Aerial Reconnaissance and Video Mapping of Stream and Near Channel Environments

A Component of the Illinois River Basin Assessments

By

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The Illinois River has a drainage area of 28,906 square miles (74,867 square kilometers) and drains nearly half of the State of Illinois and about a 4,000 square mile (10,360 square kilometer) 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.

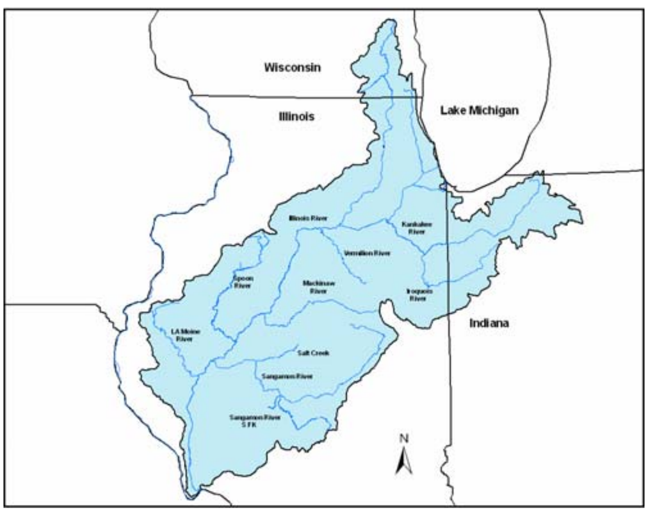

Figure 1. The Illinois River Basin in Illinois, Indiana, and Wisconsin

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). Erosion and sedimentation are, however, natural phenomena and management strategies need to fully take this into consideration. Urban and agricultural development, fragmentation of floral landscape components, and alteration of upland drainage networks, hillslopes, and floodplains caused advanced rates of erosion and related resource problems in Illinois. High rates of erosion and subsequent sedimentation have negatively impacted the state's resource base and, therefore, its economic infrastructure. A loss of landscape value occurred because these landscape developments destabilized the Illinois River mainstem and tributary streams; caused sedimentation of the river mainstem, backwaters, and side-channels; induced sedimentation within lower portions of tributary floodplains; and forced unnatural flow regimes. The Comprehensive Plan for Illinois River Basin and Tributaries Ecosystem Restoration Project, developed by the U.S. Army Corps of Engineers with local sponsorship spearheaded by the Illinois Department of Natural Resources (Office of Resource Conservation and Office of Scientific Research & Analysis) on behalf of the State of Illinois, acknowledges that watershed and channel 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).

Ecological problems within the Illinois River Basin have been identified by monitoring including the analysis of data pertaining to habitat, biological integrity, and ecological sustainability. Hydrologic, hydraulic, geologic, geomorphic, and water quality conditions are also monitored and data analyzed to better assess ecosystem function within the Illinois River Basin. Recently aerial reconnaissance using a helicopter with a high resolution stabilized aerial cameral and Global Positioning System (GPS) tracking has been added as a stream and watershed assessment tool.

The Illinois State Water Survey, Center for Watershed Science (ISWS-CWS) within the 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; SEE LINK TO THE FULL ARTICLE).

Currently available and additional new data were analyzed in this assessment effort. Assessment data is being 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.

Because not all areas in the Illinois River Basin could be selected for assessment in the first few years of the project, a general set of criteria was used as a "working model" by IDNR to select initial sub-basins, watersheds, and sub-watersheds for initial assessment including aerial video mapping. Assessment protocols were selected and used to 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…, and
- Economic limitations and opportunities

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-watersheds 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

When conducting assessments 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 <u>short list</u> 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 such as stone toe protection, Bendway weirs, stream barbs, etc…) 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

Naturalization of tributary streams and restoration of biodiversity are key components of contemporary watershed planning and management efforts yet stream channel alterations and channel changes are among the most poorly documented watershed monitoring efforts during initial technical assessments and assessments of Best Management Practice needs. 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.

Occasionally, the success of programs depends upon rapid assessment and remediation to gain the interest of the public and maintain interest of funding agencies. Recent advancements in camera stabilization and digital recording and playback capabilities now make it technologically and economically possible to acquire broadcast quality geo-referenced aerial corridor video footage using both fixed wing and rotary wing platforms. Assessment using a helicopter equipped with Global Positioning System (GPS)-tracking and a high resolution stabilized aerial camera allows for aerial video mapping and rapid identification of potential restoration project site areas. Low-level aerial surveys significantly help identify stable and unstable reaches of stream now that the technological advances are available and economical. The helicopter used for this project was a Bell Ranger with a stabilized aerial camera that synchronizes GPS coordinates within aerial imagery (Photo 1). Although low-altitude aerial imagery cannot

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Photo 1. Bell Ranger Helicopter with Stabilized Aerial Camera

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. Low-altitude aerial video mapping allows increased ability to rapidly see some channel and near-channel disturbances or sources of sediment and possibly help identify some of the causative factors for channel morphological change. After potential sites are identified, office and field analyses can then help determine hydrological, hydraulic, geomorphological, and biological conditions which aid in prioritizing where to proceed with design and construction of restoration work. Streams which were video mapped for this project are shown (Figure 2).

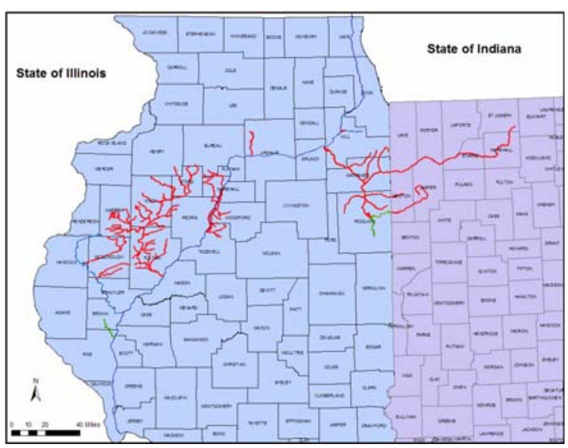

Figure 2. Aerial Assessment Streams in the Illinois River Basin

Aerial video mapping was acquired along 1292.04 miles (2079.18 kilometers) of stream channels in the spring of 2004 and the fall of 2005 as a component of the watershed and stream assessment efforts. The majority of aerial reconnaissance work in the spring of 2004 was funded by a contract from the Illinois Department of Natural Resources; Office of Resource Conservation. Aerial reconnaissance of portions of the LaMoine River watershed were funded, in part, by the Illinois Department of Natural Resources; Office of Realty & Environmental Planning (Ecosystems Division--Conservation 2000 Program) and the U.S. Fish and Wildlife Service. The aerial reconnaissance flown in the fall of 2005 was funded entirely by the IDNR, Office of Resource Conservation. The exact sub-basins, watersheds, and sub-watersheds flown and the channel lengths that were video mapped can be viewed in Table 1.

Table 1. Aerially Assessed Streams
(Spring 2004 and Fall 2005)

Spring 2004

Illinois River and Sub-Basins	*Miles (km) of Aerial Reconnaissance*
Peoria Pool	
Ackerman Creek	6.83 (11.00 km)
Blue Creek	7.04 (11.33 km)
Farm Creek	21.19 (34.10 km)
Partridge Creek	15.77 (25.39 km)
Mundinger Creek	3.10 (4.99 km)
Tenmile Creek	7.62 (12.26 km)
Spring Creek	4.00 (6.44 km)
Senachwine Creek	32.80 (52.79 km)
Peoria Lake	
Lacon to Downtown Peoria	27.50 (44.26 km)
LaMoine	
Camp Creek	29.30 (47.15 km)
East Fork LaMoine River	52.00 (83.69 km)
Drowning Fork	18.00 (28.97 km)
Grindstone Creek	18.40 (29.61 km)
Des Plaines	
Hickory Creek	5.40 (8.69 km)
Vermilion	
Little Vermilion River	40.10 (64.53 km)
Kankakee	
Kankakee River (IL, IN)	119.00 (191.51 km)
Baker Creek	12.00 (19.31 km)
Exline Slough	11.00 (17.70 km)
Rock Creek	30.50 (49.08 km)
Trim Creek	23.00 (37.01 km)
Iroquois	
Iroquois River (IL, IN)	40.40 (65.02 km)
Beaver Creek (IL, IN)	27.50 (44.26 km)
Langan Creek	27.50 (44.26 km)

Pike Creek	25.50 (41.04 km)
Indiana	
Yellow River	63.20 (101.71 km)
Total for 2004	**668.65 mi. (1076.09 km)**

Fall 2005

Spoon River Sub-basin	
Spoon River - Mainstem	146.50 (235.77 km)
Barker Creek	5.80 (9.33 km)
Coal Creek	14.50 (23.34 km)
East Fork of Spoon River	12.70 (20.44 km)
Francis Creek	4.00 (6.44 km)
Indian Creek	24.40 (39.27 km)
Littlers Creek	12.80 (20.60 km)
Shaw Creek	7.00 (11.27 km)
Snake Den Hollow	5.50 (8.85 km)
Stuart Creek	7.30 (11.75 km)
Tater Creek	12.60 (20.28 km)
Walnut Creek	32.70 (81.1 km)
West Fork of Spoon River	10.60 (17.06 km)
Cedar Creek	25.30 (40.72 km)
Big Negro Creek	8.80 (14.16 km)
Dago Slough/Indian Creek	8.10 (13.04 km)
Little Negro Creek	6.40 (10.30 km)
Little Swan Creek	7.24 (11.65 km)
Negro Creek	2.30 (3.70 km)
Picayune Creek and Tributaries	38.70 (95.11 km)
Slug Run/Cedar Fork	13.80 (22.21 km)
Swan Creek	15.20 (24.46 km)
Court Creek	7.00 (11.27 km)
Middle Creek	7.50 (12.07 km)
North Creek	3.50 (5.63 km)
Haw Creek	22.25 (35.81 km)
Brush Creek	18.60 (36.37 km)
Hermon Creek	7.60 (12.23 km)
Lake Bracken	1.80 (2.90 km)
French Creek	17.50 (28.16 km)
Swab Run	10.30 (16.58 km)
Put Creek	10.00 (16.09 m)
Laswell Branch	5.20 (8.37 km)
Lost Grove Creek	6.70 (10.78 km)
Turkey Creek	11.00 (17.70 km)
Big Creek	28.60 (46.03 km)
Slug Run	3.20 (5.15 km)
Crow Creek West	27.50 (44.26 km)
Scholes Branch	8.70 (14.00 km)
North West Branch	4.10 (6.60 km)

Total for 2005	**623.39 mi. (1003.09 km)**
Total Distance 2004 + 2005	**1292.04 mi. (2079.18 km)**

A list of potential problem areas, including coordinates and a general description of the problem, has been prepared for each of the channel systems flown in the spring of 2004 and a similar list is being compiled for the channel systems flown in the fall of 2005. Further inspections both add and eliminate sites based on intensive review of aerial features from historic panchromatic aerial photographs and geomorphological field investigation. Sites that continue to remain on the list for potential restoration will receive further monitoring and analysis. Data will be collected upstream and downstream of targeted sites to verify geomorphic history of the channel and near channel environment, channel equilibrium conditions, and potential response to restoration. Specific monitoring and analysis will be conducted and used to aide managers with development of restoration design, actual restoration, and performance evaluation.

In conclusion, sediment contributed from erosion of 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 Illinois and the nation. Low level aerial video mapping integrating GPS location tracking provides an economic means to collect information and rapidly assess with some scientific basis the condition of watersheds and their stream systems and to target and prioritize potential stream degradation areas and remediation efforts. Geo-referenced aerial video mapping also helps identify monitoring locations within multiple watersheds. 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. However, stream and near-channel aerial reconnaissance does provide useful baseline and supplemental information which can be utilized 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. Rapid project identification and demonstration of innovative restoration practices, while research in nature, are useful for showing the public examples of progress early in the project or program planning process. Showing forward progress early in the process helps maintain public interest and funding support.

Aerial reconnaissance information and follow-up field-based geomorphological and biological data collection and monitoring add useful data to the Illinois Rivers Decision Support System (ILRDSS); a 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.

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