Environmental Scientists and Hydrologists

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Significant Points

- Environmental scientists and hydrologists often work in offices, laboratories, and field sites.
- Federal, State, and local governments employ 43 percent of all environmental scientists and hydrologists.
- Although a bachelor's degree in an earth science is adequate for a few entry-level jobs, employers prefer a master's degree; a Ph.D. degree generally is required for research or college teaching positions.
- Job prospects are expected to be favorable, particularly for hydrologists.

Nature of the Work

Environmental scientists and hydrologists use their knowledge of the physical makeup and history of the Earth to protect the environment, study the properties of underground and surface waters, locate water and energy resources, predict water-related geologic hazards, and provide environmental site assessments and advice on indoor air quality and hazardous-waste-site remediation.

Environmental scientists conduct research to identify, abate, and eliminate hazards that affect people, wildlife, and their environments. These workers analyze measurements or observations of air, food, water, and soil to determine the way to clean and preserve the environment. Understanding the issues involved in protecting the environment—degradation, conservation, recycling, and replenishment—is central to the work of environmental scientists. They often use this understanding to design and monitor waste disposal sites, preserve water supplies, and reclaim contaminated land and water to comply with Federal environmental regulations. They also write risk assessments, describing the likely affect of construction and other environmental changes; write technical proposals; and give presentations to managers and regulators.

Hydrologists study the quantity, distribution, circulation, and physical properties of bodies of water. Often, they specialize in either underground water or surface water. They examine the form and intensity of precipitation, its rate of infiltration into the soil, its movement through the Earth, and its return to the ocean and atmosphere. Hydrologists use sophisticated techniques and instruments. For example, they may use remote sensing technology, data assimilation, and numerical modeling to monitor the change in regional and global water cycles. Some surface-water hydrologists use sensitive stream-measuring devices to assess flow rates and water quality.

Many environmental scientists and hydrologists work at consulting firms, helping businesses and government agencies comply with environmental policy, particularly with regard to ground-water decontamination and flood control. They are usually hired to solve problems. Most consulting firms fall into two categories: large multidisciplinary engineering companies, the largest of which may employ thousands of workers, and small niche firms that may employ only a few workers. When looking for jobs, environmental scientists and hydrologists should consider the type of firm and the scope of the projects it undertakes. In larger firms, environmental scientists are more likely to engage in large, long-term projects in which they will work with people in other scientific disciplines. In smaller specialty firms, however, they work more often with business professionals and clients in government and the private sector.

Environmental scientists who work on policy formation may help identify ways that human behavior can be modified in the future to avoid such problems as ground-water contamination and depletion of the ozone layer. Some environmental scientists work in managerial positions, usually after spending some time performing research or learning about environmental laws and regulations.

Many environmental scientists do work and have training that is similar to other physical or life scientists, but they focus on environmental issues. Many specialize in subfields such as environmental ecology and conservation, environmental chemistry, environmental biology, or fisheries science. Specialties affect the specific activities that environmental scientists perform, although recent understandings of the interconnectedness of life processes have blurred some traditional classifications. For example, *environmental ecologists* study the relationships between organisms and their environments and the effects of factors such as population size, pollutants, rainfall, temperature, and altitude, on both. They may collect, study, and report data on air, soil, and water using their knowledge of various scientific disciplines. *Ecological modelers* study ecosystems, pollution control, and resource management using mathematical modeling, systems analysis, thermodynamics, and computer techniques. *Environmental chemists* study the toxicity of various chemicals, that is, how those chemicals affect plants, animals, and people. (Information on geoscientists, who also study the Earth, is located elsewhere in the *Handbook*.)

Environmental scientists and hydrologists in research positions with the Federal Government or in colleges and universi-

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ties often have to find funding for their work by writing grant proposals. Consultants face similar pressures to market their skills and write proposals so that they will have steady work.

Work environment. Most entry-level environmental scientists and hydrologists spend the majority of their time in the field, while more experienced workers generally devote more time to office or laboratory work. Many beginning hydrologists and some environmental scientists, such as environmental ecologists and environmental chemists, often take field trips that involve physical activity. Environmental scientists and hydrologists in the field may work in warm or cold climates, in all kinds of weather. In their research, they may dig or chip with a hammer, scoop with a net, come in contact with water, and carry equipment. Travel often is required to meet with prospective clients or investors.

Researchers and consultants might face stress when looking for funding. Occasionally, those who write technical reports to business clients and regulators may be under pressure to meet deadlines and thus have to work long hours.

Training, Other Qualifications, and Advancement

Most environmental scientists and hydrologists need a master's degree. A Ph.D. is usually necessary for jobs in college teaching or research.

Education and training. A bachelor's degree in an earth science is adequate for a few entry-level positions, but environmental scientists increasingly need a master's degree in environmental science, hydrology, or a related natural science. A master's degree also is the minimum educational requirement for most entry-level applied research positions in private industry, in State and Federal agencies, and at State geological surveys. A doctoral degree generally is necessary for college teaching and most research positions.

Some environmental scientists have a degree in environmental science. Many, however, earn degrees in life science, chemistry, geology, geophysics, atmospheric science, or physics and then apply their education to the environment. They often need research or work experience related to environmental science.

A bachelor's degree in environmental science offers an interdisciplinary approach to the natural sciences, with an emphasis on biology, chemistry, and geology. Undergraduate environmental science majors typically focus on data analysis and physical geography, which are particularly useful in studying pollution abatement, water resources, or ecosystem protection, restoration, and management. Understanding the geochemistry of inorganic compounds is becoming increasingly important in developing remediation goals. Students interested in working in the environmental or regulatory fields, either in environmental consulting firms or for Federal or State governments, should take courses in hydrology, hazardous-waste management, environmental legislation, chemistry, fluid mechanics, and geologic logging, which is the gathering of geologic data. An understanding of environmental regulations and government permit issues also is valuable for those planning to work in mining and oil and gas extraction.

Students interested in hydrology should take courses in the physical sciences, geophysics, chemistry, engineering science, soil science, mathematics, aquatic biology, atmospheric science, geology, oceanography, hydrogeology, and the management or conservation of water resources. In some cases, a bachelor's degree in a hydrologic science is sufficient for positions consulting about water quality or wastewater treatment.

For environmental scientists and hydrologists who consult, courses in business, finance, marketing, or economics may be useful. In addition, combining environmental science training with other disciplines such as engineering or business, qualifies these scientists for the widest range of jobs.

Other qualifications. Computer skills are essential for prospective environmental scientists and hydrologists. Students who have some experience with computer modeling, data analysis and integration, digital mapping, remote sensing, and Geographic Information Systems (GIS) will be the most prepared to enter the job market. Familiarity with the Global Positioning System (GPS)—a locator system that uses satellites—is vital.

Environmental scientists and hydrologists must have good interpersonal skills, because they usually work as part of a team with other scientists, engineers, and technicians. Strong oral and written communication skills also are essential because writing technical reports and research proposals and communicating results to company managers, regulators, and the public are important aspects of the work. Because international work is becoming increasingly pervasive, knowledge of a second language can be an advantage. Those involved in fieldwork must have physical stamina.

Certification and advancement. Environmental scientists and hydrologists often begin their careers in field exploration or, occasionally, as research assistants or technicians in laboratories or offices. They are given more difficult assignments as they gain experience. Eventually, they may be promoted to project leader, program manager, or some other management and research position. (Information on engineering and natural science managers is located elsewhere in the *Handbook*.)

The American Institute of Hydrology offers certification programs in professional hydrology. Certification may be beneficial for those seeking advancement.

Employment

Environmental scientists and hydrologists held about 92,000 jobs in 2006. Jobs for hydrologists accounted for only 9 percent of the total. Many more individuals held environmental science faculty positions in colleges and universities, but they are classified as postsecondary teachers. (See the statement on teachers—postsecondary elsewhere in the *Handbook*.)

About 35 percent of environmental scientists were employed in State and local governments; 21 percent in management, scientific, and technical consulting services; 15 percent in architectural, engineering and related services; and 8 percent in the Federal Government. About 2 percent were self-employed.

Among hydrologists, 26 percent were employed in architectural, engineering, and related services, and 18 percent worked for management, scientific, and technical consulting services. In 2006, the Federal Government employed about 28 percent of hydrologists, mostly within the U.S. Department of the Interior for the U.S. Geological Survey (USGS) and within the U.S. Department of Defense. Another 21 percent worked for State agencies, such as State geological surveys and State departments of conservation. About 2 percent of hydrologists were self-employed, most as consultants to industry or government.

Job Outlook

Employment of environmental scientists and hydrologists is expected to grow much faster than the average for all occupations. Job prospects are expected to be favorable, particularly for hydrologists.

Employment change. Employment of environmental scientists is expected to increase by 25 percent between 2006 and 2016, much faster than the average for all occupations. Over the same period, employment of hydrologists should increase by 24 percent, also much faster than the average. Job growth for environmental scientists and hydrologists should be strongest in private-sector consulting firms. Growth in employment of environmental scientists and hydrologists will be spurred largely by the increasing demands placed on the environment and water resources by population growth. Further demand should result from the need to comply with complex environmental laws and regulations, particularly those regarding ground-water decontamination, clean air, and flood control.

Much job growth will result from a continued need to monitor the quality of the environment, to interpret the impact of human actions on terrestrial and aquatic ecosystems, and to develop strategies for restoring ecosystems. In addition, environmental scientists will be needed to help planners develop and construct buildings, transportation corridors, and utilities that protect water resources and reflect efficient and beneficial land use.

Demand for hydrologists should also be strong as the population increases and moves to more environmentally sensitive locations. As people increasingly migrate toward coastal regions, for example, hydrologists will be needed to assess building sites for potential geologic hazards and to mitigate the effects of natural hazards such as floods, landslides, and hurricanes. Hydrologists also will be needed to study hazardous-waste sites and determine the effect of pollutants on soil and ground water so that engineers can design remediation systems. Increased government regulations, such as those regarding the management of storm water, and issues related to water conservation, deteriorating coastal environments, and rising sea levels also will stimulate employment growth for these workers.

Many environmental scientists and hydrologists work in consulting. Consulting firms have hired these scientists to help businesses and government address issues related to underground tanks, land disposal areas, and other hazardous-waste-management facilities. Currently, environmental consulting is evolving from investigations to creating remediation and engineering solutions. At the same time, the regulatory climate is moving from a rigid structure to a more flexible risk-based approach. These factors, coupled with new Federal and State initiatives that integrate environmental activities into the business process itself, will result in a greater focus on waste minimization, resource recovery, pollution prevention, and the consideration of environmental effects during product development. This shift in focus to preventive management will provide many new opportunities for environmental scientists and hydrologists in consulting roles.

Job prospects. In addition to job openings due to growth, there will be additional demand for new environmental scientists and hydrologists to replace those who retire, advance to management positions, or change careers. Job prospects for hydrologists should be favorable, particularly for those with field experience. Demand for hydrologists who understand both the scientific and engineering aspects of waste remediation should be strong. Few colleges and universities offer programs in hydrology, so the number of qualified workers may be limited.

Job prospects for environmental scientists also will be good, but less favorable than for hydrologists because of the larger number of workers seeking to enter the field.

Funding for Federal and State geological surveys depend largely on the political climate and the current budget. Thus, job security for environmental scientists and hydrologists may vary. During periods of economic recession, layoffs of environmental scientists and hydrologists may occur in consulting firms; layoffs are much less likely in government.

Earnings

Median annual earnings of environmental scientists were $56,100 in May 2006. The middle 50 percent earned between $42,840 and $74,480. The lowest 10 percent earned less than $34,590, and the highest 10 percent earned more than $94,670.

Median annual earnings of hydrologists were $66,260 in 2006, with the middle 50 percent earning between $51,370 and $82,140, the lowest 10 percent earning less than $42,080, and the highest 10 percent earning more than $98,320.

Median annual earnings in the industries employing the largest number of environmental scientists in 2006 were as follows:

Federal executive branch	$82,490
Management, scientific, and technical consulting services	57,280
Engineering services	56,080
Local government	52,100
State government	50,590

According to the National Association of Colleges and Employers, beginning salary offers in July 2007 for graduates with bachelor's degrees in an environmental science averaged $38,336 a year.

Projections data from the National Employment Matrix

Occupational Title	SOC Code	Employment, 2006	Projected employment, 2016	Change, 2006-2016	
				Number	Percent
Environmental scientists and hydrologists	—	92,000	114,000	23,000	25
Environmental scientists and specialists, including health	19-2041	83,000	104,000	21,000	25
Hydrologists	19-2043	8,300	10,000	2,000	24

NOTE: Data in this table are rounded. See the discussion of the employment projections table in the *Handbook* introductory chapter on *Occupational Information Included in the Handbook*.

In 2007, the Federal Government's average salary for hydrologists was $82,217.

Related Occupations

Environmental scientists and hydrologists perform investigations for the purpose of abating or eliminating pollutants or hazards that affect the environment or plants, animals, and humans. Many other occupations deal with preserving or researching the natural environment, including conservation scientists and foresters, atmospheric scientists, and some biological scientists, science technicians, and engineering technicians. Environmental scientists and hydrologists have extensive training in physical sciences, and many apply their knowledge of chemistry, physics, biology, and mathematics to the study of the Earth, work closely related to that of geoscientists.

Using problem-solving skills, physicists; chemists; engineers; mathematicians; surveyors, cartographers, photogrammetrists, and surveying technicians; computer systems analysts; and computer scientists and database administrators may also perform similar work related to the environment.

Sources of Additional Information

Information on training and career opportunities for environmental scientists is available from:

➤ American Geological Institute, 4220 King St., Alexandria, VA 22302. Internet: **http://www.agiweb.org**

For information on careers in hydrology, contact:

➤ American Institute of Hydrology, 300 Village Green Circle, Suite #201, Smyrna, GA 30080.
Internet: **http://www.aihydro.org**

Information on obtaining a position as a hydrologist or an environmental protection specialist with the Federal Government is available from the Office of Personnel Management through USAJOBS, the Federal Government's official employment information system. This resource for locating and applying for job opportunities can be accessed through the Internet at **http://www.usajobs.opm.gov** or through an interactive voice response telephone system at (703) 724-1850 or TDD (978) 461-8404. These numbers are not toll free, and charges may result.