it is unlawful for any person to discharge any pollutant into waters of the United States without authorization under specific provisions of the CWA, including § 402 (NPDES) and § 404 (discharge of dredged or fill material). While the definition of “person” (§ 502(5)) does not include the United States, pursuant to § 313, federal agencies are required to comply with all Federal and State requirements respecting the control and abatement of water pollution:

“Each department, agency, or instrumentality of the Federal Government possessing the following rights and/or authorities:

- Having jurisdiction over any facility
- Engaged in any activity resulting, or which may result, in the discharge or runoff of pollutants shall be subject to, and comply with, all Federal, State, interstate, and local requirements and administrative authority, and process and sanctions respecting the control and abatement of water pollution in the same manner as any nongovernmental entity.

. . . The preceding sentence shall apply

- To any requirement whether substantive or procedural, (including any recordkeeping or reporting requirement, any requirement respecting permits and any other requirement whatsoever)
- To the exercise of any Federal, State, or local administrative authority, and (C) to any process and sanction, whether enforced in Federal, State, or local courts or in any other manner

This subsection shall apply notwithstanding any immunity of such agencies, officers, agents, or employees under any law or rule of law.”

Some CWA requirements which may affect Federal facilities (including Federal facility contractors) include, but may not be limited to:

§ 303: Water Quality Standards and Implementation Plans

Section 303(d) and EPA water quality planning and management regulations require States to identify waters that do not meet or expected to meet applicable water quality standards even after technology-based or other required controls are in place. States are required to establish a priority ranking for such waters, taking into account the severity of the pollution and the uses to be made of such waters.

§ 307: National and Local Pretreatment Standards

Facilities that discharge to POTWs are excluded from NPDES permitting requirements but are subject to national general pretreatment standards (40 CFR Part 403), applicable categorical pretreatment standards (specified in 40 CFR Parts 405-471), and any State or local pretreatment standards. Facilities must sample the effluent, submit reports on the results of such sampling at a frequency specified in the permit and submit monitoring reports to EPA, States, or POTWs with approved pretreatment programs.

§ 308: Inspections, Monitoring, and Entry

EPA, State agencies, or their authorized representatives (e.g., contractors) have broad authority to conduct compliance inspections at any premises on which an effluent source is located (including Federal facilities), or in which any records required to be maintained under § 308 are located. EPA or State inspectors may have access to any records, inspect any monitoring equipment, and sample any effluent to check compliance with NPDES permit requirements, water quality standards, pretreatment standards, effluent limitations, or toxic standards.

§ 402: National Pollutant Discharge Elimination System

Point source discharges of pollutants to waters of the United States are prohibited unless they are in compliance with certain provisions of the CWA. The most common way to achieve such compliance is to obtain authorization to discharge pursuant to an NPDES permit issued by EPA or a State agency that has an approved NPDES program.

NPDES permits generally contain water quality-based and/or technology-based standards for effluent discharges (specified in 40 CFR Parts 405-471 or by the best professional judgment of the permit writer), monitoring requirements, analytical testing methods, and reporting requirements. Dischargers generally must submit Discharge Monitoring Reports that record flow measurement, sample collection data, and laboratory test results on a quarterly or monthly basis.

The provisions of NPDES permits for municipal separate storm sewer systems sometimes vary from other NPDES permits with respect to water quality-based effluent limits, monitoring, and reporting requirements. Noncompliance reports generally must be submitted quarterly or monthly stating the cause of a noncompliance, period of noncompliance, and plans to eliminate recurrence of the incident.

Point source stormwater discharges from large, medium and certain small municipal separate storm sewer systems (MS4s), and stormwater discharges associated with certain industrial activities, construction site stormwater discharges, and other stormwater discharges designated by EPA or an authorized State also require a NPDES permit.

MS4s commonly transport and discharge untreated polluted stormwater run-off into local rivers and streams. Common pollutants include oil and grease from roadway/run-ways/parking lots, pesticides from lawns/golf courses, sediment and debris from sites and discarded trash. MS4 permits require operators to develop and implement a stormwater management program to reduce the discharge of pollutants in discharges from the MS4 to the maximum extent practicable, and to meet other permit requirements as determined appropriate by the permitting authority.

§ 404: Permits for Dredged or Fill Material

Facilities that discharge dredged or fill materials into waters of the United States must apply for a permit issued by the Army Corps of Engineers. In certain circumstances, EPA also may prohibit, restrict or deny the issuance of a Section 404 permit to discharge dredged or fill material into a water of the United States whenever the Administrator determines the discharge will have an unacceptable adverse effect on resources identified in the Act.

States may apply for the authority to implement the § 404 program. However, the Army Corps of Engineers retains authority over certain waters and their adjacent wetlands within the State. Under limited circumstances identified in § 404(r), the discharge of dredged or fill materials, as part of a Federal project specifically authorized by Congress, is not prohibited by, or subject to, regulation under § 404.

§405: Permits for Sludge Management

All treatment works that treat domestic sewage are required to meet Federal requirements for the use and disposal of sewage sludge through land application, surface disposal, or incineration. These requirements are incorporated into permits issued under § 402 of CWA, under the appropriate provisions of other legislation (e.g., Solid Waste Disposal Act), under EPA-approved State sludge management programs, or, in the case of a treatment works that is not subject to the above requirements, in a sludge-only permit.

National Recommended Water Quality Criteria - Aquatic Life Criteria Table

This table contains the most up to date criteria for aquatic life ambient water quality criteria. Aquatic life criteria for toxic chemicals are the highest concentration of specific pollutants or parameters in water that are not expected to pose a significant risk to the majority of species in a given environment or a narrative description of the desired conditions of a water body being "free from" certain negative conditions. The table lists the U.S. Environmental Protection Agency's recommended aquatic life criteria. State and Tribal governments may use these criteria or use them as guidance in developing their own.⁸

Select pollutant name for current criteria document.

On this page:

- National Recommended Aquatic Life Criteria Table
- Appendix A - Conversion Factors for Dissolved Metals
- Appendix B - Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent

National Recommended Aquatic Life Criteria table

Pollutant (P = Priority Pollutant)	CAS Number	Freshwater CMC ¹ (acute) (µg/L)	Freshwater CCC ² (chronic) (µg/L)	Saltwater CMC ¹ (acute) (µg/L)	Saltwater CCC ² (chronic) (µg/L)	Publication Year	Notes
Acrolein (P)	107028	3ug/L	3ug/L	—	—	2009	
Aesthetic Qualities	—	—	—	—	—	1986	Refer to Quality Criteria for Water, 1986 ("Gold Book") for narrative statement.
Aldrin (P)	309002	3.0	—	1.3	—	1980	These criteria are based on the 1980 criteria which used different Minimum Data Requirements and derivation procedures from the 1985 Guidelines. If evaluation is to be done using an averaging period, the acute criteria values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.
Alkalinity	—	—	20000	—	—	1986	The CCC of 20mg/L is a minimum value except where alkalinity is naturally lower, in which case the criterion is the natural alkalinity of the water in question. Where natural alkalinity is > 20 mg/L, the criterion cannot be lower than 25% of the natural level, or 20 mg/L whichever is higher.

⁸ Source: U.S. Environmental Protection Agency, "National Recommended Water Quality Criteria - Aquatic Life Criteria Table", <https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table>, last updated June 9, 2026.

Pollutant (P = Priority Pollutant)	CAS Number	Freshwater CMC ¹ (acute) (µg/L)	Freshwater CCC ² (chronic) (µg/L)	Saltwater CMC ¹ (acute) (µg/L)	Saltwater CCC ² (chronic) (µg/L)	Publication Year	Notes
alpha-Endosulfan (P)	959988	0.22	0.056	0.034	0.0087	1980	These criteria are based on the 1980 criteria which used different Minimum Data Requirements and derivation procedures from the 1985 Guidelines. If evaluation is to be done using an averaging period, the acute criteria values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines. This value was derived from data for endosulfan and is most appropriately applied to the sum of alpha-endosulfan and beta-endosulfan.
Aluminum pH 5.0 - 10.5	7429905	--	--	—	—	2018	The criteria is based on the water chemistry data (for pH, hardness and DOC) entered into the criteria calculator for a given location.
Ammonia	7664417	—	—	—	—	2013 (Freshwater), 1989 (Saltwater)	Freshwater criteria are pH, temperature and life-stage dependent. Saltwater criteria are pH and temperature dependent.
Arsenic	7440382	340	150	69	36	1995	This recommended water quality criterion was derived from data for arsenic (III), but is applied here to total arsenic. Freshwater and saltwater criteria for metals are expressed in terms of the dissolved metal in the water column. Refer to Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria.
Atrazine	1912249						
beta-Endosulfan (P)	33213659	0.22	0.056	0.034	0.0087	1980	These criteria are based on the 1980 criteria which used different Minimum Data Requirements and derivation procedures from the 1985 Guidelines. If evaluation is to be done using an averaging period, the acute criteria values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines. This value was derived from data for endosulfan and is most appropriately applied to the sum of alpha-endosulfan and beta-endosulfan.
Boron	—	—	—	—	—	1986	Refer to Quality Criteria for Water, 1986 ("Gold Book") for narrative statement.

Pollutant (P = Priority Pollutant)	CAS Number	Freshwater CMC ¹ (acute) (µg/L)	Freshwater CCC ² (chronic) (µg/L)	Saltwater CMC ¹ (acute) (µg/L)	Saltwater CCC ² (chronic) (µg/L)	Publication Year	Notes
Cadmium (P)	7440439	1.8	vacated	33	7.9	2016	On August 18, 2023, the U.S. District Court for the District of Arizona issued an order vacating EPA's 2016 national recommended chronic freshwater cadmium aquatic life criterion. EPA is continuing to evaluate the Order. But as a result of that Order, the current national recommended chronic freshwater cadmium aquatic life criterion can be found in EPA's 2001 Update of Ambient Water Quality Criteria for Cadmium. Freshwater acute and chronic criteria are hardness-dependent and were normalized to a hardness of 100 mg/L as CaCO ₃ to allow the presentation of representative criteria values. . Freshwater and saltwater criteria for metals are expressed in terms of the dissolved metal in the water column. Refer to Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria.
Carbaryl	63252	2.1	2.1	1.6	—	2012	
Chlordane (P)	57749	2.4	0.0043	0.09	0.004	1980	These criteria are based on the 1980 criteria which used different Minimum Data Requirements and derivation procedures from the 1985 Guidelines. If evaluation is to be done using an averaging period, the acute criteria values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.
Chloride	16887006	860000	230000	—	—	1988	
Chlorine	7782505	19	11	13	7.5	1986	
Chlorpyrifos	2921882	0.083	0.041	0.011	0.0056	1986	
Chromium (III) (P)	16065831	570	74	—	—	1995	Freshwater and saltwater criteria for metals are expressed in terms of the dissolved metal in the water column. Refer to Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria. The freshwater criterion for this metal is expressed as a function of hardness (mg/L). The value given here corresponds to a hardness of 100 mg/L.
Chromium (VI) (P)	18540299	16	11	1,100	50	1995	Freshwater and saltwater criteria for metals are expressed in terms of the dissolved metal in the water column. Refer to Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria.
Color	—	—	—	—	—	1986	Refer to Quality Criteria for Water, 1986 ("Gold Book") for narrative statement.

Pollutant (P = Priority Pollutant)	CAS Number	Freshwater CMC ¹ (acute) (µg/L)	Freshwater CCC ² (chronic) (µg/L)	Saltwater CMC ¹ (acute) (µg/L)	Saltwater CCC ² (chronic) (µg/L)	Publication Year	Notes
Copper (P)	7440508	—	—	4.8	3.1	2007	Freshwater criteria calculated using the Biotic Ligand Model. Freshwater and saltwater criteria for metals are expressed in terms of the dissolved metal in the water column. Refer to Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria.
Cyanide (P)	57125	22	5.2	1	1	1985	These recommended water quality criteria are expressed as µg free cyanide (CN/L).
Demeton	8065483	—	0.1	—	0.1	1985	
Diazinon	333415	0.17ug/L	0.17ug/L	0.82ug/L	0.82ug/L	2005	
Dieldrin (P)	60571	0.24	0.056	0.71	0.0019	1995	The freshwater CCC criterion and both Saltwater criteria are based on the 1980 criteria which used different Minimum Data Requirements and derivation procedures from the 1985 Guidelines. If evaluation is to be done using an averaging period, the acute criteria values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.
Endrin (P)	72208	0.086	0.036	0.037	0.0023	1995	The derivation of the CCC for this pollutant did not consider exposure through the diet, which is probably important for aquatic life occupying upper trophic levels.
gamma-BHC (Lindane) (P)	58899	0.95	—	0.16	—	1995	The Saltwater CCC criterion is based on the 1980 criteria which used different Minimum Data Requirements and derivation procedures from the 1985 Guidelines. If evaluation is to be done using an averaging period, the acute criteria values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.
Gases, Total Dissolved	—	—	—	—	—	1986	Refer to Quality Criteria for Water, 1986 ("Gold Book") for narrative statement.
Guthion	86500	—	0.01	—	0.01	1986	Refer to Quality Criteria for Water, 1986 ("Gold Book") for narrative statement.
Hardness	—	—	—	—	—	1986	Refer to Quality Criteria for Water, 1986 ("Gold Book") for narrative statement.
Heptachlor (P)	76448	0.52	0.0038	0.053	0.0036	1980	These criteria are based on the 1980 criteria which used different Minimum Data Requirements and derivation procedures from the 1985 Guidelines. If evaluation is to be done using an averaging period, the acute criteria values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.

Pollutant (P = Priority Pollutant)	CAS Number	Freshwater CMC ¹ (acute) (µg/L)	Freshwater CCC ² (chronic) (µg/L)	Saltwater CMC ¹ (acute) (µg/L)	Saltwater CCC ² (chronic) (µg/L)	Publication Year	Notes
Heptachlor Epoxide (P)	1024573	0.52	0.0038	0.053	0.0036	1981	These criteria are based on the 1980 criteria which used different Minimum Data Requirements and derivation procedures from the 1985 Guidelines. If evaluation is to be done using an averaging period, the acute criteria values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines. This value was derived from data for heptachlor and there was insufficient data to determine relative toxicities of heptachlor and heptachlor epoxide.
Iron	7439896	—	1000	—	—	1986	Refer to Quality Criteria for Water, 1986 ("Gold Book") for narrative statement.
Lead (P)	7439921	65	2.5	210	8.1	1984	Freshwater and saltwater criteria for metals are expressed in terms of the dissolved metal in the water column. Refer to Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria. The freshwater criterion for this metal is expressed as a function of hardness (mg/L). The value given here corresponds to a hardness of 100 mg/L.
Malathion	121755	—	0.1	—	0.1	1986	Refer to Quality Criteria for Water, 1986 ("Gold Book") for narrative statement.
Mercury ***** (P)	7439976; 22967926	1.4	0.77	1.8	0.94	1995	Freshwater and saltwater criteria for metals are expressed in terms of the dissolved metal in the water column. Refer to Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria.
Methoxychlor	72435	—	0.03	—	0.03	1986	Refer to Quality Criteria for Water, 1986 ("Gold Book") for narrative statement.
Methyl Tertiary-Butyl Ether (MTBE)							
Mirex	2385855	—	0.001	—	0.001	1986	Refer to Quality Criteria for Water, 1986 ("Gold Book") for narrative statement.
Nickel (P)	7440020	470	52	74	8.2	1995	Freshwater and saltwater criteria for metals are expressed in terms of the dissolved metal in the water column. Refer to Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria. The freshwater criterion for this metal is expressed as a function of hardness (mg/L). The value given here corresponds to a hardness of 100 mg/L.
Nonylphenol	84852153	28 ug/L	6.6 ug/L	7 ug/L	1.7 ug/L	2005	
Nutrients	—	—	—	—	—	—	Refer to EPA'S nutrient criteria by waterbody type.

Pollutant (P = Priority Pollutant)	CAS Number	Freshwater CMC ¹ (acute) (µg/L)	Freshwater CCC ² (chronic) (µg/L)	Saltwater CMC ¹ (acute) (µg/L)	Saltwater CCC ² (chronic) (µg/L)	Publication Year	Notes
Oil and Grease	—	—	—	—	—	1986	Refer to Quality Criteria for Water, 1986 ("Gold Book") for narrative statement.
Oxygen, Dissolved Freshwater Oxygen, Dissolved Saltwater	7782447	—	—	—	—	1986	Refer to Quality Criteria for Water, 1986 ("Gold Book") for freshwater. For saltwater, Refer to Aquatic Life Criteria for Dissolved Oxygen (Saltwater) Cape Cod to Cape Hatteras.
Parathion	56382	0.065	0.013	—	—	1995	
Pentachlorophenol (P)	87865	19	15	13	7.9	1995	Freshwater aquatic life values for pentachlorophenol are expressed as a function of pH and values displayed in table correspond to a pH of 7.8.
Perfluorooctanoic Acid (PFOA)	45285-51-6; 335-67-1; 3825-26-1	3,100	100 in water; 1.18 mg/kg Wet Weight in Invertebrate Whole-Body Tissue; 6.49 mg/kg Wet Weight Fish Whole-Body Tissue; 0.133 mg/kg Wet Weight Fish Muscle Tissue	7000	—	2024	The chronic freshwater-based and chronic tissue-based criteria are independently applicable and no one criterion takes primacy. The value listed as the saltwater CMC represents a benchmark value, not a criterion. Data limitations precluded the development of a CCC in saltwater.
Perfluorooctane Sulfonate (PFOS)	45298-90-6; 1763-23-1; 2795-39-3; 56773-42-3; 4021-47-0; 29457-72-5	71	0.25 in water; 0.028 mg/kg Wet Weight in Invertebrate Whole-Body Tissue; 0.201 mg/kg Wet Weight in Fish Whole-Body Tissues; 0.087 mg/kg Wet Weight in Fish Muscle Tissue	550	—	2024	The chronic freshwater-based and chronic tissue-based criteria are independently applicable and no one criterion takes primacy. The value listed as the saltwater CMC represents a benchmark value, not a criterion. Data limitations precluded the development of a CCC in saltwater.

Pollutant (P = Priority Pollutant)	CAS Number	Freshwater CMC ¹ (acute) (µg/L)	Freshwater CCC ² (chronic) (µg/L)	Saltwater CMC ¹ (acute) (µg/L)	Saltwater CCC ² (chronic) (µg/L)	Publication Year	Notes
pH	—	—	6.5 - 9	—	6.5 - 8.5	1986	Refer to Quality Criteria for Water, 1986 ("Gold Book") for narrative statement. For open ocean waters where the depth is substantially greater than the euphotic zone, the pH should not be changed more than 0.2 units from the naturally occurring variation or any case outside the range of 6.5 to 8.5. For shallow, highly productive coastal and estuarine areas where naturally occurring pH variations approach the lethal limits of some species, changes in pH should be avoided but in any case should not exceed the limits established for fresh water, i.e., 6.5-9.0.
Phosphorus Elemental	7723140	—	—	—	—	1986	
Polychlorinated Biphenyls (PCBs) (P)	—	—	0.014	—	0.03	—	This criterion applies to total PCBs, (e.g., the sum of all congener or all isomer or homolog or Aroclor analyses.)
Selenium (P)	7782492	—	---	290	71	2016 Freshwater 1999 Saltwater	Refer to Aquatic Life Ambient Water Quality Criterion for Selenium - Freshwater 2016 for narrative statement.
Silver (P)	7440224	3.2	—	1.9	—	1980	If evaluation is to be done using an averaging period, the acute criteria values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.
Solids Suspended and Turbidity	—	—	—	—	—	1986	Refer to Quality Criteria for Water, 1986 ("Gold Book") for narrative statement.
Sulfide-Hydrogen Sulfide	7783064	—	2.0	—	2.0	1986	
Tainting Substances	—	—	—	—	—	1986	Refer to Quality Criteria for Water, 1986 ("Gold Book") for narrative statement.
Temperature	—	—	—	—	—	1986	Criteria is species dependent. Refer to Quality Criteria for Water, 1986 ("Gold Book").
Toxaphene (P)	8001352	0.73	0.0002	0.21	0.0002	1986	
Tributyltin (TBT)	—	0.46	0.072	0.42	0.0074	2004	
Zinc (P)	7440666	120	120	90	81	1995	Freshwater and saltwater criteria for metals are expressed in terms of the dissolved metal in the water column. Refer to Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria. The freshwater criterion for this metal is expressed as a function of hardness (mg/L). The value given here corresponds to a hardness of 100 mg/L.
4,4'-DDT (P)	50293	1.1	0.001	0.13	0.001	1980	

***** It is important to note that the mercury aquatic life criterion includes a caution that it might not be adequately protective of such important fishes as the rainbow trout, coho salmon and bluegill. The criterion was derived from data for inorganic mercury (II), but is applied to total mercury and may be under-protective if a substantial portion of the mercury in the water column is methylmercury.

Also, even though inorganic mercury is converted to methylmercury and methylmercury bioaccumulates to a great extent, this criterion does not account for uptake via the food chain because sufficient data were not available when the criterion was derived. In light of these issues, EPA is working on an update to the mercury criterion.

Appendix A

Conversion Factors for Dissolved Metals

Metal	Freshwater CMC	Freshwater CCC	Saltwater CMC	Saltwater CCC
Arsenic	1.000	1.000	1.000	1.000
Cadmium	$1.136672 - [(\ln \text{ hardness})(0.041838)]$	$1.101672 - [(\ln \text{ hardness})(0.041838)]$	0.994	0.994
Chromium III	0.316	0.860	—	—
Chromium VI	0.982	0.962	0.993	0.993
Copper	0.960	0.960	0.83	0.83
Lead	$1.46203 - [(\ln \text{ hardness})(0.145712)]$	$1.46203 - [(\ln \text{ hardness})(0.145712)]$	0.951	0.951
Mercury	0.85	0.85	0.85	0.85
Nickel	0.998	0.997	0.990	0.990
Selenium	—	—	0.998	0.998
Silver	0.85	—	0.85	—
Zinc	0.978	0.986	0.946	0.946

Appendix B

Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent

Chemical	mA	bA	mC	bC	Freshwater Conversion Factors (CF): CMC	Freshwater Conversion Factors (CF): CCC
Cadmium ³	0.9789	-3.866	—	—	$1.136672 - [(\ln \text{ hardness})(0.041838)]$	—
Chromium III	0.8190	3.7256	0.8190	0.6848	0.316	0.860
Lead	1.273	-1.460	1.273	-4.705	$1.46203 - [(\ln \text{ hardness})(0.145712)]$	$1.46203 - [(\ln \text{ hardness})(0.145712)]$

Chemical	mA	bA	mC	bC	Freshwater Conversion Factors (CF): CMC	Freshwater Conversion Factors (CF): CCC
Nickel	0.8460	2.255	0.8460	0.0584	0.998	0.997
Silver	1.72	-6.59	—	—	0.85	—
Zinc	0.8473	0.884	0.8473	0.884	0.978	0.986

Hardness-dependent metals' criteria may be calculated from the following:

CMC (dissolved) = $\exp\{mA [\ln(\text{hardness})] + bA\}$ (CF)

CCC (dissolved) = $\exp\{mC [\ln(\text{hardness})] + bC\}$ (CF)

1/ CMC: Criterion Maximum Concentration

2/ CCC: Criterion Continuous Concentration

3/ On August 18, 2023, the U.S. District Court for the District of Arizona issued an order vacating EPA's 2016 national recommended chronic freshwater cadmium aquatic life criterion. EPA is continuing to evaluate the Order. But as a result of that Order, the current national recommended chronic freshwater cadmium aquatic life criterion can be found in EPA's 2001 Update of Ambient Water Quality Criteria for Cadmium.

Groundwater and aquifers (USGS)

Aquifers and Groundwater

A huge amount of water exists in the ground below your feet, and people all over the world make great use of it. But it is only found in usable quantities in certain places underground — aquifers. Read on to understand the concepts of aquifers and how water exists in the ground.⁹

Groundwater and aquifers

Groundwater is one of our most valuable resources—even though you probably never see it or even realize it is there.

Have you ever dug a hole at the beach and watched as it partially filled with water from the underlying sand? This is a great way to illustrate the concept of how the ground, if it is permeable enough, can hold water but still stay solid. The upper surface of this water-filled area, or "zone of saturation", is called the water table.

The saturated area beneath the water table is called an aquifer, and aquifers are huge storehouses of water. In our sand hole example, you have essentially dug a "well" that exposes the water table, with an aquifer beneath it. At the beach, the level of the water table is always at the same level as the ocean, which is just below the surface of the beach.

As you may have read, most of the void spaces in the rocks below the water table are filled with water. These rocks have different porosity and permeability characteristics, which means that water does not move around the same way in all rocks below ground.

When a water-bearing rock readily transmits water to wells and springs, it is called an aquifer. Wells can be drilled into the aquifers and water can be pumped out. Precipitation eventually adds water (recharge) into the porous rock of the aquifer. The rate of recharge is not the same for all aquifers, though, and that must be considered when pumping water from a well.

Pumping too much water too fast draws down the water in the aquifer and eventually causes a well to yield less and less water and even run dry. In fact, pumping your well too much can even cause your neighbor's well to run dry if you both are pumping from the same aquifer.

Visualizing groundwater

In the diagram below, you can see how the ground below the water table (the blue area) is saturated with water. The "unsaturated zone" above the water table (the gray area) still contains water (after all, plants' roots live in this area), but it is not totally saturated with water. You can see this in the two drawings at the bottom of the diagram, which show a close-up of how water is stored in between underground rock particles.

On the average, the porosity and permeability of rocks decrease as their depth below land surface increases. The pores and cracks in rocks at great depths are closed or greatly reduced in size because of the weight of overlying rocks and formation of cement between the grains. However a relationship does not always exist between the water-bearing capacity of rocks and the depth at which they are found.

⁹ Source: U.S. Geological Survey, "Aquifers and Groundwater", <https://www.usgs.gov/water-science-school/science/aquifers-and-groundwater>, September 17, 2026.

A very dense granite that will yield little or no water to a well may be exposed at the land surface. Conversely, a porous sandstone may lie hundreds or thousands of feet below the land surface and may yield hundreds of gallons per minute of water. Rocks that yield freshwater have been found at depths of more than 6,000 feet, and salty water has come from oil wells at depths that range from a few hundred feet to 30,000 feet.

Pumping can affect the level of the water table

Groundwater occurs in the saturated soil and rock below the water table. If the aquifer is shallow enough and permeable enough to allow water to move through it at a rapid-enough rate, then people can drill wells into it and withdraw water. The level of the water table can naturally change over time due to changes in weather cycles and precipitation patterns, streamflow and geologic changes, and even human-induced changes, such as the increase in impervious surfaces on the landscape.

The pumping of wells can have a great deal of influence on water levels below ground, especially in the vicinity of the well, as this diagram shows. Near a pumping well there is "cone of depression". This pressure differential causes water to flow to the well. If water is withdrawn from the ground at a faster rate that it is replenished, either by infiltration from the surface or from streams, then the water table can become lower.

Depending on geologic and hydrologic conditions of the aquifer, the impact on the level of the water table can be short-lived or last for decades, and it can fall a small amount or many hundreds of feet. Excessive pumping can lower the water table so much that the wells no longer supply water—they can "go dry."

Water movement in aquifers

After entering an aquifer, water moves slowly toward lower lying places and eventually is discharged from the aquifer from springs, seeps into streams, or is withdrawn from the ground by wells.

Groundwater in aquifers between layers of poorly permeable rock, such as clay or shale, may be confined under pressure. This is an example of a confined aquifer. In this case, the rocks surrounding the aquifer confine the pressure in the porous rock and its water. If a well is drilled into this "pressurized" aquifer, the internal pressure might be enough to push the water up the well and sometimes completely out of the well without the aid of a pump.

Water confined in this way is said to be under artesian pressure, and the aquifer is called an artesian aquifer. Wells tapping these aquifers are called artesian. The flow of water from an artesian well can be quite dramatic.

Visualizing artesian pressure

Here's a little experiment to show you how artesian pressure works. Fill a plastic sandwich baggie with water, put a straw in through the opening, tape the opening around the straw closed, point the straw upward (but don't point the straw towards your teacher or parents or friends or computer!) and then squeeze the baggie. Artesian water is pushed out through the straw.

Groundwater Use in the United States

Groundwater is one of our most valuable resource—even though you probably never see it or even realize it is there. Groundwater is essential for irrigation and human use in many parts of the country. The use of groundwater in the United States in 2015 is described below.¹⁰

Groundwater serves many purposes

Fresh groundwater was used for many important purposes, with the largest amount going toward irrigating crops, such as the delicious eggplants, squash, and rutabagas that children love to have for dinner. Local city and county water departments withdraw a lot of groundwater for public uses, such as for delivery to homes, businesses, and industries, as well as for community uses such as fire fighting, water services at public buildings, and for keeping local residents happy by keeping community swimming pools full of water.

Industries and mining facilities also used a lot of groundwater. The majority of water used for self-supplied domestic (people who supply their own home water, usually by a well) and livestock purposes came from groundwater sources.

This diagram uses a "cylinder and pipe" layout to show the source (surface water or groundwater) of the Nation's freshwater and for what purposes the water was used in 2015. The data are broken out for each category of use by surface water and groundwater as the source.

Data are rounded and are reported in million gallons per day (Mgal/d).

The top row of cylinders represents where America's freshwater came from (source) in 2015, either from surface water (blue) or from groundwater (brown). You can see most of the water we use came from surface-water sources, such as rivers and lakes. About 26 percent of water used came from groundwater. The pipes leading out of the surface-water and groundwater cylinders on the top row and flowing into the bottom rows of cylinders (green) show the categories of water use where the water was sent after being withdrawn from a river, lake, reservoir, or well.

For example, the blue pipe coming out of the surface-water cylinder and entering the public supply cylinder shows that 23,800 Mgal/d of water was withdrawn from surface-water sources for public-supply uses (you probably get your water this way). Likewise, the brown pipe shows that public-suppliers withdrew another 15,200 Mgal/d of water from groundwater sources.

Each green cylinder represents a category of water use. The industrial cylinder, for instance, shows how much groundwater, surface water, and total water was used in the United States, each day, by industries.

You can see that although the Nation uses much more surface water than groundwater, groundwater has significant importance for some of the categories. Almost all self-supplied domestic water came from groundwater; over 40 percent of irrigation water was groundwater; and more groundwater than surface water was used for livestock purposes.

¹⁰ Source: U.S. Geological Survey, "Groundwater Use in the United States", <https://www.usgs.gov/water-science-school/science/groundwater-use-united-states>, June 18, 2018.

Groundwater withdrawals, by State, 2015

Of the total fresh groundwater withdrawals nationwide (82,300 Mgal/d), irrigation accounted for 70 percent, primarily in California, Arkansas, Nebraska, Idaho, and Texas. Fresh groundwater irrigation withdrawals in these five States cumulatively accounted for 46 percent of the total fresh groundwater withdrawals for all categories nationwide. Nearly all groundwater withdrawals (97 percent) were from freshwater, predominantly used for irrigation.

Saline groundwater withdrawals were predominantly used for mining (80 percent) and occurred in Texas, California, and Oklahoma. Irrigation used greater than three times more fresh groundwater than public supply, which was the next largest use of fresh groundwater in the Nation.

Groundwater withdrawals for the United States, 1950-2015.

Data are in billion gallons per day (Bgal/d).

Year	Fresh	Saline
1950	34	(c)
1955	47	0.6
1960	50	0.4
1965	60	0.5
1970	68	1
1975	82	1
1980	83	0.93
1985	73.4	0.66
1990	79.4	1.30 ^a
1995	76.4 ^a	1.11
2000	84.3 ^a	2.47 ^a
2005	78.9	1.51
2010	75.9 ^a	2.22 ^a
2015	82.3	2.34

^a Data revised from Maupin and others (2014) because of revisions to individual State data during interim years

(c) Data not available

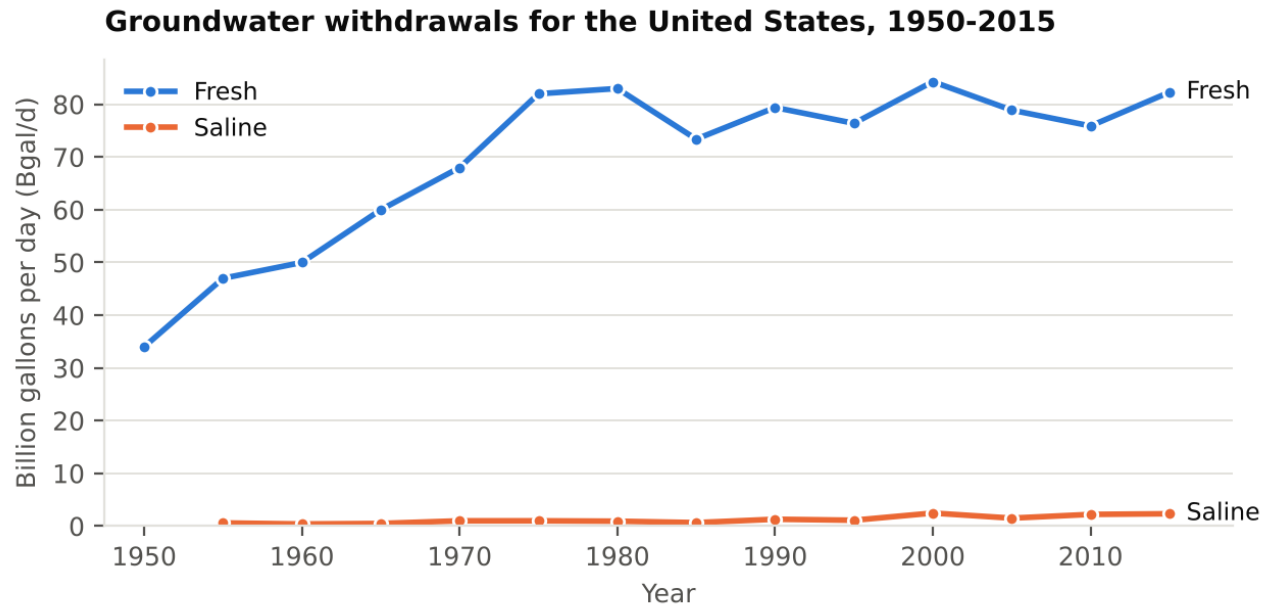


Figure 1. Groundwater withdrawals for the United States, 1950-2015. Data are in billion gallons per day (Bgal/d). Chart drawn from the table above. Source: U.S. Geological Survey, *Groundwater Use in the United States*.

Groundwater Decline and Depletion

Groundwater is a valuable resource both in the United States and throughout the world. Groundwater depletion, a term often defined as long-term water-level declines caused by sustained groundwater pumping, is a key issue associated with groundwater use. Many areas of the United States are experiencing groundwater depletion.¹¹

Groundwater Decline and Depletion

Groundwater is a valuable resource both in the United States and throughout the world. Where surface water, such as lakes and rivers, are scarce or inaccessible, groundwater supplies many of the hydrologic needs of people everywhere. In the United States, it is the source of drinking water for about half the total population and nearly all of the rural population, and it provides over 50 billion gallons per day for agricultural needs. Groundwater depletion, a term often defined as long-term water-level declines caused by sustained groundwater pumping, is a key issue associated with groundwater use. Many areas of the United States are experiencing groundwater depletion.

Excessive pumping can overdraw the groundwater "bank account"

The water stored in the ground can be compared to money kept in a bank account. If you withdraw money at a faster rate than you deposit new money you will eventually start having account-supply problems. Pumping water out of the ground faster than it is replenished over the long-term causes similar problems. The volume of groundwater in storage is decreasing in many areas of the United States in response to pumping. Groundwater depletion is primarily caused by sustained groundwater pumping. Some of the negative effects of groundwater depletion:

¹¹ Source: U.S. Geological Survey, "Groundwater Decline and Depletion", <https://www.usgs.gov/water-science-school/science/groundwater-decline-and-depletion>, September 17, 2026.

- drying up of wells
- reduction of water in streams and lakes
- deterioration of water quality
- increased pumping costs
- land subsidence

What are some effects of groundwater depletion?

Pumping groundwater at a faster rate than it can be recharged can have some negative effects of the environment and the people who make use of the water:

LOWERING OF THE WATER TABLE

Pumping has removed water from storage in basalt aquifers and caused declines in many areas of the Columbia Plateau.

The most severe consequence of excessive groundwater pumping is that the water table, below which the ground is saturated with water, can be lowered. For water to be withdrawn from the ground, water must be pumped from a well that reaches below the water table. If groundwater levels decline too far, then the well owner might have to deepen the well, drill a new well, or, at least, attempt to lower the pump. Also, as water levels decline, the rate of water the well can yield may decline.

REDUCTION OF WATER IN STREAMS AND LAKES

There greater interaction between the water in lakes and rivers and groundwater than most people think. Some, and often a great deal, of the water flowing in rivers comes from seepage of groundwater into the streambed. Groundwater contributes to streams in most physiographic and climatic settings. The proportion of stream water that comes from groundwater inflow varies seasonally and according to a region's geography, geology, and climate.

Groundwater pumping can alter how water moves between an aquifer and a stream, lake, or wetland by either intercepting groundwater flow that discharges into the surface-water body under natural conditions, or by increasing the rate of water movement from the surface-water body into an aquifer. A related effect of groundwater pumping is the lowering of groundwater levels below the depth that streamside or wetland vegetation needs to survive. The overall effect is a loss of riparian vegetation and wildlife habitat.

LAND SUBSIDENCE

The basic cause of land subsidence is a loss of support below ground. In other words, sometimes when water is taken out of the soil, the soil collapses, compacts, and drops. This depends on several factors, such as the type of soil and rock below the surface. Land subsidence is most often caused by human activities, mainly from the removal of subsurface water.

INCREASED COSTS FOR THE USER

As the depth to water increases, the water must be lifted higher to reach the land surface. If pumps are used to lift the water (as opposed to artesian wells), more energy is required to drive the pump. Using the well can become prohibitively expensive.

Where does groundwater depletion occur in the United States?

Groundwater depletion has been a concern in the Southwest and High Plains for many years, but increased demands on our groundwater resources have overstressed aquifers in many areas of the Nation, not just in arid regions. In addition, groundwater depletion occurs at scales ranging from a single well to aquifer systems underlying several states. The extents of the resulting effects depend on several factors including pumpage and natural discharge rates, physical properties of the aquifer, and natural and human-induced recharge rates. Some examples are given below.

ATLANTIC COASTAL PLAIN - In Nassau and Suffolk Counties, Long Island, New York, pumping water for domestic supply has lowered the water table, reduced or eliminated the base flow of streams, and has caused saline groundwater to move inland.

Many other locations on the Atlantic coast are experiencing similar effects related to groundwater depletion. Surface-water flows have been reduced due to groundwater development in the Ipswich River basin, Massachusetts. Saltwater intrusion is occurring in coastal counties in New Jersey; Hilton Head Island, South Carolina; Brunswick and Savannah, Georgia; and Jacksonville and Miami, Florida (Barlow).

The chart below shows monthly-mean water levels from 1964 to 2003 for a well in Cook County, southwest Georgia. The well is used for irrigation and public-supply purposes and offers a good visual representation of long-term groundwater declines due to excessive pumping. Periods of drought also have an effect on groundwater levels, as replenishing water infiltrating into the aquifer is reduced.

WEST-CENTRAL FLORIDA - Groundwater development in the Tampa-St. Petersburg area has led to saltwater intrusion and subsidence in the form of sinkhole development and concern about surface-water depletion from lakes in the area. To reduce its dependence on groundwater, Tampa has constructed a desalination plant to treat seawater for municipal supply.

GULF COASTAL PLAIN - Several areas in the Gulf Coastal Plain are experiencing effects related to groundwater depletion:

- Groundwater pumping by Baton Rouge, Louisiana, increased more than tenfold between the 1930s and 1970, resulting in groundwater-level declines of approximately 200 feet.
- In the Houston, Texas, area, extensive groundwater pumping to support economic and population growth has caused water-level declines of approximately 400 feet, resulting in extensive land-surface subsidence of up to 10 feet.
- Continued pumping since the 1920s by many industrial and municipal users from the underlying Sparta aquifer have caused significant water-level declines in Arkansas, Louisiana, Mississippi, and Tennessee.
- The Memphis, Tennessee area is one of the largest metropolitan areas in the world that relies exclusively on groundwater for municipal supply. Large withdrawals have caused regional water-level declines of up to 70 feet.

HIGH PLAINS - The High Plains aquifer (which includes the Ogallala aquifer) underlies parts of eight States and has been intensively developed for irrigation. Since predevelopment, water

levels have declined more than 100 feet in some areas and the saturated thickness has been reduced by more than half in others.

PACIFIC NORTHWEST - Groundwater development of the Columbia River Basalt aquifer of Washington and Oregon for irrigation, public-supply, and industrial uses has caused water-level declines of more than 100 feet in several areas.

DESERT SOUTHWEST - Increased groundwater pumping to support population growth in south-central Arizona (including the Tucson and Phoenix areas) has resulted in water-level declines of between 300 and 500 feet in much of the area. Land subsidence was first noticed in the 1940s and subsequently as much as 12.5 feet of subsidence has been measured. Additionally, lowering of the water table has resulted in the loss of streamside vegetation.

These pictures show a reach of the Santa Cruz River south of Tucson, Arizona. In the 1942 picture vegetation is growing in the riparian (riverbank) area the river, indicating that sufficient water in the soil existed at a level that plant roots could access it. The same site in 1989 shows that the riparian trees have largely disappeared because of lowered groundwater levels.

Perennial streams, springs, and wetlands in the Southwestern United States are highly valued as a source of water for humans and for the plant and animal species they support. Development of groundwater resources since the late 1800's has resulted in the elimination or alteration of many perennial stream reaches, wetlands, and associated riparian ecosystems.

As an example, a 1942 photograph of a reach of the Santa Cruz River south of Tucson, Ariz., at Martinez Hill shows stands of mesquite and cottonwood trees along the river (left photograph). A replicate photograph of the same site in 1989 shows that the riparian trees have largely disappeared (right photograph). Data from two nearby wells indicate that the water table has declined more than 100 feet due to pumping, and this pumping appears to be the principal reason for the decrease in vegetation.

CHICAGO-MILWAUKEE AREA - Chicago has been using groundwater since at least 1864 and groundwater has been the sole source of drinking water for about 8.2 million people in the Great Lakes watershed. This long-term pumping has lowered groundwater levels by as much as 900 feet.

This map shows contours of water-level declines, in feet, in the Chicago-Milwaukee area from 1864 to 1980.

Source: Alley, William & Reilly, T.E. & Franke, O.L. (1999). Sustainability of Ground-Water Resources. U.S. Geological Survey Circular 1186.

Sources and more information:

- Ground-Water Depletion Across the Nation, USGS Fact Sheet 103-03
- Sustainability of Ground-Water Resources, USGS Circular 1186

Sources

1. U.S. Environmental Protection Agency, "Air Quality Index (AQI) Basics"
<https://www.airnow.gov/aqi/aqi-basics>

2. U.S. Environmental Protection Agency, "Ground-level Ozone Basics", last updated February 18, 2026
<https://www.epa.gov/ground-level-ozone-pollution/ground-level-ozone-basics>
3. U.S. Environmental Protection Agency, "Research on Health Effects from Air Pollution", last updated May 21, 2026
<https://www.epa.gov/air-research/research-health-effects-air-pollution>
4. U.S. Environmental Protection Agency, "Health and Environmental Effects of Particulate Matter (PM)"
<https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm>
5. U.S. Environmental Protection Agency, "Summary of the Clean Water Act", last updated February 23, 2026
<https://www.epa.gov/laws-regulations/summary-clean-water-act>
6. U.S. Environmental Protection Agency, "History of the Clean Water Act", last updated February 23, 2026
<https://www.epa.gov/laws-regulations/history-clean-water-act>
7. U.S. Environmental Protection Agency, "Designated Uses", last updated April 6, 2026
<https://www.epa.gov/wqs-tech/designated-uses>
8. U.S. Environmental Protection Agency, "Clean Water Act (CWA) and Federal Facilities", last updated March 5, 2026
<https://www.epa.gov/enforcement/clean-water-act-cwa-and-federal-facilities>
9. U.S. Environmental Protection Agency, "National Recommended Water Quality Criteria - Aquatic Life Criteria Table", last updated June 9, 2026
<https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table>
10. U.S. Geological Survey, "Aquifers and Groundwater", September 17, 2026
<https://www.usgs.gov/water-science-school/science/aquifers-and-groundwater>
11. U.S. Geological Survey, "Groundwater Use in the United States", June 18, 2018
<https://www.usgs.gov/water-science-school/science/groundwater-use-united-states>
12. U.S. Geological Survey, "Groundwater Decline and Depletion", September 17, 2026
<https://www.usgs.gov/water-science-school/science/groundwater-decline-and-depletion>