A USGS PROPOSAL
July 30, 1991

# SEDIMENTATION OF THE KANKAKEE RIVER IN ILLINOIS

prepared in cooperation with the

NORTHERN ILLINOIS ANGLERS ASSOCIATION, *et al.*

Kankakee, Illinois

U.S. Geological Survey
Water Resources Division
Illinois District
Urbana, Illinois
1991

**PROJECT.** Sedimentation of the Kankakee River in Illinois.

**BACKGROUND.** The Kankakee River basin occupies more than 5,000 square miles in northeastern Illinois and northwestern Indiana. About 85 percent of the basin is divided almost equally between the Iroquois River above Chebanse and the main stem of the Kankakee River above Momence (Fig. 1). Before drainage, about half of the basin above Momence was a riverine wetland referred to as the Grand Marsh.

At the time of settlement in the early 1800's, while the Grand Marsh still existed, the Kankakee River was reportedly noted for its clear water. Several companies were organized during the 1870's to harvest ice from the river. During the mid-1880's, drainage districts were formed that had the power to levy taxes with which to finance drainage work. By about 1910, all of the main stem of the Kankakee River through the Grand Marsh in Indiana had been channelized, and work was in progress to build levees and dredge or channelize lateral ditches. Channelization allowed the Grand Marsh to be drained, cleared, and placed into agricultural production.

It has been estimated that channelization decreased the length of the main stem of the river in the Grand Marsh from about 250 to about 80 miles. Various authorities would agree that natural adjustments to the increased gradient resulting from channelization of this magnitude must have caused (and are still causing) movement of an enormous amount of sediment in the river. Because the marsh is in an area of Pleistocene beach ridges, much of the sediment reaching the State line is of sand-size particles.

Nationwide, there is growing interest in riverine wetlands such as the Grand Marsh. This is not only because wetlands are great wildlife habitats, but because wetlands reduce the effects of floods and act as settling basins or sediment sinks. Nearly all of the Grand Marsh has been cleared and drained. The remaining miniscule remnants of wetland in Indiana are not capable of removing significant amounts of silt. Furthermore, the ability of the remaining wetlands to continue to act as sediment sinks is related to the general ecological stability of the wetlands. An appraisal of the general ecological stability of the wetlands, particularly as it regards the ability to trap and hold sediments, has not been done.

Previous studies have concentrated on measuring sediment load. No studies have been directly concerned with determining sediment deposition trends or in determining sediment sources. Little seems to be known regarding the fluvial geomorphology of the Kankakee River. As a consequence, it is not clear how much of the sediment reaching the State line is because the Grand Marsh has been destroyed and no longer functions as a viable wetland, and how much is because of channel scour that is largely independent of wetland viability. Remedial actions to mitigate any particular sediment problems could well be dependent on knowledge of both sediment amount and source.

**PROBLEM.** Local concerns have been expressed that the natural, aesthetic, and recreational resource values of the Kankakee River Basin in Illinois are imperiled as a direct result of increased sedimentation. Because long term sediment trends have never been determined scientifically, and no sediment load measurements have been performed since the study by Bhowmik and others (1980), it cannot be proveen if the rate of sedimentation is agrading or degrading. Non-scientific observation and local testimony strongly supports an agrading trend.

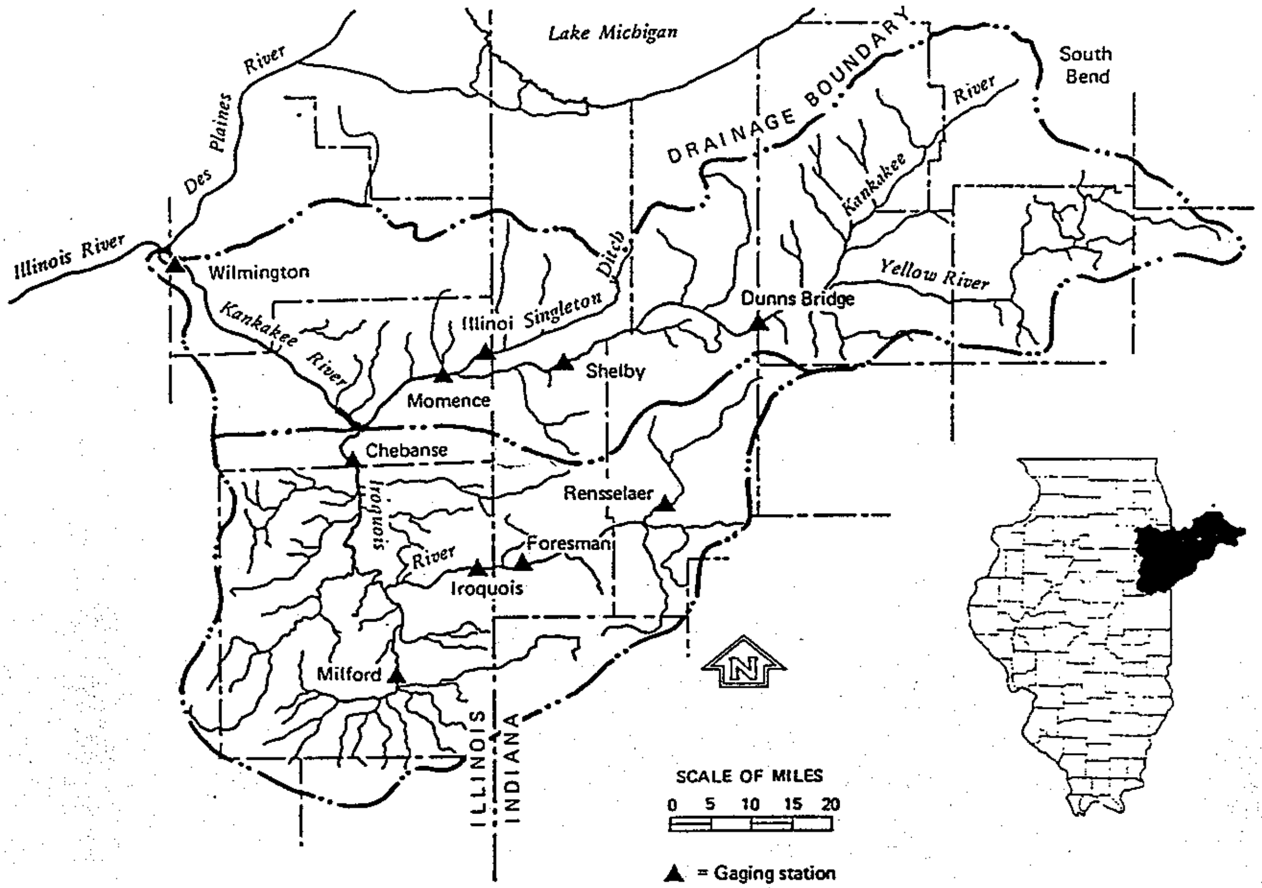


Figure 1. Drainage basin of the Kankakee and Iroquois Rivers

**OBJECTIVES.** In order for any group concerned with the river to determine the degree of remedial action needed to achieve a desired effect on the Kankakee River and then to select the most practical alternative, additional information and analysis are needed. The major objective of the proposed work is to provide information that can be used in the decision-making process. The major objective may be subdivided into three specific objectives.

1. Determine *present sedimentation rates* of the Kankakee River in Illinois.

2. Determine *long-term sedimentation trends*, thereby indicating if present sedimentation rates are increasing or decreasing.

3. Determine *sediment sources*; thereby indicating what portion of sediments come from the river channels (primarily as a consequence of channelization) and what portion comes from cultivated agricultural land (primarily as a consequence of destruction of wetlands).

**APPROACH** (described separately for each of the specific objectives).

1. *Present sedimentation rates.* Sediment may be thought of as being composed of a suspended load (fine material in suspension throughout the water column) and a bed load (heavier material that moves along the bottom). Measurements conducted in 1979 indicated that sand accounted for a large portion of the sediment load at Momence (Bhowmik and others, 1980). Intuitively, the same conditions would be expected today. Essentially all the sand would be expected to be transported as bed-load material, and essentially all of the bed-load material would be expected to be sand. Suspended-sediment load can be measured with consistent results, but little of the sand is transported in the suspended load. Although good bed-load samplers exist, none can apparently measure sand-size bed load with consistent results.

One (or possibly two or more) short reach(es) will be selected for bathymetric observation between the Sixmile Pool and the State line. Sonic depth finders will be used following each flood to plot a number of cross sections at bench marks along the reach(es). It is expected that some of the sonic data along the cross section(s) will be collected by NIAA. From the cross-section data, calculations will estimate amount and movement of bed material.

The primary purpose of sediment sampling is to establish present sedimentation rates by methods that will allow data comparison with any previously collected data. It is proposed that sediment loads be sampled primarily during flood events. Sampling will be done for both suspended load and bed load using manually operated samplers. At this point, it is not anticipated that automatic sediment samplers will be necessary.

A series of periodic photographs will be taken to show emergent bar movement associated with flood events. Some of the photography could be done by NIAA. Bench marks will be used to establish location and direction.

2. *Long-term sedimentation trends.* It is assumed that bed load (material in transport) and sand bars (material in storage) are somewhat independent. Thus, even if more sand seems to have been accumulating in the Sixmile Pool in recent years, it does not necessarily mean that more sand is being transported by the river. Both material in transport and material in storage will be examined.

Most sediment transport (both suspended and bed load) is associated with flood events. Only during flood events can sediments be deposited on flood plains. If it is assumed that the amount of silt deposited on the flood plain is proportional to the sediment load, then measures of flood-plain deposition provide estimates of sediment load. Flood-plain deposition will be determined by a dendrohydrologic study of sediment deposition around trees. Basically, the procedure amounts to determining the amount of deposition that has occurred during the lifetimes of individual trees of a variety of ages (Hupp and Morris, 1990). This will allow an examination of the trend in deposition rates for the range of years represented by the trees. For example, if approximately the same deposition is associated with trees 40 years old as with trees 80 years old, then most of the sedimentation has occurred since establishment of the younger trees. Trees of enough different ages will be used so as to distinguish sedimentation by decade. Wood samples obtained to determine tree age will also be used to examine growth trends (Phipps and Whiton, 1988). These are expected to provide insights to changes in the general health of the wetlands and to date events such as levee construction and dredging operations.

A measure of channel storage (change in amount of material in sand bars) will be obtained from channel cross-sectional data. Data were obtained by the Illinois Department of Transportation, Division of Water Resources in 1966-67 and again in 1977-78. Data will be taken from selected sections and compared with the earlier data. These data, along with the periodic photographs of emergent bars and the measures of changes in bottom topography obtained with sonic depth finders, should indicate how dynamic the storage system is, and if there has been a marked change.

3. *Sediment sources*. Sediment in the Kankakee River Basin can be thought of as originating from two major sources:

- the channel itself (largely independent of wetland size or condition), and
- cultivated fields (made possible by drainage of the Grand Marsh).

When the main stem of the Kankakee River was reduced from about 250 to about 80 miles, the slope of the channel was necessarily increased more than three times. Consequently, the channel was geomorphologically out of balance. Since then, fluvial processes have acted to adjust the channel bottom to a slope more closely matching the original slope. Erosion of the channel bottom started from a controlled elevation in the lower reaches (the rock outcrop at Momence) and has since been working upstream. This natural process has been complicated by dredging operations that have continued in Indiana. Dredging has been conducted in areas of sediment accumulation. Many parts of the channel in Indiana are lined by levees or berms that decrease sediment movement from the flood plain to the channel (that is, reduced loss of sediments from sheet erosion from fields), and from the channel to the flood plain (that is, reduced flood-plain deposition). That sediments still accumulate in the river and dredging still occurs, strongly suggest that sediments from agricultural sources are still reaching the river.

Sediments may be thought of as having three fates:

- deposition in the channel itself (perhaps as temporary storage in sand bars),
- deposition on the flood plain (including riverine wetlands), and
- transportation farther down the river and ultimately out of the basin.

Knowledge of channelization dates and channel dimensions compared with current dimensions, nick-point locations, and geomorphic descriptions will allow an estimate of the amount of material that has been removed from the channels.

Attempts will be made to estimate sediment quantities deposited in the channels and on the flood plains from measurements of geomorphic features and from dendrohydrologic determinations of flood-plain deposition rates. Estimates of the amount transported out of the system and the amount held on the flood plain will be used to estimate the amount of sediment that has originated from cultivated fields.

Portions of the basin will be identified that include some type of controls to the system. For example, a totally channelized headwaters area could be compared with a comparably sized headwaters area that has had no channelization. These will be used to relate different treatments or histories with different effects or results.

**BENEFITS** (described in terms of information expected to accrue from each specific objective).

1. *Present sedimentation rates*: sampling of sediment (both suspended and bed load) provides a point of comparison with data collected by Bhowmik and others (1980). In addition, these data will be related to the long-term sedimentation trends data. Measurements of sandbar movement and changes in channel bottom topography will allow determinations of velocity and volume of sand movement. These data should be helpful in examining the relationship between the amount of sand moving through the area (bed load) and the amount deposited and held as sand bars.

2. *Long-term sedimentation trends*: allows determination of whether present rates are increasing or decreasing. Management decisions regarding sand accumulation in the Sixmile Pool could depend strongly on whether or not sedimentation trends are increasing or decreasing.

3. *Sediment sources*: allows distinction of channel and field erosion as sources. If the long-term sedimentation trend is distinctly declining, then this portion of the project may be somewhat irrelevant and not worth pursuing. On the other hand, if the long-term trend is not distinctly declining, determination of sediment sources will be essential to decisions of remedial actions.

**REPORTS.** Journal articles on specific findings will be prepared as data become available. Additionally, a USGS Water Supply Paper will serve as a comprehensive final report of the study. Video tapes will be prepared to document the activities and progress of the project. The tapes will be edited and organized, but not assembled into a professionally finished documentary.

**REFERENCES.**

Bhowmik, N.G., A.P. Bonini, W.C. Bogner, and R.P. Byrne, 1980, Hydraulics and sediment transport in the Kankakee River in Illinois: Illinois State Water Survey, Champaign, Report of Investigation 98, 170+ pp.

Hupp,C.R., and E.E. Morris, 1990, A dendrogeomorphic approach to measurement of sedimentation in a forested wetland, Black Swamp, Arkansas: Wetlands, vol. 10, pp. 107-124.

Phipps, R.L., and J.C. Whiton, 1988, Decline in long-term trends of white oak: Can. Jour. For. Res., vol. 18, pp. 24-32.

## MAJOR BUDGET CATEGORIES.

The project, as described, is intended to be completed in three years. Salary is part-time and includes benefits. Travel for first two years is field work. Travel for third year is to meetings to present results. Equipment is for sonic depth finders, a camcorder, increment borers to sample wood from trees, and miscellaneous field supplies such as spades. Publication costs are for office supplies, drafting costs, and so forth.

| | 1st year | 2nd year | 3rd year |
|---|---|---|---|
| Salaries | | | |
| Botanist | $34,900 | 35,950 | 37,000 |
| Hydrologist | 23,400 | 24,100 | 24,700 |
| Travel | 5,400 | 5,400 | 2,400 |
| Equipment | 4,300 | -- | -- |
| Computer | -- | 550 | 500 |
| Publications | -- | -- | 1,000 |
| Misc. | -- | 2,000 | 1,400 |
| | $68,000 | $68,000 | $68,000 |
| Indirect costs | 32,000 | 32,000 | 32,000 |
| Totals | $100,000 | $100,000 | $100,000 |

A.R.K. - Alliance to Restore the Kankakee

CHARTER MEMBERSHIP FORM

We, ______________________________________________
(organization name)

______________________________
(address)

______________________________
(city, state, zipcode)

do hereby seek out membership in the Alliance to Restore the Kankakee, and do accept and undertake the responsibilities that such a membership entails, to wit:

> To seek local matching funds for and otherwise support the comprehensive study entitled SEDIMENTATION OF THE KANKAKEE RIVER IN ILLINOIS, to be performed by the U. S. Geological Survey; to then seek out and otherwise support effective reparation measures, should said study provide scientific evidence of a sedimentation problem.

Further, that we do hereby appoint the following representative(s) to the Alliance:

Voting: ______________________________
(name - please print)

Alternate: ______________________________
(optional - please print)

AUTHORIZATION

Agreed to this the ________ day of __________________, 19________.

______________________________
(signature)

______________________________
(name - please print)

______________________________
(title)