Illinois River Basin Assessment Framework

William P. White
Illinois State Water Survey
Center for Watershed Science
P.O. Box 697
Peoria, IL 61652-0697
Phone: (309) 671-3196
E-mail: bwhite@sws.uiuc.edu

Misganaw Demissie
Illinois State Water Survey
Center for Watershed Science
2204 Griffith Drive
Champaign, IL 61820-7495
Phone: (217) 333-3468
E-mail: demissie@uiuc.edu

Laura L. Keefer
Illinois State Water Survey
Center for Watershed Science
2204 Griffith Drive
Champaign, IL 61820-7495
Phone: (217) 333-3468
E-mail: lkeefer@sws.uiuc.edu.

Executive Summary

A framework to assess areas and select potential targets for critical restoration is required to efficiently and effectively implement a comprehensive plan for restoring ecosystem functions in the Illinois River Basin. This paper briefly describes the framework for these assessments and outlines the process used to identify potential critical restoration sites. The framework is intended to provide additional guidance to the U. S. Army Corps of Engineers and the State of Illinois for assessment and restoration activities in the Illinois River Basin and serves to supplement locally driven assessment and management activities currently underway.

Ecosystem problems within the Illinois River Basin are identified, in part, by monitoring and analyzing data pertaining to loss of habitat, biological integrity, and ecological sustainability. Hydrologic, hydraulic, geologic, geomorphic, and water quality conditions are also monitored and data analyzed to better assess the nature of the Illinois River Basin ecosystem. Many people and organizations have been engaged in the monitoring and management of the Illinois River Basin for many years and these efforts need to continue to achieve ecosystem restoration objectives.

Erosion and sedimentation in the Illinois River Basin are natural phenomena and management strategies need to fully take this into consideration. However, human activities such as urban and agricultural development, fragmentation of the landscape, and alteration of upland drainage networks

and floodplains resulted in more advanced problems that impact economic infrastructure. Landscape alterations resulted in advanced rates of erosion in some areas; destabilization of the Illinois River mainstem and tributary streams; sedimentation of the river mainstem, backwaters, and side-channels; sedimentation of significant tributary floodplain pools and lakes; and unnatural flow regimes (U. S. Army Corps of Engineers, 2005). The draft Comprehensive Plan for Illinois River Basin and Tributaries Ecosystem Restoration Project acknowledges that erosion by the Illinois River and its tributaries, as well as sediment deposition within the river valley, are significant problems that require more attention (U. S. Army Corps of Engineers, 2005).

Naturalization of tributary streams and restoration of biodiversity are key components of contemporary watershed planning and management efforts. Watershed plans often outline general problem categories and list potential conceptual solutions but rarely target specific problem sites for action. It is suggested that programmatically planned assessment of channel and near-channel environments is a needed component of a landscape or watershed-wide assessment effort. Assessment of channel and near channel environments is required to identify critical ecosystem restoration needs in the Illinois River Basin and to fill gaps where current programmatic efforts do not sufficiently target the current restoration and management needs. Conservation work on channel and near-channel environments would significantly complement traditional soil conservation efforts and programs in Illinois. Watershed assessments that rapidly, yet effectively, identify potential on-the-ground natural resource restoration sites are well received by the public and public institutions in charge of funding ecosystem restoration efforts. Assessments that provide relatively rapid project identification and examples of restoration encourage commitment and support which fosters program success.

The Illinois State Water Survey, Center for Watershed Science (ISWS-CWS) within the Illinois Department of Natural Resources (IDNR) and affiliated with the University of Illinois, has been working to assess and evaluate the Illinois River watershed to facilitate implementation of the larger goals of the draft Comprehensive Plan for Illinois River Basin Ecosystem Restoration. Watershed assessments conducted by the Illinois Scientific Surveys under the auspices of the Illinois River Basin and Tributaries Ecosystem Restoration Project include analysis of watershed scale Geographic Information System (GIS) data, aerial reconnaissance of specific problem areas selected for survey by agreed upon criteria, and field data collection and analysis of geomorphological data and biological indicators (White et al., 2005). Data and analyses are used specifically to locate, characterize, and prioritize potential conservation projects which will eventually be considered for the design and construction of multi-objective restoration projects that reduce erosion, restore habitat, and protect overall ecosystem health. The objectives are to 1) implement projects that will produce independent, “immediate,” and sustainable restoration; 2) implement projects that address several goals and have systemic impacts; 3) evaluate alternatives which will address common system problems; and 4) utilize adaptive management concepts in project implementation while being responsive to long-term management and maintenance needs.

The assessment and ecosystem restoration process utilizes an accessible and integrated data retrieval and analysis system referred to as the Illinois Rivers Decision Support System (ILRDSS). The ILRDSS will provide scientific support and access to high-quality information for restoration of the Illinois River and its watershed. It will enable decision-makers to assess and evaluate the effectiveness of different restoration projects, and the consequences of other natural or human-induced changes in the watershed (State Scientific Surveys, 2002). The ILRDSS will improve dissemination of scientific tools and information by using the Internet as the primary access to inventories of current and historical projects, data, simulations, and involved agencies/participants within the Illinois River watershed. Once fully developed, the ILRDSS may be used for tracking activities, evaluating project performance, and making adaptive management decisions. The ILRDSS website provides this information to a larger

audience at a lower cost, in a more usable form, and much more quickly than previous outreach methods.

This paper summarizes information on the general nature of the Illinois River Basin and the sources and impacts of erosion since erosion and subsequent sedimentation has repeatedly been cited as the most significant problem in the Illinois River Basin. The framework for assessment and restoration is briefly described as is the criteria for selecting sub-basins, watersheds, and sub-watersheds for initial assessment. Further criteria for selecting site specific project areas within the sub-watersheds are also outlined. A very brief synopsis of aerial reconnaissance efforts to date is provided but a description of the existing spatial GIS information, geomorphological and biological data, and spatial GIS information are only briefly covered and generally deferred to presentation at another time because of space limitations.

The Illinois River Basin: Erosion and Sedimentation Issues

The Illinois River has a drainage area of 28,906 square miles (74,867 square kilometers or sq km) and drains nearly half of the State of Illinois and about a 4,000 square-mile (10,360 sq km) area in Indiana and Wisconsin (Demissie et al., 2003, Demissie et al., 2004) (Figure 1). The river has long been recognized as an important environmental resource to the state and the nation but is also an important economic resource, in part, because it connects Lake Michigan of the Great Lakes to the Mississippi River and the Gulf of Mexico.

Landscape characteristics of the Illinois River basin were strongly influenced by the Quaternary Period, a time of widespread continental glaciation in the Midwest. A progressive series of major drainage changes occurred because ice caps developed in two general regions northwest and northeast of Illinois. As glaciers from these regions advanced into Illinois along different routes and at different times, glacial deposits from different sources overlapped. The interfingered sequence of glacial tills, outwash, and loess presents unusual possibilities for correlation and also problems of an uncommon kind and variety (Frye, 1968). On repeated occasions, until its final diversion approximately 20,000 years ago, the ancient Mississippi River carried drainage from the north into the center of Illinois and then southward along the lower valley of the present day Illinois River (Frye, 1968). Consequently, the upper Illinois River formed a relatively narrow floodplain with steeper longitudinal gradient than the middle and lower sections of the Illinois River valley in which the ancient Mississippi River once flowed. Specifically, the Illinois River basin exhibits a “youthful” or poorly integrated drainage network pattern in younger Wisconsinan-aged glacial drift in the eastern and northern portions of Illinois and a more “mature” or better integrated drainage texture in southern and western portions of the state in which the glacial depositional environment initially was constructed by deposits of the somewhat older Illinoisan-aged glacier. The current parent materials, vegetation,

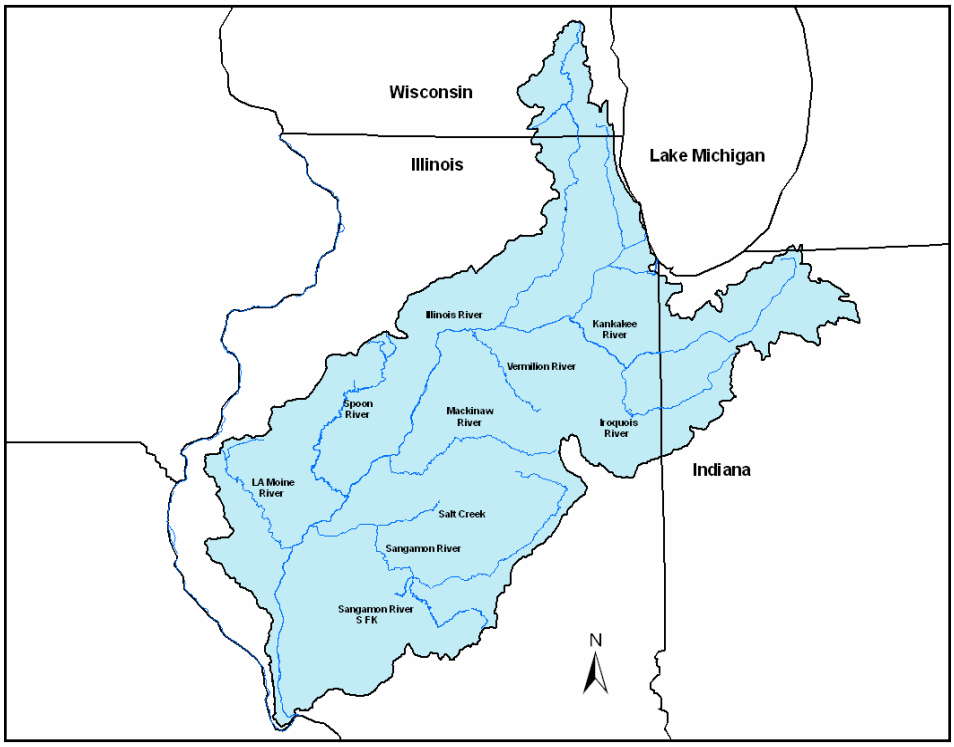

Figure 1. The Illinois River Basin in Illinois, Indiana, and Wisconsin

drainage network and general physiography of the Upper Midwest and Illinois ultimately owe their origin and character to these glacial processes. Several other extrinsic and intrinsic factors such as spatial and temporal patterns of weather and climate, geologic type and structure, and biotic assemblages have combined to form complex environmental systems. In addition to the major environmental complexities, specific human endeavors have evolved through time to alter rates of natural processes on the landscape and create serious challenges relating to development and management of our economic infrastructure and sustainability of our overall quality of life. These challenges must be addressed in a contemporary fashion utilizing state-of-the-art scientific analysis and contemporary management techniques.

Erosion and sedimentation have been recognized as the primary environmental issue in the Illinois River valley (Illinois State Water Plan Task Force, 1987). The ISWS-CWS has generally concluded that the most persistent problem for the Illinois River is sedimentation in the river channel and the backwater lakes (Demissie et al., 2003). The main sources of sediment to the Illinois River valley are watershed erosion, streambank erosion, and bluff erosion (Demissie et al., 2003).

A sediment budget analysis for the Illinois River valley (Figure 2) indicated that, on average, tributary streams annually deliver 12.1 million tons of sediment to the Illinois River valley (Demissie et al., 2003; Demissie et al., 2004). About 5.4 million tons (~ 45% of the load) are discharged downstream of Valley City and about 6.7 million tons (~ 55% of the load) remain in the Illinois River valley every year (Demissie et al., 2003; Demissie et al., 2004). Demissie et al. (2003), however, note that this may not be the total amount of sediment deposited in the valley. Data presently available are not sufficient to make a reasonable estimate of the amount of sediment generated from bank and bluff erosion along the Illinois River (Demissie et. al., 2003).

Long term data collection is necessary to improve quantification of sediment budgets. For example, Peoria Lake is a large natural lake in the middle section of the Illinois River valley. Based upon sedimentation data for Peoria Lake, the rate of sedimentation from 1965 to the present is significantly higher than from 1903 to 1965 (Demissie and Bhowmik, 1986; Demissie, 1997; Demissie et al., 2003). Bhowmik et al. (1993) estimated that local tributaries contributed 65 percent of the total sediment load to Peoria Lake during drought Water Year 1989. The rate of sedimentation,

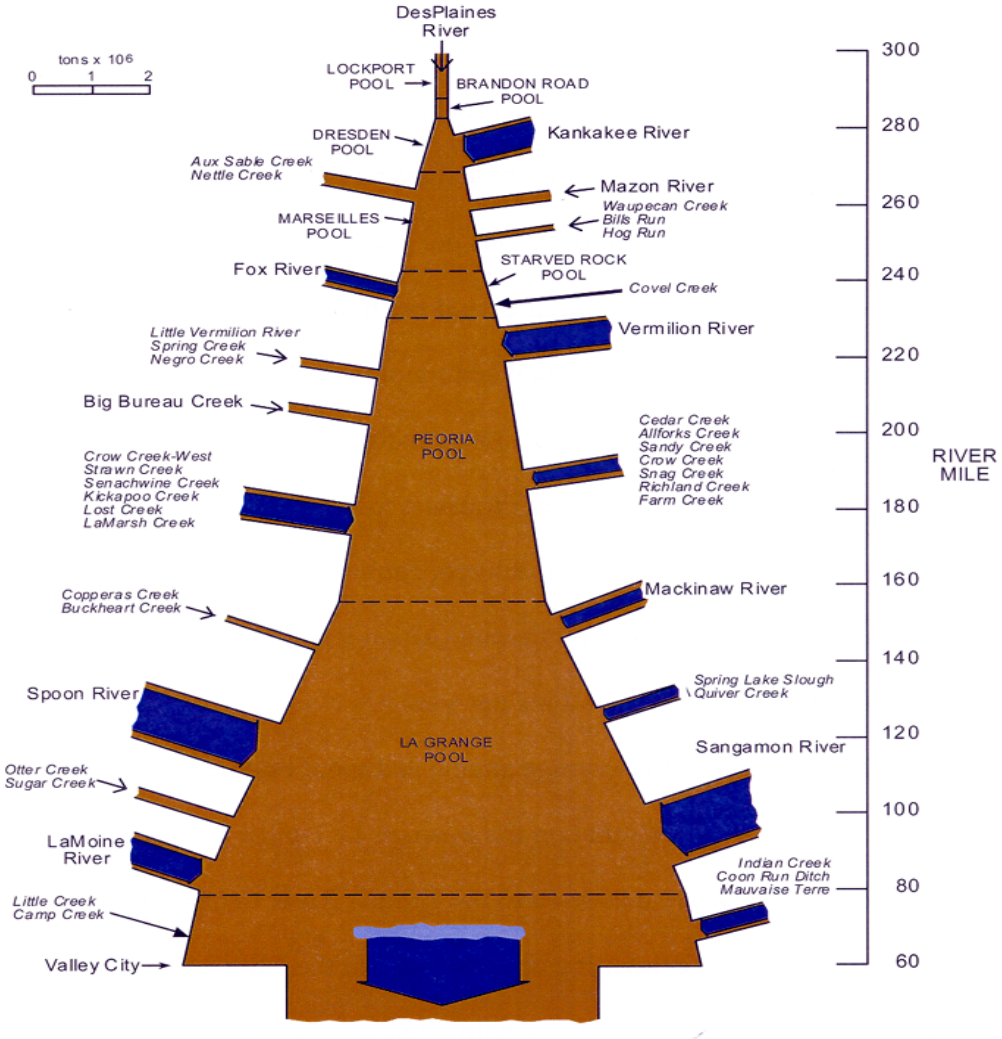

Figure 2. Annual Sediment Budget–Illinois River Valley (Demissie et al., 2003)

however, varies depending upon rainfall patterns in any given year. The sediment budget estimate for the Illinois River Basin for a 20-year period from 1981 to 2000 is lower than a previous estimate in 1992 for the 10-year period from 1981 to 1990 primarily due to the additional sediment data that were available in the more recent studies that improved the sediment rating curves and thus sediment budget estimate (Demissie et al., 2004). Because sediment inflow/outflow varies significantly from year to year, it is necessary to select a reasonable period of time to represent long-term records of the Illinois River (Demissie et al., 2004). Climate and physical changes between the two periods were not considered, however, the case is nonetheless made that long term monitoring records are necessary to appropriately understand erosion and sedimentation rates from tributary streams. Clearly, there is a need for additional data collection and analysis to clarify many important questions regarding sources of

sediment and impacts of erosion and sedimentation on mainstem pools, backwater lakes, tributaries, deltas, and the Illinois River valley in general.

Sediment in the Illinois River and its tributaries originates from all portions of the watershed; however, some areas contribute sediment directly to stream systems more than other areas. Most soil conservation-oriented agencies concentrate erosion control practices in the uplands of agricultural and urban lands. While this effort is justifiable and needs continued support, current evidence suggests that streambeds, streambanks, and near-channel areas such as hill slopes are significant sources of sediment where conservation practices need to be targeted. However, programs designed to specifically address channel and near-channel sources of sediment are not well established nor adequately funded.

Several studies document the importance of sediment contributions from streambanks and streambeds. A study on Court Creek in western Illinois utilized spatial and temporal channel morphological data and suspended sediment transport information to determine that streambank erosion constituted more than 50 percent of the sediment yield to the stream (Roseboom and White, 1990). At least two papers (Grissinger et al., 1991; Simon and Rinaldi, 2000) estimate that 90 percent of channel sediments eroded from unstable stream systems originate from streambanks. Evans and Schnepper (1977) estimated that more than 40 percent of the sediment in the Spoon River in western Illinois resulted from bank erosion. Vagt (1982) estimated that 50 percent of the annual sediment yield in northern Illinois streams resulted from bank erosion. Further observations about the channel slope, geology, and morphology of some areas in Illinois indicate that streambed erosion could also be a very significant sediment source. For example, Leedy (1979) estimated that more than 50 percent of the annual sediment yield of Illinois streams resulted from streambed erosion. Using stream cross-sectional data, Lee et al. (1982) estimated that 50 percent of the sediment yield from the Blue Creek watershed in western Illinois came from the eroding streambed. Hamlett et al. (1982) estimated that stream channel contributions to an Iowa stream represent between 25 and 50 percent of stream sediment yield.

Channel and near-channel sources of sediment have a higher rate of sediment delivery to streams or floodplain lakes than other areas in the watershed and, therefore, significantly contribute to degradation of aquatic resources, disruption of navigation, deterioration of public infrastructure (i.e., roads, pipelines, bridges, etc.), and generally limit overall quality of life. With each passing year it becomes clearer that sediment contributions to Illinois streams from in-channel sources are significant and warrant increased attention. There is a need for a more comprehensive stream channel and near-channel restoration or naturalization program in Illinois, especially given the problem's significance and scope and the fact that sedimentation problems will not be solved without more adequately targeting these significant sources to compliment more traditional upland conservation treatment.

A Call for Assessment and Restoration

The IDNR, Office of Resource Conservation (ORC) had the above issues in mind when they requested the State Scientific Surveys to work with them and the U.S. Army Corps of Engineers (USACOE) to assess Illinois River pools and watersheds to facilitate the larger goal of restoring ecosystem health of the Illinois River Basin. A draft comprehensive plan for ecosystem restoration of Illinois River Basin by the U. S. Army Corps of Engineers (federal sponsor) with advisors from the State of Illinois (local sponsor) was developed in a manner consistent with federal planning requirements for ecosystem restoration in accordance with Congressional authority. This draft plan will be available for public review very soon.

The plan addresses the ecosystem needs in the Illinois River basin and describes the need to develop critical restoration projects as called for in Section 519 of Water Resources Development Act (WRDA, 2000) and as defined in the Project Management Plan (USACOE, 2004). The draft

comprehensive plan outlines multiple components, including the development and implementation of a program for planning, conservation, evaluation and rehabilitation, and stabilization and enhancement of land and water resources in the basin.

The task of the ISWS-CWS, as requested by the IDNR/ORC and for use as IDNR cost-share to the USACOE, is to rapidly assess selected pools and sub-watersheds of the Illinois River. As a component of that effort an assessment strategy was developed to identify project locations where restoration-related construction will be critical to help achieve the overall goals of the Illinois River Basin Ecosystem Restoration Plan objectives. The ISWS-CWS is facilitating this coordination effort with the Illinois State Geological Survey and the Illinois Natural History Survey.

The ORC provided the ISWS-CWS with a set of potential watersheds to review for scientific justification before selecting candidates for initial assessment. The main concern of IDNR (ORC and ISWS-CWS) is the ecological degradation of these areas (watersheds and mainstem pools) due to excessive erosion and deposition. Researchers from the Illinois Scientific Surveys reviewed the list of target watersheds and pools and recommended certain modifications to the list based on the established criteria. The list was shared with regional team leaders from IDNR for review, comments, recommendations, and concurrence(s). Regional team leaders work with other stakeholders from various other governmental and non-governmental organizations within each of four regional areas in Illinois and function as advisors and regional facilitators for the Illinois River Basin Ecosystem Restoration Project (Figure 3). A regional team is now being organized for Indiana and perhaps another soon will be organized for Wisconsin. The intent was to have consensus that the initial list of watersheds targeted appropriate areas in the Illinois River basin in at least the initial assessment efforts. Additional assessment areas will be added as funding becomes available.

Initial Criteria for Selecting Sub-basins, Watersheds, and Sub-watersheds

Because not all areas could be selected for assessment in the first few years of the project, a general set of criteria has been used as a “working model” by IDNR to select initial sub-basins, watersheds, and sub-watersheds for initial assessment.

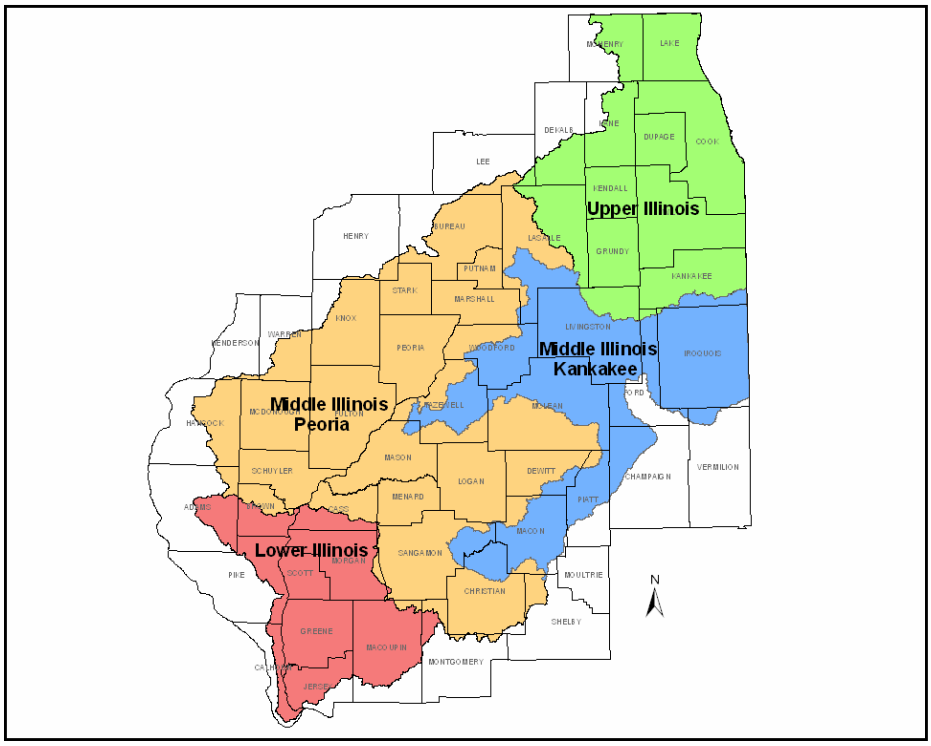

Figure 3. Regional Team Areas in the Basin in Illinois

Assessment protocols were selected and used to rapidly identify and describe significant erosion problem areas within the Illinois River Basin since erosion and sedimentation were deemed to be two of the most important problems. Sediment delivery and biological conditions were used as major criteria; however, other criteria were also used to select initial assessment areas from broad areas of interest within the entire basin. The intent has always been to move forward on initial assessment areas but, in time, to add additional areas in the river basin using initial protocols, criteria, and subsets of streams as a model framework. Criteria for selecting sub-basins, watersheds, and sub-watersheds for assessment include:

- Sediment budget information
- Location in the basin (primarily sub-basins, watersheds, and sub-watersheds draining directly into Peoria Pool and areas upstream and then Alton and LaGrange Pools)
- Potential to reduce sediment delivery to the Illinois River, increase base flows, or decrease peak flows
- Threats to ecological quality or system integrity (population and rate of population change and rate of change in impervious surface, water quality impairment, etc…)
- Biologically significant areas and ecosystem partnership concerns (Biologically Significant Streams, Resource Rich Areas, regionally significant species and areas, etc…)
- Level of local, state, and federal support (including recommendations from agencies, non-government organizations, the Illinois River Basin Ecosystem Restoration Project Regional Teams, Conservation 2000 Ecosystem Partnerships, regional planning commissions, watershed planning and technical advisory groups, other local coordination groups, etc
- Economic limitations and opportunities

GIS Data

Geographic Information System (GIS) are useful for analyzing massive amounts of information and this and other sources of information are shared and analyzed jointly among the State Scientific Surveys and IDNR/ORC and IDNR/OREP and used to determine where additional ecosystem restoration assessment needs to be performed. The analysis of GIS data at an appropriate scale gives particular insight when prioritizing selection of sub-basins, watersheds, and sub-watersheds for more detailed assessment. The GIS framework includes, but is not limited to examination of biologically significant areas, natural areas, nature preserves, threatened and endangered species, invasive species, nuisance species, biologically significant streams, resource rich areas, bedrock and surficial geologic materials, soils, slope maps, historical aerial photography, digital Ortho photo-quads, landcover, landuse, hydrologic and other available GIS data. The streams and watershed component of watershed assessment data collection protocols can be reviewed in Figure 4.

Existing GIS data is very useful for analyzing landscape scale phenomena such as percent forest, savanna, and prairie and estimating where opportunities might occur to increase native stands of vegetation and other biotic assemblages. The GIS data is also useful for planning eradication of nuisance species as well as managing a multitude of terrestrial and aquatic ecosystem restoration efforts. However, currently available statewide and regional GIS data does not always provide information that specifically pin-points significant erosion site problems and sediment contribution areas to be targeted for restoration or naturalization. Therefore, analysis of GIS data is a vital endeavor but is only one step in an assessment process. As a partial solution to this problem and to outline additional steps in the assessment process the ISWS-CWS adapted rapid assessment protocols from a variety of sources and developed a more customized approach for assessment of the Illinois River Basin.

Protocols for Assessment and Restoration

A useful assessment effort that not only prioritizes sub-basins, watersheds and sub-watershed for action, but pinpoints specific restoration projects related to a major problem (erosion and sedimentation) within those areas requires a closer examination of unstable channel and near-channel environments. More specific aerial and field-

Watershed Assessment Data Collection Protocols
"Streams and Watershed Component"
For Identification, Assessment, and Monitoring of Targeted Watersheds

General Assessments:

GIS Coverage

- Biologically Significant Areas, including but not limited to Nature Preserves, Natural Areas, Open Space, T & E Species, Invasive Species, Nuisance Species, Biologically Significant Streams, Resource Rich Areas, Land and Water Resource Areas, Fish and Wildlife Conservation Areas, etc…)
- Maps of Bedrock, Surficial Geologic Materials, Soils, Sand Deposits, Terrain and Slope Maps, etc…
- Historic Photography, Conventional Panchromatic Imagery, Satellite Imagery, Special Spectral Imagery, DOQ's, LIDAR, etc…
- Landcover and Land-Use Analysis and Modeling
- Spatial and localized Hydrologic and Hydraulic Data and Model Information
- Etc…

Figure 4. Watershed Assessment Data Collection Protocols
"Streams and Watershed Component"

based data from channel and near-channel environments is required so that more detailed project-specific assessment and design can commence in a timely fashion. Assessments are even more useful if they combine appropriate GIS data to provide insight about potential causative factors responsible for landscape instability and sediment delivery. The watershed assessment efforts employed in this effort use data collection and analysis to locate, characterize, and prioritize, potential multi-objective projects that reduce erosion and sedimentation and restore or enhance habitat and overall ecosystem health of the basin. Much of the data collected in the assessment is also useful for actual design and construction of restoration projects. The ISWS-CWS is performing trial assessments that can efficiently identify specific problem areas to direct needed attention quickly to project sites. The streams component of the watershed assessment data collection protocols was developed to outline a process for collecting information from channel and near channel environments. This component of the assessment effort helps fill a programmatic gap by identifying and describing erosion problems from streambank, streambed, and floodplain hillslopes thereby affording the opportunity to develop multi-objective restoration projects that will significantly reduce sediment delivery from these source areas and increase or enhance habitat (Figure 5).

Watershed Assessment Data Collection Protocols
"Streams Component"
For Data Collection of Specifically Targeted Streams

- Aerial Reconnaissance Using GPS Technology
- Rapid Geomorphologic Assessment
  - Geomorphologic Assessment Stream-Evaluation Data Sheet
  - Channel Stability Ranking Scheme
  - Biological/Habitat Ranking Scheme
- Methodology & Protocols—Index of Biotic Integrity (IBI)
- Methodology & Protocols—Macro-Invertebrate Biotic Index (MIBI)
- Methodology & Protocols—Instream Habitat Monitoring
  - Potential Index of Biotic Integrity (PIBI)

Figure 5. Watershed Assessment Data Collection Protocols
"Streams Component"

The approach to perform geomorphic assessments for Illinois River tributary watersheds needs to be systematic and consistent to insure uniform data collection and quality assurance. Low-altitude GPS referenced aerial reconnaissance integrated with focused geomorphic and biological assessments best fit the particular needs described.

First, general watershed assessments, particularly aerial reconnaissance efforts, pinpoint the most critical bed and bank erosion sites, potential wetland restoration areas, channel re-meandering opportunities, and other potential restoration projects. Then, more thorough field reconnaissance including biological and geomorphological field assessments (Kuhnle and Simon, 2000) can be conducted in the target areas. Such baseline data collection efforts help provide data to be used to prioritize restoration work, describe site conditions, offer potential design information, and also help understand and document the response of restoration efforts after restoration alternatives are reviewed, selected, and applied. The geomorphological data collection contributes to improved modeling of fluvial processes using a suitable channel evolution model.

The goal of a stream geomorphic assessment is to determine the potential for future stream-channel adjustments based on existing and current data in a watershed system. The purpose is to provide meaningful guidance in the application of best management practices (BMPs) for watersheds and streams that reduce channel erosion and also address subsequent sedimentation or aggradation issues, typically channel incision and the burial of productive substrates. Such assessments also will be useful for apprising State, Federal, and local decision makers and Regional Teams of potential restoration sites and design opportunities and developing consensus for funding through the State- and USACOE-coordinated Illinois River Basin Ecosystem Restoration Project.

Several geomorphic assessment protocols have been proposed for use in Illinois streams based on geomorphic studies in the United States and applicable to the Midwest (Keefer, L., 2004). This is the first time that customized geomorphological protocols systematically are being incorporated into assessment efforts by the State of Illinois. This adapted geomorphic assessment approach involves gathering existing watershed and stream-channel data/information (historical and recent); evaluating watershed physical characteristics based on geology, soils, hydrology, land cover, and climate; conducting and recording aerial flyovers to preliminarily evaluate channel conditions and identify unstable reaches; and performing a field-based rapid channel-stability/physical-habitat ranking of many sites (Kuhnle and Simon, 2000) throughout the watershed. Biological indicators being used are standard U.S. Environmental Protection Agency aquatic sampling protocols and include ranking indicators of fish (Index of Biotic Integrity), macro-invertebrate (Macro-Invertebrate Biotic Index), and habitat (Potential Index of Biotic Integrity) data.

It was also necessary to develop additional criteria for targeting and prioritizing potential individual restoration sites within each of the sub-basins, watersheds, and sub-watersheds. These additional criteria are similar to criteria used to select the initial list of sub-basins, watersheds, and sub-watershed for initial assessment but are more specific to individual project concerns. The criteria for selecting individual project sites include:

- Sediment contributions from the watershed and particularly from the site in question
- Availability of a watershed plan and progress with planning and implementation
- Landowner willingness to participate
- Availability of access
- Future potential damages if a project is not implemented
- Federal, state, and local ability to improve the area and
- Economic opportunities or limitations to succeed

Aerial Reconnaissance Component

Occasionally, the success of programs depends upon rapid assessment and remediation to gain the interest of the public and maintain interest of funding agencies. Assessment using a helicopter equipped with a Global Positioning System (GPS)-tracking system and aerial camera allows for rapid

identification of potential restoration project site areas. After potential sites are identified, office and field analyses can then determine hydrological, hydraulic, geomorphological, and biological conditions before prioritizing where to proceed with design and construction of restoration work.

Low-altitude aerial reconnaissance allows increased ability to rapidly see some channel and near-channel sources of sediment and possible disturbances. Selected stream segments for which aerial reconnaissance information has been obtained for this project are shown (Figure 6). The helicopter used was a Bell Ranger with an aerial camera that synchronizes GPS coordinates within aerial imagery. Although low-altitude aerial imagery cannot provide information on all sediment sources and disturbances, it still is an economical way to conduct rapid reconnaissance and identify potentially significant problems in or near a channel that otherwise would not be recognized and addressed for several years.

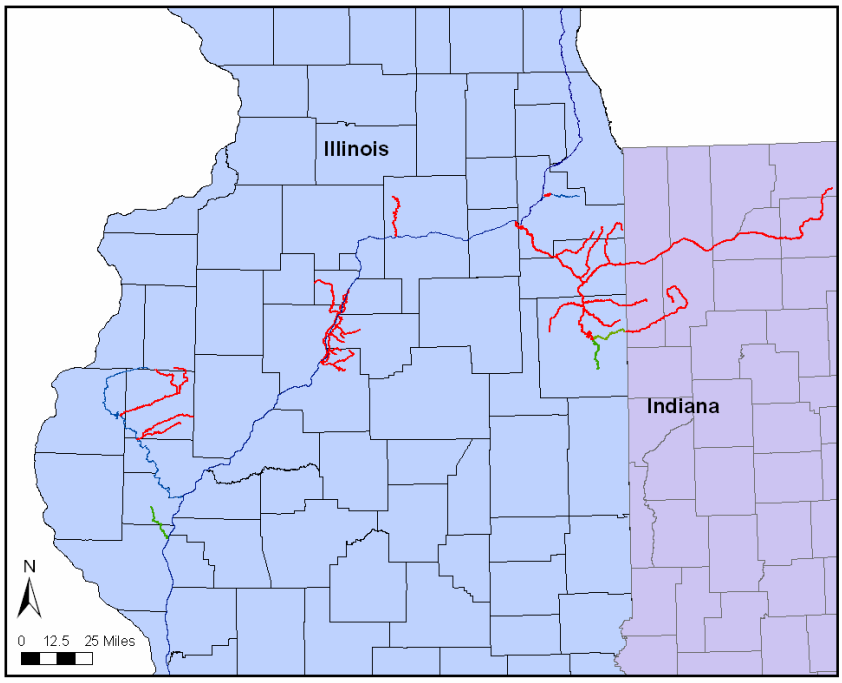

Figure 6. Aerial Assessment Streams in the Illinois River Basin as of 2004

When conducting aerial and field-based reconnaissance it is important to keep in mind what can actually be improved or accomplished at any given site of concern, therefore, it is useful to consider what general types of channel and near-channel restoration practices may be applied. A short list of potential restoration practices and issues considered include, but are not limited to the following:

- Bioengineering (sometimes combined with Lunker Structures and even "harder" structures) to stabilize or naturalize streambanks and address channel equilibrium issues
- Control of channel incision using riffle/pool structures (Newbury Weirs, etc…)
- Channel re-meandering and reconnection of streams to parent floodplains
- Wetland restoration or enhancement
- Hydrologic restoration or naturalization of flow regimes
- Alternative futures planning and contemporary conservation designs for urban and rural stormwater infiltration and filtering

Aerial photography was acquired on 668.65 miles (1,069.84 km) of streams in the spring of 2004 as part of the rapid stream assessment (Table 1). Table 1 also indicates 504 potential restoration sites identified. Further inspection will add sites and eliminate sites based on more intensive review of aerial features and detailed field geomorphic investigation.

Table 1. Aerially Assessed Streams and Potential Restoration Sites (Spring 2004)

Illinois River and Sub-Basins	*Miles (km) of Aerial Reconnaissance*	*Potential Sites*
Peoria Pool Tributaries and Illinois River Mainstem from Downtown Peoria to Lacon	125.85 (201.36 km)	110
Little Vermilion River	40.10 (64.16 km)	45
DesPlaines River (Hickory Creek)	5.40 (8.64 km)	11
Kankakee River Mainstem and Selected Tributaries in Illinois and Indiana	195.50 (312.80 km)	50
Iroquois River Mainstem and Selected Tributaries in Illinois and Indiana	120.90 (193.44 km)	47
LaMoine River Tributaries	117.70 (188.32 km)	166
Yellow River in Indiana	63.20 (101.12 km)	75
Grand Total	**668.65 (1,069.84 km)**	**504**

Sites that continue to remain on the list for potential restoration will receive further analysis and design. Data also will be collected upstream and downstream of targeted sites to verify channel equilibrium conditions and the geomorphic history of the channel.

Illinois Rivers Decision Support System

The Illinois River Basin has become a focus of state and federal agencies and other organizations interested in integrated watershed management. With this in mind, the Illinois Scientific Surveys initiated development of the Illinois Rivers Decision Support System (ILRDSS) for use in documenting project activities within the watershed and assessing and evaluating the effectiveness of potential restoration projects and management practices (State Scientific Surveys, 2002).

The ILRDSS will integrate and expand existing databases and numerical models of segments of the Illinois River into an integrated decision support system for the entire Illinois River watershed. It is a technology and communication framework to provide scientific support and access to high-quality information for restoration of rivers, streams, and watersheds in Illinois. This network and communication framework includes information resources; modular databases; and simulation models to evaluate the impact of water resources developments, land-use changes, economic developments, and climate variability on sedimentation, water quality, ecology, hydrology, and hydraulics in terms of long-term restoration and sustainability of rivers and streams within Illinois.

The ILRDSS also will improve dissemination of scientific tools and information by using the Internet as the primary access to inventories of current and historical projects, data, simulations, and involved agencies/participants within the Illinois River Basin. The ILRDSS website provides this information to a larger audience at a lower cost, in a more usable form, and much more quickly than previous outreach methods. The ILRDSS website can be accessed at http://ilrdss.sws.uiuc.edu.

Once fully developed, the ILRDSS will enable decision-makers to assess and evaluate the effectiveness of different restoration projects, and the consequences of other natural or human-induced changes in the watershed. The watershed assessment effort for the Illinois River Basin and tributaries ecosystem restoration project intends to one-day utilize this accessible and integrated data retrieval and analysis system for tracking activities, evaluating project performance, and making adaptive management decisions.

Conclusions

Many of the environmental problems in the Illinois River Basin are due to urban and agricultural development, fragmentation of the landscape, alteration of upland drainage networks and floodplain alterations. These and other landscape alterations resulted in advanced rates of landscape erosion; destabilization of the Illinois River mainstem and tributary streams; sedimentation of the river mainstem, backwaters, and side-channels; sedimentation of significant tributary floodplain pools and lakes; and unnatural flow regimes. Sediment contributed from channel and near-channel environments is significant and programs need to continue to incorporate assessment and restoration in these areas more adequately to supplement and enhance existing watershed planning and management efforts in the Illinois and the nation.

Geomorphological data is being collected systematically for the first time in Illinois as part of this Illinois River Basin and tributaries assessment effort. Geomorphological and biological data collection and analyses are being used in conjunction with existing GIS information specifically to locate, characterize, and prioritize potential multi-objective restoration projects which will reduce erosion, restore habitat, and protect overall ecosystem health.

Aerial reconnaissance does not provide all information necessary to identify, prioritize, design, and restore sites nor does it replace the more traditional partnership and consensus-building efforts gained from participating in a comprehensive watershed planning process. Stream and near-channel aerial reconnaissance does, however, provide useful supplemental or baseline information which can be included in the watershed planning and management process; particularly by adding more site-specific and detailed project data about potential stream and riparian projects relatively rapidly into the planning process to serve as demonstration projects that sustain public interest and ecological integrity. To date, this assessment effort has acquired aerial reconnaissance of 668.65 miles (1,069.84 km) of streams as part of the rapid stream assessment and identified 04 potential restoration sites.

The Illinois Rivers Decision Support System (IRDSS) is used for tracking activities, evaluating project performance, and making adaptive management decisions. It is a technology and communication framework to provide scientific support and access to high-quality information for restoration of rivers, streams, and watersheds in Illinois. The Scientific Surveys are using the ILRDSS on this project for documenting project activities within watersheds and for assessing and evaluating the effectiveness of potential restoration projects and management practices.

Aerial reconnaissance information and follow-up field-based geomorphological and biological data collection and monitoring add useful data to the computerized inventory and database retrieval

system. These tools allow resource managers to make timely and better decisions regarding restoration priorities, designs, adaptive management needs, and overall performance evaluations.

Acknowledgements

The authors would like to recognize several people who have played key roles, directly and indirectly, in the assessment efforts for the Illinois River Basin and we express our gratitude for their guidance, recommendations, and support. They include Deputy Director Leslie Sgro, Mike Conlin, Debbie Bruce, Jim Mick, and Rick Mollohan, from the Illinois Department of Natural Resources (IDNR); IDNR Regional Team members and coordinators; John Beardsley, Long Duong, Jon Rodsater, Joy Telford, Linda Dexter, Jim Slowikowski, and David Crowder with the (IDNR/Illinois State Water Survey (ISWS); Bev Herzog and Andrew Philips from the Illinois State Geological Survey (ISGS); Mark Pegg and Matt Ohara with the Illinois Natural History Survey; John Marlin with the Illinois Waste Management Research Center (WMRC); numerous colleagues from the U. S. Army Corps of Engineers including but not limited to Gary Loss, Brad Thompson (Project Manager), Karen Hagerty, and Mike Schwar; Bill Gradle, Jim Evans, and several District Conservationists from the United States Department of Agriculture Natural Resources Conservation Service (USDA/NRCS); Bruce Yurdin and Amy Walkenbach from the Illinois Environmental Protection Agency (IEPA); Mike Beaty, Steve Chard, Mike Rahe, and Alan Gulso from the Illinois Department of Agriculture (IDOA); Rich Nichols with the Illinois Association of Conservation Districts (IACD); numerous Resource Conservationists from local Soil and Water Conservation Districts (SWCD's), particularly Adam Beardsley (Knox County SWCD) and Josh Joseph (Peoria County SWCD); Bob Frazee with the University of Illinois Cooperative Extension Service (CES); several members of the IDNR local Ecosystem Partnership organizations (EP); Directors of the Heartland Water Resources Council; Regional Planning Commissions, particularly Terry Kohlbus and Melissa Eaton from the Tri-County Regional Planning Commission; local watershed planning and technical advisory groups; and a host of others. The authors are also particularly grateful to numerous private landowners without whose support nothing could be accomplished on the ground.

References

Bhowmik, N.G., W.C. Bogner, J. Slowikowski, J.R. Adams. 1993. *Source Monitoring and Evaluation of Sediment Inputs for Peoria Lake.* Illinois Department of Energy and Natural Resources Report No. IENR/RE-WR-93/01. Illinois State Water Survey Contract Report 514, Champaign, IL.

Demissie, M. 1997. Patterns of Erosion and Sedimentation in the Illinois River Basin. *Proceedings of the 1997 Governor's Conference on the Management of the Illinois River System*. Peoria, IL, pp. 69-78.

Demissie, M., and N.G. Bhowmik. 1986. *Peoria Lake Sediment Investigation*. Illinois State Water Survey Contract Report 371, Champaign, IL.

Demissie, M., R. Xia, L. Keefer, and N. Bhowmik. 2003. Sediment Budget of the Illinois River. *International Journal of Sediment Research* **18**(2):305-313.

Demissie, M., R. Xia, L. Keefer, and N. Bhowmik. 2004. *Sediment Budget of the Illinois River*. Illinois State Water Survey Contract Report 2004-13, Champaign, IL.

Evans, R.E. and D.H. Schnepper. 1977. Sources of Suspended Sediment: Spoon River, Illinois. *Proceedings of the North-Central Section of the Geological Society of America*, Peoria, IL, pp. 592-593.

Frye, J.C. 1968. *Development of Pleistocene Stratigraphy in Illinois*. In The Quaternary of Illinois; A Symposium in Observance of the Centennial of the University of Illinois. February 12 and 13, 1968. Ed. Robert Bergstrom, Illinois State Geological Survey. pp. 3-10.

Grissinger, E.H., A.J. Bowie, and J.B. Murphey. 1991. Goodwin Creek Bank Instability and Sediment Yield. *Proceedings of the Fifth Federal Interagency Sedimentation Conference*, Subcommittee on Sedimentation of the Interagency Advisory Committee on Water Data, Las Vegas, NV, pp. 5-51 to 5-60.

Hamlett, J.M., J.L. Baker, and H.P. Johnson. 1982. Changes in Channel Morphology within an Agricultural Watershed. *Proceedings of 1982 American Society of Agricultural Engineers*, Paper No. 82-2086, University of Wisconsin, Madison, WI.

Illinois State Water Plan Task Force. 1987. *Illinois River Basin Action Plan*. Department of Transportation, Illinois Division of Water Resources, Special Report No. 11, Springfield, IL.

State Scientific Surveys. 2002. *Illinois Rivers Decision Support System (ILRDSS)*. Illinois State Water Survey Information/Educational Material 2002-02. Prepared for the Illinois Department of Natural Resources by the Illinois State Water Survey, Illinois Natural History Survey, Illinois State Geological Survey, and Waste Management and Research Center. Website (http://ilrdss.sws.uiuc.edu).

Keefer, L.L. 2004. Geomorphic Assessment Approach to Evaluate Stream Channel Stability for Regions of Illinois, Case Study: Southern Illinois Region. *EOS Trans. AGU*, 85(47), Fall Meeting Suppl., Abstract H51C-1161.

Kuhnle, R. A. and A. Simon. 2000. *Evaluation of Sediment Transport Data for Clean Sediment Tmdls*. USDA-ARS National Sedimentation Laboratory, Report No. 17, Oxford, MS.

Lee, M.T., P. Makowski, and W. Fitzpatrick. 1982. *Assessment of Erosion, Sedimentation, and Water Quality in the Blue Creek Watershed, Pike County, Illinois*. Illinois State Water Survey Contract Report 321, Champaign, IL.

Leedy, J.B. 1979. *Observations on the Sources of Sediment in Illinois Streams*. University of Illinois, Illinois Water Information System Group, Report of Investigation No. 18, Urbana, IL.

Roseboom, D. and W.P. White. 1990. The Court Creek Restoration Project. *Proceedings of Erosion Control: Technology in Transition*. 21st International Erosion Control Association Conference, Washington D.C., pp 14-17.

Simon, A., and M. Rinaldi. 2000. Channel Instability in the Loess Area of the Midwestern United States. *Journal of American Water Resources Association* 36(1):133-150.

U. S. Army Corp of Engineers. 2004. *Illinois River Basin and Tributaries Ecosystem Restoration Project Management Plan (PMP)*, Rock Island District.

U. S. Army Corp of Engineers. 2005 (Draft). *Comprehensive Plan for the Illinois River Basin and Tributaries Ecosystem Restoration Project*, Rock Island District.

Vagt, P.J. 1982. *Vertical and Horizontal Stability of Streams in Northern Illinois.* Masters Thesis, Geology Dept., Northern Illinois University, DeKalb, IL.

White, W. P. and L. L. Keefer. 2005. Rapid Stream Assessments of the Illinois River Watershed; *Proceedings of the World Water & Environmental Resources Congress 2005: Impacts of Global Climate Change*. Conference of the Environmental & Water Resources Institute of the American Society of Civil Engineers. Anchorage, Alaska.