The Kankakee River Yesterday and Today

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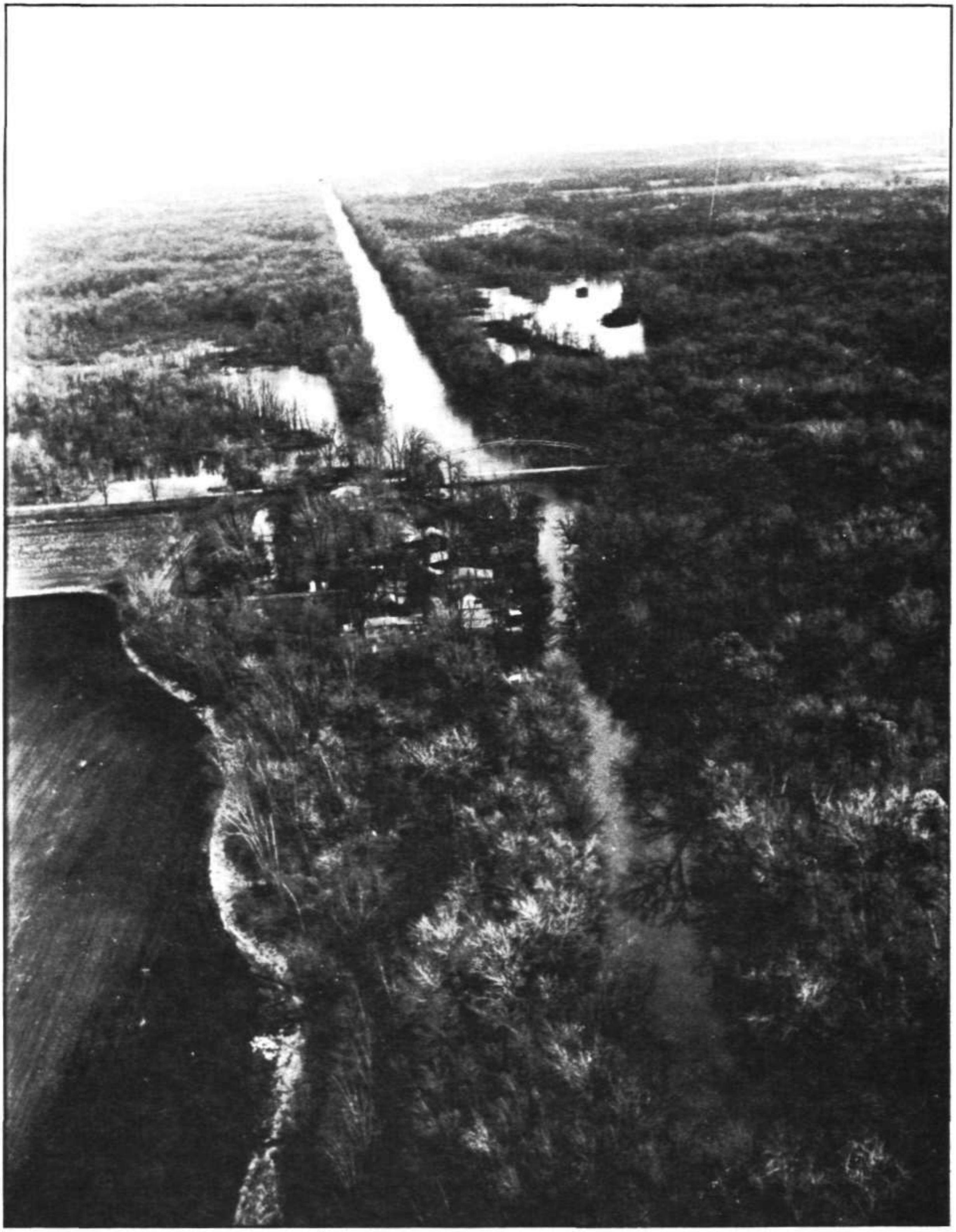

The Kankakee River at the Illinois-Indiana state line. The bridge is on the state line. The channelized portion of the river in Indiana is shown in the background and the naturally meandering portion of the river in Illinois is shown in the foreground. (Chicago Tribune photo)

Study Documents

Documentation for the information in this summary may be found in the study documents published by the three Scientific Surveys. These are:

Geology of the Kankakee River System in Kankakee County, Illinois, by David L. Gross and Richard C. Berg, Illinois State Geological Survey Environmental Geology Notes 92, January 1981, 80 pp.

Illinois State Geological Survey
615 East Peabody Drive
Champaign, IL 61820

The Effects of Sedimentation on Aquatic Life of the Kankakee River, by Allison R. Brigham, Liane B. Suloway, and Lawrence M. Page, Illinois Natural History Survey, Sections of Aquatic Biology and Faunistic and Insect Identification, December 1980, 16 pp.

Illinois Natural History Survey
607 East Peabody Drive
Champaign, IL 61820

Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois, by Nani G. Bhowmik, Allen P. Bonini, William C. Bogner, and Richard P. Byrne, Illinois State Water Survey Report of Investigation 98, December 1980, 170 pp. 9 maps.

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Introduction

Again and again residents of the Kankakee River Basin in Illinois had voiced concerns about the degrading quality of the river — particularly from sedimentation. By June 1978 it was clear — the myriad problems of the Kankakee basin could not be solved without more technical information. The amount, the source, and the physical mechanisms involved in the movement of sediment though the river basin were not known — nor the effect of this sediment on water quality and the many uses of the river.

The Task Force appointed by the Governor of Illinois in 1977 had reviewed the material then available and had talked to area residents about their concerns. The Task Force recommended that the State of Illinois should *"maintain the Kankakee River as a low density recreation and scenic river"* by keeping it *"in the most natural condition possible."* They believed that Indiana's plan to manage the basin for improved agricultural drainage was in conflict with this policy recommendation.

The Task Force recommended that the Illinois State Water Survey monitor the sediment and bed load movement, analyze the data gathered, and suggest alternative remedies. Later it was realized that geological and biological data also were needed to round out the base of technical information for the river, and the Illinois Geological and Natural History Surveys were called upon to make these studies. The studies were funded by a contract with the Illinois Department of Energy and Natural Resources (formerly the Institute of Natural Resources).

Finally, the Task Force suggested that the Water Survey obtain input from citizens of the Kankakee basin during its investigation, and this was done through a series of public meetings. This booklet is a summary report of the three studies by the Scientific Surveys intended to relay to local citizens the key results and recommendations stemming from the research.

Description of the Kankakee Basin

The Kankakee River flows westward from Indiana into Illinois. The headwaters are near South Bend, Indiana, and the mouth is the confluence of the Kankakee with the Des Plaines River where those two rivers become the Illinois River (see map, Figure 1).

Of the 5,165 square miles in the Kankakee River drainage basin, 2,169 are in Illinois and 2,996 are in Indiana. The river has a total length of about 150 miles, with 59 miles in Illinois.

In work beginning in the late nineteenth century and essentially completed by 1918, almost all of the main channel of the Kankakee River in Indiana was channelized, that is, straightened. Today that channel is a man-made ditch, extending straight for many miles between small bends. In Indiana, all of the natural meanders were removed.

In Illinois, a very small dam exists at Momence, a larger dam at Kankakee, and an overflow dam at Wilmington, but most of the river remains a naturally meandering stream. A major tributary to the Kankakee River in Illinois is the Iroquois River

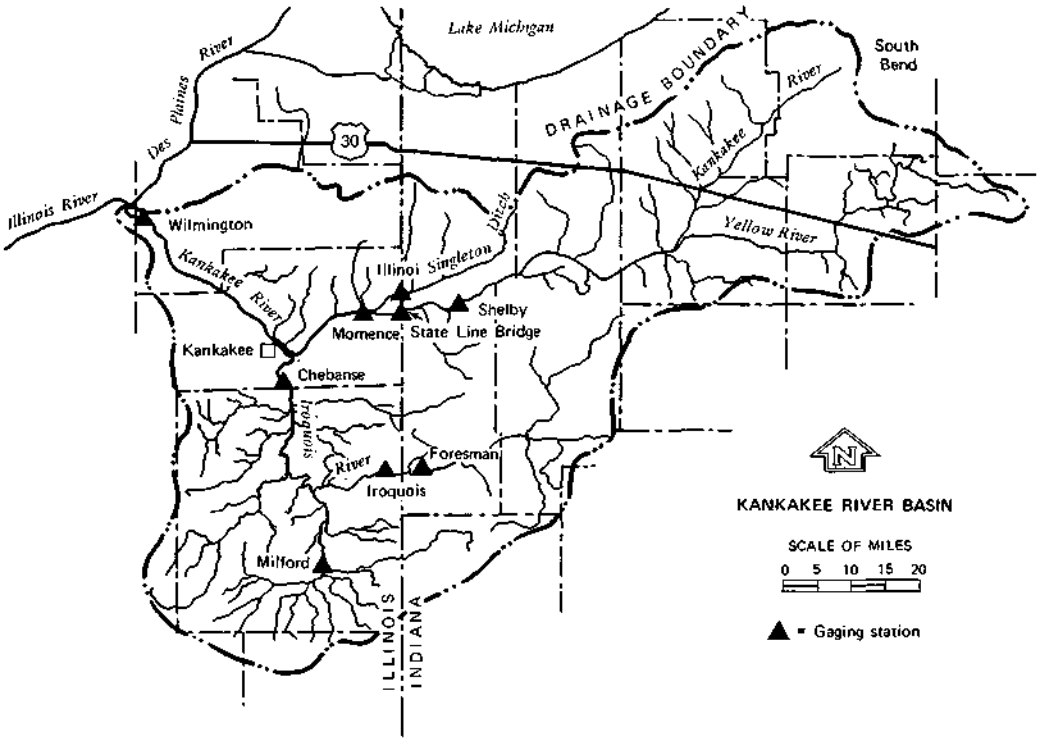


FIGURE 1
This map shows the boundary of the drainage area of the Kankakee River in Illinois and Indiana — and the stream gaging stations in the study area.

which joins the Kankakee just below Aroma Park. Most of the Iroquois drainage basin also is in Indiana. Singleton Ditch, a channelized tributary in Indiana, joins the Kankakee just above Illiana Heights in Illinois.

Before channelization, much of the drainage area of the river in Indiana was wetland — swamps and marshes — called the "Grand Marsh." The Grand Marsh encompassed approximately 400,000 acres and ranged from 3 to 5 miles in width with a water depth of from 1 to 4 feet for eight or nine months of the year. The marsh plane was only about 85 miles long, but the river course was about 250 miles in length with an average slope of 5 to 6 inches per mile. The nature of the marsh caused the Kankakee River to alter its course continuously, resulting in the formation of a variety of meanders, oxbow lakes, sloughs, and bayous.

In Indiana, the river system has been constructed and managed as an agricultural drainage project — successfully draining the wetlands and converting them into very productive agricultural land. The intent of the management has been based on the economics of agricultural production.

In Illinois, especially in Kankakee County, the river has been used as a scenic, cultural, and recreational resource. The reach between the state line and Momence is a naturally meandering stream with a sandy bottom, traversing an area of timber and relatively undisturbed wetlands, commonly called the "Momence Wetlands."

The pictures in Figures 2 and 3 reflect the present condition of the river in the two states.

The reach between the cities of Momence and Aroma Park is also a natural stream, traversing an area of alternating bedrock and sandy bottom. Between Aroma Park and the city of Kankakee, a deep-water area called Six Mile Pool (actually 4.7 miles long) was formed by the construction of the Kankakee dam. The deeper water has long been used for recreational boating, and fine homes have been built in the surrounding area. All of the river in Kankakee County is noted for high water qual-

FIGURE 2
Looking east into Indiana (upstream) from the State Line Bridge, we see the straightened channel of the Kankakee River.

FIGURE 3
Looking west and southwest into Illinois (downstream) from the State Line Bridge, we see the Kankakee River meandering in its natural course.

ity, excellent sport fishing, and scenic beauty.

The dam at Kankakee was built to generate hydroelectric power, but it is no longer used for that purpose and is now owned and operated by the Illinois Department of Conservation. During times of high flow the "damming" effect on the river is small, but during periods of low flow it retains sufficient water in Six Mile Pool to not only assure the public water supply of the city of Kankakee, but also to support the major recreation resource of boating, fishing, swimming, and scenic beauty.

Although the management practices, which are a human action, differ significantly between the two states, there are some important geological differences that also occur near the state line. The wetlands, which are a result of continental glaciation, occur mainly on the Indiana side of the line except for the small area east of Momence. The areas of bedrock outcrops, where the glacial deposits are thin or absent, occur mainly on the Illinois side of the line. These bedrock outcrops in Kankakee County have long been an important factor in the hydraulics of the river.

People and the Basin

Born of the ice melts and intermittent rock and debris dumping of the last continental glaciers, the basin of the Kankakee River has had a varied history of human activities. Its natural physical character was met with very different human responses.

The first inhabitants (at least in our recent, recorded history) were the Indians. We know that the Pottawatomi Indians lived there in the 17th century and found the rivers and marshes of the basin an excellent residence. They could fish, or hunt and trap the abundant wildlife — and the marshes were a natural refuge from their enemies (the Iroquois).

The French explorers noted such uses of the basin as they traveled the river in 1679. Soon after came the European hunters, trappers, and traders who lived a life similar to that of the Pottawatomi. Eventually, a few of these traders stopped along the Kankakee, and during the early 1800s pioneer settlers began to arrive and establish settlements along the river and on the fringes of the Grand Marsh. These rugged frontiersmen and hunters used the river for transportation and adjusted to the restrictions and limitations of their environment that included the swamps, the floods, the ice jams, and the vagaries of weather.

Next came the prairie farmer and by the mid-1800s the character of the basin's inhabitants had been completely transformed. Those who had lived in harmony with the river and the marshes had been replaced by those who wanted to change and exploit them.

Traffic on the Kankakee River increased. There was a plan (started but never completed) to build a series of locks and dams to allow commercial navigation to connect with the Illinois and Michigan Canal and Chicago — and with railroad lines. Flatboats, sternwheelers, and steamboats traveled upstream into the marsh carrying sightseers, hunters, and cargo. Tens of thousands of waterfowl and other wildlife were harvested for commercial markets of Chicago and New York. The thick, clear ice that formed every winter was good for skating and a profit for the ice companies.

But none of these activities had as great and irreversible an impact upon the Kankakee River basin as did the efforts of those who wanted to drain the lowlands and the Grand Marsh.

The Early Days

The Pottawatomi Indians called the Kankakee River Ti-yar-ac-ke, "wonderful land." The French had a variety of names for it, including The-a-ki-ki and Quin-que-que, and the name Kankakee appears to be an English version of this later French word.

The first Europeans to descend the Kankakee River were the French explorers De La Salle and Father Hennepin in December 1679. They explored its entire length after portaging from the St. Joseph River. The river they found looked far different from the one that exists today.

Their point of entry was near present day South Bend. From there, down to what is now Momence, Illinois, De La Salle's party wound its way through some 250 miles of a marshy, sandy maze of meanders, oxbows, and sloughs that were teeming with a variety of wildlife. This area would later become known as the "Grand Marsh." Downstream, below a limestone outcropping at Momence, the river had a higher gradient and probably appeared much the same as it does today.

Starting with the farmers who tried to dig ditches by hand, there were repeated attempts to drain the swamplands — with little success. Equipment was inefficient and drainage work prohibitively costly. In the mid-1800s the invention of the steam dredge and legislation permitting drainage districts with the power to levy taxes overcame the previous obstacles to draining the land for improved agriculture.

Singleton Ditch in Indiana was constructed in 1866 and Ackerman, Hayden, and Brown ditches were also built around that time. Again, the drainage work was only partially successful. The key to adequate drainage in Indiana, they thought, was the lowering or removal of the limestone rock ledge near Momence, Illinois.

In 1878 and 1879 the U. S. Army Corps of Engineers made the first of several studies of improving the Kankakee River for navigation. Most of these studies concluded that the costs of improvements could not be justified for navigation. Another

The Natural Grand Marsh

Marsh prairies of aquatic sedges and grasses, grazing areas; wild rice sloughs, scenes of countless wild geese and ducks-, flag ponds, lined with muskrat homes; a narrow but almost uninterrupted swamp forest, full of game, rimming a meandering river teeming with fish; wet prairies made humanly habitable by the interspersion of sandy island oak barrens, many of them surmounting the highest flood waters — such was the general physical set-up of the "natural" Kankakee.

Alfred H. Meyer, 1936

study for Indiana in 1882 suggested three things: 1) constructing a better main channel for the flow of the river, 2) straightening and deepening the tributary streams, and 3) digging numerous lateral ditches through the swamps to the "improved" channels.

The State of Indiana was still convinced that the rock ledge was the key to their drainage problems and appropriated $65,000 to widen and deepen the main channel near Momence. This work, done in 1893, created a channel not quite 1½ miles long, 300 feet wide, and 2½ feet deep. This channel expansion required the removal of 66,447 cubic yards of rock.

After the work at Momence was done, various public and private groups in Indiana began to channelize the main river in its uppermost reaches. By 1906, 46 miles of the main channel had been straightened, from its source near South Bend to the west edge of Starke County.

But the problem was not solved! The increased rate of runoff from the straightened reaches caused erosion and flooding downstream. The apparent solution then was to continue the straightening of the river — and remove more of the Momence rock ledge (an effort Illinois refused).

In Indiana, the channelization went ahead and was completed in 1918. The old channel, 250 miles of meandering river, had been replaced by a straightened, deepened channel 82 miles long, extending from near South Bend to the Illinois state line. Below this point, except for the work done at the rock ledge at Momence in 1893 and the small dams at Momence and Kankakee, the river remained in its natural form. In Indiana, the average slope of the river had been changed from 0.45 foot per mile to 0.83 foot per mile. The improved drainage affected nearly 400,000 acres of swamp and 600,000 acres of marginal land at a cost of about $1.2 million.

The Grand Marsh had finally been "reclaimed." However, the accomplishment was not greeted with enthusiasm by everyone. There was concern in Illinois about the impact of the change on the downstream reaches of the river. For years many have questioned the wisdom of destroying this vast natural ecosystem.

Soon after the channelization was completed, it became apparent that the drainage problem had not been completely solved. Severe flooding still occurred east of the Momence rock ledge, and the removal of additional rock was discussed. The focus of the work in the Kankakee basin after the channelization of 1918 was directed toward the construction of levees to contain the flood water and toward the improvement of lateral ditches for increased drainage.

Additional studies were made by the Corps of Engineers in 1931 and again in 1941. The later one showed that large quantities of sand had been deposited between the state line and Momence due to channel erosion upstream, but the *rate* of siltation had decreased indicating that the straightened channel in Indiana was stabilizing.

In Illinois, a number of investigations and proposals were made (1947, 1955, 1967) for the Kankakee River, primarily to improve the channel for recreation but also to reduce flooding. Many of these proposals were objected to by various groups and none was ever implemented.

After the Channelization

Fields of corn and wheat stretch over the reclaimed acres, for the utilitarian has triumphed over beauty and nature's providence for his wild creatures. The destruction of one of the most valuable bird refuges on the continent has almost been completed, for the sake of immediate wealth. The realization of this great economic wrong must be left to future generations.

From *Tales of a Vanishing River*
Earl H. Reed, 1920

In the mid-1970s, attention was again focused on the problems of the Kankakee River. This led to a set of recommendations by the Indiana Department of Natural Resources in 1976 (see box on this page) that were used by the Kankakee River Basin Commission created in 1977 to develop a comprehensive plan for Indiana.

Increased public concern in Illinois over the impact of the proposed work in Indiana prompted Illinois Governor James R. Thompson to appoint the Illinois Kankakee River Basin Task Force in June 1977. The research of the three Scientific Surveys summarized here was an outgrowth of Task Force recommendations.

Proposed Work in Indiana

Channel work on 26 miles of the Kankakee River from Ind. Route 223 in St. Joseph County to U.S. Route 30, and 49 miles of wide levees (with no channel work) along the Kankakee River from U.S. Route 30 to U.S. Route 41, for flood prevention and drainage.

Channel work on 13 selected tributaries of the Kankakee River in Indiana for flood prevention and drainage.

Accelerated land treatment program, which includes installation of conservation measures to reduce erosion and adequately treat 426,400 acres.

Accelerated land treatment program, which includes installation of on-farm resource management systems to adequately treat 247,500 acres of cropland for drainage.

Change of about 12,650 acres of erosion and drought hazard cropland to non-cropland for reduction of erosion and sedimentation, and for adequate treatment of land within its capability (in addition to the land treatment program).

Protection of about 5,000 acres of existing classified wetland.

Amendment or adoption of flood plain zoning ordinances, building codes, and similar regulations for all identified flood-prone areas in the basin, and allowance of eligibility for flood insurance.

Proposed by the Indiana Department of Natural Resources 1976

Geology of the Basin

Where do the sediments come from?

Our rivers and streams are the product not only of flowing water and land use activities but also — importantly — of the geologic foundation and land forms on which they evolved. The Illinois Geological Survey's study of the Kankakee basin provides a description of the geologic history and the geology of the sediments of the river and its basin. Their detailed study in 1978-1979 centered on that part of the Kankakee River from the city of Kankakee to the Illinois-Indiana state line (see box on this page).

The geologic materials of the Kankakee River Basin consist of a mantle of glacial deposits overlying Paleozoic bedrock. In Illinois, most of the bedrock in the basin is Silurian age dolomite, and in Indiana much of the bedrock is Devonian age shale.

The geologic events responsible for the present topography and surface materials took place during the melting of the last continental glaciers. That melting occurred during the approximate interval from 16,000 to 13,000 years ago (known to geologists as the latter portion of the Woodfordian Substage of the Wisconsinan Stage). The distribution of the surface materials is shown on the map (Figure 4). During this period, the retreating glacial lobes constructed numerous moraines including the Valparaiso moraines located along the northern portion of the Kankakee basin.

The most important geologic event shaping the landscape and the character of the deposits in the basin was the ancient "Kankakee Flood."

During the forming of the Valparaiso moraines, meltwater from three glacial lobes (the Lake Michigan, Saginaw, and Erie lobes) drained into the Kankakee valley and flooded it because of a constriction by the Marseilles moraines in the Illinois valley to the west. At peak flow, water spread widely over the uplands resulting in numerous glacial lakes (Lake Wauponsee, Lake Watseka, Lake Ottawa, and Lake Pontiac which drained soon after the glaciers melted). The evidence for these lakes is the fine-grained lacustrine sediment now found throughout much of Iroquois County in Illinois (see map).

The flood also deposited thick sand in a wide belt along the Kankakee resulting in the large tract of sandy sediments extending from west of the city of Kankakee to South Bend in Indiana. This extensive sandy deposit is the primary source area for the sediments now residing in the Kankakee River.

When a gap in the Marseilles moraines was eventually eroded, the base level of the Kankakee Flood lowered considerably. Water flow became more concentrated in the central Kankakee River valley, and the river scoured broad areas down to the bedrock surface. Bedrock at the surface is shown on the map downriver from the city of Kankakee. The erosive force of the currents deposited numerous bars of angular, bouldery rubble, as well as relatively flat-lying bouldery material.

As the Kankakee Flood continued to subside, rivers became entrenched and large expanses of sandy outwash sediments left behind by the flood were exposed to eolian (wind) activity and dune building.

The dune sand was derived directly from outwash sands deposited by the Kankakee Flood,

Geologic Data

The sources of information for the geologic studies of the Kankakee River included the following:

- □ Published geologic maps from Indiana and Illinois to describe the nature of surface materials in the entire river basin.
- □ Drillers logs, soil survey maps, geologic literature, topography maps, and field observations to produce the detailed map of the surficial geology near the river in Kankakee County, Illinois.
- □ A combination of sediment cores and grab samples from 186 locations and probes of sediment thickness at 499 locations to map the thickness of sand in the river in Kankakee County.
- □ Topographic maps surveyed in 1922, 1963-64, and 1973; vertical air photos taken in 1939, 1954, 1961, and 1973; a map combining information from 1929 and 1940; and the several hundred drillers logs to describe changes in sedimentary features in the river (islands, beaches, spits etc.) over the years.

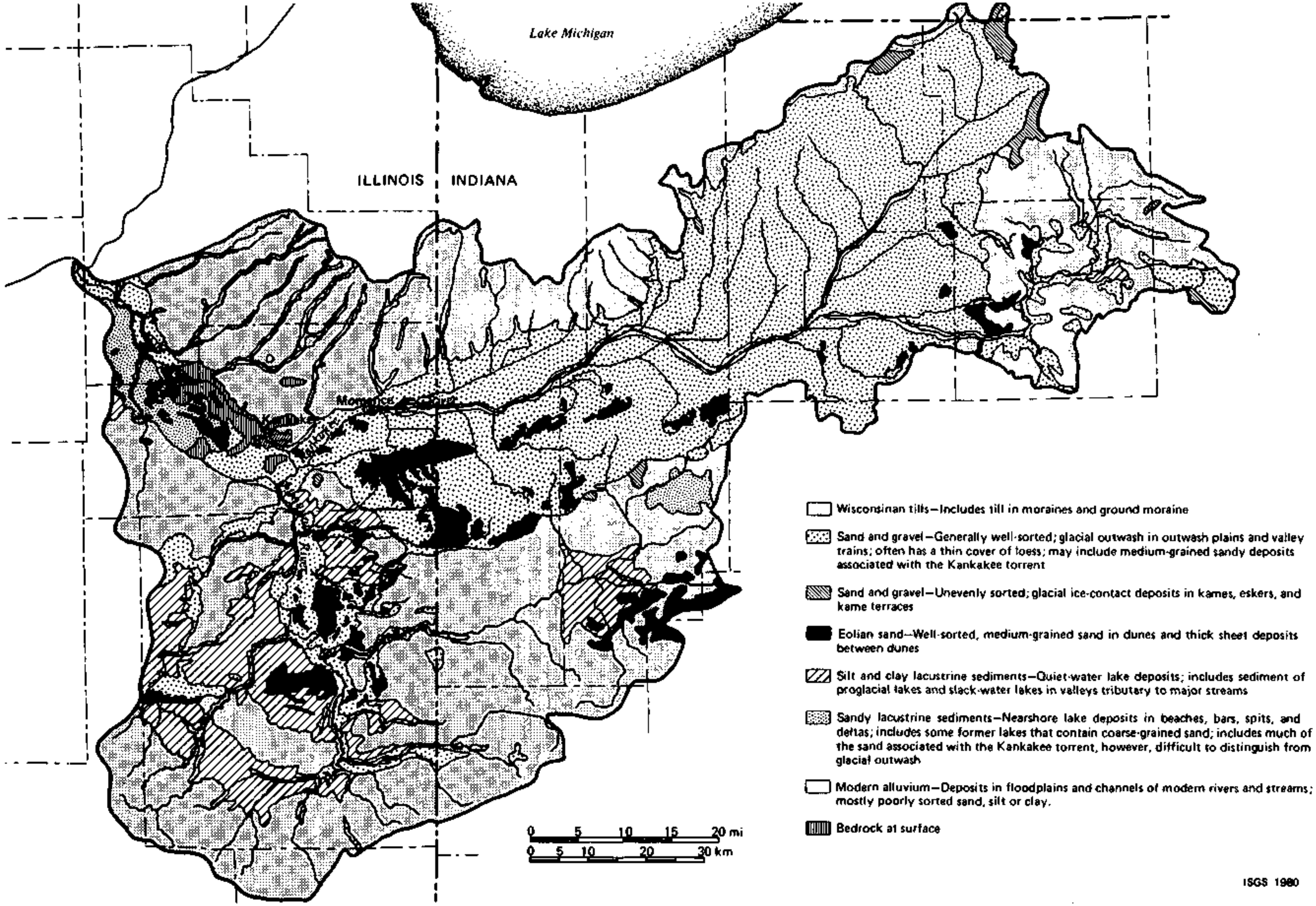


FIGURE 4
This map of the Kankakee River Basin shows the extent of the various surface materials that are present in the watershed.

which transported sediment from the erosion of local glacial deposits and bedrock as well as outwash from the three retreating glacial lobes. The end result of these processes was deposition of sand.

The final episode shaping the character of the geological materials in the river basin is the modern deposition of silt, sand, and gravel adjacent to the Kankakee River and its tributaries. In Illinois the material is referred to as Cahokia Alluvium. It consists of materials transported down the valley and deposited in floodplains during intervals of flooding and also includes sediments deposited directly by tributary streams. The alluvium generally rests conformably on bedrock and glacial deposits. Along the Kankakee River the material is primarily medium sand that often occurs on top of the sandy and gravelly Kankakee Flood materials.

What are the geologic features today?

Today, from the Illinois-Indiana state line downstream to near the city of Momence, the river channel is underlain by thick deposits of sand overlying bedrock. In the several miles of river channel adjacent to Momence and a 2-mile reach of river upstream of Aroma Park, the Kankakee River is flowing directly over bedrock. In the area between Momence and Aroma Park, the channel contains a series of massive sand bars, from 3 to 6 feet thick, overlying bedrock. The upper (eastern) end of Six Mile Pool contains thick sand deposits. In the lower (western) end of Six Mile Pool, the main channel is underlain by bedrock although the insides of the meanders have sand bars.

The use of an informal phrase "the bedrock ledge at Momence" has led to a serious misconception. Many of the residents of the basin have the incorrect impression that this "ledge" is a single obstruction, like a dam, in the river. It is in fact a 4-mile reach of the river where the water is flowing over natural bedrock.

What are the present river sediments?

The materials in the Kankakee River are of two major types — unconsolidated sediment and bedrock. As previously mentioned, the bedrock consists primarily of Silurian dolomite, and the sediment is mostly a medium-textured sand. Locally, at the junction of the Iroquois and Kankakee Rivers and a bit downstream in Six Mile Pool, there are small areas of silty, clayey sediment often occurring in depressions in the bedrock channel. But throughout the length of the Kankakee River, there is little variation in the grain size of the sand.

Chemical analyses of the composition of sediments in Six Mile Pool revealed an interesting divergence from similar studies of other lakes in Illinois (Lake Michigan, Fox Chain of Lakes, Lake Paradise, and Upper Peoria Lake).

Vertical core samples from the other lakes quite consistently showed a lower or base layer with natural (relatively low) concentrations of trace elements such as arsenic, bromine, chromium, copper, phosphorus, lead, and zinc, while the top levels were enriched in these metals by the pollutants of the 19th and 20th centuries. In contrast, similar vertical samples from the Kankakee showed little change in concentrations of these metals from bottom to top; the concentrations were all near the natural level, indicating that the Kankakee sediments are relatively unpolluted.

A vertical core sample taken from Six Mile Pool in September 1978 showed materials that could be interpreted as three cycles, each representing a typical "depositional sequence." A sequence commonly includes such events as erosion of the river bed during springtime flood flows, deposition of coarse sediment (sand) during the later portion of the flood, and finally deposition of fine-grained sediment (silt) during summer periods of low flows. Although the exact dates of the cycles in the sample are not known, it seems reasonable that they could be the deposits of 1976, 1977, and 1978.

Because major floods occurred in the early spring of 1979, the same site was resampled in June 1979. Major changes in sediment thickness and a change in grain size had occurred between the two sampling dates. This means that the sediment sampled in 1978 had been eroded and a new, thicker deposit of sand had taken its place. This also means that the material that was analyzed chemically and found to be unpolluted was probably all of very recent origin.

Are the sediments harming the river in Illinois?

The geometric form of the present-day Kankakee River in Indiana is the result of the channelization and dredging over its entire length from South Bend, Indiana, to the Indiana-Illinois state line that was completed about 1918. Old meander bends were cut off as a nearly straight channel was constructed through the area previously referred to as the "Grand Marsh." Recent surveillance of the Indiana portion of the Kankakee River shows that the river geometry has remained essentially unchanged since the dredging activities ended. It does not appear that the river has started to meander.

In Illinois, the Kankakee River flows as a naturally meandering stream. Between the state line and Momence, an area commonly called the "Momence Wetlands," the Kankakee River flows over thick sand deposits and resembles the river in Indiana prior to dredging — that is, numerous and angular bends and a relatively narrow channel. Between Momence and Kankakee, the Kankakee River flows mostly on bedrock so that the meandering pattern is less distinct, but natural and quite stable.

It has been contended that the dredging of the Indiana portion of the river has caused sand choking and increased sedimentation upriver of the bedrock areas, particularly in the Momence Wetlands and in the Six Mile Pool near Kankakee.

If sedimentation from Indiana has adversely affected the Illinois portion of the Kankakee River, the evidence could include:

- **Island formation or sedimentary buildup (accretion) on the downriver portion of islands, and**
- **An increase in the widths of beaches and spits on the banks of the river**

These changes should be observable on aerial photos taken some years apart, as well as on topographic maps. Changes in the shape of the Kankakee River between the Indiana state line and the city of Kankakee were evaluated by studying vertical air photos and topographic maps from different periods (see box page 7).

Between 1939 and 1954, the air photos revealed increasing sedimentation in the Kankakee River resulting in growth of beaches and islands, particularly at the confluence of the Kankakee and Iroquois Rivers. Downriver of this confluence there was no photo evidence of sedimentation.

The relatively quiet water at the mouth of the Iroquois River encourages backwater and deposition from the Kankakee and Iroquois Rivers. A spit that protrudes from the north bank of the Kankakee River at the confluence point is a sensitive fluvial feature that increases or decreases in size in response to changes in the supply of sand. From 1939 to 1954 the length of the spit increased by about 330 feet. However, the extent of vegetative cover on the connecting portion of the feature on photos of both years suggests stability for considerable time prior to 1939.

The later air photos (1961, 1973) show no significant changes during this subsequent 19-year period in river bank profiles due to sedimentation between Momence and Kankakee. In summary, the air photos indicate that sedimentation resulting in spit extensions and island and beach growth attained relative stability by the early 1950s. Study of the topographic maps gave similar results. These both suggest that the river system is in a state of near equilibrium, at least temporarily.

Further, the geometric form of the channelized portion of the river in Indiana is amazingly stable. The channel has remained straight, there has been very little tendency to meander, and the banks are relatively free of serious erosion problems. This is not at all typical of channelized rivers in the Midwest, which usually start meandering immediately.

For Additional Information

Very detailed maps showing geologic deposits adjacent to the Kankakee River in Illinois from the state line to the city of Kankakee were prepared for this study. These maps describe the unconsolidated layers, in stack units from top layers to a working depth of 20 feet, as developed from both soil survey and geologic information. These maps are presented and described in the Geological Survey's study document. Copies of this document may be obtained from the Illinois Geological Survey, see address on page facing page 1.

Also available for the Illinois area of the basin are detailed maps of the bedrock topography and the thickness of sand in land areas adjacent to the river. These maps were developed from data on file at the State Geological Survey and from drill samples taken for this study, which together augment the information about the contributions of land areas to the river.

A third series of detailed maps in the study document describes the thickness and location of sand in the river itself. These were made from sand probes and core samples taken during 1978-1979 and in some cases reflect the continuing movement of sediments in different parts of the river in Illinois.

Flow Hydraulics and Sediment Transport

Some of the important factors that determine the hydraulic and sediment transport characteristics of a river are:

- **The materials through which a river flows**
- **The amount of water moving through the river**
- **The characteristics of the watershed**
- **The rainfall-runoff pattern from the basin**
- **The geology of the watershed**
- **The constraints imposed by humans**

Most of the major rivers of the world flow through alluvial materials consisting mainly of sand and silt. In a sand bed channel, the flow velocity and water discharge, the turbulence associated with the flow velocity, and the pattern of the secondary circulation all have the capability and the opportunity to mold the shape of the channel.

As a result of all the constraints on an alluvial channel, the velocity changes both from side to side and vertically. The velocity distribution in both the lateral and vertical directions varies in time and space. The longitudinal water slope, or the hydraulic gradient, also constantly adjusts to reflect the constraints of the channel geometry on the flow in a natural channel. This variability of the water surface profile is more pronounced for flow around a bend in the river than it is for a straight reach.

The Water Survey's study of the hydraulics of river flow and the mechanics of sediment transport in the Kankakee River was a two-year project. The first year was devoted to collecting physical data in the field and the second year to analyzing historical as well as field data (see box on next page).

It must be clear that *one year* of field data cannot adequately describe all of the physical characteristics of the river — such information must be collected over 5 to 15 or more years. This means that for a dynamic river such as the Kankakee, the measurements that we obtained in 1978-1979 will change from year to year, and any "trends" that we have discerned so far may or may not prevail in future years.

Analyses of water discharges for water year 1979 (October 1, 1978 - September 30, 1979) indicated that the year was about average for the Momence and Iroquois stations but that it was a wet year (slightly above normal rainfall) for the Chebanse and Wilmington stations.

Have flow conditions changed?

Local residents and others had mentioned a belief that the peak flows in the river basin have changed with time. The peak flow is defined as the *instantaneous* maximum flow that may occur in a stream at a certain section over a year; it is not. the total quantity or volume of water that passes during a length of time such as a week or a month.

The peak flows at any gaging station can increase because of a number of man-made or natural factors. Increased precipitation in the basin, clearing of natural cover, heavy urban development, decrease in the natural infiltration rate, changes in the river regime (such as channelization), and other factors can change the peak flows in a natural stream.

Peak flows from various gaging stations were analyzed to identify trends. Annual peak flows at Shelby and Momence (see Figure 5) showed a trend toward increases from the 1930s through 1979, while peak flows at Iroquois and Chebanse did not show any trend (to either increase or decrease). The increasing peak flow trend at Momence seems to have a minimal effect, or no effect, on peak flows at the Wilmington gaging station. Apparently, by the time the peak flow from Momence travels to Wilmington, it is modified, truncated, and dampened by the flow from the Iroquois River and the pools behind the dams at Kankakee and Wilmington.

Trend analyses were also performed for the average annual and low flows from all the stations. Although the low flows did not show any trend, the average flows from the Momence and Wilmington stations did show a trend toward increases. The rates of increase of these average flows were almost identical at the two stations.

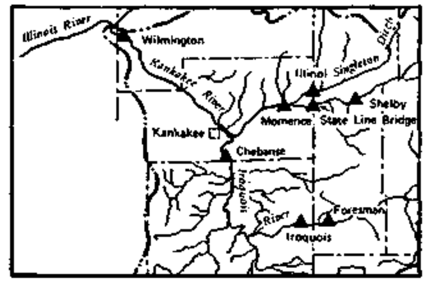
The trends at Momence for increased average and peak flows indicate that something must have happened in the watershed over the years that is responsible for this change in the flow regime.

Historical precipitation data over the basin were analyzed to test whether or not precipitation has been increasing. In the upper northeastern part of the basin (an area that is about 25 percent of the drainage basin at Momence) the precipitation is much higher than that at any other place. However, no average trend was observed for the watershed as a whole.

Hydrologic Data Collection

The data used for the hydraulics and sediment transport analyses included both historical records and field data primarily from long established U.S. Geological Survey stream gaging stations (See map, page 2). The stations were:

Kankakee River at Shelby, Indiana
Kankakee River at the State Line Bridge (temporary)
Singleton Ditch at Illinoi, Illinois (temporary)
Kankakee River at Momence, Illinois
Iroquois River near Foresman, Indiana
Iroquois River at Iroquois, Illinois
Iroquois River near Chebanse, Illinois
Kankakee River near Wilmington, Illinois



Index stations for the Kankakee River were *Momence* near the state line where 93 percent of the drainage area is in Indiana, and *Wilmington* near the mouth of the Kankakee where it enters the Illinois River. Index stations for the Iroquois River were at *Iroquois* near the state line and near *Chebanse* not far from the confluence of the Iroquois and the Kankakee.

During the one year of special data collections for this project (water year 1979 which is from October 1, 1978—September 30, 1979) four types of data were collected at the four index stations:

1) **Daily suspended sediment samples (and more frequently during flood events)**
2) **Daily stage (river height) records**
3) **Detailed velocity distribution data once a month**
4) **Bed material samples from the stream**

The same kinds of data were collected at the two temporary stations (Illinoi and State Line Bridge) but less frequently, about once every two weeks but more often during flood stages. Bed materials in the main stem of the Kankakee in Indiana up to U.S. Highway 30 also were sampled. Long-term monthly suspended sediment data were available from the U.S. Geological Survey for the two Indiana stations (Shelby and Foresman). Bed load samples were collected at State Line Bridge, Iroquois, and Chebanse stations.

Water surface slope (gradient) data were collected at the Illinoi station on Singleton Ditch, at Chebanse and Iroquois on the Iroquois River, and at Wilmington and Momence on the Kankakee River.

Six trips on the river were taken during the study to observe the present conditions and in some cases to collect samples of the bed and bank materials.

Other historical records also were analyzed, including:

- □ Historical data on flow duration, peak flows, and average annual flows for all of the main gaging stations in Illinois to discern any trends in flow conditions.
- □ Historical precipitation data for the entire basin to find out if rainfall had changed through the years.
- □ Cross-sectional data from 1967-1968 and 1977-1978 from soundings taken by the Illinois Division of Water Resources to measure any changes in the shape of the river bed. The 1977 and 1978 data were used to prepare the detailed hydrographic maps of Six Mile Pool.

What are the bed materials like?

The Kankakee River is a dynamic river. Changes on the bed of the river have been occurring and will continue to occur. In some areas the river will erode its bed of erodible materials and in other areas it will deposit them (see Figure 6). this pattern will probably continue for the foreseeable future.

Some 375 samples of river bed and bank materials were collected in Illinois and Indiana. These were analyzed to characterize the particle size distribution of the materials and its effect on the sediment transport characteristics.

The characteristics of these materials are aimost identicai. The median diameters vary from 0.2 to 0.4 millimeters, considered fine to medium sand. Because of the uni-

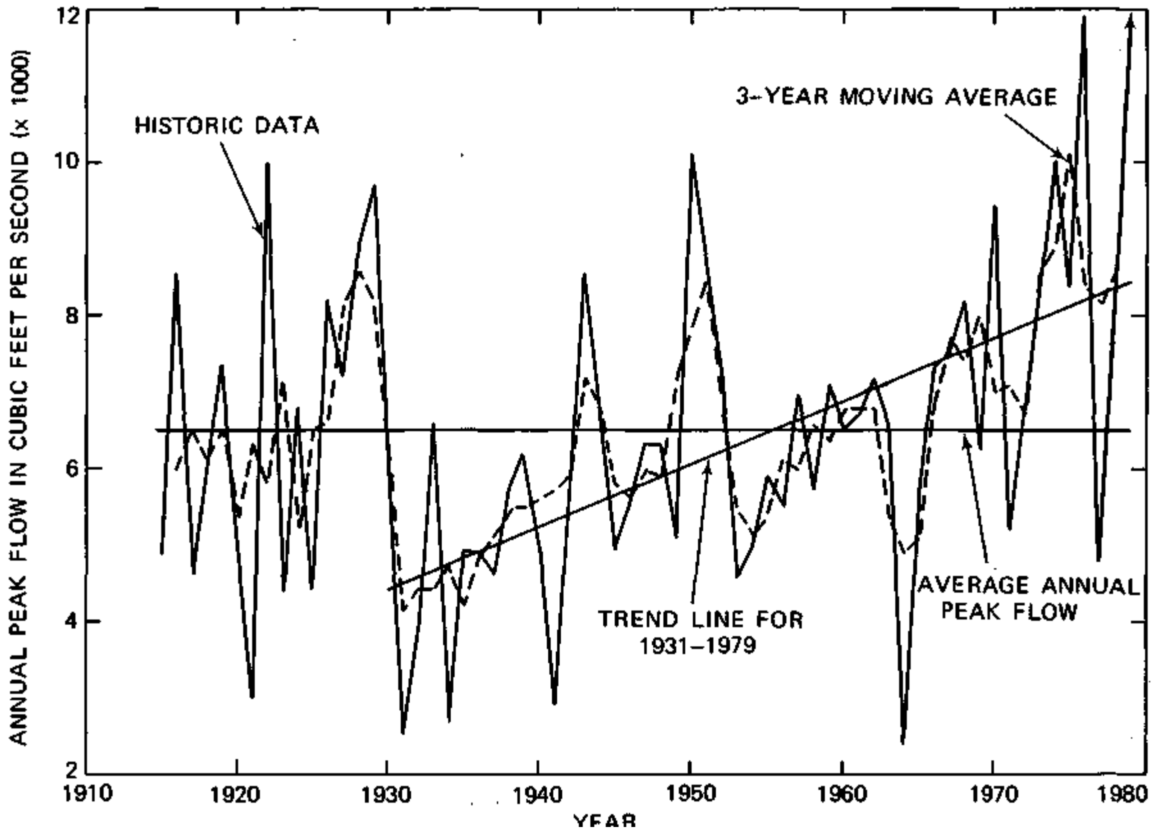


FIGURE 5

This graph depicts the annual peak flows at Momence for the years of record at that station and the "trend" of increasing peak flows from 1931-1979.

(The trend line was developed from the 3-year moving averages, a statistical technique. To obtain the 3-year moving average values, the peak flows for the first 3 years are added, the arithmetic average is computed, and the average value is assigned to the middle year. Then the peak flow for the 4th year is taken, the 1st year is dropped, and the average value from these 3 years is computed and assigned to the new middle year. This is continued for the entire period of record. This technique smooths out sharp peaks and valleys in the data and provides a workable statistic.)

formity of the bed materials collected at different locations, it would be very difficult to identify the origin of a sand particle on the river bed.

The bed materials were less than 5 percent silt and clay from Highway 30 in Indiana to Six Mile Pool, where values rose as high as 30 percent. These high silt and clay contents in the pool are a normal characteristic of any pool created by a dam, as fine materials settle out because of the reduced flow velocity.

Except for a few rocky segments in Illinois, the Kankakee River is flowing on a sandy bed with the contributing tributaries also flowing on sandy beds. Even the bank materials are composed of sand, especially in Indiana. This point is very important as far as the hydraulics of flow is concerned. The sand particles on a steep bank are unstable unless the banks are protected by artificial or natural materials. Well-graded stones or rock (called riprap) with properly designed filter blankets can be constructed to protect the banks in sandy channels. Natural cover such as tree roots, bushes, and other vegetation can also protect a sandy river bank.

What is the sediment load?

The total sediment load carried by a river consists of a suspended load and a bed load. The *suspended load,* which is the sediment that moves in suspension within the water body, consists of bed or bank materials and materials washed from the watershed which are usually silt and clay. The *bed load,* on the other hand, is composed of the materials that move near the bed either in suspension or with a sliding or rolling motion. These materials are usually sand in midwestern streams.

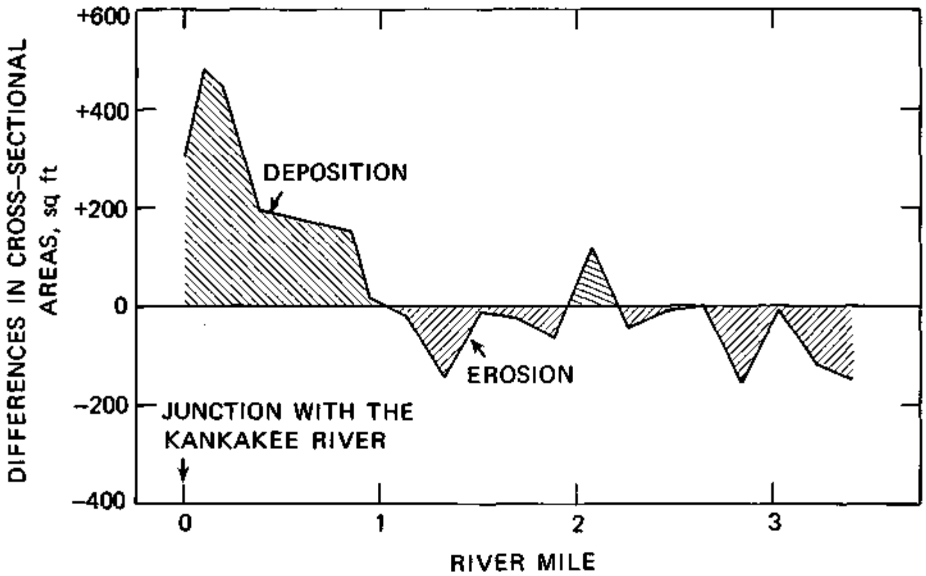


FIGURE 6
Near the mouth of the Iroquois River where it joins the Kankakee, considerable sediment has been deposited, while upstream in the Iroquois there has been both erosion and deposition. The differences shown here are over a 20-year period, 1958-1979. Similar bed scour and deposition on the bed at other locations occur in the main channel of the Kankakee River.

The sediment load carried by a stream is a function of a number of variables. The major ones are:

1) **The characteristics of the watershed, such as soils, forest cover, and agricultural practices**
2) **The meteorological conditions, such as rainfall and runoff characteristics, and snow and ice melt**
3) **Physical features, determined by land use and urbanization practices, the nature of the bed and bank materials, soil cover, bank cover, and characteristics of the tributaries or dainage ditches**
4) **Man-made constraints, such as river straightening and channelization, repair or maintenance of stream banks and levees, and construction of dams**

These variables can interact and may modify or change the sediment load in a river though the water discharge remains the same. For midwestern streams, the constraints exerted on the watershed may have more influence on the sediment load than does the normal discharge of the stream. Thus, for the same discharge at two different times of year, such as early spring when the watershed has been plowed, and fall when a large part of the watershed is covered with residue from harvested corn or soybeans, the sediment load can be completely different.

A comparison of daily water discharge and sediment discharge at the Illinois gaging stations showed that the peak of sediment discharges does not always occur at the same time as the peak of water discharges (see Figure 7). This difference may have resulted from the varying conditions of the watershed, as mentioned above. At many stations, during different periods of the year the suspended sediment yield per square mile changed by 100 percent with the same water discharge.

The composition of the suspended sediment load carried by the river also changed from one station to another and from one season of the year to another.

During low flows in the winter and late summer, the suspended sediment load consisted of silt and clay, but during high flows, the composition of the suspended load changed drastically, and sandy materials made up 50 to 80 percent of the suspended load.

The Iroquois River stations (Iroquois and Chebanse) were exceptions, for their suspended sediment loads remained silt and clay throughout the year, reflecting the finer glacial lake sediments left in the Iroquois basin — and giving a cloudy appearance to the water.

The composition analyses of the suspended sediment load indicated that in all probability the suspended load measured at Momence and Wilmington *is the total load* carried by the Kankakee River at

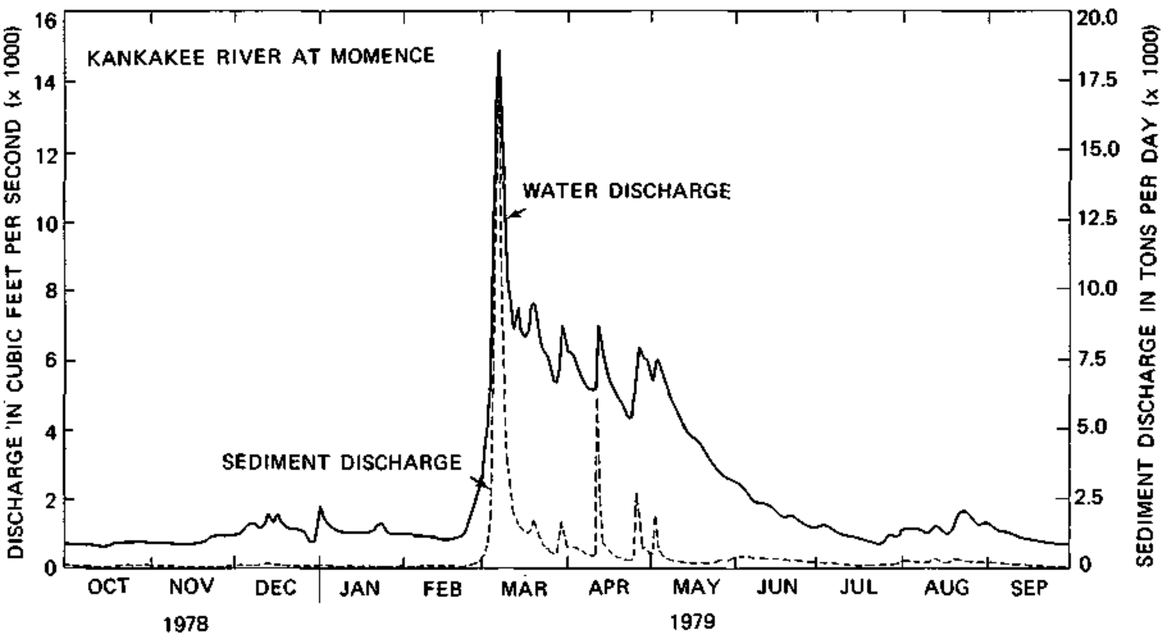


FIGURE 7
That peaks in sediment discharge do not always coincide with peaks in water discharge is illustrated here. Though the two peaks in early March (1979) were nearly the same, the water discharge remained fairly high through April while the sediment load was comparatively low. The increase in sediment load in mid-April was during a storm episode.

those two stations. Actually, the larger rocks, cobbles, and boulders that make up the river bed near Momence and Wilmington create greater turbulence and thus suspend almost all of the sediment load.

Analysis of the daily suspended load from the Illinois stations showed that during the flooding season and within a period of about 60 to 80 days, approximately 70 to 80 percent of the total yearly suspended load passed the four main stations in Illinois. Thus, extensive samples during flood stages and infrequent samples during other times of the year may be adequate to account for about 80 percent of the total yearly suspended load in the river.

A simple suspended sediment load budget performed for the stations in Illinois showed the suspended loads passing the stations to be as follows for water year 1979:

State Line Bridge	-	**131,900 tons (estimated)**
Momence	-	**157,700 tons**
Iroquois	-	**93,100 tons**
Chebanse	-	**558,500 tons**
Wilmington	-	**932,800 tons**

Thus, not all of the sediment in the Kankakee River in Illinois comes from Indiana. Part of it is picked up from local sources.

The contribution of suspended sediment load by different drainage areas above the four index gaging stations was different and indicated the nature and amount of sediment load carried by the river at various locations. For water year 1979, the suspended load in the Kankakee River at Momence was 67.7 tons per square mile of drainage area, and for Chebanse, at the mouth of the Iroquois River, it was 267 tons per square mile of drainage area. The drainage areas at these two stations are almost identical in size. Thus, the watershed of the Iroquois River (in both Indiana and Illinois) is obviously contributing much more suspended load than the watershed of the main stem of the Kankakee River.

Although the Iroquois River carries more suspended sediment load than the main stem of the Kankakee, most of the *suspended* load from both rivers is transported all the way to the Illinois River. In contrast, the *bed load* in the Kankakee River requires a much longer time for most of it to be transported to the Illinois River.

The bed load data were collected at the State Line Bridge, Iroquois, and Chebanse stations during flood stages. No significant amount of bed load was observed to move at other times. Briefly, the

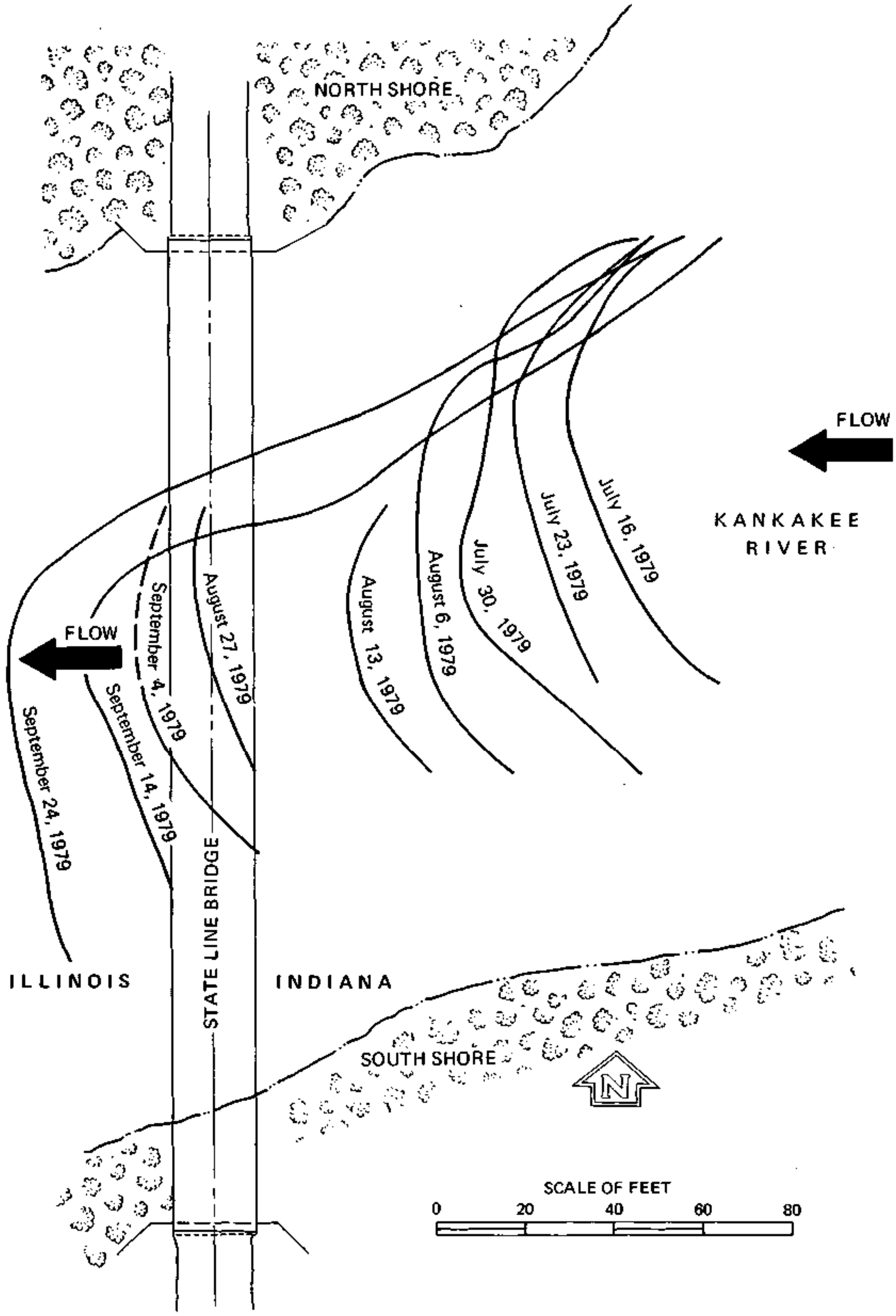


FIGURE 8
The successive movement during the summer of 197S of a sand bar near the State Line Bridge is shown here. The lines represent the leading edge of the sand bar, which was entirely under water. Its shape became skewed as it reached the slower-moving water on the Illinois side of the bridge. Formation of sand bars is believed to be a recurring event at this location.

bed load portion of the total sediment load:

- **Moves mostly during flood stages**
- **Occasionally makes up a significant portion of the total sediment load**
- **Consists of the same kind of material as the bed material itself**
- **Often is in the form of sizable, slow-moving sand bars in the main stem of the Kankakee River**
- **Was insignificant on the Iroquois River**

A number of active sand bars on the Kankakee River were surveyed. One sand bar near the State Line Bridge (see Figure 8) was monitored through the summer of 1979. This sand bar moved about 18 to 24 inches a day. The bar was about 150 to 200 feet wide, approximately 1600 feet long, and about 3 to 4 feet high at the leading edge. Its total volume was about 12,000 to 18,000 tons, which is about 9 to 14 percent of the total sediment load (suspended and bed load) at this location. *It will take the sand moving as a bar a long time before it finally moves through the Kankakee River.* Possibly the formation of the bar at the state line is a recurring phenomenon.

Although the sand bar at the state line was not carrying a tremendous amount of sand when compared to the total suspended load, it must be remembered that most of the *suspended* load flows downstream into the Illinois River.

The movement and the presence of a sand bar that remains at one location for a long time, such as this one, will reduce the effective depth of water and thus the recreational use of the river at that location. Thus the total volume of sand moving as a sand bar may not be very large compared to the total sediment load, but its effect on recreational use of the river may be very significant.

FIGURE 9
Many of the sand bars in the Kankakee River remain in one place for a long time and are visible above water at normal river stages. The one shown here is in Six Mile Pool, which is just downstream from the junction of the Iroquois and Kankakee Rivers.

Figure 9 shows a sand bar in Six Mile Pool.

A generalized analysis of changing flow regimes in a river has shown that increasing the gradient of a river having uniform bed materials and slightly increasing average flows results in an increase in the sediment load in the river (see box on next page). At the same time, dredging near the confluence of two rivers can increase the sediment load from the tributary and cause the formation of sand bars in the main river downstream.

Maps of Six Mile Pool

Nine hydrographic maps covering the entire length of Six Mile Pool were developed primarily from the sounding data collected in 1977-1978 by the Division of Water Resources. Some additional soundings were made in 1979.

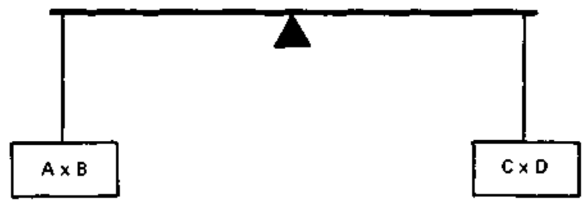
Six Mile Pool stores about 2400 acre-feet of water at the spillway elevation of 595 feet above mean sea level. Computations determined that the trap efficiency of the pool is negligible. However, localized sand deposits have occurred and it is likely that some rearrangement of these deposits takes place within the pool each year. For this reason, the hydrographic maps *reflect only the conditions of the pool for 1977-1978* and caution must be exercised in extrapolating these data for the future. It is probable though that 80 to 90 percent of the pool may not change significantly over the years.

The detailed hydrographic maps are available from two sources: the Illinois State Water Survey (see address on page facing page 1) and the Illinois Department of Energy and Natural Resources, 309 West Washington Street, Chicago, IL 60606, Attention: David Jones.

What Happens When a River Is Changed?

A natural river sets its own course and builds its own natural balance or equilibrium. Several physical characteristics play a role in this balance. The amount of water flowing in the stream, called water discharge (A), the slope or gradient of the stream (B), the sediment load (C), and the type of bed material through which the river flows (D) are the important ones, though there are other physical and hydrological variables of lesser importance.

Hydrologists have found that a river will remain in balance as long as the product of the discharge and slope (A x B) is proportional to the product of the sediment load and the median size of the bed material (C x D). (See top sketch).

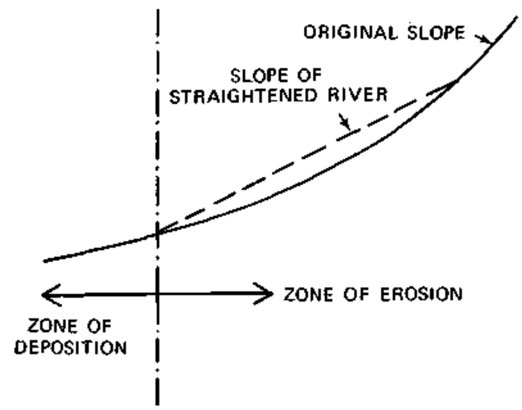


A STREAM IN BALANCE

water discharge (A) and stope (B) are proportional to sediment load (C) and bed material size (D)

However, if for any reason any one of the four variables is changed, there must be a compensatory change in one or both of the variables on the other side, as the river seeks its balance once again.

The bottom sketch shows a hypothetical example of how this might work. Here a river has been straightened so that its length has been decreased. The shortened length has resulted in an increase in the gradient. It has been assumed for this example that the water discharge and bed materials have not changed and are more or less the same through the length of the river. In this situation, the only alternative for the river to achieve equilibrium is to increase its sediment load, either from scouring its bed and banks or from picking up materials (washoff) of the watershed. However, when this increased sediment load is delivered to the downstream reaches where the gradient has not been changed, it will be an extra burden —and the river will deposit this sediment, forming sand bars or islands. This compensation also occurs when the other variable, water discharge, changes.



To balance the river, C (sediment load) must increase to balance the increase in slope (B)

Effects on Aquatic Life

There was concern among Illinois citizens that sediments, especially sand, washed into the Kankakee River in Indiana are deposited as they reach the slower-moving Illinois portion of the river and that these deposits have detrimental effects, including a reduction in diversity and abundance of aquatic life.

Sedimentation adversely affects the aquatic life of a stream through loss of habitat, direct mortality, injury, and growth suppression. The degree of damage is directly related to the amount of sediment deposited.

Although the large expanses of sand in the river between Momence and the Indiana border have existed for thousands of years and even though the sand-associated aquatic communities have developed together, there was concern that the sand might move farther downstream, covering bedrock, boulder, rubble, and gravel substrates (the base on which an organism lives). If this were to occur as a result of increased sedimentation, sizable populations of native species would be eliminated from these areas.

The Natural History Survey's research for this biological study was designed to:

1) **Assess the impact in Illinois of upstream activities which might increase sedimentation or sediment transport into the Illinois portion of the river, especially upstream of the city of Kankakee, by providing quantitative estimates of the principal macroinvertebrate populations, mussels, and fishes associated with known substrate types**
2) **Combine this quantitative sampling with additional qualitative sampling in the Illinois portions of the river to assess the status of species officially classified as threatened or endangered by either state or federal agencies, or species considered rare or unique, or whose status is uncertain.**

Emphasis in this study was on quantitative biological sampling in the Kankakee River upstream of the city of Kankakee. Additional sampling was done as necessary throughout the Illinois portion of the river to assess the status of threatened, endangered, or rare species. The sampling was done during October and November of 1979.

Seven sampling sites in the river were selected to represent the three general substrate types: mostly sand, mostly coarse rocks, and mixed sand and coarse rocks (see box on this page). The table shows the percentage of the various substrate materials found at each sampling station.

Biological Sampling Stations

□ **Predominantly sand substrates**
- Station 1, upstream of Momence (1 mile SE of Illiana Heights)
- Station 7, between Aroma Park and the city of Kankakee (a little over ½ mile WSW of Aroma Park)

□ **Coarse substrates — rock, gravel, cobble, little sand**
- Station 2, vicinity of Momence (about % mile WSW)
- Station 6, upstream of Aroma Park (3/10 mile SE)

□ **Transition area — rock and shallow to deep sand areas in rapid succession (rather than in long expanses)**
- Station 3, about 3½ miles SW of Momence
- Station 4, about 4½ miles SW of Momence
- Station 5, about 2½ miles SE of Aroma Park

Estimated Substrate Composition (%) at Sampling Stations

Substrate	*Percent at each station*						
material	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Silt	20	–	10	30	10	10	–
Debris	10	–	–	–	–	–	–
Sand	70	20	10	40	20	20	100
Gravel	–	60	30	10	50	40	–
Cobble	–	20	40	20	10	20	–
Bedrock	–	–	10	–	10	10	–

What is the fish population?

In all, 44 species of fishes were collected in 1979 at the seven stations. Sites with sand or silt-sand substrates supported fewer species, fewer individuals, and lower biomass (total weight of fishes per unit of area) than did sites with coarser substrates. The transition area had about the same number of species and biomass as the coarse substrate areas but had fewer individuals.

Analyses of the data indicated that if the areas of coarse substrates were converted to chiefly sand areas, the num-

ber of fish species would reduce by about 30 percent, the number of individuals by about 70 percent, and the biomass by about 85 percent.

The status of six species of Kankakee River fishes considered to be endangered, threatened, or rare in Illinois was reviewed. These are the pallid shiner, blacknose shiner, northern brook lamprey, ironcolor shiner, weed shiner, and river redhorse.

The *pallid shiner* was thought to be eliminated in Illinois until 1978 when populations were discovered in the Kankakee River at Custer Park (Will County) and in the Mississippi River in Carroll County. It is now being considered for legal protection as an endangered species in Illinois. The population remaining in the Kankakee River persists because of high water quality and clear, rocky habitats. Increased sand deposition and turbidity in the river would be detrimental.

At the turn of the century the *blacknose shiner* was distributed throughout the northern two-thirds of Illinois, and its decline has been among the most dramatic of any Illinois fish. It now occurs in the state only in parts of the Fox, Green, Rock, and Kankakee Rivers. The blacknose shiner is restricted primarily to tributaries of the Kankakee in Illinois and is seldom found in the main stream. It does well in sand substrates, and in fact prefers them. So increased sand deposition would probably not have a significant detrimental effect upon the blacknose shiner. However, the total consequences of habitat and other alterations in the river as a result of increased sand deposition are unknown. Even a small change could be serious for a species already suffering a decline.

The *northern brook lamprey* was found in the Kankakee River in Kankakee County in the early 1960's, and has since been found at two additional sites in the river. Northeastern Illinois, northern Indiana, and the northern half of Ohio are on the southern periphery of its range, and distribution of this lamprey is sporadic. In Illinois, it is restricted to the Kankakee River.

The *ironcolor shiner* is restricted to the sand-bottom creeks in Iroquois and Kankakee Counties, where it is common, and Mason and Tazewell Counties, where it is uncommon and sporadic in occurrence. It once was found in the Des Plaines River in Cook County. It is generally distributed and apparently common in most of the southern states.

All but two of the known Illinois records for the *weed shiner* are from the sand areas of Iroquois and Kankakee Counties, where it is a common creek fish. While never abundant in Illinois, it was formerly more widely distributed in the northern and central parts of the state. It also is widely distributed in the southern states.

The *river redhorse* is known in Illinois from the Fox, Kankakee, and Vermilion (of the Wabash River systems). The largest population appears to be in the Kankakee. There are too few early records to make inferences about its former distribution and abundance.

How have the mussels fared?

Thirteen species of mussels were collected in 1979. Predominantly sand substrates such as those found upstream of Momence and downstream of Aroma Park support few, if any, mussels. Density and number of species varied at sites with substrates other than predominantly sand. While substrate is an important factor in the distribution and size of mussel communities, other factors, such as presence or absence of fish hosts, are also important.

Since mussels occur at various densities throughout the upstream portion of the Kankakee River in Illinois, sedimentation of the present non-sand areas would destroy some part of the mussel fauna. Two large and diverse mussel beds exist upstream at Momence and Aroma Park. If these areas were covered by deep, rolling sand, a significant portion of the mussel fauna of the Kankakee River would be destroyed.

Among the past and present mussel fauna of the Kankakee River in Illinois, 12 species are rare and/or threatened with elimination from Illinois and, in some cases, extinction. These species include *Anodonta imbecillis, Cumberlandia monodonta, Cyclonaias tuherculata, Dysnomia triquetra, Ellipsaria lineolata, Lampsilis higginsi, Lasmigona compressa, Ligumia recta, Plethobasus cyphyus, Quadrula metanevra, Simpsoniconcha ambigua,* and *Villosa iris.* Damage by sedimentation to endangered, threatened, or rare species would depend upon the degree and location of the sedimentation.

How are macroinvertebrates affected?

Benthic macroinvertebrates are organisms large enough to be visible to the unaided eye that live on or in the bottoms of streams or lakes. In the Kankakee River they include a variety of species of midges, caddisflies, and water beetles. Larvae of aquatic insects are an important part of the aquatic food chain.

In 1979, 143 species of benthic macroinvertebrates were collected. Their diversity increased with increasing diversity of the habitat. That is, sites with progressively more complex substrates supported a greater variety of species. Sites where sand or sand-silt substrates predominated supported fewer species than sites with substrates composed of varying amounts of silt, sand, gravel, cobble, and bedrock.

For example, in the predominantly sand areas upstream of Momence and downstream of Aroma Park, only 25 to 28 species were collected; in the transition area (where bedrock and shallow to deep sand areas occur in rapid succession), 44 to 50 taxa were collected; and at sites with the most complex substrates of silt, sand, gravel, cobble, and bedrock, 70 to 80 taxa were found.

In the Kankakee River, the conversion of areas where coarse substrates predominate to areas chiefly composed of sand (as a result of erosion from snag removal or bank clearing upstream) would reduce the number of invertebrate taxa.

The number of species would be reduced approximately 36 percent if moderate increases in the transport of sand sediment occur and create conditions comparable to those observed in the transition area. If increased sand were to move downstream to cover existing gravel, rubble, and bedrock with deep, rolling sand, the number of species would be reduced approximately 65 percent. Although the density of invertebrates occurring among different substrate types varies, the coarse substrates generally supported greater mean numbers per unit area.

The character of the substrate may be the primary physical factor influencing the distribution and abundance of benthic macroinvertebrates in the Kankakee River. Thus, any variable that affects the nature of the riverbed will produce a corresponding effect upon the invertebrates inhabiting it.

Although the large expanses of sand in the Kankakee River between Momence and the Indiana border and downstream of Aroma Park have existed for a long time, the movement of sand farther downstream to cover exposed gravel, rubble, and bedrock substrates will have a significant impact upon benthic macroinvertebrates.

Preventive and Remedial Measures

The preventive and remedial measures suggested here are based on the analyses and interpretations of the data collected in water year 1979. This is a very short data base, though at present the only data base available, which should be remembered in interpreting the suggested measures. The data base was augmented by an extensive literature search and input from various agencies and researchers.

There are two ways to reduce the sediment load in a river: to take preventive measures, and to take remedial measures. If it is at all possible, it is better to use preventive measures rather than to have to solve an existing problem. (Sources of information about methods of carrying out these measures are given in the Water Survey's study document.) The following are preventive measures that should be given serious consideration:

1) **Best Management Practices (BMPs) on the watershed.** These should include the whole watershed, both in **Indiana and in Illinois. It is better to control the source of the sediment than it is to control it once it has reached the stream. The following BMPs may be suitable for the Kankakee basin, especially in relation to agricultural land: access road protection; conservation cropping systems; conservation tillage systems such as no-till, chisel planting, plow planting; contour farming; cover crop; crop residue use; "debris basin" to catch debris; grade stabilization; field border and filter strips; strip cropping; terraces; grassed waterways; and others. These and other methods should help in reducing sheet, rill, and gully erosion from the watershed.**
2) **Proper repair and maintenance of drainage ditches and levees. This can prevent excessive sediment load in the river. Repair work in which dredged spoils are dumped on top of the bank should be avoided, since most of these materials will eventually erode back to the ditch and to the river. When such repair work is necessary, the exposed banks should be protected either by artificial means or by natural protection such as seeding.**

FIGURE 10
In Indiana at this location, well-established trees and other vegetation are protecting the banks of the channelized Kankakee River.

FIGURE 11
Also in Indiana some locations along the Kankakee River are bare of vegetation. Bank erosion is evident at these locations.

3) **Minimal disturbance of the banks. If at all possible, the banks of the main stem of the Kankakee River should not be disturbed. Bank materials of die river in Indiana are basically sand. Roots and vegetation are protecting these banks, but examples of erosion of exposed banks were found (see Figures 10 and 11). If the banks are disturbed by clearing of the vegetation or trees, the exposed bank may erode and dump the sandy materials in the river, increasing its sediment load.**
4) **Avoidance of structural disturbance of the river. The main stem of the Kankakee River in Illinois and Indiana (up to Highway 30) is basically stable. Any man-made disturbance will alter this equilibrium and may initiate bed and bank erosion. A skewed railroad bridge upstream of Shelby is responsible for initiating bank erosion on the downstream left side and then on the right side of the river. This illustrates the adverse consequences of structural modification on the river.**
5) **Reduction of sediment excesses from construction activities. During construction activities, excessive amounts of sediment may be released from the watershed to the stream and its tributaries. There are various methods available to reduce the sediment load from such activities.**
6) **Artificial and natural means for preventing erosion. Erosion from the watershed can be prevented by using near-stream vegetation, grassed waterways, chemical treatment, soil stabilization, and mulching.**

Since sediment is already a problem in limited areas, some remedial measures that have been used by various researchers and administrators are described briefly below.

1) **Construction of detention reservoirs, sedimentation ponds, or settling basins. Sediment carried by the stream can be removed by initially forcing the sediment particles to settle out in a semistagnant pool and then removing these settled particles by physical means. Normally, detention reservoirs and settling basins are designed to remove sediment from watersheds of much smaller size than that of the Kankakee River. However, it is feasible to use settling basins for sub-watersheds within the Kankakee River Basin where erosion is a problem.**
2) **Development of side channel flood retention basins. Here the flood water is allowed to move into a side channel flood retention reservoir where the suspended sediment will setde out. During low flows, these basins are not affected by the flow from the main channel. Depending upon the size of the watershed and the size and location of the side channel detention basin, these basins can be very effective for settling sediment particles. Work done on Horseshoe Lake in Illinois has shown the effectiveness of this type of basin.**
3) **Removal of deposited sediment by dredging. Removing the deposited sediment from the stream, lake, or reservoir by dredging is another remedial measure that can be undertaken.**

The main purpose of describing the preventive and remedial measures is to inform the reader about the various alternatives that are available. No comparison is made between these alternatives, and no suggestion is made as to the suitability of one over another. Before any remedial measures are adopted, they must be thoroughly investigated and all the benefits and adverse effects studied. The preventive measures can be adopted and implemented with the least difficulty. Some of the suggested measures are nothing but good engineering and management practices that should be followed whether or not a problem related to excessive sediment load is present.

Conclusions

The major conclusions from the three scientific studies are these:

The Kankakee River as we see it today is the result of many natural and man-made activities. The channelization of the upper stem of the river in Indiana did change the river regime and did result in more sedimentation in the downstream reaches in Illinois. It did not solve all the problems of drainage and flooding.

The Kankakee River has now balanced itself and is quite stable — in both states. In Illinois it still maintains a healthy quality, a sturdy aquatic life, and scenic beauty. It still floods in the flooding season. It still carries sediment downstream from Indiana into Illinois. The misnamed "ledge" near Momence is not a removable object like a dam but a 4-mile stretch of bedrock on which the river flows.

However, any change in this new, balanced regime of the river will only unbalance the system once again. Further dredging, clearing, or construction can lead to more bed and bank erosion and more sediment and to serious disturbance to the aquatic life.

The several preventive or restorative recommendations stemming from these studies indicate one general thought:

If at all possible, leave the river alone — work on improving the land around it.

FIGURE 12
Flooding of the Kankakee River is still a problem! This scene was photographed on June 17, 1981. The main channel of the river is the circle around the trees at the top of the picture.

Epilog

After the 1978-1979 studies, the Water Survey continued to monitor the Kankakee River under the auspices of the Illinois Institute of Natural Resources (now the Department of Energy and Natural Resources). In particular, the Survey hydrologists are monitoring the sediment load and hydraulics of flow at the Momence, Iroquois, Chebanse, and Wilmington stream gaging stations, as well as sand bar movement in the Kankakee River.

The continuing data indicate that the sand bar at the state line appears to be an annual phenomenon. The second year's assessment of the suspended sediment load showed that the relationship between water discharge and sediment discharge was nearly the same as in water year 1979. About 60 to 90 percent of the annual suspended sediment load moved in a period of 80 to 100 days in water year 1980, which was nearly the same time span as in 1979. The storage capacity of Six Mile Pool in 1980 was slightly more than that in 1978, indicating some net scouring of the pool.

The Water Survey hopes that the monitoring of the Kankakee River can be continued as long as 10 years, if not longer, in order to get a clearer picture of trends in sediment loads and to observe the results of any future changes in the river.

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