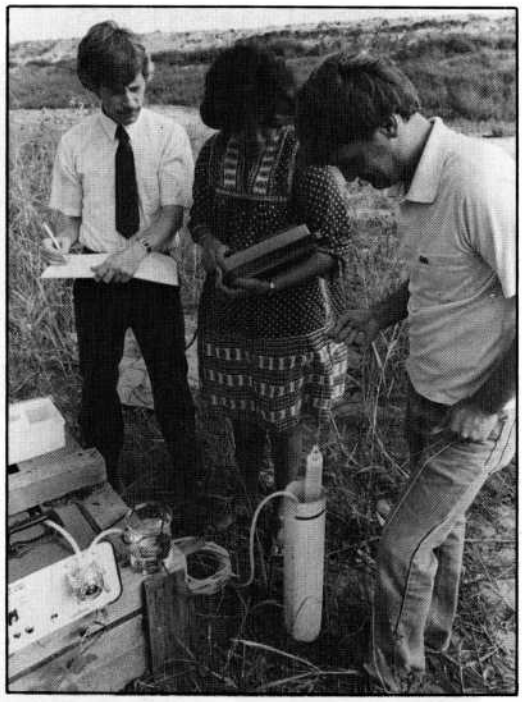


Research is being conducted at the landfill by the Environmental/Ground Water Institute.

Ground Water
A Matter of Survival

Environmental engineers are taking the lead in studies to combat depletion and pollution of our most precious buried treasure.

By CATHERINE BISHOP

Beneath the High Plains of Nebraska through Kansas to Colorado and the Panhandle regions of Oklahoma and Texas lies a body of water which, since the 1930s, has turned the flat, barren land into an agricultural belt supporting 20 percent of all the food production in the United States — and has provided drinking water for residents of those areas as well.

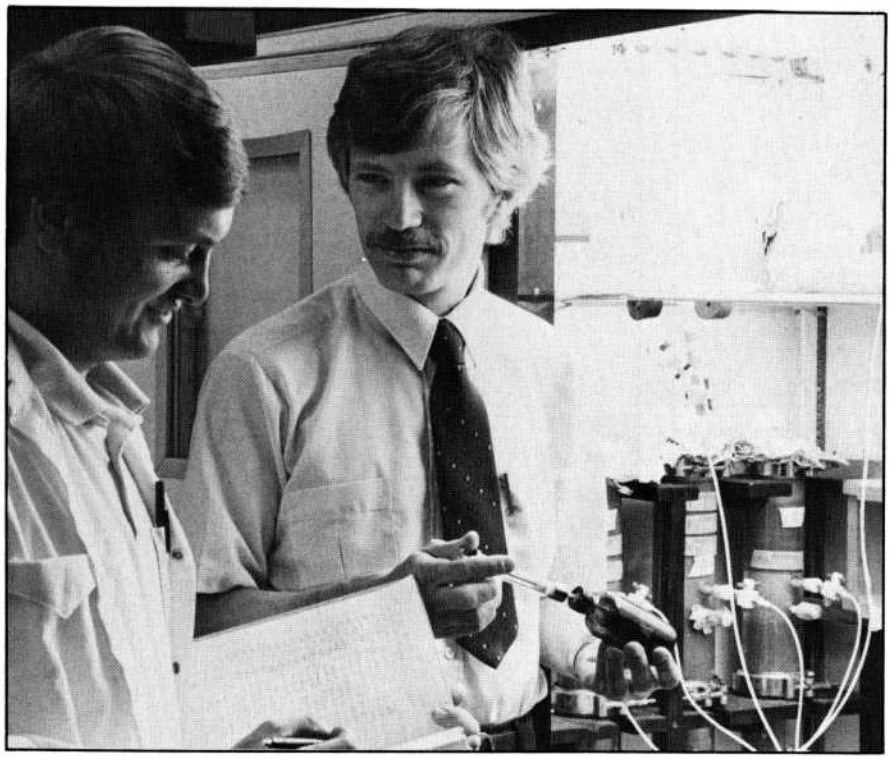
Today, this underground zone of water — known as the Ogallala aquifer — is imperiled by overuse and the looming specter of pollution.

The threat to the Ogallala is not an isolated problem. Food, energy and the economic health of the entire country and of much of the world is endangered by depletion and pollution of this most abundant known source of fresh water — ground water.

How serious is the dependence of the U.S. economy on the water that rests below the earth's surface? An estimated 50 percent of the population is directly dependent on ground water as a source of drinking water, while agricultural irrigation consumes more than 70 percent of all the ground water used. Little wonder that many scientists and technologists perceive ground water to be the most vital environmental issue of the 1980s. Many of them also believe that anxiety over ground water management and related concerns will heighten and possibly reach crisis proportions within the next 20 years.

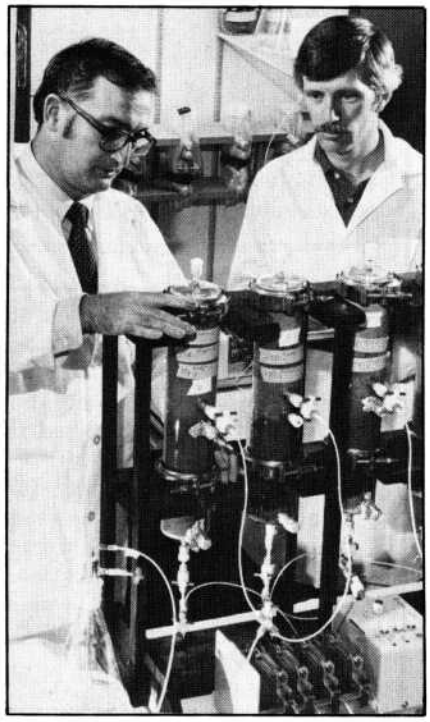
To address the problem, a dedicated team of teachers and researchers at the University of Oklahoma is training engineers, geologists, and other scientists to work in this field, and is conducting research that may find answers to many of the critical questions surrounding ground water management, protection and utilization.

The Environmental and Ground Water Institute was formed at the University of Oklahoma in July 1982, under the direction of Larry Canter, an OU professor of civil engineering and environmental science who has attained national and international



Graduate assistant George Deeley (left) and assistant professor Gary Miller check the movement of pollutants through soil samples in the environmental chamber.

Environmental impact and ground water research projects already being conducted will tie in with the programs of OU's new Energy Center.



Larry Canter (left) and Miller prepare new soil samples for the chamber.

stature as a specialist in environmental engineering, ground water and environmental impact assessment. The team which he has assembled is well-suited to the task and includes a biologist/chemist, Gary Miller; an environmental engineer, Robert Knox; a soil microbiologist, Deborah Fairchild; a chemist, Rita Kamat; and a technical writer/editor, Ralph Martin.

Also involved in the effort are the personnel and resources of OU's Science and Public Policy program, directed by Michael Devine, and the Oklahoma Geological Survey, through its associate director, Kenneth S. Johnson.

The new OU institute, the first organized research unit to be formed by the College of Engineering, includes the U.S. Environmental Protection Agency's National Center for Ground Water Research, which has been located at OU since 1979 and also is directed by Canter. The environmental impact and ground water research projects already being conducted by the Institute will tie in with the programs of OU's new Energy Center.

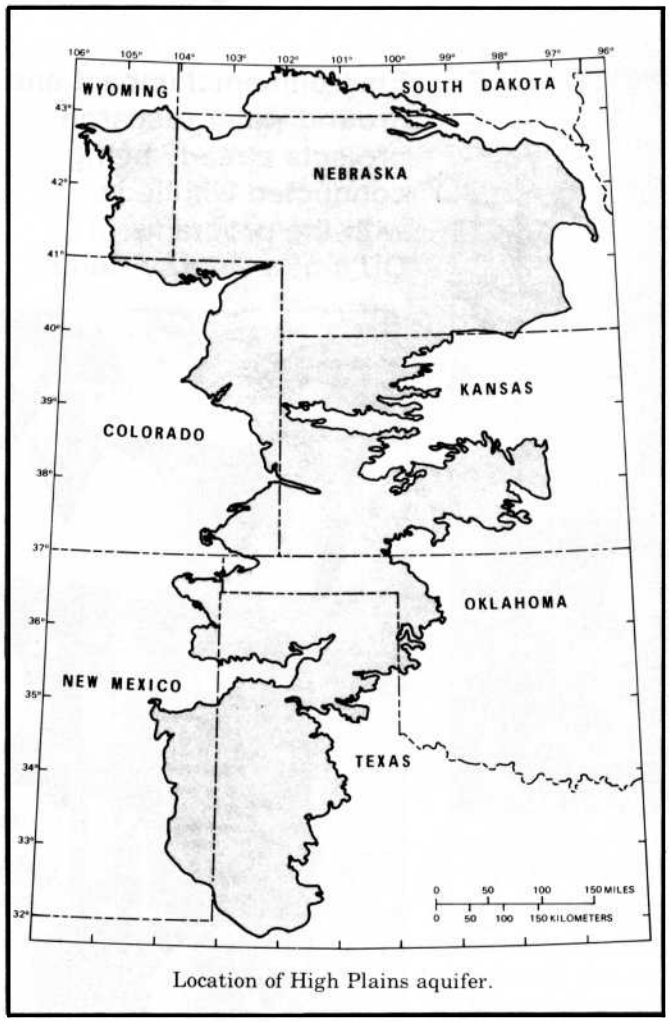
Many ground water issues involved in Institute research impact directly on energy industries, and a partnership between the University and private enterprise is being formed to address this environmental concern. Sun Company of Radnar, Pennsylvania, is in the process of endowing a professorship in ground water hydrology at OU. Sun's endowment will enrich both the teaching and research activities of the School of Civil Engineering and Environmental Science, which has had ground water/environmental impact studies under way since 1970.

Concern about the quantity and quality of ground water is not unique to Oklahoma, the Southwest or the United States. In most industrialized nations, including the United States, interest is focused largely on appropriate management of this vital resource, while developing countries have concentrated on provision of water supplies. However, Canter believes that even in less developed societies, pollution is commanding increasing attention worldwide.

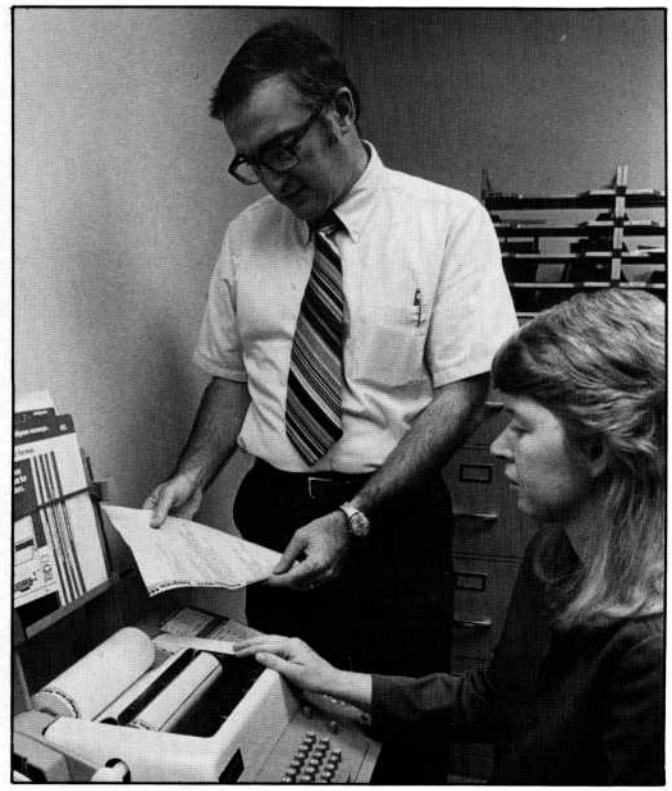
Ground water problems fall generally into two main categories, natural and man-made pollution and resource extraction. Resource extraction, in turn, can lead to salt or saline water intrusion, land subsidence, and ground water mining or depletion, resulting from the withdrawal of water from an aquifer at a rate greater than its natural rate of replenishment.

The Ogallala aquifer, which supplies water to Oklahoma, Nebraska, Texas, Kansas and Colorado, is a frequently cited example of resource depletion. However, Canter notes that most states have localized areas where similar depletion of ground water is occurring due to wells being placed too close together or pumping rates that are too high for those particular wells.

Over-pumping of a fresh water aquifer can result in salt water intrusion, a common problem along the Atlantic and Gulf coasts, while land subsidence has become a problem in some areas where ground water mining has occurred, such as in Houston and parts of Arizona and California.



Location of High Plains aquifer.



ABOVE: Canter reads a telegram just received by technical typist Leslie Rard. Contact with professionals in environmental impact assessment is a top Institute priority.

AT LEFT: The U.S. Geological Survey diagram graphically illustrates the vital importance of the Ogallala aquifer.

Poor ground water quality can be caused by natural geological conditions which allow the introduction of inorganics and metals. But more important to the energy industry are the numerous man-made sources of ground water pollution, including inappropriate waste disposal practices.

"The potential for ground water pollution," Canter says, "exists from abandoned and unplugged oil and gas wells, improperly completed wells, poorly designed brine disposal wells and poorly located off-site disposal pits for brine waters and drilling fluids and muds."

The cleaning up of polluted aquifers is one of the possibilities being examined by the Environmental and Ground Water Institute researchers to reverse the depletion of ground water resources. Their objectives are to define those state-of-the-art clean-up technologies and determine the cost.

"For a long time, people in the United States thought once an aquifer was polluted, it could no longer be used," Canter explains. "Yet, there have to be certain contaminated aquifers that can be economically cleaned up with the application of appropriate technology."

In addition to cleaning up polluted aquifers, Canter suggests three other ground water depletion safeguards, the first of which is implementation of water use conservation programs.

"We also can try to increase the rate of natural replenishment by the use of artificial recharge," he continues. "Here we actually try to promote water going into the ground and becoming a part of the ground water resource through the construction of various types of man-made lakes."

The third safeguard involves better planning of resource use. When a well drilling permit is being issued, for example, Canter would insist that industry personnel and city planners consider the implications of well fields and spacing of wells.

However central the problem is to OU researchers, ground water pollution from oil and gas production is only one element in the ever-present danger of contamination.

"The old philosophy that ground water is pure just isn't necessarily true, Canter says, noting that ground water contamination is largely a result of previous improper waste disposal practices. "One of the most common sources of ground water pollution is improperly located and improperly designed septic tank systems."

Additional sources of contamination are revealed with alarming regularity in the daily newspapers: a pesticide that once was an ally to citrus growers becomes an enemy gaining strength in ground water sources, while poisons from toxic waste dumps wage chemical warfare in the nation's water supply.

While the OU researcher does not claim to be an authority on federal control vs. states' rights, Canter does see a need for federal initiative to provide general direction for ground water management in the United States.

"Federal initiatives should provide a framework so that all states can conform to certain general approaches to monitoring ground water management," he contends.

Canter insists that each state has its own unique problems and that the state itself needs to address them. "Each state should develop a ground water quality management plan and begin to implement it," he says.

One of the problems with ground water quality management is the multiple federal, state and local agencies that have jurisdictional responsibility in that area.

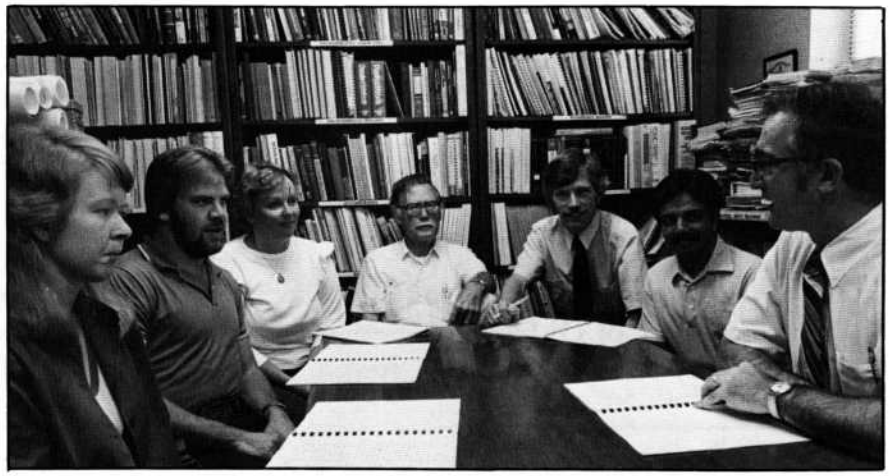
"Federal agencies charged with some responsibility in regard to ground water are estimated to number 40," he explains. In Oklahoma alone, at least a half dozen agencies oversee some aspect of ground water.

With the current emphasis being given to ground water issues, and the attention which these issues will command in the coming years, many career opportunities exist and more are expected for ground water professionals both in the private sector and in governmental agencies.

OU has taken a leadership role in responding to this educational need by developing academic programs beyond traditional geology and environmental engineering curricula.

The University now offers graduate programs in ground water quality management designed to equip students to address this vital environmental concern by providing additional training in hydrogeology, ground water chemistry and microbiology, ground water pollution control, subsurface water quality modeling, and ground water quality management.

The nationwide implications of environmental issues make communicating with other professionals in the field of environmental impact assessment a top priority for Canter and his colleagues. As a result, their studies are shared with scientists and engineers throughout the United States and in other countries through the presentation of research papers and the publication of a new bimonthly publication, the Environmental Impact Assessment *Worldletter,* a joint endeavor with the University of Aberdeen in Scotland.



Canter (right) reviews ongoing research with staffers Leslie Rard (left), Robert Knox, Debby Fairchild, Ralph Martin, Gary Miller, Seshu Dharmavaram.

The EIA *Worldletter,* which is airmailed to subscribers in some 30 countries, provides an informal, rapid communication link between environmental impact assessment professionals.

"Environmental impact assessment is the means by which all countries, developing and developed, evaluate the impact of major developments on the natural environment and on the economic and social aspects of the environment," says Canter, who is a senior editor of the newsletter.

Canter's counterpart at the University of Aberdeen's Centre for Environmental Management and Planning, Co-Editor Brian D. Clark, sees *Worldletter* as an important networking device to help people in developing and developed countries keep in touch.

The EIA *Worldletter* staff and contributors worldwide will be reviewing newly available EIA information, including technical reports, newsletters, journals and private and governmental publications that will be condensed and rewritten to provide a topical, timely awareness letter for active participants in the EIA field.

Among international environmental concerns, for example, is the potential long-term effect of acid rain on ground water and soil chemistry.

"When acid rain is mentioned, the immediate focus of attention goes to lakes and the fish and other aquatic life that are dead or dying," Canter says. "That's the immediate, obvious effect of acid rain. The longer-term, more subtle effect of acid rain could be associated with soil chemistry — in particular, changes in the patterns of retention of certain chemicals in the soil."

Another long-term implication of acid rain is its effect on ground water, and Canter contends that the need for further study in this area is critical.

While the OU researchers spend a major portion of their time looking for answers to problems beneath the earth's surface, they are also intensely interested in the air around them.

"Air quality is of vital concern," Canter says. "Pollutants continue to be introduced into the atmosphere at alarmingly increasing amounts."

Unfortunately, since air has limited dispersion capabilities, pollution knows no national boundaries, one reason why environmentalists should be concerned about standards for all countries.

"Many countries simply do not have air pollution standards," Canter explains. "I would not be surprised to witness a major air pollution disaster with some major health effects."

One of the most graphic demonstrations of the worldwide transfer of air pollutants was the transportation of volcanic ash from Mount St. Helens. Scientists can cite evidence to support the theory that a parcel of air travels around the world in 30 days, and that a complete exchange of air occurs from the northern to the southern hemisphere every two years.

Canter calls the worldwide scope of ground, air and water pollution "our shrinking earth," and he accepts the challenges of preserving, yet utilizing, its resources as the environmental engineer's responsibility.