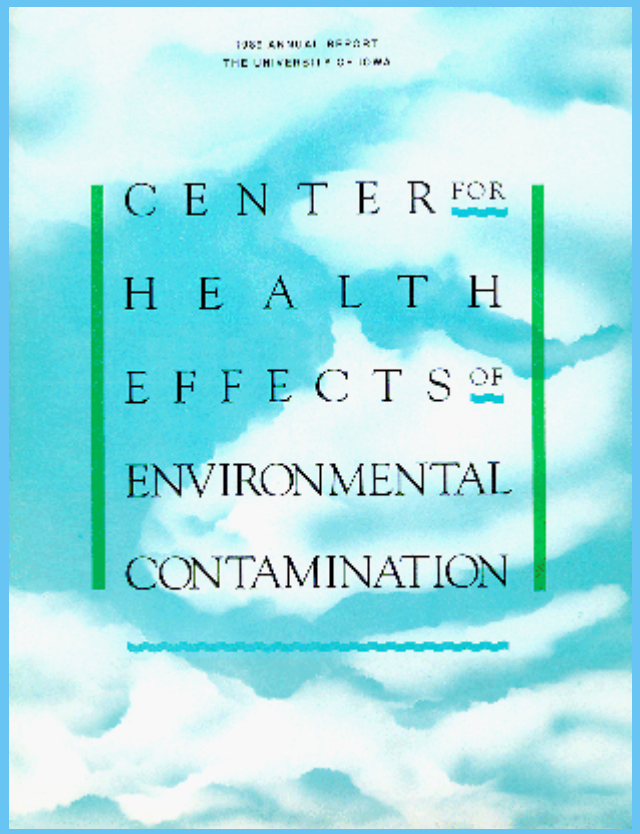
Center for Health Effects of Environmental Contamination | CHEEC

1989 Annual Report



A message from State Senator Pat Deluhery...

Mothers and grandmothers deserve significant credit for enactment of the Iowa Groundwater Protection Act. The issue was hotly contested. But amid all the talk, and interest group position papers, and governmental reports, their message came through. Their suspicion that contaminants in our natural environment threaten the health of our children and grandchildren swept the state in 1987.

Uncertainty over the extent of the problem was expressed by participants on all sides of the legislative debate that spring. How much pollution is too much? How much contamination is harmful to human life and human health? Debate on that question laid the groundwork for approval of the Center for Health Effects of Environmental Contamination (CHEEC) at the University of Iowa.

In our society an immense amount of information accumulates on the causes of illness and death. Birth certificates. Death certificates. Insurance claims. Hospital admission forms. Everything which relates to our health seems to appear on someone's form, somewhere.

All this information is collected. Isn't someone, we wonder, doing something with it? The answer, of course, is that we have plenty of information What we're short of is analysis.

Approval of the Center was based on the hope among legislators that the various academic disciplines, government departments and citizens' initiatives could accomplish more by working together than any one of them could achieve on its own. Evidence of progress toward this goal can be found in reports of cooperative efforts by state and local units with federal agencies in areas such as environmental protection and agriculture.

Many enlightened Americans expect the decade of the '90's to be the decade of the environment. But the problems seem so vast. The questions are often asked: Can anything be done? Can one person's effort make a difference?

The work of the Center ... described in the pages that follow ... reveals how it's done. Breakthroughs in the understanding can uncover solutions to our most perplexing problems. Individual effort does indeed count.

Establishment of the Center marks a beginning, a welcome new resource in a task of great consequence to Iowa and the Nation. The prospects for the future are unknown but exciting.

Pat Deluhery
State Senator
Chairman, Senate Committee on Environment & Energy Utilities

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The Iowa Groundwater Protection Act of 1987

In the spring of 1987, environmental scientists at the University of Iowa presented a proposal to the State Board of Regents which expressed their concerns about the quality of drinking water in Iowa:

> "The human health hazard of contaminated drinking water has become a major concern to Iowans. Detectable levels of potentially dangerous substances, including agricultural chemicals, have been found in groundwater sources supplying both municipal residents and users of private wells. While many of these contaminants are known to cause disease in lower animals or acute toxic effects in humans after high levels of exposure, it has not been directly shown that the lower levels in drinking water are responsible for human disease. Until the question of relationship to human health effects can be answered, precise standards cannot be established, and action taken to protect the public may either be inadequate or may result in unnecessarily stringent and costly regulations."

The Regents subsequently directed the document to the environment committees of the Iowa Legislature. Buoyed by an Iowa Department of Natural Resources (IDNR) report detailing levels of contaminants in drinking water supplies, and by a groundswell of public concern over possible deleterious effects on human health, members of the committees began work on a comprehensive bill aimed at preventing the flow of toxic substances into the states' groundwater and requiring active and passive clean up effort on already contaminated sources. In May of 1987 the Iowa General Assembly passed House File 631, the Groundwater Protection Act, which was signed into law by Governor Branstad. This Act represents perhaps the most progressive groundwater protection legislation to date in the United States:

"An Act...

Relating to public health and safety by establishing measures to improve and protect groundwater quality and to manage substances which post health and safety hazards, by establishing goals, policies, funding mechanisms, including taxes and fees, and administrative provisions for the measures, by establishing programs relating to the management of agricultural activities, solid waste disposal, household hazardous wastes, storage tanks, fertilizers, pesticides, landfills, and watersheds, by providing penalties, establishing effective dates, making appropriations, and by providing for other properly related matters."

Mandated within the Act was the establishment of the Center for Health Effects of Environmental Contamination (CHEEC) at the University of Iowa in Iowa City. As stated in the Act, the mission of the Center is "the determination of the levels of environmental contamination which can be specifically associated with human health effects."

The Act also provided for the establishment of the Leopold Center for Sustainable Agriculture at Iowa State University in Ames. The goals of the Leopold Center are "to develop and promote agricultural systems that combine responsible stewardship of natural resources with farm profitability."

The Iowa Waste Reduction Center at the University of Northern Iowa in Cedar Falls was established to provide advice and consultation to small businesses regarding solid waste and hazardous substances.

The Center for Health Effects of Environmental Contamination

The Groundwater Protection Act set in July 1, 1988, as the date CHEEC would officially being operation. Between August and December, 1987, a working group of scientists (the Center Executive Committee) met bimonthly to discuss Center development. A document describing the administrative structure, operation procedures, general research goals, and membership and responsibilities of Center committees was drafted. This organizational document was reviewed and approved by the Center Advisory Committee and submitted to the IDNR in December, 1987, and to the Iowa General Assembly in January, 1988. Since that time, the Executive Committee's efforts have been directed toward identifying deferral funding sources, developing research grant proposals, assembling and managing an environmental data base, and making the Center as visible as possible through seminars, presentations to various environmental agencies, and participation in a number of groundwater programs and public meetings.

The Center is comprehensive in scope and coordinates, integrates, and administers multidisciplinary research projects involving both exposure and risk assessments. Exposure assessment refers to identification and measurement of toxic substances in the environment which may potentially cause adverse human health effects. Risk assessment involves quantifying the possible health consequences of human exposure to environmental contaminants and includes mathematical modeling in the laboratory as well as epidemiologic investigations of exposed populations.

Center activities include the development of the new research designs as well as the expansion of the large base of health effects research currently in progress. Based on the findings of such research, the Center may develop professional and public information programs in the causes and prevention of environmentally-induced disease. The Center collaborates on a number of research projects with the IDNR and the Iowa Department of Public Health (IDPH).

Center Activities

Activities of the Center will encompass a wide variety of research involving exposure and risk assessments. Within the sphere of this research, the Center may

- Assemble all pertinent laboratory data on the presence and concentration of contaminants in the soil, air, water, and food, and develop a data retrieval system to allow the findings to be easily correlated with existing health outcomes.
- Make use of the existing cancer and birth defect statewide recording systems and develop similar recording systems for specific organ diseases which are suspected to be caused by exposure to environmental toxins
- Develop registries of persons known to be exposed to environmental hazards so that the health status of these persons may be examined over time.
- Develop highly sensitive biomedical assays which may be used in exposed persons to determined early evidence of adverse health effects.
- Perform epidemiologic studies to relate occurrence of a disease to contaminant exposure and to ensure that other factors known to cause the disease in question can be ruled out.
- Foster relationships and unsure the exchange of information with other teaching institutions or laboratories in the state which are concerned with the many forms of environmental contamination.
- Implement programs of professional education and training of medical students, physicians, nurses, scientists, and technicians in the causes and prevention on environmentally-induced disease.
- Implement public education programs to inform persons of research results and the significance of studies.

Participants in the Center

The success the Center attains will depend on the capabilities and expertise afforded by the multidisciplinary foundation upon which it was established. The Center is comprised of a number of laboratories and research units within the Colleges of Medicine and

Engineering, and the University Hygienic Laboratory. A description of each participant including main research thrusts and areas of expertise with respect to the activities of the Center follows.

EXPOSURE ASSESSMENT AND LABORATORY COMPONENTS

The Department of Civil and Environmental Engineering: Laboratory for Research in Groundwater Quality and Exposure Assessments

As part of CHEEC, a new laboratory with chemistry and computing facilities is being developed in the College of Engineering Research Facility. These laboratories will be used to study and perform environmental exposure assessments. Exposure assessments are the first step in assessing risk and managing.

In an exposure assessment, a mathematical model is used to predict the concentration and duration of exposure of a population to a chemical released into the environment. Knowledge of the pertinent physical, chemical, and biological reactions are obtained from carefully controlled laboratory studies as input to the exposure assessment model.

It has been reported in the literature that approximately 15-28% of the nation's groundwater supplies are contaminated with synthetic organic chemicals, pesticides, and fertilizers; the number may be slightly higher for Iowa.

Our knowledge of the processes affecting the movement and fate of these pollutants in groundwater is inadequate, and methods for groundwater monitoring, protection, and restoration are in general primitive. Health risks associated with exposure to contaminated groundwater are relatively uncertain. Research to assess health effects is of huge importance as we decide how to manage the risk once it is assessed. For example, it is estimated that more than 30% of permitted Iowa municipal landfills are leaking toxic leachate. The need for better exposure and health assessments is apparent. The general objectives of the CHEEC research being conducted within the Department of Civil and Environmental Engineering are:

1. To establish a chemistry and computer laboratory within the College of Engineering Research Facility for conducting environmental exposure assessments as a part of CHEEC.

2. To develop an understanding of the mechanisms governing the fate and transport of organics (e.g., pesticides and solvents), metals (e.g., mercury, arsenic, lead), and nitrates in the subsurface environment.
3. To research in-situ microbial degradation of agricultural chemicals and other groundwater pollutants.
4. To calculate the exposure concentration, duration, and frequency for input to risk assessments by the Epidemiology group at CHEEC.

This research will involve laboratory and modeling experiments, and field studies for calibration and validation of exposure assessment models. Risk assessment models developed in the laboratory will also be an important contribution of the CHEEC engineering component.

In summary, the primary emphasis of the CHEEC research conducted within Civil and Environmental Engineering is to study the mechanisms by which groundwater pollutants are transported and transformed in order to develop methods for predicting exposure concentrations, duration, and frequency. These predictions will be used to assess the overall risk associated with exposure to various levels of groundwater pollution. They can also be used to evaluate best management practice scenarios for agricultural chemical use.

The University Hygienic Laboratory (UHL)

Since its inception in 1904 the University Hygienic Laboratory has served as the public health and environmental laboratory for the state of Iowa. In this role the UHL functions as a technical and analytical support facility for the IDNR, the IDPH, the Iowa Geological Survey Bureau (IGSB), and the Iowa Bureau of Labor. The UHL staff includes an interdisciplinary collection of scientists with expertise ranging from the isolation and identification of bacteria and viruses to the determination of minute levels of organic contaminants as well as radionuclides in environmental samples. Available for the staff is an array of modern analytical equipment including gas chromatograph/mass spectrometers, atomic absorption spectrophotometers, and high pressure liquid chromatography equipment.

Analyses are performed on samples from virtually all matrices, including air, water, and wastewater, soil, sediment, industrial effluents, oil, fish and clinical specimens. In addition to performing analyses by specified methods, the UHL provides methods development and procedure verification for non-routine analyses, water and air quality monitoring services and on-site training and consultation to laboratory operators and sample collectors.

The UHL is certified by the EPA for analytical testing of all contaminants specified by the Safe Drinking Water Act, is designated by the EPA as the State Principal Laboratory for Iowa under SDWA and is licensed under the Clinical Laboratories Improvement Act. In addition, the UHL is one of the EPA's contract laboratories charged with analyzing samples for Superfund sites throughout the United States.

The UHL will conduct many of the laboratory analyses for future CHEEC research projects, and is currently analyzing water samples for the Statewide Rural Well Water Survey (SWRL), and the IDNR's Grants to Counties Program (both projects involving private rural wells).

The Institute of Agricultural Medicine and Occupational Health

The Institute began in 1955 with a grant from the W.K. Kellogg Foundation for the purpose of studying health problems of farmers and their families. Administratively, the Institute is a Division of the Department of Preventive Medicine and Environmental Health in the College of Medicine. The Institute is presently composed of five subsections: the Accident Prevention Laboratory, Comparative Medicine and Rural Health, Environmental Chemistry and Toxicology, Occupational Health, and the International Studies Program. The Iowa Pesticides Epidemiology Study Center, now in its sixteenth year, is located within the Environmental Assessment Toxicology section of the Institute and functions as part of a nationwide collaborative program sponsored by the EPA. Its purpose is to elucidate the adverse effects of pesticides on human health.

Laboratories located at the Institute will provide CHEEC with analyses of water samples for 15 organophosphate pesticides and herbicides (ongoing EPA Research), and microtoxicologic assessments including environmental screening bioassays. Currently, the Institute's Analytical Toxicology Laboratory is analyzing water samples for the SWRL Projects.

In 1986, the Institute received a $1.2 million Kellogg Foundation grant to establish a three part continuing education and occupational health program to combat the health hazards in agriculture and general industry. Specifically, this program will address community and worker right-to-know issues and will provide education to extension agents and agricultural workers on the relative risks in occupational exposure and risk reduction techniques.

RISK ASSESSMENT AND HEALTH EFFECTS COMPONENTS

The Department of Preventive Medicine and Environmental Health

The Department of Preventive Medicine and Environmental Health originated in 1920 and for many years was primarily concerned with infectious disease and sanitation. In 1972, the Department was reorganized into three main Divisions: Epidemiology, Biostatistics, and Environmental Health. Major areas of activity within the Epidemiology Division currently include studies of the elderly, cardiovascular risk factors, hormonal factors in breast cancer, and farming and water quality as cancer risk factors. The Department has extensive experience in community surveillance of cancers, birth defects, injuries, agriculturally and occupationally-related diseases and cardiovascular disease.

The Epidemiology component of CHEEC research will include biostatistics, data management, and chemical analytical methods development. Epidemiologic studies will investigate the occurrence of disease in Iowa due to contamination of drinking water supplies with toxic substances arising from point or non-point sources in the environment. Activities will include both expansion of ongoing funded studies and the development of new approaches.

In addition to providing the laboratory analyses already described, CHEEC researchers at the Institute of Agricultural Medicine and Occupational Health are conducting environmental epidemiologic research studies and providing consultation on projects funded by the IDNR and other agencies (see Current Health Effects Research).

The State Health Registry of Iowa

One of the mail goals of the CHEEC Epidemiology research section will be to expand the outcome data bases housed in the State Health Registry, which currently provides statewide recording of cancer and birth defects, to include other acute and chronic diseases which have been related to exposure to environmental toxins.

A number of epidemiologic studies are currently in progress which are either directly dependent upon or closely associated with Registry cancer data. Basic Registry cancer data have been expanded to routinely include features directly pertinent to occupational and environmental epidemiology. Chief among these are mobility histories, which will enable correlations to be made not merely with residence at diagnosis, but also with length of prior exposure to possible occupational and other environmental risks.

The Iowa Birth Defects Registry is a joint project of the Division of Medical Genetics of the Department of Pediatrics and the Department of Preventive Medicine and Environmental Health at the University of Iowa, and the Birth Defects Institute at the IDPH. In addition to maintaining a statewide system of collection of occurrence and types of birth defects, a specific objective of the Registry is to monitor that occurrence with respect to geographic distribution and characteristics of the community, and sources of environmental pollution.

Each component within CHEEC will provide essential and unique analyses involving exposure or risk assessments of environmental contaminants. In addition, there are many faculty at the University of Iowa with demonstrated expertise in groundwater quality, exposure modeling, and related areas:

- Department of Chemical and Materials Engineering, College of Engineering: research on materials processing.
- Department of Microbiology, College of Medicine: research on the degradation of toxic chemicals and in-situ biotransformations.

- Department of Geology, College of Liberal Arts and Sciences: research on hydrogeologic aspects of groundwater problems for purposes of hydrogeologic and contaminant modeling.
- Department of Urban and Regional Planning, Graduate College: research on community planning aspects and economic development.

It is obvious that the potential for synergistic interactions under the central umbrella provided by CHEEC is great.

Environmental Databases

One of the objectives of CHEEC is to evaluate potential associations between drinking water contamination and the health effects of cancer and adverse reproductive outcomes (birth defects). The statewide incidence recording systems within the State Health Registry must be efficiently linked with drinking water contamination data in order for this objective to be accomplished.

Currently, the Environmental Data Management Core for CHEEC is concentrating on accumulating a computerized data base of water sample analyses, water supply sources, and water supply treatment characteristics of municipal and private drinking water in Iowa. The goal is to establish an environmental data base that can address potential associations between our statewide Registry health data and a number of environmental issues, including

- chlorination by-product micropollutants in municipal drinking water supplies,
- pesticides and synthetic organic chemicals in municipal drinking water supplies,
- pesticides, nitrates, and coliforms in private drinking water supplies, and
- municipal drinking water contamination from toxic waste dumpsites.

The following projects represent the primary sources of environmental data the CHEEC environmental Data Core has been assimilating since August, 1987.

A Case-Control Study of Cancer and Drinking Water Contaminants

This study included a NCI-EPA funded project of finished water sample analyses from the 280 largest municipal water supplies in Iowa, serving roughly two-thirds of the state's population (1980 census: 2.9 million). The project was conducted during the spring and summer of 1987. The three major components were:
1) collection and analyses of finished water samples for trihalomethanes, six other volatile organic compounds, total organic carbon, total organic halide, pH, dissolved and total solids, and water temperature;

2) administration to municipal water operators of a three page questionnaire collecting data on the source and treatments applied to the collected water samples;

3) administration of a seven page questionnaire collecting data on sources and treatments applied to municipal drinking water during the 20th century. Editing has been completed on the second and third components; the data are being analyzed.

Statewide Municipal Drinking Water Survey of Pesticides and Synthetic Organic Chemicals

In 1986, the state of Iowa appropriated funds for a one time testing of all municipal finished drinking water supplies for 35 pesticides and 35 organic compounds. The 800 municipalities in this survey represent almost 75% of Iowa's population. Water sample collection took place from November,1986, through October, 1987. Retrospectively, municipal water operators completed a questionnaire on the source and treatments applied to those samples. Linkage of the questionnaire data with the analytical sample data has been completed. Linkage of the water sample data with the historical data is currently underway.

Another data base the Data Management Core has been working with is the SWRL Study.

Research

CURRENT GROUNDWATER RESEARCH

The Statewide Rural Well Water Survey (SWRL)

As part of the implementation of the Iowa Groundwater Protection Act, the IGSB and CHEEC are conducting a one-time survey of the quality of private water supplies used by rural Iowans. Principal Investigators on this project are George Hallberg, Ph.D. (IGSB), and Burton Kross, Ph.D. (Dept. of Prev. Medicine and CHEEC). Support for the SWRL study comes from the Iowa Groundwater Protection Fund.

Rural Iowans derive their drinking water primarily from wells. This study is, therefore, a survey of the condition of those well waters and the groundwater they tap. The intent of the SWRL study is to provide a statistically valid generalization of conditions across the state. This survey may also serve as a baseline for developing a long term monitoring program for water quality sampling in other programs, and to measure future trends and changes in groundwater or rural private drinking water quality.

A stratified systematic sample of 700 rural wells is included. Sample design is based on rural population density, total geographic coverage of all 99 counties, and repeat sampling to measure temporal variability. Parameters measured for each site include nitrate, coliform bacteria, 27 pesticides, selected environmental metabolites of pesticides, organic screening, typical water ions, toxicity screening, field measurements, and radon gas concentration in residences.

Various site evaluation forms and individual health assessment questionnaires are also used to gather information about well characteristics, possible point sources of contamination, agrichemical use and practices, and existing health symptoms or conditions.

Projects funded by the EPA Hazardous Substances Research Centers Program
Recently, CHEEC scientists have received grants to conduct research on modeling the movement of pesticides in the environment, bioreclamation of various toxics, and removal of pesticides by ozonation. CHEEC is not involved in conducting these studies. CHEEC seed grants supported pilot studies for the modeling and ozonation projects. The EPA funded research studies are:

Modeling Dissolved Oxygen, Nitrate, and Pesticide Contamination in the Subsurface Environment
Investigators: J. Schnoor, G. Parkin

A one-dimensional time-variable model is being developed to describe the vertical percolation and reactions of pesticides in the unsaturated zone and surficial aquifer. Pesticides atrazine and alachlor are the focus of the research, but nitrate and oxygen dynamics are also being studied as electron acceptors that influence pesticide degradation rates.

Feasibility of In-Situ Bioreclamation of Mixtures of Toxic Chemicals
Investigators: G. Parkin, D. Gibson

The Parkin research will investigate the effect of mixtures of various chlorinated solvents on the degradation of individual compounds (1,1,1-trichloroethane, chloroform, and methylene chloride). Attempts will be made to isolate the organisms actually degrading the target compounds. The feasibility of using in-situ anaerobic bioremediation will also be assessed. The Gibson study will investigate the feasibility of using genetically altered bacteria to aerobically degrade trichloroethylene. The goal is to evaluate the suitability of using these bacteria in wastewater treatment facilities to degrade target toxic chemicals.

Destruction of Nitrogenous Pesticides by Combined Ozone/H202 and Enzymatic Polymerization Process
Investigator: B. Kross

The objective of this study is to determine the mechanisms of removal for nitrogenous pesticides (atrazine, alachlor, and propachlor) and their decomposition products from water using a combined ozone/H202 and enzymatic polymerization process. This research will

contribute information for the development of an inexpensive, point-of-use water treatment system for rural water supplies. A better understanding of enzymatic polymerization reactions may lead to new hazardous substances waste treatment technologies as well.

Other pesticide studies being conducted at the University of Iowa which will directly impact CHEEC research include the following:

Biotransformation of Pesticides and Toxic Chemicals in the Subsurface Environment under Aerobic, Anoxic, and Methanogenic Conditions
Investigators: G. Parkin, J. Schnoor
Funding source: Iowa State Water Resources Research Institute

Laboratory glass-bead columns are being used to determine the kinetics, extent, and by-products of microbial transformation of the pesticides alachlor and atrazine, and the trihalomethane chloroform. A vertical, one-dimensional model describing the fate and transport of these pollutants is being developed. Such information can be used to assess the feasibility of in-situ bioremediation as a management alternative.

Poplar Tree Buffer Strips Grown in Riparian Zones for Biomass Production and Nonpoint Source Pollution Control
Investigators: J. Schnoor, L. Licht
Funding source: Leopold Center for Sustainable Agriculture

This two year seed grant is being used to investigate excess nitrate uptake capabilities and growth rate of poplar trees for use as an annual fuel wood. Results from the first year of the project have shown that the trees grow well in the groundwater, and that they can absorb large amounts of nitrates. Another important objective of the study is to investigate the fate and transport of alachlor and atrazine herbicides. The purpose is to determine if poplar trees, deep-planted and deep-rooted in riparian zone buffer strips, can be used as an innovative treatment technology for the removal of pesticides and other toxic organic chemicals.

Grants to Counties Program, Groundwater Protection Act of 1987
Investigator: University Hygienic Laboratory
Funding source: Iowa Department of Natural Resources

This program, mandated by the Iowa Groundwater Protection Act, involves testing of private rural water supplies for nitrates, bacteria, and a number of pesticides and organics. The UHL performs the analytical work as contracted through County Health Departments and County Sanitarian offices.

Pesticide Formulation and Residue Cooperative Agreement
Investigator: University Hygienic Laboratory
Funding source: U.S. EPA

Under this grant, the UHL provides analytical services for the EPA's Office of Pesticide Programs. Soil, foliage, water, and tissue samples are analyzed for the presence of pesticide residues where misapplication, overspray, or other violations of FIFRA regulations are suspected. Samples of commercial pesticide products (sent in by field collectors) are also analyzed to determine whether products meet the criteria, including indicated concentrations and required labeling, under which they are registered with EPA.

Iowa Pesticide Survey: Temporal Variation Study
Investigator: B. Kross
Funding source: U.S. EPA

This study will provide supplemental water quality data in support of the EPA Office of Pesticide Program's National Pesticide Survey of groundwater/drinking water. These data will help to assess the temporal variation in pesticide concentrations in well water. Other objectives of this project are to provide an assessment of qualitative hydrogeologic models and factors for predicting pesticide contamination of groundwater, and to collect additional data and perform selected analyses for a subset of sites in Floyd and Mitchell counties.

CURRENT HEALTH EFFECTS RESEARCH

Aggregate Analyses: Low Birth Weight

Increased rates of low birth weight (LBW: less than 2500 grams or 5.5 pounds) have been associated with a number of risk factors. Specifically, rates are higher in infants born to very young or very old women, in multiple births, in Afro-Americans or Asians, in small females, in women with complications of pregnancy, and in women of low income with poor nutrition and inadequate access to medical care. Other important factors are cigarette smoking, alcohol, and drug abuse. Environmental contamination has not been well studied as a cause of LBW. However, it may be noted that in the Love Canal exposure studies, an increased rate of LBW during the period of active dumping was the only established human health effect.

Birth weight is recorded on over 99% of all Iowa birth certificates; also indicated is whether or not the mother resided within limits of an incorporated municipality at the time of delivery. Previous sample surveys have shown that approximately 8% of women use bottled water during pregnancy. Thus, with a limited error, characteristics of water supplies used by pregnant Iowans can be inferred from the extensive CHEEC data base of water supply source and treatment. Rates of LBW, expressed as singleton white births per 100 live births, were calculated for the years 1974 to 1987 by municipality, county, and true rural areas within counties. Elevated rates were not evenly distributed within the state, but were most frequent in the southern tiers of counties.

Statistical analysis showed that the factor most strongly associated with this distribution was the percent of rural persons employed in agriculture, with the lowest rural LBW rates being found in counties with the highest level of agricultural activity. Although less pronounced, another associated factor was the source of drinking water used in the rural areas and small towns. Areas whose water supply came primarily from surface sources or shallow wells exhibited higher rates of LBW than areas supplied primarily by drinking water from deep wells.

While suggestive, these results cannot be considered definitive at this time since data on many other important risk factors for LBW are not yet completely available in sub-populations of the state. It is possible, for example, that in rural agricultural areas lifestyle factors, such as lower rates of smoking or different patterns of diet, are of major importance. These factors are now being investigated and will be considered along with area differences in occupation and environmental pollution.

Aggregate Studies of Other Health Problems

Earlier Iowa studies have clearly shown that non-Hodgkin's lymphoma (NHL) occurs at somewhat higher rates in Iowa's farming population. A study from Nebraska showed a higher rate of NHL in communities whose drinking water supplies contained elevated levels of nitrates. Under CHEEC auspices this has been examined in Iowa, and the same relationship has held. It is possible that the relationship to nitrates simply reflects an increased level of agricultural practice in the area, or that nitrates are a surrogate for other water contaminants. Further studies are in progress.

Initial studies of birth defects are focusing on large population subdivisions, since the number of cases available for analysis is as yet too small to allow accurate rates to be determined in smaller communities. However, the initial observations on regional patterns may provide insights for further studies as the data accumulate over time.

A number of research projects on health effects related to environmental exposures are currently being conducted by CHEEC scientists. Included are the following:

The Iowa Rural Radon Survey
Investigator: B. Kross
Funding source: U.S. EPA/IDNR

In conjunction with a statewide residential radon gas survey conducted by the IDPH, a survey of about 650 rural family dwellings was conducted in 1989. Detailed questionnaires about house construction, family health symptoms, and perceptions about radon gas health risks were completed. Long-term alpha track detectors were placed where initial screening tests indicated the need for further monitoring. Results indicate about 72% of the rural residences tested exceeded the U.S. EPA action guideline of 4.0 pCi/L.

Exposure Assessment Methods for Pesticides
Investigator: B. Kross
Funding source: National Cancer Institute

The objective of this investigation is to improve procedures used to assess historical pesticide exposures among farmers in case-control epidemiologic studies of cancer. This statewide study will include 250 male Iowa farmers and their family members who have direct or indirect exposure to agricultural chemicals. The ultimate goal is identify the amount and detail of information that can be reliably obtained by interviews or from purchase records.

Hazardous Waste Site Health Assessments
Investigator: B. Kross
Funding source: Agency for Toxic Substances and Disease Registry/IDPH

As part of this project, CHEEC provides consultative services to the Iowa Department of Public Health on health assessments conducted at Superfund sites in Iowa. Consultations related to environmental health and engineering, occupational medicine, and environmental chemistry are included. CHEEC representatives participate in site visits to select Superfund sites to review field conditions and receive exiting monitoring data.

Chlorination and Cancer in Iowa
Investigator: C. Lynch
Funding source: U.S. EPA

This project will involve preliminary analyses of data from the "Case-Control Study of Cancer and Drinking Water Contaminants" to evaluate possible associations of exposure to chlorinated drinking water and cancer incidence.

Center for Craniofacial Anomalies Research
Investigators: M. Solursh, J. Hanson, J. Murray
Funding source: NIDR

The objective of this Center is to identify human genes and other risk factors important in the etiology of craniofacial anomalies. An epidemiologic study of cleft lip and cleft palate cases in Iowa will be one of the projects conducted by the Center. Mothers of cases and mothers of a matched control group will be interviewed to assess parental exposures to environmental agents, including occupational and agricultural exposures, water quality, diet, etc. The independent contribution of these factors to the risk of facial clefts will be assessed.

Seed Grants

The Center for Health Effects of Environmental Contamination awards small seed grants for collaborative pilot studies on exposure or risk assessment. Proposed studies need not necessarily involve human subjects, but must have a potential relationship to studies of human health effects. The Center administration encourages qualified researchers interested in exploring potential development of collaborative research projects with Center scientists to contact our offices in Iowa City.

To date, the following projects have been awarded seed grants:

Title: Modeling Dissolved Oxygen, Nitrate, and Pesticide Concentrations in the Subsurface Environment
Investigators: J. Schnoor, G. Parkin, D. Nair

The goal of this project is to develop a mathematical groundwater model that would allow State and Federal regulatory personnel to determine the exposure concentration of pesticides and nitrates in surficial groundwater for risk assessment procedures and risk management decisions. In tandem with ongoing laboratory studies, the model will enable predictions of concentrations in Iowa's groundwater under various Best Management Practices (BMP) scenarios. This research will contribute to building a scientific basis for further field and laboratory research and provide data to facilitate the formulation of BMP for eventual protection and management of groundwater resources for drinking and other beneficial purposes. Methods developed in this pilot study will be utilized in the large scale project funded by EPA.

Title: Development of Methods for Epidemiologic Studies of Birth Defects and Environmental Exposures in Iowa
Investigators: R. Munger, J. Hanson

The goal of this project is to develop a questionnaire that can be used to assess environmental exposures that may increase the risk of birth defects and to link these data with existing environmental data bases. Specifically, researchers will test the hypothesis, generated from previous studies, that exposure to selected agricultural practices increases the risk of facial clefts. A telephone-administered questionnaire will be developed to evaluate exposures among mothers of infants with facial clefts identified by the Iowa Birth Defects Registry and a comparison group of normal infants. The questionnaire developed in this study will be used in research conducted by the Center for Craniofacial Anomalies Research which was recently funded by the National Institute of Dental Research.

Title: Identification and Toxicity of Decomposition of Nitrogenous Pesticides Following Ozonation
Investigator: B. Kross

The goals of this project are to develop test jar procedures for reacting ozone with individual pesticides to determine reaction kinetics, to predict steady-state conditions, and to determine the identity of decomposition products of pesticides after ozonation. A strong national research effort is currently underway to identify specific pesticides and their metabolites in water supplies. Due to concern over the carcinogenicity of chlorination by-products, alternative disinfection processes such as ozonation are receiving greater research and process design attention. Moreover, groundwater contamination in rural areas is turning attention to the development of ozonation processes for point of use water treatment systems. Results of this pilot study will be utilized in the ozonation research funded by EPA.

Title: Development of a Model Surveillance Program for Agricultural Health and Safety
Investigators: J. Merchant, K. Donham

The goal of this project is to complete the preliminary work needed to develop a model agricultural health and safety surveillance program. Several epidemiologic studies of agricultural workers have shown increased risk of acute and chronic chemical toxicity as well as sunlight and probable herbicide-related cancers. Therefore, there is a clear need to develop surveillance models for agriculture which will provide representative and reliable information on environmental exposure and associated morbidity. For this project, a population-based sample of farms will be identified and followed prospectively to determine certain exposures and health effects.

Designing effective intervention and protection strategies in agriculture is impossible without detailed information about significant risk factors. Development of a model surveillance system is a logical and mandatory first step in collecting the data.

Title: Feasibility of DNA Flow Cytometry in Renal Cell and Colorectal Carcinoma among Iowa Residents *Investigators:* C. Lynch, R. Robinson

The goal of this project is to evaluate the feasibility of performing DNA ploidy analyses on fixed tissue from patients who recently participated in a statewide, population-based, cancer case-control study and who had tumorous tissue removed at the University of Iowa Hospitals & Clinics. Specific objectives include developing computer data entry forms that will permit efficient linkage of study data for pathologic predictors of outcome and DNA ploidy analyses results, evaluating the importance of DNA ploidy pattern as a predictor of outcome for renal cell and colorectal carcinomas, and evaluating the importance of known risk factors for renal cell and colorectal carcinomas as predictors of the DNA ploidy pattern. This will be the first CHEEC project where flow cytometry (i.e. DNA ploidy pattern determination) was utilized in an epidemiologic study design. The coupling of flow cytometry and epidemiology may assist future evaluation of the relationship between environmental contamination and adverse health outcomes.

Title: Collection of Historical Municipal Drinking Water Data for Iowa Municipalities with a 1980 Population Between 750-1,000
Investigators: C. Lynch, M. Gleaves, M. Finn

The goal of this project is to identify the types of treatment that have been historically utilized in Iowa municipalities with a 1980 population between 750-1,000. Specific aims of the project are to evaluate the completeness of data and response rate that can be obtained from these municipalities through a mailout questionnaire and follow-up telephone survey, and to evaluate the accuracy and completeness of existing data that are currently available to CHEEC for these municipalities. There are currently 5 data sources containing fragments of historical water supply and treatment data for the study municipalities (IGSB files, the 1986-87 Statewide Pesticide and Volatile Organic Survey file, Iowa Public Water Supply data from the 1960s, and records of treatment practices for two points in time: the early 1960s and the mid 1970s). These data will be recorded on a single data entry form for each municipality, and

will be sent to the municipal water operator for verification and update. Municipal drinking water contamination is frequently related to type of water supply and treatment characteristics. In relating health effects to water supplies, quite commonly questions arise concerning years of use, type of source and treatments, and amount of drinking water obtained from these supplies. Possessing these edited data in a relational data base that will allow for efficient linkage with health effects data is desirable.

Seminar Series

One of the activities CHEEC may pursue involves implementing programs of professional education and training of medical students, physicians, nurses, scientists, and technicians in the causes and prevention of environmentally-induced disease. The Center has instituted a continuing seminar series at the University of Iowa. To date, the following presentations have been made:

Topic: "The role of hazardous waste cleanup in protecting human health"
Speaker: J. Winston Porter, Ph.D., Asst. Administrator for Solid Waste and Emergency Response, U.S. EPA

Topic: "Environmental epidemiology: separating politics and science"
Speaker: Michael Gough, Ph.D., Project Manager, Environ Corp., Washington, D.C.

Topic:"Endangerment assessment at Superfund sites"
Speaker: Jerald Schnoor, Ph.D., Professor and Head, Department of Civil and Environmental Engineering, University of Iowa

Topic: "Love Canal: at the frontier of science and politics"
Speaker: John Deegan, Jr., Ph.D., Dean of College of Social and Behavioral Sciences, University of Northern Iowa

Topic: "Trihalomethanes in Iowa municipal drinking water supplies"
Speaker: Charles Lynch, M.D., Ph.D., Asst. Professor, Dept. of Preventive Medicine and Environmental Health, University of Iowa

Topic: "Sustainable agriculture and environmental health"
Speaker: David Osterberg, State Representative, Mt. Vernon, Iowa, Chair, Agriculture Committee, Iowa House of Representatives

Topic: "Agent Orange: the misuse and abuse of science by the U.S. Government"
Speaker: Jeanne Stellman, Ph.D., Assoc. Professor, School of Public Health, Columbia University, New York, N.Y.

Topic: "Studies of non-occupational radon exposure and lung cancer"
Speaker: John Neuberger, M.D., Assoc. Professor, Dept. of Preventive Medicine, University of Kansas

Topic: "The annual report on carcinogens: A study in science, policy and the law"
Speaker: Dorothy Canter, Ph.D., National Toxicology Program, National Institute of Environmental Health Sciences

Topic: "Risk assessment and EPA drinking water standards"
Speaker: Joseph Cotruvo, Ph.D., Director of Criteria and Standards, Office of Drinking Water, U.S. EPA

Future Directions

CHEEC represents a unique collection of interdisciplinary researchers brought together by a common interest in studying the health effects of various environmental insults. A number of universities have environmental studies institutes and public health programs that address different aspects of these health effects issues. CHEEC is exceptional in that it draws on the expertise and research interests of faculty members in nationally recognized Colleges of Medicine and Engineering, along with scholars in the nationally and internationally recognized University Hygienic Laboratory. It is this official collaboration which makes the Center unique, and in a position to provide leadership in the critical area of health effects of environmental contamination. Special opportunities exist for CHEEC in the following areas:

- research in adverse health effects of rural and agricultural exposures
- relating environmental exposures to birth defects and other adverse reproductive outcomes, and cancer
- development of sensitive biomedical assays for early detection of adverse health effects
- investigation of the health effects associated with global climate change

While current research is focused towards drinking water quality and groundwater contamination, CHEEC has been directed by the State to investigate potential associations between health effects and exposure to contaminants in air, soil and food. The specific goals of the Center for Health Effects of Environmental Contamination are the following:

- Through quality research, to determine the levels of environmental contamination which can be specifically associated with human health effects, with a special focus on rural and agricultural exposures.
- To become known as a state resource for environmental health research and information.
- To establish a mechanism for disseminating environmental and health effects information.
- To become a nationally and internationally known center of excellence for environmental health research.

Executive Committee

James W. Hanson, M.D.
Dr. Hanson is Professor of Pediatrics and Director of the Division of Medical Genetics at the University of Iowa. A native of Jefferson, Iowa, he attended Johns Hopkins University and subsequently received his Doctor of Medicine degree from the University of Iowa College of Medicine in 1969. His internship and residency in Pediatrics were at the Johns Hopkins Hospital. Thereafter, he spent two years as a medical epidemiologist in the Birth Defects Section at the U.S. Centers for Disease Control in Atlanta, Georgia. From 1974 through 1976 he was a postdoctoral fellow in dysmorphology at the University of Washington in Seattle prior to his return to the University of Iowa on the Pediatrics faculty. Since 1977 he has been Director of the Division of Medical Genetics. In that capacity he has assisted with the development of a statewide system of genetic health care services in Iowa which include a Regional Consultation Service, a Genetic and Metabolic Screening Program for newborn infants, a High Risk Pregnancy Detection Program, a statewide Teratogen Information Service and the Iowa Birth Defects Registry, which he also directs. He has been a consultant to numerous federal and state agencies regarding genetic health care services and matters relating to birth defects.

Dr. Hanson's research interests include the effects of environmental agents on fetal growth and development, patterns of malformation and abnormal fetal development, birth defects epidemiology, and public health aspects of genetics. He is a member of the American Society of Human Genetics, American Academy of Pediatrics, Genetics Society of America, Teratology Society, and other professional and scientific organizations.

William J. Hausler, Jr., Ph.D.
Dr. Hausler has been Director of the University Hygienic Laboratory since 1965. He holds a joint appointment as an Associate Professor of Preventive Medicine in the College of Medicine and an Associate Professor of Oral Pathology in the College of Dentistry at the University of Iowa. Under his leadership, the Hygienic Laboratory has come to be considered by many as one of the finest environmental and public health laboratories in the country. Dr. Hausler holds a doctorate in microbiology from the University of

Kansas, is certified by the American Board of Medical Microbiology and is a Fellow in the American Academy of Microbiology. He is past president of the Association of State and Territorial Public Health Laboratory Directors and is currently Chairman of their task force on HIV testing. He is a member of the Board of Directors of the National Committee for Clinical Laboratory Standards and is past Chairman of the Board of Governors of the American Academy of Microbiology. He is past chairman of the American Society for Microbiology Committee on Laboratory Standards and Practices and the Publications Board of the American Public Health Association.

Dr. Hausler has directly participated in the drafting of legislation at the state and federal levels, primarily in those areas dealing with the environment and clinical laboratory regulations. He serves as a consultant to industry, local, state, and federal government, including having served on the EPA Drinking Water Advisory Committee and as a World Health Organization consultant to Iran. Dr. Hausler is currently a member of the FDA HIV Working Group.

In addition to his effective laboratory management and leadership he has also published extensively and broadly. He is editor of the 13th edition of Standard Methods for the Examination of Dairy Products, a member of the editorial board of Compendium of Methods for the Microbiological Examination of Foods, co-editor of the third, fourth, and fifth editions of the Manual of Clinical Microbiology, co-editor of the 6th edition of Diagnostic Procedures for Bacterial, Mycotic, and Parasitic Infections, and co-editor of Laboratory Diagnosis of Infectious Diseases, Principles and Practice. His biography is listed in several reference works, including American Men and Women in Science and Who's Who in the United States.

Peter Isacson, M.D.
Dr. Isacson is Professor and Division Head of Epidemiology in the Department of Preventive Medicine and Environmental Health at the University of Iowa. He received his Doctor of Medicine degree from the University of Nebraska and completed his internship and residency in Medicine at University Hospitals of Cleveland.

Dr. Isacson served as an EIS officer with the Communicable Disease Center, USPHS, and was a Fellow at the Walter and Eliza Hall Institute in Melbourne, Australia, prior to receiving a faculty appointment in the Department of Microbiology at Yale University in

1961. In 1966, he was appointed Associate Professor in Preventive Medicine at SUNY, Buffalo. In 1972, Dr. Isacson came to the University of Iowa as Professor and Head of the Department of Preventive Medicine and Environmental Health. Since 1977 he has been Principal Investigator of the Iowa SEER (Surveillance, Epidemiology, and End Results) Program. Dr. Isacson is a member of the EPA Task Force on Planning Epidemiology Research and sits on the Safe Drinking Water Committee of the National Research Council. He served as Interim Director of CHEEC in 1987-88.

Dr. Isacson's research interests include cancer epidemiology, water quality as a risk factor for cancer and adverse reproductive outcomes, and risk assessments at toxic waste dump sites. He participated in drafting groundwater protection legislation in Iowa and is actively involved in efforts aimed at increasing both public and professional awareness of water quality problems.

Burton C. Kross, Ph.D., P.E.
Dr. Kross is Assistant Professor of Preventive Medicine and Environmental Health and has a secondary appointment in the Department of Civil and Environmental Engineering at the University of Iowa. He received his Ph.D. from the Department of Civil and Environmental Engineering at the University of Iowa in 1987. From 1969-1984, Dr. Kross held progressively responsible management positions with ERT, Inc., a subsidiary of Communications Satellite Corporation (COMSAT). During this time he served as Regional Manager, General Manager and Group Vice President and was involved in formulating strategies to establish business agreements in Mexico, Venezuela, Panama, Saudi Arabia, Abu Dhabi, Greece, Egypt, Indonesia, Peoples Republic of China, Australia, Nigeria, and Sudan.

Dr. Kross has served on the Board of Directors for Farm Safety for Just Kids, Platte River Power Authority, Ecology Consultants, Inc., Western Scientific Services, Inc., and other concerns. He serves on advisory groups for the Iowa Waste Reduction Center, Agricultural Energy Management Committee for the Iowa Department of Agriculture and Land Stewardship, rules review committees for the Iowa Department of Public Health, and the Governor's Steering Committee on Radon.

Dr. Kross' research and teaching interests involve groundwater, hazardous waste, health effects, environmental assessments, ozonation treatment processes, and indoor radon gas exposures.

Charles F. Lynch, M.D., Ph.D.
Dr. Lynch is Assistant Professor with a joint appointment in the Department of Preventive Medicine and Environmental Health and the Department of Pathology at the University of Iowa. He received his Doctor of Medicine degree from the University of Iowa in 1979, and his Ph.D. from the Department of Preventive Medicine and Environmental Health at the University of Iowa in 1984. From 1982-86, he was in a residency training program in anatomic pathology at the University of Iowa Hospitals & Clinics and during 1986-87 he was an Associate in the Department of Pathology. In 1987, Dr. Lynch was the recipient of a Preventive Oncology Academic Award from the National Cancer Institute. In 1988, he received his joint faculty appointment at the University of Iowa.

Currently, he is the Director of the Data Management Core for CHEEC. His research interests include the pathology of cancer, cancer epidemiology, environmental epidemiology, and adverse reproductive outcome epidemiology. He has a special interest in cancer and drinking water contaminants, and is currently Principal Investigator of a large case-control study evaluating this potential association within the Department of Preventive Medicine and Environmental Health.

James A. Merchant, M.D., Dr. P.H.
Dr. Merchant is Professor of Preventive Medicine and Environmental Health and Director of the Institute of Agricultural Medicine and Occupational Health at the University of Iowa. He received his Doctor of Medicine degree from the University of Iowa in 1966, and completed his internship and residency in Medicine at Cleveland Metropolitan General Hospital. Dr. Merchant was an EIS officer with the USPHS assigned to the North Carolina State Board of Health from 1968-70. He received his Doctor of Public Health degree from the University of North Carolina at Chapel Hill in 1973, and completed a Fellowship at the Cardiothoracic Institute Brompton Hospital, University of London, in 1974.

In 1974 he was appointed Assistant Professor in Medicine at the University of North Carolina, and from 1975-81 was Director of the Appalachian Laboratory for Occupational Safety and Health, Department of Health and Human Services, NIOSH/CDC USPHS at Morgantown, West Virginia, and Associate Professor at West Virginia University.

In 1981 he was appointed Professor of Preventive Medicine at the University of Iowa and became Director of the Institute of Agricultural Medicine in 1983. Dr. Merchant has taken a lead role in promoting CHEEC research goals to federal agencies and to state and federal legislators. His research interests include occupationally related lung disease, agricultural health and safety, and rural and environmental health.

Gene F. Parkin, Ph.D.
Dr. Parkin is Professor of Civil and Environmental Engineering and Director of the Center for Health Effects of Environmental Contamination at the University of Iowa. He received his Ph.D. in Civil Engineering from Stanford University in 1977 and was appointed to the faculty of the Department of Civil Engineering at Drexel University, Philadelphia, in 1978.

Dr. Parkin joined the University of Iowa Civil and Environmental Engineering faculty in 1986. He is a member of the EPA's Environmental Engineering Review Panel, reviews research proposals for the National Science Foundation, and reviews manuscripts for Science, Water Research, Journal Environmental Engineering Division, American Society of Civil Engineers (ASCE), and for the Journal Water Pollution Control Federation. Dr. Parkin is a member of the Water Pollution Control Federation, the Iowa Groundwater Association, the American Waterworks Association, the Society for Environmental Toxicology and Chemistry, the International Association on Water Pollution Research and Control, and other professional societies. He has served as a consultant to du Pont Corporation for assessing the feasibility of in-situ biodegradation for remediation of various hazardous waste sites.

Dr. Parkin has expertise in biodegradation of organic chemicals and the fate and effects of toxic materials (both organic and inorganics such as heavy metals) in the subsurface and in above-ground treatment systems. In 1983, he was awarded the James R. Croes Medal from the ASCE for research on modeling the effects of toxic substances in anaerobic biological processes. Recently, Dr. Parkin and two colleagues conducted a Workshop on Research Needs in Hazardous Waste Treatment and Disposal for the National Science Foundation. In April of 1989, the University of Iowa presented Dr. Parkin the prestigious Hancher-Finkbine medallion in recognition of his commitment to education.

Jerald L. Schnoor, Ph.D.
Dr. Schnoor is Professor and Chair of the Department of Civil and Environmental Engineering at the University of Iowa. He received his Ph.D. in Civil Engineering from the University of Texas in 1975. He was a National Science Foundation Fellow at Manhattan College, Bronx, New York, in 1976, prior to his faculty appointment at the University of Iowa in 1977.

Dr. Schnoor was a visiting Professor at the Swiss Federal Institute of Technology, Zurich, in 1982 and summers from 1983 through 1986. He has expertise in the mathematical modeling of hydrogeology and groundwater problems including pesticides, heavy metals, and microbial degradation of industrial organic chemicals. In 1985, he was awarded the Walter L. Huber Research Prize from the ASCE for research on the modeling of pesticides in the environment. In 1984-85, he served as first President of the Iowa Groundwater Association and is a groundwater consultant and expert reviewer for Batelle Pacific Northwest Laboratories on the fate and effects of radionuclides and Hanford's nuclear defense waste program.

Research projects directed by Dr. Schnoor have covered a wide variety of water quality problems including: low dissolved oxygen in Lake Lyndon B. Johnson, Texas; eutrophication of Lake Ontario; pesticides in the Iowa River; and heavy metals and trace organics contamination of groundwaters in the U.S. and Switzerland. Recently he has developed a mathematical model for acid precipitation risk assessments which is being applied to lakes in the eastern U.S. as part of EPA's Acid Precipitation Assessment Program. His research interests lie in the areas of surface water and groundwater quality modeling and physical-chemical treatment of toxic chemicals.

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