Volume 1

Geology

FOX RIVER AREA ASSESSMENT

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

FOX RIVER AREA ASSESSMENT

VOLUME 1: GEOLOGY

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About This Report

The Fox River Area Assessment examines an area situated along the Fox River which spans eleven counties in north-eastern Illinois. Because significant natural community and species diversity is found in the area, it has been designated a state Resource Rich Area.

This report is part of a series of reports on areas of Illinois where a public-private partnership has been formed. These assessments provide information on the natural and human resources of the areas as a basis for managing and improving their ecosystems. The determination of resource rich areas and development of ecosystem-based information and management programs in Illinois are the result of three processes -- the Critical Trends Assessment Program, the Conservation Congress, and the Water Resources and Land Use Priorities Task Force.

Background

The Critical Trends Assessment Program (CTAP) documents changes in ecological conditions. In 1994, using existing information, the program provided a baseline of ecological conditions.[1] Three conclusions were drawn from the baseline investigation:

1. the emission and discharge of regulated pollutants over the past 20 years has declined, in some cases dramatically,
2. existing data suggest that the condition of natural ecosystems in Illinois is rapidly declining as a result of fragmentation and continued stress, and
3. data designed to monitor compliance with environmental regulations or the status of individual species are not sufficient to assess ecosystem health statewide.

Based on these findings, CTAP has begun to develop methods to systematically monitor ecological conditions and provide information for ecosystem-based management. Five components make up this effort:

1. identify resource rich areas,
2. conduct regional assessments,
3. publish an atlas and inventory of Illinois landcover,
4. train volunteers to collect ecological indicator data, and
5. develop an educational science curriculum which incorporates data collection

At the same time that CTAP was publishing its baseline findings, the Illinois Conservation Congress and the Water Resources and Land Use Priorities Task Force were presenting their respective findings. These groups agreed with the CTAP conclusion that the state's

[1] See *The Changing Illinois Environment: Critical Trends*, summary report and volumes 1-7.

ecosystems were declining. Better stewardship was needed, and they determined that a voluntary, incentive-based, grassroots approach would be the most appropriate, one that recognized the inter-relatedness of economic development and natural resource protection and enhancement.

From the three initiatives was born Conservation 2000, a six-year program to begin reversing ecosystem degradation, primarily through the Ecosystems Program, a cooperative process of public-private partnerships that are intended to merge natural resource stewardship with economic and recreational development. To achieve this goal, the program will provide financial incentives and technical assistance to private landowners. The Rock River and Cache River were designated as the first Ecosystem Partnership areas.

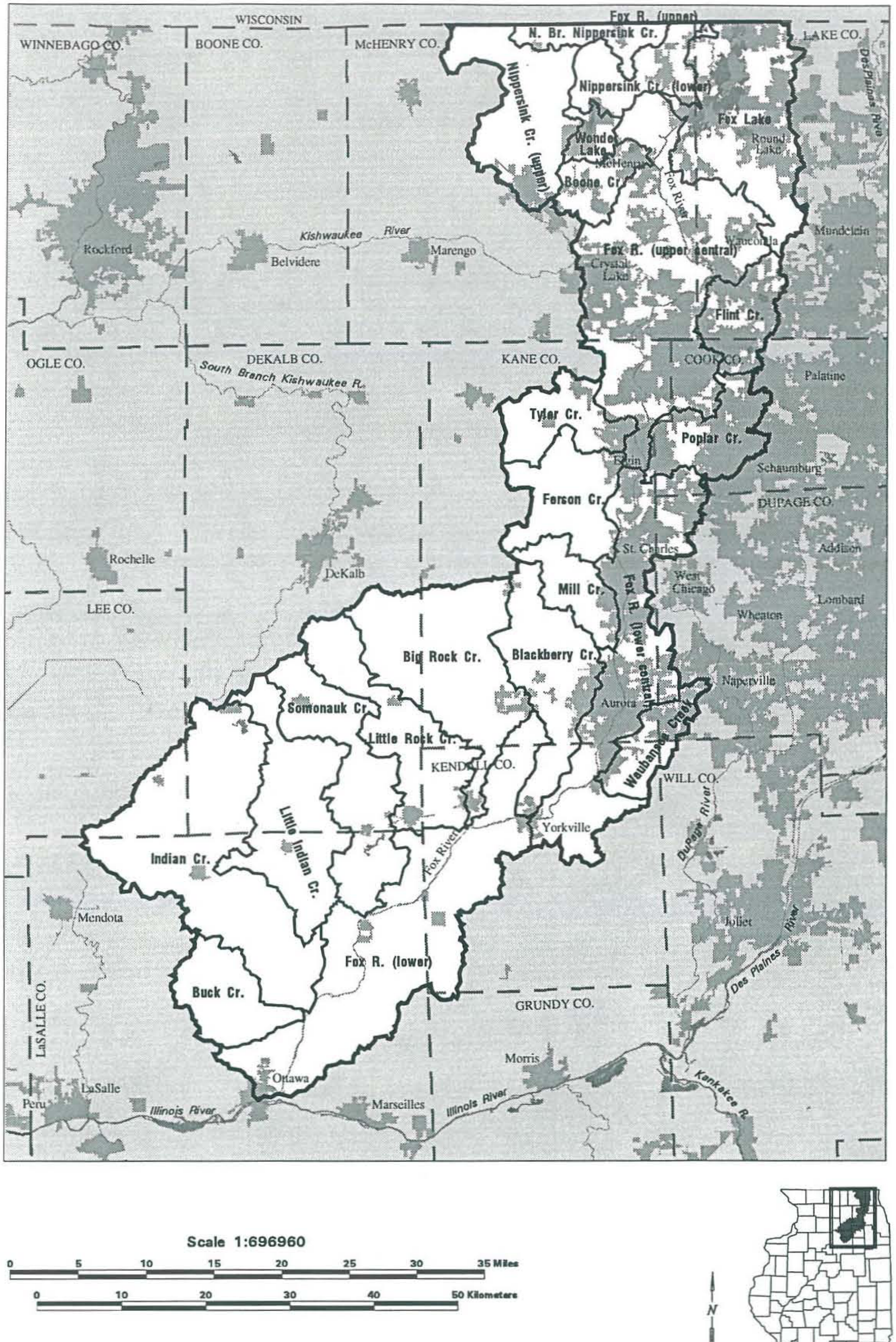
At the same time, CTAP identified 30 Resource Rich Areas (RRAs) throughout the state. In RRAs where Ecosystem Partnerships have been formed, CTAP is providing an assessment of the area, drawing from ecological and socio-economic databases to give an overview of the region's resources -- geologic, edaphic, hydrologic, biotic, and socio-economic. Although several of the analyses are somewhat restricted by spatial and/or temporal limitations of the data, they help to identify information gaps and additional opportunities and constraints to establishing long-term monitoring programs in the partnership areas.

The Fox River Area Assessment

The Fox River assessment covers an area of approximately 1,720 mile (1,092,874 acres) spanning eleven counties in north-eastern Illinois, including parts of Lake, McHenry, Kane, Cook, Kendall, DeKalb, and LaSalle counties, and small parts of Lee, DuPage, Will, and Grundy counties. The boundaries of the assessment area coincide with the boundaries of the Illinois portion of the Fox River Basin. This area encompasses 22 subbasins of the Fox River watershed (identified by the Illinois Environmental Protection Board), from the Illinois-Wisconsin border to the confluence of the Fox and Illinois Rivers at Ottawa, Illinois. This is a distance of 115 miles along the river. The northernmost eight subbasins, totaling 285,844 acres, have been designated as a "Resource Rich Area" because they contain significant natural community diversity. The Fox River Ecosystem Partnership was subsequently formed around this core area of high quality ecological resources.

This assessment is comprised of five volumes. In Volume 1, *Geology* discusses the geology, soils, and minerals in the assessment area. Volume 2, *Water Resources*, discusses the surface and groundwater resources and Volume 3, *Living Resources*, describes the natural vegetation communities and the fauna of the region. Volume 4 contains three parts: Part I, *Socio-Economic Profile*, discusses the demographics, infrastructure, and economy of the area, focusing on the six counties with the greatest

Major Drainage Basins of Illinois and Location of the Fox River Assessment Area



Subbasins in the Fox River assessment area. Subbasin boundaries depicted are those determined by the Illinois Environmental Protection Agency.

amount of land in the area -- DeKalb, Kane, Kendall, Lake, LaSalle, and McHenry counties; Part II, *Environmental Quality*, discusses air and water quality, and hazardous and toxic waste generation and management in the area; and Part III, *Archaeological Resources*, identifies and assesses the archaeological sites, ranging from the Paleo-Indian (B.C. 10,000) to the Postwar Industrial (A.D. 1946), known in the assessment watershed. Volume 5, *Early Accounts of the Ecology of the Fox River Area*, describes the ecology of the area as recorded by historical writings of explorers, pioneers, early visitors and early historians.

Contributors

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Introduction: Influence of Geology and Soils on Ecosystem Development

Geology is . . . the original source of inorganic chemical nutrients for the biosphere and provides the abiotic physical environment of the biosphere. Through knowledge of rock type mineralogy, the geologist can predict the amount and variety of toxic or beneficial inorganic chemical nutrients present. . . . Geological processes modifying geologic materials create landforms that are commonly a basis for land unit hierarchies. Geologists can increase understanding of land unit hierarchies in ecosystem studies. . . . Geologists can be critical players in understanding ecosystems."[1]

The "Natural Divisions of Illinois" is a classification of the natural environments and biotic communities of Illinois based on physiography, flora, and fauna. . . . Factors considered in delimiting the 14 natural divisions are topography, soils, bedrock, glacial history, and the distribution of plants and animals.[2]

In the few areas of the earth that have not been modified by human settlement, the patterns of vegetation and the animals that interact with vegetation are directly influenced by geological factors. In fact, in undisturbed areas, surficial geology and to some extent bedrock geology can be mapped using inferences drawn from vegetation patterns observed on air photographs and satellite images and during field observations. For example, in the pristine terrains of northern North America, ecosystem variations were used to infer and eventually map underlying geological conditions.

The geological characteristics that most influence ecosystem development are soil moisture and composition, topography (including slope angle, slope direction, and local drainage), and texture of the parent material. In some places, geological events such as earthquakes, glacial advances and retreats, and volcanic eruptions exert a strong influence over ecosystems. Even animal activities that are seemingly removed from geological control are influenced by geological factors such as availability of salt for migrating herds, availability of suitable vegetation for food, or—in the case of carnivores—suitable colonies of prey that congregate near geologically controlled food sources.

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[1] P. Hughes, A geologic response to the Seventh American Forest Congress and Round Tables: Environmental Geology 28 (1) July 1996, p. 52–53.

[2] Comprehensive Plan for the Illinois Nature Preserves System, Part 2, The Natural Divisions of Illinois, John E. Schwegman, principal author, 1984, Illinois Nature Preserves Commission, p. 3.

In uninhabited areas of the glaciated North American Arctic, ridges of gravel (eskers) left by retreating glaciers served as transportation routes for early humans and animals alike. The ridges provided ease of footing, vantage points for hunters or the hunted, and protection from ravenous insects that prefer the calmer air of low-lying areas. Even in modern America, roads in New England are often constructed on these ridges. These examples clearly illustrate the dominant role local geologic factors can play in ecosystem development.

Before human settlement, the whole panoply of Illinois' ecological components was in equilibrium with the geology and climate of each area. The original ecological systems were closely attuned to the variety of near-surface conditions that are generated by the distribution of glacial deposits and by spatial variations in bedrock units.

Glacial moraines (arc-shaped ridges) in northeastern Illinois provided well-drained soils for forest growth and refuge for forest-dwelling animals. The low, flat plains are sites where shallow lakes were dammed between moraines and became poorly drained seas of herbaceous plants whose luxuriant growth provided the biomass for the thick organic-rich soils that support so much agriculture. Illinois' soils developed on tills or thick loess that are mixtures of crushed bedrock particles. These soil parent materials, formed and homogenized by the grinding action of glaciers, supply abundant nutrients vital to the crops that are the agricultural basis of our society.

Where glaciers did not cover the terrain, the topography, soils, and vegetation differed significantly. The soils are directly related to the composition of the immediately underlying bedrock from which they were formed by chemical and physical weathering. The contrasts in our ancient ecosystems can be imagined by observing the ways modern society has adjusted to the differences between the soils of the glaciated and unglaciated parts of the state: except on alluvial plains, crops are not a major source of income outside the large area of the state that was glaciated.

On our modern landscape, original ecosystems cannot be restored or maintained without respecting the geologic factors that generated the original complex plant and animal interrelations. For instance, attempting to reestablish a wetland consisting of acid-loving plants that require periodic drying will not succeed in depressions actively fed by groundwater that passes through alkaline glacial till. Likewise, reestablishing certain types of forest vegetation on an unstable terrain underlain by thick, easily erodible loess is likely to fail.

> *Land on a high terrace of the Illinois River, about 100 feet above the river channel, was purchased for wetlands restoration. The permanent water table was 9 feet below the surface, and the sandy soils were highly permeable. Wetlands plants installed at the site died and were replaced naturally by upland plant species tolerant of the dry conditions. Had readily available information on the geology and hydrogeology of the area been taken into consideration, it would have clearly indicated that this site was inappropriate as a potential wetlands compensation site. Given that the existence of wetlands depends on hydrology, and hydrology depends on*

geologic and geomorphic factors, such information identifies areas most favorable for the occurrence of wetlands or wetland mitigation.
—Michael V. Miller, Illinois State Geological Survey

Hine's emerald dragonfly, a federally listed endangered species, is associated with seep areas that receive groundwater flows from dolomitic limestone formations. The exact habitat requirements of larvae and adults are still unclear. —Illinois Natural History Survey Annual Report, 1995–1996, p. 10

These two examples of the interrelations between geology and ecosystem elements illustrate the four geologic factors considered by the Illinois Nature Preserves Commission (Schwegman 1984) in delineating the 14 natural divisions of the state: (1) topography (high terrace of a river channel), (2) soils (sandy permeable soils), (3) bedrock (dolomitic limestone formations), and (4) glacial history (the Illinois River channel's location and configuration are due largely to the area's glacial history).

Topography, or landscape features such as hills or valleys, influences the biota of Illinois by controlling the diversity of habitats: generally, the more rugged the topography, the greater the diversity. The type of ***bedrock*** is often reflected by a characteristic topography (for example, hard and resistant sandstone forms bluffs and ledges, whereas soft and erodible shale forms smooth slopes). Bedrock also exerts a control on plant life because thin soils commonly develop in it. A crucial factor in controlling ***soil type*** is the geologic material in which the soil developed (parent material); the diversity of soil parent materials is partly responsible for the varied environments and biota within ecosystems. The ***history of glaciers*** advancing into and retreating from Illinois has played a major role in shaping the topography of the landscape: the subdued, irregular topography characteristic of recently glaciated areas generally is poorly drained, resulting in an abundance of aquatic habitats (Schwegman 1984).

An interesting example of the interrelationships between geology and ecosystems is an observation made at certain landfills in which the water table assumes a mounded shape within the landfill. Cattails have been observed to grow where the water table is high, and cattails help clean up the water by taking some of the pollutants out of the leachate.
—Keros Cartwright, Illinois State Geological Survey

Water is a crucial element in each of the preceding examples. Water is also an inherent aspect of the four geologic factors used to delineate natural divisions: topography determines drainage; soil moisture is a function of soil texture; bedrock types determine resistance to erosion; and glacial materials, which range from clayey glacial tills (see Glacial and Surficial Geology section) to sands and gravels, vary widely in texture, moisture-holding capacity, and ability to yield moisture to plants (Schwegman 1984).

* * *

The geologic characteristics of the assessment area—from bedrock to the surface soils in the glacial sediments—are a product of continuous interactions between natural processes and materials. In accord with this natural order, Part 1 of this volume, *The Natural Geologic Setting*, is organized "from the bottom up"—that is, we begin by describing the bedrock geology, then work our way upward from the bedrock surface and describe the sediments and features that stack on top of each other until they reach the landscape on which we live. This approach may seem counterintuitive to many readers: why don't we begin at the surface, with the geology we can see, and work our way downward? We believe the strategy we have chosen is more logical and natural for two reasons: (1) it reflects the chronological order in which geologic materials were emplaced, and (2) it better describes how the bedrock geology and glacial deposits influence each other and how they combine to create the surface landscape upon which life exists.

Part 2 of this volume, *Geology and Society*, examines the use of geologic resources within the assessment area and some of the consequences and hazards from the extraction of resources. It also describes some of the major natural and society-induced geologic hazards that can occur in the assessment area.

The following discussions and accompanying maps are generalized for the entire Fox River Assessment Area (Figure 1) and cannot be used for site-specific purposes. Users needing more detailed information should contact the authors at the agency address and telephone number listed in the front of this publication. The databases used in this report are discussed in Appendix A.

That Illinois is incorporating geologic data into this report on the Fox River Assessment Area and into reports on other assessment areas in the state is an appropriate recognition of the necessity of integrating geologic and biological data into efforts to preserve our natural heritage.

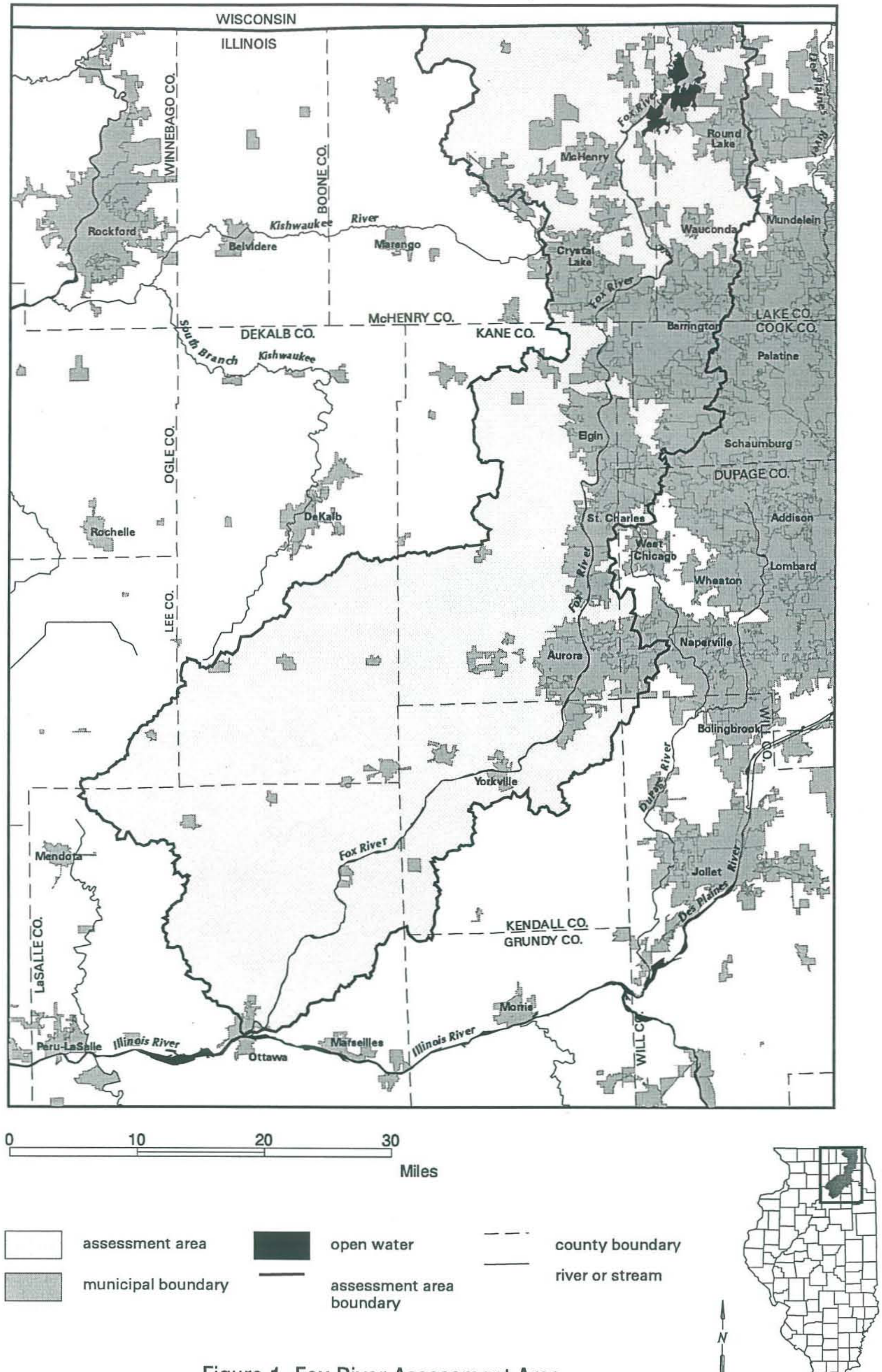

Figure 1. Fox River Assessment Area

Part 1: The Natural Geologic Setting

Imagine that you are standing on the valley side overlooking the floodplain of the Embarras River. In the distance you see broad, flat plains, gently rolling hills, and perhaps a tributary valley. Now imagine that 100 feet below that surface (more or less, depending on where you are standing), lies another landscape, complete with rolling hills, flat plains, and valleys. This is the bedrock surface. Every aspect of this surface—its shape, its composition, its stability or lack of it—and every aspect of the layers of glacial and surficial materials above the bedrock surface exerts some control on life at the surface of the earth. The nature of the geologic framework below us plays a key role in where flora and fauna prefer to grow, where streams flow, where humans build their homes, factories, cities, and where land is set aside for parks and natural areas. Part 1 discusses the geologic framework of the Fox River Assessment Area and, where possible, describes how the geology relates to ecosystems and habitat.

Bedrock Geology

Description of Materials

Bedrock beneath the mantle of Quaternary unconsolidated glacial material within the Fox River Assessment Area consists of sedimentary rocks of Cambrian, Ordovician, Silurian, and Pennsylvanian age (Figures 2 and 3). Cambrian strata, the oldest rocks, are dominated by sandstone, with dolomite, siltstone, and shale as minor components. Ordovician strata are dominated by three lithologies (rock types): dolomite, sandstone, and shale. The Prairie du Chien Group is dominantly dolomite and sandstone; the Ancell Group is sandstone; the Galena and Platteville Groups are dolomite; and the Maquoketa Group is shale. Silurian rocks are predominantly dolomite. Pennsylvanian strata consist of many relatively thin layers of sandstone, siltstone, shale, limestone, and coal. Sandstone, siltstone, and shale are the dominant lithologies. Within the assessment area, the Pennsylvanian strata are separated into two formations (Kosanke and others 1960, Willman and others 1967), which are generally similar. Each formation is differentiated by key beds (rock layers with diagnostic features) and is characterized by the relative abundance, character,

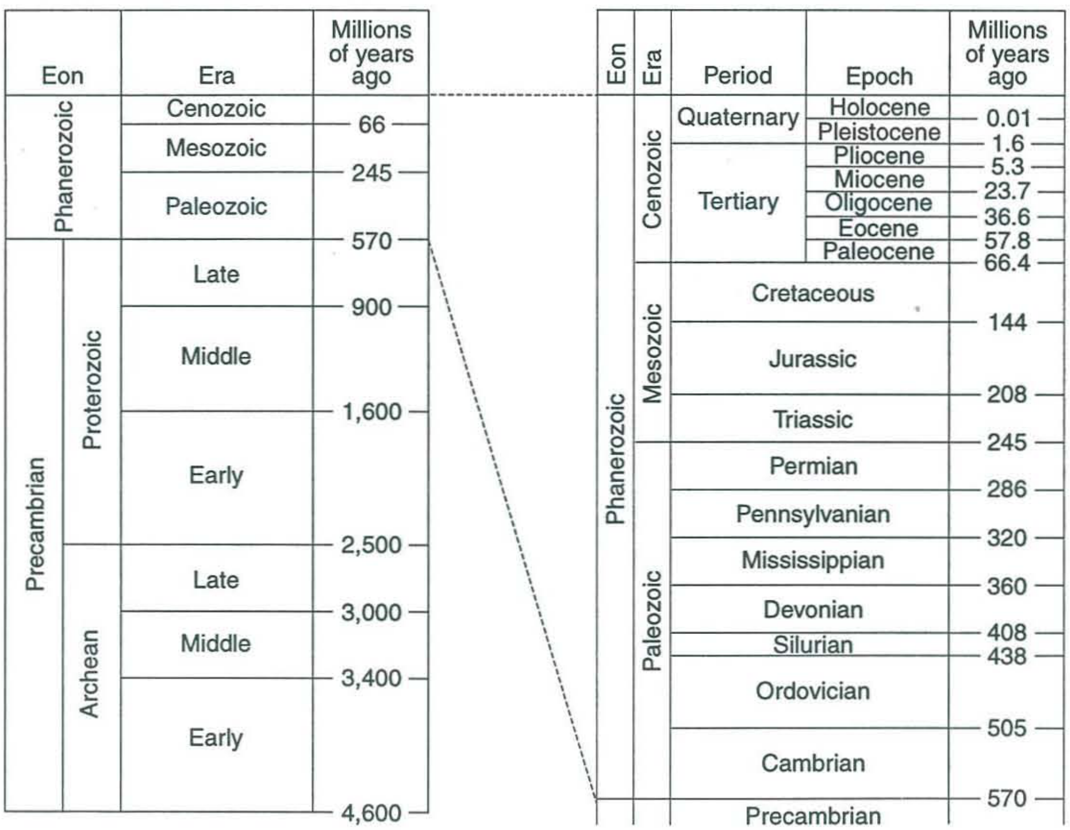

Figure 2. Major Subdivision of Geologic Time (Palmer 1983)

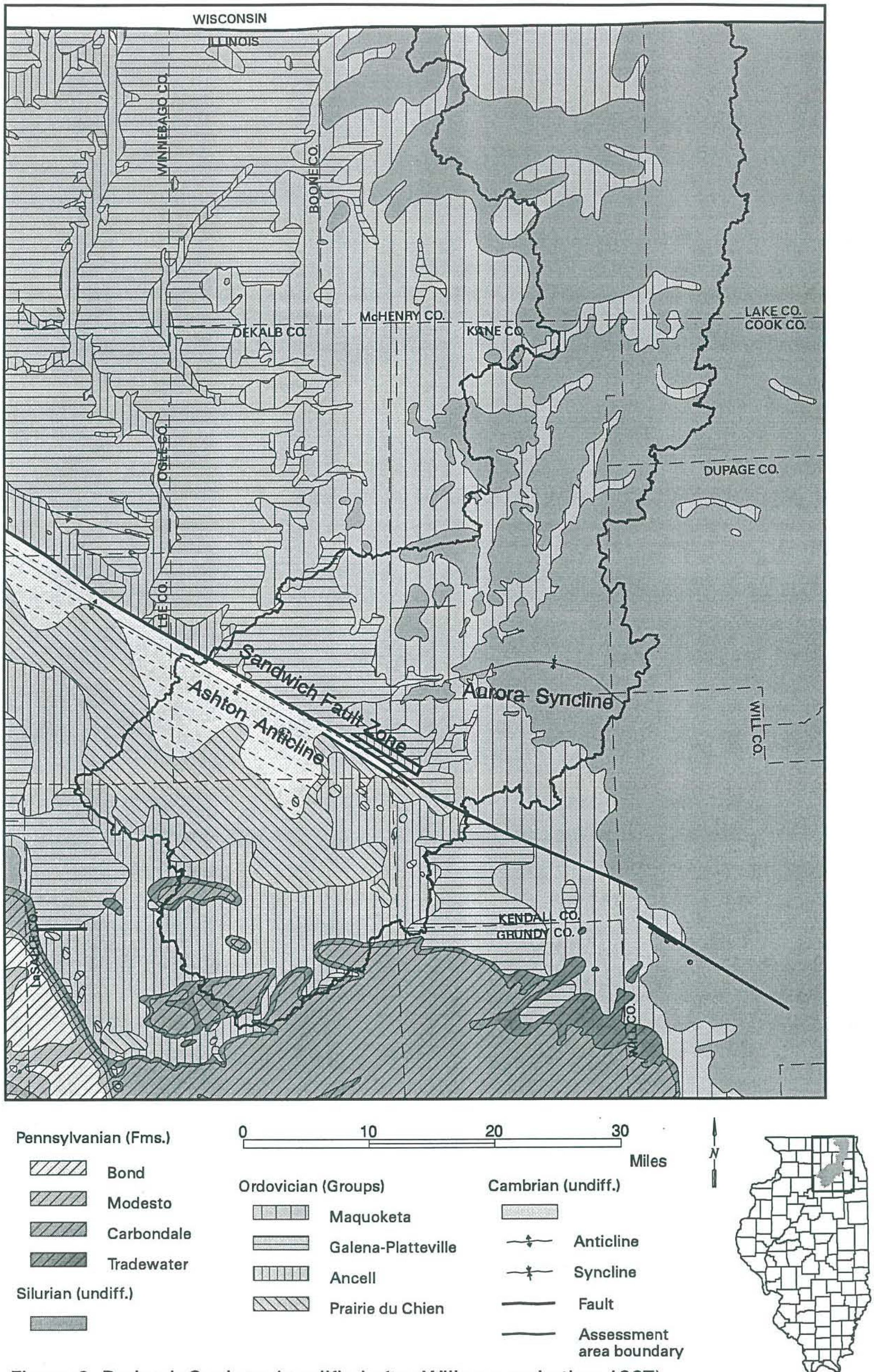

Figure 3. Bedrock Geology (modified after Willman and other 1967)

and distribution of four basic lithologies—sandstone, shale, coal, and limestone. The oldest and lowermost Pennsylvanian formation is characterized by thin, widespread limestones and coals. The overlying Carbondale Formation contains the thickest coal beds in Illinois. (The Colchester Coal Member, considered to be one of the most extensive coal beds in the United States, is a member of the Carbondale Formation [Hopkins and Simon 1975]; see Coal Mine Subsidence and Acid Drainage section below).

Most of the bedrock subcrop (bedrock that occurs directly beneath glacial sediment) within the assessment area is of Ordovician and Silurian age (Figure 3). Cambrian and Pennsylvanian rocks make up smaller parts of the subcrop in the area. North of Kendall County, the bedrock surface is almost entirely composed of the Ordovician Maquoketa Group and Silurian dolomite. In the southern part of the assessment area, a major structural feature, the Sandwich Fault Zone (Willman and Payne 1942), trends in a northward direction. This feature, composed mostly of high-angle faults (breaks or fractures in the rock resulting in displacement of rocks on either side of the breaks), and the Ashton Anticline (an upfold in the rocks; Willman and Templeton 1951), are the primary reason for the relatively more complex bedrock geology in this area as compared to the area north of Kendall County. Approaching the fault zone from the northeast, the bedrock units generally become older (from Silurian to Late Ordovician Maquoketa, to Middle Ordovician Galena-Platteville). The strata on the southwest side of the fault zone are upthrown by as much as 800 feet relative to the strata on the northeast side (Kolata and others 1978). Across the fault zone, the rock units range from the Cambrian Eminence and Potosi Dolomites to the Ordovician Ancell Group. On the southwest side of the fault zone, the Silurian dolomites and the Ordovician Maquoketa Group rocks are absent, and only a few small areas of the underlying Galena-Platteville Group remain at the bedrock surface within the assessment area. In a few areas near the southern edge of the assessment area, the Pennsylvanian Tradewater and Carbondale Formations unconformably overlie the much older Ordovician Ancell, Galena, and Platteville Groups and occur at the bedrock surface.

Bedrock Topography

The top of the bedrock surface in the Fox River Assessment Area is a complex topographic surface containing buried valleys, lowlands, and uplands (Figure 4). Several large, buried valleys in the bedrock surface traverse the watershed area (Horberg 1950). The buried bedrock valleys generally contain coarse grained sediments (sands and gravels) that form important, productive aquifers (Horberg 1945). A segment of an unnamed valley, an east-trending tributary to a Pleistocene (Ice Age) ancestor of Lake Michigan, occurs in northern McHenry and Lake Counties. A short segment of the Troy Valley traverses the westernmost portion of the assessment area in De Kalb, La Salle, and Lee Counties. The Troy is a major valley, much of it entrenched in bedrock, that drained parts of southern Wisconsin and northern Illinois during the Pleistocene. The Newark-St. Charles Valley "system" traverses the largest portion of the modern watershed of the Fox River. These bedrock valleys are subparallel to, and in a few places nearly coincide

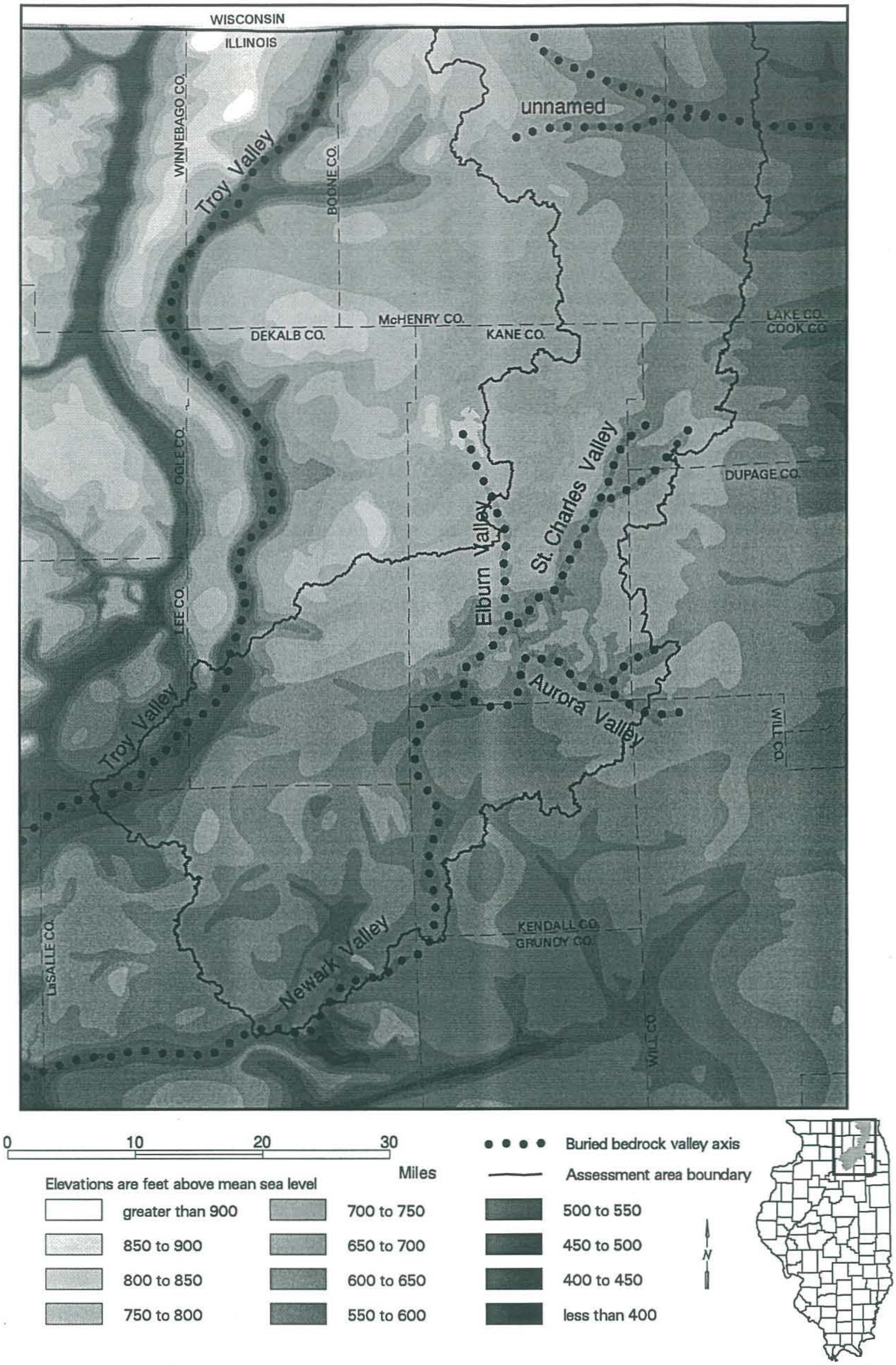

Figure 4. Bedrock Topography and Buried Valleys (modified after Herzog and others 1994)

with, the modern Fox River drainage. The modern Fox River is eroding into bedrock in a few areas, primarily south of the town of Elgin. North of the Sandwich Fault Zone, the exposed bedrock is mostly Silurian dolomite (which is relatively resistant to erosion) and in a few areas, Ordovician Maquoketa Group (which tends to erode easily). Near the south edge of the modern watershed, the two Pennsylvanian formations and the underlying Ordovician Ancell Group crop out along the Fox River just north of the confluence with the Illinois River in La Salle County.

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Glacial and Surficial Geology

Description of Materials

Most of the unlithified sediments that overlie the bedrock were deposited by the succession of continental glaciers that advanced across the area during the Pleistocene Epoch, or Great Ice Age. These sediments fall into two major categories: ***till*** (sometimes called diamicton by geologists) and ***outwash***. Less common types of deposits include ***lacustrine*** (lake) sediments and ***organic-rich*** debris (peat). Overlying the deposits of glacial origin is a windblown silt, or ***loess*** (pronounced "luss"), of late glacial and post-glacial age. Collectively, glacial sediments are called glacial drift. Knowledge about these deposits is especially important because they strongly influence land use, ecosystem development, landscape processes that can affect ecosystems (see also Modern Soils and the Landscape—Influences on Habitat and Agriculture section below), and the effects of geologic hazards.

Till is a mixture of all sizes of rocks and ground-up rock debris, ranging from the smallest clay particles to the largest boulders. Most till is a compact mixture of clay, silt, and sand particles that provides the matrix that surrounds and supports larger grains, such as pebbles, cobbles, and boulders. Some till was deposited across the pre-existing landscape at the base of the glacier as it moved forward; other till is sediment that flowed as a muddy mass of material off the front of the melting ice sheet or through crevasses (cracks) that developed within the ice. Each layer (or bed) of till may represent a particular glacial advance that can be recognized over large regions. These layers help identify major groups of sediment associated with particular glacial episodes.

When exposed in stream banks, the dense, compact till can be involved in slumping and minor landslides (see Landslides subsection below). During the infrequent earthquakes experienced in the area, however, till is less likely to enhance seismic energy than the loose, water-saturated sediments found along river floodplains.

Outwash is sand and gravel that literally "washed out" from the ice in meltwater streams along the front of a glacier. Outwash is found in (1) stream valleys that served as meltwater outlets in front of, or beneath, the glacier, (2) fan-shaped deposits in front of end moraines (the arc-shaped ridges of till that built up on the landscape where the ice margin temporarily stabilized), and (3) isolated hillocks (kames) and ridges (kame terraces, eskers) on the landscape that formed where meltwater carrying rock debris plunged through crevasses in the ice. Where extensive layers of outwash are associated with particular tills, the identification of the tills in drillholes helps geologists predict the occurrence of major bodies of outwash that can serve as aquifers.

Outwash is a potential resource for construction sand and gravel (see Mineral Resources section below). Layers (or beds) of outwash also occur within the glacial sediments between bedrock and today's land surface. Such sand and gravel deposits are generally porous and permeable; that is, fluids such as water can move easily among the grains. When thick enough, these deposits can be excellent aquifers (see Aquifer Delineation section below).

Lacustrine (lake) deposits generally consist of fine grained sediments such as silt and clay deposited in temporary lakes that commonly formed along the margin of the ice as it melted or between a moraine and the melting ice front. These sediments commonly are poorly drained and may cause water problems in construction projects.

Organic-rich layers of sediment that sometimes occur between layers of glacial sediment can serve as important marker beds that represent major intervals of warmer climate between glaciations during which soils developed and vegetation grew. Organic deposits that separate major sequences of glacial sediments help geologists interpret the sequence of deposits and predict where outwash may occur below the surface. The low bearing capacity (weight the ground can safely support) of organic soils can affect construction.

Loess, a windblown silt, blankets much of the landscape in the Fox River Assessment Area. It has important properties that make it an excellent parent material for the region's productive soils: it crumbles easily when lightly squeezed, drains well yet has good moisture-holding capacity, and contains no pebbles or cobbles to interfere with plowing. Loess is derived from sediments that were deposited along the major meltwater valleys, such as the Illinois River valley, by sediment-laden meltwater flowing from the melting glaciers to the northeast. Prevailing westerly winds picked up the finer sediments—silt, fine sand, and some clay—from the floodplain and blew them across the landscape. Loess is thickest immediately east of the major valleys and thins rapidly with distance eastward.

Regional Glacial History

Hundreds of records (logs) and samples of sediments from borings drilled throughout the assessment area are stored and catalogued at the Illinois State Geological Survey. Many borings penetrated the entire sequence of glacial sediments overlying bedrock and provide the record from which the general glacial history of the region can be interpreted.

The sediments left by the earliest glaciers to enter Illinois have been almost entirely eroded away in the Fox River Assessment Area. Meltwaters of these early glaciers, however, may have deepened the bedrock valleys, such as the Troy and Newark-St. Charles Bedrock Valleys (see Bedrock Geology section). Some sand layers in the lowest parts of the valleys may also have been deposited by meltwaters of these early glaciers.

Numerous studies of the glacial geology of the region have been conducted over the past several decades. Some of the more accessible publications include Kempton (1963), Hackett and McComas (1969), Frye and others (1969), Gross (1970), Landon and Kempton (1971), Willman (1971), Larsen (1973), Killey (1982), Hansel and others (1985), Johnson and Hansel (1985), Hansel and Johnson (1986), Johnson and Hansel (1989), and Grimley and others (in preparation). In addition, a series of studies of the surficial geology of northeastern Illinois, conducted in the early 1970s for the Northeastern Illinois Planning Commission, was published as Open File Series reports by the Illinois State Geological Survey (Bogner and others 1976, Gilkeson and Westerman 1976, Specht and Westerman 1976, Stoffel and Larsen 1976, Bogner 1976, Larsen 1976, and Taylor and Gilkeson 1977). Finally, a series of regional reports was produced on the geology of the area for the proposed Superconducting Super Collider in Illinois (Kempton and others 1985, 1986, and 1987; Curry and others 1988; Graese and others 1988; Gilkeson and others 1988; Vaiden and others 1988).

All these studies have confirmed that the glacial drift overlying bedrock consists of a complex interfingering of beds and lenses of outwash with layers of till. The tills and outwash can generally be grouped into four categories (Grimley and others, in preparation): (1) till and outwash of the Glasford Formation; deposited during the Illinois Episode of glaciation, these deposits nearly everywhere overlie bedrock and underlie sediments of the Wisconsin Episode of glaciation; (2) a fairly uniform till with lenses of outwash that belongs to the Tiskilwa Formation of the Wedron Group (Hansel and Johnson 1996) and represents a major ice advance during the Wisconsin Episode of glaciation, (3) Henry Formation outwash; at and near the land surface, this formation is related to the Wisconsin Episode of glaciation, and (4) in the eastern part of the area, clayey till of the Wadsworth Formation of the Wedron Group. The Wadsworth generally contains only minor local lenses of outwash.

The glacial geology beneath the thin loess cover of the Fox River Assessment Area is a complex of tills (Glasford, Tiskilwa, Lemont, and Wadsworth Formations; Figure 5) and areas of outwash and modern stream alluvium (Henry and Cahokia Formations). The multiple morainal ridges, composed mostly of till, indicate that the ice front advanced and melted back several times while the ice was active in the area. Several of the moraines, especially in the northern part of the assessment area, consist of sand and gravel with minor amounts of till, which indicates they were formed by a complex process of ice melting and withdrawal. The moraines in the northern part of the area were dissected by stream erosion both during the melting of glacial ice out of the region as well as during post-glacial time.

The Cahokia Formation, the name given by geologists to modern river alluvium, is generally restricted to the modern stream valleys. The broader areas paralleling the streams are occupied primarily by Henry Formation outwash. Henry Formation sediments also occur as kames and kame terraces, landforms that account for some of the higher areas on the landscape. They are all related to meltwater processes near the margin of the melting ice.

The intricate pattern of Henry Formation outwash and Equality Formation lake sediments scattered among the morainic remnants attests to the complex history of deglaciation of the area. The fine-grained lake sediments were deposited in temporary lakes formed by

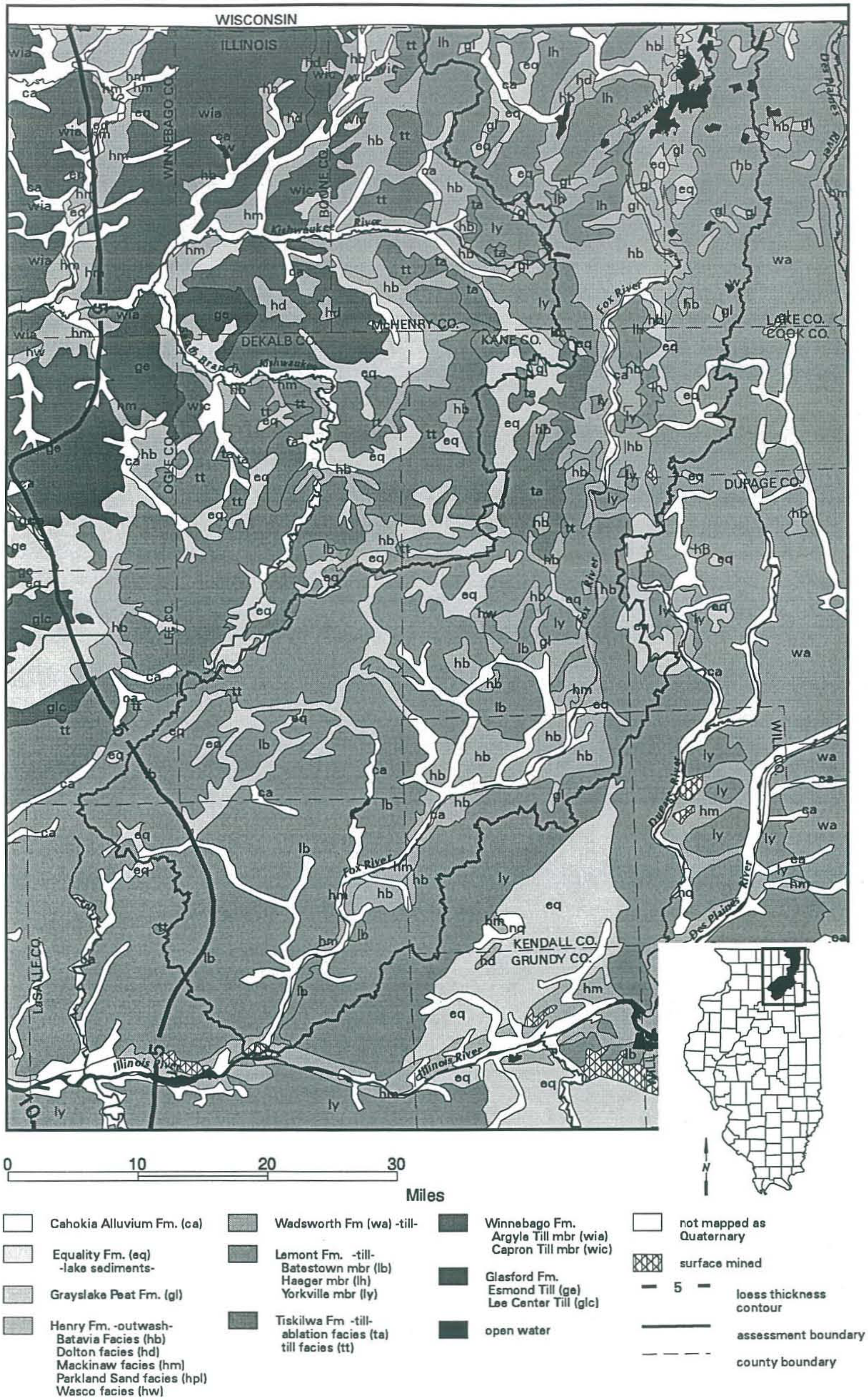

Figure 5. Glacial Geology (modified after Lineback 1979, Hansel and Johnson 1996)

meltwater as the ice withdrew from the region. Areas too small to be shown in Figure 5, generally located on the end moraines, have significant deposits of peat in them. Peat consists of unconsolidated, semicarbonized plant remains that were deposited in a water-saturated environment, such as a bog or fen.

Thickness of Materials

Deposits of glacial origin range from less than 100 feet to more than 400 feet thick within the Fox River Assessment Area (Figure 6). The approximate northern one-third of the area is covered by drift ranging generally from 100 to 300 feet thick, with some localized areas between 300 and 400 feet thick. The greatest thickness occurs along the narrow part of the southwestern border of the assessment area that coincides with the Troy Bedrock Valley. Elsewhere, thicker drift generally coincides with the occurrence of end moraines.

Each of the four major categories of geologic materials discussed above exhibits a considerable range of thickness. Overall, Glasford (Illinois Episode) sediments are generally thinner than sediments related to the Wisconsin Episode of glaciation, with the exception of some of the bedrock valleys where Illinoian sediments may range up to 200 feet thick or more (Curry, Berg, and Vaiden 1997). Tiskilwa Formation till achieves thicknesses of between 100 and 200 feet in parts of the area (Curry, Berg, and Vaiden 1997) but thins to less than 50 feet in other parts, especially over the St. Charles Bedrock Valley. It generally thins southward and eastward, and may be absent in southern Kane, northern Kendall, and southern De Kalb Counties (Wickham and others 1988). Henry Formation is generally thinner than the Glasford and Tiskilwa Formations but reaches up to 100 feet thick in some of the kames and kame terraces in the area. Wadsworth Formation may reach up to 50 feet thick in some areas but overall is probably somewhat less.

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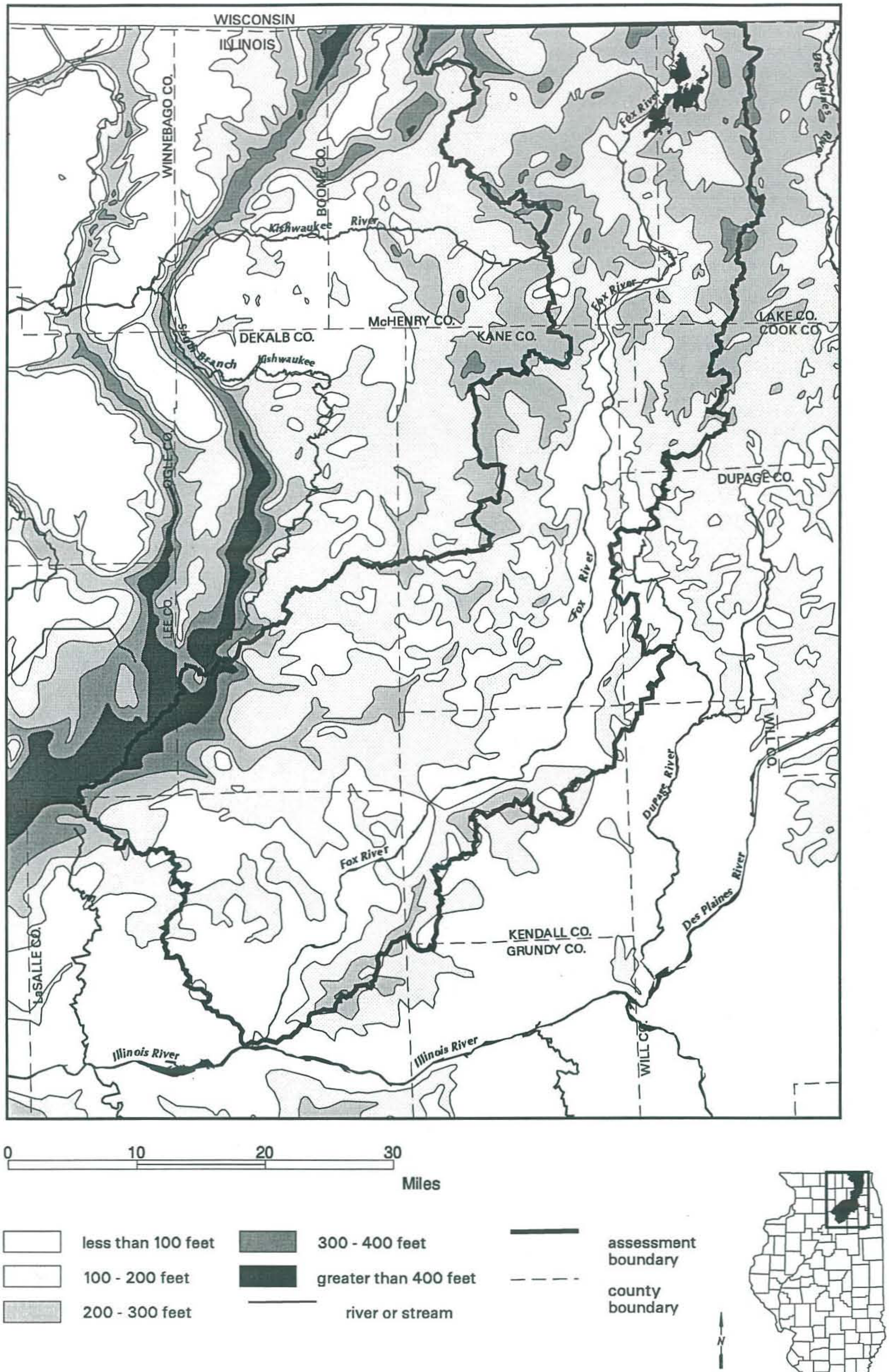

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Modern Soils and the Landscape—Influences on Habitat and Agriculture

The Fox River Assessment Area contains a mixture of soils ranging from productive agricultural loessial soils to soils developed in peat and beach sand (Figure 7). Soil development in the assessment area is strongly influenced by is geologic, topographic, and biologic differences that create habitats conducive to the development and survival of particular natural communities. Differences in the frequency, rate, and magnitude of surficial geologic processes have created many combinations of slope angle, length, and orientation that are now influencing local drainage and erosion and sedimentation processes. Topographic controls of drainage and erosional and depositional processes are important in the long-term development of the landscape. Human activities are also causing significant changes in surficial processes that directly impact localized natural communities.

Geologic Factors

Loess, till, outwash, and lacustrine materials are the dominant parent materials of the soils on the area's uplands. Major drainage ways and floodplains (lowlands) are dominated by silty materials and some sandy deposits. These materials differ significantly in their permeability, erodibility, and physical and chemical characteristics. By affecting water table elevation, erosion, sedimentation, and water chemistry, these differences create localized habitats.

The overall thickness of geologic materials in which soils have developed (primarily loess) varies across the assessment area from the far northern part to the south. The loess cover is rather continuous across the landscape, and it has relatively uniform physical and chemical characteristics. Loess covers most of the assessment area, generally to a thickness of 3 to 4 feet (see Figure 5). The loess overlies coarse-textured outwash and fine-textured tills and lacustrine sediments in the northern part of the assessment area and fine-textured tills in the southern part. Major drainages and floodplains are dominated by silty materials with occasional sandy deposits. These materials constitute the parent materials in which modern soils are developing.

Loess, till, outwash, and lacustrine sediments can differ significantly in their permeability, erodibility, and physical and chemical characteristics. The predominance of loess as the uppermost parent material creates an erosion hazard in some parts of the assessment area. Also, wherever a change in slope occurs, erosion and sedimentation become important factors in landscape development. The presence of soils that have developed in colluvial sediments (slope deposits) usually predicts the functioning of these geologic processes. These physical and chemical differences in geologic materials, however, also

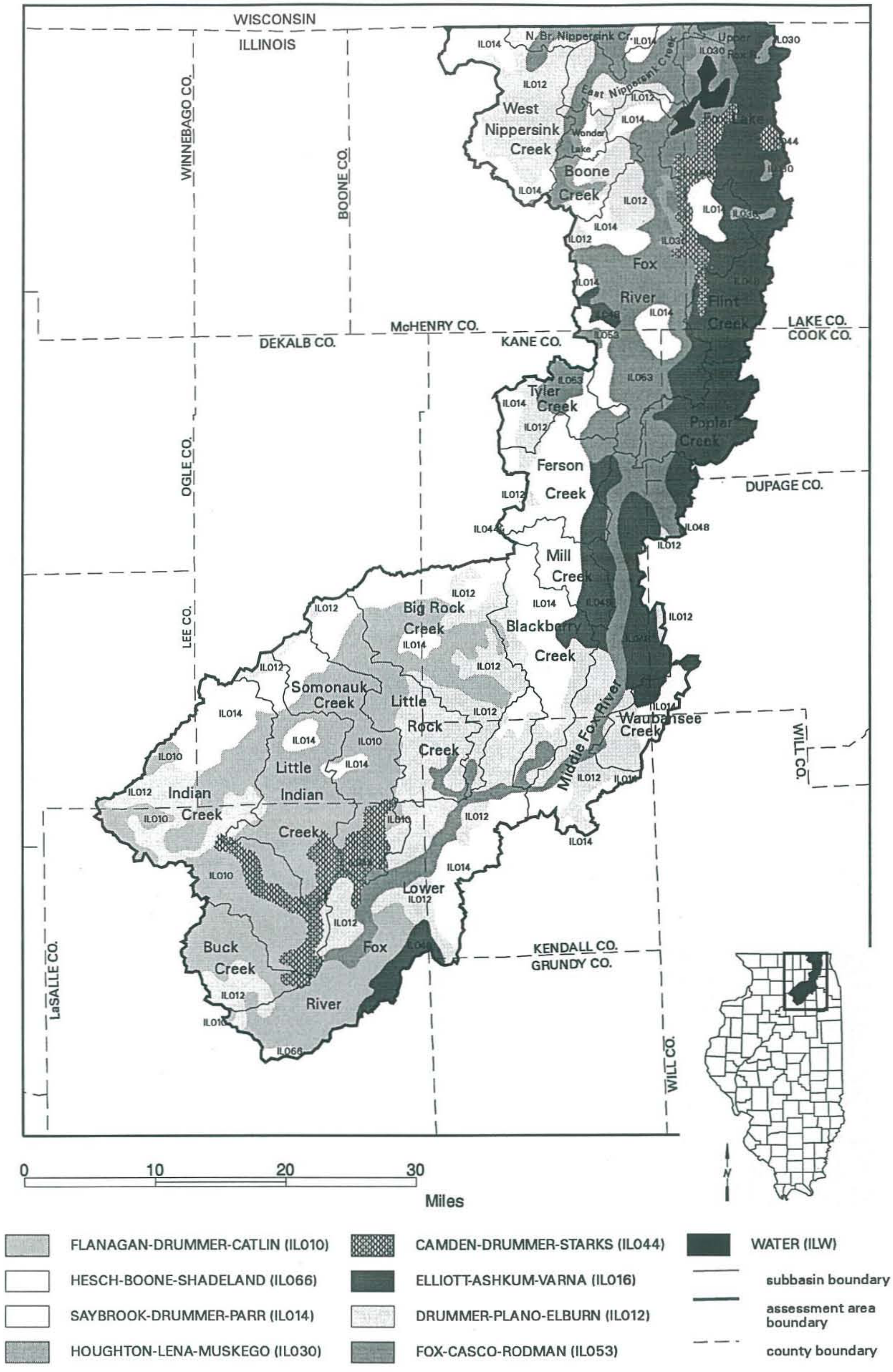


Figure 7. Soil Associations of the Fox River Assessment Area (modified after STATSGO 1994).

assist in developing localized habitats by affecting water-table elevations, erosion and sedimentation patterns, organic-matter accumulations, and water chemistry. Localized and isolated outcrops of bedrock can create drainage, textural, chemical, and microclimatic environments that foster unique biological habitats.

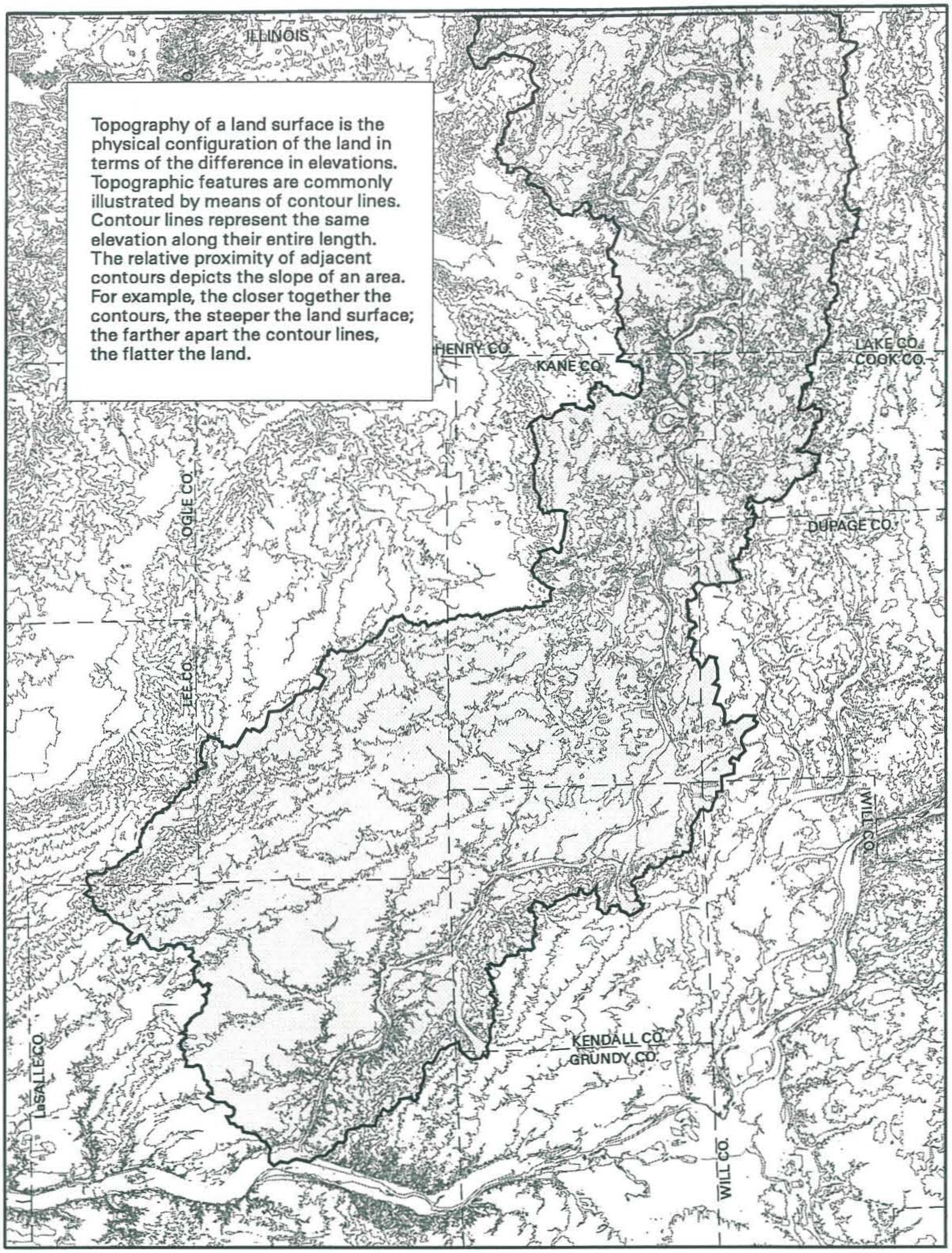
Bedrock occurs at or near land surface in the lowermost part of the Fox River Assessment Area. This assessment area is a good example of the diversity of landscapes that can result from the complex interactions of glacial, fluvial, eolian (wind), colluvial (slope), biological, and human processes. It is also a good example of the need to carefully, but quickly, assess the natural resources and ecosystems in the area because of the rapid expansion of human activities.

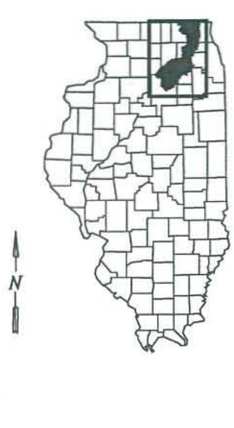
The age and texture of the geologic materials that underlie the thin layer of loess that blankets the landscape also play an important role in this assessment area. Specifically, the northern part of the area has a greater amount of wetlands and poorly drained soils than does the southern part of the area. The recency of glacial activity that deposited these materials is reflected in the poorly developed soil profiles and general lack of surface-water drainage in the area. The hummocky topography strongly influences soil development, drainage, and human activities. In fact, in many areas of western Lake and eastern McHenry Counties (Fox Lake, Upper Fox River, East Nippersink Creek, North Branch Nippersink Creek, Fox River, Wonder Lake, Boone Creek, and Flint Creek subbasins), the increase in urban land is directly affecting the vitality of wetlands by altering the surface drainage. Many of the soils in these areas have low permeabilty, experience seasonally high water tables, are susceptible to frost heave and shrink-swell due to clay plasticity, and are marginally suitable for construction materials. We tend to think of wetlands and other specialized habitats as small, but only because we are viewing the remnants of once larger systems. Even small ecosystems like beach ridge communities are often connected hydrologically to neighboring communities. Soils are often predictors of drainage conditions and are used in developing plans for reconstructing and developing habitats.

The percentage of cropland in each subbasin generally increases toward the south, where a thicker layer of loess blankets the glacial tills. The loess, however, is generally only 3 to 4 feet thick over tills that are silty clay loam to loam, so the underlying tills are influential as parent materials for the soils as well.

Topographic Factors

Topographic influences (Figure 8) on drainage, erosion, and deposition are important in the long-term development of the landscape. Differences in the frequency, rate, and magnitude of surficial geologic processes have created many combinations of slope angle, slope length, and slope orientation that influence local drainage, erosion, and sedimentation. Modifications by human activities are also creating significant changes in surficial processes (discussed in Soil Erosion and Sedimentation subsection below).





In the Fox Assessment Area the interval between contour lines represents about 33 feet (10 meters) of elevation difference. Surface elevation ranges from about 952 feet (290 meters) above sea level in the northwest to 492 feet (150 meters) in the extreme southern floodplain of the Fox River.

Figure 8. Topography of Land Surface

Soil Classification

The soils in the Fox River Assessment Area fall into two soil dominant orders—Alfisols and Mollisols, with scattered occurrences of Entisols on floodplains and sandy outwash areas and Inceptisols along steeper, eroded uplands. In general, Alfisols have developed under forest vegetation, whereas Mollisols have developed under natural prairie or marsh vegetation. They can be differentiated by the accumulation of organic matter in the upper soil horizon. Mollisols have a darker soil color (black to dark brown), whereas Alfisols are not as organic rich and have a thinner upper soil horizon. Prairie grassland soils (Mollisols) tend to be more fertile than Alfisols. Some specific soils with high sodium or calcium carbonate concentrations and abundant clay require special attention. Most soils in the area, however, respond to good management and crop production practices. Entisols and Inceptisols (soils with minimal soil horizon development) occupy small acreages in the area but are significant because they help create niche communities (for example, where exceptionally sandy sediments exist). Poorly drained Mollisols and Alfisols are common along drainages, floodplains, former lake beds (lacustrine areas), and flat upland areas and may also play an important role in the development and maintenance of localized communities.

The northern third of the assessment area contains several Histosols, soils developed in high-organic-content materials. These soils are either calcareous or medium acid to mildly alkaline, which gives them specific chemical and biologic characteristics. Drainage alterations due to redirection of surface water or water-table lowering can significantly affect these soils. Once desiccated, these soils are susceptible to considerable shrinkage and surface lowering because of oxidation and decomposition of the organic matter. If surface water is directed into these areas, the sediment load can smother the vegetation and alter the drainage and permeability. Any chemical compounds attached to (adsorbed on) the sediment particles will also be deposited.

The STATSGO database (USDA 1994) lists seventeen soil associations[1] in the Fox River Assessment Area; several associations have been combined for this report to simplify the map (Figure 7). The associations were combined so that little information was lost, especially given the small scale of the map. The largest soil associations are the Drummer-Plano-Elburn (22% of the land area), Saybrook-Drummer-Parr (21%), Flanagan-Drummer-Catlin (20%), Fox-Casco-Rodman (16%), and Morley-Markham-Ashkum (15%). In general, soils classified within the same association will behave in a similar fashion and can be treated as single units for basic planning purposes. Differences in drainage class are often the reason for differences in soil characteristics on a local scale. Also, soils may be different only due to their color, with light-colored forested soils occurring in the same area as darker-colored prairie soils. For example, the St. Clair-Nappanee-Frankfort soils (Alfisol) are the light-colored counterparts of the Swygert-Bryce-Mokena soils (Mollisol). The two associations developed under similar drainage conditions and from the same

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[1] A soil association is a geographical grouping of similar soil series. A soil series is a grouping of soils similar in composition, thickness, and arrangement of soil horizons (layers within a soil).

parent materials—the Alfisols under forest vegetation, and the Mollisols under prairie vegetation. They are grouped in different soil associations but could be considered very similar with respect to most management practices (Fehrenbacher and others 1984).

The more productive soils generally are located in the southern part of the assessment area, are associated with the thicker loess deposits, and tend to be Mollisols, which owe their fertility, in part, to their high organic-matter content. The Drummer soil is very prevalent and is one of the most productive soils in Illinois; it averages 6% organic matter. An analysis of the STATSGO data by subbasin reveals that the Drummer-related soil associations occur almost entirely within the subbasins located in the southwestern part of the assessment area. In the northern area, the Houghton and other histosols are found almost entirely within the Fox Lake, Fox River, and Boone Creek subbasins. There is a strong spatial relationship between soil association and location in this assessment area due, in large part, to the surficial geology. The diversity of geologic materials and geomorphology in the assessment area would be difficult to equal elsewhere in Illinois.

Soil Erosion and Sedimentation

Soil erosion becomes a major concern where slopes steeper than 5% occur. Where slope angles increase around moraines and drainages, erosion rates increase significantly. Flat, upland areas will generally have poorer drainage, and tiling is commonly necessary on agricultural lands. Tiling has led to increased drainage of water from the flatter surfaces, and has increased the amounts of runoff reaching nearby streams. The resulting increase in runoff has created serious erosion problems along streams of all sizes in the assessment area. Increased surface runoff is also caused by urbanization. Increased areas covered by impermeable surfaces, installation of artificial drainages, and slope modifications increase the total discharge in streams, the timing of discharge peaks, and the peak discharge volume following precipitation.

Changes in these three hydraulic components promote soil erosion and stream channel degradation by channeling more water into stream channels over shorter periods of time. The channel responds to the increased discharge by deepening and widening its channel. Most often the result is rapid, local incision and headward advancement of gullies into backyards and other human-occupied areas. Rapid housing development often overwhelms the natural drainage system and results in gully erosion.This is especially common along major rivers where significant bluffs and hillsides exist. In-channel habitats can quickly degrade through erosion or deposition within the channel. Stream bank undercutting and slumping are also common. Sediment and nutrients are transported along the drainage and are deposited and removed in episodic events. Lakes are often major sediment traps and frequently suffer severe habitat degradation. Current Fox River Partnership efforts to determine the nature of the sediment problem near Grass Lake are to be encouraged. A successful mitigation and prevention program will depend upon an accurate and broad-based environmental database.

The widespread distribution and thickness of loess across the assessment area further contributes to the erosion hazard. Loess is easily picked up (entrained) and carried by moving water or wind. When dry, loess has the consistency of talcum powder and, if unprotected, is easily carried by wind. Loess is also particularly susceptible to erosion by running water because of its low shear resistance. It is rapidly incised and develops into a deeply dissected landscape characterized by rills and gullies that are difficult to control. On topographic maps, this characteristic drainage pattern is shown as highly crenulated (sinuous) topographic contour lines (see Figure 8). Where loess overlies less permeable geologic materials such as fine-textured tills, the contrast in permeability and erodibility creates problems in land management, especially where the overlying loess unit is dissected or eroded and the less permeable underlying materials are exposed at or near the land surface.

Further increasing the erodibility of loess is its tendency to develop piping within the soil. Piping can form where when surface water penetrates to the subsurface and flows along macropores, such as open channels formerly occupied by roots, or along other natural fractures in the ground. These linear "pipes" may enlarge and ultimately collapse, causing the ground surface to subside and form small surface drainage channels. These channels then begin to collect and transport sediment and water as they are integrated into the local drainage system.

Areas with forested soils are especially susceptible to piping and are where hillside gullies often begin, even when the ground surface has not been disturbed by deforestation or cultivation. Once begun, these small rills and gullies can quickly enlarge and erode upstream, extending the drainage network and directing increased water and sediment into the existing drainage system. The increased water and sediment discharge can initiate streambank erosion and streambed changes that are detrimental to the biologic communities that inhabit the stream channels. Lowland areas may be inundated with sediment that degrades wildlife food supplies and fills stream channels, decreasing their capacity to transport water and increasing the frequency of overbank discharges. Pools along the stream are especially prone to damage from sedimentation. Pesticides and other agricultural chemicals adsorbed to the sediment may also be deposited.

Landscape flatness combined with the relatively fine-textured underlying sediments results in high water tables, frequent flooding, and sedimentation problems in the broad, flat regions of the assessment area. While these areas may be prime wildlife habitats and wetland areas if they have not been cleared for cultivation, their slow soil permeability and general lack of drainage dissection increases the potential for surface flooding and severe channel and stream-bank erosion. The steeper slopes adjoining the floodplains are often susceptible to severe soil erosion through sheetwash and the development of extensive gully networks. Eroded sediment is often transported into small local channels and, ultimately, into the larger drainages.

The physical load of sediment can accumulate quickly enough to bury part of the modern soil. Buried modern soils can be seen in some vertical soil profiles exposed along stream courses where a dark-colored former soil horizon lies beneath recently deposited, lighter-colored sediments. Such buried modern soils are evidence of accelerated erosion resulting from human activity and are environmental indicators of current and potential problems in a drainage system.

Land Management Practices

Sound land use and management practices are especially important in controlling erosion on loessial soils. Damaged land should quickly be remediated and appropriate erosion control measures should be implemented to prevent additional damage to the landscape. It is unlikely that severe erosion caused by gullying on hillslopes will repair itself quickly enough to prevent extensive damage to adjacent land. Gullies developing in loess can quickly become too deep for farm equipment to cross and eliminate through tillage. Farming along narrow ridgetops is generally not advisable due to the lack of transition zones along field edges to keep water from running off the field and entering hillside drainage channels.

The Fox River system is currently adjusting to past and current drainage alterations caused by human activities (such as agricultural tiling and irrigation) and physical changes in channels (such as widening and straigtening due to urbanization and flood control). Because streams seek to maintain an equilibrium between drainage discharge and channel size, natural stream processes are on-going and frequently create areas where severe bank erosion and in-channel sedimentation occur.

Care must be taken when designing and installing any remediation or mitigation project because it, too, will alter drainage patterns and thereby play a role in the natural adjustments of stream channels. Reclamation projects seldom create perfect solutions because the landscape is sensitive to changes that are imposed upon it; some additional follow-up reclamation work is generally necessary even when environmentally-friendly methods are used. Engineered structures such as straightened and concrete channels are seldom environmentally friendly and often create excessive and quick natural responses in adjacent parts of the drainage system because straight, concrete channels are not natural. A judicious application of common sense and a holistic or basin-wide approach to managemen can avoid many of these problems.

The upland areas between tributary drainages and in the uppermost parts of the assessment area are generally level and poorly to somewhat poorly drained. This soil feature is a concern for agricultural and urban developers. In areas of prime farmland (shown on Figure 15) slow permeability and large erosion potentials of the soil are the two major management problems. Appropriate conservation tillage practices and tiling can reduce the effects of these problems on agricultural production. Housing developments are moving into areas where soils and sediments are not favorable for septic systems unless there are expensive construction measures.

County Soil Survey Reports

County soil survey reports are increasingly being updated and converted to digital format. Although this process will take some years to complete, interested individuals and groups should check with their local NRCS agent to learn what materials and information are available for their specific location. The individual soil maps presented in each county soil survey report are published at a scale of 1:15,840, or 1 inch equals 1,320 feet (0.25 miles). A smaller-scale soil association map is also included, usually at a scale of about 1:250,000, or 1 inch equals about 4 miles. The scale of the soil association map is too small (contains too little detail) for site specific planning and analysis, but the individual soil sheets are ideal for this purpose. Even these maps, however, lack the detail necessary for specific site assessments for construction, but they are valuable for most environmental-scale planning.

The large-scale soil maps in county soil-survey reports are valuable sources of information regarding local conditions. Tabulated information within the reports summarizes the capabilities and limitations of each soil series for various land uses as well as their physical and chemical characteristics. There are also tables with information concerning the suitability and capability of soils for supporting wildlife and woodland habitats.

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Landscape Features and Natural Areas with Geologic Features of Interest

Landscape Features

The landscape features of the Fox River Assessment Area were formed by processes associated with multiple glacial advances across the area. The assessment area is almost evenly divided between two physiographic subdivisions: the northern half falls within the Wheaton Morainal Country, a subdivision of the Great Lake Section of the Central Lowland Province; and the southern half falls within the Bloomington Ridged Plain, a subdivision of the Till Plains Section of the Central Lowland Province (Figure 9, Leighton and others 1948). The Wheaton Morainal Country contains dissected north–south trending moraines, whereas the Bloomington Ridged Plain is characterized by end moraines that arc across the land surface in a general northeast- to southwestward trend.

The landscape can also be characterized as uplands and lowlands. Much of the land in the Fox River Assessment Area is in uplands—the extensive regions of higher ground that include end moraines and ground moraine. The lowlands occur mostly along stream valleys, floodplains, and areas occupied by sediments deposited in former lakes. Because of the geologically brief time since the retreat of the last glaciers, the Fox River Assessment Area still has many of the features typical of deglaciation: dissected moraines, numerous areas covered by glacial outwash deposits (Henry Formation), and fine-grained sediments that were trapped in lakes (Equality Formation) between moraines and the melting ice.

Natural Areas with Geologic Features of Interest

According to available Illinois Natural History Survey records, nine natural areas in or near the Fox River Assessment Area contain features of geologic interest. Three of these are in La Salle County and include the Rhodes Relicts, Wedron Palisades, and Sheridan Red Pine Site Natural Areas. The Rhodes Relicts Natural Area, which is on private land, contains a sandstone cliff of the widespread bedrock unit named the St. Peter Sandstone (Ordovician Ancell Group). The Wedron Palisades Natural Area, also on private land, has a cliff of the St. Peter Sandstone. The Sheridan Red Pine Site has a cliff composed of the New Richmond Sandstone, a sandstone in the Prairie du Chien Group (Ordovician), which underlie the Ancell Group (Figures 2 and 3).

Kane County also contains three sites: the Mooseheart Ravine, Johnson's Mound, and Kaneville Geological Areas. The Mooseheart Ravine Natural Area, which contains a cliff of Silurian dolomite, is located on private land. Johnson's Mound, loctaed on public land, is an outstanding example of the glacial landform called a kame (a mound of sand

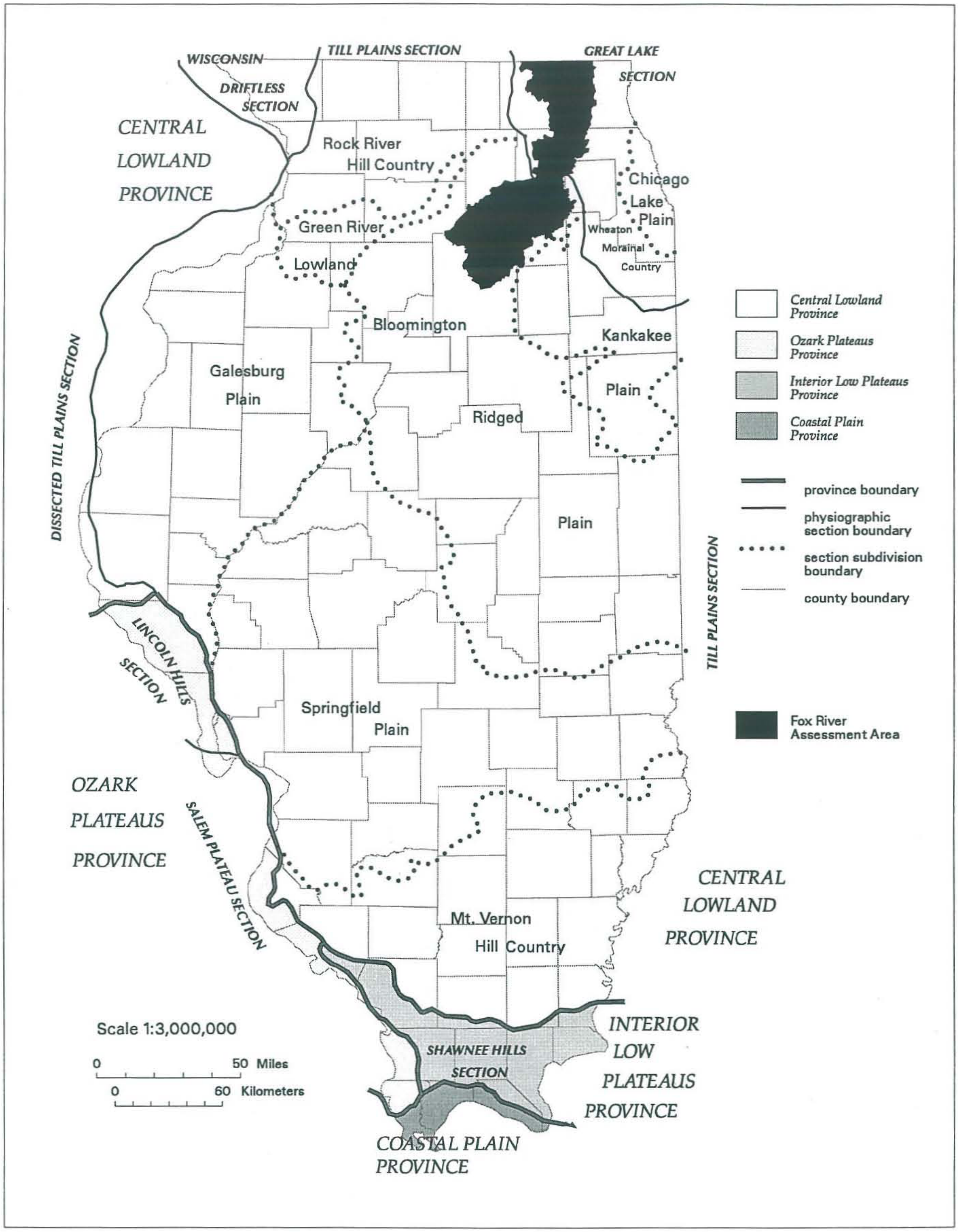

Figure 9. Physiographic Divisions of Illinois (from Leighton, Ekblaw, and Horberg 1948)

and gravel formed when meltwater laden with rock debris plunged through a crevasse in the ice and left the rock debris standing in a mound above the landscape when the ice melted away). Johnson's Mound stands nearly 100 feet higher than the surrounding landscape. The Kaneville Geological Area once contained an outstanding example of another glacial landform called an esker, which is relatively uncommon in Illinois. (An esker is a sinuous ridge of sand and gravel left when a meltwater stream carrying this rock debris beneath the ice was left as a ridge on the landscape after the ice melted away.) Unfortunately, sand and gravel mining over the years has removed most of this feature.

McHenry County contains two natural areas with geological features of interest: Delta Kames and Algonquin Geological Areas. The Delta Kames Natural Area contains an outstanding example of "knob-and-kettle topography," a type of hummocky land surface characterized by rounded knolls and depressions that is generally found on end moraines. The Compton Geological Area in Lee County, which is only about 3 to 4 miles outside the western boundary of the Fox River Assessment Area, is a particularly interesting example of a moraine front. It lies on the outermost moraine of the area covered by the glaciers of the Wisconsin Episode, and the Illinoian till plain lies less than 1 mile to the northwest.

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Land Cover Inventory

Introduction

Land is the "raw material" of Illinois. Current and detailed information regarding this fundamental natural resource is essential for making wise decisions affecting the land and ensuring good stewardship. Land can be described in terms of a number of biological, geological, and hydrological characteristics. This section focuses on *land cover*, a principal factor of a region's land resource. The following paragraphs introduce and explain some basic concepts.

Land use refers to human activities on the land and emphasizes the principal role of land in describing a region's economic activities. Since the concept describes human activity, land use is not always directly observable; that is, we often cannot "see" the specific use of a parcel of land. For example, the presence of forested land in an aerial photograph or satellite image does not convey the possible multiple uses of that land, which may include recreation, wildlife refuge, timber production, or residential development.

Land cover refers to the vegetation and manmade features covering the land surface, all of which can be directly observed using remote sensing imagery.[1] Whereas land use is abstract, land cover is tangible and can be determined by direct inspection of the land surface; it is the visible evidence of land use (Campbell 1987).

In association with other geologic data (such as aquifer location, distribution of water wells, and soil characteristics), geologists can use land cover and land use maps to infer geologic conditions in an area. For example, knowledge of land cover (such as location and extent of urban lands and cropland) is essential to accurately assess the potential for groundwater contamination. Land cover information is also important for resource conservation. In areas where natural vegetation predominates, land cover maps can be used as substitutes for ecosystems in conservation evaluation because vegetation effectively integrates many physical and biological factors in a geographic area (Scott 1993).

Remote Sensing Products

Land use and land cover maps are derived directly from remote sensing imagery. Geologists use a variety of data sources to derive information concerning surface and near-surface

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[1] Remote sensing is the science of deriving information about an object or phenomenon at or near the surface of the earth through the analysis of data acquired by a camera or sensor system located in an aircraft or orbiting satellite.

conditions, and the usefulness of remote sensing imagery for mapping geologic features has been long recognized (USGS 1994).

For assessments at the site level (for example, sample sites or plots) or small regions (for example, county-level), land cover information is typically derived from the interpretation of aerial photography. At the statewide level, land cover information is usually derived from the analysis of satellite imagery, and the resulting inventory offers accurate, regional-level information regarding surface cover characteristics.

Although agricultural lands dominate three-fourths of the surface of Illinois, and many landscape features have been obscured as a result of 175 years of European settlement, remote sensing imagery can show subtle changes in the uppermost few feet of materials and is often more detailed than soils maps. Factors of biodiversity associated with resource quality, richness, and quantity can be estimated with remotely-sensed data, principally because the remote sensing approach compares changes in land use over time (Stoms and Estes 1993).

In 1996, the Illinois Department of Natural Resources published *Illinois Land Cover: An Atlas* (IDNR 1996) and *Illinois Land Cover: An Atlas on Compact Disc* (IDNR 1996), which present the most recent and comprehensive inventory of the state's surface cover. Multitemporal, Landsat Thematic Mapper satellite imagery acquired during 1991–1995 was the principal data source. All of the land cover information presented in this section is derived from *Illinois Land Cover: An Atlas on Compact Disc.*

Land Cover Inventory

The Fox River Assessment Area encompasses a surface area of approximately 1,080 square miles (Figure 1) and comprises 23 adjoining subbasins, ranging in size from 1.2 square miles (Upper Fox River) to 202.8 square miles (Fox River) (Figure 10). Parts of ten Illinois counties are included in the Fox River Assessment Area including (from north to south), McHenry, Lake, De Kalb, Kane, Cook, Du Page, La Salle, Kendall, Will, and Grundy Counties.

The type and extent of land cover within the Fox River Assessment Area is presented in Table 1. For purposes of comparison, a statewide summary is presented in Table 2. Appendix B provides a land cover inventory for each subbasin; and to facilitate subbasin comparisons, the 19 categories of land cover given in Table 1 have been consolidated into nine principal land cover categories (Table 3). The original satellite imagery used to compile these data was acquired on September 10, 1992, and May 31, 1996 (IDNR 1996). To better visualize the spatial relationships of land cover and subbasin position, Figures 13, 15, 16, 18, 20, and 22 are maps that represent the nine principal land cover categories (two maps are composites of two categories; and one category, barren land, is not applicable). It should be noted that for the scope of this report, both the scale and categorical

Table 1. Land Cover of the Fox River Assessment Area*

Category	*Sq. Mi.*	*Acres*	*% Basin*
Agricultural Land	**1,080**	**723,422**	**66.2**
Row Crops	828	529,741	48.5
Small Grains	18	11,468	1.1
Orchards/Nurseries	3	2,134	0.2
Rural Grassland	231	180,080	16.5
Forest & Woodland	**157**	**100,547**	**9.2**
Deciduous, closed	119	75,867	6.9
Deciduous, opened	38	24,327	2.2
Coniferous	1	353	0.0
Urban & Build-Up Land	**302**	**193,494**	**17.7**
High Density	26	16,465	1.5
Medium Density	59	37,482	3.4
Low Density	65	41,339	3.8
Major Roadways	14	8,931	0.8
Active Railroads	6	3,892	0.4
Abandoned Railroads	1	494	0.1
Urban Grassland	133	84,890	7.8
Wetland	**77**	**49,463**	**4.5**
Shallow Marsh/Wet Meadow	35	22,176	2.0
Deep Marsh	13	8,061	0.7
Forested	13	8,178	0.8
Shallow Water	17	11,048	1.0
Other Land	**41**	**25,960**	**2.4**
Open Water	25	16,007	1.5
Perennial Streams	12	7,490	0.7
Barren & Exposed	4	2,463	0.2
Totals	**1,658**	**1,092,886**	**100.0**

* Small errors in totals are due to rounding.

resolution of the original land-cover inventory have been generalized to conform to a standardized map format. Figure 11, a composite land cover map for the Fox Lake subbasin, is an example of the increased detail available within the statewide land cover inventory.

The Fox River Assessment Area is unusually diverse not only in the types of land cover present but also in their spatial distribution. For example, 19 of the 20 major land cover categories that compose the state are represented within the assessment area, with only

Table 2. Land Cover of Illinois (DNR 1996)*

Category	*Sq. Mi.*	*Acres*	*State %*
Agricultural Land	**43,638.8**	**27,928,797.0**	**77.5**
Row Crops	30,600.4	19,584,247.0	54.3
Small Grains	3,166.0	2,026,268.0	5.6
Rural Grassland	9,847.5	6,302,371.0	17.5
Orchards & Nurseries	24.9	15,911.0	0.0
Forest & Woodland	**6,388.5**	**4,088,623.0**	**11.3**
Deciduous, Closed Canopy	5,618.0	3,595,538.0	10.0
Deciduous, Open Canopy	657.8	421,013.0	1.2
Coniferous	112.6	72,072.0	0.2
Urban & Built-Up Land	**3,261.6**	**2,087,396.0**	**5.8**
High Density	476.7	305,065.0	0.8
Medium/High Density	186.5	119,352.0	0.3
Medium Density	729.5	466,894.0	1.3
Low Density	392.5	251,180.0	0.7
Transportation	492.0	314,866.0	0.9
Urban Grassland	984.4	630,038.0	1.8
Wetland	**1,829.0**	**1,170,550.0**	**3.2**
Shallow Marsh/Wet Meadow	219.8	140,664.0	0.4
Deep Marsh	54.5	34,855.0	0.1
Swamp	18.3	11,726.0	0.0
Forested	1,264.0	808,987.0	2.2
Shallow Water	272.4	174,318.0	0.5
Other Land	**1,228.7**	**786,361.0**	**2.2**
Lakes & Streams	1,203.4	770,183.0	2.1
Barren & Exposed	25.3	16,178.0	0.0
Totals	**56,346.5**	**36,061,727.0**	**100.0**

* Small errors in totals are due to rounding.

the Swamp category not being found in the assessment area. The northern part of the assessment area, represented by the Fox Lake subbasin (Figure 10), is especially diverse in the spatial distribution of its land cover. This diversity is a result of the recent Wisconsin-age glacial deposits that mantle the region and the growing development associated with the Chicago metropolitan area. The most noticeable differences between the land cover of the assessment area and the State are in the amount of land devoted to agricultural and urban uses (Figure 12).

Urban and Built-Up Land comprises nearly 18% (17.7%) of the Fox River Assessment Area, and much of this is in the northern and central thirds of the assessment area

Table 3. Principal Land Cover of the Fox River Assessment Area*

Category	*Sq. Mi.*	*Acres*	*% Basin*
Agricultural Land	**1,130**	**723,422**	**66.2**
Cropland	849	543,342	49.7
Rural Grassland	281	180,080	16.5
Forest & Woodland	**157**	**100,547**	**9.2**
Urban & Build-Up Land	**302**	**193,494**	**17.7**
Urban/Built-Up	170	108,603	9.9
Urban Grassland	133	84,890	7.8
Wetland	**77**	**49,463**	**4.5**
Forested	13	8,178	0.8
Non-Forested	65	41,286	3.8
Other Land	**41**	**25,960**	**2.4**
Lakes & Streams	37	23,497	2.2
Barren & Exposed	4	2,463	0.2
Totals	**1,708**	**1,092,886**	**100.0**

* Small errors in totals are due to rounding.

(Figure 13). The relationship between urban land use and subbasin position within the assessment area can also be visualized by means of a graph.In Figure 14, the subbasins have been organized along the horizontal axis such that the northern part of the assessment area is at the left margin, and the southern portion is at the right margin of the graph. Note the significant increase in the percentage of urban land cover associated with subbasins 10 to 14 (Flint Creek, Tyler Creek, Poplar Creek, Ferson Creek, and Fox River), over one-half of the surface area (53.5%) of subbasin 12 (Poplar Creek) is Urban and Built-Up Land.The high percentages of land area devoted to urban use indicate that the potential for impacts to the natural cover, drainage, and groundwater by development pressures are much increased in this central part of the assessment area.

Agricultural Land accounts for slightly over 66% (66.2%) of the Fox River Assessment Area, with nearly half of this amount (49.72 %) devoted to Cropland (Table 3). Figures 15 and 16 show the abrupt dichotomy between the diverse landscape in the north half of the assessment area and the south half, which has a predominantly agricultural landscape. Figure 17 shows the increasing predominance of Cropland from subbasins 14 to 24 (Fox River, Mill Creek, Blackberry Creek, Big Rock Creek, Little Rock Creek, Somonauk Creek, Little Indian Creek, Waubansee Creek, Indian Creek, Fox River, and Buck Creek), culminating with Cropland accounting for nearly 90% of the Buck Creek subbasin (subbasin 24). Interestingly, the percentage of Rural Grassland remains generally constant across the subbasins. Despite the concentrations of Urban and Built-Up Land, when Cropland and Rural Grassland are combined, Agricultural Land still accounts for more than 50% of the surface area in two-thirds (15 of 23) of the subbasins in the Fox River Assessment Area (see Appendix B).

Forest and Woodland cover accounts for slightly over 9% (9.2%) of the assessment area (Figure 18), with the largest amounts concentrated in the north part of the assessment area in subbasins 2 to 10 (Fox Lake, Fox River, East Nippersink Creek, North Branch Nippersink Creek, West Nippersink Creek, Fox River, Wonder Lake, Boone Creek, and Flint Creek; see also Figure 19). Figure 19 also shows a noticeable decline in Forest and Woodland cover between subbasins 10 and 11 (Flint Creek and Tyler Creek). This decline is also associated with part of the assessment area that has increased amounts of Urban and Built-Up Land. The surface area of the lower half of the Fox River Assessment Area, devoted predominantly to agricultural land uses, is also characterized by low amounts of Forest and Woodland.

Wetland land cover accounts for 4.5% of the assessment area, whereas Lakes and Streams covers 2.2 % (Figures 20 and 22). Figure 21 shows that the greatest concentration of wetland habitat is situated in the northern portion of the area, and, in fact, almost one-third (31.2%) of the wetland cover within the assessment area is concentrated in a single sub-basin (subbasin 2, Fox Lake). Wetland cover generally decreases southward through the assessment area, reaching a minimum of only 41.9 acres (0.2%) within subbasin 24 (Buck Creek). Not surprisingly, the highest percentage of Cropland within the assessment area is also associated with this subbasin.

Notes on Land Cover Maps

In addition to *Illinois Land Cover: An Atlas* (IDNR 1996), two other publications relating to the statewide land cover inventory are available from the Illinois Department of Natural Resources: (1) *Illinois Land Cover: An Atlas on Compact Disc* (IDNR 1996), which contains the statewide land cover digital database; and (2) *Land Cover of Illinois* (IDNR 1996), a printed 1:500,000-scale map. All are available through DNR Conservation 2000 Publications (524 South Second Street, Springfield, IL 62701-1787; telephone: 217-782-7940). Land cover information and data are also available through the DNR website at

http://dnr.state.il.us/ctap/landmap.htm

It is useful to discuss appropriate mapping scales that should be used as guidelines with applications involving the statewide land cover database. Using standardized map scales and associated National Map Accuracy Standards (NMAS) established by the U.S. Geological Survey, maps developed from the land cover database can range from 1:62,000 (1 inch = 1 mile) to 1:100,000 (1 inch = 1.6 miles) and still maintain NMAS standards for raster data possessing a ground spatial resolution of 28.5 meters (93.5 feet). Of course, any smaller scale maps (for example, 1:250,000) will also maintain NMAS accuracy standards. Given these guidelines, the Illinois land cover database can support regional applications but should not be expected to fulfill the needs of site specific projects.

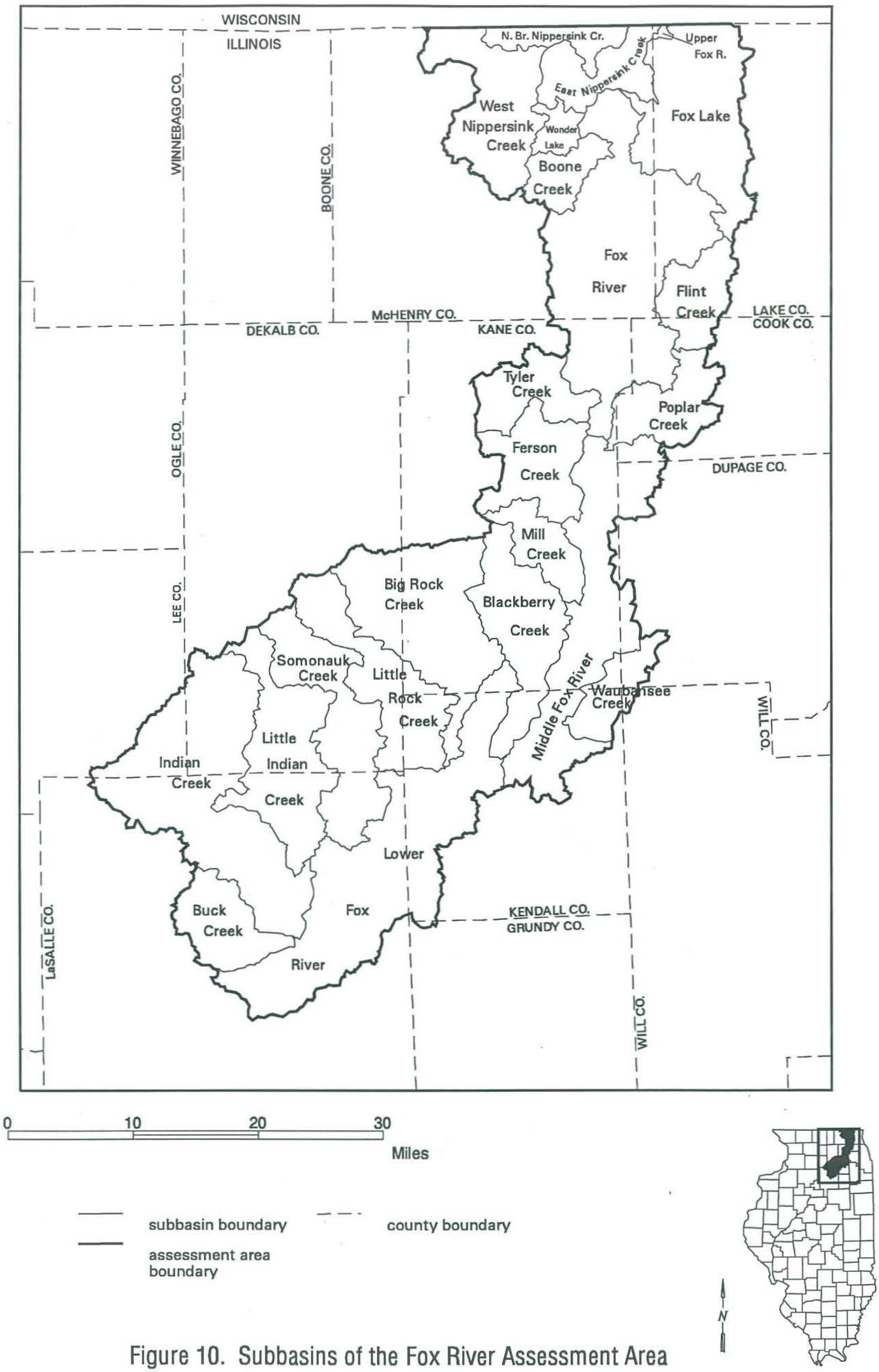


Figure 10. Subbasins of the Fox River Assessment Area

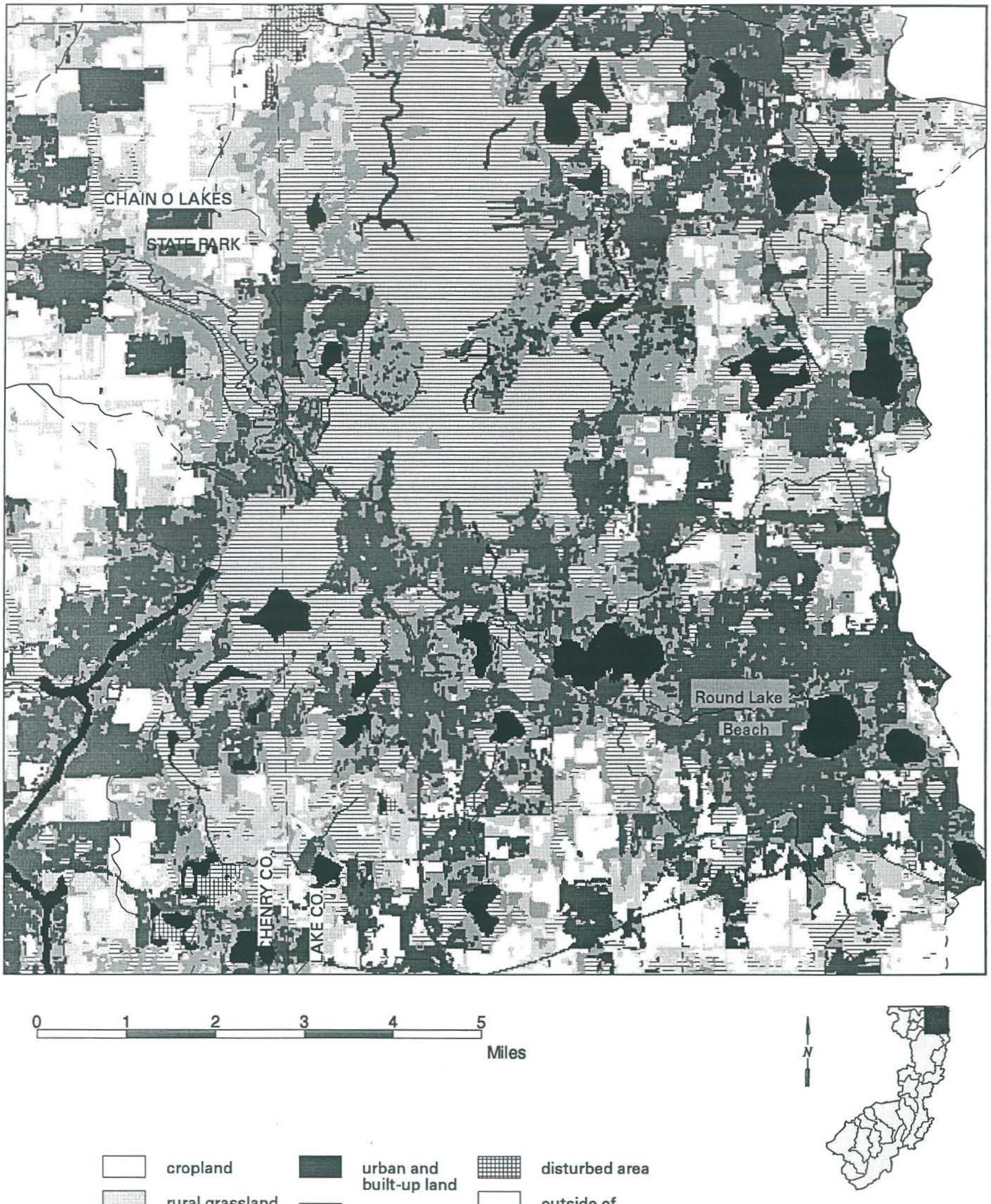
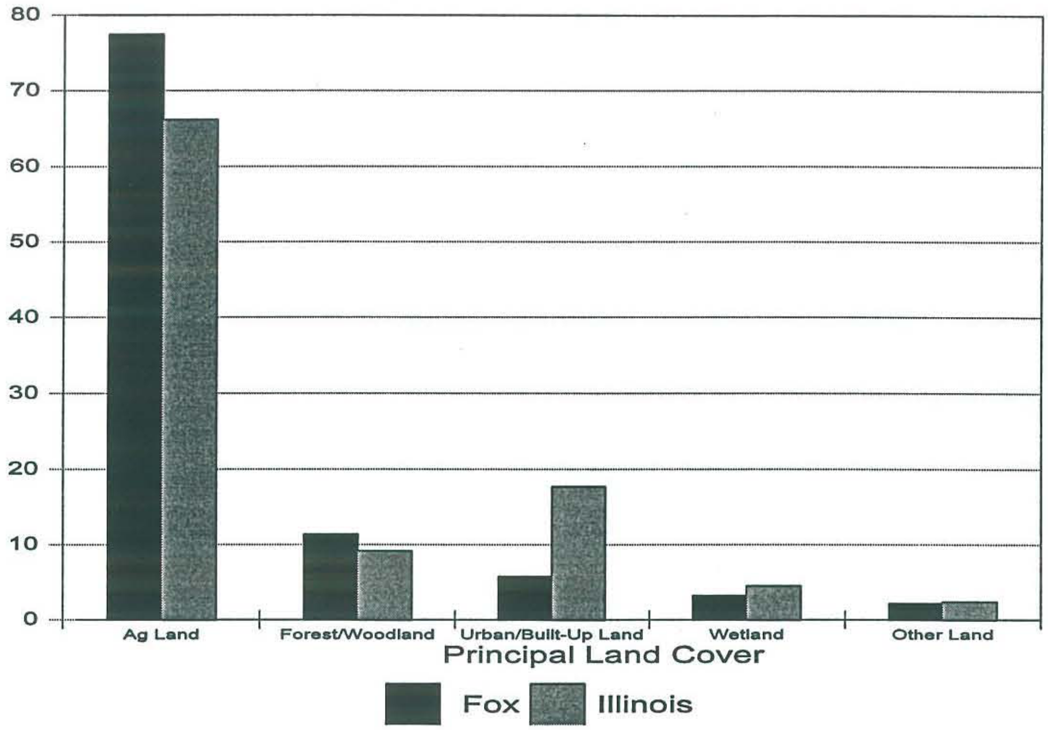


Figure 11. Composite Land Cover Map centered over the Fox Lake Subbasin (IDNR 1996)



2	Fox Lake Subbasin
3	Upper Fox River Subbasin
4	Nippersink Creek Subbasin
5	N. Branch Nippersink Cr. Subbasin
6	Nippersink Creek Subbasin
7	Fox River Subbasin
8	Wonder Lake Subbasin
9	Boone Creek Subbasin
10	Flint Creek Subbasin
11	Tyler Creek Subbasin
12	Poplar Creek Subbasin
13	Ferson Creek Subbasin
14	Middle Fox River Subbasin
15	Mill Creek Subbasin
16	Blackberry Creek Subbasin
17	Big Rock Creek Subbasin
18	Little Rock Creek Subbasin
19	Somonauk Creek Subbasin
20	Little Indian Creek Subbasin
21	Waubansee Creek Subbasin
22	Indian Creek Subbasin
23	Lower Fox River Subbasin
24	Buck Creek Subbasin

Figure 12. Percentage of Principal Land Cover for the Fox River Assessment Area and the State of Illinois

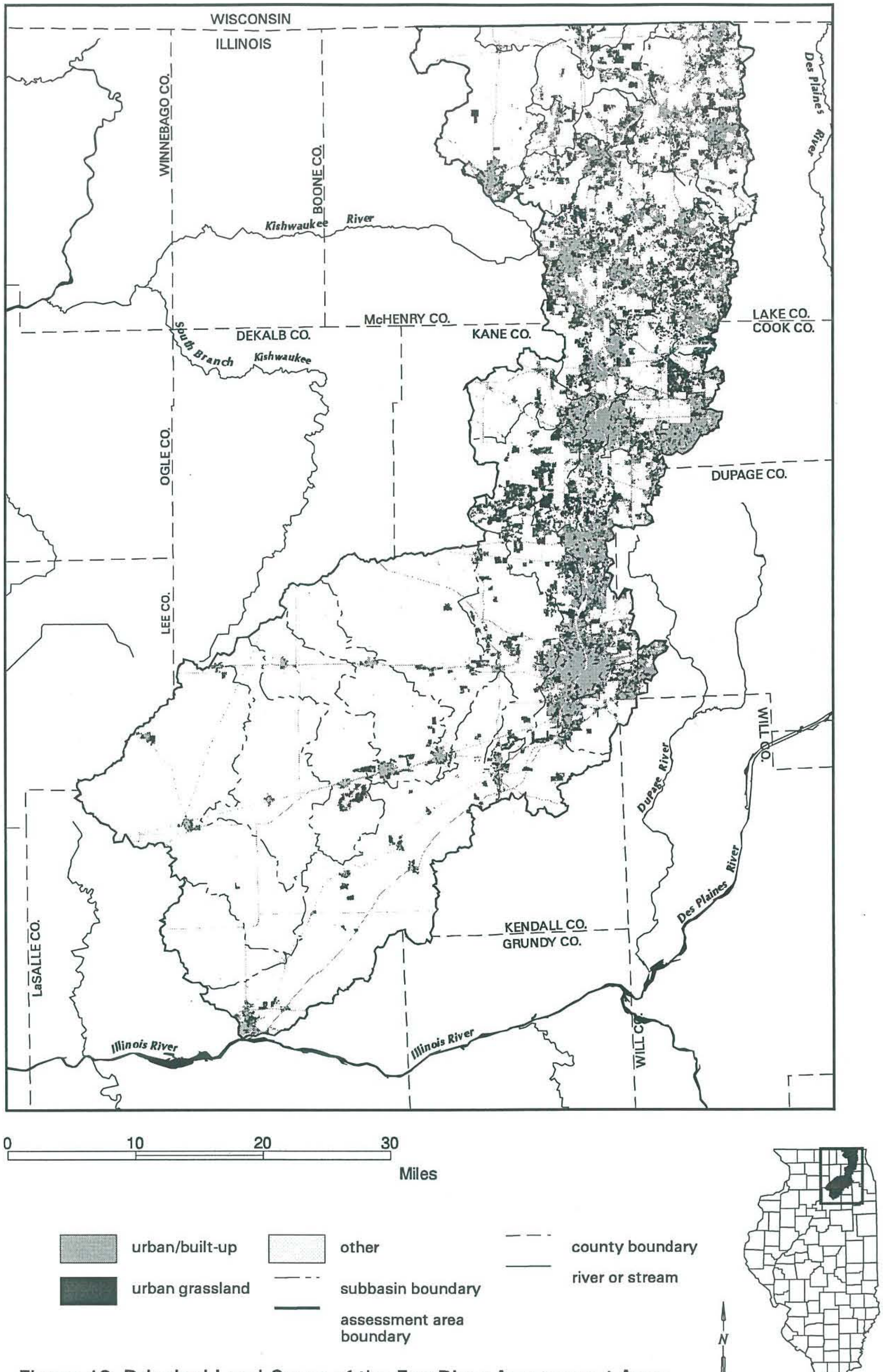
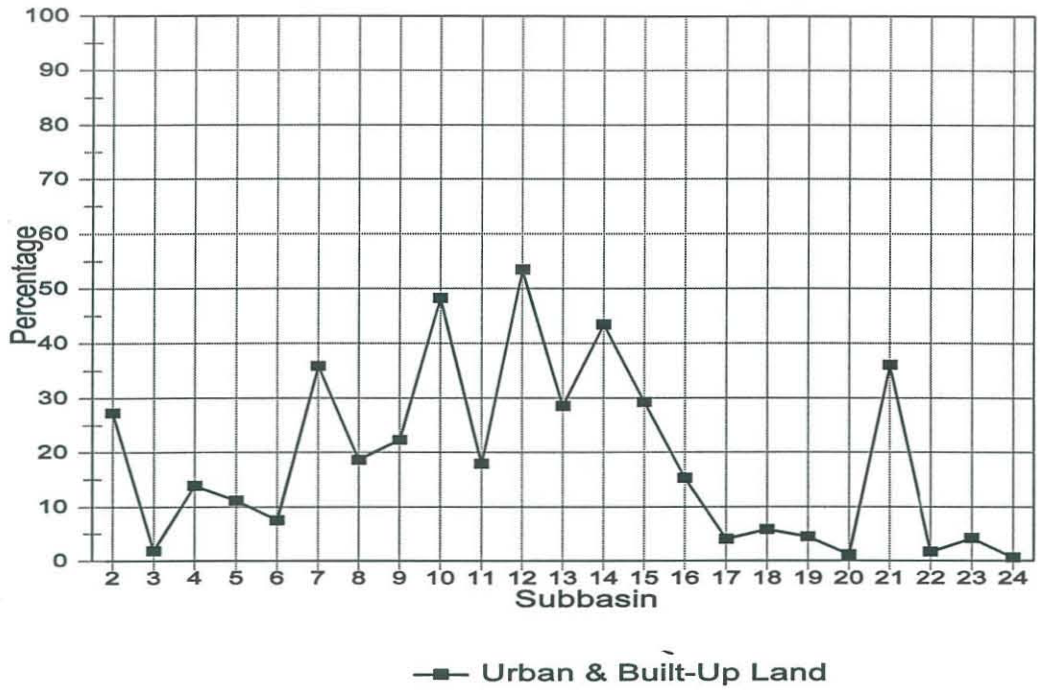


Figure 13. Principal Land Cover of the Fox River Assessment Area: Urban and Built-Up Land, Urban Grassland (IDNR 1996)



2	Fox Lake Subbasin	13	Ferson Creek Subbasin
3	Upper Fox River Subbasin	14	Middle Fox River Subbasin
4	Nippersink Creek Subbasin	15	Mill Creek Subbasin
5	N. Branch Nippersink Cr. Subbasin	16	Blackberry Creek Subbasin
		17	Big Rock Creek Subbasin
6	Nippersink Creek Subbasin	18	Little Rock Creek Subbasin
7	Fox River Subbasin	19	Somonauk Creek Subbasin
8	Wonder Lake Subbasin	20	Little Indian Creek Subbasin
9	Boone Creek Subbasin	21	Waubansee Creek Subbasin
10	Flint Creek Subbasin	22	Indian Creek Subbasin
11	Tyler Creek Subbasin	23	Lower Fox River Subbasin
12	Poplar Creek Subbasin	24	Buck Creek Subbasin

Figure 14. Percentage of Urban & Built-Up Land by subbasin. Subbasins are organized from head of the assessment area (left margin) to the bottom of the assessment area

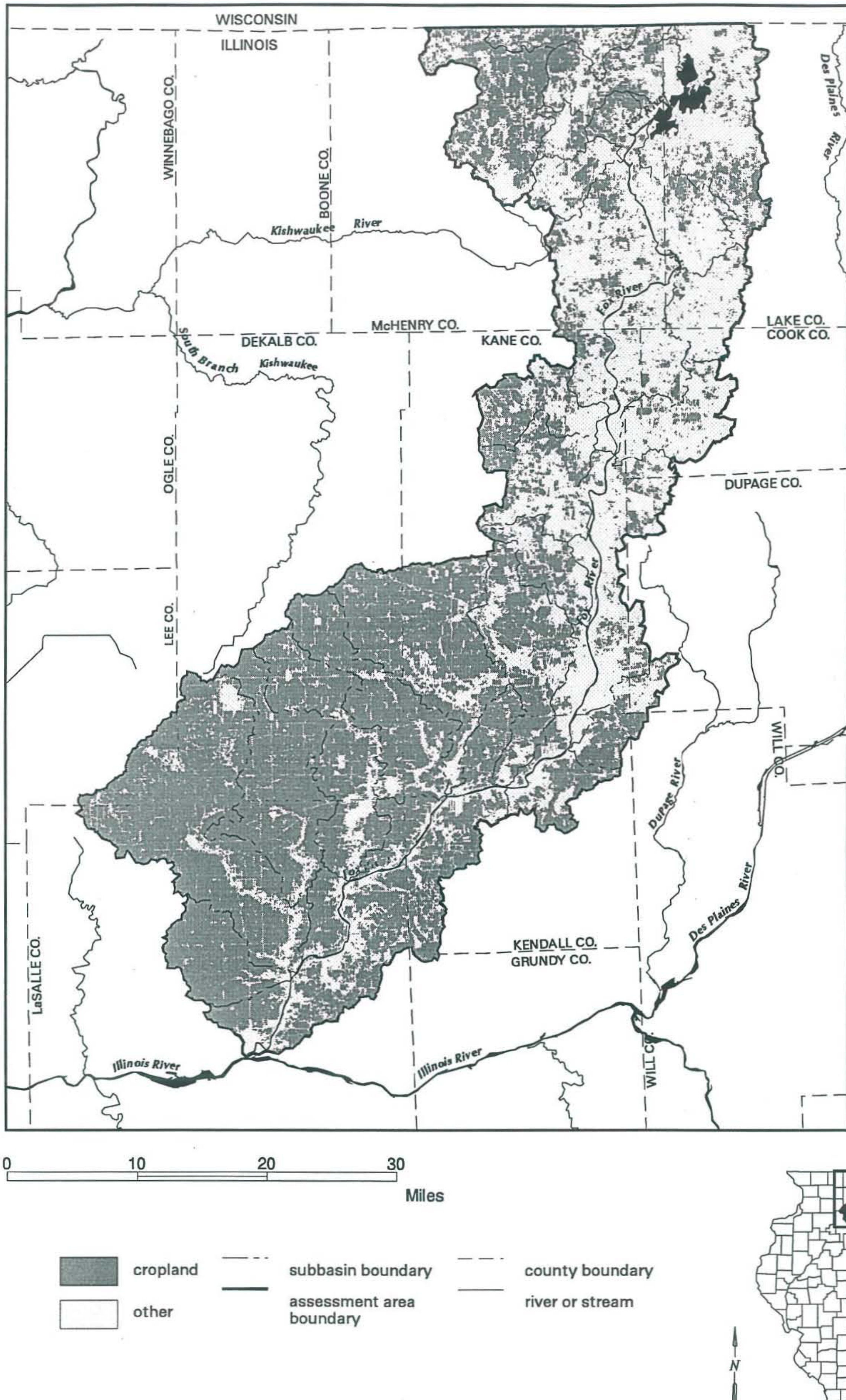


Figure 15. Principal Land Cover of the Fox River Assessment Area: Cropland (IDNR 1996)

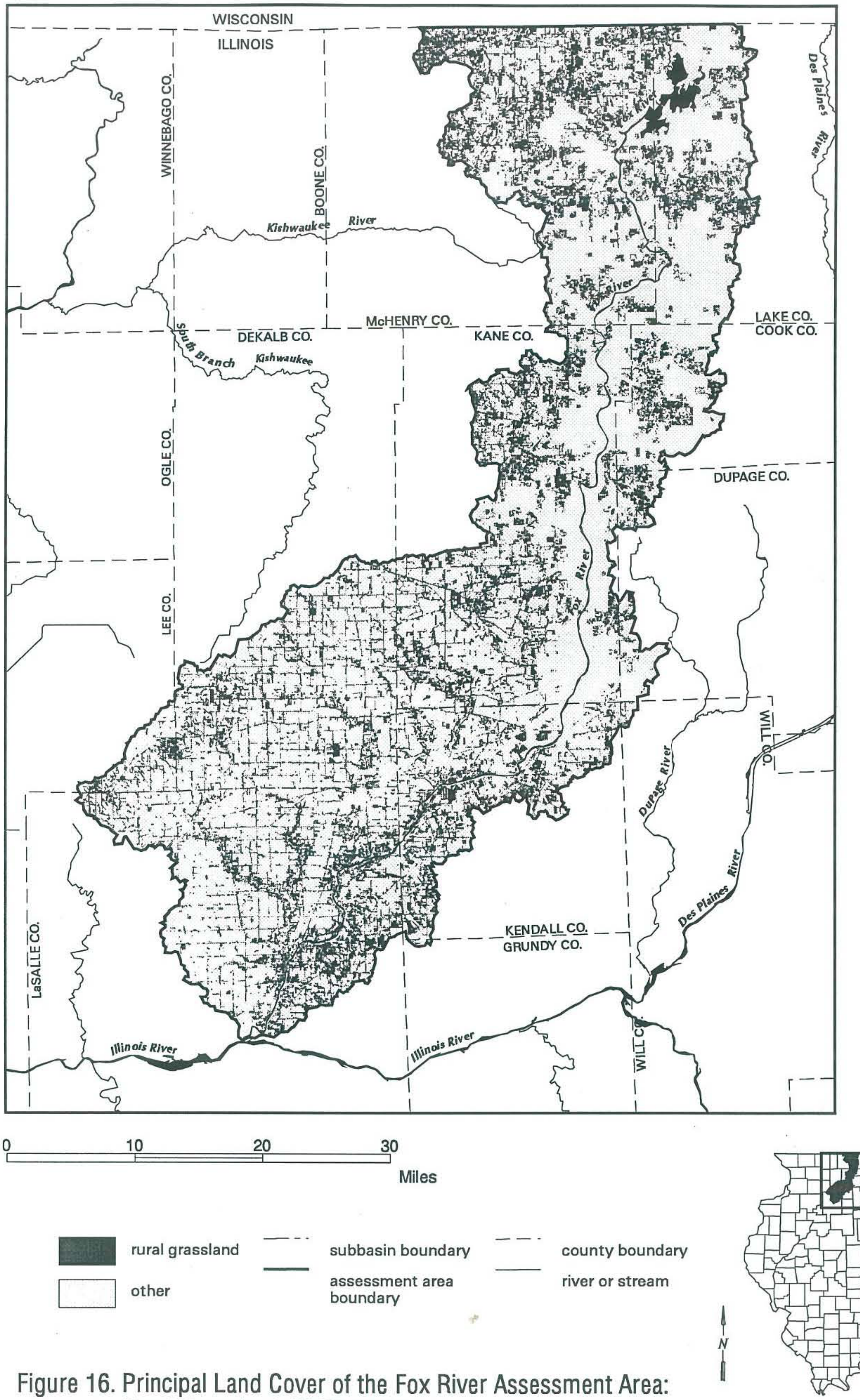
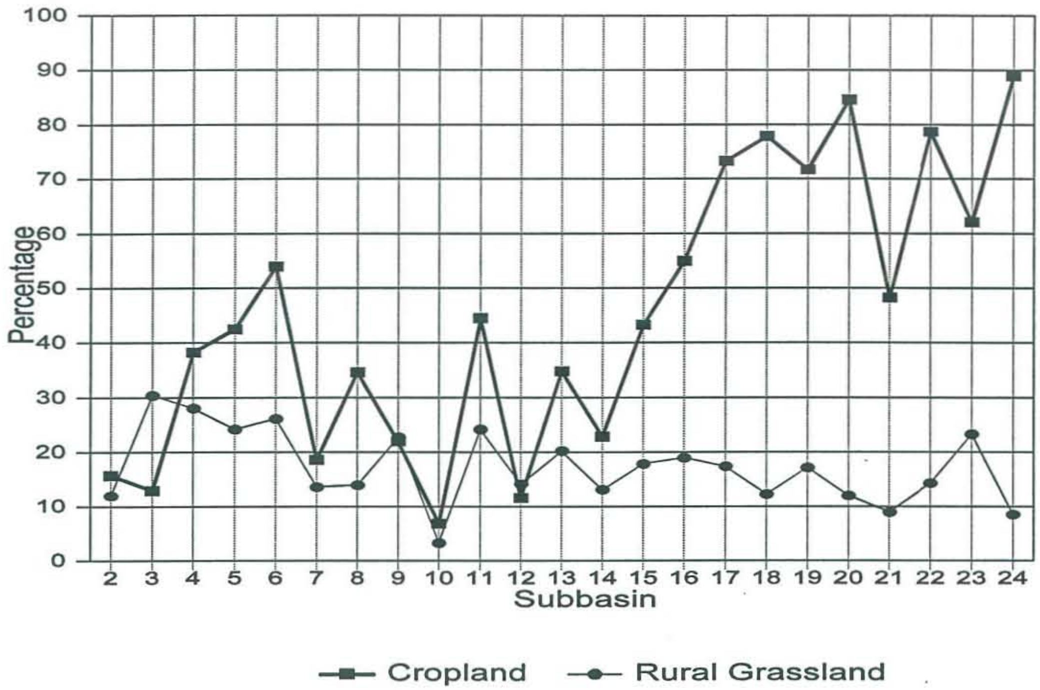


Figure 16. Principal Land Cover of the Fox River Assessment Area: Rural Grassland (IDNR 1996)



2	Fox Lake Subbasin	13	Ferson Creek Subbasin
3	Upper Fox River Subbasin	14	Middle Fox River Subbasin
4	Nippersink Creek Subbasin	15	Mill Creek Subbasin
5	N. Branch Nippersink Cr. Subbasin	16	Blackberry Creek Subbasin
		17	Big Rock Creek Subbasin
6	Nippersink Creek Subbasin	18	Little Rock Creek Subbasin
7	Fox River Subbasin	19	Somonauk Creek Subbasin
8	Wonder Lake Subbasin	20	Little Indian Creek Subbasin
9	Boone Creek Subbasin	21	Waubansee Creek Subbasin
10	Flint Creek Subbasin	22	Indian Creek Subbasin
11	Tyler Creek Subbasin	23	Lower Fox River Subbasin
12	Poplar Creek Subbasin	24	Buck Creek Subbasin

Figure 17. Percentage of Cropland and Rural Grassland as compared to subbasin position within the Fox River Assessment Area

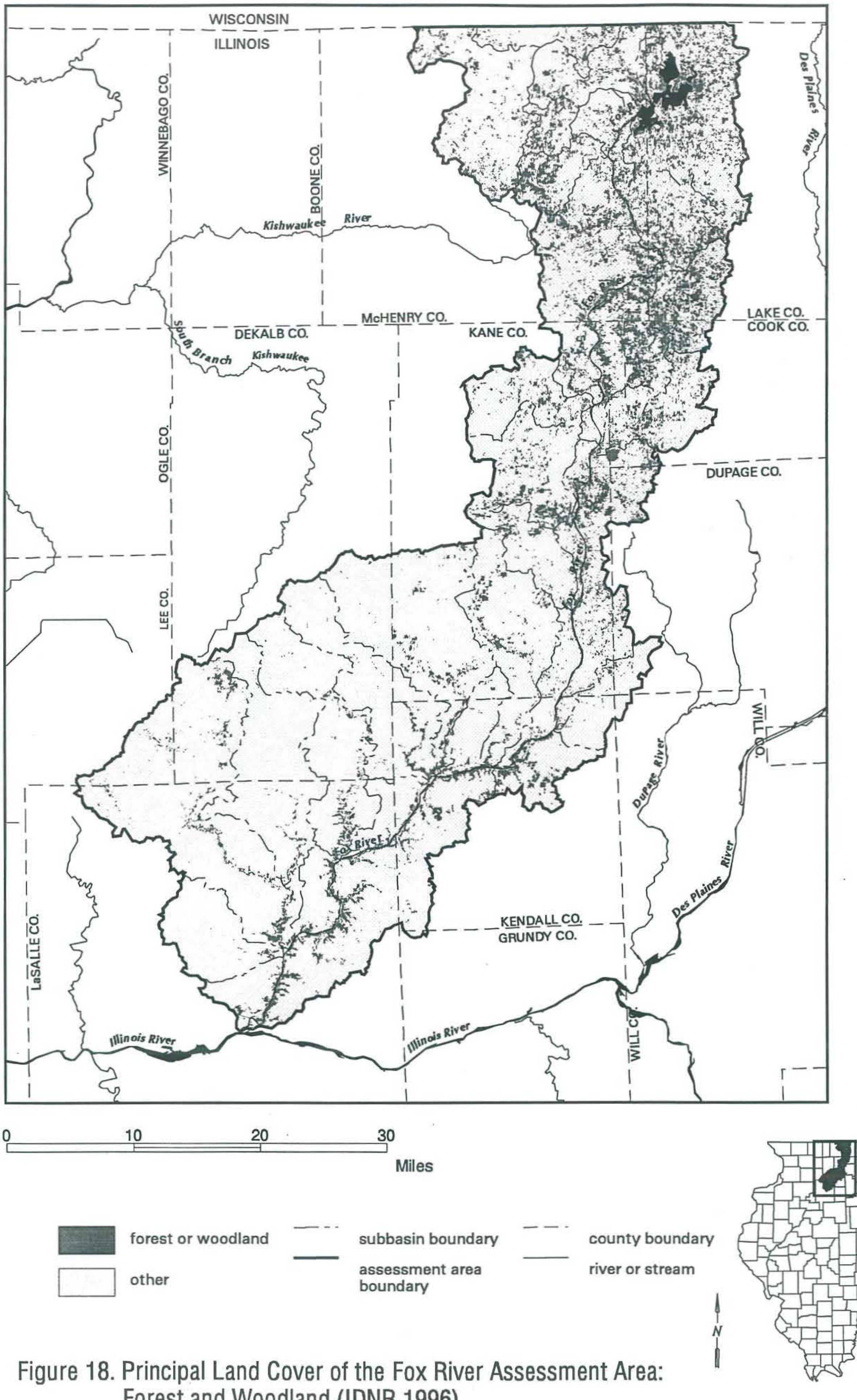
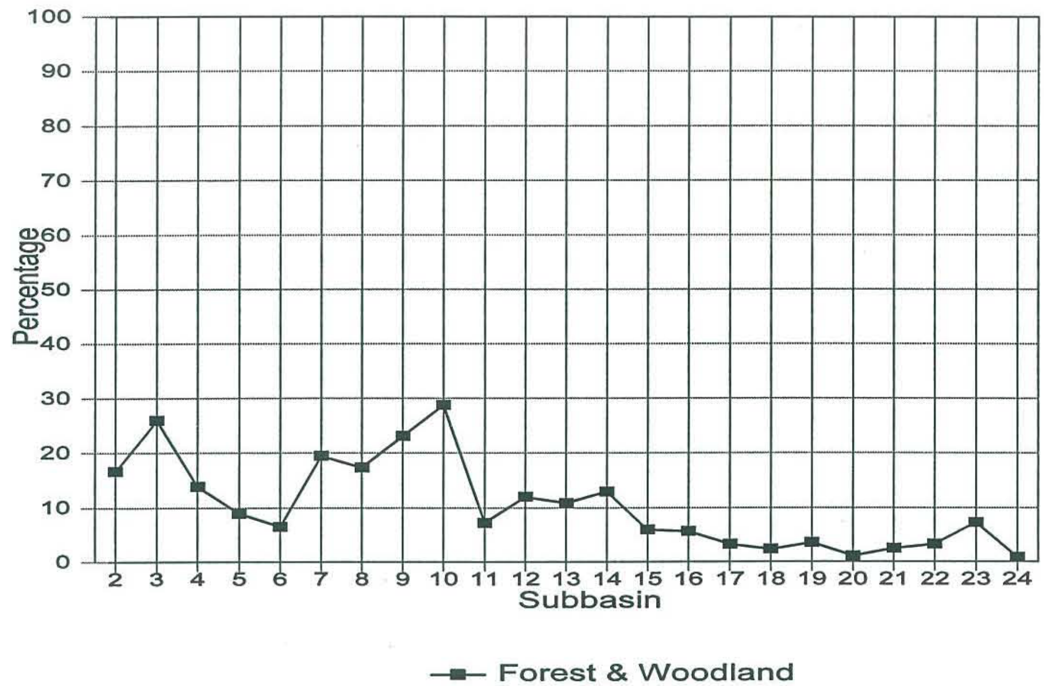


Figure 18. Principal Land Cover of the Fox River Assessment Area: Forest and Woodland (IDNR 1996)



2	Fox Lake Subbasin
3	Upper Fox River Subbasin
4	Nippersink Creek Subbasin
5	N. Branch Nippersink Cr. Subbasin
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14	Middle Fox River Subbasin
15	Mill Creek Subbasin
16	Blackberry Creek Subbasin
17	Big Rock Creek Subbasin
18	Little Rock Creek Subbasin
19	Somonauk Creek Subbasin
20	Little Indian Creek Subbasin
21	Waubansee Creek Subbasin
22	Indian Creek Subbasin
23	Lower Fox River Subbasin
24	Buck Creek Subbasin

Figure 19. Percentage of Forest and Woodland as compared to subbasin position within the Fox River Assessment Area

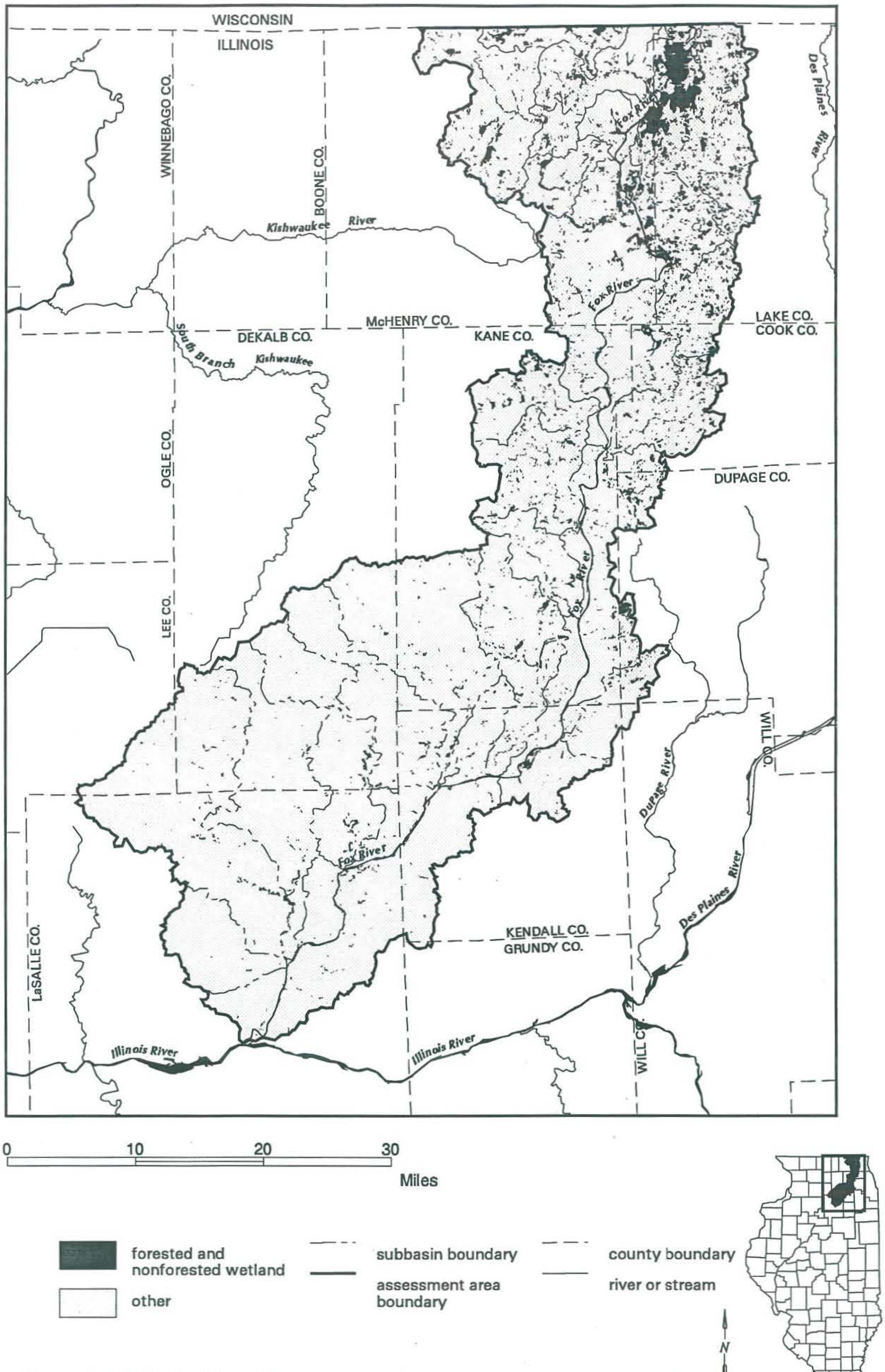
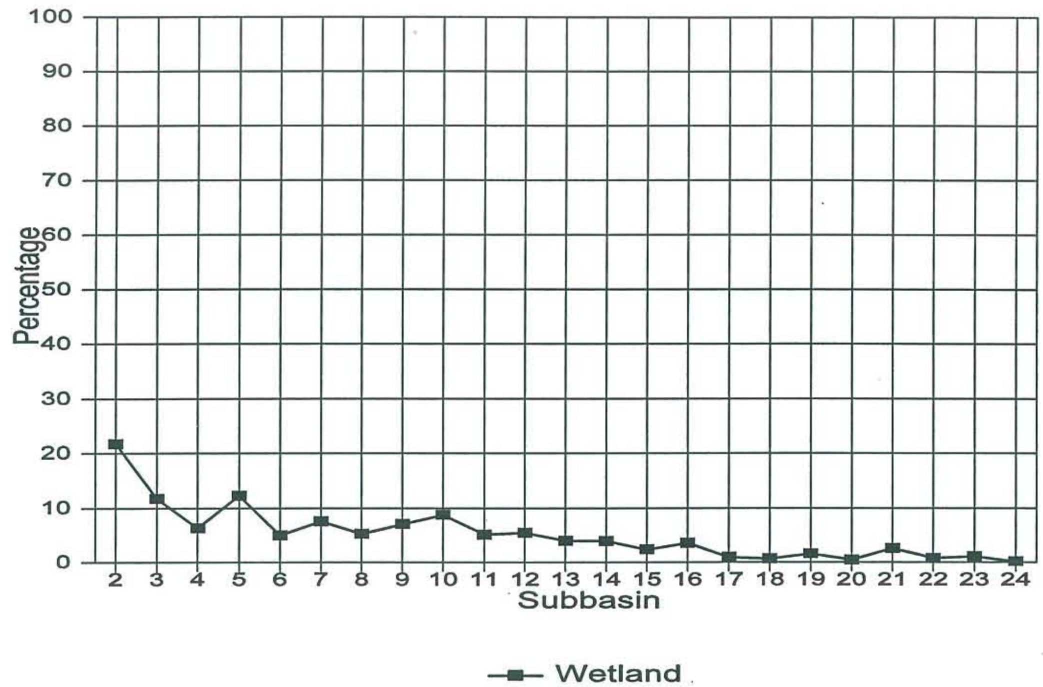


Figure 20. Principal Land Cover of the Fox River Assessment Area: Wetland (IDNR 1996)



2	Fox Lake Subbasin	13	Ferson Creek Subbasin
3	Upper Fox River Subbasin	14	Middle Fox River Subbasin
4	Nippersink Creek Subbasin	15	Mill Creek Subbasin
5	N. Branch Nippersink Cr. Subbasin	16	Blackberry Creek Subbasin
		17	Big Rock Creek Subbasin
6	Nippersink Creek Subbasin	18	Little Rock Creek Subbasin
7	Fox River Subbasin	19	Somonauk Creek Subbasin
8	Wonder Lake Subbasin	20	Little Indian Creek Subbasin
9	Boone Creek Subbasin	21	Waubansee Creek Subbasin
10	Flint Creek Subbasin	22	Indian Creek Subbasin
11	Tyler Creek Subbasin	23	Lower Fox River Subbasin
12	Poplar Creek Subbasin	24	Buck Creek Subbasin

Figure 21. Percentage of Wetland as compared to subbasin position within the Fox River Assessment Area

Figure 22. Principal Land Cover of the Fox River Assessment Area: Lakes and Streams (IDNR 1996)

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Part 2: Geology and Society

Most of us live, work, and play on the surface of the earth. But what we often fail to recognize is that beneath the office building or factory where we work, beneath the home where we live, or beneath the park where we play, is a framework of geology that supports our lives on the surface. The geologic framework contains the mineral resources that are the raw ingredients of most of the manufactured materials that furnish our homes, offices, and playgrounds; and it provides the water that flows freely from the faucets we turn on and off daily. At the same time, the contamination of water resources, the slumping of banks along our roads, or damage from earthquakes are hazards that we do not think about until they happen—let alone realize that a supporting framework of geology affects why they occur.

The interrelatedness between geology and human society is so intimate and intricate that it is easier ignored than understood. Nevertheless, to understand and wisely use the natural heritage we value, we must consider the geological factors that are part of our daily lives. Some of the major ways geologic materials, geologic resources, and geologic processes affect modern society are discussed below.

Mineral Resources

The mineral resources produced in the Fox River Assessment Area are sand and gravel, limestone and silica sand (Figure 23). In this area in 1996, forty-five pits were producing sand and gravel, two quarries producing limestone (dolomite), and one pit producing silica sand (Table 4). The sand and gravel pits are located in the parts of Cook, Lake, McHenry, Kane, Kendall, and La Salle Counties that lie within this assessment area. Most of the sand and gravel pits are in areas surrounding metropolitan Chicago. The few coal mines that operated in this watershed are now abandoned. There is no oil and gas production in this watershed. Silica sand is mined from the Ordovician St. Peter Sandstone at Wedron in La Salle County. The silica sand is mainly used in glass making and as foundry molding sand, but it has many other uses.

Data on production and employment are not available for the individual pits and quarries or for the assessment area as a whole. These pits and quarries play an important role in the economy of these areas because their products are essential to almost all construction projects. The sand and gravel and stone operations cater to the construction demands of the major metropolitan areas in and around Chicago. Limestone is also used for agricultural purposes as agricultural lime.

The average unit value of sand and gravel in Illinois in 1996 was about $4 per ton. Similarly, the unit value of crushed and broken limestone in 1996 was about $5.70 per ton. These figures show that the unit values of these minerals are low. Hence, efficiency in production and transportation is important. Table 4 lists mineral producers in the assessment area.

Known or expected deposits of useful mineral commodities are sources for possible future exploitation (Figure 24). Significant quantities of sand and gravel deposits occur in certain parts of the assessment area (Lineback 1979). The primary source of sand and gravel is the Henry Formation (Willman and Frye 1970). Additional deposits may be found in the Cahokia Formation in valleys that overlie well-sorted Henry sand and gravel.

In addition to the sand and gravel, there is some potential for stone in the assessment area. The primary sources of stone are the Ordovician rocks in parts of La Salle, Kendall, and De Kalb Counties within the assessment area. Silurian dolomite occurs in Kane County near Aurora. In the northeastern part of the assessment area, urban expansion has eliminated the possibility of opening new quarrying operations where stone deposits are close to the ground surface.

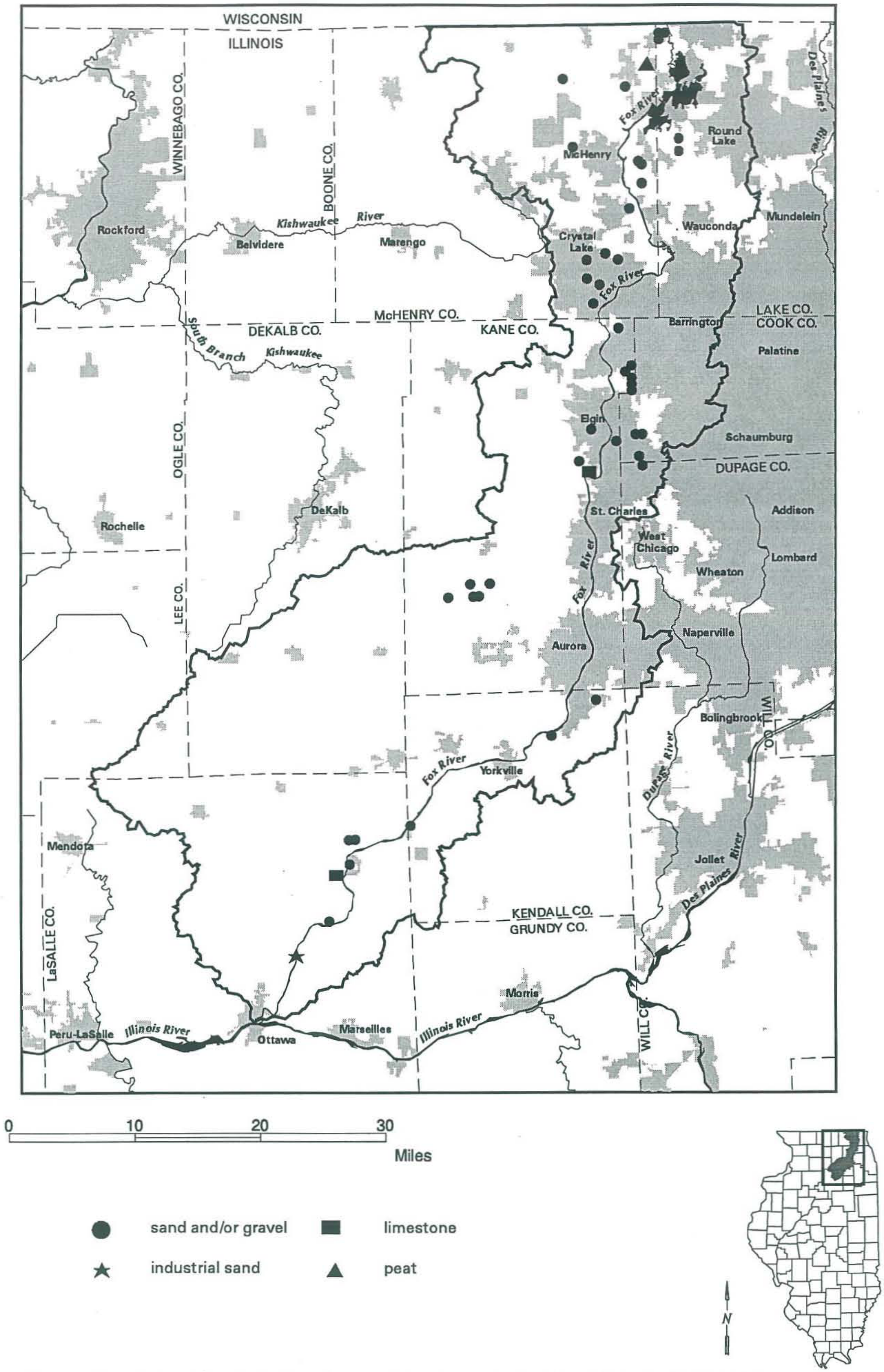

Figure 23. Active Sand and/or Gravel Pits, Limestone Quarries, and Peat Pits

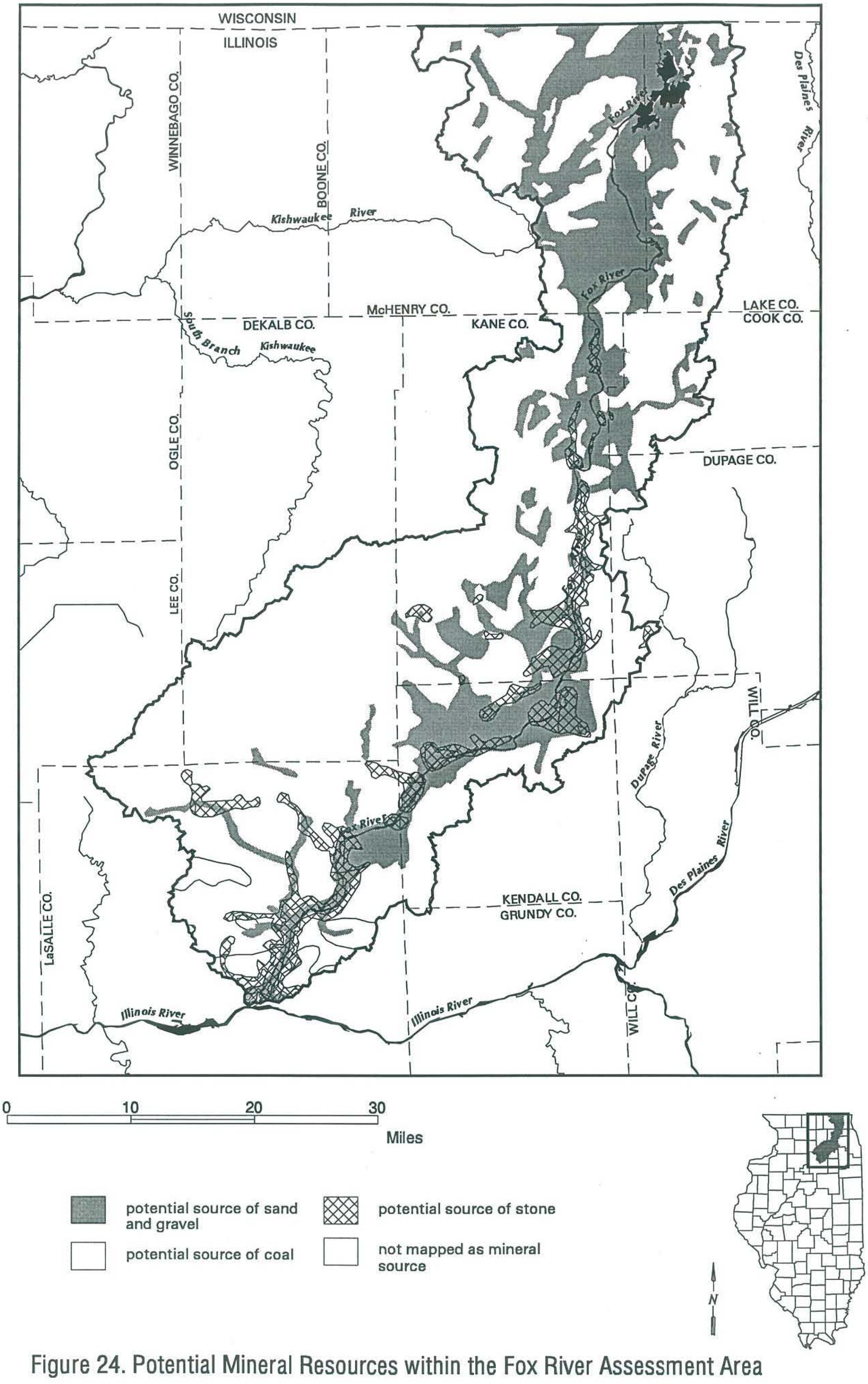

Figure 24. Potential Mineral Resources within the Fox River Assessment Area

Table 4. Mineral Producers in the Fox River Assessment Area

Stone

Fox River Quarry
Fox River Stone Co.
1250 Larkin Av., Suite 10
Elgin, IL 60123
Phone: (708) 742-6060
Mineral: Limestone
County: Kane

Troup Quarry
L.S. Garrow and Sons, Inc.
P.O. Box 179, Serena, IL 60549
Phone: (815) 434-5377
Mineral: Limestone
County: La Salle

Silica Sand

Wedron Pit
Wedron Silica Company
P.O. Box 177, Wedron, IL 60557
Phone: (616) 465-6893
Mineral: Silica
County: La Salle

Sand and Gravel

Antioch Pit
Midwest Aggregates
P.O. Box 7126
Libertyville, IL 60048
Phone: (708) 395-2595
Mineral: Sand and gravel
County: Lake

Fox Pit
Thelen Sand and Gravel, Inc.
28955 West Rt. 173
Antioch, IL 60002
Phone: (708) 395-3313
Mineral: Sand and gravel
County: Lake

Barthel Pit
Thelen Sand and Gravel, Inc.
8955 West Rt. 173
Antioch, IL 60002
Phone: (708) 395-3313
Mineral: Sand and gravel
County: Lake

Dahl Enterprises, Inc.
P.O. Box 613
Antioch, IL 60002
Phone: (217) 395-8634
County: Lake

Glacier Lakes
Glacier Lakes Sand and Gravel
P.O. Box 127
Spring Grove, IL 60081
Mineral: Sand and gravel
County: McHenry

Spring Grove Pit
Spring Lake Sand and Gravel
P.O. Box 127
Spring Grove, IL 60081
Phone: (815) 385-0856
Mineral: Sand and gravel
County: McHenry

Volo Pit
Doetsch Brothers Co.
35 E. Paletine Rd.
Prospect Heights, IL 60070
Mineral: Sand
County: Lake

McHenry West Pit #26
Meyer Material Co.
580 S. Wolf Rd., P.O. Box 129
Des Plaines, IL 60017
Phone: (708) 824-4111
Mineral: Sand and gravel
County: McHenry

Spruce Lake Sand and Gravel
4501 Route 12
Richmond, IL 60071
Phone: (815) 675-6677
Mineral: Sand and gravel
County: Lake

Petersen or Freund Pit
Petersen Sand and Gravel, Inc.
914 West Route 120
McHenry, IL 60050
Phone: (815) 344-6221
Mineral: Gravel
County: McHenry

Possum Run Pit #27
Meyer Material Co.
580 S. Wolf Rd., P.O. Box 129
Des Plaines, IL 60017
Phone: (708) 824-4111
Mineral: Sand and gravel
County: McHenry

Raven Pit
Reliable Sand and Gravel Co., Inc.
P.O. Box 707
Island Lake, IL 60042
Phone: (815) 385-5020
Mineral: Sand and gravel
County: McHenry

Nisha Road Mine
4501 Route 12
Richmond, IL 60071
Phone: (815) 675-6677
Mineral: Gravel
County: McHenry

Corral Lake Sand and Gravel, Inc.
400 E. Terra Cotta
Crystal Lake, IL 60014
Phone: (815) 459-9975
Mineral: Sand and gravel
County: McHenry

Koch's Pit
Cary Gravel Inc.
3410 NW Highway
Cary, IL 60013
Phone: (708) 695-9300
Mineral: Sand and gravel
County: McHenry

Vulcan #498-Crystal Lake
Vulcan Materials Co.
747 E. 22nd Street, Suite 200
Lombard, IL 60148
Phone: (708) 261-8627
Mineral: Gravel
County: McHenry

Algonquin Yard 46
Material Service Corporation
4226 Lawndale Ave.
Lyons, IL 60534
Phone (708) 442-4624
Mineral: Gravel
County: McHenry

Preco Yd #12
Meyer Material Co.
580 South Wolf Rd.
P.O. Box. 129
Des Plaines, IL 60017
Phone: (708) 824-4111
Mineral: Sand and gravel
County: McHenry

Algonquin Pit #5
Meyer Material Co.
580 South Wolf Rd.
P.O. Box 129
Des Plaines, IL 60017
Phone: (708) 824-4111
Mineral: Sand and gravel
County: McHenry

Carpentersville Pit #25
Meyer Material Co.
580 South Wolf Rd.
P.O. Box. 129
Des Plaines, IL 60017
Phone: (708) 824-4111
Mineral: Sand and gravel
County: Kane

Nagel Pit
Prairie Group
7601 W. 79th St.
P.O. Box 1123
Bridgeview, IL 60455
Mineral; Sand and gravel
County: Kane

Dundee Pit Yard 52
Plote Inc.
1100 Brandt Dr.
Elgin, IL 60120
Phone: (708) 695-8900
Mineral: Sand and gravel
County: Kane

Grand 7/11 L.P.
321 Center St.
Hillside, IL 60162
Phone: (708) 544-9440
Mineral: Sand and Gravel
County: Kane

Plote, Inc.
1100 Brandt Dr.
Elgin, IL 60120
Phone: (708) 695-8900
Mineral: Sand and gravel
County: Kane

Beverly Sand and Gravel Mine
Beverly Gravel Inc.
1100 Brandt Dr.
Elgin, IL 60120
Phone: (708) 695-9317
Mineral: Sand and gravel
County: Kane

East Riverdale Gravel
East Riverdale Gravel Co.
100 Brandt Dr., Elgin, IL 60120
Phone: (708) 695-9300
Mineral: Sand and gravel
County: Kane

Elgin Pit
7601 W. 79th St.
Bridgeview, IL 60455
Mineral: Sand and gravel
County: Kane

Portable Crusher No. 1
Northwest Materials
6 N 360 Crane Rd.
St. Charles, IL 60175
Phone: (708) 584-8400
Mineral: Sand and gravel
County: Cook

Bluff City Materials, Inc.
2109 W. Bartlett Rd.
Elgin, IL 60120
Phone: (708) 697-8700
Mineral: Sand and gravel
County: Cook

Chicago Gravel Co.
1000 Skokie Blvd., Suite 210
Wilmette, IL 60091
Phone: (708) 251-6616
Mineral: Sand and gravel
County: Kane

Earth Inc.
1100 Ellis
Bensonville, IL 60108
Phone: (708) 860-7711
Mineral: Sand and gravel
County: Cook

Elgin Mat./Van Acker
Sand and Gravel
Fox River Stone Co.
1250 Larkin Ave.
Elgin, IL 60123
Phone: (708) 742-6060
Mineral: Sand and gravel
County: Kane

Bartlett (Reese)
Elmhurst Chicago Stone Co.
400 W. First St., P.O. Box 57
Elmhurst, IL 60126
Phone: (708) 832-4000

Rowe Pit
Feltes Sand and Gravel Co.
P.O. Box 159
North Aurora, IL 60542
Phone: (708) 896-9098
Mineral: Sand and Gravel
County: Kane

Elburn Pit
7601 W. 79th St.,
P.O. Box 1123
Bridgeview, IL 60455
Mineral: Sand and Gravel
County: Kane

P&M Sewer & Water, Inc.
28 W 660 Childs St.
W. Chicago, IL 60185
Mineral: Sand and Gravel
County: Kane

Kaneville Mine
Elmhurst-Chicago Stone Co.
400 W. First St., P.O. Box 57
Elmhurst, IL 60126
Phone: (708) 832-4000
Mineral: Sand and gravel
County: Kane

Elmhurst-Chicago Stone Co.
400 W. First St., P.O. Box 57
Elmhurst, IL 60126
Phone: (708) 832-4000
Mineral: Sand and gravel
County: Kane

Hafenrichter Pit
Hafenrichter Gravel Co.
138 Saugatuck
Aurora, IL 60538
Phone: (708) 892-9252
Mineral: Sand and Gravel
County: Kendall

Oswego Pit
Fox Ridge Stone Co.
6110 Rt. 71
Oswego, IL 60543
Phone: (708) 554-9101
Mineral: Sand and gravel
County: Kendall

Scheidecker Pit
Otto Machine Co.
R.R.1 Box 252
6190 Millington Rd.
Sandwich, IL 60548-9738
Mineral: Sand and Gravel
County: Kendall

Sheridan Sand and Gravel
Rt. 1 Box 85
Sheridan, IL 60551
Phone: (815) 496-2627
Mineral: Sand and Gravel
County: La Salle

Christopherson Pit
The Western Sand
and Grave Pit
P.O. Box. 128
Spring Valley, IL 61362
Phone: (815) 664-2341
Mineral: Sand
County: La Salle

Bowers Pit
L.S. Garrow Sons, Inc.
P.O. Box 179
Serena, IL 60549
Phone: (815) 434-5377
Mineral: Sand
County: La Salle

Tri-con Pit
Tri-con Materials Inc.
P.O. Box 234
Princeton, IL 61356
Mineral: Sand and Gravel
County: La Salle

No coal mines now operate in the assessment area. Coal deposits are present only in parts of La Salle County. The Colchester (No.2) Coal was mined in the vicinity of Ottawa from the1800s until 1960. Most of these operations were surface mines. Because of thethickness and depth of the remaining resources, any future extraction would also most likely be by surface mining. The costs of extraction, quality of these deposits, and potential conflicts with other development activities in this area are the major constraints limiting commercial extraction.

The Fox River Assessment Area lies more than 70 miles north of the known limit of oil and gas production in Illinois. Almost no potential for development of oil and gas resources exists in the area. The primary source rock for oil and gas, the Devonian (New Albany Shale) is absent in this area. Nearly all of the rocks known to serve as oil reservoirs in Illinois are either absent or at the bedrock surface, which would have permitted hydrocarbons to escape in the assessment area.

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Aquifer Delineation

An aquifer is a body of saturated earth materials capable of yielding sufficient groundwater to a spring or the intended use of a well. An aquifer will also yield water to any stream intercepting it. Aquifers in Illinois are composed of saturated sand and gravel, fractured or jointed limestone and dolomite, or permeable sandstone. Fine-grained earth materials such as silt, clay, shale, or till may restrict the flow of groundwater through and between aquifers.

Aquifers found in both the glacial drift and the bedrock are the principal sources for private, agricultural, industrial, and municipal water supplies in the Fox River Assessment Area. Bedrock and glacial (sand and gravel) aquifers are present in the assessment area, but bedrock aquifers are perhaps more often utilized because of the favorable availability of water supply from bedrock aquifers at most locations, and the ease of construction of wells in the bedrock. In addition, water found in the shallow bedrock tends to have a lower iron content. Approximately 30 public water supply systems use groundwater to serve communities in the three counties with large populations: Lake, McHenry, and Kane. Fewer systems are found in the less populated areas that include Kendall, La Salle, and De Kalb Counties. Several water supply systems serve the narrow eastern margin of the assessment area that includes the western fringe of the urbanized areas of Cook and Du Page Counties.

More detailed information on the character, distribution, and water-yielding potential of glacial drift and bedrock aquifers is available from publications prepared by the State Geological and Water Surveys. These publications have various areas of coverage that may range from the entire state (Herzog and others 1994, Horberg 1950, Piskin and Bergstrom 1975) to a more limited regional or area coverage (Bergstrom and others 1955, Hackett and McComas 1968, Kempton and others 1985, Landon and Kempton 1971, Larsen 1973, Masters 1978, Nelson 1995, Riggs and others 1993, Suter and others 1959, Visocky and others 1985, Willman and others 1967, Willman and Frye1970, Woller and Gibb 1974, 1976, Woller and others 1986, and Zeizel and others 1962). From 1989 to1993, the Illinois State Geological and Water Surveys produced many reports and maps about Kane County.

Bedrock Aquifers

The rock units making up the bedrock tend to be relatively uniform in character horizontally, and are most variable in character in the vertical direction. In the assessment area, bedrock aquifers are found in the shallow and intermediate-depth dolomites, and intermediate and deeply buried sandstones. Shales and unfractured dolomites restrict the vertical movement of groundwater between bedrock aquifers. Aquifer distribution in the bedrock strata is generally rather straightforward due to the rather uniform character within each bedrock unit underlying the Fox River Assessment Area. The distribution of strata exposed at the bedrock surface beneath the glacial deposits is shown in Figure 3. The Silurian dolomite and Ordovician Maquoketa Group shale or shaley dolomite forming the bedrock surface in the northern two-thirds of the assessment area gives way southward to dolomites of the underlying Galena and Platteville Groups. Further south a large upward displacement at the Sandwich Fault Zone causes Cambrian and Ordovician rocks to form the bedrock surface on the southwest side of the fault zone whereas the younger Ordovician Galena and Platteville dolomites are exposed on the northeast side. Southwest of the fault the bedrock dips generally southward and southeastward beginning with the uppermost Cambrian and Lower Ordovician dolomites at the fault, then the overlying Ancell Group (mostly St. Peter Sandstone), and farther to the southeast the Galena and Platteville dolomites. In the extreme southern part of the assessment area, Pennsylvanian-age shales form the bedrock surface in local downwarpings of the bedrock.

Within a given aquifer, yields vary the most in fractured and jointed limestone and dolomite aquifers found in the bedrock. Yields to wells finished in bedrock range from moderate to large quantities from the upper part of the basal Cambrian sandstone (Mt. Simon Sandstone), which is over 1500 feet thick; large supplies from the Ironton-Galesville Sandstone in the intermediate Cambrian rocks; small to large supplies from uppermost Cambrian rocks and from dolomites in the lower part of the Ordovician interval; moderate supplies from the Ancell Group; very limited to small from the dolomites of the Ordovician Galena and Platteville Groups; and small to moderate in the dolomites comprising the Silurian and part of the Maquoketa Group. Public water supply systems utilize all aquifers. Size of supply and quality of water determine which aquifers are utilized.

Glacial Drift Aquifers

Aquifer thickness and distribution tend to be most variable in glacial deposits. Sand and gravel aquifers in the glacial drift were formed where glacial meltwaters flowed over the landscape in stream channels during and following successive incursions and retreats of glacial ice in the Fox River Assessment Area. Although sand and gravel may be the dominant lithology locally, the bulk of the glacial drift is composed of fine-grained till.

Because the glacial aquifers were deposited in stream channels and elsewhere during successive glacial advances and retreats, the configuration (topography) of both the bedrock surface and the surface of the various glacial landscapes controlled sand and gravel distribution patterns. In the older glacial deposits, sands and gravels are most commonly found buried on the bedrock surface (see Figure 4 for the location of these valleys). At shallower depths, the glacial sand and gravel deposits trend in two directions: one trend is westward away from the ice fronts that had advanced and then retreated from the northeast across the region several times. The other trend is south- to southwestward along major drainage ways that carried meltwaters from these glacial ice fronts. The Fox River and its tributaries are the components of the last drainage system to form in the area.

Aquifers in glacial deposits can be roughly separated into basal aquifers (those resting on or near the bedrock), interbedded aquifers (those wholly contained within the glacial deposits), and surficial aquifers (generally the most recently deposited aquifers material with little or no surface cover). Surficial aquifers are the most vulnerable to contamination.

Basal Aquifers

Basal glacial aquifers rest on or near the bedrock surface, particularly in the valleys on the buried bedrock surface. In the northern part of the Fox River Assessment Area, these aquifers generally are limited in thickness and unlikely to provide a major or even moderate water supply. An exception occurs where surficial sands and gravels extend to or near the bedrock.

The basal aquifer is thick and continuous along the trend of the Newark Bedrock Valley in eastern and southern Kane County (see Figure 4). Thickness exceeds 50 feet, and in places 100 feet, and the aquifer may potentially yield moderate to large supplies. More limited basal deposits with less yield potential are present in this bedrock valley and its tributary bedrock valleys in both southern De Kalb and northern La Salle Counties. In southern De Kalb County, the primary aquifer is the basal aquifer in the Troy Bedrock Valley which underlies the southwestern margin of the study area. The aquifer there is commonly thick (50 to 100 feet), and generally occurs within the elevation interval of 550 to 580 feet above sea level. At some specific sites, it may be continuous from that elevation down to the bedrock surface. It may also be discontinuous and in many places often contains interbedded silts and clays. Small to moderate water supplies may be obtained from this aquifer, but large supplies may not be available because of a lack of continuity of the aquifer deposits.

Interbedded Aquifers

Aquifers in sediments deposited during the Illinois Glacial Episode are found throughout the area, but are generally limited in thickness and lateral extent. They are commonly sufficient for domestic use, and in places may yield enough water for small municipalities. Thicker interbedded sand and gravel deposits of Illinoian age are commonly present near and along the trend of the bedrock valley in eastern Kane County and, to a lesser extent, along the trend of the Troy Valley in southwest De Kalb County. They are less continuous than the basal deposits, and may be completely absent in some areas. Moderate yields may be obtained from these deposits. In the southern part of the Fox River Assessment Area (De Kalb and La Salle Counties), interbedded aquifers within the Illinois Episode sediments have the potential to yield small to possibly moderate water supplies.

Aquifers of limited thickness but of considerable lateral extent occur at the base of the Wisconsin Episode sediments. These deposits may be more continuous than older interbedded deposits, but are generally used only for domestic supplies.

In the northern part of the Fox River Assessment Area, interbedded aquifers of limited extent occur in places within the Wedron Group. There is only a very limited use of these aquifers.

Surficial Aquifers

A surficial aquifer in the upper portion of the Wedron Group is widespread and thick throughout much of eastern McHenry County. Where it is topographically high, its position may cause the aquifer to be partially drained in some areas. The deposits composing the aquifer are often characterized as dirty gravel or gravelly till, and its potential yield is limited for that reason. The unit is used as a source for domestic water supply needs and is also mined for sand and gravel aggregate. The aquifer often blends indistinguishably into the overlying or interfingering Henry aquifer, which may occur in both lowlands and uplands.

The Henry Formation is widespread in the Fox River Assessment Area throughout eastern McHenry and western Lake Counties in topographically low areas (former and current drainage channels), where it may extend to bedrock. It is laterally extensive and can be fairly continuous throughout much of the Fox River valley, particularly in northeast Kane County near Elgin, the northern and west-central part of Kendall County in the area from Yorkville to Oswego, and in northeast La Salle County. Moderate to large water supplies may be obtained from this aquifer. Minor deposits of the Henry aquifer may be encountered in many present-day stream valleys and provide small water yields.

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Potential for Geologic Hazards

Determining appropriate land use in the Fox River Assessment Area requires an understanding of the potential natural and human-caused geologic hazards inherent to the area. Geologic hazards develop through interactions between geologic materials and natural forces and can be influenced by human activities. This section will sensitize readers to some of the potential geologic hazards, including groundwater contamination, that can occur in the Fox River area. Site-specific geologic conditions or hazards are not comprehensively discussed. For a broader view of geologic hazards and what measures to take when they occur, consult *The Citizen's Guide to Geologic Hazards*. Prepared by the American Institute of Professional Geologists, this publication covers both hazards that arise from naturally occurring geologic materials (such as radon and asbestos) and from geologic processes (such as earthquakes, landslides, and flooding). In addition, its appendices list sources of help from professional geologists and insurance professionals. The publication may be ordered by contacting:

American Institute of Professional Geologists
7828 Vance Drive
Suite 103
Arvada, CO 80003
Telephone: (303) 431-0831

Potential for Contamination of Groundwater Resources

Groundwater contamination is a valid concern for residents of Illinois. Many potential sources of groundwater contamination occur in the Fox River Assessment Area. In rural areas, the most widespread potential sources of groundwater contamination are agricultural. The use of insecticides, herbicides, and nitrates for agriculture can have a negative effect on the quality of shallow groundwater in many areas of the state.

Agricultural uses of chemicals are considered "non-point" sources of groundwater contamination because they are used over such a great area. Potential "point" sources of contamination are also present in the Fox River Assessment Area. These point sources include landfills, waste treatment plants, fertilizer and pesticide dealerships, septic tanks, faulty chemical and petroleum storage tanks, and faulty oil wells. Contamination from these point sources often occurs as plumes emanating from the source, and the contaminants generally have greater concentrations than those leaching from non-point sources.

The presence of a potential contaminant on the land surface does not always result in actual groundwater contamination. Several processes affect a potential contaminant before it reaches the water table or aquifer material. Most of these processes are affected by climatic variables, the quantity and characteristics of the chemical of concern, and various characteristics of the geologic materials. Groundwater contamination occurs when a chemical is detected in a water sample at or below the water table in concentrations that exceed federal or state acceptable levels.

For a groundwater resource to be considered contaminated, it must contain a measurable amount of contaminant that exceeds federal or state acceptable levels. Under the Illinois Groundwater Protection Act, groundwater resources are divided into four classes, based upon the quality and geologic setting of the groundwater:

- Class I Potable Resource Groundwater (fit for human consumption)
- Class II General Resource Groundwater (capable of agricultural, industrial, recreational, or other beneficial uses)
- Class III Special Resource Groundwater (groundwater that contributes to a particularly sensitive ecological system)
- Class IV Other Groundwater (any other groundwater not covered in the above sections)

Effects of Climatic Variables on the Fate of the Contaminant

Several climatic variables can affect the fate of potential contaminants. Three of the variables—precipitation, temperature, and wind speed—help determine the fate of subsurface chemicals through their impact on various processes. The amount and intensity of precipitation helps to determine *runoff* or *infiltration*. The amount of a chemical that can dissolve into water that later infiltrates the soil will help determine the quantity, or *loading*, of that chemical that may reach the shallow groundwater system. Temperature and wind speed can influence water and chemical movement through their effects on the processes of *evaporation*, *transpiration*, *volatilization*, and *condensation*.

Evaporation of water from the soil and transpiration of water from plants both reduce the tendency of contaminated water in the soil to percolate downward to the water table. In the heat of summer, high temperatures and strong winds can even cause the plants to remove water from below the water table as water taken in through roots is quickly transpired into the atmosphere.

Volatilization at or near the land surface occurs when a chemical in a liquid state is heated enough to be converted to its gaseous state. Gasoline is one example of a chemical that can volatilize at temperatures normally found in the soil during Illinois summers. Volatilization of a contaminant reduces its ability to reach groundwater by separating it from near-surface groundwater, its medium of transport.

Condensation is the process whereby gaseous chemicals are cooled back into a liquid state. Once condensed, the contaminant may again combine with groundwater, increasing its potential mobility toward groundwater resources. Chemicals that have been volatilized and remain trapped as gases in soil, for instance, can—if they remain in the soil long enough to cool down—condense and rejoin groundwater,

Effects of Quantity and Chemical Characteristics on the Fate of Contaminants

The chemical and physical nature of the contaminant determines how it will interact with water and soil. The chemical characteristics that most affect the fate of a chemical in the subsurface include *water solubility* (the amount of a chemical that can dissolve in water) and the *adsorption coefficient* (a measure of the tendency for a chemical to stick to the outside of soil particles). Many chemicals applied to agricultural fields are locally lost to runoff and soil erosion during rain events. Excess water that remains in the soil may dilute the chemicals that have greater water solubility, lessening their harmful effects. Adsorption is important in controlling the amount and rate of chemical movement in the subsurface. Many organic chemicals found in pesticides or used in solvents are often adsorbed to organic matter or clay, which slows their movement to groundwater resources. In addition to the alteration by water and soil, potential contaminants may also be degraded by microbial organisms in the subsurface. In general, metabolic processes of microbes break the chemical down into smaller compounds. Thus, for a potential contaminant to actually have a negative effect on the quality of groundwater resources, it must survive these processes in sufficient quantities.

Effects of Geologic Materials

Whether groundwater becomes contaminated also depends heavily upon the geologic characteristics of the area. *Depth from ground surface to the uppermost aquifer material* and *hydraulic conductivity* of both aquifer and non-aquifer materials are two important factors that affect the potential for aquifer contamination. Both are a function of the geology of a particular area; both "aquifer" and "hydraulic conductivity" are defined in the context of this discussion below.

An aquifer is a body of water-saturated geologic material yielding sufficient water to satisfy the need for drilling it (Berg, Kempton, and Cartwright 1984). In Illinois, common aquifer materials include sand, gravel, fractured limestone or dolomite, and sandstone. Common non-aquifer materials in Illinois include silt, till, shale, and non-fractured limestone or dolomite. Throughout the state, the depth to the uppermost aquifer varies significantly, depending on location and type of aquifer material. Generally speaking, as depth to the top of the uppermost aquifer increases, the sensitivity to contamination of that particular aquifer decreases. Greater depth affords an aquifer greater protection due to the increased opportunity for adsorption, microbial degradation, and dilution. The validity of this statement, however, depends on several other factors, including the type of material that directly overlies the aquifer. Due to the range of aquifer depths found in Illinois, an aquifer with a depth greater than 50 feet below the ground surface is generally classified as having low or "limited" sensitivity for contamination (Keefer 1995; Berg, Kempton, and Cartwright 1984).

Hydraulic conductivity is the ease with which water can move through a subsurface material, such as soil, glacial sediments, or rock. Sand and gravel and other aquifer materials generally have high hydraulic conductivity values, whereas non-aquifer materials generally have low hydraulic conductivity values. Under a given difference in water pressure within a body of subsurface material (often described as a pressure gradient), water and associated contaminants will move more quickly through a geologic material with high hydraulic conductivity than through a material with low hydraulic conductivity.

Aquifer Sensitivity to Contamination in the Fox River Assessment Area

Most of the geological characteristics of the Fox River Assesment Area are the result of the action of glacial ice and running water (Stoffel and Larsen 1976). Because of the thick deposits of glacial sediments, much of the groundwater in the area is drawn from glacial outwash (see Glacial and Surficial Geology section above).

Throughout the Fox River Assessment Area, the depth to the top of the uppermost aquifer varies greatly. However, a large portion of the assessment area is underlain by aquifers within 20 feet of ground surface (Keefer 1995). These shallow aquifers are very vulnerable to contamination because of the excessive potential for nitrates and pesticides to leach into aquifers. Areas underlain by till or other fine-grained deposits, as shown by white and light-gray areas on Figure 25, have moderate to limited potential for nitrates and pesticides to leach into aquifers.

Areas containing aquifers that are close to the surface and highly vulnerable to becoming contaminated by potentially adverse land uses are concentrated in the east half of McHenry County, along the border of Kane and Kendall Counties, and along the Fox River, between McHenry and Kendall Counties. There are also isolated areas with aquifers in the 20- to 50-foot-depth range. As shown on Figure 25, these aquifers are less vulnerable to contamination than are the shallower aquifers, but they are still classified in the high-risk category. The remainder of the assessment area is underlain by aquifers that are more than 50 feet below the ground surface.

The sensitivity problem associated with the shallow aquifers in the north part of the assessment area is compounded by the presence of thick deposits of permeable sands and gravels. Aquifers within these types of materials are classified as excessively sensitive to contamination because of the high hydraulic conductivity (85 cm/day) of the sands and gravels. Figure 25 shows areas that are categorized as excessively sensitive to contamination. Other isolated areas of sand and gravel deposits exist throughout the assessment area. The edges of some of these sand and gravel deposits are overlain by till or other fine-grained material, and underlain by till or low permeability bedrock. These unique sand and gravel deposits have a lower sensitivity to groundwater contamination because of the 10 to 20 feet of overlying lower permeability material that adds a layer of protection between the contaminant and the aquifer. The remainder of the assessment area consists mostly of uniform, relatively impermeable silty or clayey till or other fine- grained materials extending from the ground surface to deeper than 50 feet (Figure 25). These areas have an

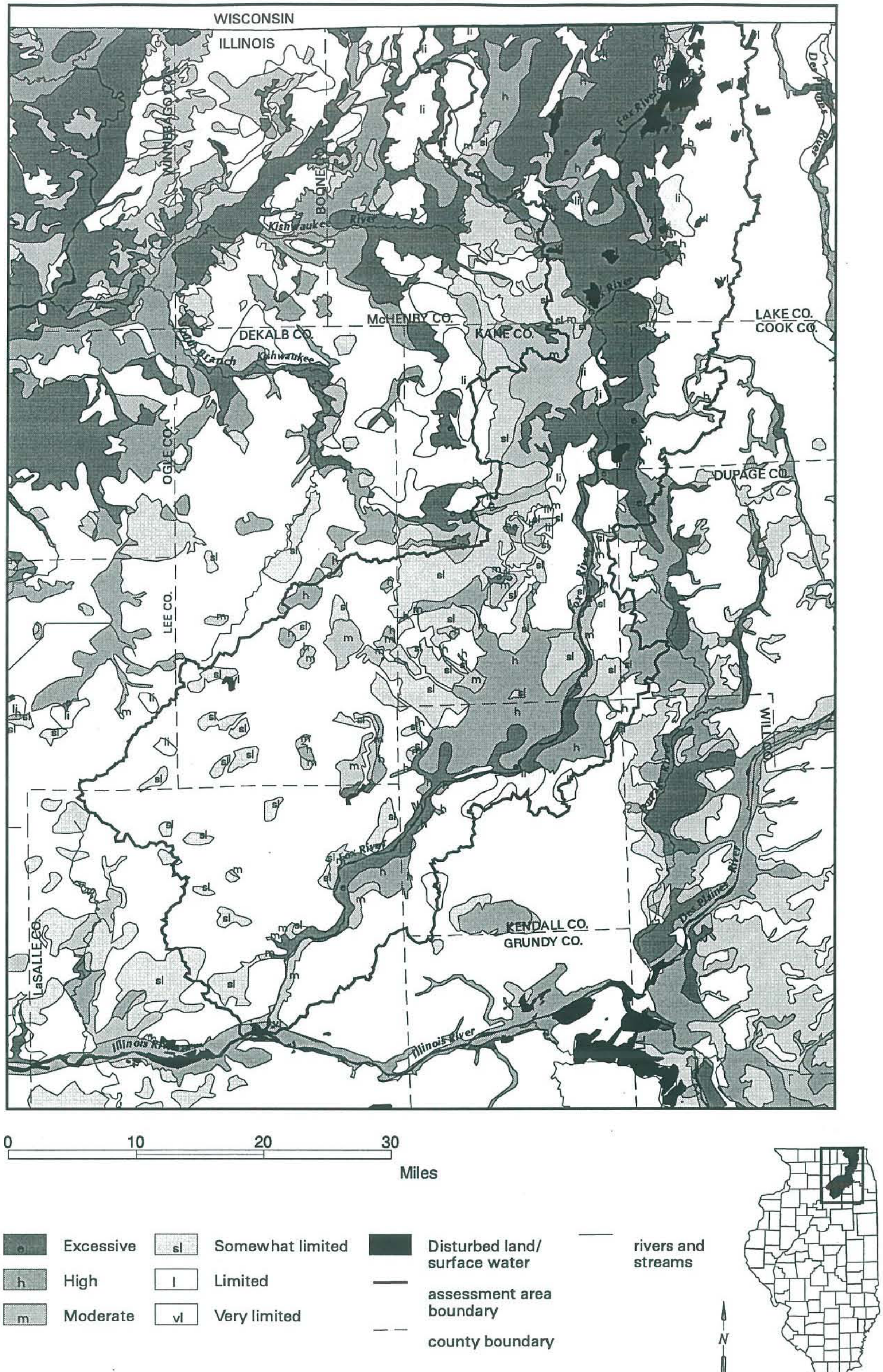

Figure 25. Aquifer Sensitivity to Contamination by Pesticide Leaching (Keefer 1995)

extremely low sensitivity to aquifer contamination because of the low hydraulic conductivity of the fine-grained material or the absence of aquifers within the mapped area.

More detailed information about aquifer depth and soil and geological characteristics related to groundwater can be obtained from a number of Illinois State Geological Survey or Illinois State Water Survey publications, or by contacting a representative of either of these DNR agencies.

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Regional Earthquake History

Earthquakes are more of an occasional curiosity than a dangerous hazard in the Fox River Assessment Area. Some people might be surprised to learn, however, earthquakes, ranging from magnitude 3.0 to 5.0, do occur about once every 20 years somewhere in northern Illinois (Figure 26). These small earthquakes are felt throughout the Fox River Assessment Area and occasionally cause minor damage. Larger earthquakes in the more seismically active regions of southern Illinois, Missouri, and Tennessee also shake the area.

The most notable of the small northern Illinois earthquakes occurred in 1909. This earthquake is estimated to have been about magnitude 5.1 on the Richter scale. There is uncertainty about the location of its epicenter; some maps place it near Beloit on the Wisconsin border, others farther south in Illinois. This earthquake was widely felt in the Midwest and particularly in the Fox River community of Aurora. Chimneys fell, stoves were overturned, connections on gas mains were loosened, and several fires started. Many people were frightened and schools were closed. Clocks stopped in Geneva and Elgin.

A similar, though somewhat weaker, shock occurred in 1912. This quake was apparently centered near Aurora. In 1972, a magnitude 4.5 earthquake in Lee country, located just west of the Fox River Assessment Area, was also felt throughout the region. Earthquake motions are intensified in lowland alluvial soils, hence they are felt more strongly in riverside communities such as Ottawa, Yorkville, Aurora, Elgin, and McHenry. These small earthquakes occasionally reach magnitudes as great as 5.0. At that size, minor damage, such as broken chimneys and cracked or broken plaster walls, could be expected. As at Aurora in 1909, the possibility of further damage from fire is also present.

There are so few earthquakes in the region that it is difficult to find the faults that cause them. The La Salle Anticlinorium, a complex upfold in the crustal rocks beneath the area, theoretically could produce earthquakes. However, the few earthquakes that have been reported do not appear to be related to this or any other known feature.

The Wabash Valley Seismic Zone, about 200 miles to the southeast, spawns magnitude 5 earthquakes about every 10 years. The magnitude 5.0 earthquake of 1987 and the magnitude 5.2 earthquake of 1968 were felt in the Fox River Assessment Area by people indoors, but they generally were not felt by people who were outdoors at the time. The Wabash Valley area could produce earthquakes as large as Richter magnitude 6.5. These larger quakes might cause damage to chimneys and older brick structures in the Fox River area, but the likelihood of their occurring in the near future is very low.

The New Madrid Seismic Zone in far southern Illinois, Missouri, Kentucky, and Tennessee is capable of producing very powerful earthquakes; but because it is over 350 miles to the south, the resulting ground motion in the Fox River area is not expected to be dangerous. The last major earthquake in the New Madrid Seismic Zone occurred on October 31, 1895. This magnitude 6.2 earthquake caused severe damage in some southern Illinois towns. In northern Illinois, the passing of the seismic waves issued an early (5:00 A.M.) wake-up

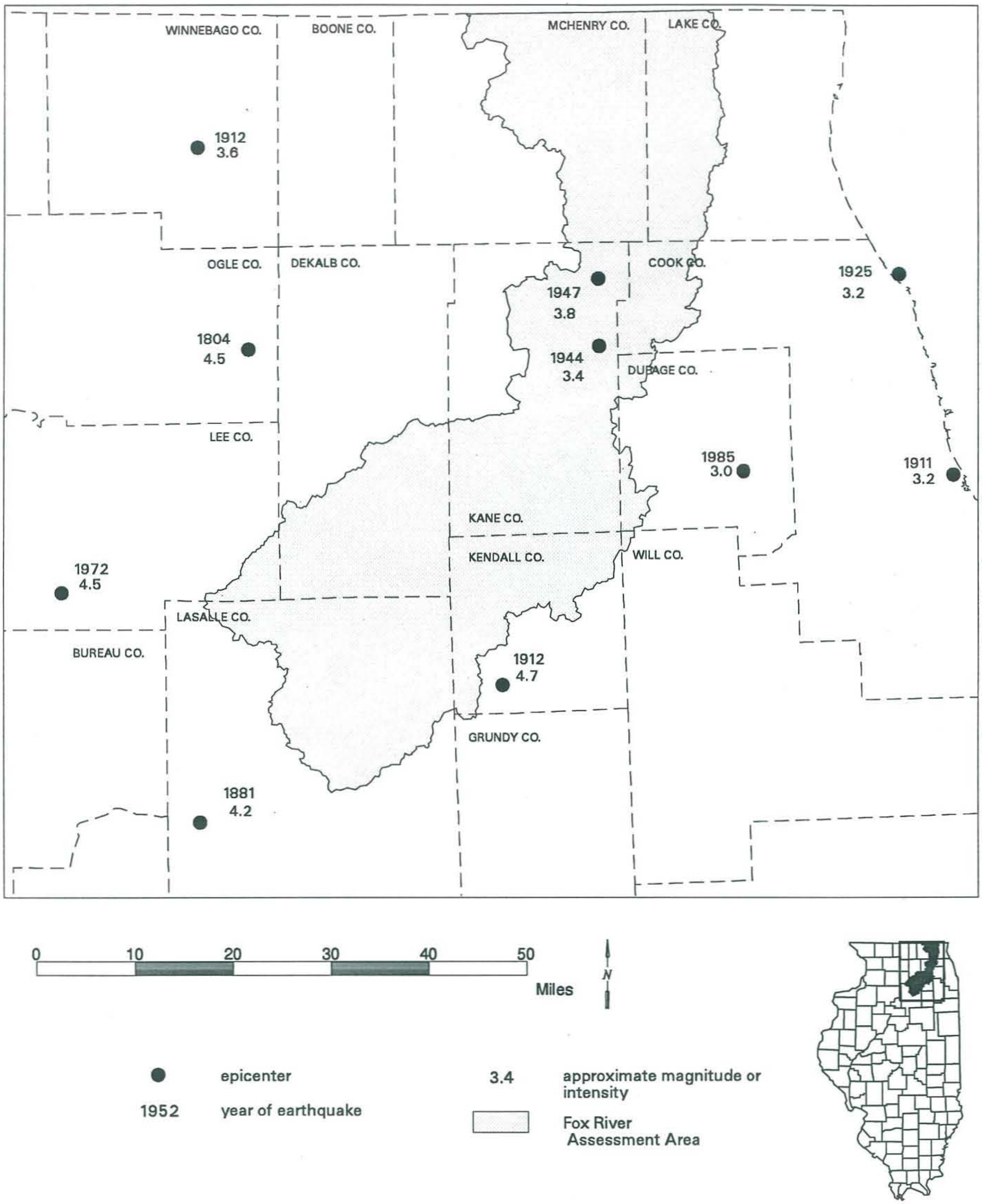

Figure 26. Earthquakes in the Vicinity of the Fox River Assessment Area (St. Louis University Earthquake Center database, 1996)

call to residents from Elgin to Chicago. Many frightened people ran outside in their night clothes, but no serious damage was reported in the Fox River area. A similar earthquake, with similar effects, is expected to occur in the New Madrid Seismic Zone sometime in the next 15 years.

An even stronger series of earthquakes occurred in the New Madrid Seismic Zone in 1811–1812. Devastating earthquakes, probably as large as Richter magnitude 8, occurred three times that winter. No ground motions were recorded in the Fox River area from those earthquakes, but it is estimated that the motions would probably have been strong enough to damage masonry structures. Fortunately, such large earthquakes are not expected to recur within the next several hundred years.

Landslides

When most people think of landslides, they usually envision a massive body of boulders, gravel, sand, and dirt crashing down a hillside, destroying everything in its path. Rightly so, for that type of "mass wasting," as geologists call it, often occurs on landscapes dominated by steep slopes or frequent seismic activity. Several such landslides have been inventoried in Illinois and have caused hundreds of thousands of dollars in property damage. In the relatively young, low-relief, glacially sculpted landscape common to most of Illinois, however, more subtle mechanisms of mass wasting can be just as threatening and costly to engineers, community planners, and landowners as their more extreme but less common counterparts.

Nearly 60% of the landslides inventoried thus far in Illinois have been classified as "slumps" (Killey and others 1985). A slump is a mass of rock or earth that moves down along one or more underground surfaces of slippage within the mass or between the mass and the body of rock or earth beneath it. Slump-type landslides may be recognized by one or more of the following characteristics:

- a sharp cliff (also called a "scarp") several inches to several feet high that results from the initial downward movement
- one or more additional scarp faces resulting from successive slump movement
- poor drainage (ponding or development of marshy areas) due to disturbance of normal drainage patterns
- dead trees (due to root damage or excess moisture) and tilted trees, fence posts, and utility poles (Killey and others 1985).

Landslides in the Fox River Assessment Area

All landslides inventoried for the Fox River Assessment Area are located in La Salle County and are associated with natural erosion along the Illinois River. Most landslides in the assessment area involve loess and glacial till sliding along wet shale bedrock surfaces. One such rock slump occurred 7 miles west of Ottawa on Illinois 71 as Pennsylvanian shale moved over friable (easily crumbled) St. Peter Sandstone. Reported damage or repair costs to construction and property for these landslides ranges from $60,000 to $560,000 (1982 dollars). The most costly damages result from bridge or highway construction that blocks or disrupts natural underground drainage ways (such as seeps or springs) and, in turn, causes water to build up in earth materials adjacent to the construction. The confined water not only adds weight to the materials but provides lubrication, resulting in land that is considerably less stable than before construction. Although no landslides are recorded along the Fox River, many of the characteristics responsible for landslides along the Illinois River (groundwater seeps; loess or glacial till overlying thin shale or limestone) can be found along its course. Stream erosion is a continuous, natural process. When compounded with natural catastrophic events (for example, flooding or seismic activity) or society-induced forces (for example, road or bridge construction) and the right hydrogeologic conditions, it can result in costly landslides.

Information on landslides in Illinois is contained in *Landslide Inventory of Illinois* (Killey and others 1985), produced by the Illinois State Geological Survey in cooperation with the United States Geological Survey. This publication contains historical photos of landslides that have occurred in Illinois and provides essential information on landslide classification, factors contributing to landslide potential, and what can be done to stabilize landslides. It can be purchased from the Illinois State Geological Survey at (217) 333-ISGS.

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Coal Mine Subsidence and Acid Drainage

The coal industry has long been an important component of the Illinois economy. Currently, coal generates approximately 40% of the electricity in the state. The coal mining industry directly and indirectly employs about 41,000 people (Bauer 1995). Despite these obvious economic contributions, coal production can threaten many natural resources.

Mine subsidence (the sinking of land surface over mined-out areas) can damage structures and affect farmland productivity. Unreclaimed mine wastes can pollute air and water resources. Achieving a balance between the advantages and disadvantages of coal production can be aided when citizens are knowledgeable about past and present coal mining methods, and how these methods affect natural resources.

Piles of mining waste, often called "gob piles," can contribute to groundwater contamination. Composed mostly of shale (clay-rich rock) and poorer quality coal, the waste often contains sulfur-rich minerals, particularly pyrite and marcasite. These minerals react with rainfall and air to produce sulfuric acid; eventually, the sulfuric acid may drain or percolate into surface water and groundwater resources. The resulting increase in the acidity of the surface water can affect aquatic life and weaken concrete structures such as bridge piers, retainer walls, utility pipes, and well casings (Nuhfer and others 1993).

Coal Mines of the Fox River Assessment Area

Although there are no active coal mines, numerous strip mines operated for several decades along the southern edge of the Fox River Assessment Area. Adjacent to the confluence of the Fox and Illinois Rivers, these mines operated near the city of Ottawa from 1883 to 1960. It is not uncommon for strip-mined land to settle, but the problems caused by subsidence (commonly associated with underground mines) are not likely to occur.

Two essential publications for land-use planners and homeowners who want further information about coal mine subsidence are *Planned Coal Mine Subsidence in Illinois, A Public Information Booklet* and *Mine Subsidence in Illinois: Facts for Homeowners*. These booklets contain information on coal-mine reserves in Illinois, coal-mining methods, the history of subsidence in Illinois, what to do if subsidence occurs, and sources for additional information. Contact the Illinois State Geological Survey at (217) 333-ISGS to request these publications.

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Appendix A: Overview of Databases

Illinois Wetlands Inventory

This digital database contains the location and classification of wetland and deepwater habitats in Illinois. Following U.S. Fish and Wildlife Service definitions, the Illinois Natural History Survey (INHS) compiled the information from interpretations of 1:58,000-scale high-altitude photographs taken between 1980 and 1987. Identifiable wetlands and deepwater habitats were represented by points, lines, and polygons on 1:24,000--scale U.S. Geological Survey (USGS) 7.5- minute quadrangle maps. These data were digitized and compiled into the Illinois Wetlands Inventory. Because no wetland or deepwater habitats smaller than 0.01 acres were included, many farmed wetlands are not in the database. This database is appropriate for analysis on a local and regional scale; due to the dynamics of wetland systems, however, boundaries and classifications may change over time. For detailed explanation of wetland classification in Illinois, see *Wetland Resources of Illinois: An Analysis and Atlas* (Suloway and Hubbell 1994).

Quaternary Deposits of Illinois

Originally automated in 1984, this database is the digital representation of the 1:500,000-scale map *Quaternary Deposits in Illinois* (Lineback 1979). Because these data, modified by Hansel and Johnson (1996), represent a generalization of the glacial sediments that lie at or near the land surface, this database is most appropriate for use at a regional scale. For further information about surficial deposits in Illinois, see *Wedron and Mason Groups: Lithostratigraphic Reclassification of the Wisconsin Episode, Lake Michigan Lobe Area* (Hansel and Johnson 1996).

Thickness of Loess in Illinois

This database contains 5-foot-interval contour lines indicating loess thickness on uneroded upland areas in Illinois. These data were originally automated in 1986 from the 1:500,000-scale map in *Glacial Drift in Illinois—Thickness and Character* (Piskin and Bergstrom 1975, plate 1). This database is most appropriate for use at a regional scale.

Thickness of Surficial Deposits

This database contains polygons delineating glacial and stream materials throughout the state, with thicknesses ranging from less than 25 feet to greater than 500 feet. The data were originally automated in 1986 from the 1:500,000-scale map in *Glacial Drift in Illinois—Thickness and Character* (Piskin and Bergstrom 1975, plate 1). This database is most appropriate for use at a regional scale.

Noncoal Mineral Industry Database

Compiled by the ISGS from Illinois Office of Mines and Minerals permit data and information from the ISGS Directory of Illinois Mineral Producers, this database contains the locations of mineral extraction operations (other than coal, oil, and gas producers) in Illinois.

The database contains both active and inactive sites and is updated every year. The 1996 data include 7 active underground mines and 449 active surface pits and quarries. This is a point database and is appropriate for analysis on a local to regional scale. For more information on the current locations of noncoal mineral extraction sites or on the location of potential noncoal mineral resources, contact the Industrial Minerals Section of the Illinois State Geological Survey.

1:100,000-Scale Topography of Illinois

Depicting the general configuration and relief of the land surface in Illinois, this database was compiled by the ISGS from 1:100,000-scale digital line graph (DLG) format data files, originally automated by the USGS from USGS 1:100,000-scale 30- by 60-minute quadrangle maps. The USGS collected the land surface relief data for Illinois from stable-base manuscripts, photographic reductions, and stable-base composites of the original 1:100,000 map separates using manual, semiautomatic, and automatic digitizing systems. The contour interval of this topographic data is 5.0 meters (16.4 feet). These digital data are useful for the production of intermediate- to regional-scale base maps and for a variety of spatial analyses, such as determining the slope of a geographic area. DLG format topographic data are available from the USGS and can be down loaded on the Internet from

http://edcwww.cr.usgs.gov/glis/hyper/guide/100kdlgfig/states/Il.html

A full description of the DLG format can be found in the Digital Line Graphs from 1:100,000-Scale Maps—Data Users Guide 2 produced by the USGS. These data are also available from the ISGS in ARC format.

State Soil Geographic (STATSGO) Data Base for Illinois

The Illinois STATSGO was compiled by the USDA Natural Resources Conservation Service (NRCS). The database is the result of generalizing available county-level soil surveys into a general soil association map. If no county survey was available, data on geology, topography, vegetation, and climate were assembled along with Land Remote Sensing Satellite (LANDSAT) images. Soils of like areas were studied, and the probable classification and extent of the soils were determined. The data were compiled at 1:250,000--scale using USGS 1- by 2- degree quadrangle maps. This database was designed to be used primarily for regional, multistate, state, and river basin resource planning, management, and monitoring. It is not intended to be used at the county level. Illinois STATSGO data are available in DLG, ASCII, or ARC format and can be downloaded on the Internet from

http://www.gis.uiuc.edu/nrcs/soil.html

The data are also available from the ISGS in ARC format. For more information visit the USDA web site or contact the Natural Resources Conservation Service, 1902 Fox Drive, Champaign, IL 61820.

Land Cover Database of Illinois

Compiled for the IDNR Critical Trends Assessment Project by the INHS, the land cover database is intended as a base line for assessment and management of biologic natural resources in Illinois. Twenty-three major land cover classes were defined using Thematic Mapper (TM) Satellite data. Dates of the imagery range from April 1991 to May 1995. Ancillary data used to interpret the TM imagery include the 1992 Topologically Integrated Geographic Encoding and Referencing System (TIGER) line files, the Illinois Wetlands Inventory, NRCS county crop compliance data, 1988 National Aerial Photography Program (NAPP) photography, and USGS transportation and hydrography data. This database is most appropriate for use at medium and regional scales. For more information on land cover in Illinois see *Illinois Land Cover—An Atlas* (Illinois Department of Natural Resources 1996).

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Appendix B: Land Cover by Subbasin*

Fox Lake

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**19,485**	**27.7**	**1.8**
Cropland	11,038	15.7	1.0
Rural Grassland	8,447	12.0	0.8
Forest & Woodland	**11,736**	**16.7**	**1.1**
Urban & Built-Up Land	**19,196**	**27.3**	**1.8**
Urban/Built-Up	11,083	15.7	1.0
Urban Grassland	8,112	11.5	0.7
Wetland	**15,373**	**21.8**	**1.4**
Forested	1,378	2.0	0.1
Non-Forested	13,996	19.9	1.3
Other Land	**4,647**	**6.6**	**0.4**
Lakes & Streams	4,426	6.3	0.4
Barren & Exposed	221	0.3	0.0
Totals	**70,437**	**100.0**	**6.4**

Upper Fox River

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**319**	**43.4**	**0.0**
Cropland	95	12.9	0.0
Rural Grassland	224	30.5	0.0
Forest & Woodland	**190**	**26.0**	**0.0**
Urban & Built-Up Land	**14**	**1.9**	**0.0**
Urban/Built-Up	14	1.9	0.0
Wetland	**86**	**11.7**	**0.0**
Forested	41	5.6	0.0
Non-Forested	45	6.1	0.0
Other Land	**125**	**17.1**	**0.0**
Lakes & Streams	43	5.8	0.0
Barren & Exposed	83	11.3	0.0
Totals	**734**	**100.0**	**0.1**

* Small errors in tables are due to rounding

East Nippersink Creek

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**16,677**	**66.4**	**1.5**
Cropland	9,613	38.3	0.9
Rural Grassland	7,065	28.1	0.7
Forest & Woodland	**3,484**	**13.9**	**0.3**
Urban & Built-Up Land	**3,116**	**12.4**	**0.3**
Urban/Built-Up	1,264	5.0	0.1
Urban Grassland	1,851	7.4	0.2
Wetland	**1,580**	**6.3**	**0.1**
Forested	245	1.0	0.0
Non-Forested	1,335	5.3	0.1
Other Land	**248**	**1.0**	**0.0**
Lakes & Streams	227	0.9	0.0
Barren & Exposed	20	0.1	0.0
Totals	**25,105**	**100.0**	**2.3**

North Branch Nippersink Creek

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**9,029**	**66.6**	**0.8**
Cropland	5,756	42.5	0.5
Rural Grassland	3,273	24.2	0.3
Forest & Woodland	**1,202**	**8.9**	**0.1**
Urban & Built-Up Land	**1,519**	**11.2**	**0.1**
Urban/Built-Up	682	5.0	0.1
Urban Grassland	837	6.2	0.1
Wetland	**1,665**	**12.3**	**0.2**
Forested	189	1.4	0.0
Non-Forested	1,476	10.9	0.1
Other Land	**135**	**1.0**	**0.0**
Lakes & Streams	135	1.0	0.0
Totals	**13,549**	**100.0**	**1.3**

West Nippersink Creek

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**40,343**	**80.1**	**3.7**
Cropland	27,163	54.0	2.5
Rural Grassland	13,180	26.2	1.2
Forest & Woodland	**3,279**	**6.5**	**0.3**
Urban & Built-Up Land	**3,781**	**7.5**	**0.4**
Urban/Built-Up	2,405	4.8	0.2
Urban Grassland	1,376	2.7	0.1
Wetland	**2,532**	**5.0**	**0.2**
Forested	209	0.4	0.0
Non-Forested	2,323	4.6	0.2
Other Land	**411**	**0.8**	**0.0**
Lakes & Streams	411	0.8	0.0
Totals	**50,346**	**100.0**	**4.6**

Fox River

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**41,833**	**32.2**	**3.8**
Cropland	24,160	18.6	2.2
Rural Grassland	17,673	13.6	1.6
Forest & Woodland	**25,258**	**19.5**	**2.3**
Urban & Built-Up Land	**46,660**	**35.9**	**4.3**
Urban/Built-Up	26,746	20.6	2.5
Urban Grassland	19,914	15.3	1.8
Wetland	**9,817**	**7.6**	**0.9**
Forested	1,098	0.9	0.1
Non-Forested	8,719	6.7	0.8
Other Land	**6,238**	**4.8**	**0.6**
Lakes & Streams	5,394	4.2	0.5
Barren & Exposed	845	0.7	0.1
Totals	**129,806**	**100.0**	**11.9**

Wonder Lake

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**3,831**	**48.6**	**0.4**
Cropland	2,729	34.6	0.3
Rural Grassland	1,102	14.0	0.1
Forest & Woodland	**1,371**	**17.4**	**0.1**
Urban & Built-Up Land	**1,471**	**18.7**	**0.1**
Urban/Built-Up	973	12.3	0.1
Urban Grassland	498	6.3	0.1
Wetland	**419**	**5.3**	**0.0**
Forested	89	1.1	0.0
Non-Forested	330	4.2	0.0
Other Land	**794**	**10.1**	**0.1**
Lakes & Streams	731	9.3	0.1
Barren & Exposed	63	0.8	0.0
Totals	**7,885**	**100.0**	**0.7**

Boone Creek

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**7,022**	**44.9**	**0.7**
Cropland	3,449	22.0	0.3
Rural Grassland	3,573	22.8	0.3
Forest & Woodland	**3,626**	**23.2**	**0.3**
Urban & Built-Up Land	**3,481**	**22.3**	**0.3**
Urban/Built-Up	1,608	10.3	0.2
Urban Grassland	1,873	12.0	0.2
Wetland	**1,110**	**7.1**	**0.1**
Forested	190	1.2	0.0
Non-Forested	920	5.9	0.1
Other Land	**410**	**2.6**	**0.0**
Lakes & Streams	322	2.1	0.0
Barren & Exposed	88	0.6	0.0
Totals	**15,649**	**100.0**	**1.4**

Flint Creek

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**2,417**	**10.1**	**0.2**
Cropland	1,617	6.8	0.2
Rural Grassland	799	3.3	0.1
Forest & Woodland	**6,881**	**28.8**	**0.6**
Urban & Built-Up Land	**11,547**	**48.3**	**1.1**
Urban/Built-Up	5,330	22.3	0.5
Urban Grassland	6,217	26.0	0.6
Wetland	**2,109**	**8.8**	**0.2**
Forested	118	0.5	0.0
Non-Forested	1,991	8.3	0.2
Other Land	**965**	**4.0**	**0.1**
Lakes & Streams	965	4.0	0.1
Totals	**23,919**	**100.0**	**2.2**

Tyler Creek

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**17,657**	**68.7**	**1.6**
Cropland	11,432	44.5	1.1
Rural Grassland	6,225	24.2	0.6
Forest & Woodland	**1,849**	**7.2**	**0.2**
Urban & Built-Up Land	**4,618**	**18.0**	**0.4**
Urban/Built-Up	3,002	11.7	0.3
Urban Grassland	1,616	6.3	0.2
Wetland	**1,297**	**5.1**	**0.1**
Forested	135	0.5	0.0
Non-Forested	1,162	4.5	0.1
Other Land	**269**	**1.1**	**0.0**
Lakes & Streams	269	1.1	0.0
Totals	**25,689**	**100.0**	**2.4**

Poplar Creek

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**7,370**	**25.8**	**0.7**
Cropland	3,316	11.6	0.3
Rural Grassland	4,054	14.2	0.4
Forest & Woodland	**3,431**	**12.0**	**0.3**
Urban & Built-Up Land	**15,273**	**53.5**	**1.4**
Urban/Built-Up	10,545	36.9	1.0
Urban Grassland	4,727	16.6	0.4
Wetland	**1,568**	**5.5**	**0.1**
Forested	115	0.4	0.0
Non-Forested	1,453	5.1	0.1
Other Land	**914**	**3.2**	**0.1**
Lakes & Streams	781	2.7	0.1
Barren & Exposed	132	0.5	0.0
Totals	**28,556**	**100.0**	**2.6**

Ferson Creek

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**19,053**	**55.1**	**1.7**
Cropland	12,029	34.8	1.1
Rural Grassland	7,023	20.3	0.6
Forest & Woodland	**3,761**	**10.9**	**0.3**
Urban & Built-Up Land	**9,889**	**28.6**	**0.9**
Urban/Built-Up	2,806	8.1	0.3
Urban Grassland	7,082	20.5	0.7
Wetland	**1,397**	**4.0**	**0.1**
Forested	279	0.8	0.0
Non-Forested	1,118	3.2	0.1
Other Land	**475**	**1.4**	**0.0**
Lakes & Streams	475	1.4	0.0
Totals	**34,575**	**100.0**	**3.2**

Middle Fox River

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**30,768**	**36.1**	**2.8**
Cropland	19,569	22.9	1.8
Rural Grassland	11,199	13.1	1.0
Forest & Woodland	**11,068**	**13.0**	**1.0**
Urban & Built-Up Land	**37,151**	**43.5**	**3.4**
Urban/Built-Up	23,656	27.7	2.2
Urban Grassland	13,495	15.8	1.2
Wetland	**3,356**	**3.9**	**0.3**
Forested	891	1.0	0.1
Non-Forested	2,466	2.9	0.2
Other Land	**3,006**	**3.5**	**0.3**
Lakes & Streams	2,486	2.9	0.2
Barren & Exposed	520	0.6	0.1
Totals	**85,349**	**100.0**	**7.8**

Mill Creek

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**12,044**	**61.1**	**1.1**
Cropland	8,522	43.3	0.8
Rural Grassland	3,522	17.9	0.3
Forest & Woodland	**1,175**	**6.0**	**0.1**
Urban & Built-Up Land	**5,776**	**29.3**	**0.5**
Urban/Built-Up	2,244	11.4	0.2
Urban Grassland	3,532	17.9	0.3
Wetland	**476**	**2.4**	**0.0**
Forested	54	0.3	0.0
Non-Forested	423	2.2	0.0
Other Land	**229**	**1.2**	**0.0**
Lakes & Streams	229	1.2	0.0
Totals	**19,701**	**100.0**	**1.8**

Blackberry Creek

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**34,470**	**74.0**	**3.2**
Cropland	25,625	55.0	2.3
Rural Grassland	8,845	19.0	0.8
Forest & Woodland	**2,646**	**5.7**	**0.2**
Urban & Built-Up Land	**7,109**	**15.3**	**0.7**
Urban/Built-Up	3,109	6.7	0.3
Urban Grassland	4,000	8.6	0.4
Wetland	**1,660**	**3.6**	**0.2**
Forested	256	0.6	0.0
Non-Forested	1,404	3.0	0.1
Other Land	**685**	**1.5**	**0.1**
Lakes & Streams	519	1.1	0.1
Barren & Exposed	166	0.4	0.0
Totals	**46,570**	**100.0**	**4.26**

Big Rock Creek

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**67,209**	**90.6**	**6.2**
Cropland	54,320	73.3	5.0
Rural Grassland	12,888	17.4	1.2
Forest & Woodland	**2,467**	**3.3**	**0.2**
Urban & Built-Up Land	**2,999**	**4.1**	**0.3**
Urban/Built-Up	1,652	2.2	0.2
Urban Grassland	1,347	1.8	0.1
Wetland	**700**	**1.0**	**0.1**
Forested	375	0.5	0.0
Non-Forested	324	0.4	0.0
Other Land	**769**	**1.0**	**0.1**
Lakes & Streams	660	0.9	0.1
Barren & Exposed	109	0.2	0.0
Totals	**74,143**	**100.0**	**6.8**

Little Rock Creek

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**44,041**	**90.2**	**4.0**
Cropland	38,031	77.9	3.5
Rural Grassland	6,010	12.3	0.6
Forest & Woodland	**1,155**	**2.4**	**0.1**
Urban & Built-Up Land	**2,848**	**5.8**	**0.3**
Urban/Built-Up	1,462	3.0	0.1
Urban Grassland	1,386	2.8	0.1
Wetland	**363**	**0.7**	**0.0**
Forested	211	0.4	0.0
Non-Forested	152	0.3	0.0
Other Land	**403**	**0.8**	**0.0**
Lakes & Streams	403	0.8	0.0
Totals	**48,810**	**100.0**	**4.5**

Somonauk Creek

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**47,028**	**88.9**	**4.3**
Cropland	37,923	71.7	3.5
Rural Grassland	9,106	17.2	0.8
Forest & Woodland	**1,918**	**3.6**	**0.2**
Urban & Built-Up Land	**2,376**	**4.5**	**0.2**
Urban/Built-Up	1,143	2.2	0.1
Urban Grassland	1,233	2.3	0.1
Wetland	**840**	**1.6**	**0.1**
Forested	565	1.1	0.1
Non-Forested	275	0.5	0.0
Other Land	**729**	**1.4**	**0.1**
Lakes & Streams	719	1.4	0.1
Barren & Exposed	9	0.0	0.0
Totals	**52,891**	**100.0**	**4.8**

Little Indian Creek Subbasin

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**54,602**	**96.6**	**5.0**
Cropland	47,818	84.6	4.4
Rural Grassland	6,784	12.0	0.6
Forest & Woodland	**612**	**1.1**	**0.1**
Urban & Built-Up Land	**694**	**1.2**	**0.1**
Urban/Built-Up	588	1.0	0.1
Urban Grassland	106	0.2	0.0
Wetland	**255**	**0.5**	**0.0**
Forested	185	0.3	0.0
Non-Forested	70	0.1	0.0
Other Land	**383**	**0.7**	**0.0**
Lakes & Streams	383	0.7	0.0
Totals	**56,546**	**100.0**	**5.2**

Waubansee Creek

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**10,765**	**57.2**	**1.0**
Cropland	9,088	48.3	0.8
Rural Grassland	1,677	8.9	0.2
Forest & Woodland	**465**	**2.5**	**0.0**
Urban & Built-Up Land	**6,745**	**36.1**	**0.6**
Urban/Built-Up	4,020	21.6	0.4
Urban Grassland	2,726	14.5	0.3
Wetland	**497**	**2.6**	**0.0**
Forested	12	0.1	0.0
Non-Forested	485	2.6	0.0
Other Land	**335**	**1.8**	**0.0**
Lakes & Streams	335	1.8	0.0
Totals	**18,807**	**100.3**	**1.7**

Indian Creek

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**104,378**	**93.0**	**9.6**
Cropland	88,336	78.7	8.1
Rural Grassland	16,042	14.3	1.5
Forest & Woodland	**3,687**	**3.3**	**0.3**
Urban & Built-Up Land	**1,858**	**1.7**	**0.2**
Urban/Built-Up	1,170	1.0	0.1
Urban Grassland	689	0.6	0.1
Wetland	**916**	**0.8**	**0.1**
Forested	740	0.7	0.1
Non-Forested	175	0.2	0.0
Other Land	**1,353**	**1.2**	**0.1**
Lakes & Streams	1,353	1.2	0.1
Totals	**112,192**	**100.0**	**10.3**

Lower Fox River Subbasin

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**105,734**	**85.5**	**9.7**
Cropland	76,757	62.1	7.0
Rural Grassland	28,977	23.4	2.7
Forest & Woodland	**9,041**	**7.3**	**0.8**
Urban & Built-Up Land	**5,196**	**4.2**	**0.5**
Urban/Built-Up	2,924	2.4	0.3
Urban Grassland	2,273	1.8	0.2
Wetland	**1,407**	**1.1**	**0.1**
Forested	803	0.7	0.1
Non-Forested	604	0.5	0.1
Other Land	**2,218**	**1.8**	**0.2**
Lakes & Streams	2,012	1.6	0.2
Barren & Exposed	206	0.2	0.0
Totals	**123,596**	**100.0**	**11.3**

Buck Creek Subbasin

Category	*Acres*	*% Subbasin*	*% Basin*
Agricultural Land	**27,348**	**97.6**	**2.5**
Cropland	24,957	89.0	2.3
Rural Grassland	2,391	8.5	0.2
Forest & Woodland	**245**	**0.9**	**0.0**
Urban & Built-Up Land	**177**	**0.6**	**0.0**
Urban/Built-Up	177	0.6	0.0
Wetland	**42**	**0.2**	**0.0**
Non-Forested	42	0.2	0.0
Other Land	**220**	**0.8**	**0.0**
Lakes & Streams	220	0.8	0.0
Totals	**28,032**	**100.0**	**2.6**