UNITED STATES GEOLOGICAL SURVEY

USGS Activities in Iowa

UNITED STATES DEPARTMENT OF THE INTERIOR

BRUCE BABBITT, Secretary

UNITED STATES GEOLOGICAL SURVEY

Gordon P. Eaton, Director

UNITED STATES GEOLOGICAL SURVEY ACTIVITIES IN IOWA

by Rob G. Middlemis-Brown

UNITED STATES GEOLOGICAL SURVEY
Open-File Report 95-392
Iowa City, Iowa

(cover is a scene of Roberts Creek in Clayton County, Iowa)

For additional information write to:

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U.S. Geological Survey
Earth Science Information Center
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U.S. Geological Survey

Earth Science in the Public Service

Water-quality data-collection site on Roberts Creek in Clayton County

"The United States Geological Survey program emphasis has changed over time, from general geologic and hydrologic appraisals to issue-oriented investigations, from traditional topographic mapping to digital coverages, and from predominately data-collection activities to surveillance networks of streamgages, investigative studies, and research. Yet the mission of the USGS remains as important today as it did when the Survey was established on March 3, 1879; providing scientific information for understanding and managing the Nation's land, mineral, and water resources. The proud heritage and tradition of the USGS that is associated with providing high-quality information on critical resources to the Nation have given each of us as employees a special feeling, not only about what the agency represents but also the contributions to present and future generations.

"The following pages will provide you with an overview of recent activities of the USGS here in Iowa and how those activities have provided the information needed to effectively manage the land, mineral, and water resources in Iowa. Together with local, State, Tribal, and Federal clients we can work together to continue our service to Iowa and the Nation."

USGS State Representative
Iowa City, Iowa

Scene of rolling topography in northeast Iowa

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The technical, manuscript preparation, editing, and computer expertise of many employees in the United States Geological Survey greatly improved the content and quality of this publication. The author gratefully acknowledges their contributions

INTRODUCTION

The United States Geological Survey was established by an act of Congress on March 3, 1879, as a Federal agency in the United States Department of the Interior. Its mission is to conduct systematic and scientific classification of the public lands and to examine the geological structure, mineral resources, and products of the national domain. An integral part of that original mission includes publishing and disseminating the Earth-science information needed to understand, to plan the use of, and to manage the Nation's energy, land, mineral, and water resources.

ORIGIN AND MISSION OF THE USGS

For over 100 years the United States Geological Survey (USGS) has provided the Earth-science information on which many decisions regarding Iowa's natural resources have been based. Some of the agency's activities touch a broad spectrum of the general public, such as preparation of topographic maps, while others benefit a more limited customer base, such as flood frequency analysis for a small stream. Regardless of the activity or client, the nonregulatory, independent, and scientific nature of the agency ensures that our products are

- technically sound,
- unbiased,
- timely,
- quality assured and controlled, and
- cost effective.

For these reasons, the USGS has a well-deserved reputation for quality whose services are held in high regard.

The various programs of the USGS in Iowa reflect a responsiveness to the public's need for Earth-science information. Much of that work is part of the Federal-State Cooperative Program in which the diversity of interests among local, State, Tribal, and Federal governmental groups is done through joint planning and funding. The USGS provides up to 50 percent of the required funding for this program and the remainder is provided by reimbursements from the cooperating agency.

Below Saylorville Spillway during the Flood of 1993

Water-quality data-collection site on Deer Creek, Clayton County

WATER-DATA NETWORKS

A historical record of water resources information provides a foundation on which to build future investigations and a firm basis for decision making.

In virtually all parts of Iowa, the quantity, quality, and distribution of water are critical to the State's economy, public-health welfare, and resource management. Public protection from floods and droughts, multiple use of limited ground-water resources, and effects of land use and water use on water quality are among the typical issues.

The USGS is the principal Federal agency cooperating with State and local agencies in Iowa for the collection of water-resources data (May, 1995). The USGS operates and maintains statewide networks of monitoring sites. The monitoring sites are locations at which surface-water, ground-water, and water-quality data are collected and recorded on a continuous basis. These data are all collected and processed by highly qualified USGS personnel using nationally standardized techniques. Among the special-purpose instrumentation used are satellite telemetry, multi-parameter water-quality sensors, global positioning systems, and water-level sensors. All data are stored in computer files, available through the Internet, and published annually.

Surface-Water Data-Collection Network

In Iowa, the network of sites for surface-water data collection includes over 120 surface-water gaging stations for monitoring discharge (figure 1) and over 110 crest-stage sites for measurement of peak flows (figure 2). These data are used in such water-related fields as water supply, hydroelectric power, flood control and warning systems, bridge design, and water-resources development.

Ground-Water Data-Collection Network

The ground-water data network in Iowa (figure 3) consists of over 230 wells measured at least four times a year. There have been over 2,000 water-quality samples taken from about 800 wells since 1982. These data are used to document water levels in aquifers located across Iowa. Some of the wells are measured monthly as part of a USGS National network.

Water-Quality Data-Collection Network

Physical data and water samples for laboratory determination of chemical, sediment, and biological characteristics are collected at over 60 sites (figure 4).

Reference

May, J. E., and others, 1995, Water resources data, Iowa, water year 1994: USGS Water-Data IA-94-1, 370 pages (published annually).

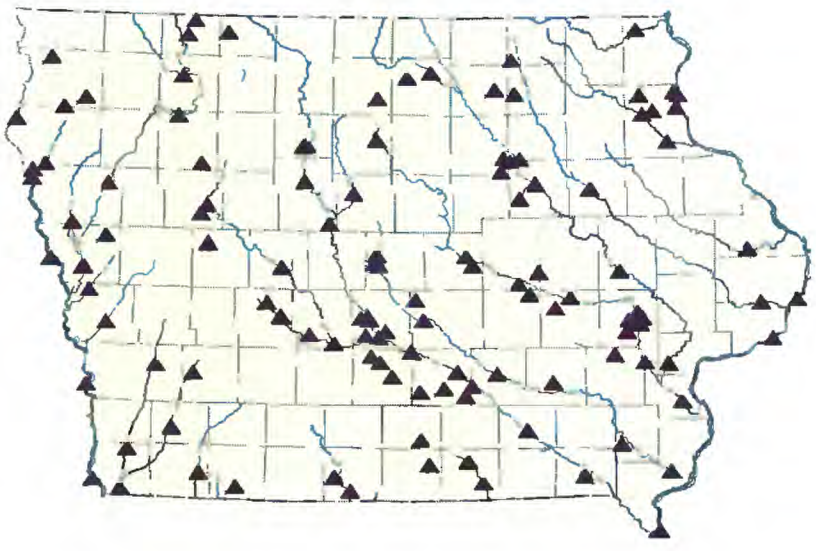


Figure 1.-- Location of surface-water gaging stations for measuring streamflow

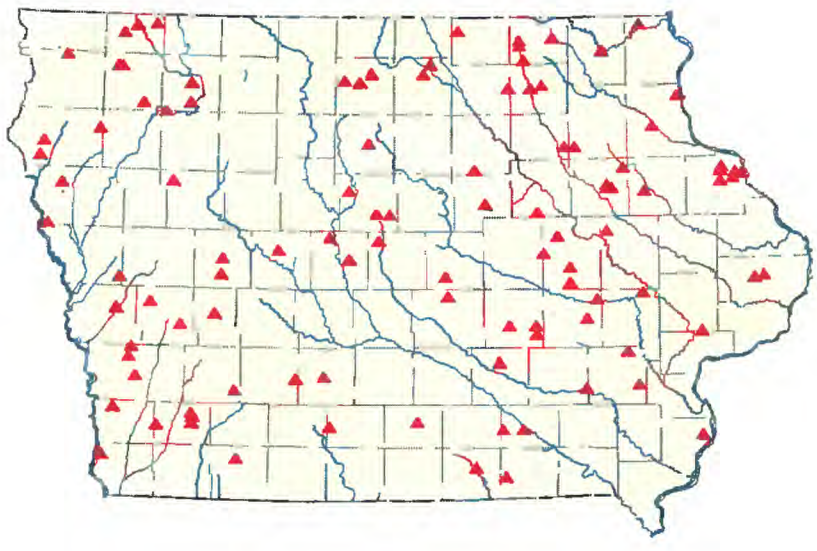


Figure 2.-- Location of crest-stage sites for measuring peak flows

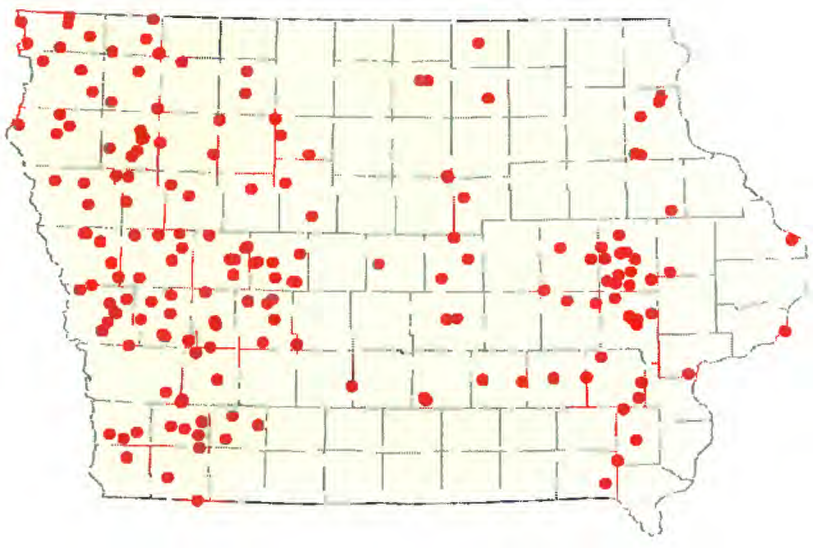


Figure 3.-- Location of ground-water level measurement sites

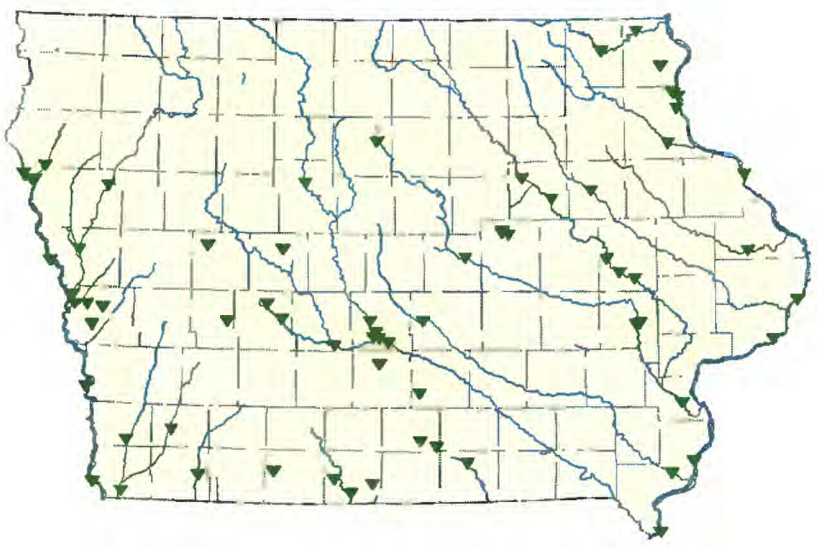


Figure 4.-- Location of surface-water sites to measure water quality

Damage to road below Saylorville Reservoir during Flood of 1993

HYDROLOGIC AND GEOLOGIC HAZARDS

Earth-science information concerning naturally occurring hazards improves planning and protects lives.

Due to its climatic and geologic characteristics, Iowa has a variety of hydrologic and geologic hazards, such as floods, droughts, and landslides. Data collection and investigations conducted by the Geologic and Water Resources Divisions address these issues as well as many others. The Geologic Division works closely with the Iowa Geologic Survey Bureau (GSB) to collect, evaluate, and correlate geologic and geochemical data. The Water Resources Division, working with a variety of cooperators, conducts flood magnitude/ frequency assessments, surveys high-water marks for the indirect determination of flood discharge, and studies erosion of stream channels.

Geologic Hazards in Missouri Basin

The USGS and GSB, in partnership, are studying the geologic aspects of land-use issues in the Middle Missouri River Basin. The study will include analysis of expanding soils, landslides, and subsidence as affected by land uses on the natural system.

Channel and Flood-Plain Aggradation

The aggradation of sediment in Iowa stream channels and flood plains can greatly affect the design of bridge structures, the flood-profile for channel conveyance of flow, and the capacity for flood-water storage in flood plains. The objective of the study, being done in cooperation with the Iowa Highway Research Advisory Board, is to identify areas where channel and flood-plain aggradation are occurring along the Iowa River and to quantify the rates of sediment deposition. Figures 5 and 6 illustrate the aggradation in the Iowa River near Marshalltown, Iowa.

Seepage from Red Rock Dam Structure

In cooperation with the Corps of Engineers, the USGS is determining the amount and extent of seepage through the foundation of the Red Rock Dam on the Des Moines River (Lucey, 1991). Water-quality and ground-water level data are being analyzed to determine the effect of a remedial grouting program for sealing the bedrock foundation beneath the dam's structure.

Reference

Lucey, K.J., 1991, Analysis of the ground-water flow system, geochemistry, and underseepage in the vicinity of the Red Rock Dam, near Pella, Iowa: USGS Water-Resources Investigations Report 91-4092, 68 pages.

Figure 5.-- Aerial view of the State Highway 14 bridge over the Iowa River at Marshalltown, Iowa

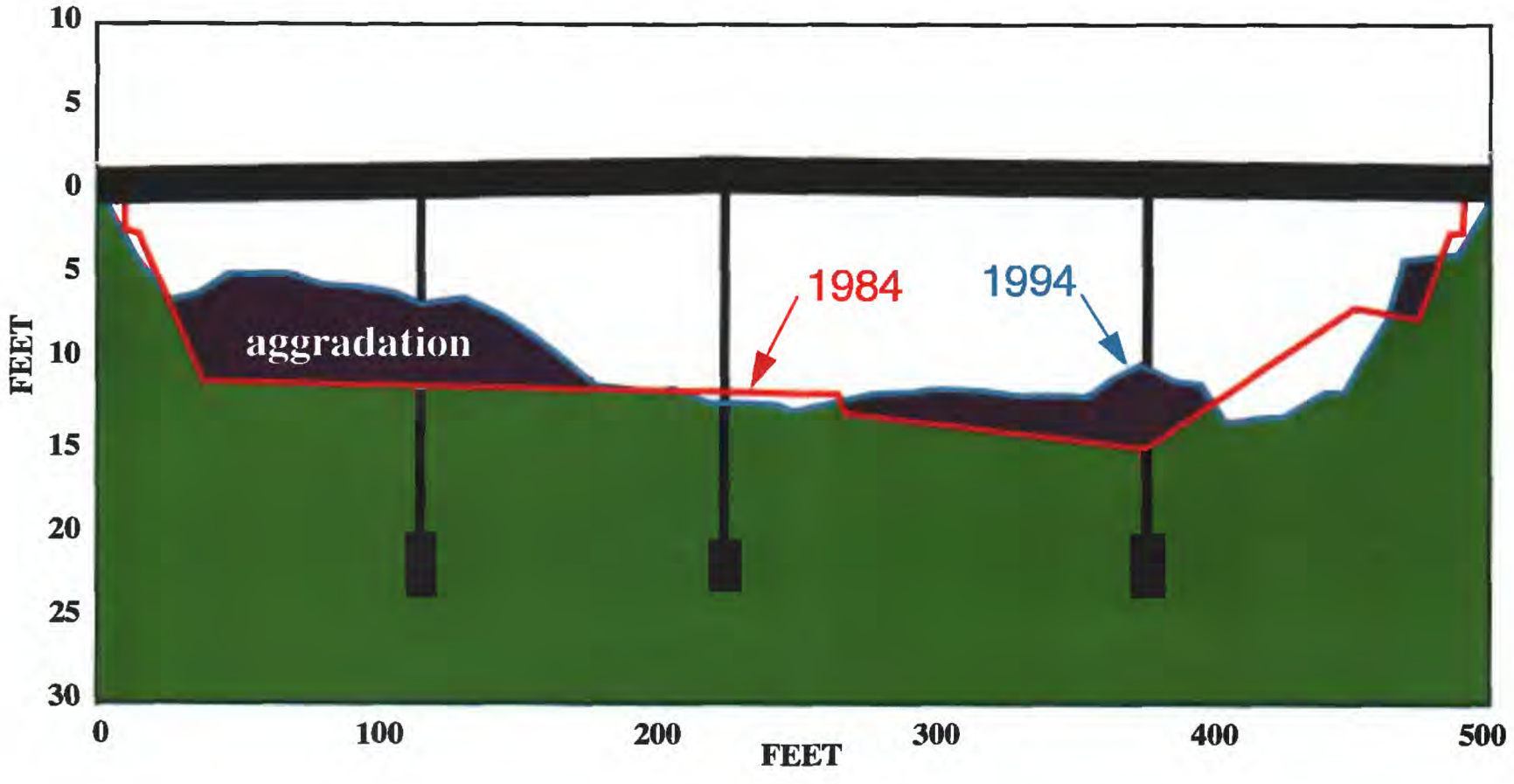


Figure 6.--Aggradation from 1984 to 1994 at the State Highway 14 bridge over the Iowa River at Marshalltown, Iowa

Installation of wells for environmental assessment

ENVIRONMENTAL ASSESSMENT

The USGS corporate knowledge of Iowa's geohydrology, comprehensive data bases of hydrologic and geologic information, specialized skills, and experience, and extensive resources make it well suited for environmental assessments.

Human impact on the environment, particularly its water resources, continues to be a major concern to Iowa and the Nation. To provide the specialized data-collection skills required by environmental assessments, USGS personnel have been trained to comply with the National Environmental Protection Act of 1976. Resources available from USGS include soil, water, and air sampling with associated analytical services, surface and borehole geophysics, drilling capabilities (auger, air/mud rotary, and pushrod), and experience in preparation of all required planning documents (Workplan, Sampling and Analysis Plan, Quality Assurance Plan, and Health and Safety Plan).

Technical Assistance for RCRA

For more than two years, the USGS has been providing technical assistance to the United States Environmental Protection Agency (USEPA) for the Federal Resource Conservation and Recovery Act (RCRA) within the State of Iowa. The technical assistance includes data collection and analysis, reviewing reports, assessing environmental conditions at selected RCRA sites, and technology transfers through training of USEPA staff.

Eastern Iowa Basins NAWQA Study Unit

The USGS's National Water-Quality Assessment Program (NAWQA) Study Unit in Iowa is located in eastern Iowa, including the Iowa, Cedar, Wapsipinicon, and Skunk River basins (Figure 7). The long-term goals of the NAWQA program are to describe the status of and trends in surface- and ground-water resources, and to identify the natural and human factors that affect their quality (Leahy and Thompson, 1994). Communication and coordination with local water-management officials and other water-resources agencies are key components of the program.

Reference

Leahy, P.P. and Thompson, T.H., 1994, U.S. Geological Survey National Water-Quality Assessment Program: USGS Open-File Report 94-70, 4 pages.

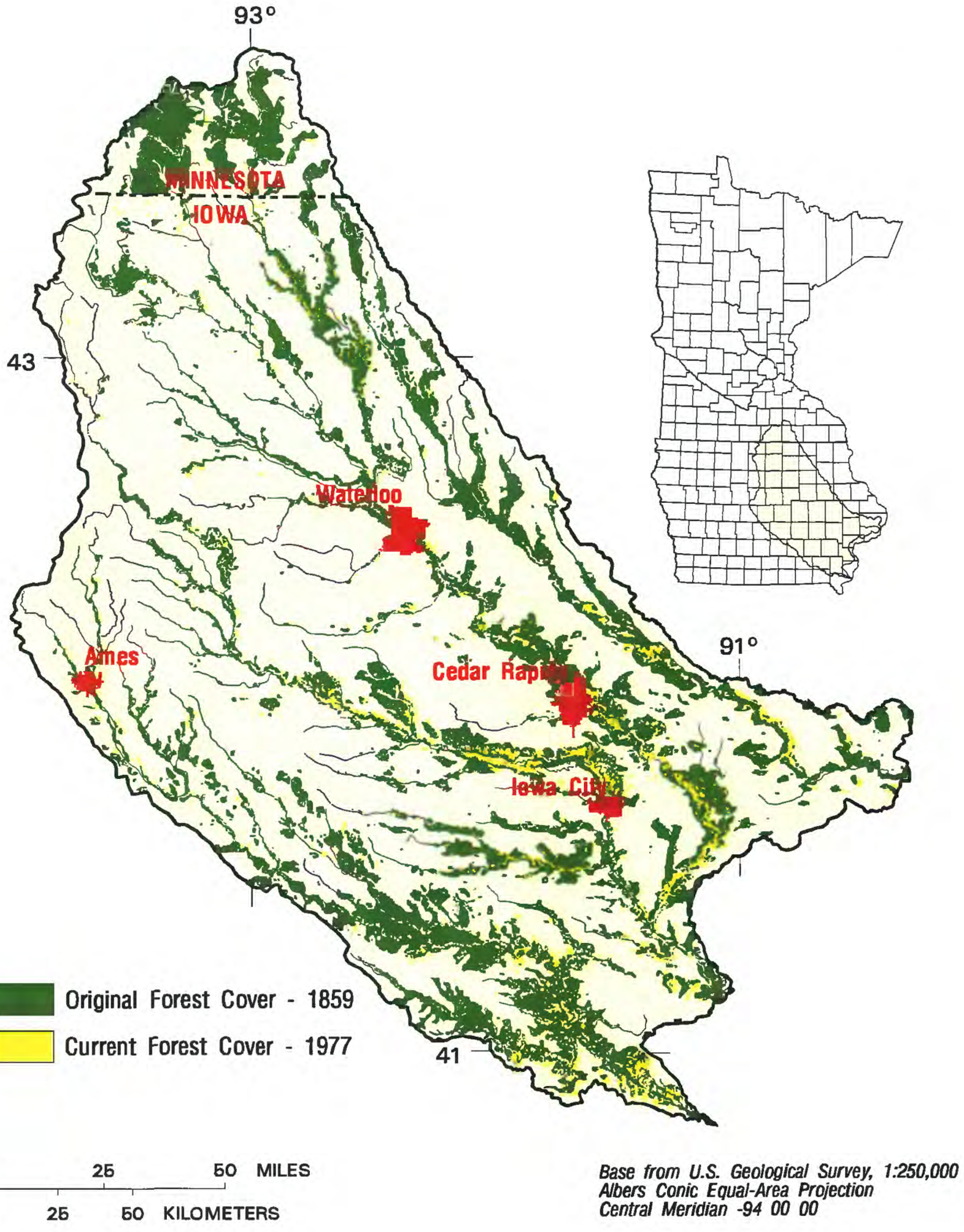


Figure 7.--Original and current forest cover in the NAWQA Study Unit

University of Iowa's Physical Plant on the Iowa River

WATER SUPPLY

"The United States possesses abundant water resources and has developed and used those resources extensively. The future health and economic welfare of the Nation's population depend on a continuing supply of uncontaminated freshwater."

W. B. Solley (1995)

The availability of ground and surface water for private, municipal, industrial, and agricultural use has been of utmost importance within Iowa. The assurance of high quality water for domestic use, quantities needed for industrial use, and the availability of water for agricultural activities have been critical issues statewide. Many of the activities of the USGS are directed at the numerous hydrologic and geologic issues associated with water supply. Examples include quantification of aquifer yields, simulating the hydrologic stress on aquifers and surface-water supplies, and documenting and projecting the changes in water quality.

USGS Water-Use Information Program

Since 1980, the USGS has been collecting and compiling reliable site-specific and aggregated water-use information for the State of Iowa. The data is collected and updated annually according to the guidelines established by the National Water-Use Information Program. Water-use information is then compiled and water usage estimates are published every five years.

City of Cedar Rapids Water Supply

The USGS, in cooperation with the Cedar Rapids Water Department, is determining the potential yield from the alluvial aquifer located along the Cedar River, identifying the potential threats to the quality of water in the aquifer, and providing a simulation of ground-water withdrawals under various projected water demands. Water-quality samples are being collected from the Cedar River, municipal wells, and observation wells to determine spatial and temporal variability in water quality (figure 8). Based upon the analysis of geophysical data (figure 9), the geographical extent of the alluvial aquifer has been mapped. A ground-water flow model is being developed to simulate flow in the aquifer.

Reference

Solley, W.B., 1995, United States Geological Survey National Water-Use Information Program: USGS Fact-Sheet FS-057-95, 4 pages.

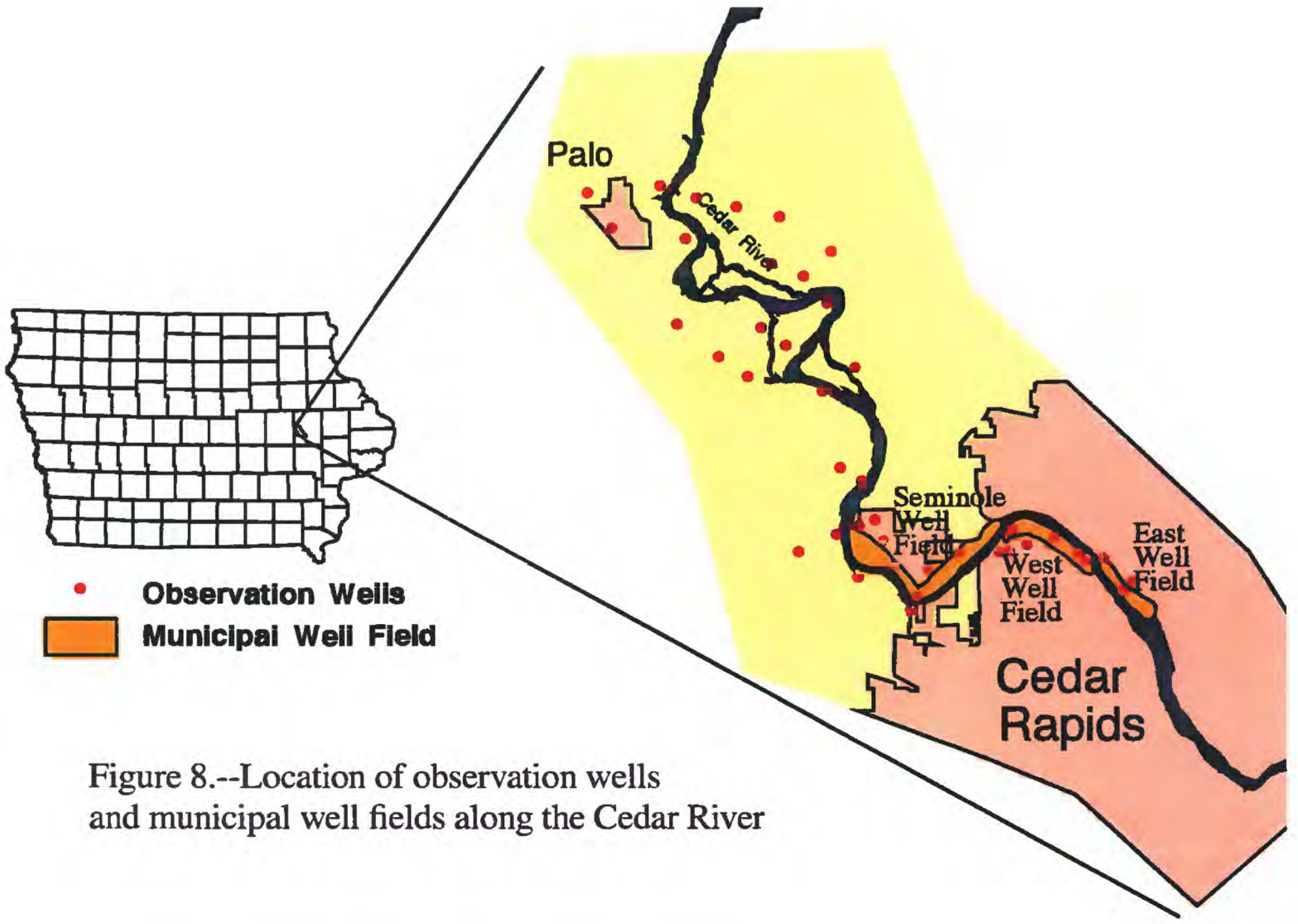


Figure 8.--Location of observation wells and municipal well fields along the Cedar River

Figure 9.--Photographs of marine seismic survey on the Cedar River (top) and a City of Cedar Rapids municipal water-supply well (right)

Abandoned farm well that is open to contamination

WATER QUALITY

Concerns that changing water quality may impair the capability of the State's water resources to meet future uses, including the impact upon the environment, are ever present. Those concerns range from the effects of land use change to urban storm water.

Degradation of the quality of the Nation's water resources is frequently caused by human impact on the environment. Information on the status, trends, and causes of water-quality conditions in the State is vital to decision makers who need to set policies, regulations, priorities, and manage the water resources of Iowa. Examples include determining the relative effects on water quality of various types of point and nonpoint sources, identifying priority aquifers requiring protection from contamination, identifying the extent and cause of water-quality problems, and demonstrations of successful implementations of best-management practices for mitigating water-quality problems.

Agricultural Chemical Transport

The processes governing how agricultural chemicals are transported from points of application to streams need to be understood in order to minimize contamination of those resources (Soenksen and others, 1992). The USGS, in cooperation with the United States Department of Agriculture's (USDA) Agricultural Research Service and Cooperative State Research Service, studied the transport of chemicals to Walnut Creek, located near Ames, Iowa.

Water Quality in an Alluvial Aquifer

Recent increases in concentrations of iron and manganese in an alluvial aquifer adjacent to the Mississippi River represented a potential threat to other supply wells in the area (figure 10). The USGS, in cooperation with Muscatine Power and Water, have been collecting water-quality samples from observation wells installed upgradient of the well field (figure 11). Data analysis of those samples will be used to determine the potential geochemical processes causing the large metal concentrations in the aquifer.

Reference

Soenksen, P.J., Hatfield, J.L., and Baker, J.L., 1992, Management Systems Evaluation Area--Iowa-Walnut Creek watershed: USGS Open-File Report 92-176, Water Fact Sheet, 2 pages.

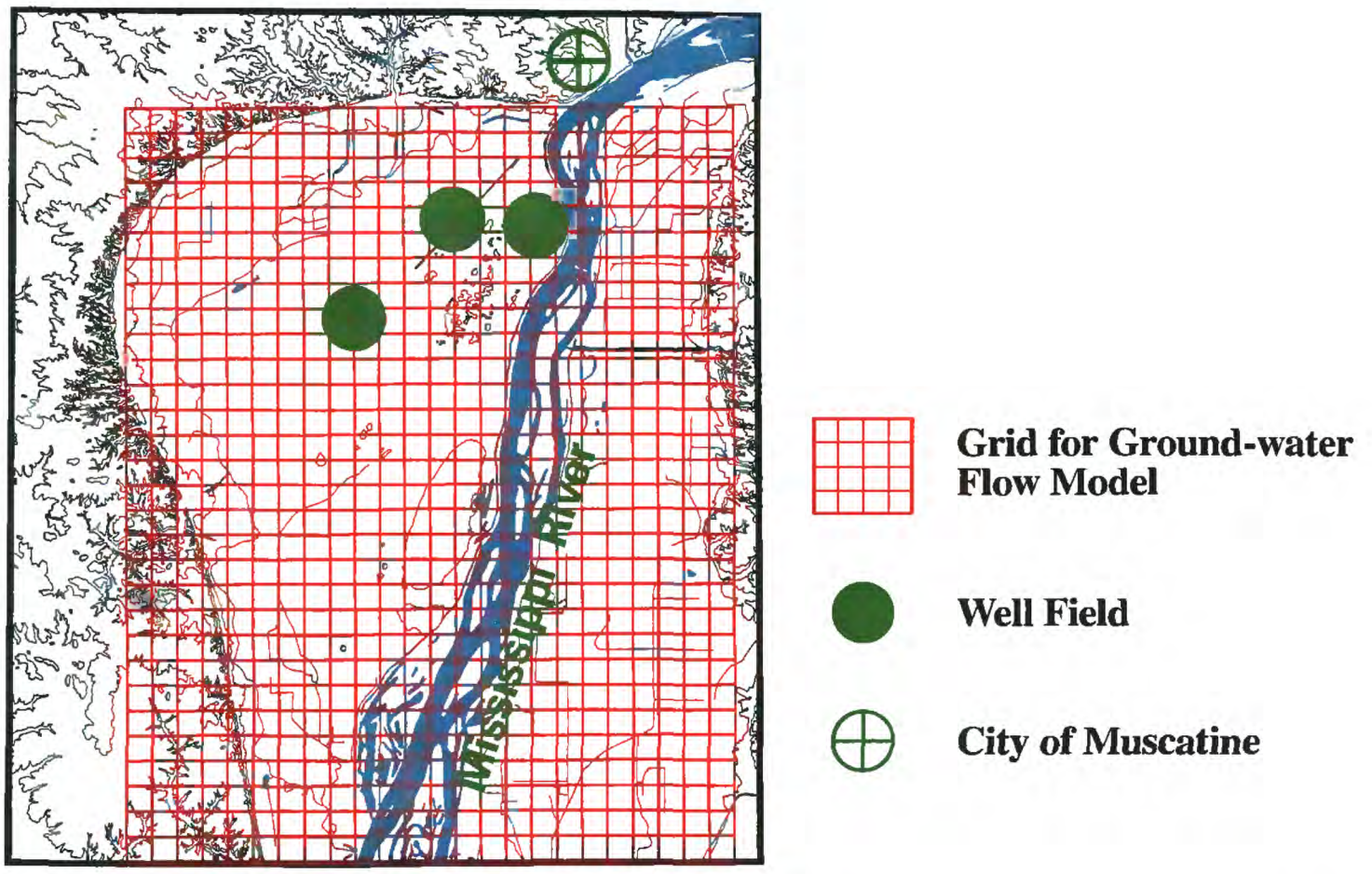
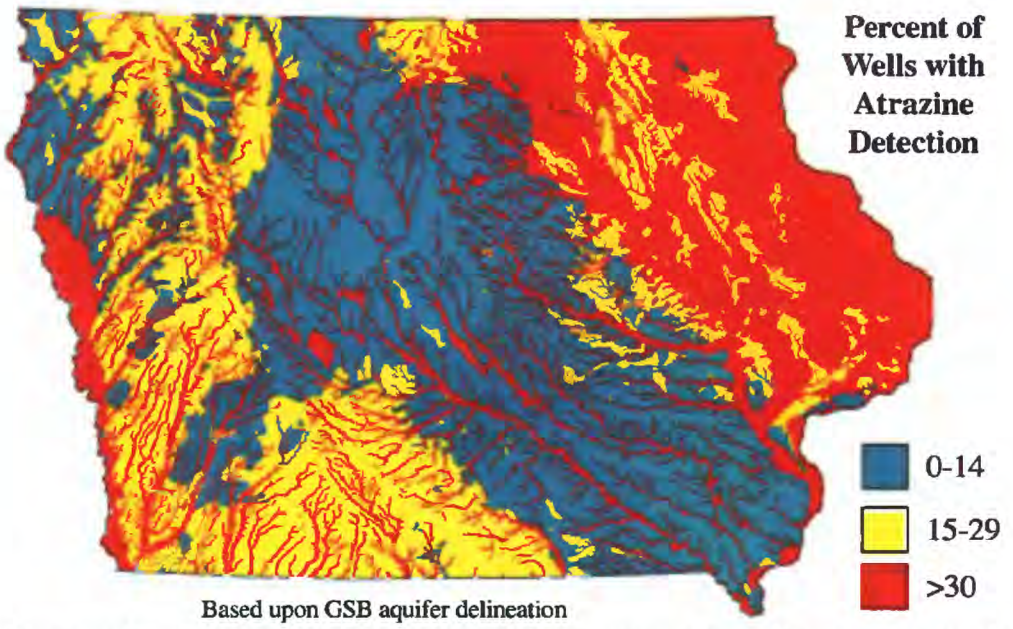


Figure 10.-- Location of study area for alluvial aquifer adjacent to the Mississippi River

Figure 11.-- Photograph showing water-quality data-collection in the well field



Geographic information for determining extent of aquifer contamination

GEOGRAPHIC INFORMATION

Recent advances in the use of satellite and high-altitude imagery, along with Geographic Information Systems, have produced highly useful map products.

Accurate, up-to-date map data serve as the fundamental framework to which all other land and resource data are spatially referenced to provide the basic information and analytical capability for resource decision making. USGS cartographic and thematic maps documenting the Earth's natural and constructed features and conditions represent the only spatial framework available for resource management and disaster mitigation. The USGS is responsible for coordinating Geographic Information Systems (GIS) coverages and planning a data framework for geospatial GIS information.

Land Cover and Land Use Coverages

Aerial photographs obtained from USDA, Consolidated Farm Service Agency were scanned and digitized to calculate the land cover and land use in a two-kilometer radius around a ground-water well (figures 12 and 13). The USGS developed the process to provide systematic calculation of land cover and land use around hundreds of wells in the Central Midwest. This was part of a study to determine the factors affecting the occurrence of agricultural chemicals in water resources.

Watershed Characteristics from DEM

The USGS developed a procedure to automatically calculate over 20 watershed characteristics using USGS Digital Elevation Models (DEM). The program uses GIS data that is readily available for the State of Iowa.

National Mapping Program

Among the most popular and versatile products of the USGS are its 1:24,000 topographic maps, of which 1,129 cover the State of Iowa. In cooperation with the Iowa Department of Natural Resources, the maps are now complete and available to the public.

Earth-Science Applications of Geographic Information Systems

The use of GIS has been found to enhance and broaden the usage of Earth-science data. The USGS has used GIS in a variety of applications, including ground-water modeling and analysis of water-quality data. Coverages available for selected areas in Iowa include the following:

Data Network Sites
Demographics
Digital Elevation Models
Drainage Basins
Geology
Hydrography
Land Cover
Land Use
Precipitation
Political Boundaries
Roads
Shaded Relief Map
Soils
Streams
Water Wells
Wetlands

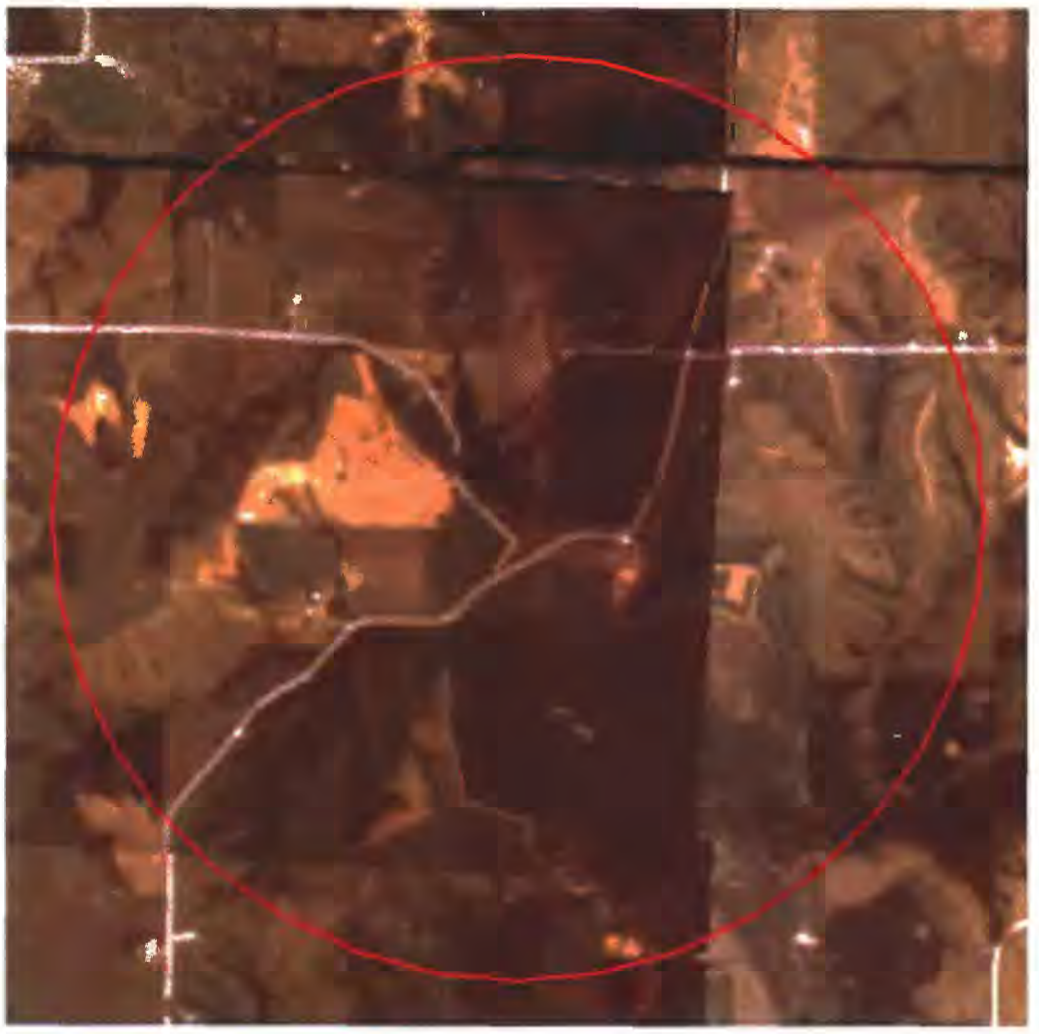
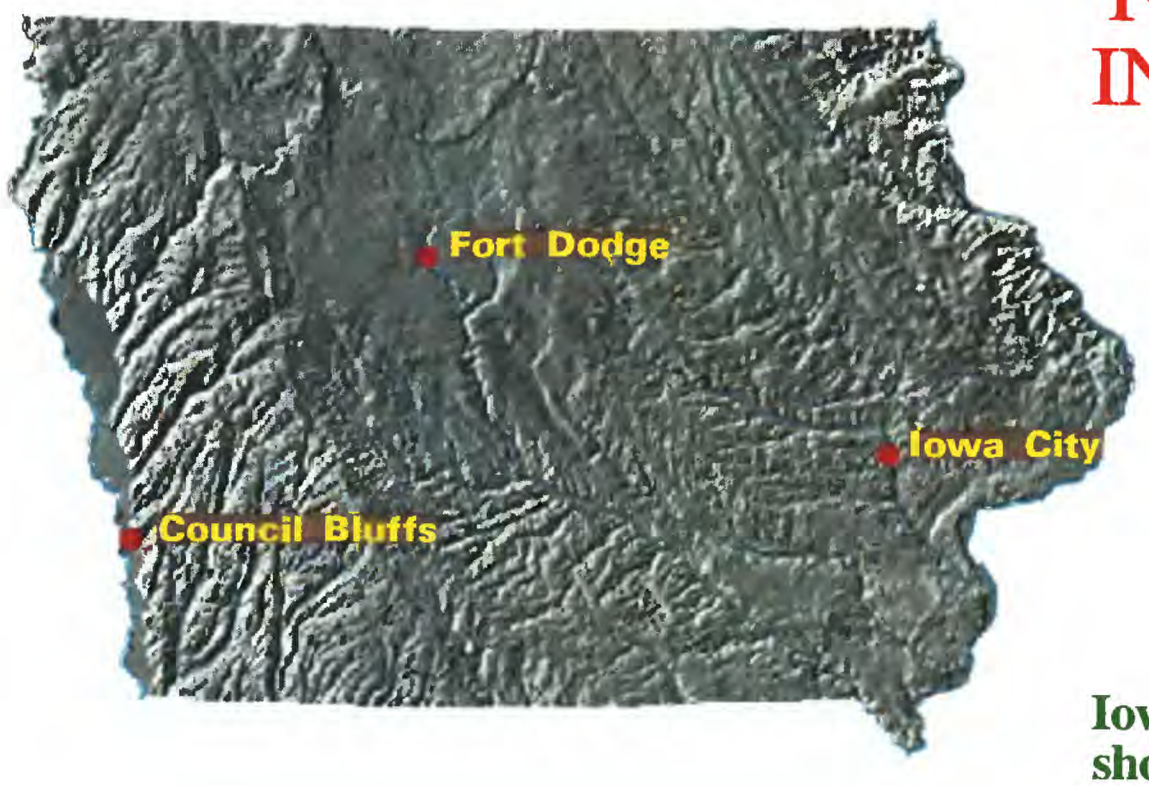


Figure 12.--Example of aerial photography used in an investigation of the effects land use may have on concentrations of pesticides and nitrate in ground water. Scene is from Union County, Iowa (photograph from USDA, Consolidated Farm Service Agency). The red circle is a two-kilometer radius around the water well.

Figure 13.--Example of land-use information compiled from photograph in Figure 12. The land use is for the area within the two-kilometer circle around the water well. This data will be used to investigate the effects land use may have on concentrations of pesticides and nitrate in ground water.

FOR FURTHER INFORMATION



Iowa USGS office locations shown with topography and major rivers

USGS CONTACTS IN IOWA

The primary contact for the USGS in Iowa is the State Representative located in Iowa City:

State Representative
U.S. Geological Survey
Room 269, Federal Building
400 South Clinton Avenue
P.O. Box 1230
Iowa City, Iowa 52244
319-337-4191
FAX: 319-358-3606

The Director's Representative will be able to provide information on water resources, geologic, and mapping activities within the State of Iowa. USGS offices within Iowa are:

District Office in Iowa City, Iowa

Field Office in Council Bluffs, Iowa

Field Office in Fort Dodge, Iowa

INTERNET AND WORLD WIDE WEB

Additional Earth-science information can be found by accessing the USGS Homepage (Figure 14) on World Wide Web (WWW) at:

http://www.usgs.gov

Specific information for Iowa can be obtained from the Iowa District Homepage in the WWW at:

http://dg00diaiwc.cr.usgs.gov/index.html

The Iowa Homepage includes:

- Iowa Fact Sheet
- Active USGS Projects in Iowa
- Current Hydrologic Conditions
- Historical Hydrologic Conditions
- Other USGS WWW Sites and Other Government Agencies
- GIS links on the WWW

USGS REPORTS AND PRODUCTS

For more information on all USGS reports and products (including maps, images, and computerized data), call **1-800-USA-MAPS**

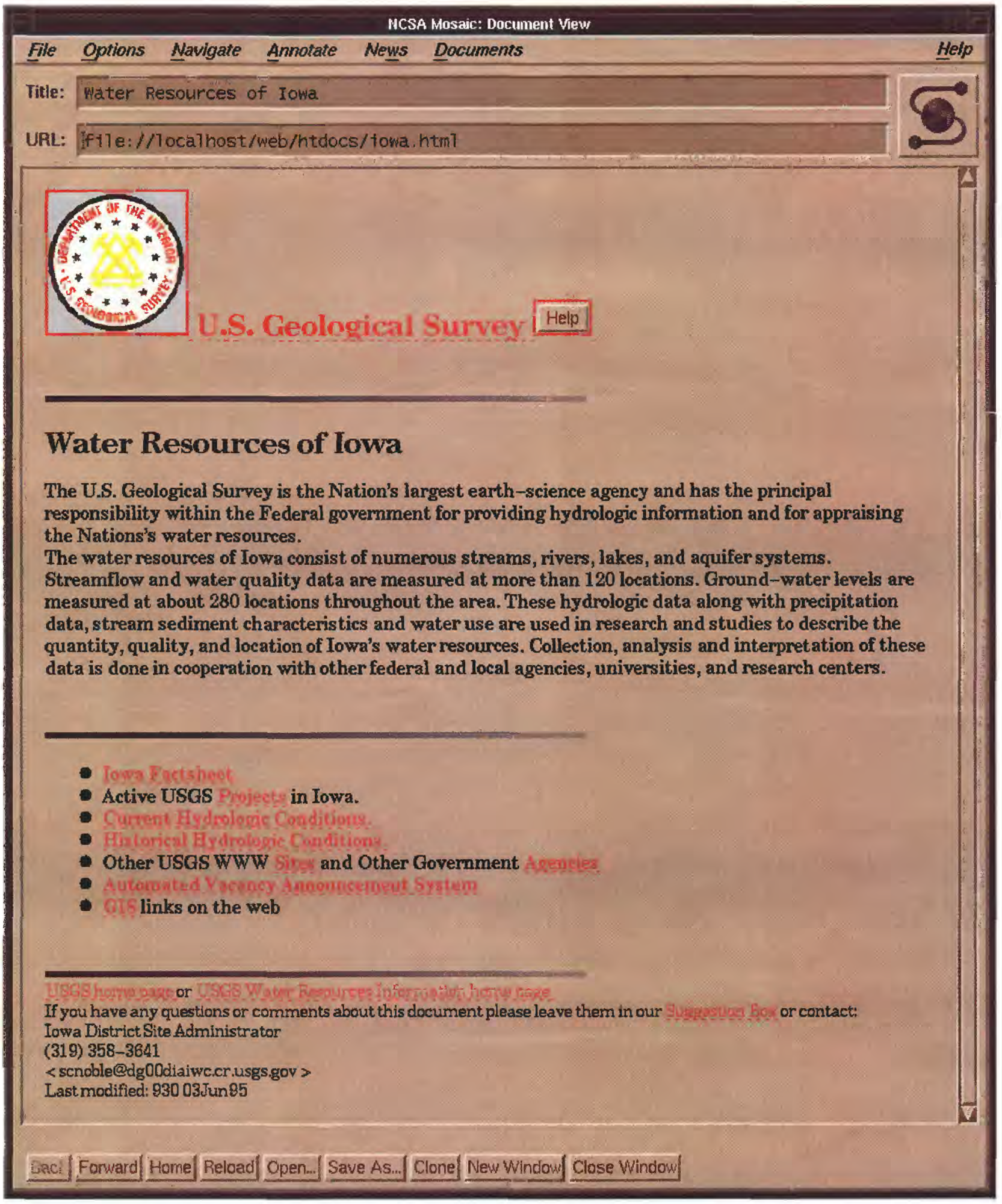


Figure 14.--Image of USGS Iowa Homepage on the World Wide Web in Mosaic