

United States Geological Survey

Programs in Illinois



The USGS provides maps, reports, and information to help others meet their needs to manage, develop, and protect America's water, energy, mineral, and land resources. We help find natural resources needed to build tomorrow, and supply scientific understanding needed to help minimize or mitigate the effects of natural hazards and environmental damage caused by human activities. The results of our efforts touch the daily lives of almost every American.

Coastal Erosion of Lake Michigan

Record high-water-surface elevations of Lake Michigan occurred from 1985–1987; peak water-surface levels periodically reached during this century have been successively higher than the last. Storm waves superimposed on high water-surface levels have caused extensive and costly damage to the Illinois shoreline, and particularly Chicago lake-front businesses, parks, and condominiums. U.S. Geological Survey (USGS) studies have shown:

- That prehistoric lake-level fluctuations have been at least twice as great as those observed historically;
- Why and where the structures supporting the shoreline are failing; and,
- Why and where the sand, which normally protects the shoreline and maintains the beaches, is being depleted.

The USGS study of the Chicago shoreline support structures serves as a basis for planning extensive reconstruction. Understanding sand movement by mapping lake-bottom physiography and sediment distribution by using sidescan sonar imagery and seismic reflection geophysical techniques (fig. 1) can save millions of dollars in beach replenishment and maintenance costs. To carry out this study, the USGS has worked closely with researchers from the Illinois State Geological Survey, several Illinois universities, the U.S. Army Corps of Engineers, and the National Oceanic and Atmospheric Administration.

Rainfall–Runoff Studies in Urban Areas

Rapid urbanization of drainage areas has often led to unanticipated higher peak flows and increased frequency of floods

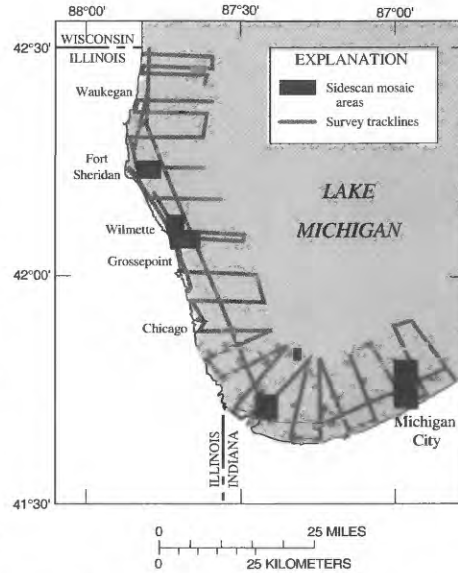


Figure 1. Southern Lake Michigan showing areas surveyed by using sidescan sonar imagery and seismic reflection track lines. Together, these data provide the basis for preparing lake-bottom maps of physiography and sediment distribution.

downstream. Collection of rainfall and streamflow data is being done in several suburban counties of Metropolitan Chicago that are undergoing rapid development. Distributed-parameter, continuous-simulation, rainfall-runoff models have been calibrated to a variety of watershed conditions. A one-dimensional unsteady-flow model, Full Equations Hydraulic Routing Model, for flood-flow computations with instream controls and obstructions, such as dams, culverts, and bridge piers, is being verified and documented.

A detailed description of the characteristics and responses of rainfall-runoff during large storms for various land-use types is necessary for the application of storm data to planning, design, and management of roads, bridges, culverts, and dams. Solutions for mitigating anticipated stormwater runoff can be included in zoning restrictions and construction plans for future development in areas undergoing

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rapid urbanization. Cooperators on these studies are the Du Page County Department of Environmental Concerns, the Lake County Stormwater Management Commission, and the Illinois Department of Transportation, Division of Water Resources.

Coal, Toxic Elements, and the Economy

The Illinois Sedimentary Basin, which underlies the State of Illinois, comprises layers of coal that contain elevated levels of toxic elements, such as cadmium and lead. When the coal is burned, these toxic elements are released to the atmosphere. Because of this environmental problem, coal companies may have to look elsewhere for clean coal, which would adversely affect the economy of the region.

Coal production in the Illinois Basin has declined over the past two decades, even though it has the largest resource of bituminous coal in the United States. This decline is due, in part, to a lack of comprehensive information about the quality of the major coal deposits in the basin, in particular the occurrences and distributions of sulfur and other potentially hazardous air-pollutant elements. The Illinois

State Geological Survey (ISGS) and the USGS initiated a major effort to expand significantly information on the quality of Illinois Basin coals. The USGS is providing coal-element analyses and geochemical models to estimate variability of trace metals in coals in the Basin. The ISGS is providing field expertise for collection and documentation of coal samples and interpretation of results. The study has resulted in the creation of a coal-quality digital data base and the production of various coal-quality maps as data become available. These products can be used by coal producers, the coal utilization industry, and regulatory agencies to identify coal resources having specific composition for various uses.

Oil and Gas Resources

The State of Illinois has a long history of exploration and production of oil and gas. Most of the State has been explored thoroughly for oil and gas, yet there are areas that are underexplored relative to new resources located at great depths in the Illinois Basin. A technique to estimate the undiscovered amount of oil and gas can be determined from available data on the total amount of resources that the basin could produce and how much has actually been produced. This technique, known as the mass balance method, primarily uses geochemical data to predict the hydrocarbon expulsion capacity of source rocks to predict how much oil and gas can ultimately be generated in an area. Indications are that the Illinois Basin has not reached its prime-producing capacity and still could supply the Nation with much-needed clean-burning natural gas. As part of its national gas and oil assessment, the USGS is working with the ISGS to determine and refine oil and gas plays in the State.

National Water-Quality Assessment Program

Sedimentation in the Illinois River Basin has resulted in the shallowing of navigation pools and backwater lakes on the Illinois River and the loss of aquatic habitat. The navigation pools, established when lock and dam structures were built on the Illinois River, are silting up and the navigation channel has to be continually dredged to allow barge traffic. Fish and migratory bird

populations are being adversely affected by a loss of food and habitat as a result of increased sediment loads in the water and sediment deposition in the aquatic habitats. A highly productive fishery on the Kankakee River, a tributary of the Illinois River, is thought to have been diminished by increased sedimentation due to channelization upriver in Indiana.

Recently, the USGS National Water-Quality Assessment (NAWQA) Program has started a study of the lower Illinois River Basin and completed a study of the upper Illinois River Basin (fig. 2). The identification of the magnitude and trends of the sedimentation problem is a major thrust of both studies. Other objectives include identifying source areas and volumetric trends of sedimentation on the lower Illinois River and the distribution of the organic and inorganic content of the sediment on the upper Illinois River. Sedimentation studies on the Kankakee River include dendrochronologic techniques to establish historic trends in flood-plain deposition of sediment. The NAWQA Programs in Illinois have established liaison committees with representatives from Federal, State, and local agencies, such as the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, and the Metropolitan Water Reclamation District of Greater Chicago. These liaison committees identify the important topics for study, coordinate cooperative data-collection efforts, and evaluate the adequacy of the data to fulfill the needs of the study. The USGS also is cooperating with the Illinois Department of Conservation to determine a detailed sediment budget for a navigation pool on the lower Illinois River.



Figure 2. National Water-Quality Assessment Program study units in Illinois.

Earthquake Hazards

In the past decade, there has been increasing awareness that the seismic hazard in the Eastern United States may be greater than the historic earthquake record would suggest. Recent discoveries have shown evidence of at least seven strong earthquakes. This region has experienced at least 40 felt earthquakes since 1875. An earthquake of magnitude 7.5 struck about 6,000 years ago in the Wabash River Valley near the Indiana-Illinois border. Numerous other prehistoric earthquakes of magnitude 6 to 7 have struck southern Indiana and Illinois. According to USGS studies, geologic evidence of these earthquakes in the form of liquefaction-induced intrusions of sand and gravel in river sediments has been discovered at more than a hundred sites in the Wabash River Valley and along its tributaries. These intrusions permit the use of geologic, archaeologic, and engineering techniques to determine when the earthquakes occurred, as well as their epicenters and approximate magnitudes. This work was carried out in cooperation with the Illinois State Museum.

Hazardous-Waste Studies

Site-characterization studies of several Superfund sites are being conducted by the USGS, in cooperation with the U.S. Environmental Protection Agency (USEPA), Region V. The USGS is contributing technical expertise, such as borehole logging, aquifer-test analysis, and water-quality sampling and analysis, to the USEPA to aid in understanding the geologic and hydrologic characteristics of the study areas. These studies also establish an understanding of the concentration and distribution of soil and ground-water contamination in preparation for site remediation.

Lake Michigan Diversion Accounting

Joint ownership of the Great Lakes by the United States and Canada has necessitated regulation of the diversion of the water from the Lakes. Historically, water has been diverted down the Illinois River (through the Chicago River and associated waterways) by the State of Illinois to carry sanitary sewage away from Lake Michigan and allow barge traffic on the Illinois River between the Mississippi River and Chi-

cago. The most recent U.S. Supreme Court decree (December 1, 1980) regulating the diversion of water from Lake Michigan limits diversion in Illinois. The U.S. Army Corps of Engineers (COE) has determined that Illinois has exceeded the 3,200-cubic-foot-per-second limit for the 1986 to 1989 water years.

Water allocated from Lake Michigan for Illinois is a finite resource for which there are competing needs. The best possible accounting of the various components of the water diversion ensures that the water is effectively and efficiently used. The USGS is cooperating with the COE; the Illinois Department of Transportation, Division of Water Resources; and the Metropolitan Water Reclamation District of Greater Chicago to refine various components of the Lake Michigan diversion accounting. The USGS is applying current techniques and technology, such as Doppler acoustic-flow profilers, acoustic velocity meters, and dye dilution to measure more accurately the flow in the Chicago River and the Chicago Sanitary and Ship Canal, and leakage through the lakefront diversion-control structures. Previous estimated values of leakage through the diversion-control structures were too low, and the water-budget accounting was adjusted accordingly. More accurate measurements of flow in the Chicago Sanitary and Ship Canal have enabled the COE and other agencies to account for and manage the diversion of water from Lake Michigan more accurately.

Collection of Hydrologic Data

Surface- and ground-water and water-quality data are needed for surveillance, planning, design, hazard warning, operation, and management in water-related fields, such as water supply, hydroelectric power generation, flood control, irrigation, bridge and culvert design, wildlife management, pollution abatement, flood-plain management, and water-resources development. The USGS, in cooperation with more than 20 Federal, State, and local agencies, collects streamflow, ground-water-level, and water-quality data (figs. 3, 4) throughout the State.

Landslide Hazards

Landslides are of local concern in Illinois because they have been responsi-

ble for at least \$8 million in documented damages since 1928. Repair of individual landslides has cost as much as \$980,000. The USGS has assisted the Illinois State Geological Survey in compiling an inventory of landslide locations by using published sources of information. The compiled data show that most landslides in the State have been induced by construction activities and that most occur along the Illinois and the Mississippi Rivers. Land-

slide action along a 15-mile stretch of coastal bluffs on Lake Michigan north of Chicago has resulted in erosion and retreat of the bluffs that averages more than 9 inches per year and locally exceeds 3 feet per year. An inventory map of locations of severe problems assists developers, businesses, and local governmental agencies to develop mitigation strategies.

Geologic Mapping

The USGS has on-going cooperative mapping programs with the Illinois State Geological Survey involving identification of coal resources for public-energy needs, delineating of glacial deposits for determining of sand and gravel resources, and identifying aquifers susceptible to surficial contamination. These programs also include structural studies of southern Illinois to assess the character and extent of earthquake hazards associated with the New Madrid Fault Zone.

National Mapping Program

Among the most popular and versatile products of the USGS are its topographic maps at the scale of 1:24,000 (one inch on the map represents 2,000 feet on the ground). These maps depict basic natural and cultural features of the landscape, such as lakes and streams, highways and railroads, boundaries, and geographic names. Contour lines are used to depict the elevation and shape of terrain. Illinois is covered by 1,072 maps at this scale, which is useful for civil engineering, land-use planning, natural resource monitoring, and other technical applications. These maps have long been favorites with the general public for outdoor uses, including hiking, camping, exploring, and back-country fishing expeditions.

The USGS has jointly funded and produced printed maps for many years and, more recently, computerized geographic and cartographic data in cooperation with Federal, State, and county governmental agencies in Illinois. Agencies that are currently (1995) participating in the joint production of digital mapping data include the Illinois State Geological Survey, Department of Energy and Natural Resources; the Illinois Department of Transportation; and Lake County. The resulting data serve many of geographic



Figure 3. Sites with water-quality data in Illinois.



Figure 4. Surface-water data-collection sites in Illinois.

information system applications in addressing various natural-resources, conservation, waste-disposal, emergency, hazard, and other environmental and societal issues confronting the State's citizens.

Currently (1995), cartographic production in Illinois that is partially funded or produced in partnership with the USGS includes 1:100,000-scale topographic county maps, 1:24,000-scale digital contour files, 1:24,000-scale digital raster graphics, digital elevation models, 1993 statewide aerial photographs, digital image photographs, and updated 1:24,000-scale topographic maps.

Earth Observation Data

Through its EROS Data Center near Sioux Falls, South Dakota, the USGS distributes a variety of aerial photographs and satellite image data products that cover the entire State. Mapping photographs of some sites go back about 40 years. Satellite images dating from 1972 can be used to study changes in regional landscapes.

Illinois Mapping Advisory Committee

The Illinois Mapping Advisory Committee (IMAC) currently serves as the primary statewide geographic information system (GIS) coordination body for Illinois. Representatives to IMAC are volunteers from various Federal, State, and local governmental agencies, academia, and the private sector. Meetings feature

presentations on mapping and GIS issues, demonstrations, information exchange, and USGS representatives participate in these meetings and provide updated information on USGS programs, services, and data availability.

These activities in Illinois exemplify how government agencies can work together to reduce duplication of effort and resources while increasing efficiency in managing their respective responsibilities. Increased future cooperation and savings are likely because many of these agencies require much of the same data to accomplish their different missions.

Coastal Wetlands

Coastal wetlands of Lake Michigan protect the drinking water and shoreline communities of Illinois. Many processes have been interacting to cause the deterioration of Great Lakes wetlands ever since the glaciers melted. Cores are being collected and analyzed to correlate the similarities and differences in the wetlands of the States that border the Great Lakes. The analysis delineates high stands of the lakes, timing of onset of peat deposition, changing climatic regimes, history of wetland deterioration and regrowth, and history of early human effects on the wetlands. Work on developing a map based on land use and physical features of areas that border the Great Lakes is underway by using geographic information system data coverages. Monitoring the trajectory of change in the wetlands through time by using these maps will provide a predictive

tool of use to land-use planners, political entities that sort out conflicting best management practices, and scientists trying to understand geological limits on biodiversity. The ability to predict the response of Illinois' coastal wetlands to natural processes and human activities has required close cooperation with the Illinois State Geological Survey, the Morton Arboretum, the Chicago Department of Engineering and Public Works, the Field Museum of Natural History, as well as with the National Wetlands Inventory of the U.S. Fish and Wildlife Service.

Cooperative Programs

The USGS cooperates with more than 40 Federal, State, and local agencies in Illinois. Cooperative activities include water-quantity and water-quality data collection, interpretive hydrologic studies, mineral-resource assessments, and mapping. Activities typically are funded on a matching-funds basis when State and local agencies are supporting the effort. The USGS cooperates with the Illinois State Geological Survey, the U.S. Army Corps of Engineers, the Illinois Department of Transportation, the U.S. Environmental Protection Agency, and the Metropolitan Water Reclamation District of Greater Chicago, to name only a few.

The USGS provides support to the Illinois Water Resources Center, which conducts a program of research, education, and information and technology transfer.

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Additional earth science information can be found by accessing the USGS "Home Page" on the World Wide Web at "<http://www.usgs.gov>".

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