ILLINOIS RIVER BASIN RESTORATION COMPREHENSIVE PLAN WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

US Army Corps of Engineers
Rock Island District
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MAIN REPORT
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ILLINOIS DEPARTMENT OF NATURAL RESOURCES

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of Engineers®

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Various personnel from the State of Illinois and from Federal agencies were active collaborators for the *Illinois River Basin Restoration Comprehensive Plan With Integrated Environmental Assessment*. The primary project development team members who contributed to the technical aspects of this effort are:

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EXECUTIVE SUMMARY

The Illinois River, described by early explorers as a "boundless marsh", has long been characterized by the productivity of its extensive backwater and floodplain complexes. However, over time the ecological health of the system has declined significantly due to the combined effects of sedimentation, altered hydrology, and other modifications to the basin. Despite these declines, the Illinois River Basin represents one of the most productive resources in the Midwest and has high potential for restoration. The National Research Council identified the Illinois River as one of three large-floodplain river systems in the lower 48 states with the potential to be restored to an approximation of their outstanding biological past.

This post authorization change report represents a final response to the Comprehensive Plan portion of the Illinois River Basin Restoration authority provided in Section 519 of the Water Resources Development Act (WRDA) 2000 and to the Illinois River Ecosystem Restoration Feasibility Study conducted under Section 216 of the 1970 Flood Control Act as a review of the completed 9-Foot Channel Navigation Project. Section 519 also provides ongoing authority to evaluate and implement Critical Restoration Projects. This report assesses the total basin restoration needs and makes specific recommendations regarding modification of the existing authority to improve implementation. The Corps of Engineers and Illinois Department of Natural Resources (sponsor) worked together in coordination with numerous other state and Federal agencies on these two similar and complimentary studies.

This Comprehensive Plan provides the vision, goals, objectives, desired future, and recommended plan to restore the ecological integrity of the Illinois River Basin System. This plan documents the need for and scope of the four components called for in Sec 519 (b)(3): a restoration program; a long-term resource monitoring program; a computerized inventory and analysis system; and a program to encourage innovative dredging technology and beneficial use of sediments. An implementation framework and criteria are also presented to guide the identification, selection, study and implementation of restoration projects, monitoring and adaptive management activities, and further system investigations.

SIGNIFICANCE OF THE ILLINOIS RIVER BASIN

The Illinois River's significance was recognized by Congress in WRDA of 1986 as a "nationally significant ecosystem" as part of the Upper Mississippi River System. A 1995 report by the U.S. Department of the Interior lists large streams and rivers as an endangered ecosystem in the United States, with a documented 85 to 98 percent decline since European settlement. The Illinois River is one of a small number of world-class river floodplain ecosystems; where biological productivity is enhanced by annual flood pulses that advance and retreat over the floodplain and temporarily expand backwaters and floodplain lakes.

The predevelopment Illinois River floodplain was a complex mosaic of prairies, forests, wetlands, marshes, and clear water lakes. In the main stem river floodplain, the main channel threaded through a variety of connected and isolated backwater lakes, bottomland forests, prairies, marshes, and swamps.

The productivity of the predevelopment system was demonstrated by the millions of migratory birds that stopped to rest and feed on their migrations or stopped to nest in the floodplain marshes. The fishery was reputed to be vast and exceptionally large fish catches were common. At the turn of the century, the river produced 10 percent of the nation's catch of freshwater fish. The Illinois River system also supported more freshwater mussels per mile than any other river on the continent. The forests supported a higher diversity of trees, many that produced fruit and seeds. Today's flora and fauna are but a remnant of these historic levels, but they still include some of the richest habitat in the Midwest, even some unique in North America.

Despite the ecological damage and degradation, the landscape and river system remain surprisingly diverse and biologically productive. The Illinois River basin is a critical mid-migration resting and feeding area of the internationally significant Mississippi River Flyway, utilized by 40 percent of all North American waterfowl and 326 total bird species, representing 60 percent of all species in North America. A survey conducted by the Illinois Natural History Survey in the fall of 1994 found that 81 percent of the fall waterfowl migration in the Mississippi flyway utilized the Illinois River. Twenty-six avian species are state listed as threatened or endangered; one of which is federally-threatened, the Bald Eagle, and four others are Federal species of concern. Many of these species are associated with wetlands or grasslands, and are also sensitive to landscape fragmentation.

The Illinois River system is home to approximately 35 mussel species, representing 12 percent of the freshwater mussels found in North America. Five mussel species are listed by the State of Illinois as threatened or endangered, one of which is a candidate for Federal listing. Fish diversity is similarly high, with 115 fish species found, 95 percent of which are native species. Many of these species require riverine, backwater, and floodplain habitat as part of their life cycle. Eighteen fish species are listed by the state of Illinois as threatened or endangered. Many of these species are endemic to the basin and/or intolerant of high silt levels. A group of aquatic organisms that is particularly representative of the Illinois River is the "Ancient Fishes" such as the paddlefish and sturgeon. The majority of these fish are migratory by nature and utilize a diversity of river habitats, flowing channel habitats, side channels, and backwater areas.

The Illinois River has long been a significant resource to the nation and the State of Illinois. It supported large Native American populations and provided a route for European explorers and settlers, and helped make the Midwest agricultural economy viable as early as the nineteen century. This waterway provides navigation from Lake Michigan and Chicago to the Upper Mississippi River, linking the inland waterway system with the Great Lakes. In 2004, 45 million tons of commodities were transported on the Illinois Waterway. The river and its tributaries provided water for residential and industrial users and also assimilated the wastes of burgeoning metropolitan communities. In Illinois, 90 percent of the state's population, more than 11 million people, reside in the basin.

The State of Illinois has demonstrated tremendous commitment to the restoration of the Illinois River System for many years. The State of Illinois initiated, developed, adopted and implemented an *Integrated Management Plan for the Illinois River Watershed (1997)* working with multiple local, state, and Federal groups and enacted the Illinois River Watershed Restoration Act (1997). In 2000, the Governor of Illinois set the vision for Illinois Rivers 2020, a proposed $2.5 billion, 20-year State and Federal restoration program to restore the Illinois River Basin. This plan was the first of many steps leading to the development of the goals and objectives for this comprehensive plan. In addition, Illinois leads the nation in the number of acres currently enrolled in the Conservation Reserve

Enhancement Program (CREP) at 110,000 in the Federal program, and the most acres permanently protected (92 of the 73,000 acres enrolled, in the state portion of the program).

Local communities, counties, and non-governmental organizations have demonstrated commitment to the Illinois River, by implementing approximately 40 management plans calling for restoration of all or a portion of the Illinois River Basin. The Nature Conservancy and The Wetlands Initiative have both made major investments purchasing more than 11,000 acres of Illinois River floodplain and adjacent habitats for the purpose of restoration in recent years, adding to the approximately 135,000 acres already in State and Federal ownership in the basin. However, many of the restoration efforts have focused only on small components of the basin without considering the broader basin context, which is the focus of this comprehensive plan.

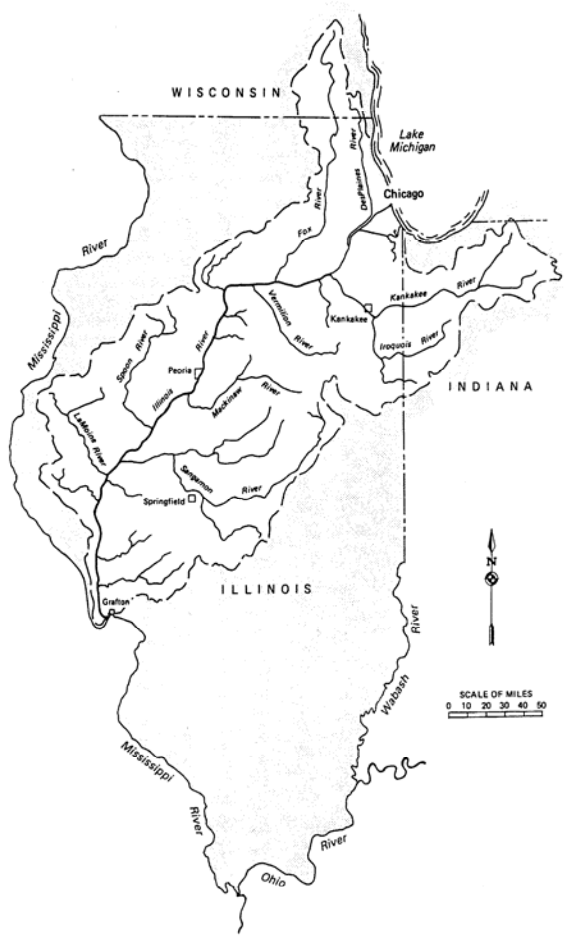

Figure ES-1. Location of Illinois River Basin

STUDY AREA

The study area encompasses the entire Illinois River Basin, defined as the Illinois River, its backwaters and side channels, and all tributaries, including their watersheds (Figure ES-1). The entire Illinois River Basin includes 30,000 square miles (19 million acres), and includes 1,000 square miles in Wisconsin (upper Fox and Des Plaines Rivers), and 3,200 square miles in Indiana (Kankakee and Iroquois Rivers). In Illinois, the basin includes 44 percent of the land area, 46 percent of the state's agricultural land, 28 percent of its forests, 37 percent of its surface waters, and 95 percent of its urban areas.

PROBLEMS AND SYSTEM LIMITING FACTORS

The Illinois River Basin has and continues to experience a loss of ecological integrity due to sedimentation of backwaters and side channels, degradation of tributary streams, increased water level fluctuations, reduction of floodplain and tributary connectivity, and other adverse impacts caused by intensive human development over the last 150 years. While many of the original plant and animal species are still present in the basin, but at reduced levels, the physical habitats (structure) and the processes that create and maintain those habitats (function) have been greatly altered. In total, these alterations have led to a decline in the ecological health to the point where aquatic plants beds have been virtually eliminated from the lower river; macro-invertebrate numbers have declined significantly; the loss of backwaters areas with sufficient depth for spawning, nursery and overwintering habitat is now considered limiting for many native fish; and floodplain, riparian, and aquatic habitat loss and fragmentation is a threat to the population viability of State and federally listed species in the basin. The following areas have been identified as the physical factors that limit system ecological integrity: excessive sedimentation; loss of productive backwaters, side channels, and islands; loss of floodplain, riparian, and aquatic habitats and functions; loss of aquatic connectivity (fish passage) on the Illinois River and its tributaries; altered hydrologic regime; water and sediment quality, and invasive species.

There are numerous opportunities for restoration. Figure ES-2 illustrates how projects formulated addressing these system limiting factors collectively, can improve ecosystem integrity to the point where higher levels of function are restored. Monitoring, at both the system and individual project level, would provide the vital feedback loop needed to ensure success and increase understanding of the Illinois River Basin ecosystem.

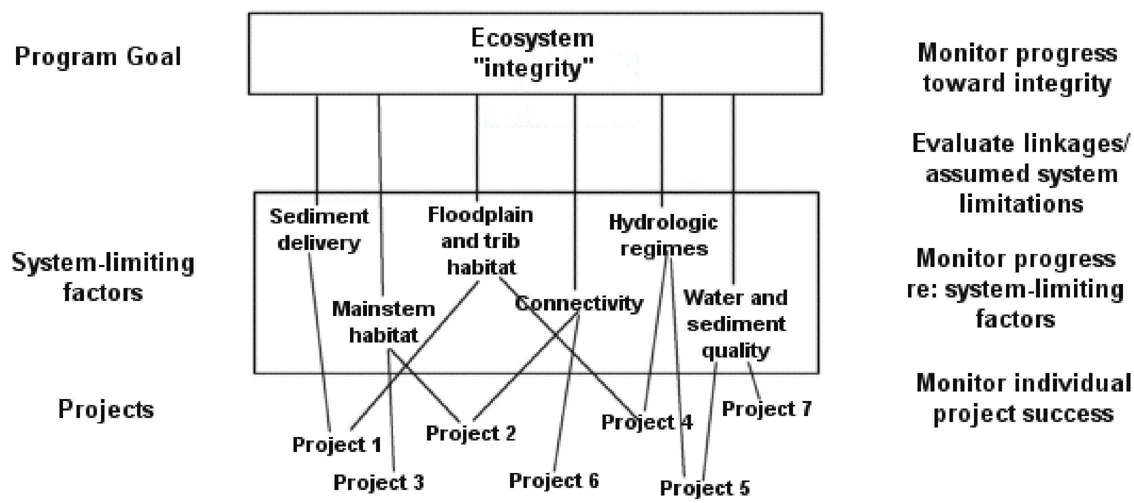

Figure ES-2. Conceptual Model of Illinois River Basin Restoration Project and Monitoring

VISION AND GOALS

The vision for the Illinois River Basin, accepted by the Federal, State and local stakeholders involved in the development of the Illinois River Basin Restoration Program, is:

> *A naturally diverse and productive Illinois River Basin that is sustainable by natural ecological processes and managed to provide for compatible social and economic activities.*

The interagency study team developed the Illinois River Basin system wide ecosystem restoration goals and objectives in direct response to the widely identified system limiting factors. Also included are proposed measures to address the limiting factors and their expected outputs. These goal categories are interrelated and improvements in all areas are needed to substantively improve ecological integrity. As efforts are undertaken across several goal categories, the restoration activities would reverse complex, systemic declines that have degraded the system below some critical thresholds.

Overarching Goal: Restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them

Objectives

A. Identify and address system wide limiting factors to ecological integrity (structure and function) described in the previous section

B. Restore and conserve natural habitat structure and function, including, but not limited to:
   1. Concentrations of flora and fauna or areas that are high in biodiversity; especially vulnerable to disturbance; and/or important in fulfilling a life-history requirement of the species present.
   2. Specific suitable habitat for Federal and State endangered and threatened species, or other species of concern, that is capable of supporting long-term sustainable populations at the site and protect additional acres of the identified suitable habitat as appropriate.
   3. Representative examples of all community types in the Illinois River Basin, best of kind or as needed, to protect and restore habitat structure and function at the system level.

C. Establish existing and reference conditions for ecosystem functioning and sustainability against which change can be measured; monitor and evaluate actions to determine if goals and objectives are being achieved, at both the project and system level.

System Limiting Factors

1. Excessive Sedimentation. Increased sediment loads from the basin have severely degraded environmental conditions along the main stem Illinois River by increasing turbidity and filling backwater areas, side channels, and islands. Similar problems can be seen throughout the basin where excessive sediment has degraded tributary habitats. The average amount of sediment delivered to the Illinois River each year is approximately 12.1 million tons; of which 6.7 million tons (55 percent) is deposited within the river, its bottomlands, and backwater lakes.

Goa1: Reduce sediment delivery to the Illinois River from upland areas and tributary channels with the aim of eliminating excessive sediment load (Goal 1)

Objectives

A. Reduce total sediment delivery to the Illinois River by at least 10 percent by 2025 (reduction from an average of 12.1 to 10.9 million tons per year above Valley City, based on Illinois State Water Survey (ISWS) estimate of delivery for water year (WY) 1981 to 2000)

B. Reduce total sediment delivery to the Illinois River by at least 20 percent by 2055 (reduction to an average of 9.7 million tons per year above Valley City, based on ISWS estimate of delivery for WY 1981to 2000)

C. Eliminate excessive sediment delivery to specific high-value habitat both along the main stem and in tributary areas

Measures. Incising channels would be treated with rock riffle structures, if possible, otherwise using sheet-pile grade control structures. The preferred method of treating bank erosion was assumed to be stone barbs, then stone toe (photograph ES- 1), or finally a stone armor blanket if necessary; bioengineering was incorporated in most of the bank erosion stabilization measures. Finally, upland sediment control measures include the construction of dry basins.

Photograph ES-1. Example before and after stream restoration with stone toe protection

Outputs. Anticipated project outputs related to Goal 1 include: reducing sediment delivery to the Illinois River, reducing turbidity in the tributaries and Illinois main stem and backwaters, increasing the life of existing and restored backwaters as critical habitats for native species. These effects would benefit system aquatic plants, mussels, invertebrates, fish, and other native species.

2. Loss of Productive Backwaters, Side Channels, and Islands. A dramatic loss in productive backwaters, side channels, and islands due to excessive sedimentation is limiting ecological health, connectivity to the river, and altering the character of this unique floodplain river system. The Illinois River has lost much of its critical spawning, nursery, and overwintering areas for fish, habitat for waterbirds (including diving ducks), aquatic species, and backwater aquatic plant communities. On average, the backwater lakes along the Illinois River have lost 72 percent of their capacity.

Goal: Restore aquatic habitat diversity of side channels and backwaters, including Peoria Lakes, to provide adequate volume and depth for sustaining native fish and wildlife communities (Goal 2)

Objectives

A. Restore, rehabilitate, and maintain up to19,000 acres of habitat in currently connected areas (1989 data shows approximately 55,000 acres of backwaters during summer low water). Restoration should result in a diversity of depths. For restored backwaters, a general target would be to have the following distributions of depths during summer low flow periods: 5 percent >9 feet; 10 percent 6 to 9 feet; 25 percent 3 to 6 feet; and 60 percent <3 feet

B. Restore and maintain side channel and island habitats

C. Maintain all existing connections between backwaters and the main channel. (connections at the 50 percent exceedance flow duration)

D. Identify beneficial uses of sediments

E. Compact sediments to improve substrate conditions for aquatic plants, fish, and wildlife

Measures. The measures evaluated for backwater restoration included various configurations and levels of sediment removal and placement. For side channels and island protection, various measures were evaluated including instream structures for habitat (photograph ES-2), and restoration of depth and flow.

Photograph ES-2. Example of Instream Rock Pile Structure

Outputs. Anticipated project outputs include immediately addressing critically limited off-channel aquatic habitat. These effects would benefit the system fish, invertebrates, aquatic plants, mussels, and other native species. At a completed side channel and backwater restoration project a comparison of pre- and post-project construction monitoring data showed a dramatic increase in the number and diversity of fish and waterfowl species as well as an increased total number of individuals. This success is anticipated for similar projects.

3. Loss of Floodplain, Riparian, and Aquatic Habitats and Functions. Land-use and hydrologic change has reduced the quantity, quality, and functions of floodplain, riparian, and aquatic habitats. Flood storage, flood conveyance, habitat availability, and nutrient exchange are some of the critical aspects of the floodplain environment that have been adversely impacted. Habitat loss and fragmentation are widespread problems that, in the long term, could limit attempts to maintain and enhance biodiversity. In addition, habitat forming disturbance regimes have been altered, affecting habitat and species diversity. An analysis of the main stem Illinois River floodplain cover types reveals a loss of approximately 75 percent of the forest, 81 percent of the grassland, and 70 percent of the wetlands. In addition, nearly 50 percent of the floodplain has been isolated from the river. A similar analysis of the tributary floodplains reveals approximate losses of 16 percent of the forest, 36 percent of the grassland, and 70 percent of the wetlands. Channelization is estimated to impair approximately 1,400 miles of perennial stream within the Illinois River Basin.

Goal: Improve floodplain, riparian, and aquatic habitats and functions (Goal 3)

Objectives

A. Restore up to an additional 150,000 acres of isolated and connected floodplains along the Illinois River main stem to promote floodplain functions and habitats

B. Restore up to 150,000 acres of the Illinois River Basin large tributary floodplains

C. Restore and or protect up to 1,000 additional stream miles of riparian habitats

Measures. Potential measures for implementation cover a wide range of practices designed to improve floodplain, riparian, and aquatic habitats, including riffle structures, channelization remeandering, gated levees, wetland restoration (photograph ES-3), plantings (wetland, forest, prairie), and invasive species management.

Photograph ES-3. Before and After Floodplain Wetland Restoration

Outputs. A healthy functioning floodplain, riparian and aquatic systems in the Illinois River Basin would result in ecological benefits due to connectivity of the river and floodplain habitats critical to the life stages of numerous native species. In addition, restored riparian and floodplain corridors provide one of the best opportunities for landscape scale restoration and connectivity of remaining resource rich areas in the highly modified Midwestern landscape, improving the viability of sensitive populations and species.

4. Loss of Aquatic Connectivity (fish passage) on the Illinois River and Its Tributaries. Construction of dams on the main stem and tributaries alters the temperatures, flow regime, sediment transports, chemical concentrations, and isolates biotic communities. As a result, aquatic organisms do not have sufficient access to diverse habitat such as backwater and tributary habitats that are necessary at different life stages. Lack of aquatic connectivity (fish passage) slows repopulation of stream reaches following extreme events such as flooding, drought, and pollution and reduces genetic diversity of aquatic organisms. There are seven dams on the Illinois waterway and approximately 467 within the basin where fish passage could be implemented.

Goal: Restore aquatic connectivity (fish passage) on the Illinois River and its tributaries, where appropriate, to restore or maintain healthy populations of native species (Goal 4)

Objectives

A. Restore main stem to tributary connectivity, where appropriate, on major tributaries

B. Restore within tributary connectivity

C. Restore passage for large-river fish at Starved Rock, Marseilles, and Dresden Lock and Dams where appropriate

Measures. Fish passage can be accomplished through a variety of techniques. These options include dam removal; rock ramp on the downstream face of the dam to provide a relatively flat 3 to 5 percent gradient (photograph ES-4); bypass channels; and Denil fishways, rectangular chutes or flumes with baffles extending from the sides and bottoms.

Photograph ES-4. Before and After Rock Ramp Fish Passage at a Low Head Dam

Outputs. The dams found throughout the Illinois River Basin block fish movement, but most dams are partially passable under some conditions. For native fish species, fish passage must be available during the appropriate times of the year or life stages, which is often not the case. Expected outputs would include improved fish access to spawning, nursery, and overwintering areas at appropriate times. Connectivity also allows for recolonization and improved genetic diversity of populations of native fish and mussels.

5. Hydrology and Water Levels. The biotic composition, structure, and function of aquatic, wetland, and riparian ecosystems depend largely on the hydrologic regime. The flow regime (magnitude, frequency, duration, timing, rate of change) affects water quality, energy sources, physical habitat, and biotic interactions, which, in turn, affect ecological integrity. Historical basin changes and river management have altered the water level regime along the main stem Illinois River, stressing the natural plant and animal communities along the river and its floodplain. The most critical changes include an increased incidence of water level fluctuations, especially during summer and fall low water periods, and the lack of drawdown in areas upstream of the navigation dams. Approximately 32 significant water level fluctuations occur during the growing season, severely limiting plant germination, growth or survival.

Goal: Naturalize Illinois River and tributary hydrologic regimes and conditions to restore aquatic and riparian habitat (Goal 5)

Objectives

A. Reduce low water fluctuations along the main stem Illinois River where possible, concentrating on the months of May through October and using pre 1900 water level records as a reference

B. Reduce peak flows from the major Illinois River tributaries by 2 to 3 percent for 2- to 5-year recurrence storm events by 2023. This will help to reduce peak flood stages and reduce high-water fluctuations along the river. Long term, reduce tributary peak flows by at least 20 percent for these events

C. Reduce the incidence of low-water stress throughout the basin by increasing tributary base flows by 50 percent

D. Remove the dramatic water level fluctuations associated with the operation of wicket dams at Peoria and La Grange

E. At an appropriate resolution (approximately 1 square mile in urban areas, 10 square miles in rural areas) identify and quantify the land and drainage alterations that contribute to unnatural fluctuations and flow regimes

F. Draw the pools at Peoria and La Grange down for at least 30 consecutive days at least once every 5 years

Measures. Reducing peak flows and increasing base flows on the tributaries will be accomplished by increasing the volume of storm water storage in the watershed (through the use of various measures including: tile management, detention structures, and extended riparian areas) and directing storm water runoff to areas where it can infiltrate the soil and recharge groundwater (through the use of various measures including: tile management, filter strips, and grassed fields enclosed with a berm). Many of the detention and riparian areas will function as wetlands. Reducing fluctuations on the mainstem will be accomplished through the following measures including: performing pool drawdowns (photograph ES-5), installing automated dam gates, and installing new gates at existing dam sites were evaluated.

Photograph ES-5. Before and After Pool Drawdown in Backwater Area

Outputs. In regard to tributary flows, regimes with reduced peaks and increased baseflows would provide more desirable levels of ecosystem function than currently occur. Within the tributaries, improved aquatic species survival is anticipated including, fish and macroinvertebrate populations. Like the tributary systems, two types of benefits were identified for the main stem: reduced fluctuations and area exposed by drawdown. In particular, the reductions in sudden water level rises in the summer is considered a critical element in restoring aquatic plant populations and reductions in rapid winter drops would protect native fish and other aquatic organism populations.

6. Water and Sediment Quality. Water clarity is the primary factor limiting submersed aquatic plants. During periods of high turbidity, aquatic plant growth is limited, since suspended sediments interfere with light penetration into the water. In addition to turbidity, the quality of the sediments, particularly in the main stem, may limit macroinvertebrates such as fingernail clams. Water resources in the Illinois River Basin are also impaired due to a combination of point and non-point sources of pollution.

Goal: Improve water and sediment quality in the Illinois River and its watershed (Goal 6)

Objectives

A. Achieve full use support for aquatic life in all surface waters, as defined in 303(d) of the Clean Water Act, of the Illinois River Basin by 2025

B. Achieve full use support for all uses on all surface waters of the Illinois River Basin in 2055

C. Encourage remediation of sites with contaminant issues that affect habitat

D. Achieve USEPA nutrient standards by 2025, following standards to be established by 2008

E. Work to minimize sedimentation as a cause of impairment as defined by 305(b) of the Clean Water Act by 2035

F. Maintain waters that currently support full use.

Measures. Separate measures were not identified for the sole purpose of water and sediment quality restoration. However, benefits would result from reductions in sediment, nutrient processing in restored floodplain and riparian areas.

Outputs. It is expected that water quality would continue to improve somewhat in the future because of improved waste and storm water treatment practices and local conservation efforts, and that improved water quality would translate into improvements in other ecosystem components. However, future gains would be less dramatic than in the past without also working on the other limiting factors.

PLAN FORMULATION

Eight alternative plans (including the No Action alternative) were formulated to provide a range of restoration options for consideration in addressing the system limiting factors to restore ecosystem structure and function. All alternatives, except the No Action alternative, would reduce anticipated future degradation. While the smaller scale alternatives would include focused efforts to provide regional habitat and regional ecological integrity benefits over the 50-year planning horizon, the larger scale alternatives would provide improvements in overall basin ecological integrity. In addition to restoration planning and implementation, all alternatives included a Technologies and Innovative Approaches Component and management costs. The Technologies and Innovative Approaches Component addresses the other components called for in Section 519: development and implementation of dredging and beneficial use technologies; long term resource monitoring; and a computerized inventory and analysis system.

Alternatives were formulated in coordination with State and Federal agencies to address the total additional restoration needs beyond the existing and expected future without project restoration funding levels. Based on the assessment of key evaluation criteria, Alternative 6 was selected as the preferred alternative. If fully implemented over the next 50 years, it would cost approximately $8 billion and provide measurable increases in system ecological integrity and sustainability over the without project condition. The Comprehensive Plan was formulated to address system restoration needs and was not specific to Corps of Engineers and Illinois Department of Natural Resources activities. As a result, the total restoration costs include a relatively large portion of work for other agencies. The process of identifying agency missions and programs has been initiated and documented in Section 6. The process of full multiple agency implementation will continue to develop over the initial years of the program.

Alternative 6 includes:

- Reducing systemic sediment delivery by 20 percent
- Restoring 12,000 acres of backwaters
- Restoring 35 side channels
- Protecting 15 islands
- Restoring 75,000 acres of main stem floodplain
- Restoring 75,000 acres of tributary floodplain and riparian areas
- Restoring 1,000 stream miles of aquatic habitat
- Providing fish passage along the Fox, DuPage, Des Plaines, Kankakee, Spoon, and Aux Sable Rivers

- Producing an 11 percent reduction in the 5-year peak flows in tributaries
- Increasing tributary base flows by 20 percent
- Reduce water level fluctuations along the main stem during the growing season by 66 percent
- Providing system level improvements in water quality

In total, this plan would provide benefits to approximately 225,000 acres and 33,000 stream miles. This alternative would achieve approximately 63 percent of the desired future conditions. Fully implemented, the anticipated benefits of Alternative 6 include reaching a number of key thresholds that are currently limiting ecological integrity. These include:

- Reducing water level fluctuations and turbidity to levels that allow for reestablishment of aquatic plants beds in the Illinois River
- Increase macro-invertebrate numbers as a food base for the system
- Increased depth diversity in backwaters areas providing spawning
- Nursery and overwintering habitat for native fish and habitat for the return of diving ducks
- Increased connectivity of riparian and aquatic habitats providing improved species and population viability of State and federally listed species

A tiered restoration program implementation is proposed for the Corps of Engineers participation, based on the scope of restoration activities in the 30,000 square mile basin and the uncertainties regarding funding for the other agencies. Tier I would involve an initial $153.85 million of effort ($100 million Federal) through roughly 2011. This timing would coincide with the proposed writing of a Report to Congress describing the accomplishments of the program and any needed adjustment to improve effectiveness. Tier II would address further restoration activities up to a total of $384.6 million ($250 million Federal) through 2015. Additional tiers would address remaining restoration needs. The timing and funding levels for further tiers can be refined based on increased understanding of system responses to the initial restoration projects and consideration of further developments regarding interagency funding and partnerships.

DESCRIPTION OF THE RECOMMENDED 2011 PLAN

The recommendation calls for continuing restoration efforts under the existing authority of Section 519. Initial Tier I restoration efforts with the first $153.85 million through 2011 are described below and would begin significant restoration consistent with eventual implementation of Alternative 6 (Tentatively Selected Plan). This initial phase is proposed to demonstrate the benefits of the various practices and project components prior to seeking additional funds. These restoration efforts would focus on the upper watershed and in particular the Peoria Pool and tributaries and Kankakee River. These are two of the high value resource areas, and due to their location in the upper reaches of the basin, have potential to more rapidly demonstrate the effectiveness of the various projects.

These efforts would be cost shared 65 percent Federal ($100 million) and 35 percent non-Federal ($53.85 million). This funding level would provide approximately $127.0 million for planning, design, construction and adaptive management of critical restoration projects; $24.1 million for the technologies and innovative approaches component; and $2.75 million for system management. The estimated annual Operation and Maintenance cost, once all features are in place, is $125,000. If funding is available a report to Congress will be submitted in the 2011 time frame, documenting the project successes and the results from Tier I efforts.

The following sections describe these aspects of the initial restoration efforts in greater detail. Funding would address three major areas with funding at approximately the level indicated.

Restoration Projects. The majority of the funding, roughly 82.5 percent or $127.0 million (including $7.75 million in adaptive management if required) of the initial $153.85 million, would be targeted to address component (b)(3)(B) of Section 519 (WRDA 2000) calling for the development and implementation of a program to plan, design, and construct restoration projects. While all goal categories are important and would be addressed to some extent in efforts through 2011, initial activities will emphasize the most critical restoration issues: reduce sediment delivery (Goal 1), restore side channels and backwaters (Goal 2), and reduce water level fluctuations (Goal 5). The following priority areas will be addressed initially, with potential for more depending on actual costs/availability of funds.

- Small Watersheds – 8 watersheds
- Major Tributaries – two reaches
- Mainstem – three backwaters, four side channels and islands, and one floodplain

Included in the restoration projects will be the sixteen critical restoration projects identified to date. These include eight small watershed projects: Waubonsie Creek, Senachwine Creek, Crow Creek West, Tenmile Creek, Yellow River, Iroquois River, Blackberry Creek, and McKee Creek; two major tributary projects on the Kankakee River and Fox River; and seven main stem projects, including backwater restorations, Peoria Riverfront – Upper Island and Pekin Lake – Southern Unit and a main stem floodplain restoration at Pekin Lake – Northern Unit, and side channel and island projects in Starved Rock, LaGrange, and Alton Pools.

Based on the large study area, complexity of the ecosystem restoration and the opportunities for increased cost effectiveness, adaptive management is recommended to be included within restoration funding.

Technologies and Innovative Approaches Component. Approximately 15.7 percent or approximately $24.1 million of the $153.85 million authority would be utilized to conduct a Technologies and Innovative Approaches Component to address the other three components called for in Sec 519 (b)(3): a long-term resource monitoring program; a computerized inventory and analysis system; and a program to encourage innovative dredging technology and beneficial use of sediments. Monitoring is particularly important due to the complexity and scale of the Illinois River Basin; feedback from monitoring efforts will be necessary to determine if adjustments are needed to the goals and restoration approaches to maximize the cost effectiveness of activities. The outputs of all monitoring efforts will be closely coordinated with project teams and adaptive management efforts to maximize the effectiveness of restoration activities.

1) System Level and Goal Level Monitoring: Estimated cost - $12.5 million
2) Project Level Monitoring: Estimated cost - $8.7 million
3) Computerized Inventory and Analysis (CIA) System: Estimated cost - $960,000
4) Special Studies: Estimated cost - $2 million
5) Innovative Sediment Removal and Beneficial Use Technologies: Funding would be drawn from special studies or incorporated in construction activities

System Management. Approximately 1.8 percent or $2.75 million of the $153.85 million authority would be utilized to manage the restoration efforts. Management funds would include funding for both the Corps of Engineers Districts and non-Federal Sponsors for project management and coordination activities.

IMPLEMENTATION STRATEGY

An implementation framework for the Illinois River Basin Restoration study will guide the actions taken to achieve the system study recommendations. The system formulation developed the restoration vision, goals, objectives, and level of restoration effort identified in the recommended plan. The implementation framework provides the organizational structure to oversee: identification, selection, study and implementation of restoration projects; monitoring and adaptive management activities; and further system investigations.

The plan implementation process specifically addresses how activities proposed for funding through the Corps of Engineers would be conducted. However, the approach of utilizing multi-agency regional teams to review project submissions and the involvement of higher level staff from other agencies in an Illinois River Basin Steering Committee will provide a sound basis for the matching of proposed restoration with the authorities and funding of various agencies.

The proposed assessment and implementation process seeks to create a systemic, comprehensive approach that is transparent and accessible to project partners and stakeholders. The ecological merits of proposed projects will be the most important factor. Other factors to be considered will include goal-specific factors, presence of threats, sustainability, public interest and acceptability, and administrative issues. It is important to emphasize that project implementation will not proceed rigidly in strict order of numerical rankings. Flexibility is essential, and the Corps of Engineers, working with the sponsor, in consultation with the program partners, will need to exercise reasonable judgment to resolve unexpected issues, respond to opportunities, and ensure efficient program execution. Due to the watershed approach being taken during implementation, regulatory agencies will be included in assessment and feasibility phases to better identify areas of concern.

RECOMMENDATIONS

It is recommended that the Illinois River Basin Restoration Program, authorized in Section 519 of WRDA 2000, be continued and expanded to more fully address the restoration needs of this nationally significant resource. Corps of Engineers cost shared restoration efforts would begin with $153,850,000 ($100,000,000 Federal funds) in restoration funds through 2011 (Tier I) with the potential to expand to $384,615,000 ($250,000,000 Federal funds) in restoration efforts through 2015 (Tier II). The funding and activities would begin significant restoration consistent with eventual implementation of Alternative 6 (Tentatively Selected Plan). These initial phases are proposed to demonstrate the benefits of the various practices and project components prior to seeking additional funding.

Tier I efforts would be cost shared 65 percent Federal ($100 million) and 35 percent non-Federal ($53.85 million). This funding level would provide approximately $127.0 million for planning, design, construction and adaptive management of restoration projects; $24.1 million for the technologies and innovative approaches component; and $2.75 million for system management. The estimated annual Operation and Maintenance cost, once all features are in place, is $125,000. If funding is available a Report to Congress will be submitted in the 2011 time frame, documenting the project successes and the results from Tier 1 activities.

The current authorization provides ongoing authority to evaluate and implement Critical Restoration Projects. It is recommended that the Illinois River Basin Restoration Program, authorized in Section 519 of WRDA 2000, be modified to more fully address restoration needs of this nationally significant resource. These recommendations were developed in cooperation with the State of Illinois Department of Natural Resources, other Federal and State agencies, local governments, and various non-governmental organizations.

Recommended Amendments to Section 519 of the Water Resources Development Act (WRDA) of 2000, Public Law 106-541

A. That the per project Federal cost limit for Critical Restoration Project be increased from $5 million to $20 million. Increasing the per project cost limit would allow implementation of a wider range of critical restoration projects more directly matching the scale identified in the Comprehensive Planning efforts. Without modification many larger projects could not be implemented as effectively or at all.

B. That the current authorization for Critical Restoration Projects be expanded to more fully address component (b)(3)(B) calling for the development and implementation of a program for the planning, conservation, evaluation and construction of measures for fish and wildlife habitat conservation and rehabilitation, and stabilization and enhancement of land and water resources in the Basin. Replace the specific criteria for Critical Restoration Projects found in Section 519, with a requirement that restoration projects be identified following an implementation framework and inter-agency coordination. Individual critical restoration projects may involve restoration activities at several non-contiguous locations within a pool or sub-watershed.

C. That authorization for implementation of a Technologies and Innovative Approaches Component be provided as a complement to the Critical Restoration Project activities. Activities would include initiatives called for in Section 519 (b)(3)(A) development and implementation of dredging and beneficial use technologies; (C) long term resource monitoring; and (D) and a computerized inventory and analysis system.

D. That authorization be provided allowing the development of cooperative agreements and fund transfers between the Corps of Engineers and the State of Illinois: scientific surveys at the University of Illinois; and units of local government: counties, municipalities, and Soil and Water Conservation Districts to facilitate more efficient partnerships.

E. That authorization be provided that the Chief of Engineers may enter into cooperative agreements with the Natural Resources Conservation Service for services to be performed by contract, grant or agreement, or by any other instrument or resource available to and consistent with the authorities of the Natural Resources Conservation Service.

F. That the authorization be expanded to allow non-profit organizations to serve as sponsors and sign PCAs for restoration projects implemented under the Illinois River Basin Restoration program. Notwithstanding Section 221 of the Flood Control Act of 1970 (42 U.S.C. §1962d-5b), for any Illinois River Basin Restoration project carried out under Section 519 (c) of the Water Resources Development Act of 2000, a non-Federal interest and sponsor may include a non-profit organization, with the consent of the of the affected local government.

G. That the Secretary of the Army, in consultation with the State of Illinois, submit a report to Congress every 6 years describing the accomplishments of the programs and any needed adjustment. Submittal of this report is to be timed to allow consideration as part of a comprehensive Water Resources Development Act.

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

CONTENTS

* Denotes sections required for Environmental Assessment/NEPA Compliance

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

PUBLIC REVIEW DRAFT

1. INTRODUCTION

A. STUDY AUTHORITY

Prior to initiating Federal involvement in addressing water resources problems, the U.S. Army Corps of Engineers (Corps) must have authority to investigate the problem. In the case of the Illinois River Basin, the Corps is partnering with the Illinois Department of Natural Resources (DNR) on two similar and complementary studies of the resources in the Basin.

This post authorization change report represents a final response to the Comprehensive Plan portion of the Illinois River Basin Restoration authority provided in Section 519 of the Water Resources Development Act (WRDA) 2000 and to the Illinois River Ecosystem Restoration Feasibility Study conducted under Section 216 of the 1970 Flood Control Act as a review of the completed 9-Foot Channel Navigation Project. The complementary nature of the Illinois River Ecosystem Restoration efforts and the Illinois River Basin Restoration Comprehensive Plan (Comprehensive Plan) effort led to the decision to present the findings in a joint Comprehensive Plan document. The Section 519 authorization also provides ongoing authority to evaluate and implement critical restoration projects.

Study efforts in the basin were first initiated through the Illinois River Ecosystem Restoration Study as part of the Corps' General Investigations (GI) Program. The study was initiated pursuant to the provision of funds in the Energy and Water Development Appropriations Act, 1998. The study reviewing the 9-Foot Channel Navigation Project was authorized by Section 216 of the 1970 Flood Control Act, which reads:

> *The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to significant changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest.*

Congress provided an authority to more specifically address Illinois River Basin Restoration in Section 519 of the Water Resources Development Act (WRDA) of 2000. This authority calls for the completion of a comprehensive plan and critical restoration projects. Efforts under Section 519 were initiated following the provision of funds in the Energy and Water Development Appropriations Act of 2002. The authority states:

SEC. 519 (WRDA 2000). ILLINOIS RIVER BASIN RESTORATION.

(a) ILLINOIS RIVER BASIN DEFINED- In this section, the term `Illinois River basin' means the Illinois River, Illinois, its backwaters, its side channels, and all tributaries, including their watersheds, draining into the Illinois River.

(b) COMPREHENSIVE PLAN-

(1) DEVELOPMENT- The Secretary shall develop, as expeditiously as practicable, a proposed comprehensive plan for the purpose of restoring, preserving, and protecting the Illinois River basin.

(2) TECHNOLOGIES AND INNOVATIVE APPROACHES- The comprehensive plan shall provide for the development of new technologies and innovative approaches--
(A) to enhance the Illinois River as a vital transportation corridor;
(B) to improve water quality within the entire Illinois River basin;
(C) to restore, enhance, and preserve habitat for plants and wildlife; and
(D) to increase economic opportunity for agriculture and business communities.

(3) SPECIFIC COMPONENTS- The comprehensive plan shall include such features as are necessary to provide for—
(A) the development and implementation of a program for sediment removal technology, sediment characterization, sediment transport, and beneficial uses of sediment;
(B) the development and implementation of a program for the planning, conservation, evaluation, and construction of measures for fish and wildlife habitat conservation and rehabilitation, and stabilization and enhancement of land and water resources in the basin;
(C) the development and implementation of a long-term resource monitoring program; and
(D) the development and implementation of a computerized inventory and analysis system.

(4) CONSULTATION- The comprehensive plan shall be developed by the Secretary in consultation with appropriate Federal agencies, the State of Illinois, and the Illinois River Coordinating Council.

(5) REPORT TO CONGRESS- Not later than 2 years after the date of enactment of this Act, the Secretary shall transmit to Congress a report containing the comprehensive plan.

(6) ADDITIONAL STUDIES AND ANALYSES- After transmission of a report under paragraph (5), the Secretary shall continue to conduct such studies and analyses related to the comprehensive plan as are necessary, consistent with this subsection.

(c) CRITICAL RESTORATION PROJECTS-

(1) IN GENERAL- If the Secretary, in cooperation with appropriate Federal agencies and the State of Illinois, determines that a restoration project for the Illinois River basin will produce independent, immediate, and substantial restoration, preservation, and protection benefits, the Secretary shall proceed expeditiously with the implementation of the project.

(2) AUTHORIZATION OF APPROPRIATIONS- There is authorized to be appropriated to carry out projects under this subsection $100,000,000 for fiscal years 2001 through 2004.

(3) FEDERAL SHARE- The Federal share of the cost of carrying out any project under this subsection shall not exceed $5,000,000.

(d) GENERAL PROVISIONS-

(1) WATER QUALITY- In carrying out projects and activities under this section, the Secretary shall take into account the protection of water quality by considering applicable State water quality standards.

(2) PUBLIC PARTICIPATION- In developing the comprehensive plan under subsection (b) and carrying out projects under subsection (c), the Secretary shall implement procedures to facilitate public participation, including providing advance notice of meetings, providing adequate opportunity for public input and comment, maintaining appropriate records, and making a record of the proceedings of meetings available for public inspection.

(e) COORDINATION- The Secretary shall integrate and coordinate projects and activities carried out under this section with ongoing Federal and State programs, projects, and activities, including the following:

(1) Upper Mississippi River System-Environmental Management Program authorized under Section 1103 of the Water Resources Development Act of 1986 (33 U.S.C. 652).

(2) Upper Mississippi River Illinois Waterway System Study.

(3) Kankakee River Basin General Investigation.

(4) Peoria Riverfront Development General Investigation.

(5) Illinois River Ecosystem Restoration General Investigation.

(6) Conservation Reserve Program (and other farm programs of the Department of Agriculture).

(7) Conservation Reserve Enhancement Program (State) and Conservation 2000 Ecosystem Program of the Illinois Department of Natural Resources.

(8) Conservation 2000 Conservation Practices Program and the Livestock Management Facilities Act administered by the Illinois Department of Agriculture.

(9) National Buffer Initiative of the Natural Resources Conservation Service.

(10) Nonpoint source grant program administered by the Illinois Environmental Protection Agency.

(f) JUSTIFICATION-

(1) IN GENERAL- Notwithstanding Section 209 of the Flood Control Act of 1970 (42 U.S.C. 1962-2) or any other provision of law, in carrying out activities to restore, preserve, and protect the Illinois River basin under this section, the Secretary may determine that the activities--

(A) are justified by the environmental benefits derived by the Illinois River basin; and
(B) shall not need further economic justification if the Secretary determines that the activities are cost-effective.

(2) APPLICABILITY- Paragraph (1) shall not apply to any separable element intended to produce benefits that are predominantly unrelated to the restoration, preservation, and protection of the Illinois River basin.

(g) COST SHARING-

(1) IN GENERAL- The non-Federal share of the cost of projects and activities carried out under this section shall be 35 percent.

(2) OPERATION, MAINTENANCE, REHABILITATION, AND REPLACEMENT- The operation, maintenance, rehabilitation, and replacement of projects carried out under this section shall be a non-Federal responsibility.

(3) IN-KIND SERVICES- The Secretary may credit the value of in-kind services provided by the non-Federal interest for a project or activity carried out under this section toward not more than 80 percent of the non-Federal share of the cost of the project or activity. In-kind services shall include all State funds expended on programs and projects that accomplish the goals of this section, as determined by the Secretary. The programs and projects may include the Illinois River Conservation Reserve Program, the Illinois Conservation 2000 Program, the Open Lands Trust Fund, and other appropriate programs carried out in the Illinois River basin.

(4) CREDIT-
(A) VALUE OF LANDS- If the Secretary determines that lands or interests in land acquired by a non-Federal interest, regardless of the date of acquisition, are integral to a project or activity carried out under this section, the Secretary may credit the value of the lands or interests in land toward the non-Federal share of the cost of the project or activity. Such value shall be determined by the Secretary.
(B) WORK- If the Secretary determines that any work completed by a non-Federal interest, regardless of the date of completion, is integral to a project or activity carried out under this section, the Secretary may credit the value of the work toward the non-Federal share of the cost of the project or activity. Such value shall be determined by the Secretary.

B. DESCRIPTION OF THE STUDY AREA

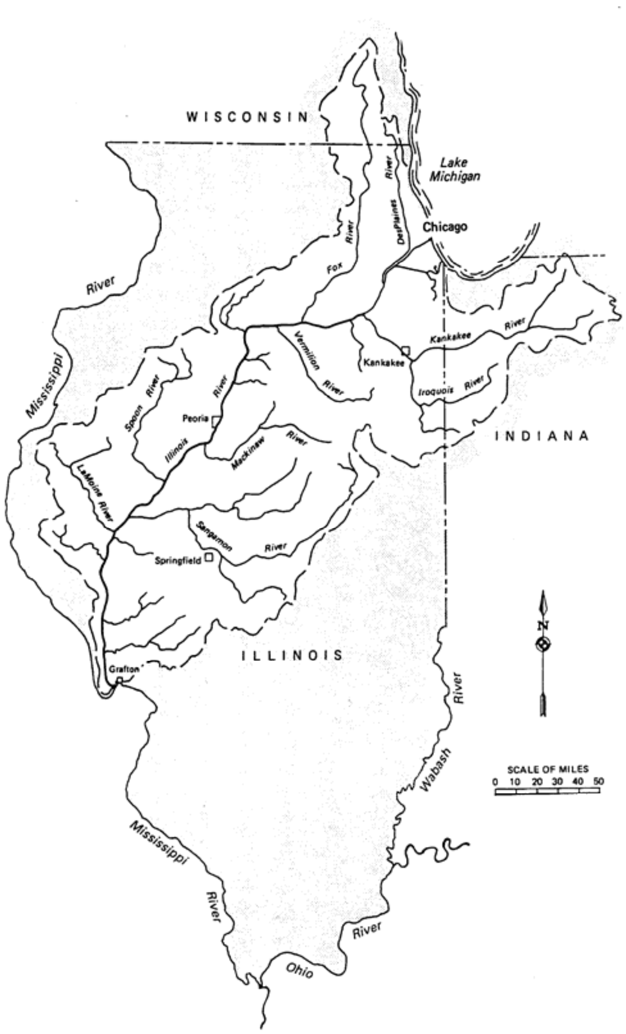

Figure 1-1. Location of the Illinois River Basin

The Illinois River begins at the point where the Des Plaines, and Kankakee Rivers converge near the Will and Grundy County lines. The river flows for a distance of 273 miles, ultimately entering the Mississippi at Grafton, IL, about 40 miles north of St. Louis. The Illinois River is the largest tributary to the Mississippi River above the mouth of the Missouri River. Major tributaries to the Illinois include the Des Plaines, Kankakee, Fox, Vermilion, Mackinaw, Spoon, Sangamon, and La Moine Rivers. The Illinois Environmental Protection Agency (IEPA) 305(b) report (2002), states that nearly 11,000 miles of perennial streams occur in the Illinois River Basin, with an estimated 20,000-25,000 additional miles of ephemeral streams. The study area encompasses the entire Illinois River Basin, the extents of which are shown in Figure 1-1.

The Illinois Waterway (figure 1-2) refers to the river and the navigation system that connects it to Lake Michigan through the Des Plaines and Chicago Rivers and man-made navigation channels. With this added length, the Illinois Waterway spans 327 miles from Lake Michigan to its confluence with the Mississippi River. A series of eight lock and dam facilities maintain conditions suitable for navigation.

The entire Illinois River Basin encompasses approximately 30,000 square miles (19.2 million acres), covering 44 percent (16.5 million acres) of the land area of the State of Illinois and including more than a dozen tributaries of the main river. About 1,000 square miles of the watershed, the upper portions of the Fox and Des Plaines Rivers, extend into Wisconsin. The Kankakee and Iroquois Rivers extend 3,200 square miles into Indiana. The Illinois River Basin includes 46 percent of Illinois' agricultural land, 28 percent of its forests, 37 percent of its surface waters and streams, and 95 percent of its urban areas.

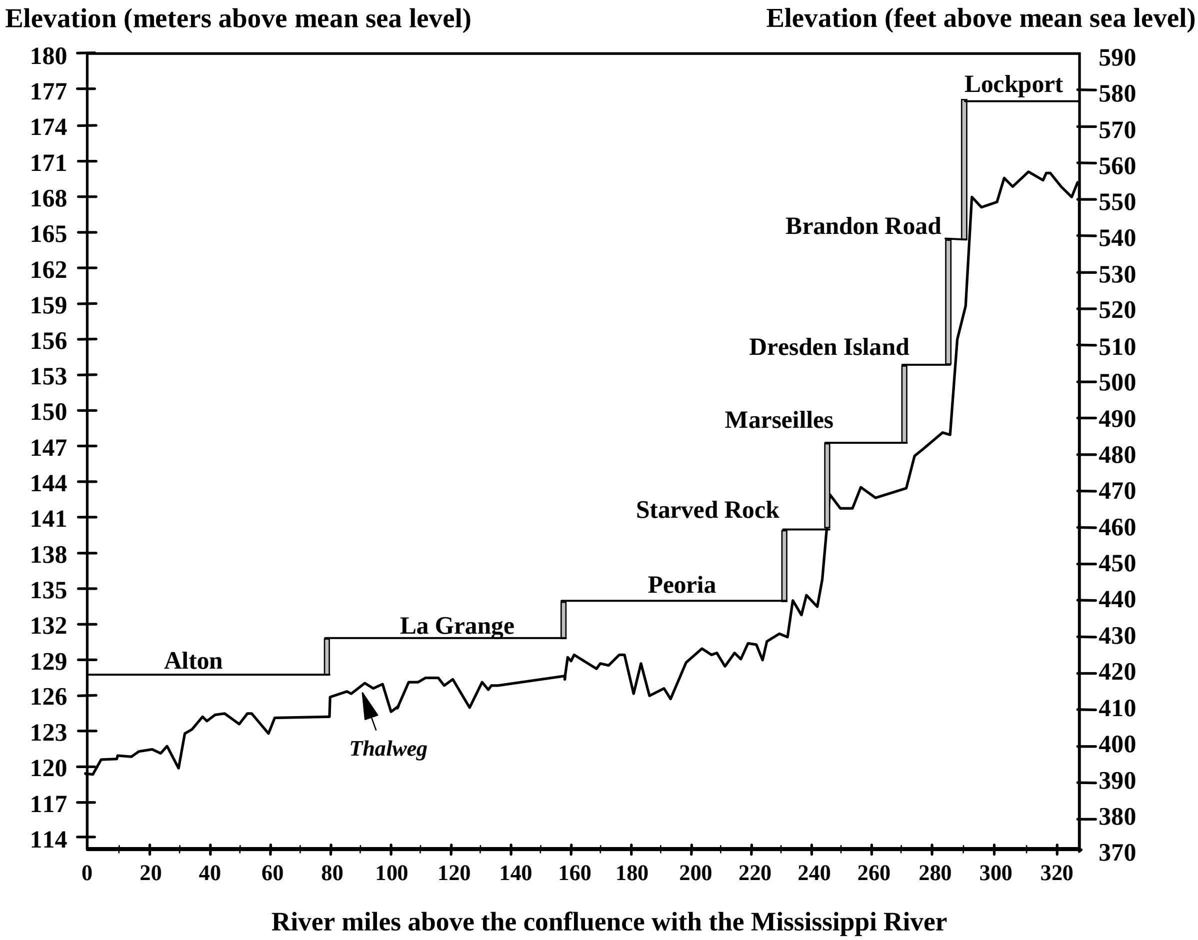

Figure 1-2. A Longitudinal Profile of the Illinois Waterway Lock and Dam System

The original efforts for this program focused on the Illinois portion of the basin. If and when future projects associated with this comprehensive plan are proposed for areas outside Illinois, individual coordination with appropriate Federal and State agencies would be required during project planning for compliance with National Environmental Policy Act (NEPA) and other Federal laws and policies applicable to all plans recommended for implementation.

The Congressional Districts located at least partially within the Illinois River Basin include Rush IL-1, Jackson IL-2, Lipinski IL-3, Gutierrez IL-4, Emanuel IL-5, Hyde IL-6, Davis IL-7, Bean IL-8, Schakowsky IL-9, Kirk IL-10, Weller IL-11, Biggert IL-13, Hastert IL-14, Johnson IL-15, Manzullo IL-16, Evans IL-17, LaHood IL-18, Shimkus IL-19, Visclosky IN-1, Chocola IN-2, Ryan WI-1, and Sensenbrenner WI-5.

C. STUDY PURPOSE AND SCOPE

The Rock Island, St. Louis, Chicago, and Detroit Districts of the Corps of Engineers and the Illinois DNR (non-Federal sponsor) collaborated to produce the Comprehensive Plan in response to two similar and complementary authorities to investigate the Federal and State interest in ecosystem restoration within the Illinois River Ecosystem. An Illinois River Basin Restoration Reconnaissance Study identifying a Federal interest in restoration under Section 216 was completed in February of 1999, with feasibility efforts initiated in 2000. Authorization of this Comprehensive Plan was provided in Section 519 of WRDA 2000 as described earlier in this Section. Following Corps Headquarters' approval of an Initial Assessment for the Section 519 authority in June 2002, the study team has progressed toward the completion of this Comprehensive Plan that presents the joint findings of investigations undertaken as part of both studies.

1. Study Purpose. At the broadest level, the Comprehensive Plan seeks to develop, evaluate, and implement a collaborative and sustainable watershed-based approach to ecosystem restoration. While a number of existing programs within the Corps of Engineers and other Federal agencies are designed to plan and implement ecosystem restoration or environmental quality improvements at specific locations in the basin, no program was in place that allowed for watershed-wide evaluation, problem identification, project selection, and implementation within one authority. Existing programs are limited in geographic extent or by available resources. The Illinois River Basin Restoration program meets that need by allowing for a comprehensive and collaborative watershed-based approach to solving the basin's problems and maximizing opportunities.

The Comprehensive Plan is being carried out in a manner consistent with the Corps' Environmental Operating Principles. The principles are consistent with NEPA; the Army's Environmental Strategy with its four pillars of prevention, compliance, restoration and conservation; and other environmental statutes and WRDAs that govern Corps activities. The Environmental Operating Principles are as follows:

- Strive to achieve environmental sustainability. An environment maintained in a healthy, diverse, and sustainable condition is necessary to support life.

- Recognize the interdependence of life and the physical environment. Proactively consider environmental consequences of Corps programs and act accordingly in all appropriate circumstances.

- Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.

- Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems.

- Seek ways and means to assess and mitigate cumulative impacts to the environment; bring systems approaches to the full life cycle of our processes and work.

- Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and impacts of our work.

- Respect the views of individuals and groups interested in Corps activities, listen to them actively, and learn from their perspective in the search to find innovative win-win solutions to the nation's problems that also protect and enhance the environment.

The proposed project was formulated according to the Environmental Operating Principles, especially in terms of maximizing the sustainability of ecological features. The project includes a watershed approach that seeks to address the water resources needs holistically. The goal of this project is to build on existing knowledge and share lessons learned on the restoration of this significant natural resource through the use of monitoring, adaptive management, and innovative technologies and approaches. The implementation framework proposed as part of this system study seeks to work collaboratively, fully engaging individuals, agencies, and local groups in the identification, planning, and implementation of restoration efforts.

2. Study Scope. This report assesses the total basin restoration needs and makes specific recommendations regarding modification of the existing Section 519 authority to improve implementation. The Corps and Illinois DNR (non-federal sponsor) worked together in coordination with numerous other State and Federal agencies on the Comprehensive Plan. The Illinois River Ecosystem Restoration Feasibility Study was initiated in 2000 to evaluate the need for and plan restoration at the watershed scale. Since the Illinois River Basin Ecosystem Restoration Feasibility Study was ongoing and already provided a general analysis of the basin's restoration needs. The focus of Section 519 activities was on addressing the four components identified in Sec 519 (b)(3). Less effort and focus was placed on (b)(2). The Comprehensive plan activities address the four areas of technologies and innovative approaches identified in Sec 519 (b)(2) and the four components identified in Sec 519 (b)(3), as described below."

(b) COMPREHENSIVE PLAN-

(2) TECHNOLOGIES AND INNOVATIVE APPROACHES- The comprehensive plan shall provide for the development of new technologies and innovative approaches--

(A) to enhance the Illinois River as a vital transportation corridor; <u>Activities related to enhancing transportation are being addressed through the Upper Mississippi River – Illinois Waterway System Navigation Study and subsequent Planning, Engineering, and Design efforts, duplication of this effort was not necessary since the Navigation Study covers navigation needs in the entire Illinois River Basin.</u>

(B) to improve water quality within the entire Illinois River basin; <u>The comprehensive plan includes a goal (Goal 6) – that addresses water and sediment quality. The proposed restoration activities if implemented will address water quality on a watershed basis through a wide range of potential measures.</u>

(C) to restore, enhance, and preserve habitat for plants and wildlife; <u>The major focus of the Comprehensive report and the measures and alternatives address this item. and</u>

(D) to increase economic opportunity for agriculture and business communities <u>Activities related to economic opportunity are being addressed through the Upper Mississippi River – Illinois Waterway System Navigation Study and Upper Mississippi River Comprehensive Plan, duplication of these effort was not necessary as part of this effort..</u>

(3) SPECIFIC COMPONENTS- The comprehensive plan shall include such features as are necessary to provide for—

(A) the development and implementation of a program for sediment removal technology, sediment characterization, sediment transport, and beneficial uses of sediment; <u>This component is planned for inclusion as part of the Technologies and Innovative Components element of this Comprehensive Plan.</u>

(B) the development and implementation of a program for the planning, conservation, evaluation, and construction of measures for fish and wildlife habitat conservation and rehabilitation, and stabilization and enhancement of land and water resources in the basin; *The major focus of this report, restoration measures, system alternatives, and the recommendations address this item.*

(C) the development and implementation of a long-term resource monitoring program; *This component is planned for inclusion as part of the Technologies and Innovative Components element of this Comprehensive Plan.*

(D) the development and implementation of a computerized inventory and analysis system. *This component is planned for inclusion as part of the Technologies and Innovative Components element of this Comprehensive Plan.*

a. Comprehensive Plan. The purpose of the Comprehensive Plan is to meet Federal planning requirements and congressional authority in identifying restoration needs within the basin. The Illinois River Ecosystem Restoration Feasibility Study effort identified problems and opportunities, defined existing and future conditions in the basin, developed a consensus-based desired future condition and restoration needs, documented resource significance, and formulated at the system level to determine Federal interest and level of effort required. Related to these efforts was the development of a restoration program and prioritization process. In addition, Section 519 funding was used to address Comprehensive Plan requirements from that legislation including: (1) the development and implementation of a program for sediment removal technology, sediment characterization, sediment transport, and beneficial uses of sediment; (2) the development and implementation of a program for the planning, conservation, evaluation, and construction of measures for fish and wildlife habitat conservation and rehabilitation, and stabilization and enhancement of land and water resources in the basin; (3) the development and implementation of a long-term resource monitoring program; and (4) the development and implementation of a computerized inventory and analysis system. The study area is the entire Illinois River Basin. However, study and restoration initiatives placed particular focus on the rivers, streams, floodplain, and adjacent riparian corridors.

The following descriptions detail the major study investigations conducted under the Illinois River Ecosystem Restoration Study (Section 216) and Illinois River Basin Restoration (Section 519) efforts, respectively. These combined efforts resulted in an integrated Comprehensive Plan for the Illinois River Basin that satisfies both authorities for restoration of the Illinois River Basin Ecosystem.

b. Illinois River Ecosystem Restoration Study Major Investigations. Study activities being undertaken as part of the Illinois River Ecosystem Restoration study, Section 216, were cost shared 50/50 between the Federal Government and Illinois DNR and include:

- **Develop Goals and Objectives.** System level goals and objectives were developed under the Ecosystem Study and are presented in Section 3.

- **System Restoration Needs Assessment (RNA).** The RNA aspect of the study was designed to evaluate existing data availability; compile existing data in a Geographic Information Systems (GIS) application; describe physiographic characteristics of the basin; evaluate stream channel dynamics; evaluate rapid watershed assessment techniques; evaluate existing, predicted, and desired future conditions; and compile a list of information needs.

The RNA provided information that significantly contributed to the development of the Comprehensive Plan and monitoring program and will aid in the selection of future Critical Restoration Projects called for in Section 519 legislation. Specific items are summarized in Appendices B, *System Ecology*; C, *Hydraulics and Hydrology;* and D, *Sediment Analysis.* The following text highlights some of the major efforts:

1. Sediment Budget. An updated sediment budget for the basin was completed.

2. Summary of Illinois River Basin Landform and Physiographic Regions. The physiographic regions of the Illinois River Basin were updated and were used to provide part of the physical context necessary to evaluate restoration opportunities.

3. Illinois River Restoration Needs Assessment GIS. A GIS tool has been developed to allow for the evaluation of readily available data on basin characteristics including land use/land cover, water quality, etc.

4. Water Level Analysis. An evaluation of the causes of rapid water level fluctuations was completed. The results set the context for what types of management and restoration activities are required to improve the hydraulic regime of the Illinois River Basin.

5. Basin Hydrologic Model. A coarse grid model of the basin was developed. This model was used to assess the potential for various types of restoration approaches to affect basin hydrology and sediment movements and identify the order of magnitude of restoration actions necessary to have an effect.

- **System NEPA and Coordination.** The NEPA documentation and required coordination for this systemic project was addressed through an integrated programmatic Environmental Assessment (EA) within this report. Subsequent NEPA documentation and coordination will be represented by individual, site-specific EAs and will be compiled for all future ecosystem restoration/critical restoration projects after they have been identified.

c. Illinois River Basin Restoration Major Investigations. Major investigations undertaken as part of the Illinois River Basin Restoration (Section 519) authority are cost shared 65/35 between the Federal Government and the State of Illinois, address the legislation, and include:

- **Development and implementation of a program for sediment removal technology, sediment characterization, sediment transport, and beneficial uses of sediment.** This task focused on the review, evaluation, and determination of applicability for existing sediment removal technology, sediment characterization, sediment transport, and beneficial use of sediment within the Illinois River Basin. Two field demonstrations of innovative sediment removal methods and technologies took place in the fall of 2002. These included the testing of the viability of various technologies (concrete pump and boom and mobile conveyor belt system) to move Illinois River sediments, and the viability of transporting sediments to the City of Chicago to add topsoil to brownfield sites. The product of this task is a concise summary of the various sediment removal, transport, and beneficial use options, their advantages and disadvantages, and appropriate application recommendations for the basin.

- **Development and implementation of a program for the planning, conservation, evaluation, and construction of measures for fish and wildlife habitat conservation and rehabilitation, and stabilization and enhancement of land and water resources in the basin.** The development of this program was the major outcome of the plan formulation efforts of the Comprehensive Plan. Based on the system level understanding gained through the various information gathering and analysis tasks, a proposed implementation framework has been developed and is presented in Section 6I, *Plan Formulation.*

- **Development and implementation of a long-term resource monitoring program.** Using contracts and interagency coordination, recommendations regarding system biological and physical monitoring as well as site-specific pre- and post-project monitoring recommendations have been developed. A program for long-term resource monitoring of the basin was documented, along with recommendations for implementation. The recommended program will help to better understand the system, identify changes, and provide a measure by which the cumulative effects of the implementation of critical restoration projects can be assessed.

- **Development and implementation of a computerized inventory and analysis system.** As part of efforts to develop a long-term resource monitoring program recommendations were developed for computerized inventory, analysis, and dissemination of information collected to interested parties.

d. Assumptions and Exceptions. The following assumptions provided the basis for development of the Comprehensive Plan:

- The without-project condition of the Illinois River Basin includes continued decline in ecological integrity due to sedimentation of backwaters and side channels, degradation of tributary streams, continued water level fluctuations, loss of floodplain and tributary connectivity, habitat loss and fragmentation, and other adverse impacts caused by human activities.

- The Comprehensive Plan was developed as a post authorization change report addressing Section 519 of WRDA 2000, and serves as a response to the complementary Illinois River Ecosystem Restoration Feasibility Study authority as well. Illinois River Ecosystem Restoration Study efforts will meet NEPA, U.S. Fish and Wildlife Service (USFWS) coordination, and programmatic cultural compliance, etc. for the system investigations. A separate feasibility level Project Implementation Report will be prepared for each Critical Restoration Project. These documents will provide the basis for individual project approvals and will address Federal and State environmental and cultural requirements.

- The Comprehensive Plan developed recommendations consistent with the Upper Mississippi River - Illinois Waterway System Navigation Feasibility Study and the Upper Mississippi River Comprehensive Plan projects, but did not include efforts and investigations regarding transportation and flood protection needs, since these areas are comprehensively addressed by these aforementioned Corps studies.

- Future implementation of currently unauthorized projects—Upper Mississippi River - Illinois Waterway System Navigation Feasibility Study; the Upper Mississippi River Comprehensive Plan; and Kankakee River Basin Study—is uncertain. As a result, the implementation framework in Section 6, *Plan Implementation,* describes how the relationship with other Corps programs would be addressed, but exact funding levels are not described. In regards to Navigation Study and follow-on efforts, Section 519 evaluated restoration alternatives throughout the entire watershed, while the Navigation Study ecosystem restoration components limit activities to areas along the Mainstem Illinois River. The mainstem restoration recommendations do overlap, but if both are authorized the Navigation Study follow-on funding would be used for the majority of mainstem restoration efforts. In addition, provisions were made to closely coordinate future restoration efforts to maximize effectiveness and avoid any duplication.

e. Critical Restoration Projects. In addition to the work on the Comprehensive Plan, Section 519 also authorized the identification and implementation of projects within the watershed and along the course of the river that repair past and ongoing ecological damage so that a more highly functioning, self-regulating ecosystem can develop within the existing basin context. Critical restoration projects would produce immediate habitat and sediment reduction benefits; will help evaluate the effectiveness of various restoration methods before application system wide; and make best use of the current strong local and State interest in ecosystem restoration within the basin. The Corps of Engineers will implement these critical restoration projects in collaboration with the non-Federal sponsor and with other Federal and local agencies. Section 6, *Plan Implementation,* contains additional information on potential project types and eight critical restoration projects initiated at the time of the writing of this report.

D. STUDY ORGANIZATION

1. Study Organizational Structure

The system study and further restoration and monitoring activities will be conducted under the following organizational structure:

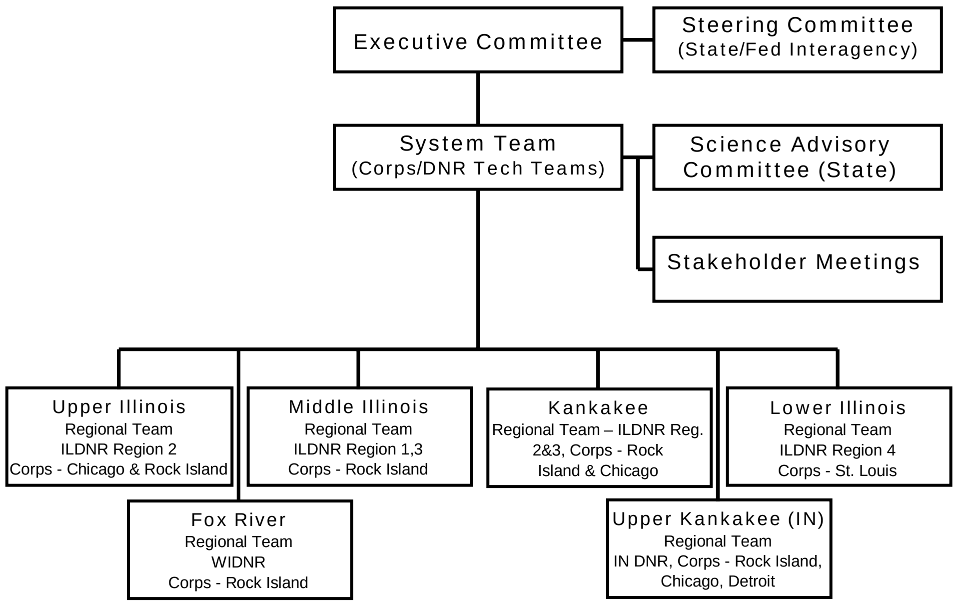

Figure 1-3. Study Organizational Structure

a. Executive Committee. The Committee will have representatives from both Regional Headquarters (i.e., Mississippi Valley Division (MVD) and Great Lakes and Ohio River Division), the Corps Districts (i.e., Rock Island, St. Louis, Chicago, and Detroit), and the non-Federal sponsors (i.e., Illinois Department of Natural Resources (DNR) and representatives from the states of Indiana and Wisconsin). The Executive Committee will be chaired by the MVD. It will be responsible for oversight on the management and implementation of the project, including decisions on project funding. The Executive Committee will meet approximately twice a year, with meeting schedules timed to synchronize receipt or provision of input from other committee meetings as needed.

b. Steering Committee. The Steering Committee will be the interagency group responsible for coordinating the Illinois River Basin and Ecosystem Restoration efforts. It will be co-chaired by the Corps of Engineers and the Illinois DNR, and will be composed of state and Federal agency representatives. This Committee will meet approximately twice a year to exchange views, information, and advice to ensure coordination among various agency programs.

c. System Team. The System Team will be composed of the multi-disciplinary technical staff primarily from the Corps of Engineers and State DNRs. Additional team members may be selected. This team will have primary responsibilities for overall project delivery and system evaluations. The team will incorporate the expertise of scientists and technical staff as necessary.

d. Regional Teams. Organizing efforts by geographic region allows for more efficient accomplishment of project activities. Four regions established for the basin are Upper Illinois, Middle Illinois, Kankakee, and Lower Illinois. The regional teams, made up of Corps of Engineers and State DNR staff, will have primary responsibilities for the evaluation and implementation of critical restoration projects. Two additional teams (Fox River and Upper Kankakee) may be added in the future if Wisconsin and Indiana choose to participate. Regional team meetings will provide a forum for groups—with detailed information on resource concerns—to exchange views and information regarding areas in need of assessment and potential critical restoration projects, evaluate the proposed site-specific projects, and facilitate the detailed study of these projects. Invited attendees include the Illinois Environmental Protection Agency, Illinois Department of Agriculture, representatives from the States of Indiana and Wisconsin, USDA Natural Resources Conservation Service and Farm Service Administration, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, U.S. Geological Survey, Ecosystem Partnership Groups, Soil and Water Conservation Districts , Non-Governmental Organizations, Levee and Drainage Districts, and Local Governments.

e. Stakeholders Meetings. Stakeholders meetings will provide a forum to present study status and information on implementation and management to all interested Federal, State, and local agencies, as well as non-governmental organizations. Stakeholders meetings will be held approximately once a year in each of the four regions or as interim products are completed. Their primary focus will be public involvement, information sharing, and dialog among all groups and interests.

f. Science Advisory Committee. The State of Illinois Science Advisory Committee, a sub-committee of the Illinois River Coordination Council, will provide input to the System Team.

2. U.S. Army Corps of Engineers Division of Responsibilities

The following structure is similar to that of the existing Upper Mississippi River - Environmental Management Program (UMR-EMP) and is proposed as a means of defining responsibilities throughout the Corps of Engineers in relation to Section 519 implementation. These responsibilities include, but are not limited to, the following:

a. Assistant Secretary of the Army (Civil Works) [ASA(CW)]. Final approval authority for products and critical restoration projects remains with ASA(CW) unless otherwise delegated.

b. Headquarters Level. The Corps of Engineers Headquarters (HQUSACE) maintains responsibility for the overall Section 519 Illinois River Basin Restoration Program, its budget, and approval authority for individual Critical Restoration Projects and coordination with ASA(CW).

c. Regional Headquarters Level. The Corps of Engineers' Mississippi Valley Division (MVD) will be responsible for overall execution direction and management of the Section 519 Illinois River Basin Restoration Program and coordination with the Great Lakes and Ohio River Division (LRD). Both MVD and LRD will serve on the Executive Committee, chaired by MVD.

d. Program Level. The Corps of Engineers' Rock Island District will administer regional project management responsibilities, including the following:

i. Serve as the primary point of contact for Illinois River Basin Restoration activities
ii. Report the program financial execution to MVD and others on a quarterly basis
iii. Coordinate the activities of the Executive Committee, Steering Committee, Stakeholders Group, and System Team
iv. Coordinate, consolidate, and forward to MVD all upward reporting requirements, such as budgetary information, fact sheets, and issue papers that require input from more than one district

v. Lead the comprehensive system study efforts
vi. Serve as lead responsible party for system monitoring efforts

e. Project Level. Each district shall carry out assigned tasks, participate in committees, and communicate funding and schedule information with the Rock Island District for consolidation and regional coordination. The responsibility for planning, design, construction, monitoring, and evaluation of Critical Restoration Projects will be assigned to the districts (Rock Island, St. Louis, Chicago and Detroit) based on their jurisdictional boundaries. The districts will be responsible for staffing, scheduling, and communicating funding needs for the efforts of individual Product Delivery Teams (PDTs) operating within their district boundaries. The assignment of projects that cross district boundaries will be determined by the Executive Committee, as necessary.

E. RELATIONSHIP AMONG CORPS, FEDERAL, AND STATE ACTIVITIES

Several ongoing activities involve collaborative efforts among Federal, State, and local agencies to address water and related land resources within the Illinois River Basin. The most significant Federal and state actions are briefly summarized below with additional detail on the activities and their relationship to this program described in greater detail in Section 6, *Plan Implementation.*

1. U.S. Army Corps of Engineers Efforts

The U.S. Army Corps of Engineers is currently conducting a wide range of study and implementation activities ranging from other ecosystem restoration activities to navigation and flood damage reduction. Specific ongoing activities in the basin include:

a. Peoria Riverfront Development (Ecosystem Restoration) Study, Illinois. The project is located within Peoria and Tazewell Counties, Illinois, between Illinois River Miles 162-167. The feasibility study was conducted by the Corps of Engineers and Illinois DNR (non-Federal sponsor) to investigate Federal and state interest in ecosystem restoration within Peoria Lake and the Farm Creek Watershed. The feasibility study, completed in 2003, recommended dredging and island creation. In 2004, approval was given to initiate dredging and construct the first of three islands as a Critical Restoration Project under Section 519 authority.

b. Upper Mississippi River System - Environmental Management Program. The Environmental Management Program (EMP) for the Upper Mississippi River System was established by WRDA 1986. Currently, the EMP is comprised of two elements—Habitat Rehabilitation and Enhancement Projects (HREPs) and the Long Term Resource Monitoring Program (LTRMP). This ongoing system program provides a combination of monitoring and habitat restoration activities.

c. Upper Mississippi River - Illinois Waterway System Navigation Study and the follow on Navigation and Ecosystem Sustainability Program (NESP). The study was completed in September 2004 and calls for navigation improvements and ecosystem restoration on the Upper Mississippi River and Illinois Waterway System. The study area includes 854 miles of the Upper Mississippi River, with 29 locks and dams, between Minneapolis/St. Paul and the mouth of the Ohio River, and 327 miles of the Illinois Waterway, with eight locks and dams. The study area lies within portions of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. The navigation system's principal problems are delays to commercial traffic due to limited lockage capacity and increasing traffic and the continued degradation of environmental resources. While no authorization for construction has been provided, follow-on study and design efforts were initiated in 2005 for a number of navigation and ecosystem restoration components.

d. Upper Mississippi River (UMR) Comprehensive Plan. The Comprehensive Plan Study was authorized by Section 459 of WRDA 1999 to "develop a plan to address water resource and related land resource problems and opportunities in the Upper Mississippi and Illinois River basins from Cairo, Illinois, to the headwaters of the Mississippi River, in the interest of the systemic flood damage reduction . . .". This study focuses primarily on the 500-year floodplains of the reach of the UMR between Anoka, Minnesota, and Thebes, Illinois, and the reach of the Illinois River between its confluence with the Mississippi and the confluence of the Kankakee and Des Plaines Rivers. The report will be completed in Fiscal Year 2006, with subsequent submission to Congress.

e. Kankakee River Basin Feasibility Study. The Kankakee River Basin, a major tributary to the Illinois River, drains an area of approximately 5,200 square miles in Illinois and Indiana. A study by the Chicago District of the U.S. Army Corps of Engineers is investigating opportunities within the basin for flood damage reduction, sediment reduction, and ecosystem restoration. The study is currently on hold due to funding.

2. Ongoing Federal Efforts

Other Federal Agencies that perform numerous restoration and monitoring programs and activities in the basin include the: U.S. Department of Agriculture, U.S. Environmental Protection Agency , U.S. Fish and Wildlife Service, and U.S. Geological Survey. More specifics on each agency's programs, authorities, and potential role in implementation are provided in Section 6, *Plan Implementation.*

3. Ongoing Efforts by the State of Illinois

The State of Illinois has focused a great deal of resources on the Illinois River Basin. These efforts include:

a. Watershed Management Committee (WMC). The WMC was formed by the directors of eight Illinois State agencies to address and coordinate issues among the state's natural resource and environmental agencies. The WMC has the following mission:

> *To serve in an ongoing capacity to coordinate watershed-based activities and programs among Illinois' natural resource and environmental agencies. The Committee will also serve a liaison function to provide for the coordination of Federal and local involvement in watershed activities.*

In 1998, the WMC was expanded to include additional State and Federal agencies, as well as several non-governmental organizations in order to both expedite the development of watershed approaches for resource planning and to promote greater coordination between State agencies and Federal counterparts. In an effort to restore and protect watersheds within the state, the WMC published *Unified Watershed Assessment and Watershed Restoration Priorities for Illinois*. This report and the associated action plan lists priority watersheds in the State of Illinois and calls for coordination of activities and resources to help protect and restore water resources. The Illinois River Watershed and many of its tributary watersheds are listed as priority watersheds.

b. The Integrated Management Plan for the Illinois River Watershed. This document was the culmination of several years of effort by local and state governments in Illinois to build a consensus-based partnership with citizens and interest groups to address the issues that face the Illinois River Basin. Conservation, environmental, industry, Federal, State, regional, and local governments all participated in shaping a vision for the future of the basin. The plan has also given policy direction to numerous independent state conservation programs in the pursuit of a unified approach to address the problems present in the basin.

c. Illinois River Watershed Restoration Act. In July 1997, the State of Illinois enacted the Illinois River Watershed Restoration Act. The legislative purposes of the Act were to: (1) create a group of leaders representing agriculture, business, conservation, and the environment to encourage the implementation of efforts to restore the Illinois River Watershed in accordance with the recommendations of the *Integrated Management Plan for the Illinois River Watershed Technical Report;* (2) work with local communities to develop projects and regional strategies; and (3) make recommendations to appropriate State and Federal agencies, or local programs.

d. Illinois River Coordinating Council IRCC). The IRCC was created by the Illinois River Watershed Restoration Act as described in (1) above, chaired by the Lieutenant Governor. The IRCC consists of a diverse group of citizens, grassroots and not-for-profit organizations, state and federal agencies, and river enthusiasts. The Agency members of the Council shall include the Director (or designee) of each of the following agencies: the Department of Agriculture; the Department of Commerce and Community Affairs; the Illinois Environmental Protection Agency; the Department of Natural Resources; and the Department of Transportation. In addition, the Council shall include one member representing Soil and Water Conservation Districts located within the Watershed of the Illinois River and its tributaries and 6 members representing local communities, not-for-profit organizations working to protect the Illinois River Watershed, business, agriculture, recreation, conservation, and the environment. The Governor may, at his or her discretion, appoint individuals representing federal agencies. The IRCC coordinates all private and public funding for river restoration in the sprawling Illinois River Watershed. Over the past four years, the IRCC has been involved in the commitment and expenditure of nearly $500 million to restore the Illinois River Basin.

e. Conservation Reserve Enhancement Program (CREP). More than $450 million has been targeted at the State and Federal level to improve the Illinois River through the CREP, which uses state funding to enhance existing USDA CRP activities. The CREP initiative if fully implemented will help preserve up to 232,000 acres of sensitive land surrounding the Illinois River and its tributaries, including upland areas. Illinois leads the nation in the number of acres currently enrolled at 110,000 in the Federal program, and the most acres permanently protected, 92 percent of the 73,000 acres enrolled in the State portion of the program.

f. Illinois Rivers 2020. This is an initiative of the State of Illinois that proposes to establish a $2.5 billion, 20-year State/Federal partnership to restore the basin. It seeks to build upon the success of the Illinois River Conservation Reserve Enhancement Program (CREP). It is a voluntary, incentive-based approach, broader and more inclusive than CREP and applies to the entire Illinois River and its tributaries. It addresses all the threats to the economic and environmental sustainability of Illinois' vitally important waterways. Illinois Rivers 2020 utilizes existing agencies, programs, and delivery mechanisms in the Farm Bill programs and the CWA Section 319 and seeks special consideration under the WRDA. The State of Illinois views the Illinois River Basin Restoration

Authority as the mechanism for the Corps of Engineers' to further develop a comprehensive plan and to initiate restoration activities. Further support for implementation of Illinois Rivers 2020 is very broad, including hundreds of individuals, elected officials, organizations, and businesses that officially support this effort.

g. Other State Programs: A number of programs administered by the Illinois DNR, Illinois Department of Agriculture, and Illinois Environmental Protection Agency (EPA) are helping to restore the basin and are described in Section 6, *Plan Implementation.*

h. Illinois Department of Natural Resources (DNR) – Conservation Lands. The Illinois DNR currently manages approximately 100,000 acres for conservation purposes in the basin. Twelve State of Illinois conservation areas totaling 26,568 acres can be found along with two state forests of 3,673 acres. Also, State Fish and Wildlife Areas can be found at 12 locations totaling 18,138 acres. Finally, the Illinois DNR operates 25 state parks within the Basin, with 42,138 acres dedicated to conservation and recreation.

F. CONCISE DISCUSSION OF STUDIES, REPORTS, AND EXISTING WATER PROJECTS

A number of documents were reviewed, including studies prepared by the U.S. Army Corps of Engineers, the Illinois DNR, the Illinois State Water Survey, the Illinois Natural History Survey, the Tri-County Regional Planning Commission, the University of Illinois, The Nature Conservancy, the Heartland Water Resources Council, and the Office of the Lt. Governor of the State of Illinois. Some of the most notable studies and actions are as follows:

The Fate of Lakes in the Illinois River Valley, Bellrose, Frank C., et al., Illinois Natural History Survey, 1983.

This document uses historical sedimentation rates for Illinois River backwater lakes to develop mathematical models of the life expectancy of Illinois River backwater lakes. Most backwaters filled dramatically with sediment at an average annual rate of 0.10 to 0.74 inches since the 1930's. System-wide, backwater lakes have lost an average of 70 percent of their volume since 1903.

Sediment Yield of Streams in Northern and Central Illinois, Adams, J. Roger, et al., Illinois State Water Survey, December 1984.

This report developed mathematical models to estimate sediment yields for streams in the Illinois River Basin based on sediment monitoring data.

Peoria Lake Sediment Investigation, prepared for the U.S. Army Corps of Engineers by the Illinois Department of Energy and Natural Resources, State Water Survey Division, January 1986.

This report summarizes the impacts of human activities on sedimentation using data from bathymetric profiles and core samples. It concludes that controlling sedimentation in Peoria Lake would require some combination of controlling sediment input, managing in-lake sediment, drawing down Peoria Lake, creating artificial islands, selective dredging, and creating marshy areas.

Illinois River from Henry to Naples, Illinois, Peoria Lake and La Grange Pool, Illinois River Basin, U.S. Army Corps of Engineers Reconnaissance Study, March 1987.

This study, authorized in Section 109 of Section 1304 of the Supplemental Appropriations Act, investigates the advisability of the preservation, enhancement, and rehabilitation of Peoria Lake near Peoria, Illinois.

Hydraulic Investigation for the Construction of Artificial Islands in Peoria Lake, Illinois Department of Energy and Natural Resources, State Water Survey Division, Champaign, Illinois, July 1988.
This investigation identifies alternative locations for building islands in Upper and Lower Peoria Lakes. Hydraulic modeling was used to determine the effects of islands upon water surface elevations, sedimentation patterns, and current velocities.

Upper Mississippi River System-Environmental Management Program, Peoria Lake Habitat Rehabilitation and Enhancement Project Definite Project Report, U.S. Army Corps of Engineers, July 1990.
This technical publication, complete with NEPA documentation and engineering plans, was the authorizing document by which a 16-acre barrier island was created in Upper Peoria Lake. This project enhanced migratory waterfowl, fish, and aquatic habitat. Project monitoring indicates an increase in absolute numbers and diversity of water bird and fish species at the project site.

The Illinois River: Working for Our State, Talkington, Laurie McCarthy, Illinois State Water Survey, January 1991.
This document summarizes information on the past, current, and projected future conditions of the Illinois River.

Erosion and Sedimentation in the Illinois River Basin, Demissie, Misganaw, et al., Illinois State Water Survey, June 1992. This report estimates a sediment budget for the Illinois River Valley.
The report also discusses the effect of changed crop practices upon sediment loads.

Source Monitoring and Evaluation of Sediment Inputs for Peoria Lake, Bhowmik, Nani G., et al., Illinois State Water Survey, February 1993.
The objectives of this study were to identify the sediment sources to Peoria Lake and to evaluate sediment loads from local tributaries. This study evaluated the sources of sediment in Peoria Lake and estimated that a large percentage of sediment in the lake comes from local tributaries.

Section 216 Initial Appraisal, Illinois Waterway System Ecosystem Restoration and Sedimentation, Illinois, U.S. Army Corps of Engineers, Rock Island District, August 1996.
This document recommends further study of the Illinois Waterway ecosystem in light of changed physical and economic conditions since the 9-foot navigation channel was constructed.

Illinois River Characterization for Restoration and Beneficial Use of Sediment, Marlin, John C., Illinois Department of Natural Resources Waste Management and Research Center, April 1997. Proposal to U.S. Department of Agriculture.

Strategic Renewal of Large Floodplain Rivers, University of Illinois, Water Resources Center.
This ongoing research effort at the University of Illinois, Urbana, Illinois, aims to develop a combined hydrologic, ecological, and economic restoration model for the La Grange Pool of the Illinois River.

Restoration of Large River Ecosystems: Hydrologic and Hydraulic Analyses of La Grange Pool of the Illinois River, Xia, R. and M. Demissie, 1997. Hydrology Division, Illinois State Water Survey, Champaign.

This report documents the hydrologic and hydraulic analysis of the La Grange Pool conducted for the Strategic Renewal of Large Floodplain Rivers research effort.

Integrated Management Plan for the Illinois River Watershed, January 1997. This plan was prepared by the Illinois River Strategy Team in cooperation with nearly 150 participants, chaired by Lt. Governor Bob Kustra.

The plan contains 34 recommendations divided into six sections: In the Corridor, Soil and Water Movement, Agricultural Practices, Economic Development, Local Action, and Education.

Ecological Status and Trends of the Upper Mississippi River System, 1998: A report of the Long Term Resource Monitoring Program. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI. 1998

This is the first report since the inception of the Environmental Management Program and beginning of data collection under LTRMP in which the monitoring data are summarized into one report, alongside historical observation and other scientific findings. This report also serves as background material for the U.S. Army Corps of Engineers' Report to Congress that provided recommendations for future environmental management of the UMRS. In addition, this report provides a timely assessment of river conditions.

Mackinaw River Watershed Management Plan, The Nature Conservancy, June 1998.

This document provides a long-range plan for the 1,138-square-mile watershed of this tributary of the Illinois River that recommends the establishment or restoration of 22,500 acres of wetlands.

Illinois River Site Conservation Plan, The Nature Conservancy, December 1998.

This document presents a plan for the implementation of conservation measures in the Illinois River Basin.

The Classification of Aquatic Communities in the Illinois River Watershed and Their Use in Conservation Planning, The Nature Conservancy, December 1998.

This report focuses on the aquatic conservation planning process, beginning with a description of the aquatic community classification system and the rationale for its development. The abiotic classification of stream and lake habitats is outlined, followed by a description of the biotic classification of fish alliances. The use of this classification system in conservation planning is discussed, followed by conclusions drawn from this work.

Threats to the Illinois River Ecosystem, The Nature Conservancy, December 1998.

The document summarizes the results of the threat assessment, which concludes that altered hydrology, habitat loss, sedimentation, and altered water quality are the four most critical stresses to the system.

Unified Watershed Assessment and Watershed Restoration Priorities for Illinois, Watershed Management Committee, 1998.

This report and the associated action plan list priority watersheds in the State of Illinois and call for coordination of activities and resources to help protect and/or restore water resources. The Illinois River Watershed and many of its tributary watersheds are listed as priority watersheds.

General Investigation Reconnaissance Study, Illinois River, Peoria Riverfront Development (Environmental/Ecosystem Restoration), U.S. Army Corps of Engineers, Rock Island District, May 1998.

This study determined the Federal interest in: (1) reducing sedimentation impacts in the Illinois River at Peoria Lake, (2) restoring fish and wildlife habitat, and/or (3) providing flood damage reduction measures as related to riverfront development near Peoria. This reconnaissance effort led to the *Peoria Riverfront Development, Illinois (Ecosystem Restoration) Feasibility Study with Integrated Environmental Assessment* described below.

General Investigation Reconnaissance Study, Illinois River, Ecosystem Restoration, Section 905(b) Reconnaissance Analysis, U.S. Army Corps of Engineers, Rock Island District, January 1999.

This report concluded that ecosystem restoration in the Illinois River Basin is within the Federal interest and that Corps of Engineers involvement is appropriate. Further, measures to address the loss of backwaters, changed hydrologic regimes and water fluctuations, and other impacts upon the system were identified and found to have no anticipated negative environmental impacts. The resulting Project Study Plan and Cost Sharing Agreements with the Illinois DNR have resulted in the initiation of the Illinois River Ecosystem Restoration Feasibility Study.

Critical Trends in Illinois Ecosystems. Critical Trends Assessment Program (CTAP), Illinois Department of Natural Resources, Springfield, IL. 2001.

This report provides an overview of each of the 16 CTAP projects. The report summarizes the findings of each project, describes land cover, and provides initial ecosystem monitoring results and results of regional assessments, including resource rich areas.

Initial Assessment, Illinois River Basin Restoration, Section 519 of the Water Resources Development Act (WRDA) of 2000, U.S. Army Corps of Engineers, Rock Island District, May 2002.

The initial assessment served as a reconnaissance-level report outlining the Federal interest, work for future phases, relationship to the Illinois River Ecosystem Restoration Study, and summary of proposed Critical Restoration Projects and Long-Term Resource Monitoring.

Peoria Riverfront Development, Illinois (Ecosystem Restoration) Feasibility Study with Integrated Environmental Assessment, U.S. Army Corps of Engineers, Rock Island District, March 2003.

This Feasibility Study was conducted by the Corps of Engineers and the Illinois DNR (non-Federal sponsor) to investigate the Federal and State interest in ecosystem restoration within Peoria Lake and the Farm Creek Watershed. The recommended plan includes dredging approximately 200 acres within Lower Peoria Lake to create deepwater habitats and constructing three islands with a total area of 75 acres.

Conservation Priorities for Freshwater Biodiversity in the Upper Mississippi River Basin, R. Weitzell, E. McKhoury, P. Gagnon, B. Schreurs, D. Grossman, and J. Higgins, Nature Serve and The Nature Conservancy, July 2003.

This study evaluates the components and patterns for the freshwater biodiversity of the UMRB and identifies the most significant places to focus conservation opportunities to maintain it.

2004 Report to Congress, Upper Mississippi River System Environmental Management Program. U.S. Army Corps of Engineers (USACE), Rock Island District, Rock Island, IL.

This Report to Congress is the second formal evaluation of the Environmental Management Program (EMP). This report evaluates the EMP; describes its accomplishments, including development of a systemic habitat needs assessment; and identifies certain program adjustments.

Upper Mississippi River-Illinois Waterway System Navigation Feasibility Study, Feasibility Report 2004. U.S. Army Corps of Engineers (USACE), Rock Island District, St. Paul District, and St. Louis District.

This feasibility study examines multiple navigation and environmental restoration alternatives, and contains the preferred integrated plan as a framework for modifications and operational changes to the Upper Mississippi River and Illinois Waterway System to provide for navigation efficiency and environmental sustainability.

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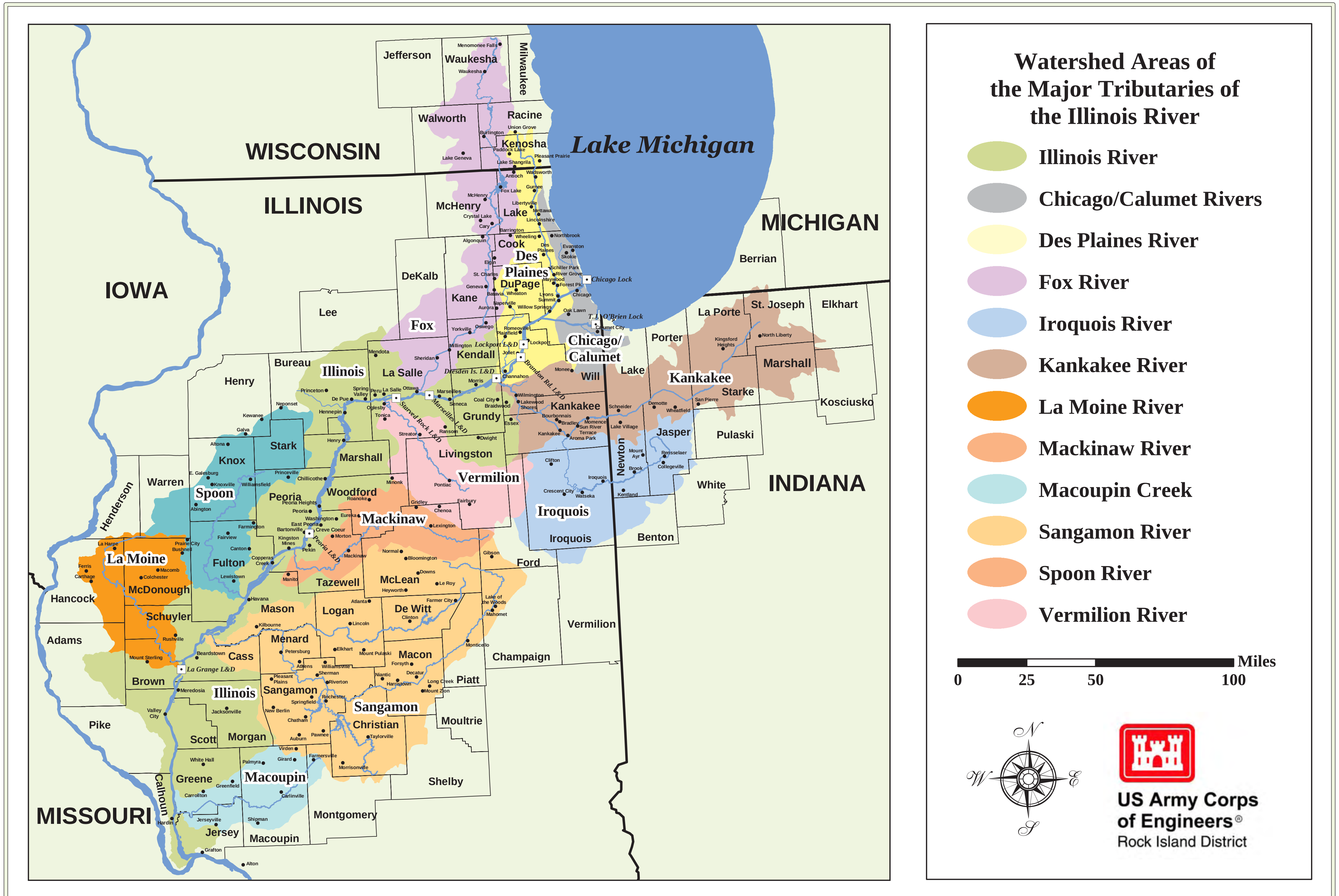


Figure 2-1. Illinois River and Tributaries

2. STUDY CONTEXT AND SETTING

A. NEED FOR ACTION

The Illinois River Basin has experienced the loss of ecological integrity due to sedimentation of backwaters and side channels; degradation of tributary streams; increased water level fluctuations; reduction of floodplain and tributary habitat and connectivity; and other adverse impacts caused by human activities. Figure 2-1 depicts the Illinois River and its tributary streams.

The combined effects of habitat losses—through changes in land use, human exploitation, habitat degradation and fragmentation, water quality degradation, and competition from aggressive invasive species—have significantly reduced the abundance and distribution of many native plant and animal species in the Illinois River Basin. Additional human alterations of Illinois River Basin landscapes have changed the timing, magnitude, duration, and frequency of habitat forming and seasonal disturbance regimes. The cumulative results of these complex, systemic changes are now severely limiting the ecological integrity of the basin.

Increased sediment loads from the basin have severely degraded environmental conditions along the main stem Illinois River by increasing turbidity and filling backwater areas, side channels, and channel border areas. Improved conservation practices have reduced the amount of sediment generated from many agricultural areas, but large quantities of sediment are still delivered to the river due to eroding channels and tributary areas, including urban and rural construction sites. The most critical problems resulting from the increased sediment loads are the loss of depth and habitat quality in off-channel areas connected to the main stem river. Similar problems can be seen at other areas within the basin where excessive sediment has degraded tributary habitats.

A dramatic loss in productive backwaters, side channels, and channel border areas due to excessive sedimentation is limiting ecological health and altering the character of this unique floodplain river system. In particular, the Illinois River has lost much of its critical spawning, nursery, and overwintering areas for fish; habitat for waterfowl and aquatic species; and backwater aquatic plant communities, limiting ecological health and altering this unique floodplain river system. A related problem is the need for timely action. If restoration is not undertaken soon, additional significant aquatic areas will be converted to lower value and increasingly common mud flat and extremely shallow water habitats.

Land use and hydrologic change have reduced the quantity, quality, and functions of aquatic, floodplain, and riparian habitats. Flood storage, flood conveyance, habitat availability, and nutrient exchange are some of the critical aspects of the floodplain environment that have been adversely impacted.

There is diminished aquatic (upstream/downstream fish passage) connectivity on the Illinois River and its tributaries. Aquatic organisms do not have sufficient access to diverse backwater and tributary habitats that are necessary at different life stages. Lack of aquatic connectivity slows repopulation of stream reaches following extreme events, such as pollution, low flows, or flooding, thereby reducing genetic diversity of aquatic organisms.

Basin changes and river management have altered the water level regime along the main stem Illinois River, stressing the natural plant and animal communities along the river and its floodplain. Land use changes, the construction of the locks and dams (which create relatively flat navigation pools), and isolation of the river main stem from its floodplain have all impacted the water level regime to varying extents. Two of the most critical results from the basin changes and river management, are the increased frequency and increased magnitude of water level fluctuations, especially during summer and fall low water periods. The lack of the ability to mimic natural hydrologic regimes in areas upstream of the navigation dams is also a problem. Increased flow variability has reduced ecological integrity in tributary areas as well.

Water resources in the Illinois River Basin are impaired due to a combination of point and non-point sources of pollution. Although effective regulatory efforts have reduced contributions from point sources, non-point sources of water quality impairment (such as sediments and nutrients) continue to degrade the surface waters.

The general ecosystem health, or integrity, of the Illinois River Basin is still declining in spite of the dramatic water quality improvements made as a result of the Clean Water Act and increasing numbers of local restoration efforts. Pressure on the remaining habitats will continue to increase as the basin's population increases. Finally, changes to the ecosystem, over time, have been dramatic. Current trends may be difficult to reverse, but with significant commitments of resources and time, this nationally-significant basin can be restored.

B. SIGNIFICANCE OF THE ILLINOIS RIVER BASIN ECOSYSTEM

The benefits of ecosystem restoration and protection projects are difficult to measure in monetary terms. When determining Federal interest, it is important that the significance of the resources being studied for restoration be clearly identified. The Corps of Engineers' *Principles and Guidelines* defines significance in terms of institutional, public, and technical recognition of the resources. For years, the State of Illinois and other agencies have been engaged in activities that clearly demonstrate the institutional, public, and technical recognition of the resources of the Illinois River Basin.

1. Institutional. The formal recognition of the Illinois River Basin in laws, adopted plans, and other policy statements of public agencies and private groups illustrates the significance of the basin to a variety of institutions. At the Federal level, the Illinois River's importance as an environmental and economic resource has long been recognized by congressional action and through the activities of several agencies. The U.S. Congress recognized the Illinois River, part of the Upper Mississippi River System (UMRS), as a unique, "…nationally significant ecosystem and a nationally significant commercial navigation system…" in Section 1103 of the Water Resources Development Act of 1986 (WRDA 86). The Upper Mississippi River System - Environmental Management Program (UMRS-EMP) was established in 1986 and has been conducting monitoring and habitat restoration activities along portions of the main stem of the Illinois River. The EMP brings together the expertise of the U.S. Army Corps of Engineers, the U. S. Fish and Wildlife Service (USFWS), the U.S. Geological Survey, and the U.S. Environmental Protection Agency (EPA). Congress reaffirmed the significance of the Upper Mississippi River System by reauthorizing the UMRS-EMP in 1999. The U.S. Department of Agriculture selected the Illinois River Basin as one of the first seven areas in the country for the Conservation Reserve and Enhancement Program (CREP), a program allowing enhanced Federal and State partnership opportunities to implement land conservation practices.

The Midwest Natural Resources Group (MVRG) is an ongoing partnership of 12 Federal Agencies, bringing focus and excellence to Federal activities supporting the vitality and sustainability of natural resources and the environment. On May 10, 2000, the U.S. Departments of Agriculture (USDA), Army, and Interior; the U.S. EPA, Federal Highway Administration, Maritime Administration and the U.S. Coast Guard signed an Intergovernmental Partnership Agreement stating that they shall work, in partnership with State and local governments, non-governmental organizations, private landowners and individuals, to restore and protect the ecological integrity of the Illinois River Basin in a manner consistent with reducing flood damage, protection of private property rights and maintaining an effective navigation system.

The State of Illinois has clearly demonstrated its institutional recognition of the Illinois River Basin as a significant resource. The state has developed, adopted, and begun implementation of the *Integrated Management Plan for the Illinois River Watershed* (1997); enacted the Illinois River Watershed Restoration Act; invested $51 million to match $271 million in Federal dollars in implementing the CREP on 110,000 acres with the potential to expand to 232,000 acres; and set the vision for Illinois Rivers 2020, a proposed $2.5 billion, 20-year Federal and State program to restore the Illinois River Basin.

The *Integrated Management Plan for the Illinois River Watershed* (1997) was the culmination of several years of effort by local and State governments in Illinois to build a consensus-based partnership with citizens and interest groups to address the issues that face the Illinois River Basin. The plan identifies 33 goals addressing restoration, economics, recreation, etc. Conservation groups, environmental groups, industry, and Federal, State, regional and local governments participated in shaping a vision for the future of the basin.

In July 1997, the State of Illinois enacted the Illinois River Watershed Restoration Act. The legislative purposes of the Act are to: (1) create a group of leaders representing agriculture, business, conservation, and the environment to encourage the implementation of efforts to restore the Illinois River Watershed in accordance with the recommendations of the *Integrated Management Plan for the Illinois River Watershed Technical Report;* (2) work with local communities to develop projects and regional strategies; and (3) make recommendations to appropriate State and Federal agencies.

More than $450 million in Federal and State funding has been targeted to improve the Illinois River through the CREP, which uses State funding to enhance existing USDA Conservation Reserve Program (CRP) activities. The CREP initiative will help preserve up to 232,000 acres of sensitive land surrounding the Illinois River and its tributaries, including upland areas. From 1998 to 2004, 110,000 acres were enrolled in Federal CRP easements and 73,000 acres in state CREP easements. While most state assets were acquired on lands enrolled in the Federal program, the State also acquired State-only easements on numerous adjacent areas and now holds roughly 28,000 acres in these State-only easements. In August 2005, the State of Illinois announced that its budget for the upcoming year included $10 million to leverage $40 million in Federal funds allowing for CREP easements on approximately 15,000 more acres.

In 2000, the Governor of Illinois set the vision for the Illinois Rivers 2020, a proposed $2.5 billion restoration effort. Illinois Rivers 2020 seeks to bring together the efforts of the Illinois Department of Natural Resources (DNR), Illinois Department of Agriculture, and Illinois EPA with Federal agencies. It is a voluntary, incentive-based approach that is much broader and more inclusive for the entire Illinois River and its tributaries than previous efforts. The support for implementation of Illinois

Rivers 2020 is very broad, including hundreds of individuals, elected officials, organizations, and businesses that officially support this effort.

In addition to Federal and State recognition, local communities, counties, and non-governmental organizations have also focused attention on the Illinois River Basin. More than 35 management plans have been developed that call for restoration of all or a portion of the Illinois River Basin. Many communities and groups have begun implementation of restoration projects. Both The Nature Conservancy and The Wetlands Initiative have made major investments by purchasing levee and drainage districts for the purpose of restoration. In total, they have recently acquired more than 11,000 acres of Illinois River floodplain and adjacent habitats. This is in addition to the 135,000 acres in State and Federal ownership within the Illinois River Basin.

Another example of the institutional significance is the Tenth Biennial Governor's Conference on the Management of the Illinois River System was held from October 4 [h] through the 6, 2005, in Peoria, Illinois. The conference focused on a systems approach to river management. Over 250 individuals from Federal, State, and local governments, as well as private citizens, attended the conference. The diversity of the groups attending demonstrates the importance of the Illinois River Basin to not only policy makers, but to the public as well.

2. Public. The Illinois River Basin is significant based on wide public recognition of the environmental resources present in the basin. The basin is noteworthy in that, while encompassing approximately 44 percent of the land area of the State, it includes nearly 90 percent of Illinois' population approximately 11 million people. Some level of significance of the Illinois River Basin to the public is measured through the actions of elected officials and policy makers who have forwarded legislation and enacted laws mentioned above to protect and enhance the watershed.

A further recognition of the value of the basin is the amount of participation by landowners in conservation programs. Approximately 138,000 acres of land have been enrolled in the Federal and State CREP and CRP programs. Each year, more Illinois landowners apply for the CREP program than are accepted. This demonstrates a willingness on the part of the landowners to set aside farmland to aid in the conservation of the Illinois River Basin.

Another example of public recognition is the participation by individuals and organizations in the State of Illinois' Conservation 2000 (C2000) program, which provides funding for streambank stabilization, wetland restoration, prairie restoration, riparian buffers, vegetative covers on construction sites, and restoration of oxbows in tributaries of the Illinois River. As of 2005, $61 million had been invested in all C2000 ecosystem projects. Although the program does not require matching, 52 percent of the program's overall value came from citizens and groups that invested additional money, land, and time to see projects completed. The strong public interest in restoration has resulted in State dollars consistently being matched or exceeded.

Recreation in the Illinois River Basin includes water-dependent activities such as fishing, waterfowl hunting, boating, and swimming. Recreation also includes activities that are enhanced by the proximity to water, such as hiking, picnicking, bird watching, and camping. These types of recreation are provided by local, State, and Federal agencies such as park districts, forest preserve districts, the DNRs, and the USFWS. Many private concerns also provide similar recreation opportunities.

The Illinois DNR owns or leases hundreds of outdoor recreation sites throughout the State including: State parks, conservation areas, nature preserves, natural areas, fish and wildlife areas, greenways, trails, and forests. The average annual attendance over the last 5 years at these sites was estimated to be over 42 million. This translates to about $500 million a year spent on trips to State parks and other recreational sites, leading to $790 million in economic output, 8,500 jobs, and $240.5 million in earnings. According to the 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, outdoor recreation activities contribute significantly to Illinois' economy—more than $4 billion in economic output, 42,000 jobs, and $315 million in State and local taxes.

The Illinois River Basin contains some of the most productive agricultural soils in the world. These soils, combined with favorable climate, excellent transportation via water, highway and rail, and highly productive farming systems, make the Illinois River Basin a world leader in agriculture and a major exporter of agricultural products, producing more crops than 40 other states. In 2000, the farms in the basin produced approximately $2.6 billion in crops, 50 percent of the Illinois State total (Illinois Agricultural Statistics Service, http://www.agstats.state.il.us/). The basin also produced more than $600 million in livestock.

3. Technical. Numerous scientific analyses and long-term evaluations of the Illinois River Basin have documented its significant ecological resources. Since the early 20th century, researchers, government agencies, and private groups have studied the large river floodplain system and proposed ecosystem restoration in the Illinois River Basin. A few examples of the efforts to identify, quantify, and understand the ecological significance of the basin are described in the following text.

In a 1995 report, the U.S. Department of the Interior (DOI) listed large streams and rivers as endangered ecosystems in the United States. The U.S. DOI documented an 85 to 98 percent decline in this ecosystem type since European settlement. In particular, large floodplain-river ecosystems, , have become increasingly rare worldwide. Two of the large floodplain-river ecosystems lie within the UMRS, namely, the Upper Mississippi and Illinois Rivers. These two ecosystems still retain seasonal flood pulses, and more than half of their original floodplains remain unleveed and open to the rivers (Sparks et al. 1998). The UMRS is one of the few areas in the developed world where ecosystem restoration can be implemented on large floodplain-river ecosystems (Sparks 1995).

The Nature Conservancy (TNC) has developed basin-level planning documents to guide restoration efforts. In these documents, the TNC states, "The Illinois River remains one of a handful of world-class floodplain-river ecosystems. These include the Nile, Amazon, the Mekong and portions of the Mississippi, where biological productivity is enhanced by annual flood pulses that advance and retreat over the floodplain and temporarily expand backwaters and floodplain lakes." (TNC 1998)

The UMRS-EMP conducted a Habitat Needs Assessment (HNA) in 2000 to help guide future habitat projects on the UMRS. The HNA highlighted the need to restore depth to 25 percent of the existing backwaters on the Illinois River, increase depth diversity and connectivity, and restore hydrologic conditions needed to restore and maintain backwater habitats.

The Illinois River has historically hosted a vast fishery, including numerous ancient fishes, and, at the turn of the century, produced 10 percent of the nation's catch of freshwater fish (yielding 178 pounds per acre in 1908). The Illinois River and its tributaries are currently home to over 100 species of fish. Side channels and backwaters serve as nurseries and spawning areas. Sport fish at home in the Illinois include: white bass, largemouth bass, bluegill, black crappie, channel catfish, carp, buffalo, bullhead, walleye, sauger, and many other warm-water species. Game fish in the upper river include largemouth bass, black bullheads and white bass, especially around Starved Rock State Park in Utica, IL. The middle river has historically been the most productive because of the aquatic habitat in the backwater lakes and wetlands along its banks. The lower river, from Beardstown to Grafton, features approximately the same mix of fish species as the middle river, but populations are smaller.

The Illinois River is a major component of the internationally significant Mississippi River Flyway, a route followed by migratory waterfowl between Canada and the Gulf Coast. The Mississippi River Flyway, shown on figure 2-2 as the Mackenzie Valley-Great Lakes-Mississippi Valley Rivers and Tributaries, is utilized by 40 percent of all North American waterfowl and 326 total bird species, representing 60 percent of all species in North America. A survey conducted by the Illinois Natural History Survey in the fall of 1994 found that 81 percent of the fall waterfowl migration in the Mississippi Flyway utilized the Illinois River. Approximately 20 species of waterfowl, primarily ducks and geese, make their home in the Illinois River Basin. Hundreds of thousands of birds migrate along the Illinois River each year, resting temporarily in the wetlands, sloughs, and backwater lakes in the basin.

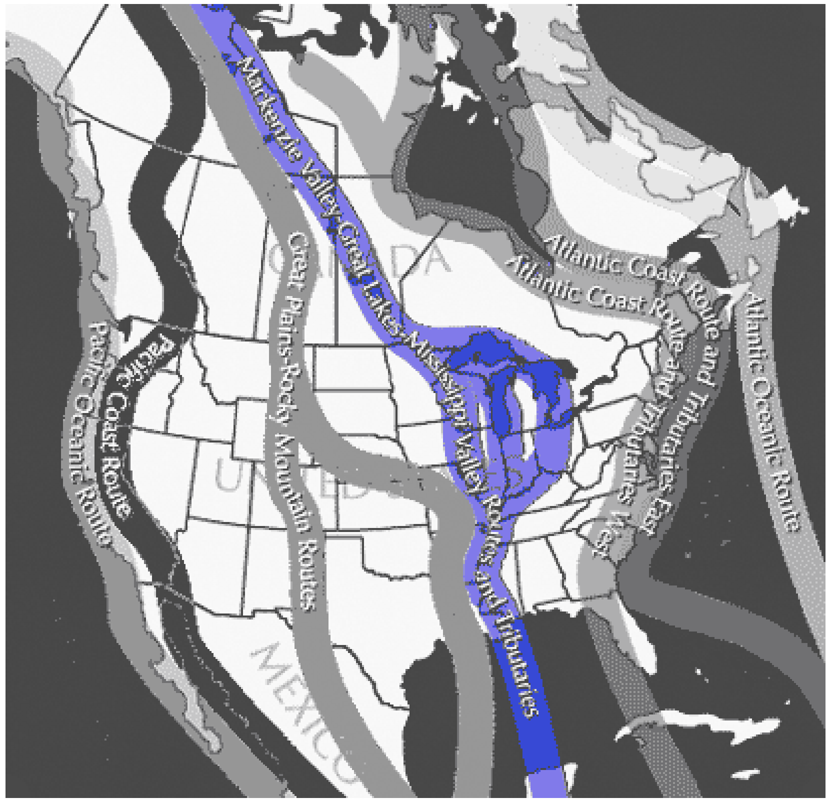


Figure 2-2. North American Flyways

The Illinois River has also been historically important to a multitude of avian species. The backwaters of the Illinois River serve as habitat for 20 to 30 species of shorebirds, 15 species of gulls and terns, and several species of marsh birds. The cottonwoods and black willows along the middle and lower river and its wetlands are host to various types of herons, egrets, plovers, sandpipers, and other migrating wading shorebirds, as well as gulls and terns. Wading shorebirds represent the farthest ranging visitors to the Illinois River Valley, traveling annually between the Arctic and South America, specifically Chile and Argentina. The river valley is a major wintering ground for the endangered bald eagle. In recent years, as many as 375 bald eagles have been counted annually, which represents about 3 percent of the total wintering population of bald eagles in the lower 48 states.

Over 4.26 million acres of Illinois land is in forest. Much of it is located adjacent to the Illinois River and its tributaries. Forest product utilization and management is important to the Illinois economy and environment. Forested riparian areas adjacent to the Illinois River and its tributaries provide a necessary buffer for surface water drainage and serve as the transition zone between land and water. Water quality benefits associated with the riparian forest are critical to the well-being of the tributary watershed. Many aquatic and terrestrial wildlife species utilize and depend upon the riparian forest found in the Illinois River Valley.

The Illinois River also serves as one of the sources for the public water supply system serving Peoria, which uses three well fields. The cities of Aurora, Elgin, Kankakee, Pontiac, Streator, Decatur, Taylorville, Springfield, Jacksonville, and Canton use water from tributaries of the Illinois River. Numerous industrial and utility providers also utilize Illinois River Basin waters for cooling purposes.

The Illinois River is a major conduit for the transport of treated wastewater throughout Illinois. It is estimated that 2,109 outfalls are currently located in the Illinois River Basin. Illinois has taken significant steps to obtain compliance for effluent limitations by dischargers in the basin. From the municipal facility perspective, approximately $5.6 billion has been expended for treatment facility construction in the Illinois River Basin alone. It can be safely estimated that several hundred million dollars have also been expended by industrial dischargers. Although the Illinois River ranks among Illinois' top recreational resources, at one time it was a primary channel for the transport of human, animal, industrial, and agricultural waste.

Archaeological and historical sites and fossil localities are found throughout the basin. Archaeological sites—localities once occupied by prehistoric or historic peoples—have been documented along the river shoreline, on the floodplain, and in valley margin and upland settings. Camps and villages established near the river by Native Americans are buried in river-deposited sediment. Major villages were often established along the river valley margin. Over the millennia, sediments eroding from nearby bluffs slowly accumulated. Preserved in these deposits, separated by lenses of sediment, are the remains of village sites representing centuries of cultural development.

C. BACKGROUND AND HISTORY

> *"The placid Illinois traverses this territory in a southwestern direction, nearly 400 miles ... Unlike the other great rivers of the western country, its current is mild and unbroken by rapids, meandering at leisure through one of the finest countries in the world. . . upwards of 400 yards wide at its mouth...The banks of the Illinois are generally high. The bed of the river being a white marble, or clay, or sand, the waters are remarkably clear. It abounds with beautiful islands,... It passes through one lake, two hundred and ten miles from its mouth, which is twenty miles in length, and three or four miles in breadth, called Illinois Lake [Lake Peoria]."* S. R. Brown 1817

The Illinois River arises at the confluence of its headwater basins, the Des Plaines, and Kankakee, and winds southwesterly through northern Illinois (figure 2-1). Along this stretch, known as the "Upper Illinois," currents are swift because the river flows down a fairly steep incline through a narrow, young valley. The upper river flows to Hennepin in Putnam County, where it encounters the "Great Bend," which marks the beginning of the middle river. Here, the Illinois turns southward and flows past Peoria to Beardstown with a gentle gradient through a broad, shallow valley 3 to 6 miles wide, the ancestral Mississippi River Valley. The banks along this stretch of the Illinois are lined with dozens of lakes and backwaters. The lower river extends from Beardstown to Grafton and was once rich with backwaters.

The Illinois River is the largest tributary of the Mississippi River above the mouth of the Missouri River. Major tributaries to the Illinois include the Des Plaines, Kankakee, Fox, Vermilion, Mackinaw, Spoon, Sangamon, and La Moine Rivers. Agriculture and urban development impacted and changed the landscape of the Illinois River Basin and the river itself. To appreciate the natural communities still found in the Illinois River Basin, one must first look at how the basin was formed, its history, and how it was developed.

1. Formation of the Illinois River Basin. The landscape of the Illinois River Basin was created by extraordinary geological processes that shaped the upper Midwest over the past one and one-half million years. The Ancient Mississippi River originally flowed in a now-buried valley from the northwest corner of Illinois near Galena to Tazewell and Mason Counties, south of Peoria, where it was joined by the westward-flowing Mahomet River. During the Pleistocene era, great continental-scale glaciers repeatedly entered Illinois from the northwest and northeast. These glaciers originated in central Canada more than 1,000 miles north of the modern Illinois River (figure 2-3). At least three major glaciations affected Illinois, and each strongly modified the landscape. Most of the lobes of glacial ice that covered Illinois emanated regionally from the Lake Michigan basin, but there is evidence that ice also flowed in from the northwest. Flowing ice and related geological agents, including winds and meltwater streams, sculpted the bedrock and pre-existing sediments, leaving sedimentary deposits up to several hundred feet thick.

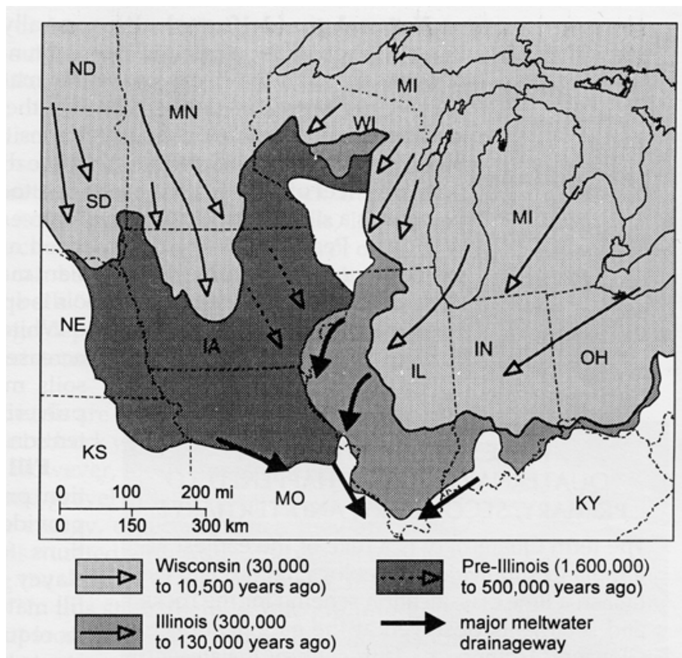


Figure 2-3. Furthest Extent of Pleistocene Ice Advances Open arrows indicate general ice flow directions; closed arrows indicate major meltwater drainage ways.

Creation of complex morainal topography, widening and incision of the Illinois Valley by huge floods, and deposition of a layer of wind-blown silt over most of the watershed uplands are effects of the last glacial episode that are perhaps most important to us today. Figure 2-4 illustrates the alterations in the flow paths of the major rivers in Illinois due to glaciation. Modification of this landscape continues today by both natural and human processes.

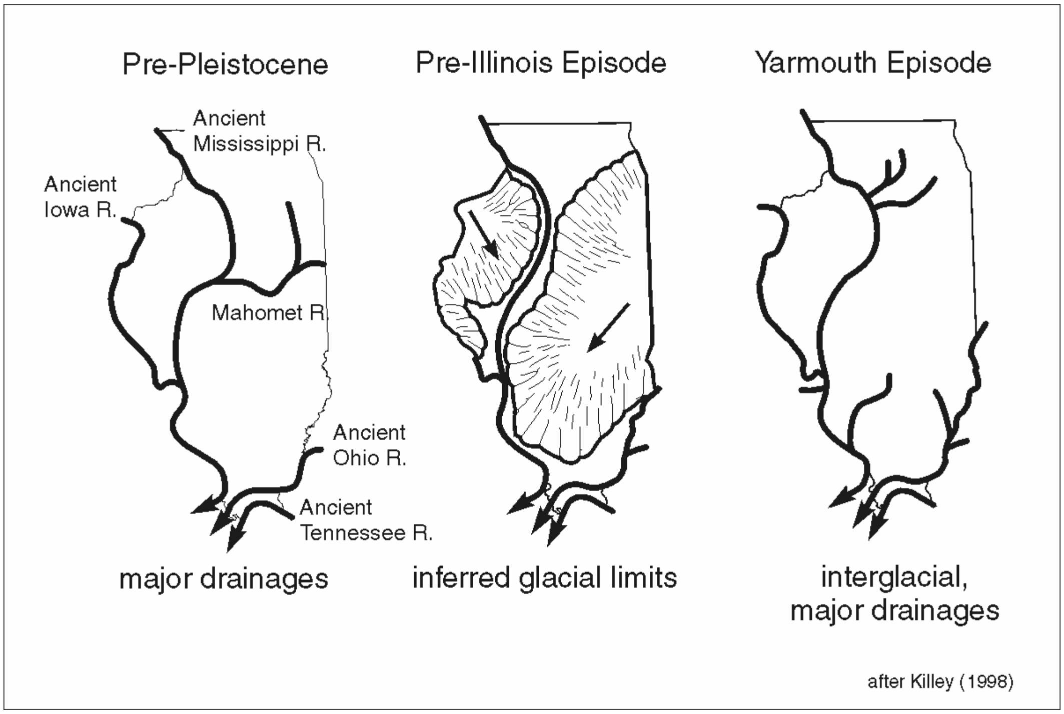


Figure 2-4. Changes in the Flow Paths of the Rivers in Illinois Over Time

The Mississippi River once occupied the lower Illinois Valley from above Henry to Grafton. With the advancement of the Wisconsin glacial-episode (~21,000 years ago), the Mississippi River was pushed westward to its present location. With the recession of the glacier and the ensuing warmer climate, meltwaters formed the Kankakee and Des Plaines Rivers, which converged into the Illinois River southwest of Chicago. From this confluence, the Illinois flowed westward, cutting a new channel until it reached the ancient and deep valley of the Mississippi River above Henry.

As the Illinois River turned southward in Putnam County, it followed a much wider and deeper glacial valley. As the waters of the Illinois entered this wide basin, their low volume produced a river of a gentle rate of fall, creating a floodplain river ecosystem. This low gradient resulted in a sluggish river that had difficulty moving the sediment load contributed by the tributary streams. Over the centuries, the sediment was deposited during overflow conditions at the interface between the faster moving water in the river channel and the slower moving waters in the bottomlands. As a result, natural levees rose, pinching off over 300 bottomland lakes and sloughs from the river channel. The floodplain below the Great Bend contains so many side channels, sloughs, swamps, and other backwater wetlands, that the river valley resembled a boundless marsh when early explores and settlers arrived.

Historical observations and measurements of flows from undisturbed areas indicate that storm flow rates from Illinois River watersheds prior to European settlement were probably much lower than current rates. Many current streams or ditches were historically ephemeral channels, wetland swales, or simply did not exist (Rhoads and Herricks 1996), and the hydrologic and hydraulic conditions likely led to a more steady discharge of water to the Illinois River from its watershed. Prior to 1900, when significant modification along the main stem began, researchers have determined that much of the Illinois River experienced a cyclical regime in which water levels gradually rose from the late fall through the spring and then fell to stable, low levels in the summer.

2. Climate. Illinois has a continental climate, which means that its winters are cold and dry and its summers are warm and wet. The transition season of spring tends to be very wet, while the fall seasons tend to be dry. Using Peoria as representative of the basin, average temperature for the year is 50.7 degrees Fahrenheit, with a peak maximum temperature of 113 degrees Fahrenheit on July 15, 1931, and a low minimum temperature of -27 degrees Fahrenheit on January 5, 1884. The average yearly precipitation is 36.25 inches, including an average snowfall of 26.2 inches per year. During the latter half of the 20th century, there was a 2.1 percent per decade increase in annual precipitation, which has contributed to the increase in the rate of runoff (5.5 percent per decade). This upward trend may be a manifestation of natural variability and will not necessarily be sustained into the future.

3. Land Cover. The predevelopment Illinois River floodplain was a complex mosaic of prairies, forests, wetlands, marshes, and clearwater lakes (Mills et al. 1966, Talkington 1991, Theiling 1999, Theiling et al. 2000). A broad view of the Illinois River Basin prior to intensive settlement illustrates the dominance of prairies across the landscape (figure 2-5). Riparian corridors formed along waterways, and the middle and lower reaches of streams and rivers were lined with forests. Densely wooded regions occurred in the Spoon and LaMoine River watersheds, topographically diverse areas compared to the rest of the basin. In the main stem river floodplain, the main channel threaded through a variety of connected and isolated backwater lakes, bottomland forests, prairies, marshes, and swamps. Bottomland lakes, sloughs, and marshes supported abundant beds of aquatic plants, such as pondweeds (*Potamogeton* spp.), coontail (*Ceratophyllum demersum*), and water lilies (*Nymphaea tuberosa*). Common emergent plants were two or more species of duck potato (*Sagittaria latifolia, S. rigida*), marsh smartweed (*Polygonum coccineum*), river bulrush (*Scirpus fluviatillis*), as well as other, less common plants, including wild rice (*Zizania aquatica*). The abundance of aquatic plants attested to the water clarity and organic sediments. Scores of small lakes and ponds, rather than large lakes, dominated the floodplain (Bellrose et al. 1983). In this system, there was relatively free movement among scales or to similar habitats in different locations through stream channels, riparian corridors, or frequently spaced wetlands.

The presettlement landscape of the basin was approximately 66 percent prairie and 29 percent forested. Open water and wetlands accounted for 4 percent of the basin area (figure 2-5). Wetlands were not particularly well mapped in the Government Land Office surveys because their methods were coarse and many wetlands were small, isolated units that might have been easily missed. Havera (1999) used soil surveys to locate hydric soils that formed under wetland conditions as a surrogate of the former distribution of presettlement wetlands throughout Illinois. A conservative estimate of a little more than 8.2 million acres of wetland, or 23 percent of the entire State was derived for Illinois. Although only 78 out of 102 counties have been resurveyed, the presettlement wetlands estimate has been increased to almost 8.9 million acres (Havera 1999). Calculating the change from presettlement conditions revealed a 90.3 percent loss of presettlement wetlands. Most of the loss occurred in the northern two-thirds of the state, particularly through the center of the Illinois River Basin.

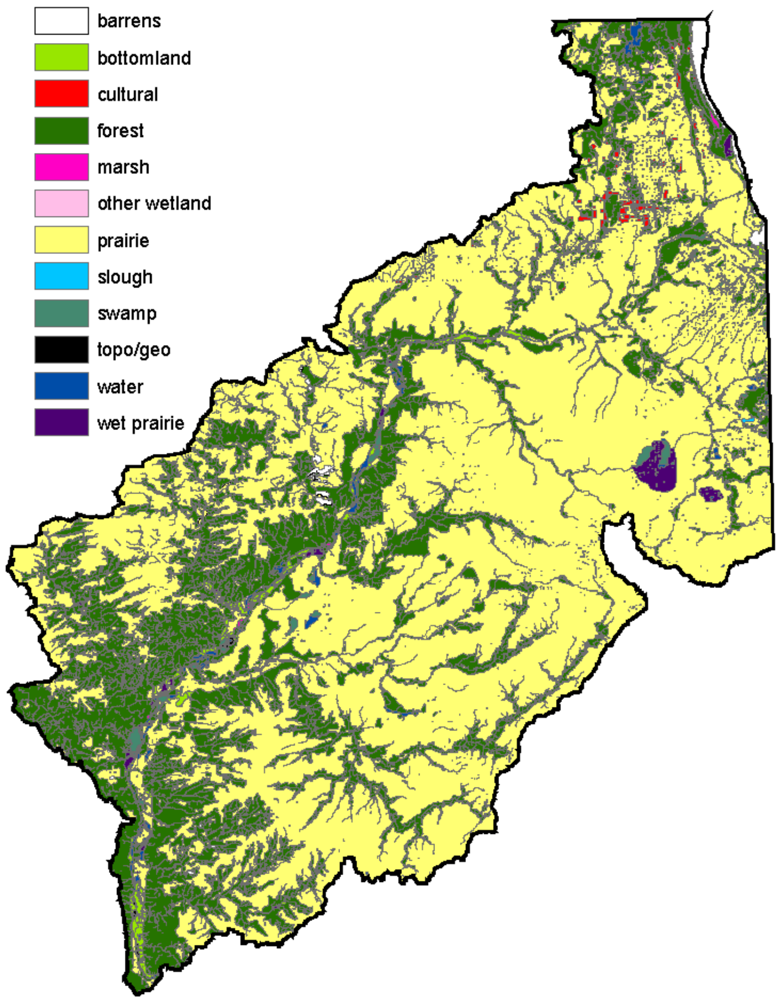


Figure 2-5. Presettlement Land Cover of the Illinois River Basin as Interpreted from Government Land Office Surveys (Szafoni 2001)

Landscapes can be described by differences in topography, glacial history, bedrock, soils, and the distribution of native plants and animals. Using these natural features, Illinois can be divided into 14 natural divisions. A division contains similar landscapes, climates, and substrate features like bedrock and soils that support similar vegetation and wildlife over the division's area.

Six of the fourteen divisions are found in the Illinois River Basin—Northeastern Morainal, Grand Prairie, Upper Mississippi River and Illinois River Bottomlands, Illinois River and Mississippi River Sand Areas, Western-Forest Prairie, and Middle Mississippi Border (figure 2-6).

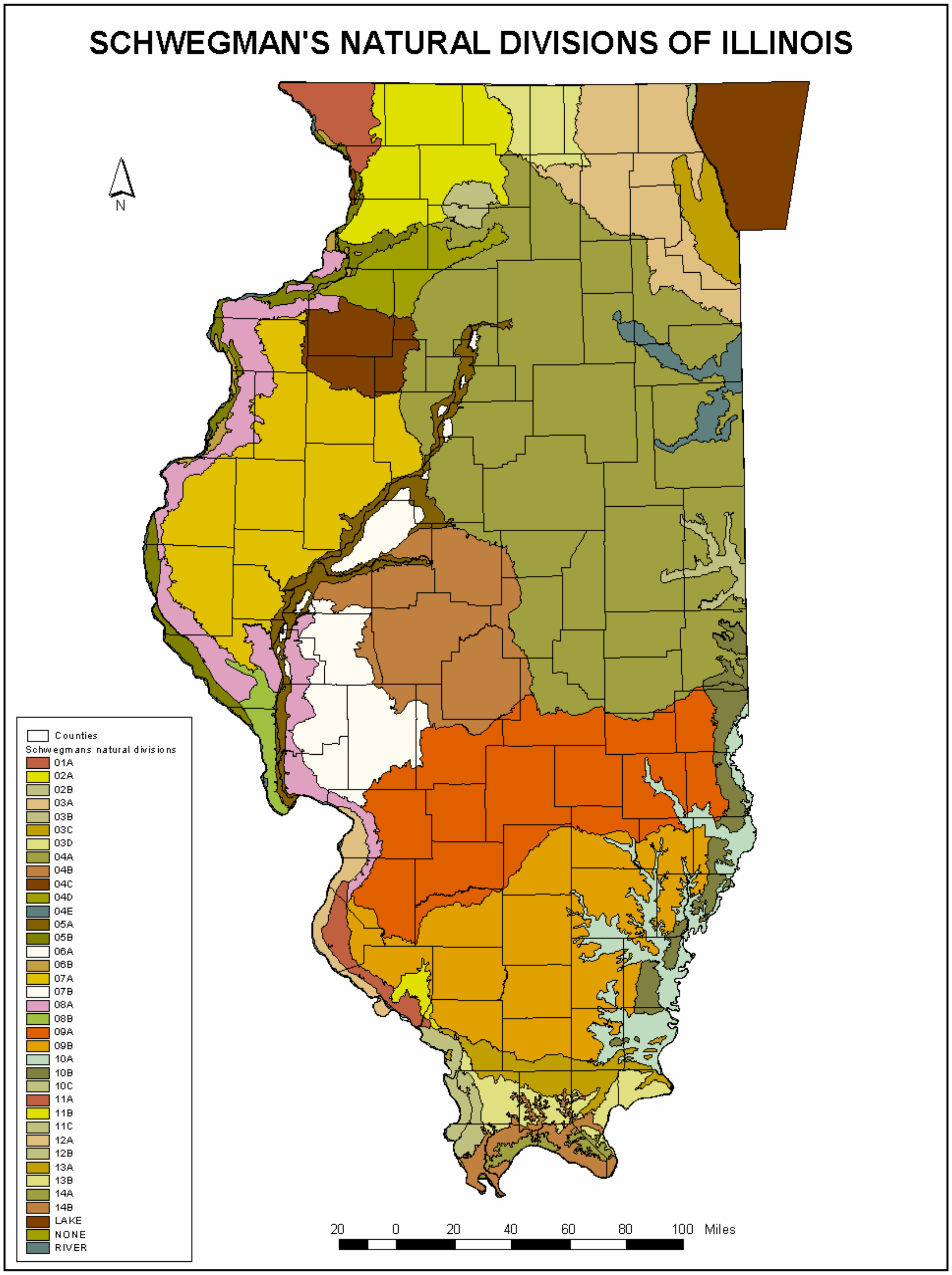


Figure 2-6. Schwegman's Natural Divisions of Illinois

Northeastern Morainal Division

- *Morainal Section (O3A)* - This section contains the moraines and related geologic features resulting from late advances in the Wisconsinian glaciation period. Most of Illinois' glacial lakes and peatlands are found here.

- *Lake Michigan Dunes Section (O3B)* - The Lake Michigan Dunes Section is distinctive for its unique plants that grow on the dunes and beaches. Plant succession from shifting sand to stabilized sand results in a variety of species. Beach grass, trailing juniper, and bearberry are three examples.

- *Chicago Lake Plain Section (O3C)* - This flat, poorly drained area is composed of the lakebed sediments of glacial Lake Chicago. Long ridges of shore-deposited sands are conspicuous features. A few natural lakes exist near Calumet City. The original vegetation of this section was prairie and marsh with scrub-oak forests on sandy ridges.

Grand Prairie Division

- *Grand Prairie Section (O4A)* - This section includes the part of Illinois that was affected by the late stages of the Wisconsinian glaciation, that is outside the Northeastern Morainal Division and that does not include outwash and sand areas. The Shelbyville and Bloomington moraines form the boundaries of this section. Black-soil prairie, marshes, and prairie potholes are common in this poorly drained area. The Kankakee mallow is found in this section, growing only on an island in the Kankakee River.

- *Springfield Section (O4B)* - The Springfield Section is part of the area covered by the Illinoian glaciation. Prairies grew on this land in presettlement times. It has better drainage than the younger Grand Prairie Section. Deep loess (a wind-blown silt) deposits support dry hill prairies along the lower Sangamon River. Large areas of floodplain forest grow in the valley of the lower Sangamon River and its tributaries.

- *Western Section (O4C)* - The Western Section was covered by the Illinoian glaciation. This well-drained land was predominantly prairie in presettlement times.

- *Kankakee Sand Area Section (O4E)* - The sand of the Kankakee Sand Area Section was deposited by the Kankakee Flood during the later stages of the Wisconsinian glaciation. Sand prairie and marsh were the predominant vegetation of this section before the land was drained for cultivation. Scrub-oak forests exist on drier sites. The primrose violet is restricted to this section in Illinois. The clear, well-vegetated, sand-bottomed streams contain fishes like the weed shiner, ironcolor shiner, and least darter.

Upper Mississippi River and Illinois River Bottomlands Division

- *Illinois River Section (O5A)* - The Illinois Section of this division is characterized by its backwater lakes and forest vegetation. Spring bogs exist along the river bluffs.

Illinois River and Mississippi River Sand Areas Division

- *Illinois River Section (O6A)* - This section differs from the Mississippi River Section by the absence of several plant and animal species.

- *Mississippi River Section (O6B)* - This section has several plant and animal species that are absent from the Illinois River Section including false heather and rock spikemoss. Both of these plants form large mats that stabilize dune blowouts.

Western Forest--Prairie Division

- *Galesburg Section (O7A)* - The Galesburg Section is the area of the Western Forest-Prairie Division that lies north of the Illinois River Valley. At the time of settlement, there were about equal amounts of forest and prairie in this section, with forests mainly along the tributaries to the Illinois River.

- *Carlinville Section (O7B)* - The Carlinville Section of this division is the land southeast of the Illinois River Valley. Originally, it was covered mostly by forest, with prairie accounting for about 12 percent of the area.

Middle Mississippi Border Division

- *Glaciated Section (O8A)* - The topography of this area was modified by the pre-Illinoian and Illinoian glaciation stages. Limestone underlies most of this section and may often be seen in cliffs along the river bluffs.

- *Driftless Section (O8B)* - This area of the state is apparently unglaciated. It has many sinkholes and sinkhole ponds.

For more than 150 years, the Illinois landscape has been shaped to serve the economic development needs of the State. Landscape development has occurred for many purposes ranging from waterway transportation, lumber harvesting, urban and suburban development, and industrial and agricultural development. The result is a managed landscape that is highly altered from its presettlement form and function. This development of the river basin has had profound effects on the river and floodplain landscape.

4. Disturbance Regimes. Disturbances such as floods and fires maintain the mosaics of habitats needed to maintain a naturally functioning ecosystem. Most of these disturbance regimes have been greatly altered or even eliminated altogether. This alteration of disturbance regimes has resulted in a more homogeneous environment, with an associated loss in ecological integrity.

Hydrology is a primary driving force for aquatic and floodplain ecosystem processes and habitats. The magnitudes, timing, and duration of flows and water levels often regulate the nature of chemical and biological functions in these systems. Because of this, unfavorable hydrologic regimes can prevent desirable levels of ecosystem function, thereby reducing biodiversity. The obvious natural disturbance pattern on the main stem Illinois River and its tributaries is the annual flood and low-flow cycle (Poff et al. 1997, Theiling et al. 2000). Prior to development, the Upper Illinois was hydrologically similar to the streams and rivers that fed it from the basin; floods rose and fell rapidly in response to storms. During low-flow periods, the river experienced base flow conditions and was fed by ground water. Some streambeds may have been nearly dry during low flow periods. On the main stem, snowmelt, spring rains, and basin runoff combined to create a long spring flood that rose into the summer and fell through the fall in what was described as a unimodal hydrograph (Sparks 1995).

Fire is another disturbance that helps shape the floodplain landscape (Nelson et al. 1996). For example, savanna and prairie habitats, both diverse habitat types, require fire disturbance to maintain their unique vegetative characteristics and accompanying biodiversity. Prior to intensive settlement, Native Americans used fire to help maintain these habitats. Fire also plays a key role in bottomland forest structure and species composition. Fire suppression is altering the species composition of forested habitat, resulting in the maple dominance of these forests (CTAP 2001). Other disturbances, such as ice and wind, sometimes kill sections of forests and create unique microhabitats that are exploited by species to create diverse landscapes (Theiling et al. 2000).

5. Biological Resources. Father Jacques Marquett (one of the first Europeans to visit the Illinois River Basin) described his impressions on the Illinois River, in 1673, as follows:

> *"We have seen nothing like this river…as regards to its fertility of soil, its prairies and woods, its cattle, elk, deer, wildcats, bustards, swans, ducks, parroquets, and even beaver. There are many small lakes and rivers."*

The productivity of the predevelopment system was illustrated by the millions of migratory birds that either stopped to rest and feed on their northward and southward migrations, or stopped to nest in the floodplain marshes (Havera 1999). The Illinois River historically was host to a vast fishery. The forests supported a higher diversity of trees, including many that produced fruit and seeds that were exploited by animals and people (Nelson et al. 1994). Although today's flora and fauna are but a remnant of these historic levels, they still include some of the richest habitat in the Midwest, even some unique to North America (Talkington 1991).

6. Development of the Basin. The assessment of the Illinois River Basin landscape history provides perspective on how and when change occurred. Native Americans arrived in the basin at least 12,000 years ago and hunted and gathered for their subsistence, causing very little impact on the habitat. Native Americans began cultivating plants in the Basin gradually, beginning around 2,000 B.C. Food production supplemented food procurement, eventually giving rise to larger, longer-term settlements, which had greater impact on local habitat.

Early explorers and trappers were in the region in the 1600s and 1700s, relying on a subsistence economy of hunting, gathering, and food production. They also introduced domesticated animals. It was not until the early 1800s, during America's Westward Expansion, that substantial numbers of settlers arrived in the Illinois River Basin. During the early 1800s, the Government Land Office (GLO) surveys of the Illinois River Basin were conducted. Significant events in history of the Illinois River are listed in table 2-1.

Table 2-1. Illinois River Timeline

Year	Event
1872	The first low dam is constructed at Henry, Illinois.
1900	The Chicago Sanitary & Ship Canal opens. The untreated wastes from a densely populated Chicago area are channeled into the Illinois River.
1902	The drainage/levee districts are established, and by 1929 there would be a total of 41 in the Illinois River Valley.
1908	The 207-mile stretch of river between Hennepin and Grafton produces 10% of the nation's catch of freshwater fish.
1910	More than 2,600 mussel boats work the Illinois River.
1919	State of Illinois begins construction in the Illinois Waterway.
1923	Illinois River devoid of oxygen to Chillicothe
1930	Levees & drainage districts removed 200,000 acres, ½ floodplain
1939	Significant completion of lock and dams.
1944	During the fall waterfowl migration, a remarkable weekly observation is recorded by biologist Frank Bellrose – over 3.6 million mallards in parts of the Illinois Valley.
1948	Last Pearl Button Factory closes
1950	Fingernail clams (major food source) disappear
1955	Aquatic Vegetation eliminated from connected aquatic areas

Settlements were first established along the lower reach of the Illinois River and on the upper reaches of its tributaries, such as the Sangamon River. Peoria, Springfield, and Chicago were in existence in the early 1800s.

The Illinois River Basin is an area that has been and remains subject to human disturbances. Some biologists argue that the degradation of the Illinois River Basin began with its opening to steamboats in 1828, while others indicate that until the turn of the century, the Illinois River remained relatively unblemished, and its waters provided a livelihood for many adjacent communities. In 1908, 2,500 commercial fishermen took nearly 24 million pounds of fish from the Illinois. The river was once one of the most productive mussel streams per mile in the United States; in 1910, over 2,600 mussel-fishing boats plied the river. Abundant waterfowl in the fall made the valley a mecca for commercial and sport hunters. As the human population increased in the basin, the prolific days of the river ended. With the increase in population came physical changes to the Illinois River and its basin that would greatly affect the river system.

Beginning in the 1830s, human activities started to exert a deleterious effect on the Illinois River and its watershed. Navigation, agriculture, levee building, and urbanization affected the natural flow of the Illinois River and the associated sedimentation processes that formed backwater wetlands. Large-scale public works projects, such as the construction of the Illinois and Michigan Canal, and private undertakings, especially draining of wetlands for agriculture, resulted in the most profound changes in the Illinois River Basin.

a. Agriculture. The Illinois River Basin is endowed with some of the best soils and climate, which support the greatest agricultural production that can be found anywhere in the world. Over the past 150 years, agriculture in the Illinois River Basin has undergone significant changes. In early settlement days, farming meant raising an assortment of crops and livestock, which would ultimately provide the food and clothing to support the farmer's family. By 1860, most of the basin's prairie had disappeared as agriculture gained in predominance. Crop production became more specialized in the late 1800s and into the 1900s as farm size and urban populations increased.

Agriculture became industrialized after the turn of the century, but especially after World War II with advances in farm machinery and chemical use. The rate at which agricultural innovations have been introduced and adopted has significantly increased over the past several decades. Adverse environmental impacts of landscape development were noticed early in the development sequence, but formal programs to address declining resource quality were not enacted until after the economic impacts to agriculture were recognized and the conservation movement became more prominent. With mechanized and labor-saving farm equipment available, intensive row crop agriculture and increased crop production became the norm. By 1935, only 20 percent of the Nation's labor force worked in farming, decreasing to 4 percent in 1974 and less than 2 percent in 2002. Since the 1950s, many farmers dramatically changed their farming operations, from diversified livestock and grain farms to specialized farms with primarily corn and soybean production, resulting in a 67 percent increase in row cropland between 1945 and 1986. From 1960 to 2000, oat, wheat, and hay acreage decreased by more than 50 percent, while soybean acreage almost doubled. This change in farming systems has resulted in considerably less land planted today with soil-conserving crops of hay, pasture, and cereal grains and significantly more land being planted to row crops that provide less protection from erosion, such as soybeans and corn. However, many farmers have implemented soil conservation practices to reduce soil erosion (Post and Wiant 2004).

b. Floodplain Alterations. Between 1902 and 1923, drainage districts greatly modified the landscape, removing approximately one-third of the terrestrial and aquatic habitat from the floodplain for agricultural purposes. By 1929, 38 organized drainage and levee districts and three private levees enclosed roughly 200,000 acres of the Illinois River Valley. Levees erected early in the 20th century isolated and facilitated the drainage of almost all of the lakes and wetlands along the lower river. Only about 53 backwater lakes now survive along the full length of the river, and the connected floodplain of the Illinois River is now just over 200,000 acres, about half its size 100 years ago. Spring and Thompson Lakes, long known for their fisheries and their concentrations of waterfowl, were leveed, drained, and converted to agricultural uses, as were a host of smaller lakes and sloughs. These levee districts isolated and altered approximately 40 percent of the total floodplain by allowing conversion of wet and mesic floodplain prairies to crops. Actual water surfaces now account for only about 60 to 100 square miles (40,000 to 70,000 acres) in the basin. The levees affected the hydrology and sediment transport processes of the river. They increased flood stages by reducing the space available for water flow, storage, and sediment deposition. The levees effectively constricted the floodplain right to the edge of the river.

c. Hydrologic Alterations. On January 1, 1900, the Chicago Sanitary and Ship Canal opened. This canal connected the Des Plaines and Illinois Rivers to Lake Michigan and as a result gave the City of Chicago a means of flushing untreated domestic sewage and industrial wastes away from Lake Michigan into the Illinois River system by diverting water from Lake Michigan into the Illinois River. At first, the diverted water enhanced the aquatic habitats of the Illinois River valley; habitats available to fishes increased as the diverted water doubled the surface area, and extended and deepened the bottomland lakes and marshes. As a result of all the water, thousands of acres of bottomland timber were inundated and eventually died as many small lakes, sloughs, and marshes were united into larger bodies of water. As late as 1940, "dead snags from this 'drowned forest' were still in evidence."

d. Navigation and Dam Alterations. Although the amount of diverted water from Lake Michigan was reduced in 1938, river levels were further altered by the construction of navigation dams. During the 1930s, six navigation dams were built along the Illinois, eventually a total of 8 locks and dams were constructed. These dams, constructed to create a 9-foot channel for commercial navigation, had a major impact on the river. This effect was not uniform along the length of the river. The upper dams raised water levels and created pools, slowing the rate of flow even more. The lower dams stabilized water levels, but did not create pools or slow river flow appreciably.

The construction of navigation dams and diversion of flows from Lake Michigan have generally increased the river water surface elevation and have altered the nature of the flooding regime along certain reaches of the river. As the water surface elevation of the river increased, so did the water surface elevations of the associated backwaters and wetlands, resulting in as many as 300 long, narrow backwater or bottomland lakes. Each dam keeps the water level in the pool upstream high enough to ensure a 9-foot navigation channel and, as a result, the floodplains immediately upstream of each dam are more continuously inundated than they would be under undammed conditions.

Short-term water level fluctuations on the mainstem, that is, water level changes over the course of several hours to several days, have been implicated in degradation of Illinois River ecosystem function because of the stress that rapid changes in river conditions places on plants and animals. The magnitude and frequency of water level fluctuations have notably increased in portions of the river since daily water level monitoring began in the 1880s.

e. Water Quality . The opening of the Chicago Sanitary and Ship Canal increased the sewage load in the Illinois River, and by 1923, the oxygen content of the river from below Chicago to Peoria was negligible. In 1911, Stephen Forbes wrote,

> "*Immediately below the mouth of the canal we have in the Des Plaines a mingling of these waters, and the Illinois River itself, below the junction of the Des Plaines and the Kankakee, the septic contributions of the former stream are largely diluted by the comparatively clean waters of the latter. Nevertheless, we had in July and August what may be called septic conditions for twenty-six miles of the course of the Illinois from its origin to the Marseilles dam. At Morris, which is on the middle part of this section, the water, July 15, was grayish and sloppy, with foul, privy odors distinguishable in hot weather*."

The pollution history of the Illinois River closely parallels population growth and hydrologic modifications by the very nature of the most influential project, the Chicago Sanitary and Ship Canal. While originally draining a basin somewhat protected from the growing population of the Chicago area, the canal increased the drainage basin by only 800 square miles (<3 percent), but increased the population pressure on the river to 4.2 million people by 1914. Untreated waste and its adverse effects progressed rapidly downstream from Chicago and Peoria. In 1911, Forbes and Richardson described the river between Morris and Marseilles as reaching its "lowest point of pollutional distress" (quoted in Starrett 1972). They describe the river during the warm summer months as completely anoxic and sludge-like, with most bottom fauna (except sludge worms and *Chironomus* larvae) and fish extirpated. The river cleared with cooler temperatures and higher river stages, but the pollution spread downstream. By 1912, the zone of degradation spread downstream to Spring Valley, and by 1920 as far as Beardstown, about two-thirds of the way to the Mississippi River. Waste treatment efforts began during the 1920s, but struggled to keep up with population growth. In 1960, wastes from a population equivalent of 9.5 million people were reduced to 1.15 million through effective treatment before being discharged to the river (summarized from Starrett 1972). Although upstream water quality and some aquatic communities have improved through time with the expenditure of more than $6 billion in waste treatment facilities, many important aquatic communities still suffer the consequences of prior perturbations and continued sedimentation (Sparks 1992).

f. Tributary Alterations. In many areas of the Illinois River Basin, current storm flows are higher than occurred under pre-development conditions due to land use changes and increased efficiency brought about by channelization in urban and rural areas. Hydrologic changes tend to be most apparent in small basins and during fairly frequent events (Knox 1977). Channelization increases peak flows as it allows flood waves to pass more quickly through the basin (Campbell et al. 1972), increasing both the volume and the erosive force of the water. In addition, drainage generally reduces low flows by lowering groundwater levels and intercepting groundwater throughflow. Small creeks that have been modified by dredging and drainage are often unstable aquatic environments because of extreme water level fluctuations and desiccation during dry periods (Larimore and Smith 1963; Rhoads and Herricks 1996).

g. Biological Impacts. As the Illinois River Basin's population increased, the combined impacts of the basin alterations described above began cause measurable changes to the flora and fauna of the basin. From 1916 to 1922, the organic pollution discharged into the Illinois River resulted in the virtual elimination of aquatic plants from the River. Aquatic vegetation returned to the river between the late 1930s and mid 1950s in response to early waste treatment efforts (Starrett 1972). After 1955, greater amounts of flocculent sediments that had accumulated in the backwater lakes and impounded areas were more frequently resuspended by wind- and boat-generated waves. Resuspended sediments lowered water clarity, and mucky sediments made poor rooting substrate, thus limiting aquatic plant growth (Mills et al. 1966, Bellrose et al. 1979, Bellrose et al. 1983, Sparks 1984, Sparks et al. 1990). As more plants were lost, a critical threshold level of plant density was reached, beyond which recovery was unlikely. Sparks and others (1990) trace the problem to the loss of plants on the perimeter of the beds that stabilized sediments and buffered wave action. As the plants on the perimeters were lost, the entire plant beds were slowly eliminated by wave disturbance and poor water quality.

In the early 1900s, the Illinois River was considered one of the most productive mussel streams in America, and young mussels (unionids) contributed a significant portion—25 percent—of the channel catfish diet. By the 1970s, extensive harvest and chemical and organic pollution resulted in the loss of 25 of the 49 species recorded in the river, and no young mussels were found in catfish guts north of Beardstown (Starrett 1972). These declines were reflected in declines in commercial activities. The last button factory on the Illinois closed in 1948, and by 1976, only two full-time commercial fishermen worked the river. The river was closed to commercial mussel harvest around 2000. In the upper Illinois River, all freshwater mussels were extirpated at one time, but they have been slowly recovering since water quality has improved. Surveys during the mid-1990s found six species had returned to the Illinois Waterway above the confluence of the Des Plaines and Kankakee Rivers (table 2-2). Beginning in 1991, unionids have been forced to compete with the exotic zebra mussel (*Dreissena polymorpha*) for food and space. Unionids also suffered from the degraded water quality common near high densities of zebra mussels.

Table 2-2. Numbers of Species of Mussels Present in the Navigation Pools of the Illinois River at Different Points in Time (Whitney 2001).

Navigation Pool	1870–1900	1906–1909	1966–1969	1993–1995
Marseilles	38	0	0	11
Starved Rock	36	0	0	8
Peoria	41	35	16	15
La Grange	43	35	18	15
Alton	41	36	20	17

Fish communities first increased dramatically with the expansion of aquatic habitat following the diversion, and the introduction of carp (Fremling et al. 1989). Commercial catch rates increased from about 8 million pounds in 1900 to over 20 million pounds in 1908. After 1908, however, fish catches declined despite a relatively high demand for fish (Starrett 1972; Fig. 32). In addition to lower catch rates, the physical condition of fishes declined through the 1970s, with the poorest condition noted in more northern reaches (Sparks 1984). There was a very high incidence of external abnormalities on sediment-associated fishes (50 to 100 percent) in the upper river during the late 1960s. There have been anecdotal and empirical observations of a small number of individuals of tolerant species with cancerous lesions and eroded fins, but the occurrence of such abnormalities has declined in all river reaches through time (Lerczac et al. 1994; Cochran, 2001)

Before the 1950s, the Illinois River Valley was one of the most productive waterfowl areas in the country, drawing local market hunters and sportsmen from around the world (Havera 1999). In 1948, the Illinois Natural History Survey initiated aerial inventories that have revealed clear patterns of the decline of the Illinois River as productive waterfowl habitat since that time. Diving ducks (lesser scaup, canvasback, etc.) were abundant before 1954 in the Illinois River Basin (figure 2-7).

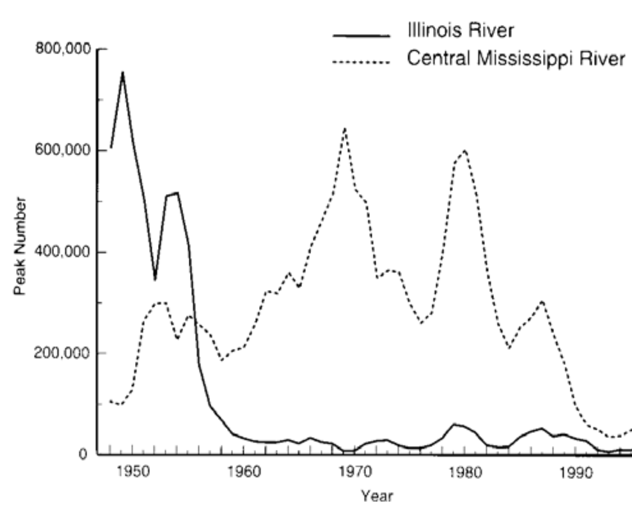
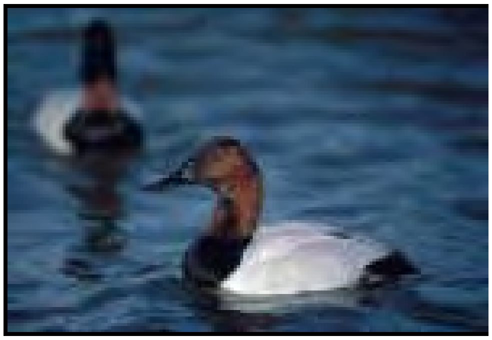


Figure 2-7. Three-Year Moving Average of Peak Numbers of Diving Ducks, Aerially Inventoried During the Fall in the Illinois River and Central Mississippi River Regions, 1948-1996 (Havera 1999)



Photograph 2-1. Canvasback Duck

The population of diving ducks along both the Mississippi and Illinois Rivers fluctuated during the early 1950s. While the Mississippi River population increased until the 1990s, the Illinois River population decreased and never recovered. The loss of fingernail clams and *Vallisneria* (primary diving duck food sources) in the mid 1950s apparently reduced the habitat value for diving ducks, such as the canvasback (photograph 2-1), in the Illinois River to the point where they shifted their migratory use patterns to the Mississippi River Valley (Havera 1999). Diving duck populations are now in serious decline nationally. Dabbling ducks were also affected by habitat loss (figure 2-8) between 1948 and 1996.

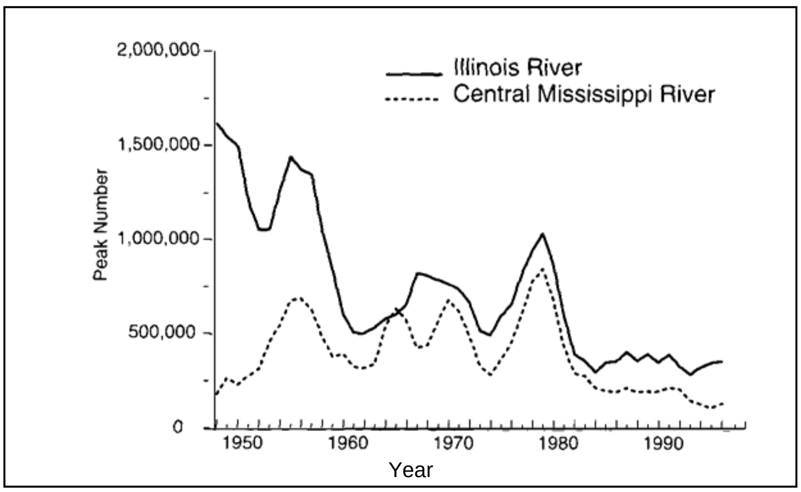


Figure 2-8. Three-Year Moving Average of Peak Numbers of Dabbling Ducks, Aerially Inventoried During the Fall in the Illinois River and Central Mississippi River Regions, 1948-1996 (Havera 1999).

Soil erosion, combined with the low gradient and flow of the Illinois River, allowed fine clay and silt particles to settle in the backwater lakes. During the 1950s, sediment deposition in the backwater lakes appears to have crossed a critical threshold, transforming the clear, vegetated lakes to turbid, barren basins (Sparks et al 1990). Fish and duck populations declined and, by the early 1960s, backwater productivity ebbed dramatically (Bellrose et al 1979).

Despite the ecological damage and degradation, the landscape and river system remain surprisingly diverse and biologically productive. The Illinois River system is home to approximately 35 mussel species, representing 12 percent of all freshwater mussels found in North America. Fish diversity is similarly high, with 115 fish species found, 95 percent of which are native species. Many of these species require both riverine and backwater (floodplain) habitat as part of their life cycle. A survey conducted by the Illinois Natural History Survey in the fall of 1994 found that 81 percent of the fall waterfowl migration in the Mississippi Flyway utilized the Illinois River. The Illinois River currently attracts more migratory ducks than nearby stretches of the Upper Mississippi River.

D. EXISTING CONDITIONS

The Illinois River Basin is ecologically degraded because of 150 years of intensive human development in the region. Figure 2-9 illustrates the change in the distribution of land cover in the Illinois River Basin. Not only have the landscapes changed, but the hydrologic regime, which drives the ecology of streams and rivers, has changed due to major initiatives to dredge channels, ditches, and drains.

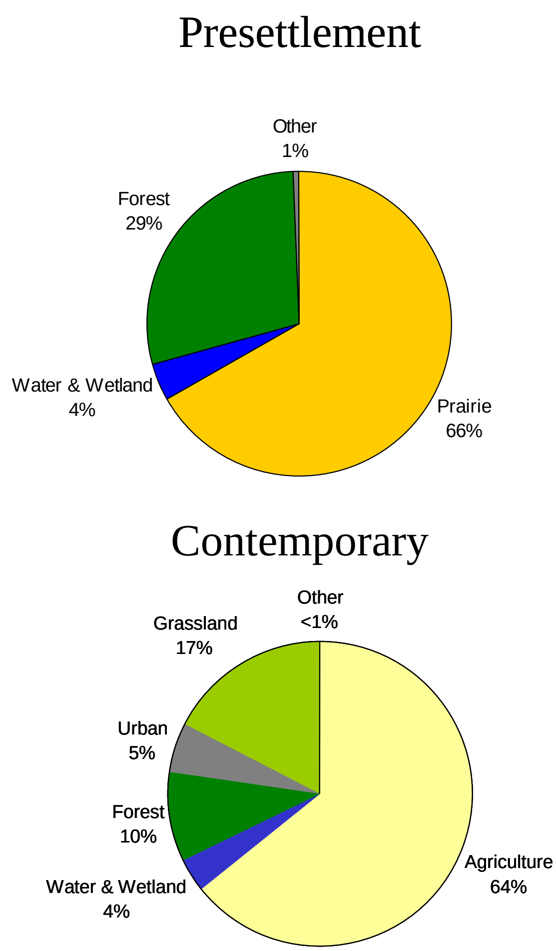


Figure 2-9. Presettlement and Contemporary Land Cover Distribution in the Illinois River Basin

In some cases, the landscape and streams are still adjusting to changes imposed by human development especially where suburban sprawl is encroaching into sensitive habitats and prime farmland. In other cases, the ecosystem has stabilized within the bounds imposed by development, and biological communities are recovering from prior disturbances.

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1. Land Cover and Associated Biological Communities. The current basin-wide land cover, as evaluated from satellite imagery, is predominantly row crop agriculture (figure 2-9, table 2-3).

Table 2-3. Basin Land Cover in Illinois

Land Cover	Square Miles
Row Crop	14,671
Rural Grassland	3,621
Woodland/Forest - Deciduous/Closed Canopy	1,980
Small Grains	984
Urban Grassland	620
Urban/Built-Up - Medium Density	518
Woodland/Forest - Deciduous/Open Canopy	354
Urban/Built-Up - High Density	351
Forested Wetlands	344
Urban/Built-Up - Low Density	305
Open Water	260
Shallow Water Wetlands	142
Shallow Marsh/Wet Meadow	108
Urban/Built-Up - Medium High Density	106
Deep Marsh	31
Barren	15
Woodland/Forest - Coniferous	12
Orchards/Nurseries	9
Swamp	0
TOTAL*	**24,432**

* sum of urban classes not included = 1,279 mi.^{2}

In contrast to the presettlement land cover distribution (which was primarily prairie), today the landscape is approximately 64 percent agriculture, 17 percent grassland, 10 percent forest, 5 percent urban or developed, and 4 percent open water and wetlands. Row crops are widely distributed, but occur in the highest density in the central portion of the Illinois River Basin. Row crops occur in lower densities in the Spoon, LaMoine, and lower Illinois watersheds, where the hilly topography is not conducive to this type of agriculture. The area of row crops is four times greater than the next most abundant land cover class, rural grassland, which includes pasture, hay fields, conservation set asides, grass waterways, roadside grasses, and other grasses. Rural grasslands are widely distributed throughout the basin, especially along waterways. Closed canopy forests occur along the main stem river bluffs, especially in the Spoon, LaMoine, and lower Illinois watersheds. Closed canopy forests are also relatively abundant in the northeast region of the basin in county forest preserves. Urban/build-up classes are widely distributed, but there are several large clusters (figure 2-10), particularly in the greater Chicago area, Springfield, and Peoria.

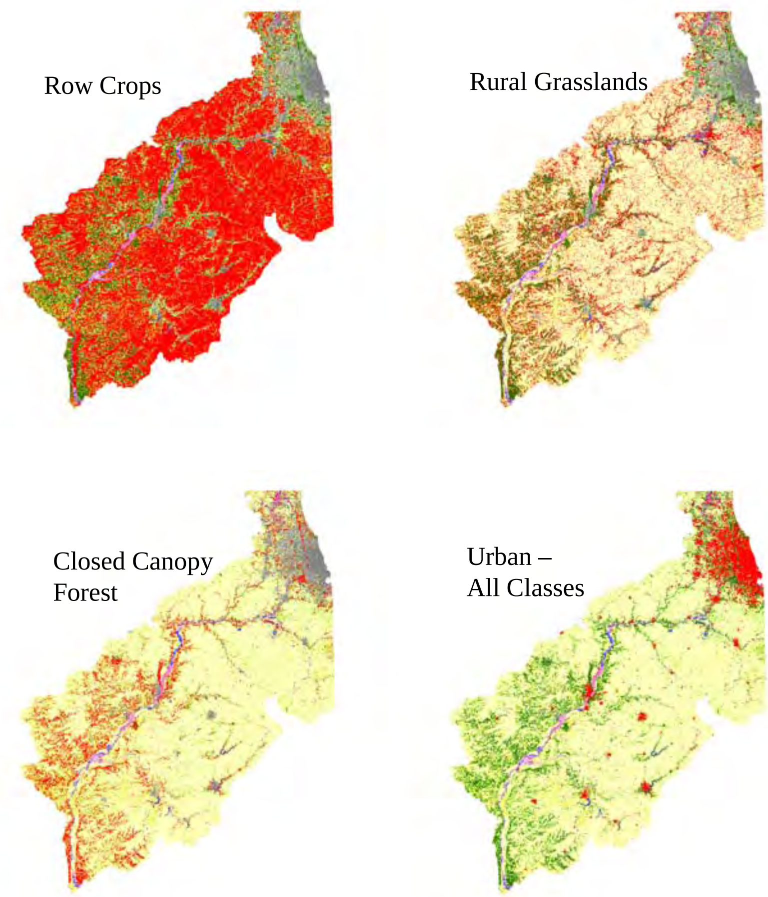


Figure 2-10. The Four Most Abundant Land Cover Classes (shaded red) in the Illinois River Basin

In addition to the losses of natural habitats in all classes, the remaining areas are highly fragmented and degraded to varying degrees. It is uncommon to find continuous natural land cover along the riparian corridor of an entire stream. Construction of roads, fields, dams, and losses of movement corridors have resulted in habitat fragmentation and the creation of small, isolated areas of forests, wetlands, prairies, and riparian corridors. Modern agriculture and the development of cities and towns have also contributed to habitat fragmentation.

The remaining animal and plant communities in these isolated tracts may only contain a few individuals or groups of each individual species. As tract size decreases, the population size of individual species also decreases because the local populations are vulnerable to disease and inbreeding stresses. Population size is the best predictor of extinction probability. Thus, fragmentation may increase the propensity for small, isolated populations to become locally extirpated (IDNR 1994, Wilson 1992). Species richness has been shown to be negatively affected with the decreasing size and increasing isolation of habitat fragments [The Nature Conservancy (TNC) 1998, Critical Trends Assessment Program (CTAP) 2001]. Fragmented habitats are often too small for species that require large home ranges or habitat blocks (such as the cerulean warbler), or are edge sensitive. Habitat fragmentation may favor competitors, predators, and parasites over native species and increases the vulnerability of native species to predators along new habitat edges. Fragmentation also severs the natural landscape links that connect blocks of similar habitat or provide access to different habitat types required by various species for different life cycle functions. Habitat loss, degradation, and fragmentation have led to measurable losses in species diversity throughout the Illinois River Basin (Fitzgerald et al. 2000, CTAP 2001).

Finally, disturbances maintain the mosaics of habitats needed to maintain a naturally functioning ecosystem. Most of these disturbance regimes have been greatly altered or even eliminated altogether. This alteration of disturbance regimes has resulted in a more homogeneous environment, with an associated loss in ecological integrity.

a. Resource Rich Areas. Critical Trends Assessment Program (CTAP) scientists used land cover data and geo-referenced biological data, such as the quantity of forests, wetlands, Illinois Natural Areas Inventory (INAI) sites, and Biologically Significant Streams (BSS), to determine where the most biologically rich areas of the state are located. Thirty such resource rich areas were identified throughout the state, 11 of which lie at least partially within the Illinois River Basin (figure 2-11).

1. Driftless Area
2. Sugar River
3. **Chain O' Lakes - Fox River**
4. Illinois Beach
5. Kishwaukee River
6. Rock River
7. **Du Page River**
8. Mississippi - Lower Rock
9. **Des Plaines River**
10. **Thorn Creek**
11. **Prairie Parklands -Midewin**
12. **Kankakee - Iroquois**
13. **Peoria Wilds**
14. Nauvoo
15. **Mackinaw River**
16. **Middle Illinois River**
17. Vermilion River
18. **Big Rivers**
19. Embarras River
20. **Sangamon River**
21. Upper Wabash River
22. Southern Till Plain
23. Karst/Cave Area
24. Lower Wabash River
25. Kaskaskia Bottoms
26. Middle Fork Big Muddy
27. Illinois Ozarks
28. Shawnee Hills
29. Cache River
30. Cretaceous Hills

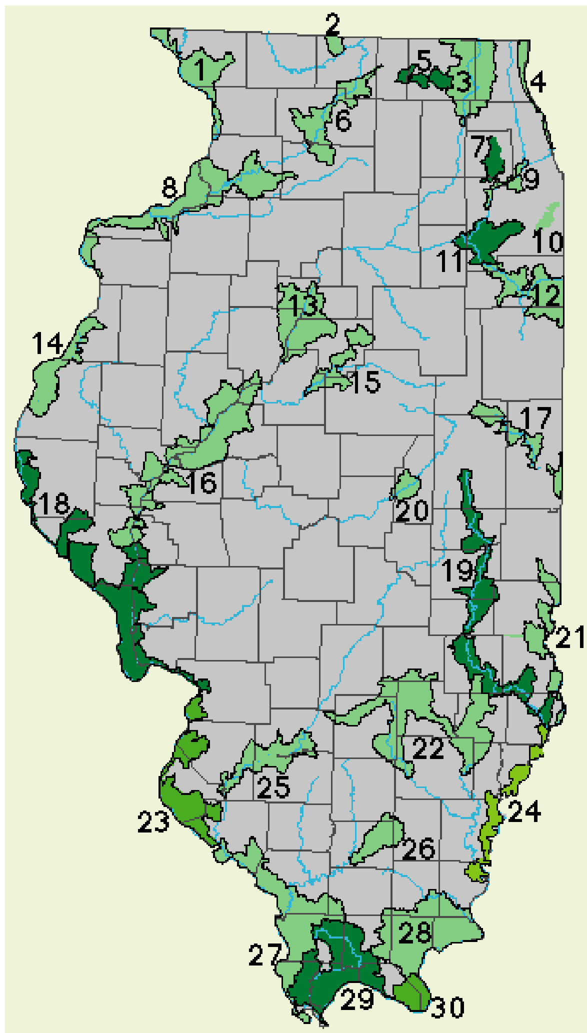


Figure 2-11. Resource Rich Areas (CTAP 2001). Those RRAs in bold are within the Illinois River Basin, wholly or in part.

The RRAs in the Illinois River Basin vary in size from 20,614 to 626,795 acres (table 2-4).

Table 2-4. Illinois Natural Areas Inventory (INAI), Biologically Significant Streams (BSS), and Natural Heritage occurrences for Resource Rich Areas within the Illinois River Basin

Resource Rich Area	Total Acres	INAI	# INAI Sites [1]	BSS Miles	# Heritage Occurrences
Chain O Lakes-Fox River	285,844	9,442	72	35.6	476
DuPage River	51,653	1,576	7	0	17
Des Plaines River	43,470	2,115	11	0	61
Thorn Creek	20,614	927	5	0	13
Prairie Parklands	152,669	10,037	18	23.8	85
Kankakee-Iroquois	231,005	6,731	17	63.3	67
Peoria Wilds	277,847	1,859	24	0	51
Mackinaw River	125,008	1,139	4	26.9	7
Middle Illinois River	575,515	13,474	38	0	134
Big Rivers	626,795	10,514	61	28.9	150
Sangamon River	53,734	880	2	15.5	8

[1] Natural areas occurring in more than one RRA are counted only once.

In most RRAs, the existing natural resources occupy a concentrated portion of the watershed, often along riparian corridors, and only a small fraction of these areas are protected from encroachment or development by being in State or Federal ownership (table 2-5).

Table 2-5. State- and Federally-Owned Lands in Resource Rich Areas

State Lands [1]							Federal Lands	
Resource Rich Area	# of Parks	# Cons Areas	# of Forests	# of FWA	State acres	% of RRA	Federal acres	% of RRA
Chain O Lakes-Fox River	2	0	0	0	5,338	1.9	0	0.0
DuPage River	0	0	0	0	0	0.0	0	0.0
Des Plaines River	0	0	0	0	0	0.0	0	0.0
Thorn Creek	0	0	0	0	0	0.0	0	0.0
Prairie Parklands	2	1	0	0	7,324	4.8	26,904	17.6
Kankakee-Iroquois	1	1	0	0	6,415	2.8	0	0.0
Peoria Wilds	0	4	0	1	9,570	3.4	1,589	0.6
Mackinaw River	0	0	0	1	1,397	1.1	0	0.0
Middle Illinois River	1	5	1	2	31,630	5.5	21,499	3.7
Big Rivers	1	1	0	0	9,547	1.5	37,901	6.0
Sangamon River	0	0	0	0	0	0.0	0	0.0

[1] Parks, Cons Areas (Conservation Areas), Forests, and FWA (Fish and Wildlife Area) refer to state lands

The Resource Rich Areas (RRA) include 45 percent of the bottomland, 43 percent of the nonforested wetland, and 34 percent of the upland forest in Illinois while occupying less than 20 percent of the state's total area. The RRAs include 76 percent of all INAI acreage and 55 percent of all INAI sites in the state. Forty-eight percent of all BSS mileage lies within RRA sites. The RRAs in the northeast portion of the Illinois River Basin, in and around the greater metropolitan Chicago area, are especially vulnerable to urban encroachment.

This inventory of resource rich areas has helped to establish priorities for Illinois' Conservation 2000 Ecosystem Program. Most of the program's Ecosystem Partnerships have a resource rich area in their core. These partnership groups work together to maintain and enhance ecological and economic conditions within a defined area (CTAP 2001).

b. Grassland Communities. Prairies once covered 61 percent of the Illinois landscape. While grassland still accounts for almost 7 million acres (20 percent) of the entire state of Illinois, only 2,300 acres (about 0.01 percent of the former area) of high quality prairie remains (CTAP 2001). The remainder of the grassland habitat has been plowed, heavily grazed, or frequently mowed. Scientists from CTAP monitored 71 grassland sites statewide from 1994-2001. The average number of vascular plant species per sample site was 20; the lowest diversity sites averaged 6 species and the highest diversity sites (prairie remnants) averaged 33 species per site. By comparison, high quality prairie habitats may contain 10-140 species in a few acres. Of the terrestrial habitats, grasslands are the most heavily dominated by introduced species, primarily meadow fescue and Kentucky and Canadian blue grasses. Although many introduced grasses dominate these grasslands, they still harbor many grassland-dependent species that rely on the structure and extent of the habitat more than the specific plant species.

Most of the bird species of concern for this physiographic region, identified by Partners in Flight (a cooperative effort focusing on bird conservation in the Western Hemisphere) are grassland birds (Fitzgerald et al. 2000). Grassland bird communities were assessed from 1994-2001 and CTAP scientists found fewer grassland-dependent bird species than expected. Of 12 grassland-dependent indicator species and an expectation of at least 6 species at any site, an average of only 1.8 species per site were found among 45 sites surveyed statewide. Except for the eastern meadowlark, brown-headed cowbirds (nest parasites) were detected more often than any grassland-dependent bird species. The species that were found most often exhibited only low to moderate sensitivity to grassland fragmentation.

c. Forest Communities. Two hundred years ago, 38 percent of the state was forested; only 14 percent remains as forest today (CTAP 2001). These losses are the result of conversion to agricultural land and timber harvesting for fuel wood and lumber. Floodplain forests serve as habitat for wildlife and, during floods, for fish; reduce soil erosion; and improve water quality. Leaf litter is a significant source of organic matter for secondary aquatic production (Yin 1999). Seventy-one randomly-selected forest sites around the state were monitored between 1997 and 1999. Results of CTAP forest monitoring revealed that upland forests are oak-hickory-ash-elm and bottomland forests are predominantly ash-elm-maple (CTAP 2001). Considering the total number of vascular plants, bottomland forests were less diverse than upland forests. Landowner reports and preliminary survey results indicate that many forests are in early stages of succession, comprise primarily young trees, are often small woodlots, and show evidence of grazing, logging, or farming. Older growth forests were rarely encountered. Timber harvesting of maple trees is becoming increasingly common (Timmons 2001). Scientists from CTAP identified three common disturbance related problems: (1) forests have lost disturbance sensitive species, (2) forests are being dominated by introduced invasive species, and (3) fire suppression is leading to maple dominance (with a concurrent decline in oak and hickory species). The species composition in bottomland forests has also been altered by higher water tables, resulting in decreased oak regeneration and also adding to maple dominance (Theiling et al. 2000).

Floodplain forests support a larger number of avian species than any other habitats in the Upper Mississippi River System, providing essential habitat for wood ducks, hooded mergansers, prothonotary warblers, and red-shouldered hawks (Yin 1999). Scientists from CTAP detected the impacts of forest structural and compositional change in bird communities. An average of 6.4 forest-dependent species was found at each site. Out of a total of 24 possible species, 10 area-sensitive species were found between 1997 and 1999 for this statewide monitoring program. A positive correlation between percent forested area within 1 km and the number of bird species was also detected. Despite the lack of historical data for comparison, the occurrence of fewer than one species (0.56) per site reflects the degraded condition of the average forest patch in Illinois (CTAP 2001).

Illinois forests provide the major habitat for more than 420 vertebrate species. Losses in the quality and quantity of forest habitat severely affect wildlife populations; 82.5 percent of mammals, 62.8 percent of birds, and 79.7 percent of amphibians and reptiles require forested habitat for a portion of their life cycle (IDNR 1994).

d. Wetland Communities. To date, approximately 90 percent of Illinois wetlands have been lost. The wetlands that remain are degraded by fragmentation, siltation, altered hydrology, and the introduction of aggressive species (Havera et al. 1997, CTAP 2001). High quality wetlands tend to be relatively free from aggressive introduced species, so species richness and the presence of introduced species were the indicators CTAP scientists used to assess wetland quality. Among 78 monitored sites statewide, the most important native species were Joe Pye weed (*Eupatorium dubium*), rice-cut grass (*Leersia oryzoides*), common reed (*Phragmites australis*), river bulrush (*Scirpus fluviatilis*), water smartweed (*Polygonum amphibium*), and broad-leafed cattail (*Typha latifolia*). There were generally few introduced species at each site, but many degraded wetland communities were dominated by a single aggressive species such as narrow-leaved cattail (*Typha angustifolia*), reed canary-grass (*Phalaris arundinacea*), and meadow fescue in the north, and common reed (*Phragmites australis*) in the south. Reed canary-grass, the most commonly encountered introduced species, often completely dominates wetland plant communities and was the dominant species in 22 of 78 monitoring sites (CTAP 2001). The northeastern counties (Cook, Lake, and McHenry) supported the greatest number of rare wetland plant species in Illinois. The extirpations of threatened and endangered wetland plants have been exceptionally high in several counties in the Illinois River Basin (IDNR 1994).


Photograph 2-2. Great Blue Heron

Most of the birds, mammals, amphibians, and reptiles in Illinois use wetlands to satisfy some or all of their life requisites. Up to 266 species of birds use wetlands in Illinois during some stage of their life cycle (IDNR 1994). Scientists from CTAP identified 15 wetland-dependent bird species, such as the great blue heron (photograph 2-2), that could occur in southern wetlands and 27 in northern wetlands. Among the 50 wetland sites surveyed statewide, an average of only 1.3 wetland-dependent bird species per site were detected. No wetland-dependent species were detected at half of the sites. Six species were detected in at least 10 sites. Only three of the 12 state-listed threatened or endangered wetland-dependent birds were found, at one site each. The rarity of these wetland-dependent birds is indicative of the degraded wetland conditions in the state (CTAP 2001).

Of the 59 mammal species in Illinois, at least 36 species use wetland habitats, including 8 of the 10 endangered and threatened mammal species that are wetland-dependent (photograph 2-3). Thirty-seven of 41 species of amphibians in Illinois use wetlands; all three threatened or endangered amphibians are dependent on wetlands. Forty-seven reptile species, out of 60 statewide, utilize wetlands, including seven of nine species listed as threatened or endangered. Twelve of the 29 endangered and threatened fish species occur in wetlands or use them for spawning. Overall, of the 94 vertebrate species listed as threatened or endangered throughout the state, 64 percent utilize wetlands for at least some portion of their life cycle (IDNR 1994).

Photograph 2-3. North American River Otter

e. Riparian Corridors. The riparian corridor is an important structural and functional element of the stream ecosystem. Riparian corridors are the transition areas between aquatic and terrestrial habitats. Riparian areas provide movement corridors along rivers and streams. The bank line forests provide shade and input organic matter into the aquatic ecosystem. Riparian habitat is critical habitat for migrating and breeding birds. Preserving large tracts of contiguous habitat is important for maintaining high levels of vertebrate and invertebrate biodiversity. Fragmentation or development of this habitat can disrupt migration and breeding patterns and could limit species that favor expanses of connected habitat.

Detailed analyses of riparian corridor changes have not been conducted, but the change in the distribution of forest, prairie, and wetland cover between the present and presettlement periods has been extensive. The current composition of bankside land cover is mostly forest or grassland (table 2-6). However, the dominant riparian land cover within a 300-meter (328 yards) buffer area is agriculture.

Table 2-6. Riparian Bankside and 328 yd. Buffer Land Cover (ISIS 1999)

Land Cover Class	Bankside (%)	328 yd. Buffer (%)
Agriculture/Cropland	1	66
Disturbed/Barren	0	1
Forest	49	14
Grass	33	5
Mixed	14	7
Reservoir	2	2
Urban	1	4
Water	0	1

f. Stream Communities. There is a great diversity of stream types in the Illinois River Basin, including small, coldwater, spring-fed creeks; stony and sandy-bottomed coolwater or warmwater streams; and soft-bottomed, warmwater streams and rivers. The diversity of habitats helps support a diversity of aquatic plant and animal species. The majority of streams have been manipulated either directly by modifications within the streams, or indirectly by modifications in the surrounding landscape, or both. Dams and channelization are the most apparent changes to small streams and rivers. Many streams that originally drained the prairies of Illinois were straightened and their canopies and riparian buffers were removed. Many current streams or ditches, constructed to provide more effective land drainage, were historically ephemeral channels, wetland swales, or simply did not exist (Rhoads and Herricks 1996). Landscape changes have also led to increased runoff rates. Much of the land that is currently used for agricultural purposes was tiled to drain more rapidly than it did historically. Increased bed and bank migration has resulted from the higher energy flows and erosive forces of these stream systems. This development in the basin has resulted in streams that are more structurally simple and homogeneous than in the past.

Several methods—including the Biological Stream Characterization (BSC) Index and habitat quality assessments performed as a part of the CTAP—were used to assess the stream quality within the state The BSC and habitat quality assessments are based on different criteria; therefore, the results display some similarities as well as differences. The BSC is based on biological data, while the habitat quality assessments are based on physical parameters of the streams. These two methods are described in the following text.

Biological Stream Characterization. Illinois DNR and Illinois EPA managers developed the BSC Index to rank stream quality uniformly across the state. The BSC is a mix of quantitative variables based primarily on the Index of Biotic Integrity for fish (Karr et al. 1986), and to a lesser extent on macroinvertebrate biotic indices and qualitative judgments of Illinois DNR biologists (Bertrand et al. 1996). The results for the 1999 Illinois River Basin assessment are shown in figure 2-12 and table 2-7. In that assessment, the Mackinaw watershed had the most highly rated stream miles. Highly valued and moderate stream reaches were the most common, and they were widely distributed throughout the Illinois River Basin. Limited value streams occurred in the urban watersheds of the Des Plaines, Fox, and Chicago Rivers, the agricultural watersheds of the Sangamon River, and the Spoon River watershed. Restricted stream reaches occurred mainly in the Chicago region, and comprised only a small fraction of the total streams assessed.

Table 2-7. Illinois River Sub-Basin Stream Miles Ranked Using the Illinois Department of Natural Resources Biological Stream Characterization (Bertrand et al. 1996: ISIS 1999)

Watershed	Unique	High	Moderate	Limited	Restricted
Des Plaines	11.3	68.8	189.2	260.0	19.5
Upper Fox	0.0	94.6	99.0	46.1	0.0
Chicago	0.0	0.0	64.9	156.7	24.1
Lower Fox	16.5	164.1	310.8	9.4	0.0
Lower Illinois-Senachwine Lake	8.8	124.2	113.4	0.0	0.0
Upper Illinois	45.0	163.4	28.9	0.0	0.0
Kankakee	0.0	228.8	92.6	0.1	0.0
Spoon	0.0	159.2	487.9	130.4	0.0
Vermilion	55.9	223.8	122.0	0.0	0.0
Iroquois	0.0	167.6	33.1	0.0	0.0
Lower Illinois-Lake Chautauqua	0.0	50.1	60.5	0.0	0.0
Mackinaw	156.1	211.5	65.4	1.2	0.0
LaMoine	19.6	176.3	231.9	0.6	0.0
Upper Sangamon	46.2	117.5	250.5	34.1	0.0
Salt	18.7	184.2	234.4	53.6	0.0
Lower Sangamon	0.0	12.8	193.9	36.1	0.0
Lower Illinois	0.0	219.7	33.9	0.0	0.0
South Fork Sangamon	0.0	0.6	116.1	81.8	0.0
Macoupin	0.0	101.2	0.5	0.5	0.0
Total Stream Miles	**378.1**	**2,468.4**	**2,728.9**	**810.6**	**43.6**
Percent of Sampled	**5.9%**	**38.4%**	**42.4%**	**12.6%**	**0.7%**

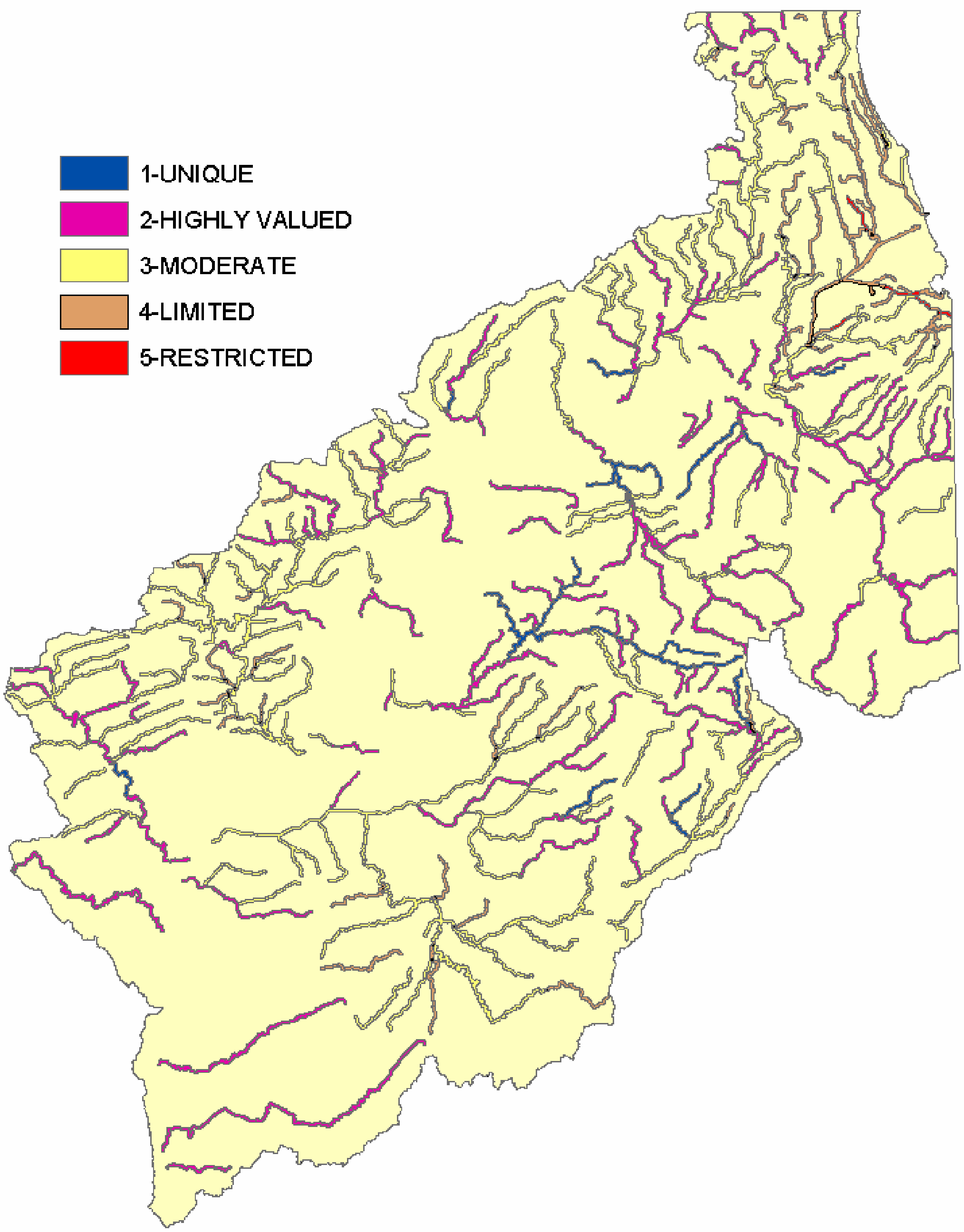


Figure 2-12. Biological Stream Characterization for Some Illinois River Basin Streams (Bertrand et al. 1996; ISIS 1999)

Stream Habitat. State scientists have been monitoring stream water quality, habitat, aquatic insects, and fishes throughout Illinois since 1995 as part of the CTAP (CTAP 2001). Habitat quality assessments, modified from the USEPA procedure, have been conducted by CTAP scientists, examining 12 stream habitat parameters that relate to the quality and width of bankline vegetation, quantity and quality of in-stream cover, condition of banks, and relative straightness of the stream course. Natural habitat features of most Illinois streams, such as wooded riparian corridors, winding channels, and in-stream habitat such as coarse rocks and woody debris, have been removed to facilitate agriculture. The statewide average habitat index score was 88.6 out of a maximum possible 180, indicating fair habitat quality. The lowest and highest scores in Illinois were 25, indicating severe landscape and drainage alterations, and 146, indicating an aquatic and riparian resource of the highest quality. Highly agricultural basins, including the Kankakee, Vermilion, Mackinaw, and Spoon scored below the statewide average. The Sangamon basin scored higher than average since it is larger and more flood-prone, discouraging row crop agriculture close to the banks. Habitat quality scores of the streams in the Illinois River Basin reflect the modifications to the floodplain that have occurred over the past 150 years (CTAP 2001).

Compared to the species found in flowing waters in Illinois at the start of the last century, approximately 19 percent of the fish, 34 percent of the amphibians and reptiles, 55 percent of the freshwater mussels, and 22 percent of the crayfish have been extirpated or are threatened by extinction (IDNR 1994). These changes can be attributed to habitat loss, degradation due to siltation and/or poor water quality, contaminated sediments, construction of dams and levees, introduction of exotic species into the system, and overharvesting (IDNR 1994).

g. Floodplain Communities. The degree of connectivity between the main channel and its floodplain is a primary structural attribute of river ecological integrity (Lubinski 1999). Seasonal floods, creating and maintaining a mosaic of habitat types that exhibit a high degree of biodiversity, characterize river-floodplain ecosystems (Sparks 1995). The lower Illinois River, including Peoria, La Grange and Alton Pools, is a remnant of the ancient Mississippi River that once flowed across northwestern Illinois. The floodplain in this reach is exceptionally large for the current river discharge and has been filling with fine loess sediments for millennia (Theiling et al. 2000).

Prior to navigation and agricultural development, the backwaters were very numerous and diverse. Currently, water level regulation maintains fewer, larger lakes with uniform shallow depths and silty substrates. Agriculture dominates the floodplain, which is about 50 percent leveed in La Grange Pool and about 70 percent leveed in Alton Pool (Theiling et al. 2000). The levees also concentrate river flows and sediment carried in suspension. Sediment-laden waters are currently concentrated in the remaining contiguous floodplain, where it settles out, causing rapid filling in backwater lakes (Bellrose et al. 1983). Levees reduce river-floodplain connectivity, which may limit production of floodplain spawning fishes and reduce nutrient transfer between the river and its floodplain (Sparks 1995, Ward 1999).

The overall productivity of the river system may have been reduced from a natural floodplain river system with significant changes in seasonal water levels to an ecosystem in which seasonal low water conditions no longer occur (Bayley 1991). These alterations to the landscape and the flood pulse and river-floodplain connectivity have initiated long-term changes in the ecosystem that are difficult to reverse (Sparks 1995).

h. Aquatic Vegetation. Historically, emergent, submersed, and floating aquatic plants were very important components of the Illinois River floodplain ecosystem (Bellrose et al. 1979, Havera 1999). The vast floodplain marshes and backwater lakes were the resources that attracted and supported the huge abundances of migratory waterfowl and other waterbirds that have been so highly valued. The ecological response to the multiple and continued disturbances of the Illinois River has been well documented through time (see Mills et al. 1966, Starrett 1972, Bellrose et al. 1979, Sparks 1984, Bellrose et al. 1983, Theiling 1999, and USGS 1999 for comprehensive reviews). From all accounts, the river was in good condition prior to 1900. After 1900, however, the diversion from Lake Michigan permanently altered the nature of the system. Initially, the expanded backwaters were vegetated with about 50 percent cover of many species of aquatic plants, such as pondweeds (*Potamogeton* spp), coontail (*Ceratophyllum* spp), bulrush (*Scirpus* spp), and wild celery (*Vallisneria* spp) (Bellrose et al. 1979, Sparks 1984).

Photograph 2-4. Degraded Backwater

Aquatic plants have not recovered from the effects of organic pollution in the early 1900s and increased wave action from wind and boats after 1955 (Bellrose et al. 1979, Sparks 1992, Havera 1993, Havera 1999, Yin et al. 2004). The continued absence of aquatic plants in backwaters and channels open to the Illinois River is significant (photograph 2-4). When submersed aquatic vegetation died out in the mid-1950s, several things occurred: backwater substrates became easily disturbed; turbidity increased; fish communities became dominated by species tolerant of low dissolved oxygen and poorer habitat conditions; and waterfowl shifted their migrations away from the river. Currently, aquatic plants in the Illinois River are largely restricted to backwaters isolated from the river by low levees (Rogers and Theiling 1999). In addition to the physical constraints to aquatic plant re-establishment, the high abundance of rough fish, including carp, exert significant grazing pressure on any plants where they are able to grow, further limiting their re-establishment.

i. Aquatic Macroinvertebrates. In the Illinois River, the aquatic macroinvertebrate community (mayflies, fingernail clams, chironomids, and worms) was seriously affected by organic pollutants and served as a strong indicator of environmental quality (summarized by Starrett 1972 and Sparks 1984). Studies conducted by Richardson in 1915 (Richardson 1921) indicated a diverse benthic community with a dominance of small mollusks (fingernail clams and snails). By 1920, pollution-tolerant sludge worms (*Tubificidae*) and bloodworms (*Chironomus* spp) dominated the benthos.

Fingernail clams were the dominant food source for many benthic feeders (diving ducks, buffalo, catfish, carp) until the mid 1950s when fingernail clams experienced a dramatic population decline (Mills et al. 1966). The likely causal agent was determined to be periodic high concentrations of ammonia, a problem from which the river has not yet recovered (Sparks and Ross 1992) and may still be occurring. The decline of fingernail clams had a substantial effect on their vertebrate predators.

Benthic communities are still poor in the northern reaches of the river, but mayflies and fingernail clams occur in low abundance in lower parts of the river. Macroinvertebrate populations in the Illinois River, such as burrowing mayflies and fingernail clams, are substantially smaller than those found in the Upper Mississippi River (Heglund 2004). However, new populations of fingernail clams have been recently documented at a few locations on the upper river (Sparks and Ross 1992, Yin et al. 2004).

Environmental conditions within the streams of the Illinois River Basin are better than those in the Illinois River itself. The EPT taxa richness index (Ephmeroptera, Trichoptera, Plecoptera) measures the number of pollution-intolerant mayflies, caddisflies, and stoneflies present in a sample. Higher EPT index values indicate less organic pollution, or better stream health. The index scores ranged from 0 to 17 statewide with an average of 7.1 EPT taxa per stream, which is a fair rating. The Illinois River Basin watersheds scored above and below the statewide mean, with the Kankakee watershed scoring the lowest, the Fox almost at the mean, the LaMoine above the mean, and the Sangamon and Spoon higher than the mean. Hilsenhoff Biotic Index and Macroinvertebrate Biotic Index scores followed similar trends as the EPT scores, with the Spoon indicating less impaired conditions (CTAP 2001).

j. Mussels. Freshwater mussels (Unionaceae) (photograph 2-5) are another sediment-associated fauna that has suffered from the impacts of pollution and sedimentation; they are among the most imperiled fauna in North America (Neves 1993, Cummings and Anderson 2003). Not only are the numbers of freshwater mussels reduced due to poor water quality, the competition from zebra mussels (an invasive species) has also led to the decline in freshwater mussels. The zebra mussel infestation, which significantly affected the mussel communities in the Illinois River, has subsided considerably since 1995. No zebra mussels were detected in over 10,000 mussels collected in Alton Pool by commercial fishers in a specially regulated research harvest (Robert Maher, Illinois DNR, Brighton, Illinois, personal communication) but they can be found on riprap and other hard surfaces (Matt O'Hara,2001)

Photograph 2-5. Clubshell Mussel

The Illinois River system still retains approximately 35 mussel species, representing 12 percent of the freshwater mussels found in North America. Five mussel species are listed by the State of Illinois as threatened or endangered, one of which is a candidate for Federal listing. However, the general trend for mussels is still declining, both in population numbers and numbers of species, attributed to excessive siltation, loss of habitat, chemical pollution (including herbicide and insecticide runoff), and competition from exotic species (zebra mussels).

k. Fish . Fish communities provide a high-level indicator of environmental quality because of their position on the food chain and because they cannot significantly alter their distribution other than to escape into suitable tributaries or downstream. While Illinois streams contain a diversity of fishes (188 native species), they are often dominated by just two to three fish species, sometimes by one or more of the 15 introduced species found in the state (CTAP 2001). Fish species diversity is still considered high in the basin, with 115 species found, 95 percent of which are native species. Many of these species require riverine, backwater, and floodplain habitat as part of their life cycle. Eighteen fish species are listed by the State of Illinois as threatened or endangered. Many of these species are endemic to the basin and/or are intolerant of high silt levels. A group of aquatic organisms that is particularly representative of the Illinois River is the "Ancient Fishes," such as the paddlefish (photograph 2-6) and sturgeon. The majority of these fishes are migratory in nature and utilize a variety of habitats.

Photograph 2-6. Paddlefish

Fisheries monitoring, as part of the Long Term Resource Monitoring Program (LTRMP) conducted under the Environmental Management Program (EMP), and the Long Term Electrofishing (LTEF) conducted by the Illinois DNR since 1973, suggest that two distinct populations of fishes exist within the main stem of the Illinois River. Index of Biotic Integrity (IBI) trend data show no significant changes in populations in the lower three pools (Alton, La Grange, Peoria). However, these data reflect a recent increase in IBI scores in the upper three pools (Starved Rock, Marseilles, Dresden), approaching the IBI score for the lower pools. These differences in scores may be due to the inherent physical differences between these two areas, as well as lingering effects of water quality impacts to the upper pools (Pegg 2001). The long-term outlook (without-project conditions) may be for populations and native species diversity to decline gradually, due to increasing invasive species, declining suitable habitat, and loss of main stem benthic community.

Photograph 2-7. Green-winged Teal

l. Waterfowl and Birds. The Illinois River Basin is a critical mid-migration resting and feeding area of the Mississippi River Flyway. The numbers of waterfowl feeding and resting in the basin have dwindled since the first half of the 20th century. Diving duck numbers have not recovered from their rapid population decrease in the 1950s, due to habitat changes and loss of food resources. Waterfowl, and particularly diving ducks, have shifted their migrations away from the Illinois River. Peak numbers of dabbling ducks have hovered around 300,000 birds. By comparison, in the late 1940s, there were over 1,500,000 dabbling ducks in the Illinois River region each fall (photograph 2-7). Mallard numbers in the Illinois Valley have declined over 80 percent since the late 1940s.

Twenty-six avian species are state listed as threatened or endangered; one of which, the Bald Eagle**,** is a listed as a Federal Threatened Species, and four others are species of concern. Many of these species are associated with wetlands or grasslands, and are also sensitive to landscape fragmentation.

2. Threatened and Endangered Species. The Illinois River Basin currently contains 257 state listed threatened or endangered species in Illinois, of which 13 are federally listed and 1 is a Federal candidate species (table 2-8). Three additional federally-listed species occur in Indiana (total of 13 species, including 2 candidate species and 1 critical habitat designation). No additional threatened or endangered species occur in Wisconsin (two total species, including one candidate species). Five mussel species that live in the Illinois River Basin are listed by the state of Illinois as threatened or endangered, one of which is a candidate for Federal listing. Eighteen fish species are listed by the State of Illinois as threatened or endangered. Many of these species are endemic to the basin and/or intolerant of high silt levels. Federally listed species are discussed more completely in Section 5 and Appendix G (Coordination Act Report) of this document.

Table 2-8. Threatened and Endangered Species in the Illinois River Basin

Group	Illinois State Listed Species	Illinois Federal Listed Species	Indiana Federal Listed Species	Wisconsin Federal Listed Species
Birds	26	1	2 [1]	
Fish	18	0	0	
Mammals	2	2	1	
Mussels	5	1	4 [2]	
Reptiles/Amphibians	9	1[2]	2 [2]	1[2]
Insects	11	2	2	
Crustaceans	1	0	0	
Plants	185	7	2	1
TOTAL	**257**	**14**	**13**	**2**

[1] includes critical habitat designation
[2] includes candidate species

3. System Limiting Factors. The Illinois River Basin continues to experience a loss of ecological integrity due to: sedimentation of backwaters and side channels, degradation of tributary streams, increased water level fluctuations, reduction of floodplain and tributary connectivity, introduction of invasive species, and other adverse impacts caused by the intensive human development over the last 150 years. While many of the original plant and animal species are still present in the basin at reduced levels, the physical habitats (structure) and the processes that create and maintain those habitats (function) have been greatly altered. These alterations have contributed to a decline in the ecological health of the Illinois River Basin to the point where: aquatic plants beds have been virtually eliminated from the lower river; macro-invertebrate numbers have declined significantly; the loss of backwaters areas with sufficient depth for spawning, nursery and overwintering habitat is now considered limiting for many native fish; and floodplain, riparian, and aquatic habitat loss and fragmentation is a threat to the population viability of state- and federally-listed species in the basin.

a. Excessive Sedimentation. Increased sediment loads from the basin (photograph 2-8) have severely degraded environmental conditions along the main stem Illinois River by increasing turbidity and filling backwater areas, side channels, and channel border areas.

Photograph 2.8. Deposition at the Mouth of Lick Creek in LaGrange Pool

Increased sediment loads from the basin have severely degraded environmental conditions along the main stem Illinois River by increasing turbidity and filling backwater areas, side channels, and channel border areas. Excessive sediment has also degraded tributary habitats. Effective erosion control, due to the implementation of soil conservation practices, has reduced the average rate of erosion from croplands. Channel erosion from unstable streams accounts for 30-40 percent of the sediment delivered from eastern Illinois River Basin watersheds, and up to 80 percent of the sediment delivered from watersheds in the western part of the basin. Channelization of streams has increased both flow rates and velocities within the streams, which has led to increased channel erosion. An average of 12.1 million tons of sediment per year were delivered to the Illinois River, above Valley City, for water years 1981-2000, of which 6.7 million tons per year were deposited within the river and its bottomlands. The physical effects of excessive sedimentation, coupled with an absence of complementary erosive forces, accelerate changes to aquatic and floodplain habitats, including the smothering and filling of habitats Low-velocity areas, such as backwater areas and side channels, are particularly susceptible. Addressing the contribution of fine sediments from the watershed is an effective way of reducing the negative effects of sedimentation in backwater areas because fine sediments can even be carried by slow-moving flows. Excessive sedimentation in the Illinois River Basin is discussed more fully in Section 3 under Goal 1. See the following section on Water and Sediment Quality for a discussion of the effects of excessive sedimentation and turbidity on aquatic plants.

b. Loss of Productive Backwaters, Side Channels, and Channel Border Areas. The loss of productive backwaters, side channels, and channel border areas due to excessive sedimentation can be attributed to the ecological problems in the Illinois River Basin, particularly because the Illinois River has lost much of its critical spawning, nursery, and overwintering areas for fish; habitat for waterfowl and aquatic species; and backwater aquatic plant communities. On average, the backwater lakes along the Illinois River have lost 72% of their capacity. The current quality of the existing backwaters is low due to the relatively shallow depths (less than 1 foot) and relatively uniform bottom surface lacking depth diversity. If current conditions persist, additional significant aquatic areas will be converted to lower value and increasingly common mud flat and extremely shallow water habitats. The loss of these areas in the Illinois River Basin is discussed more fully in Section 3 under Goal 2.

c. Loss of Floodplain, Riparian, and Aquatic Habitats and Functions. Land-use and hydrologic changes have reduced the quantity, quality, and functions of aquatic, floodplain, and riparian habitats. Flood storage, flood conveyance, habitat availability, and nutrient exchange are some of the critical aspects of the floodplain environment that have been adversely impacted. The use of levees has disconnected large areas of the floodplain from the Illinois River and its tributaries. Habitat loss and fragmentation are widespread problems that, in the long term, could limit attempts to maintain and enhance biodiversity. The degree of connectivity between the main channel and its floodplain is another primary structural attribute of river ecological integrity (Lubinski 1999). Isolation of the floodplains from the river has resulted in a reduction of habitat quality, availability, and function.

An analysis of the current main stem Illinois River floodplain cover types reveals a loss of approximately 75 percent of the forest, 81 percent of the grassland, and 70 percent of the wetlands. In addition, nearly 50 percent of the floodplain has been isolated from the river. A similar analysis of the tributary floodplains reveals approximate losses of 16 percent of the forest, 36 percent of the grassland, and 70 percent of the wetlands.

Photograph 2-9. Stream Incision and Stream Bank Erosion

Alterations within the watershed have also had a pervasive negative effect on basin stream systems. Based on the IEPA analysis, channelization potentially impairs approximately 1,400 of perennial stream miles within the Illinois River Basin. However, unassessed streams tend to be smaller, and CTAP (1994) identified that the smaller streams tend to be channelized to a disproportionately high extent. Lopinot (1972) estimated that 27 percent of streams in the state were channelized at the time of publication; this would correspond to nearly 3,000 stream miles in the Illinois River Basin. Channelization of streams shortens overall stream lengths and results in increased velocities, bed and bank erosion, and sedimentation (photograph 2-9). Modified stream channels often have little habitat structure and variability (life requisites) necessary for diverse and abundant aquatic species. Channelization also disconnects streams from floodplain and riparian areas that are often developed into agricultural or built environments.

In addition to habitat loss and fragmentation, habitat forming disturbance regimes have been altered, affecting habitat and species diversity. The degree of connectivity between the main channel and its floodplain is a primary structural attribute of river ecological integrity (Lubinski 1999). Seasonal floods, creating and maintaining a mosaic of habitat types that exhibit a high degree of biodiversity, characterize river-floodplain ecosystems (Sparks 1995). Flooding and low water regimes have been reduced or eliminated in some areas. Fire plays an important role in creating a mosaic of terrestrial habitat types, which, in turn, maintains the biodiversity of the system. Fire suppression has resulted in the increased invasion of woody species into primarily herbaceous systems and has shifted the relative abundance of species away from fire-adapted species. Fire can also suppress or kill non-native species. The loss of the oak-hickory forests in the basin is largely explained by the maple take-over, in which mature oak-hickory forest are unable to regenerate themselves because the tree seedlings are intolerant of the excessive shade that results from the absence of fire (IDNR 1994). The loss of these areas and functions in the Illinois River Basin is discussed more fully under Goal 3, "Improve floodplain, riparian, and aquatic habitats and functions."

Photograph 2-10. Low Head Dam

d. Loss of Aquatic Connectivity (fish passage) on the Illinois River and its Tributaries.

There is diminished aquatic hydrologic connectivity on the Illinois River and its tributaries due to dam construction (photograph 2-10). Aquatic organisms do not have sufficient access to diverse habitat such as backwater and tributary habitats that are necessary at different life stages. Lack of aquatic connectivity slows repopulation of stream reaches following extreme events, such as pollution or flooding, and reduces genetic diversity of aquatic organisms. Construction of dams on the main stem and tributaries alters the temperatures, flow regime, sediment transports, chemical concentrations, and isolates biotic communities. There are seven dams on the Illinois Waterway and approximately 467 within the basin. Lateral connectivity in the Illinois River Basin is discussed more fully under Goal 4, "Restore and maintain aquatic connectivity on the Illinois River and its tributaries, where appropriate, to restore or maintain healthy populations of native species."

e. Altered Hydrologic Regime. The alteration of the hydrologic regime is considered to be the most significant change affecting aquatic biodiversity. In the developed watersheds of tributary streams feeding the river, stormwater inflows likely have higher peak flows than occurred under pre-development conditions, due to land-use changes and increased efficiency brought about by channelization. These stormflows result in rapidly rising and falling water levels and more uneven delivery of flows to the Illinois River. Land-use changes and drainage are believed to have increased the volume and the erosive force of water delivered to the river and may contribute to water level fluctuations in the main stem. A major impact of increased drainage is the decrease in base flows that impact aquatic communities in the tributaries during low water periods.

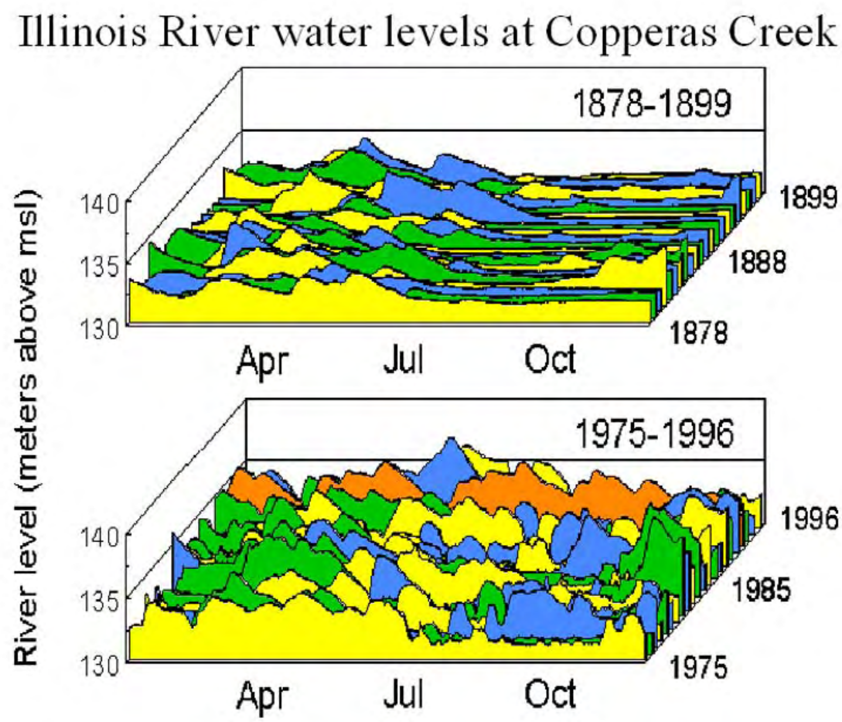


Figure 2-13. Change in Water Level Fluctuations at Copperas Creek Gage

Land use changes in the basin and river management have altered the water level regime along the main stem Illinois River, stressing the natural plant and animal communities along the river and its floodplain. The increased number of water fluctuations, especially during summer and fall low water periods, and the constant inundation of the areas upstream of the navigation dams have altered the hydrologic regime of the river (Figure 2-13), thereby contributing to the degradation of the river system. The biotic composition, structure, and function of aquatic, wetland, and riparian ecosystems depend largely on the hydrologic regime. The flow regime (magnitude, frequency, duration, timing, rate of change) affects water quality, energy sources, physical habitat, and biotic interactions, which, in turn, affect ecological integrity (Poff et al. 1997). Past management efforts have focused on requirements of one or few species of fish. The range of flows needed to sustain aquatic and riparian ecosystems may be much greater. Elimination of the summer low water periods prohibits compaction of sediments. Therefore, suspended sediments settle only loosely to the lakebed, creating a soft bottom in which aquatic plants cannot take root.

Rapidly changing water levels of the Illinois River during the growing season (a.k.a. the summer "bumps") frequently flood young, moist soil plants on mud flats before they are developed enough to survive inundation. In predevelopment conditions, water levels receded during the summer and allowed moist soil plants to grow on exposed mud flats. The summer "bumps" appear to be a critical factor, limiting these plants growing in areas within or connected to the river. Significant water level fluctuations occur during the growing season, severely limiting plant germination, growth or survival.

Past efforts may have failed to consider the full range of hydrological variability and the influence of hydrologic process on geomorphic changes and ecosystem functions (Richter et al. 1996). Hydrologic modifications to the Illinois River Basin are discussed more fully in Section 3 under Goal 5, “Naturalize Illinois River and tributary hydrologic regimes and conditions to restore aquatic and riparian habitat.” See the following paragraph on water and sediment quality for a discussion of the effects of altered hydrology and turbidity on aquatic plants.

f. Water and Sediment Quality. Water resources in the Illinois River Basin are impaired due to a combination of point and non-point sources of pollution. Although effective regulatory efforts have reduced contributions from point sources (such as wastewater treatment plants), non-point sources of water quality impairment (such as sediments and nutrients) continue to degrade the surface waters.

Water clarity is the primary factor limiting submersed aquatic plants. During periods of high turbidity, aquatic plant growth is limited, since suspended sediments interfere with light penetration into the water. The high rates of sediment delivery, and subsequent resuspension, are thought to be the primary causes of this turbidity. Loss of aquatic plants also decreases the stability of the bottom substrates for colonization by rooted plants (Wiener 1997). Under the current degraded habitat conditions, including excessive sedimentation and altered hydrology, it will be difficult to achieve the critical mass to maintain healthy aquatic plant beds. Goals 1 and 5 in Section 3 address both of these limiting factors.

In addition to turbidity, the quality of the sediments, particularly in the main stem, may limit macroinvertebrates, such as fingernail clams. Ammonia, an agricultural fertilizer, is found in the upper layers of the sediments, sometimes in toxic amounts. Toxic conditions in the sediment may have contributed to the widespread decline of fingernail clams in the Upper Mississippi River Basin, including the Illinois River (Wilson et al. 1995). Fingernail clams are very sensitive to un-ionized ammonia. During drought conditions, concentrations of un-ionized ammonia in the sediment pore water may become high enough to adversely affect fingernail clams (Frazier et al. 1996). The declines in fingernail clams may adversely affect bottom-feeding fish and wildlife, such as migrating lesser scaup, which feed heavily on this mollusk (Wilson et al. 1995). This trend has already been observed on the Illinois River since the 1950s, and may also be occurring on the Upper Mississippi River (Sparks 1984, Weiner 1997).

The impaired water and sediment quality in the Illinois River Basin is discussed more fully under in Section 3 under Goal 6, “Improve water and sediment quality in the Illinois River and its watershed.”

g. Invasive Species. Invasive species threaten biodiversity, habitat quality, and ecosystem function. These biological invasions produce severe, often irreversible impacts on agriculture, recreation, and our natural resources. They are the second-most important threat to native species, behind habitat destruction, having contributed to the decline of 42 percent of U.S. endangered and threatened species. Introduced species also present an ever-increasing threat to food and fiber production. In the United States, the economic costs of non-native species invasions reach billions of dollars each year (Pimentel et al. 2000). Invasive species compete with native species for habitat and food. Some invasive species are less sensitive to the changes that have taken place in the Illinois River Basin than the native species.

An introduced species can change the look and makeup of an entire system by changing species composition, decreasing rare species, and even changing or degrading the normal functioning of the system. Maintaining intact natural systems is important to ensure the continuation of ecosystem goods and services upon which humans depend. Many factors may cause nonindigenous species to become abundant and persist. These include the lack of natural predators and artificial and/or disturbed habitats that provide favorable conditions for invasive species (Pimentel et al. 2000).

Non-native plants can monopolize the landscape, out-competing and replacing native species in the absence of normal population controls, such as disease, insects and other controls found in their native habitats (Ikenson 2003). Invasive-dominated areas tend to provide significantly less habitat than those areas with primarily or only native species. Non-native/invasive plants common to the Illinois River Basin include reed-canary grass, purple loosestrife, garlic mustard, Japanese and shrub honeysuckle, multiflora rose, and buckthorn. Once established, these plants can be difficult and costly to control. If these invasions continue unchecked, wildlife populations will decrease as their habitat is degraded, and some species will likely become extirpated or extinct.

There are at least 15 introduced fish species in Illinois. Some of these are U.S. natives whose range has been expanded or species from other parts of the world. There has been a great nationwide increase in the total number of species introduced since 1950, and the proportion of non-U.S. species also has increased significantly (Chick and Pegg 2001). The mode of transport is shifting from intentional releases of food or sport fishes to accidental releases of aquarium fish, aquaculture species, and those carried in international shipping ballast water. The greatest proportion of non-U.S. species comes from Asia and South America.

In the Illinois River, the common carp is so plentiful and has been present for so long that few people realize it is non-native. It has been very successful since its introduction in the1880s and soon displaced buffalo and catfish as the major component of the commercial catch. More recently, grass carp have been increasing in the Long Term Resource Monitoring Program (Heglund et al. 2004) (figure 2-14) and commercial catch (figure 2-15). Asian carp are a more recent arrival and their numbers are growing rapidly. The Asian carp compete for the same food (drifting plankton and invertebrates) as gizzard shad and paddlefish. The Illinois Natural History Survey Great River Field Station is currently investigating the implications of these introductions on native species (John Chick, Illinois Natural History Survey).

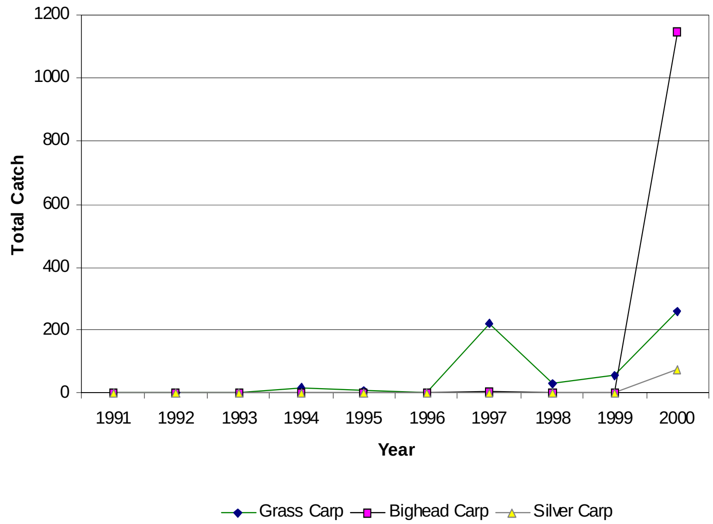


Figure 2-14. Incidence of Recently Introduced Carp Species in LTRMP Catches between 1991 and 2000

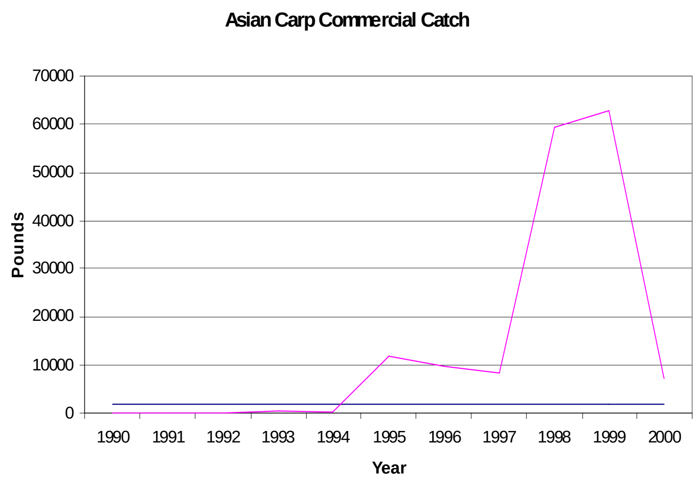


Figure 2-15. Occurrence of Asian carp in the Illinois River Commercial Catch. The great decline in 2000 is suspected to be an artifact of reduced reporting rather than a decline in abundance (Maher, 2001)

Other exotic species include zebra mussels, round gobies, European rudd, and at least two exotic zooplankton species that are entering the Illinois River system from Lake Michigan. The U.S. Army Corps of Engineers, the State of Illinois, the Sea Grant Program, and Smith-Root Manufacturing have recently installed an electric barrier on the Chicago Sanitary and Ship Canal to help block the movement of exotic species (figure 2-16). The initial purpose was to keep Great Lakes invaders from entering the river system, but the barriers may also prevent Asian carp from the Illinois River, such as grass carp, bighead carp and silver carp from getting into the Great Lakes. The construction of a second barrier, within one mile downstream, is currently under development. In combination, these two barriers should prevent some fish species from entering either the Great Lakes or the Illinois River. The damage done by these species will continue to impact the biodiversity of the Illinois River Basin.

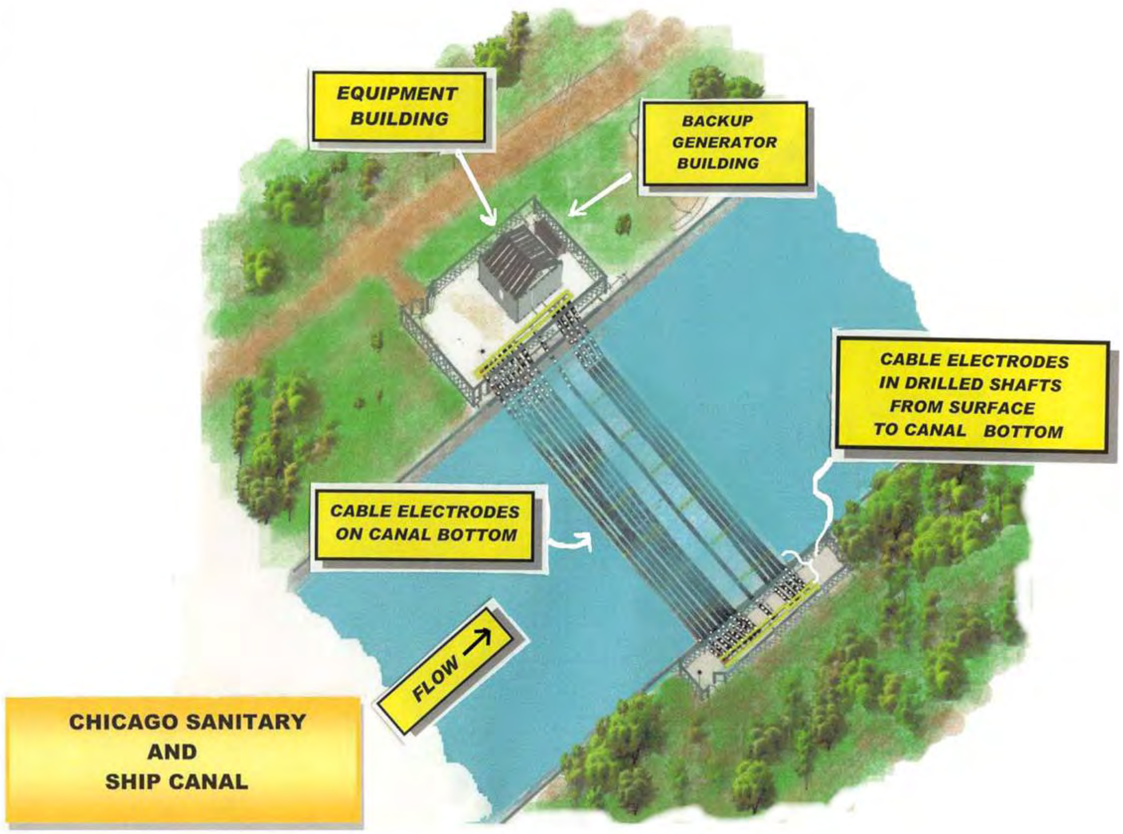


Figure 2-16. Diagram of the Fish Barrier in the Chicago Sanitary and Ship Canal

E. FUTURE WITHOUT PROJECT CONDITIONS

The future of Illinois River Basin resources is difficult to predict with accuracy. People have changed the way they treat land and water resources of the basin, which has resulted in significant improvements in environmental conditions and ecosystem health. Unfortunately, environmental conditions within the Illinois River and its basin were allowed to become extremely degraded before the changes were made.

Great strides have been made through the Clean Water Act and improved wastewater treatment facilities to curb urban and industrial pollution in an effort to improve Illinois River water quality. Through improved water quality conditions, the river has slowly regained its former oxygen carrying capacity, thus allowing fish and invertebrates to recolonize the upper river. Fish communities that were reduced to primarily the most pollution-tolerant species have become more diverse as water quality improved. Sport fishing recovered to allow professional fishing tournaments for walleye in the Upper River and largemouth bass in the lower reaches, though these species are regularly stocked by the Illinois DNR. There is evidence that fingernail clam and freshwater mussel populations are returning to portions of the upper river (Heglund et al. 2004).

Continued improvement in chemical water quality and current levels of restoration will not be sufficient to prevent further degradation of many aspects of the Illinois River ecosystem. Without further reduction of sediment entering the system from degraded tributaries and management of sediment already within the system, backwater areas will continue to rapidly fill and aquatic vegetation beds will not recover. A more subdued hydrologic regime will be necessary to allow aquatic and moist soil vegetation to return. Aquatic, floodplain, and tributary habitats that have been removed or disconnected from the system will have to be reconnected to restore appropriate system functions. Without coordinated restoration efforts, many ecological functions of the Illinois River system, such as its support of backwater fisheries and waterfowl, will continue to decline.

Natural resource managers and the public have recognized the loss of important habitats and have initiated numerous investigations and projects to better understand and reverse habitat loss throughout the Illinois River Basin. Upland terrestrial habitats show signs of recovery as landowners have taken advantage of conservation programs to protect marginal farmlands and restore grass and woodland habitats. Agriculture occupies 60 percent of the basin and the legacies from environmentally damaging practices are widespread in the basin's stream channels. The Natural Resources Conservation Service (NRCS) offers many programs to private landowners to promote the conservation and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on private working lands. One such program, in partnership with the State of Illinois, is the Conservation Reserve Enhancement Program (CREP), discussed in Section 6 of this report.

In addition to the NRCS programs, many other restoration programs or activities are ongoing in the basin (see Section 6.). These include, but are not limited to, the Corps' Environmental Management Program, the USFWS National Wildlife Refuge System, the EPA's various water quality activities, and NGO floodplain restorations. However, the magnitude of these efforts, while critical in slowing further declines in the basin, is not enough to restore ecological integrity in the Illinois River Basin. Currently, there is no program in place to holistically evaluate restoration needs and implement restoration projects at the basin scale.

1. Ecological Integrity. The general ecosystem integrity, or health, of the Illinois River Basin is still declining in spite of the dramatic water quality improvements made as a result of the Clean Water Act, as illustrated in figure 2-17. Pressure on the remaining habitats will continue to increase as the population increases. Scientists and natural resource professionals believe that the Illinois River Basin will continue to see a decline in system ecological integrity and populations of native species, resulting from continued habitat loss and fragmentation, altered natural disturbance regimes, and continued invasive species colonization.

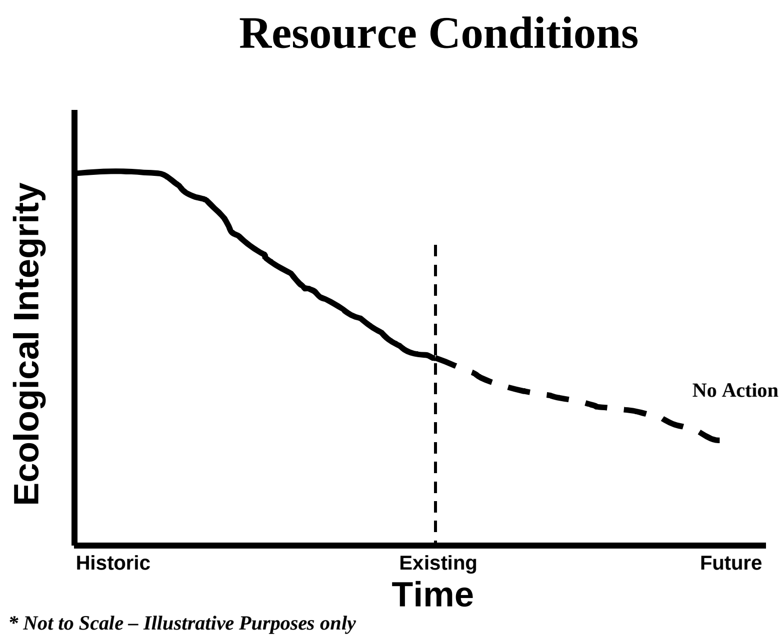


Figure 2-17. Illinois River Resource Conditions

The introduction of nonindigenous species into the Illinois River Basin is expected to continue. The electric barrier in the Chicago Sanitary and Ship Canal will only block some species from entering the Illinois River. Organisms suspended in the water column will pass through this barrier. Other non-native aquatic species may enter the system from downstream, such as the Asian carp have done. Cumulatively, these changes to the ecosystem over time have been dramatic. Current trends may be difficult to reverse and will require significant commitments of resources and time.

2. Sediment Delivery. If current conditions persist, sediment delivery from croplands and upland areas is not anticipated to decrease. Depending on economic and political conditions, the programs that have reduced sediment loading from upland practices may expand or contract in the future. Although far from certain, it is anticipated that the benefits of conservation practices will probably remain constant and possibly increase somewhat in the future. There will continue to be significant sediment transported to the Illinois River from areas not addressed by these programs, namely the stream channels themselves where approximately 40 to 60 percent of the sediment originates. Sediment delivery will increase due to continued landscape alterations, increased impervious surface area and resulting runoff, and continued channel instability due to prior alterations.

Significant sediment sources will continue to arise at points in the basin where restoration practices and sediment control regulations are inadequate or inadequately enforced. It is expected that without this program, there would be no overall program to address stream instability throughout the Illinois River Basin and that future channelization projects may destabilize additional stream miles. Without measures to naturalize the sediment transport in these streams, they will continue to incise or migrate into the foreseeable future, contributing sustained high rates of sediment loading to the main stem Illinois River.

Without action, the sediment loading to the Illinois River from unstable streams and other sources in the basin will continue at the unacceptably high levels experienced during water years 1981 - 2000. The sediment will continue to degrade vulnerable aquatic habitats and impede downstream restoration efforts. Local projects may show site-specific benefits, but the effects of high sediment loading will limit the extent where benefits may be observed.

3. Backwaters and Side Channels. By the year 2050, the Illinois River is predicted to lose a significant portion of its off-main channel backwater areas under current conditions of sediment supply, losing both surface area and volume, with continued low aquatic habitat quality. The affected contiguous and isolated backwater areas are expected to convert to mud flats or marshy wetlands. Further degradation of side channels, due to island erosion and channel sedimentation, is predicted. This will further limit off-channel habitat for fish and other aquatic species. The consensus of a number of scientists is that, due to the increasingly shallow condition of existing areas, even more rapid losses are expected in the future. This resulted in the estimation of a 1 percent loss rate per year of backwater acreage as the most likely future condition. If this rate were to continue throughout the 50-year program life, the acreage of backwaters would drop to just 32,605 acres, or a 40 percent loss of backwaters over 50 years.

Some side channel areas are experiencing sedimentation and are anticipated to be lost in the future (approximately 17 percent of side channel area in the Alton and Peoria Pools and greater in La Grange Pool). Another widespread threat to the side channels is the loss due to erosion of their protective islands. Based on data collected as part of this study, it is anticipated that, without any action, continued loss of side channel length would occur at the rate of approximately 0.25 percent per year, if it follows trends from 1903 to the present. This would result in a loss of approximately 6.5 additional miles of side channel habitats throughout the Illinois River. Some restoration of backwaters, side channels, and islands has been proposed through the NESP, though it is not currently authorized.

4. Floodplain, Riparian, and Aquatic. The habitats and ecological functions within the Illinois River main stem floodplain and the aquatic, floodplain, and riparian areas of the basin tributaries are likely to experience some further degradation in the future. The main stem Illinois River study area will likely remain relatively unchanged in terms of land use over the 50-year period of analysis. Habitat quality and ecological functions will likely remain at current degraded levels. Habitat fragmentation and unstable hydrologic regimes will continue to degrade the remaining habitat areas. Additional floodplain restoration efforts are currently proposed by several groups, including the USFWS (under the EMP), NGOs, such as The Nature Conservancy, and the Corps' Navigation Study (though not currently authorized). However, systemic restoration benefits, such as ideal spacing or connectivity of habitats, would not be as likely without a systematic plan for restoration.

The Nature Conservancy and The Wetlands Initiative have acquired more than 11,000 acres of Illinois River floodplain and adjacent habitats at Emiquon and Hennepin, respectively. Restoration efforts have begun on these sites, such as shutting off drainage pumps and planting native species.

The USFWS currently manages four refuges along the Illinois River, totaling approximately 12,000 acres. The recently completed *Illinois River National Wildlife and Fish Refuges Complex Draft Comprehensive Conservation Plan and Environmental Assessment* recommends protection management on an additional 380 acres of native grassland, 200 acres of savanna, 1,300 acres of native forest, and 4,000 acres of wetlands within the focus areas through voluntary partnerships.

Finally, the UMRS-IWW System Navigation Feasibility Study recommends restoration of 20,000 acres of Illinois River floodplain. The restoration measures identified under the Navigation Study are consistent with those of this study, and would reduce needs under this study if authorized and implemented.

Overall, the tributary floodplains are also likely to remain in a state consistent with their current degraded conditions. Urban development is perhaps more likely than on the main stem, particularly near the larger urban areas. Land conversion, outside the floodplain, to urban use and development in the State of Illinois is currently estimated at 40,000-50,000 acres of land per year. Much of this development is in the Illinois River Basin, particularly in the western Chicago suburbs. In-stream habitats throughout the basin are likely to degrade over the 50-year period of analysis. Stressors on the stream network include: (1) direct modification of stream channels for urban and rural development, (2) increases in impervious land surfaces resulting in increased runoff and higher flow, (3) increases in tile-drained agricultural areas, (4) point and non-point source pollutants into the system, and (5) invasive and exotic species invasion.

In the tributaries, the Conservation Reserve and Enhancement Program (CREP) should continue in the immediate future. While focused on sediment, the acreages that have been enrolled and are currently being enrolled are in the floodplain and riparian areas of Illinois River Basin streams. This provides opportunities for increased connectivity of various riparian habitats. These benefits may be offset by the continued degradation of aquatic stream and riparian habitats, resulting from bed and bank erosion.

5. Connectivity. No significant change in the number of dams blocking fish and aquatic species migration is anticipated. The need for potable water for increasing populations in northeast Illinois may result in construction of dams or modification of existing dams for water supply purposes. It is anticipated that new dams may be constructed to accommodate fish passage; however, any new dams would likely have some impact on connectivity. It is likely that some of the older, low-head dams will be removed in the future. Dam removal will be municipality driven and will be related to the costs of continued operations and maintenance. Municipalities will weigh the benefits and services provided by the dam with the costs of reconstruction, repair, and continued operation and maintenance. The Illinois DNR Office of Water Resources is evaluating dam modification or dam removal at State-owned dams when requested by municipalities.

6. Water Levels. Without the program, water level regulation will continue to induce fluctuations in dam tailwaters, and wicket operations will be fundamentally unchanged. Implementation of the Tunnel and Reservoir Plan (TARP), a Chicago area initiative to store stormflows in an underground reservoir system, may reduce some of the peak flows entering the river from northeastern Illinois, but increased development, even with peak flow control requirements, will increase the volume and rate of storm water entering the Illinois River, likely increasing the high-water fluctuations in the river. Without site-specific regime manipulation, backwater and floodplain areas are likely to continue to either degrade or maintain relatively low levels of ecological function.

Tributary hydrologic regimes will commonly exhibit high peak flows and low baseflows that stress aquatic biota; these conditions will likely become more stressful in areas that experience increased urbanization.

7. Water Quality. Water resources in the Illinois River Basin are impaired due to a combination of point and non-point sources of pollution. Although effective regulatory efforts have reduced contributions from point sources, non-point sources of water quality impairment (such as sediments and nutrients) continue to degrade the surface waters. Continued improvement in chemical water quality will be insufficient to prevent further degradation of many aspects of the Illinois River ecosystem. Without further reduction of sediment entering the system from degraded tributaries and management of sediment already within the system, backwater areas will continue to rapidly fill and aquatic vegetation beds will not recover. In addition to turbidity, the quality of the sediments, particularly in the main stem, may limit macroinvertebrates such as fingernail clams. Ammonia, an agricultural fertilizer, is found in the upper layers of the sediments, sometimes in toxic amounts. Minor improvements in water quality may be made due to regulation and improvements in best management practices (BMPs). The EPA's programs to reduce nonpoint source pollution and its Targeted Watersheds Grant Program will continue to provide some improvements in general water quality.

8. Natural Resources

a. Fisheries. Although fish populations improved as significant gains in water quality were made through the Clean Water Act, continuing declines in habitat quality and increasing numbers of invasive species threaten these populations. Data has been analyzed from the Illinois DNR Long Term Electrofishing Program in the main stem Illinois River (1957-2002), including trends and larger river IBI values. The monitoring period occurred during a period of very impaired water quality; therefore, the highest levels achieved during this time reflect impaired conditions. Fish populations and diversity are thought to be stable in the lower pools and still improving in the upper pools, although at lower levels than prior to European settlement. The long-term outlook (without-project conditions) may be for populations and native species diversity to decline gradually (increasing invasive species, suitable habitat declining, and loss of main stem benthic community).

b. Waterfowl and Wetlands. The declines in diving ducks (essentially gone since the 1950s) and dabbling ducks (80 percent decline in mallard populations) in the basin have been documented by the Illinois Natural History Survey. These losses can be linked to a loss of food sources (aquatic plants, macroinvertebrates) in the 1950s and ongoing habitat degradation and loss. On the main stem, habitat conditions are typically favorable only in areas isolated from the river. The loss of aquatic plants and the benthic community were identified as limiting factors on waterfowl populations. The current limited quantity and degraded wetland conditions, and lack of aquatic plants in areas hydraulically connected to the Illinois River are predicted to continue. Waterfowl populations that rely on these habitats are not anticipated to return to historic levels.

c. Mussels. Mussels declined severely in response to overharvesting and poor water quality, as well as ongoing problems with excessive sedimentation. After water quality improved, mussel populations improved also. This improvement was most evident in the upper river, where water quality impacts were most severe. Commercial mussels harvests have resumed in the lower main stem pools. However, the general trend is still declining (numbers and species), attributed to excessive siltation, loss of habitat, chemical pollution (including herbicide and insecticide runoff), and competition from exotic species (zebra mussels).

d. Macroinvertebrates. Long-term widespread declines in benthic macroinvertebrates are linked to domestic and industrial pollution, metal contaminated sediments and ammonia, as well as increasingly silty substrates. These declines have had adverse effects on river fishes and birds. Because of their wide distribution and potential to exhibit dramatic community changes when exposed to water and sediment pollution, they are ideal indicators of environmental quality. These declines are anticipated to continue.

e. Aquatic Vegetation. Currently, submersed aquatic plants are found only in isolated areas of the main stem. This loss of vegetation has led to easily disturbed backwater substrates, increased turbidity, poorer habitat conditions, and fish communities that are increasingly dominated by species that tolerate low dissolved oxygen and poor habitat. Limiting factors to submersed aquatic plant recovery include sediment quality, excessive sedimentation and turbidity, rough fish activity, and unstable water levels. Many of these same factors affect emergent and moist soil vegetation. Under current and predicted future conditions, the outlook for recovery of aquatic vegetation in areas hydraulically connected to the main stem river is very poor.

f. Forests. Forests in the Illinois River Basin will become increasingly fragmented though habitat conversion, timber harvest, and other disturbances. Species composition will continue the current trend towards maple dominance, with an increasing invasive species component. Without restoration efforts in both reestablishing forests and restoring species diversity, forests and forest-dependent species will continue to decline.

F. DESIRED FUTURE CONDITIONS

> **Vision.** A naturally diverse and productive Illinois River Basin that is sustainable by natural ecological processes and managed to provide for compatible social and economic activities.

Desired future environmental conditions are difficult to define for large and complex ecosystems. It is particularly difficult to balance conflicting economic, social, and environmental objectives when resources are limited. The primary goal should be to restore a diverse mosaic of habitats, increase the connectivity of habitats while reducing effects of fragmentation (photograph 2-11), and restore the natural range of habitat creating processes so that the Illinois River Basin can support and sustain diverse and productive food webs.

Scientists, natural resource managers, and the public have recognized the loss of important habitats and have initiated numerous investigations and projects to better understand and reverse habitat loss throughout the Illinois River Basin. In the past, many of the restoration efforts have focused only on small components of the basin without considering the broader basin context.

The following areas have been identified as the physical factors that limit system ecological integrity: excessive sedimentation, loss of productive backwaters, and side channels, loss of floodplain, riparian, and aquatic habitats and functions, loss of aquatic connectivity on the Illinois River and its tributaries, altered hydrologic regime, water and sediment quality, and invasive species. There are numerous opportunities for restoration.

Photograph 2-11. High-quality Backwater Area

Figure 2-18 illustrates how projects formulated addressing these system limiting factors can collectively improve ecosystem integrity to the point where higher levels of function are restored. Monitoring, at both the system and individual project level, would provide vital feedback needed to ensure success and increase understanding of the Illinois River Basin ecosystem.

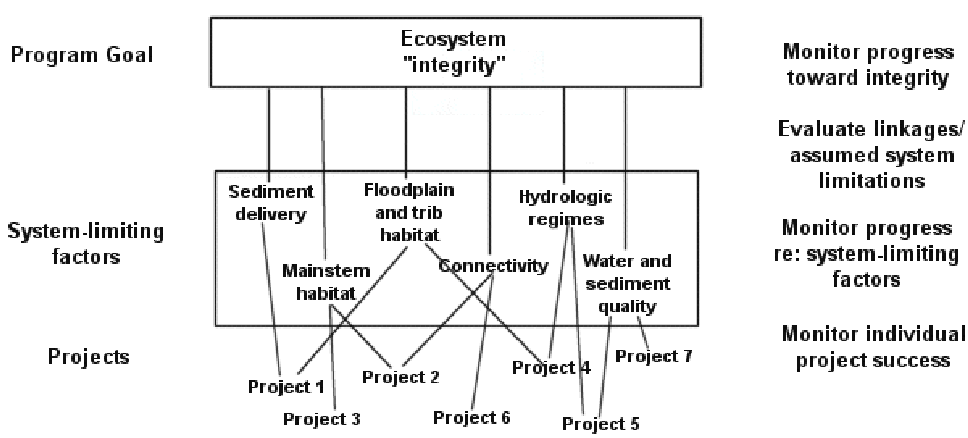


Figure 2-18. Conceptual Model of Illinois River Basin Restoration Program and Monitoring

1. Sediment Delivery. Under the desired future conditions, the rate of sediment transport within the Illinois River Basin and the main stem river, especially the transport of silt and clay particles, would be reduced to a level that will better support ecological processes. At this time, the understanding of the interconnections between sediment transport and Illinois River Basin ecosystem processes is insufficient to support definitive numerical targets for ecosystem improvement. The U.S. Army Corps of Engineers and State of Illinois scientists and managers generally accept that an overall 20 percent reduction of sediment transported to the main stem Illinois River is an appropriate initial long-term target that would demonstrate measurable positive benefits for the system. Monitoring performed as part of the Demonstration Erosion Control (DEC) project in the Upper Yazoo River Basin in Mississippi indicated that such a reduction of watershed sediment delivery is possible using proven technology (Watson and Biedenharn 1999). An interim target of 10 percent reduction of sediment transported to the main stem after 20 years was chosen to represent a measurable improvement and is feasible by treating the most significant sediment sources first. Using the sediment budget developed by Demissie et al. (2004) for WY 1981-2000 (12.1 million tons/year delivered to the Illinois River), 10 percent and 20 percent reductions represent 1.2 and 2.4 million tons per year below current levels, respectively.

Although these objectives are formulated in terms of sediment delivery to the main stem, the benefits will be achieved nearly exclusively by projects within the tributary basins. These projects would have significant benefits within their particular tributary areas. An overall 20 percent reduction in sediment delivered would necessitate higher reductions in the immediate vicinity of each project. It is envisioned that additional ecosystem benefits will be gained by placing the sediment reduction projects in areas likely to benefit high-value downstream habitats.

2. Backwaters and Side Channels. The desired future conditions were determined largely by looking at the likely future without-project conditions and assessing needs to restore aquatic habitats for fish spawning, nursery, and overwintering habitats, diving ducks, and aquatic plants.

The backwater restoration objective of restoring 19,000 acres for the Illinois River had previously been identified in the Habitat Needs Assessment. An interagency team assessing the restoration needs of the entire Upper Mississippi River System, including the Illinois River, conducted the assessment and set the restoration target. Resource managers further identified a general target of depths for backwater restoration by recommending the following distributions of depths: 5% >9 feet, 10% 6-9 feet, 25% 3-6 feet, and 60% < 3 feet. Since virtually all areas are currently less than 3 feet, restoration of up to 19,000 acres could be focused on restoring the relative depth diversity associated with the other three depth categories.

One of the major concerns on the river system is the potential loss of connected off-channel areas. The desired future condition includes the restoration and maintenance of side channel habitats, islands, and the maintenance of all existing connections between backwaters and the main channel (connections at the 50 percent exceedance flow duration).

Backwater restoration success is also related to the quality of sediments. Options should be explored to compact sediments or remove unconsolidated material to improve substrate conditions for aquatic plants, fish, and wildlife (photograph 2-12). Due to the potential for substantial amounts of dredging, additional beneficial uses of sediment should be investigated.

Photograph 2-12. Backwater Aquatic Vegetation

3. Floodplain, Riparian, and Aquatic

a. Illinois River Main Stem. The desired future condition of the Illinois River main stem floodplain is a reversal of some of the historic loss of habitat and floodplain functions and an increase in habitat area and quality. This would be accomplished by restoring up to 150,000 acres of isolated and connected floodplain areas, representing approximately 30 percent of the Illinois River Valley. This level of restoration would provide the necessary building blocks for a sustainable floodplain ecosystem in conjunction with other restoration efforts undertaken as part of this effort, particularly water level, backwaters, and side channels.

b. Illinois River Tributaries. The desired future condition for the Illinois River Basin tributaries is the restoration of a sustainable level of floodplain and aquatic habitat functions. A portion of this would be accomplished by restoring 150,000 acres of isolated and connected floodplain areas. This represents approximately 18 percent of the Illinois River Basin tributary floodplain and riparian habitat areas. This level of restoration would provide the necessary building blocks for a sustainable floodplain ecosystem within the tributaries in conjunction with other restoration efforts undertaken as part of this effort, particularly sediment delivery.

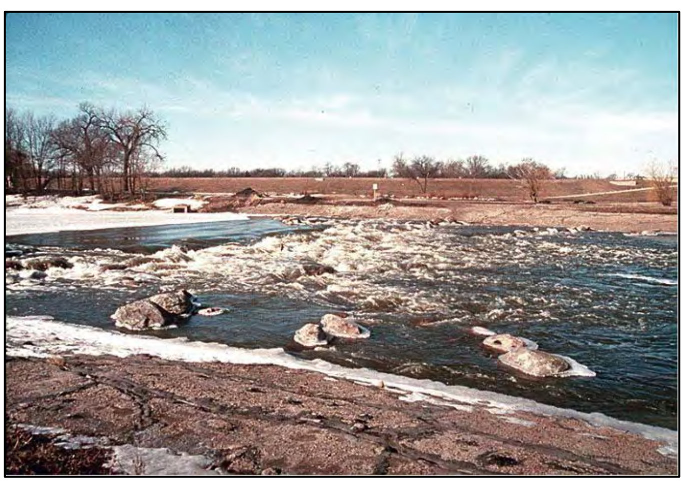
General conditions for floodplains and riparian areas include terrestrial patch size recommendations (amount shown or greater). Bottomland hardwood forest would range from 500 to 1,000 acres in size, with 3,000 acres needed for some interior avian species. Grasslands would range from 100 to 500 acres in size. Nonforested wetlands require a minimum of 100 acres, spaced 30 to 40 miles apart, and riparian zones for streams require a minimum of 100 feet on each side.

c. Aquatic Habitats. Approximately 1,000 miles of impaired streams would be restored as part of the desired future condition (photograph 2-13). This represents approximately one-third of the perennial streams impaired by channelization within the Illinois River Basin. This level of restoration would provide the necessary building blocks for sustainable aquatic environments in the perennial and intermittent streams of the Illinois River Basin.

Photograph 2-13. Restored Stream

Another general consideration for the future is developing a landscape free of introduced species that change the look and makeup of an entire system by changing species composition, decreasing rare species, and even changing or degrading the normal functioning of the system. Once the invasive species have been controlled or eliminated and restoration is initiated, ecosystems may see lost components or functions restored.

4. Connectivity. The desired future condition is a river system that provides connected habitats for native aquatic species, allowing them to utilize critical habitats at critical time periods and recolonize areas after extreme events or disturbance. This connectivity occurs at three scales; major tributary to mainstem, within the major tributary basin, and within the mainstem of the Illinois River.



Photograph 2-14. Rock Ramp Fish Passage

The desired future condition is significant restored connectivity between the main stem and the appropriate major tributaries. The main stem Illinois River would be connected to the majority of its tributaries, including the Sangamon, Spoon, Fox, Kankakee, and DuPage Rivers. The desired future condition is to restore or maintain within-tributary connectivity in the major tributary basins (photograph 2-14).

Connectivity along the main stem of the Fox River would be reestablished, and connections would be restored to a few of the Fox River tributaries. Within-tributary connection also would be restored along the main stem of the DuPage, Des Plaines, Kankakee, Vermilion, Sangamon, and Spoon Rivers.

The desired future condition is unimpeded passage of 100 percent of large-river fish on the Illinois River main stem up to RM 286 at Brandon Road Lock and Dam. This would require improved passage at Starved Rock, Marseilles, and Dresden Lock and Dams. The Lockport and Brandon Locks and Dams would continue to block fish movement, thus limiting dispersal of invasive aquatic species between the Upper Mississippi River System and the Great Lakes. Additional study is needed to assess the desirability of facilitating passage at the Brandon Road Lock and Dam. Restored connectivity between the main stem and the Des Plaines River is desirable, but this will need to be balanced with the desire to limit dispersal of invasive species.

Restoring aquatic connectivity to aquatic systems restores a measure of ecological integrity to an area. By allowing access to habitats that supply different life requisites for fish species, the future of those species is more likely. In addition, transport of mussel glochidia by different fish species ensures that mussel communities and species have access to appropriate habitats. Finally, by restoring this component to the ecosystem, some of the building blocks for a healthy and functioning system are restored.

5. Water Levels. The desirable future seeks to minimize the water level conditions that degrade ecological function in the Illinois River Basin. This does not necessarily require a return to any particular prior state, but rather creating conditions that allow ecosystem functions to sustain themselves at an acceptable level given the constraints of multiple uses throughout the basin. Rhoads and Herricks (1996) describe this concept as “naturalization.”

In regard to tributary flows, the current state of scientific knowledge suggests that flow regimes with reduced peaks and increased baseflows will provide more desirable levels of ecosystem function than currently occur. The Lieutenant Governor’s Task Force (Kustra 1997) identified an initial goal of reducing tributary peak flows by 2 percent to 3 percent. Although the precise relationships between regime components and ecosystem functions have not been fully developed, the study team analyzed the benefits of peak flow reduction measures and decided that a peak flow reduction exceeding 20 percent would be necessary to sufficiently modify the flow conditions that are currently degrading tributary ecosystems. Likewise, a significant base flow increase, 50 percent above the current levels, is desired to reduce low-flow stress to stream organisms. Finally, as a basis for project implementation, it is necessary to document and analyze the factors that lead to undesirable hydrologic conditions and assess these factors basin-wide.

Although there is a significant desire to moderate the rate of rise and fall along the main stem Illinois River, the storage available within the system is very small relative to the flows in the river (USACE 2004a). This means that river flows are driven by tributary inflows and there is very little that can be done to significantly modify the river’s flow regime. Within this constraint, the desired future conditions include a reduction in the incidence and speed of water level changes. Reducing the amount of water level fluctuation would likely provide multiple benefits to native biological communities, including sediment consolidation for improved seed germination and rooting, decreased incidence of flood-induced mortality, increased availability of spawning habitat, and a decrease in fish stranding. As such, a desired future condition would include reduced water level fluctuations, especially from the recession of the spring flood in May through the late growing season in October, but also during the rest of the year (photograph 2-15).

Photograph 2-15. Time Lapse View of Seasonal Water Level Fluctuations

The objective identified is to reduce water level fluctuations exceeding 0.5 foot to levels observed in the 1890s, during both growing season and winter time periods; a reduction of 73 percent from current conditions. One specific measure that would reduce fluctuations is a reconstruction of the wicket dams so that the dramatic water level changes associated with their operation can be removed.

Temporarily lowering water levels in the Illinois River navigation pools would provide ecological benefits to areas of the pools that are continually inundated under current conditions, allowing sediments to consolidate and encouraging reestablishment of vegetation. Significant consolidation and benefits to plant growth have been observed in drawdowns in Illinois River and Mississippi River backwaters (Dalrymple 2000, Edwards 1988) and elsewhere (Fox et al. 1977). The desired future condition would be a successful drawdown lasting at least 30 days once every 5 years in the Peoria Pool, and once every five years in the La Grange Pool.

6. Water Quality. The desired future for water quality would include all of the following: achieve full use support for aquatic life on all surface waters of the Illinois River Basin by 2025; achieve full use support for all uses on all surface waters of the Illinois River Basin in 2055; remediate sites with contaminant issues that affect habitat; achieve Illinois EPA nutrient standards by 2025, following standards to be established by 2008; work to minimize sedimentation as a cause of impairment as defined by 305(b) by 2035; and maintain waters that currently support full use or can be considered pristine waters.

7. Natural Resources. In a meeting held in August 2003 as part of this study, state scientists and natural resource professionals from the Rock Island District of the Corps of Engineers, the Illinois DNR, the USFWS Rock Island Field Office, and The Nature Conservancy met to discuss the future conditions of the Illinois River Basin. This expert panel discussed the predicted future without this restoration program and identified potential restoration targets (desired future conditions) for the basin as follows:

a. Fisheries. Data was presented from the Illinois DNR Long Term Electrofishing Program in the main stem Illinois River (1957-2002). In addition to current conditions, trends and larger river IBI values were discussed. It was proposed to set target IBIs for various pools based on the highest value measured at each individual station within that pool as an acceptable first level target. The monitoring period (1957-2005) occurred during a period of very impaired water quality; therefore, the highest levels achieved during this time reflect impaired conditions. However, the significant gains made through the Clean Water Act were dramatic, especially for the Upper Illinois River, and the group did not foresee such dramatic improvements in the future. If these initial targets could be achieved and maintained over a significant period of time, new targets could be established. Fish populations and diversity are thought to be stable in the lower pools and still improving in the upper pools, although at lower levels than prior to European settlement. Reducing excessive sedimentation, restoring overwintering habitat, and improving water and sediment quality should be major restoration efforts that will benefit the fisheries.

b. Waterfowl and Wetlands. On the Illinois River main stem, habitat conditions for waterfowl are typically favorable only in areas isolated from the river, with its high sediment load and frequent fluctuations. The loss of aquatic plants and the benthic community were identified as limiting factors on waterfowl populations. Increasing the number of managed areas and wetlands (100-500 acres, spaced 30-40 miles apart) would be a first step in increasing waterfowl numbers. Systemic restoration measures of naturalized hydrology, reduced turbidity, reduced ammonia delivery, and invasive plant species control would be required to restore aquatic plants and macroinvertebrates necessary to regain some measure of system function for waterfowl and associated species. Restoring diving duck populations, as a representative target species, was agreed to be a goal for waterfowl. A return of this guild would reflect a return of improved ecological functions in the basin, including sediment delivery, water level fluctuations, the reestablishment of aquatic plants, and increased macroinvertebrate populations; all indicators of appropriate habitat.

c. Mussels. Mussel habitat restoration efforts should include the entire watershed (main stem and tributaries), including land use, management practices, and tributary health in order to reduce the limiting factors of excessive siltation and chemical pollution. Also important are preserving and restoring wetlands, and preserving existing high quality aquatic habitat (Cummings and Anderson 2003).

d. Macroinvertebrates. Because of their wide distribution, important position near the base of the food chain, and potential to exhibit dramatic community changes when exposed to water and sediment pollution, macroinvertebrates are ideal indicators of environmental quality. The effect of ammonia on macroinvertebrates was identified as a study need. Knowledge of long-term population cycles is also poor. The desired future for macroinvertebrates is a return to healthy levels needed to support fisheries, waterfowl populations, and other species dependent upon these species as a food source. This could be accomplished by decreased sediment, nutrient, and contaminant delivery to the river.

e. Aquatic Vegetation. The desired future is a return of aquatic plant beds to all areas of the river, particularly those hydraulically connected to the river. Limiting factors to submersed aquatic plant recovery include sediment quality, excessive sedimentation and turbidity, rough fish activity, and unstable water levels. Many of these same factors affect emergent and moist soil vegetation.

f . Forests. The desired future includes protecting or restoring forested habitat in large blocks (keeping edge to a minimum) of 500 acres or more, spaced throughout the watershed, which would be required to stop/reverse the current declines.

g. Invasive Species. Because invasive species do not recognize property boundaries, successfully battling these invasions will require partnerships among public and private landowners, government, industry, academia, and non-governmental organizations at all levels. As invasive species are been controlled, native species, reestablished through restoration activities, will minimize the chances that an area will be reinvaded. It is also important to encourage activities that help keep lands and waters free from invasive species.

SECTION 3 PLAN FORMULATION

A. DESCRIPTION OF THE STUDY PROCESS

The Illinois River Basin Restoration Comprehensive Plan follows the Corps of Engineers' six-step planning process specified in Engineering Regulation (ER) 1105-2-100. The process identifies and responds to problems and opportunities associated with the Federal objective and specified State and local concerns. The process provides a flexible, systematic, and rational framework to make determinations and decisions at each step so that the interested public and decision makers are fully aware of the basic assumptions employed, the data and information analyzed, the areas of risk and uncertainty, and the significant implications of each alternative plan. As a comprehensive plan for the Basin, the formulation of alternatives was not limited to Corps and Illinois DNR activities. Implementation on a basin scale will require the work of numerous Federal, State, local, and private agencies and organizations.

If a Federal and State interest is identified, the process culminates in the selection of a plan to be recommended to Congress for implementation. The Federal interest in ecosystem restoration is to restore degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. As part of identifying the selected plan, a number of alternative plans are developed and compared with the no action alternative, allowing for the ultimate identification of the National Ecosystem Restoration (NER) plan.

The NER plan reasonably maximizes ecosystem restoration benefits compared to costs, considering the cost effectiveness and incremental cost of implementing other restoration options. In addition to considering the system benefits and costs, it will also consider information that cannot be quantified, such as environmental significance and scarcity, socioeconomic impacts, and historic properties information.

The steps used in the plan formulation process include:

1. Identify Problems and Opportunities: The specific problems and opportunities are identified, and the causes of the problems discussed and documented. Planning goals are set, objectives established, and constraints identified. Specifically for this study, the restoration objectives were set based on the desired future conditions established by system resource managers. The desired future was based on the expert opinion of resource managers as to what the system should look like in the future to restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them.

2. Inventory and Forecast Resource Conditions: This step characterizes and assesses conditions in Illinois River Basin as they currently exist and forecasts the most probable without-project condition (no action alternative) over the period of analysis. This assessment gives the basis by which to compare various alternative plans and their impacts. The without-project condition is what the river basin and its uses are anticipated to be like over the 50-year planning period without any restoration implemented as part of the study. The with-project condition is what the river and its uses are anticipated to be like if restoration measures, identified in each alternative, are implemented. An important part of this step for this study was to identify "desired future conditions." The information describing this step of the planning process is presented in Section 2 of this report.

3. Formulate Alternative Plans: Alternative plans were developed in a systematic manner to ensure that reasonable alternatives were evaluated. For this study, ecological integrity was the overarching goal and drove the identification, development, and selection of restoration measures and alternative plans. The alternative plans all address ecosystem integrity, but vary in terms of restoration efforts associated with each of the remaining six study goals.

4. Evaluate Alternative Plans: The evaluation of each alternative consists of measuring or estimating the ecosystem benefits (acres of habitat or stream miles restored, tons of sediment not delivered to the system, etc.), costs, technical limitations, and risk and uncertainty of each plan, and determining the difference between the without- and with-project conditions. Due to the size and scale of the analyses and differences in output by goal category, a complete cost effectiveness and incremental cost effectiveness analysis based on habitat units could not be conducted. The quantifiable measures of system output that provide comparability across all goal categories were the percentage attainment of restoration objectives (desired future), acres, and stream miles. These measures of benefit allowed for the completion of a cost effectiveness-incremental cost analysis for five of the seven goal categories (Goals 1-5). The outputs for the Overarching Goal and Goal 6 could not be fully quantified and, as a result, were assessed qualitatively. As part of future site-specific restoration projects, detailed and complete cost effectiveness and incremental cost analysis would be conducted.

5. Compare Alternative Plans: Alternative plans are compared, focusing on the differences among the plans identified in the evaluation phase and public comment.

6. Select Recommended Plan: A Recommended Plan is selected and justification for plan selection prepared. If a viable alternative is not identified, the Recommended Plan will be the No Action alternative.

The following sections provide a description of the system problems, goals and opportunities, objectives, and constraints pertaining to the study area as a whole. Next, the report describes the affected environment, and specific objectives and alternative formulation conducted for the overarching goal and goals 1 through 6. Finally, in the System Evaluations section, alternative plans are summarized. While these steps do follow a progression, they are iterative, i.e., as additional information was learned in subsequent steps, it was often necessary to back up and repeat portions of a previous step(s). Section 4 of this report describes the recommended plan, followed by a discussion of the environmental impacts, in Section 5.

B. ASSESSMENT OF PROBLEMS, OPPORTUNITIES, AND CONSTRAINTS

1. Problem Statement. The Illinois River Basin has experienced the loss of ecological integrity due to sedimentation of backwaters and side channels, degradation of tributary streams, increased water level fluctuations, reduction of floodplain and tributary connectivity, and other adverse impacts caused by human activities.

2. Opportunities. A restoration vision was developed for the Illinois River in 1997 as part of the development of the State of Illinois' *Integrated Management Plan for the Illinois River Watershed.* This vision for the Illinois River Basin has been accepted by the Federal, State and local stakeholders involved in the development of the Illinois River Basin Restoration Program with the minor modification of replacing the word "Valley" with "Basin." It is understood that attaining this vision will likely take decades and that various types of projects will be necessary to maintain some features until natural ecological processes are reestablished. The vision is for:

> *A naturally diverse and productive Illinois River Basin that is sustainable by natural ecological processes and managed to provide for compatible social and economic activities.*

With the *Integrated Management Plan* providing context, the list of Illinois River Basin system-wide ecosystem restoration goals was developed (Goals 1 through 6 are not listed in priority order):

Overarching Goal. Restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them

Goal 1. Reduce sediment delivery to the Illinois River from upland areas and tributary channels with the aim of eliminating excessive sediment load

Goal 2. Restore aquatic habitat diversity of side channels and backwaters, including Peoria Lakes, to provide adequate volume and depth for sustaining native fish and wildlife communities

Goal 3. Improve floodplain, riparian, and aquatic habitats and functions

Goal 4. Restore aquatic connectivity (fish passage) on the Illinois River and its tributaries, where appropriate, to restore or maintain healthy populations of native species

Goal 5. Naturalize Illinois River and tributary hydrologic regimes and conditions to restore aquatic and riparian habitat

Goal 6. Improve water and sediment quality in the Illinois River and its watershed.

3. Constraints

- No increase in flood elevations as required by Illinois law – Illinois state law specifies that any action in the floodplain that increases flood heights is not allowable or must be accompanied by mitigation of adverse effects. Due to the potential high cost associated with mitigation actions, efforts will be made to avoid this threshold.
- No significant adverse impact on the 9-Foot Channel Navigation Project on the Illinois Waterway.
- State of Illinois limitations – For efforts sponsored by the State of Illinois constraints include funding and land ownership or the ability to acquire land interests from willing landowners.
- Funding Limitations – As a Non-Federal Sponsor, the ability of the State of Illinois to afford various features, and the associated operations and maintenance, represents a potential limiting factor.
- Land Ownership, Willing Landowners, etc. – As a Non-Federal Sponsor, the State of Illinois will be required to provide the necessary real estate interests for projects they sponsor. The State will only acquire the lands, easements, and rights-of-way from willing landowners.

- A final legal determination has not been made as to ownership of submerged lands in the Illinois River Basin.
- Legal Compliance – Due to the geographic size, scope, and purpose of this study, multiple levels of legal authority apply to the project area. All efforts conducted in the implementation of the Comprehensive Plan shall comply with all Federal regulations and all applicable State and local regulations pertaining to the activities undertaken by the Corps of Engineers and the non-Federal sponsor in this study.
- Efforts will be made to minimize the unnecessary and irreversible conversion of prime farmland to non-agricultural uses. These efforts include: (1) identify and take into account the adverse effects on the preservation of prime farmland; (2) consider alternative actions, as appropriate, that could lessen adverse effects to prime farmland; and (3) ensure to the extent practicable, the project is compatible with state and units of local government and private programs to protect prime farmland.
- Landowner Rights – No site investigations (such as surveys or geotechnical investigations) will be conducted without contacting property owners and obtaining permission to access potential project areas.

4. Conceptual Framework. In addition to the overall problem statement and system goals listed previously, the system team developed a specific problem statement and objectives for each of the system goals to facilitate adequate formulation. The objectives were identified for the ecosystem integrity of the system as well as for the other goal categories by the study team, resource managers, and stakeholders based on extensive research and literature. These objectives represent a desired future condition or virtual reference of ecological condition for the Illinois River Basin.

The goals and objectives developed as part of this study were formulated to address the system limiting factors. In particular, the goals for this study were adapted from published literature for the Upper Mississippi River System, specifically, the Upper Mississippi River Conservation Committee's (UMRCC) report, *A River that Works and a Working River*. The UMRCC is comprised of more than 200 resource managers working in the fisheries, recreation, wildlife, water quality, and law enforcement disciplines, whose goal is to "Promote the preservation and wise utilization of the natural and recreational resources of the Upper Mississippi River (UMR) and to formulate policies, plans and programs for conducting cooperative studies."

Additional reports and studies evaluated include: The Environmental Management Program's *Habitat Needs Assessment*; the UMR-IWW System Navigation Feasibility Study; the State of Illinois' *Integrated Management Plan for the Illinois River Watershed*; and The Nature Conservancy's *Threats to the Illinois River Ecosystem*. These documents and studies were developed by scientists and local resource managers, and included multi-agency collaboration. The information from these sources was refined in the development of the goals for this study.

Overarching Goal. Restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them

Problem. The combined effects of habitat losses through changes in land use, human exploitation, habitat degradation and fragmentation, water quality degradation, and competition from aggressive invasive species have significantly reduced the abundance and distribution of many native plant and animal species in the Illinois River Basin. In addition, human alterations of Illinois River Basin landscapes have altered the timing, magnitude, duration, and frequency of habitat forming and seasonal disturbance regimes. The cumulative results of these complex, systemic changes are now severely limiting both the habitats and species composition and abundance in the Illinois River Basin.

Overarching Objectives

- Identify and address system-wide limiting factors to ecological integrity (structure and function), including, but not limited to:
  ***Goal 1* -** excessive sedimentation
  Goal 2 (backwaters, side channels, and islands) - reduction and fragmentation of aquatic habitat
  Goal 3 (floodplain, riparian, and aquatic) - reduction and fragmentation of aquatic and terrestrial habitat, altered disturbance regimes, and invasive plant species
  Goal 4 (aquatic connectivity) - reduction and fragmentation of aquatic habitat
  ***Goal 5* -** altered hydrologic regimes
  ***Goal 6* -** water and sediment quality

- Restore and conserve natural habitat structure and function, including, but not limited to:
  - Concentrations of flora and fauna or areas that are:
    1. High in biodiversity;
    2. Especially vulnerable to disturbance; and/or
    3. Important in fulfilling a life-history requirement of the species present.

  - Specific suitable habitat for Federal and State endangered and threatened species, or other species of concern that is capable of supporting long-term sustainable populations at the site and protect additional acres of the identified suitable habitat, as appropriate.

  - Representative examples of all community types in the Illinois River Basin, best of kind or as needed, to protect and restore habitat structure and function at the system level.

- Establish existing and reference conditions for ecosystem functioning and sustainability against which change can be measured; monitor and evaluate actions to determine if goals and objectives are being achieved, at both the project and system levels.

Goal 1. Reduce sediment delivery to the Illinois River from upland areas and tributary channels with the aim of eliminating excessive sediment load

Problem. Increased sediment loads from the basin have severely degraded environmental conditions along the main stem Illinois River by increasing turbidity and filling backwater areas, side channels, and islands. Improved conservation practices have reduced the amount of sediment generated from many agricultural areas, but large quantities of sediment are still delivered to the river due to eroding channels and tributary areas, including urban and rural construction sites. The most critical problems resulting from the increased sediment loads are the loss of depth and habitat quality in off-channel areas connected to the main stem river. Similar problems can be seen at other areas within the basin where excessive sediment has degraded tributary habitats.

Objectives

- Reduce total sediment delivery to the Illinois River by at least 10 percent by 2025 [reduction from an average of 12.1 to 10.9 million tons per year above Valley City, based on Illinois State Water Survey (ISWS) estimate of delivery for water year (WY) 1981-2000].
- Reduce total sediment delivery to the Illinois River by at least 20 percent by 2055 (reduction to an average of 9.7 million tons per year above Valley City, based on ISWS estimate of delivery for WY 1981-2000).
- Eliminate excessive sediment delivery to specific high-value habitat both along the main stem and in tributary areas.

Goal 2. Restore aquatic habitat diversity of side channels and backwaters, including Peoria Lakes, to provide adequate volume and depth for sustaining native fish and wildlife communities

Problem. A dramatic loss in productive backwaters, side channels, and islands due to excessive sedimentation is limiting ecological health and altering the character of this unique floodplain river system. In particular, the Illinois River has lost much of its critical spawning, nursery, and overwintering areas for fish, habitat for diving ducks, other waterbirds, and aquatic species, and backwater aquatic plant communities. There is a need for timely action. If restoration is not undertaken soon, additional productive backwater and side channel aquatic areas will be converted to lower value and increasingly common mudflat and extremely shallow water habitats.

Objectives

- Restore, rehabilitate, and maintain up to19,000 acres of habitat in currently connected areas (1989 data shows approximately 55,000 acres of backwaters during summer low water). Restoration should result in a diversity of depths. For restored backwaters, a general target would be to have the following distributions of depths during summer low-flow periods: 5% >9 feet; 10% 6 to 9 feet; 25% 3 to 6 feet; and 60% <3 feet.
- Restore and maintain side channel and island habitats.
- Maintain all existing connections between backwaters and the main channel (connections at the 50 percent exceedance flow duration).
- Identify beneficial uses of sediments.
- Compact sediments to improve substrate conditions for aquatic plants, fish, and wildlife.

Goal 3. Improve floodplain, riparian, and aquatic habitats and functions

Problem. Land-use and hydrologic changes have reduced the quantity, quality, and functions of aquatic, floodplain, and riparian habitats. Flood storage, flood conveyance, habitat availability, and nutrient exchange are some of the critical aspects of the floodplain environment that have been adversely impacted.

Objectives

- Restore up to an additional 150,000 acres of isolated and connected floodplains along the Illinois River main stem to promote floodplain functions and habitats.

- Restore up to 150,000 acres of the Illinois River Basin large tributary floodplains.
- Restore and/or protect up to 1,000 additional stream miles of riparian habitats.

Goal 4. Restore aquatic connectivity (fish passage) on the Illinois River and its tributaries, where appropriate, to restore healthy populations of native species

Problem. There is diminished aquatic connectivity on the Illinois River and its tributaries. Aquatic organisms do not have sufficient access to diverse habitat such as backwater and tributary habitat that are necessary at different life stages. Lack of aquatic connectivity slows repopulation of stream reaches following extreme events such as pollution or flooding and reduces genetic diversity of aquatic organisms.

Objectives

- Restore main stem to tributary connectivity, where appropriate, on major tributaries.
- Restore within-tributary connectivity.
- Restore passage for large-river fish at Starved Rock, Marseilles, and Dresden Lock and Dams where appropriate.

Goal 5. Naturalize Illinois River and tributary hydrologic regimes and conditions to restore aquatic and riparian habitat

Problem. Basin changes and river management have altered the water level regime along the main stem Illinois River, stressing the natural plant and animal communities along the river and its floodplain. Land use changes, the construction of the locks and dams (which create relatively flat navigation pools), and isolation of the river main stem from its floodplain have all impacted the water level regime to varying extents. Two of the most critical results from the basin changes and river management, are the increased frequency and increased magnitude of water level fluctuations, especially during summer and fall low water periods. The lack of the ability to mimic natural hydrologic regimes in areas upstream of the navigation dams is also a problem. Increased flow variability has reduced ecological integrity in tributary areas as well.

Objectives

- Reduce low water fluctuations along the main stem Illinois River where possible, concentrating on the months of May through October and using pre-1900 water level records as a reference.
- Reduce peak flows from the major Illinois River tributaries by 2 to 3 percent for 2- to 5-year recurrence storm events by 2023. This will help to reduce peak flood stages and reduce high-water fluctuations along the river. Long term, reduce tributary peak flows by at least 20 percent for these events.
- Reduce the incidence of low-water stress throughout the basin by increasing tributary baseflows by 50 percent.
- Remove the dramatic water level changes associated with the operation of wicket dams at Peoria and La Grange.

- At an appropriate resolution (approximately 1 square mile in urban areas, 10 square miles in rural areas) identify and quantify the land and drainage alterations that contribute to unnatural fluctuations and flow regimes.
- Draw down the pools at Peoria and La Grange for at least 30 consecutive days at least once every 5 years.

Goal 6. Improve water and sediment quality in the Illinois River and its watershed

Problem. Water resources in the Illinois River Basin are impaired due to a combination of point and non-point sources of pollution. Although effective regulatory efforts have reduced contributions from point sources, non-point sources of water quality impairment (such as sediments and nutrients) continue to degrade the surface waters.

Objectives

- Achieve full use support for aquatic life in all surface waters, as defined in 303(d) of the Clean Water Act (CWA), of the Illinois River Basin by 2025.
- Achieve full use support for all uses on all surface waters of the Illinois River Basin by 2055.
- Encourage remediation of sites with contaminant issues that affect habitat.
- Achieve USEPA nutrient standards by 2025, following standards to be established by 2008.
- Minimize sedimentation as a cause of impairment as defined by 305(b), of the CWA, by 2035.
- Maintain waters that currently support full use.

C. SYSTEM FORMULATION CONCEPT

As a basin level study addressing approximately 44 percent of the area of the State of Illinois—approximately 30,000 square miles—some modification of the general formulation approach used for a site-specific project was required. The goals and objectives were first set to address the specific resource problems (system limiting factors). Then, the focus became identifying the potential restoration measures and alternatives. In general, the system alternatives developed were not specific to particular sites (i.e., Babb's Slough, Richland Creek, etc.), but instead focused on the level of restoration effort needed to reach system restoration goals and objectives. More detailed cost information using MCACES software and benefits using habitat models will be defined as part of future site-specific project evaluations.

Since no systemic measure of ecologic integrity exists, the original measures of benefit varied by goal category, e.g. acres of wetland, backwater, floodplain; tons of sediment not delivered; stream miles; percentage changes in flows (table 3-1). Based on HQUSACE guidance, the study team also quantified system benefits for each goal category into outputs of acres or stream miles to better estimate the total system area benefited. While only the benefit area was measured, it should be recognized that the area would experience a dramatic increase in habitat quality compared to the without project condition. No single habitat suitability unit could be used for the system due to the number of habitat types and complex relationships of the benefits. However, the percent of goal attainment analysis originally conducted for this study does roughly equate to a quality and sustainability assessment.

Table 3-1. Type of Benefit Quantification by Goal

Goal	Benefit - Output By Goal	Benefit - System Area Estimate
Ecosystem Integrity	Indicators Under Development	Indicators Under Development
Sediment Delivery	Tons Not Delivered	Stream Miles
Backwaters & Side Channels	Acres (backwater) x Quality	Acres
Floodplain, Riparian, and Aquatic	Acres and Stream Miles	Acres (Floodplain and Riparian) and Stream Miles (Aquatic)
Aquatic Connectivity	Stream Miles	Stream Miles
Water Level Management	# of fluctuations % decrease in tributary peak flow % increase in tributary base flow	Acres (Main Stem) Stream Miles (Tributary)
Water Quality	Impaired Reaches, Dissolved Oxygen, Sediment, Nutrients	Not Quantified

Rather than fully developed site concepts, the evaluation of restoration measures highlighted the most promising measures and general level of effort needed (e.g., X number of riffle-pools, bank stabilization, and sediment basins to meet the system sediment tonnage reduction goal). However, the system formulation did consider the general locations of various needs and the information on available restoration measures. The primary outcome of the system formulation was a recommended plan identifying how much restoration is needed to restore the ecological integrity of the system and the associated measures and funding level needed to meet the intent of the 519 authorization.

System alternative development started with consideration of the measures available (e.g., bed and bank stabilization, backwater dredging, wetland creation, etc.) to address the problems and objectives developed under each goal category. For each of the measures, the relative cost and system benefits were identified. This information was then used to put together various alternative plans for each goal (i.e., combining benefits and costs for a certain amount of bed and bank stabilization, water and sediment retention basins, etc., in putting together a plan for sediment reduction). At this level of analysis, the various measures were evaluated, comparing their costs and benefits. The most cost-effective measures were used to develop the goal and system level alternatives.

D. AFFECTED ENVIRONMENT

Section 2 D, *Existing Conditions*, describes the general affected environment of the Illinois River Basin. As illustrated in table 3-1, each goal being evaluated affects differing amounts and types of habitat. Ecological integrity (the Overarching Goal) is expressed as increases or decreases in ecological integrity and/or impacts to the quantity and/or quality of habitat available; sediment delivery (Goal 1) is expressed in % reductions in delivery from various tributaries targeted; backwaters, side channels, and islands (Goal 2) indicates units of habitat affected in acres (backwaters), or the actual number of islands and side channels proposed; floodplain, riparian, and aquatic (Goal 3) exhibits acres of main stem and tributary areas being proposed, while the aquatic portion is expressed in miles of stream proposed; connectivity (Goal 4) references actual tributary rivers/streams that may be relevant to dam removal for fish passage, and the number of dams on the main stem that have potential to improve fish passage; water level management (Goal 5) is expressed as either % tributary peak flow reductions, % tributary base flow increases, or % reductions in main stem water level fluctuations; and water quality (Goal 6) is expressed in levels and areas of improvement. The detailed descriptions for each goal below provide insight as to which habitat type or aspect of the environment may be affected from implementation of the proposed project. When future site-specific projects are identified and evaluated, Environmental Assessments (EA) or, if required, Environmental Impact Statements (EIS), will be written detailing the alternatives and potential impacts of the proposals. Those site-specific EAs will give detailed information on what aspects of the environment would be affected based on the management measures proposed for that specific project.

E. OVERARCHING GOAL: ECOLOGICAL INTEGRITY. Restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them.

Problem. The combined effects of habitat losses, through changes in land use, human exploitation, habitat degradation and fragmentation, water quality degradation, and competition from aggressive invasive species have significantly reduced the abundance and distribution of many native plant and animal species in the Illinois River Basin. In addition, human alterations of Illinois River Basin landscapes have altered the timing, magnitude, duration, and frequency of habitat forming and seasonal disturbance regimes. The cumulative results of these complex, systemic changes are now severely limiting both the habitats and species composition and abundance in the Illinois River Basin.

Ecological (or Biological) Integrity. Definition - A system's wholeness or "health," including presence of all appropriate elements, biotic and abiotic, and occurrence of all processes that generate and maintain those elements at the appropriate rates (Angermeier and Karr 1994). The capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity, and a functional organization comparable to that of natural, unimpacted habitat of the region (Karr and Dudley 1981, Adamus 1996).

Overarching Objectives. Objectives to restore ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them are discussed in the following paragraphs.

- Identify and address system-wide limiting factors to ecological integrity (structure and function), including, but not limited to:
  - ***Goal 1 -*** excessive sedimentation
  - ***Goal 2 (backwaters, side channels, and islands) -*** reduction and fragmentation of aquatic habitat
  - ***Goal 3 (floodplain, riparian, and aquatic) -*** reduction and fragmentation of aquatic and terrestrial habitat, altered disturbance regimes, and invasive plant species
  - ***Goal 4 (aquatic connectivity) -*** reduction and fragmentation of aquatic habitat
  - ***Goal 5 -*** altered hydrologic regimes
  - ***Goal 6 -*** water and sediment quality

- Restore and conserve natural habitat structure and function, including, but not limited to:
  - Concentrations of flora and fauna or areas that are:
    1. High in biodiversity;
    2. Especially vulnerable to disturbance; and/or
    3. Important in fulfilling a life-history requirement of the species present.

- Suitable habitat for Federal and State endangered and threatened species—or other species of concern—that is capable of supporting long-term sustainable populations.

- Representative examples of all community types in the Illinois River Basin, best of kind or as needed, to protect and restore habitat structure and function at the system level.

- Establish existing and reference conditions for ecosystem functioning and sustainability against which change can be measured; monitor and evaluate actions to determine if goals and objectives are being achieved, at both the project and system levels.

1. Introduction. The goal of ecosystem management is to restore and sustain ecosystem integrity by protecting native biodiversity and the ecological and evolutionary processes that create and maintain that diversity. In order to achieve this goal, desired ecosystem structure, function, and variability must be characterized and measured against current conditions. This requires ecologically meaningful and measurable indicators that mark progress toward ecosystem management and restoration goals (Richter et al. 1996). The primary cause in the loss of ecological integrity is not direct human exploitation but rather the habitat destruction and disruption of natural processes that result from the expansion of human populations and activities (Wilson 1988).

In river systems, the physical structure of the environment, and consequently the habitat, is primarily defined by physical processes, especially the movement of water and sediment through the system. To understand the sustainability of river ecosystems and biodiversity, one must understand the dynamic and variable physical environment created by the river, as well as the human alterations to this system. The main stem Illinois River and its backwaters are the receiving body that integrate the products from all its tributaries and, in turn, store or deliver them to the Mississippi River and eventually the Gulf of Mexico. The historical diversity of in-channel and floodplain habitat types supported species that exploited the shifting habitat mosaic created and maintained primarily by the hydrologic variability. Human-induced changes to the ecosystem include habitat alteration and/or destruction, construction of dams, navigation, urbanization, agriculture, tile drainage, levees and channelization, and groundwater pumping (Poff et al. 1997). These alterations to the physical environment and hydrology, habitat loss and fragmentation, water quality degradation, and introduction of invasive species all threaten the ecological integrity of the Illinois River Basin, its natural communities, and populations of native species. In order to restore the basin to a more natural and self-sustaining state, restoration efforts must include activities to address degradation in all of these areas. Finally, education of the general public about the values of our environment is crucial to the future health of the system.

The Illinois River Basin is ecologically degraded because of 150 years of intensive human development in the region. Not only are landscapes changed, major initiatives to dredge channels, dig ditches, and increase drainage have altered the hydrologic regimes that drive the ecology of streams and rivers. In some cases, the landscape and streams are still adjusting to changes imposed by human development, especially where suburban sprawl is encroaching into sensitive habitats. In other cases, the ecosystem has stabilized within the bounds imposed by development.

2. System Limiting Factors. The Illinois River Basin has experienced the loss of ecological integrity due to sedimentation of backwaters and side channels, degradation of tributary streams, increased water level fluctuations, reduction of floodplain and tributary habitat and connectivity, and other adverse impacts caused by human activities. Although today’s flora and fauna are but a remnant of these historic levels, they still include some of the richest habitat in the Midwest, even some unique in North America (Talkington 1991), however, the physical habitats (structure) and the processes that create and maintain those habitats (function) have been greatly altered. The following areas, discussed below, have been identified as the physical factors that limit restoration of ecological integrity. Figure 3-1 illustrates how projects could be formulated addressing these system limiting factors, in turn, improving ecosystem integrity. Monitoring, at both the system and individual project level, would provide the vital feedback loop needed to ensure success and increase understanding of the Illinois River Basin ecosystem.

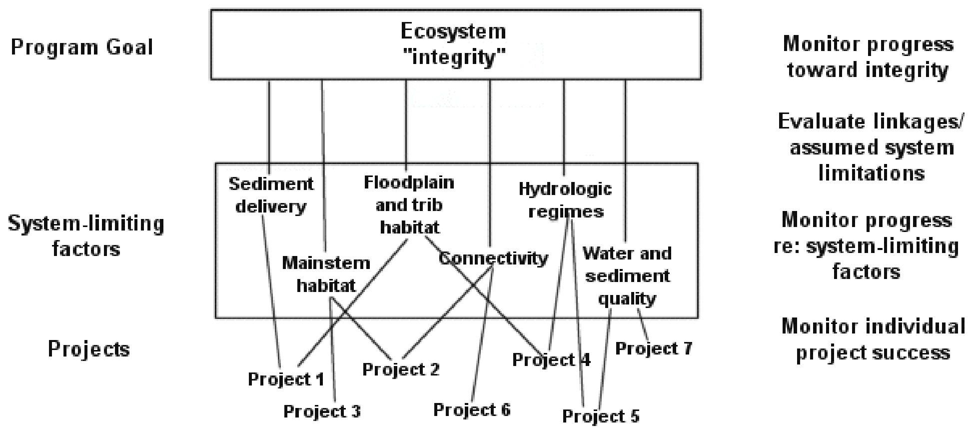


Figure 3-1. Conceptual Model of Illinois River Basin Restoration Program and Monitoring

3. Desired Future Conditions. In a meeting held in August 2003 as part of this study, natural resources professionals from the Rock Island District of the Corps of Engineers, the Illinois DNR, the USFWS Rock Island Field Office, and The Nature Conservancy met to discuss the desired future conditions of the Illinois River Basin. In addition to the declines in the biotic communities previously discussed, land conversion to urban use and development in the State of Illinois is currently estimated at 40,000 to 50,000 acres of land per year. Much of this development is in the Illinois River Basin, particularly in the western Chicago suburbs. In light of continuing habitat degradation, fragmentation, and losses, the expert panel identified preferred levels of restoration needed to restore and maintain ecological integrity to the Illinois River Basin. This expert panel also stressed that ecological integrity is the overarching goal for this restoration program and should drive the identification, development, selection, and implementation of restoration projects. In addition, the project identification and selection process should focus on the habitat quality and threats to ecological integrity and habitat sustainability. Though no specific projects or alternatives were formulated for the overarching goal, projects formulated under all of the other program goals would contribute toward restoring the ecological integrity of the Illinois River Basin.

Mapping of habitats for the evaluation species should consider edge effect and patch size. Although most birds are highly mobile, habitat fragmentation may affect species that have high fidelity to specific nesting localities. Mammals, reptiles, amphibians, and some invertebrates are particularly likely to be affected by fragmentation from development activities, and focusing protection on the relatively large tracts of natural lands remaining in the study area may conserve biological diversity. The development of corridors between terrestrial environments greatly increases the value of the formerly isolated areas. Habitat size and distribution (per pool or sub-basin) recommendations to address ecological integrity are: bottomland forest patches of at least 1,000 acres; grasslands of 100 to 500 acres each, nonforested wetlands of at least 100 acres, spaced 30 to 40 miles apart; a riparian zone at least 100 feet wide per side or 200 to 300 feet total width; and backwater depth for overwintering of at least 6 feet and spaced 3 to 5 miles apart. These recommendations are based on research and published literature, and expert panel input. Smaller areas than those described above would still provide benefits to many species and should be considered for restoration.

Preservation has a critical role in conservation of diversity; however, by itself, it is not an adequate strategy. Numerous species are already on the brink of extinction and their habitats have been degraded, reduced to a remnant, or even eliminated. Preservation of existing biodiversity, in the face of continuing change, is not enough to offset continuing declines in ecological integrity (Jordan 1988). Preservation must be coupled with restoration of both habitat structure and function in order to restore ecological integrity to the Illinois River Basin.

a. Criteria for Prioritization

- Combining habitat restoration and/or protection projects should be closely coordinated with projects developed under other goals, in order to maximize systemic ecological integrity and effectiveness of restoration efforts and dollars.
- The assessment process should focus on quality of the habitat and the presence of threats to the integrity of the quality area under consideration. Those areas threatened most immediately should be targeted for protection.
- Connectivity to the Illinois River and major tributaries and between protected areas should be key focus area.
- Preference given for improving and protecting existing moderately degraded habitat areas near rare and unique communities.
- Give special consideration to rare areas.
- Altered hydrologic regime most relevant disturbance regime.
- Terrestrial patch size recommendations (amount shown or greater):
  - Bottomland hardwood forest = 500 to1000 acres; 3000 acres needed for some interior avian species
  - Grasslands = 100 to 500 acres
  - Nonforested wetland = 100 acres, spaced 30 to 40 miles apart
  - Riparian zone = 100 feet each side; 200 to 300 feet wide total
- Aquatic habitat recommendations:
  - Main stem backwaters/side channels $\geq$ 6 feet deep, spaced 3-5 miles apart
  - In-stream riffles - Depending on the size of the stream, the number of structures required ranges from 4 per mile for large tributaries to 22 for minor tributaries.

b. Restoration Measures Available

- Identify, restore, and maintain habitat structure and function in relation to limiting factors identified in Goals 1through 6
- Identify, protect, and restore high-quality communities on state-owned lands that are not currently protected through Nature Preserve or Land and Water Reserve designations, and dedicating or registering identified communities as appropriate
- Identify, protect, and restore representative examples of all community types on other lands. Where no high-quality communities can be defined, identify the best of kind and apply restoration techniques to improve ecological integrity.
- Improve areas within or adjacent to conservation sites (i.e., groupings of ecologically significant features in a geographically discrete area) by identifying degraded components of, or are adjacent to, the site and implementing restoration practices to improve resource quality
- Permanently protect lands (permanent conservation easements, Nature Preserve designation, or acquisition)
- Improve general habitat quality at the system level by restoring specific habitats, and/or net functional value, within major tributaries and pools of the Illinois River Basin
- Increase connectivity between habitat areas; focus on both lateral and aquatic connectivity of aquatic, riparian, and terrestrial habitats
- Increase use of prescribed burning - Implement the federally approved Aquatic Nuisance Species Management Plan, and other accepted management plans, to reduce invasive species in the basin. Implement invasive species control through burning, herbicide, removal, and bio-control.
- Manage currently isolated backwater areas to improve the hydrologic regime as it relates to relevant ecological processes through controlled water level management (drawdowns/flooding)

4. Risk and Uncertainty. Biological data on which to base objectives generally are not known accurately. Quite often, the most that can be achieved is to express a parameter as a best estimate and include a set of plausible bounds (i.e., range or confidence interval) (Todd and Burgman 1998).

Ecological predictions have three fundamental, interacting problems: uncertainty, contingency, and reflexivity. In most cases, the uncertainty of ecological predictions is not rigorously evaluated. Ecological predictions are contingent on drivers that are difficult to predict, such as human behavior. Conservation biology continually confronts situations in which decisions must be made in the face of uncertainty. It is suggested that the appropriate response to uncertainty depends on the degree of uncertainty and the degree to which a system can be controlled. When control is difficult and uncertainty is high, scenario planning may provide an effective way to manage various futures for the basin. In addition, adaptive management and optimal management may also be effective ways to address uncertainty (Peterson et al. 2003).

Adaptive management is the systematic acquisition and application of reliable information to improve natural resource management over time. Ideally, under adaptive management, conservation strategies are implemented as a deliberate experiment. This approach can establish cause-and-effect relationships and point the way toward optimal strategies. Adaptive management has been promoted as essential to management under uncertainty. However, funds spent on adaptive management reduce the amount available for habitat restoration, so limited financial resources require an effective balance between restoring habitat and acquiring knowledge (Wilhere 2002).

F. GOAL 1: SEDIMENT DELIVERY. Reduce sediment delivery to the Illinois River from upland areas and tributary channels with the aim of eliminating excessive sediment load.

Problem. Increased sediment loads from the basin have severely degraded environmental conditions along the main stem Illinois River by increasing turbidity and filling backwater areas, side channels, and islands. Improved conservation practices have reduced the amount of sediment generated from many agricultural areas, but large quantities of sediment are still delivered to the river due to eroding channels and tributary areas, including urban and rural construction sites. The most critical problems resulting from the increased sediment loads are the loss of depth and habitat quality in off-channel areas connected to the main stem river. Similar problems can be seen at other areas within the basin where excessive sediment has degraded tributary habitats.

Objectives

- Reduce total sediment delivery to the Illinois River below current levels by at least 1.2 million tons per year by 2025 (10 percent reduction from an average of 12.1 to 10.9 million tons per year above Valley City, based on ISWS estimate of delivery for 1981-2000)
- Reduce total sediment delivery to the Illinois River below current levels by at least 2.4 million tons per year by 2055 (20 percent reduction to an average of 9.7 million tons per year above Valley City, based on ISWS estimate of delivery for 1981-2000)
- Eliminate excessive sediment delivery to specific high-value habitat areas along the main stem and along tributaries

Expected Outputs

Anticipated project outputs related to Goal 1 include: stabilizing tributary streams by reducing downcutting and widening of the streambed, reducing sediment delivery to the Illinois River, reducing turbidity in the Illinois River main stem and its backwaters and tributaries, and increasing the life of existing and restored backwaters as critical habitats for native species. Anticipated benefits to the Illinois River and its tributaries resulting from Goal 1 include:

- Increased light penetration - will help lead to increased production by phytoplankton and aquatic vegetation. Increased light will also aid sight-feeding fish, such as sauger and largemouth bass.
- Improved substrate conditions - will benefit benthic invertebrate and macroinvertebrate communities (i.e. mussels, fingernail clams, and mayflies) as well as most fish species (i.e. bass and bluegill), who rely on this food source and need silt free areas for spawning (i.e. paddlefish).
- Increased aquatic habitat – The riffles and other structures proposed as part of the project will provide habitat for a wide variety of species, including darters, redhorse, and suckers. Reduced sedimentation rates in existing and restored Illinois River Backwater areas will also help to protect and maintain habitat.

Working Concepts

- Stream "stability" refers to the condition under which a stream has adjusted its cross-sectional geometry, slope and planform such that it transports the water and sediment loads applied to it without experiencing aggradation, degradation or significant planform changes. "Unstable" stream systems are those that are out of balance with their sediment or water regimes, and these demonstrate progressive changes in planform or sediment storage with time. Note that stable streams transport sediment and exhibit change in planform, or cross section, over time—instability refers to the degree of adjustment required to adapt to current geomorphic conditions.
- There are different ways to define "excessive" sediment load. From a geomorphologic perspective, excessive sediment load is simply that which exceeds the sediment transport capacity of a given reach. From a watershed management perspective, an excessive sediment load may be that which is generated by unstable behavior of tributary streams, or that above an expected level of delivery. From a habitat perspective, excessive load is that which leads to increased degradation of habitat quality. For the purposes of this goal, "excessive" can refer to either perspective, but it should be noted that a load to a system might be excessive from one perspective but not the other.
- Watershed-level planning is necessary to identify the most effective means to reduce erosion within and sediment delivery from each river or stream.

1. Inventory Resource Conditions

a. Historic Conditions. Soil erosion and sedimentation are natural processes that have been accelerated by anthropogenic changes to the landscape. Prior to the last glacial period, the Illinois River Valley was carved by the Mississippi River which has much higher flow rates than the Illinois River; therefore, the valley is oversized for its current flow rate. This led to the inability of the Illinois River to transport all of the sediment it received even before land disturbance and subsequent sedimentation in many areas of the valley (Bhowmik and Demissie 1989). Early observations suggest that prior to land clearance, the rate of sediment delivery from most Midwestern watersheds was significantly lower than current rates, although no monitoring data exists for verification. Native vegetation promoted infiltration of rainfall and stabilized erodible soils (Meek 1892). Many streams or ditches of today's landscape were historically ephemeral channels, wetland swales, or simply did not exist (Rhoads and Herricks 1996). The historical hydrologic and hydraulic conditions within the basin limited sediment delivery to the Illinois River. Even under these moderate flow and erosion conditions, however, sediment transport to the Illinois River was still sufficient to form deltas at points where streams fed into slower river reaches. Because of its flat slope, the lower portion of the river has had a depositional environment since the last ice age, accumulating some of the sediment delivered from the basin within its associated backwater and floodplain areas.

The clearing of land (especially on marginal land) in the Illinois River Watershed, for cropping and for construction activities, has led to high erosion rates because soil-retaining vegetation was removed, thereby creating conditions that resulted in larger storm flows (Knox 2002). Eroded sediment carried into tributary waterways resulted in very turbid streamflows (Meek 1892) and increased sediment delivery to the Illinois River. The effects of land clearance on sediment production and transport tend to be especially pronounced in steeply sloped areas (Knox 1977). Eroded sediment degraded ecosystem integrity by both reducing water clarity and covering or filling downstream habitat. Eroded sediment also contributed to water quality impairments by transporting sorbed compounds, such as the nutrient phosphorus.

The higher levels of sediment transport accelerated the rate of sedimentation in downstream areas. Analyses completed by the Illinois State Water Survey (ISWS) indicate that, on average, the backwater lakes along the Illinois River have lost 72 percent of their original capacity. Peoria Lake is a classic example of the sedimentation problem along the Illinois River. Demissie and Bhowmik (1986) found that Peoria Lake had lost about 68 percent of its 1903 capacity by 1985. They estimated that the rate of sediment accumulation of this lake was 1.7 million tons per year for the period 1965 through 1976 and about 2 million tons per year from 1976 to 1985.

In response to the negative impacts of soil erosion from nonpoint sources (eroding farm fields and urban construction projects) and the resulting sedimentation, the Illinois General Assembly passed the Illinois Erosion and Sediment Control Program and Standards Law. The goal of the law was the incremental reduction of soil erosion to tolerable soil loss levels ("T") by the year 2000, and the "T by 2000" program was instituted. In 1982, a statewide inventory showed that more than 40 percent of the State's rural land was exceeding tolerable soil loss levels. The average soil loss from cropland was estimated to be about 6 tons per acre per year (NRCA 1997).

b. Existing Conditions. Effective erosion control due to the implementation of conservation practices has reduced the average rate of erosion from croplands (NRCS 1997, Knox 2002). Technical, educational, and financial assistance to landowners through conservation programs has significantly reduced the level of soil erosion within the Illinois River Basin. The most recent estimates indicate that only about 13 percent of the cropland acres statewide exceed "T" (IDA 2000).

Despite conservation efforts, soil erosion and sediment transport from most of the basin is still higher than occurred pre-settlement. Channelization, increased flows within the basin and increased flow velocities have resulted in high levels of channel erosion (photograph 3-1). Channel erosion can be manifested as either down-cutting or lateral migration of streambeds, or both, and leads to significant downstream sediment transport. Research by the ISWS indicates that channel erosion from unstable streams accounts for 30 to 40 percent of sediment delivered from eastern Illinois watersheds and as much as 80 percent of the sediment delivered from watersheds in the western part of the basin. Odgaard (1984) observed comparable contributions in two Iowa rivers.

Sediment transported from the watershed continues to deposit in deltas, backwaters, and floodplain areas along the Illinois River. The sparse coverage of ongoing sediment data collection efforts makes it difficult to evaluate basin-scale sediment transport trends with confidence, but using the available information, the ISWS estimated that an average of 12.1 million tons of sediment per year were delivered to the Illinois River above Valley City for water years (WY) 1981-2000 (Appendix D-3, Demissie et al. 2004).

Photograph 3-1. Incised Stream

Figure 3-2 illustrates the relative contributions from various tributaries. If the extreme water year of 1993 is not included, the average amount delivered to the river is approximately 10.5 million tons per year. Of this, 6.7 million tons per year (5.1 million tons per year without 1993) were retained within the river and its bottomlands. Most of this sediment is presumably deposited within the backwater lakes along the Illinois River, located from Lake DuPue to Meredosia Lake. It should be noted that average annual precipitation in recent years has been higher than occurred during some previous historical periods (Changnon et al. 1997) and that sediment delivery tends to be sensitive to shifts in climate conditions, especially in agricultural basins (Knox 2001). Sediment budgets for future years will be influenced by climate conditions that must be considered when interpreting any observed changes.

The size of sediment transported from the basin largely determines its potential effects on the main stem environment. Although sands and gravels (bed material) have deposited where high-gradient streams enter low-gradient reaches and have filled certain high-quality areas (Bhowmik et al. 2001), it is the finer particles (silt and clay) deposited in backwater areas that have most disrupted the ecological integrity of the Illinois River system (Lee and Stall 1977, Bellrose et al. 1983, Demissie and Bhowmik 1986). Silt and clay particles make up the bulk of the sediment load delivered to the Illinois River and approximately 80 to 90 percent of the load transported in the river (Bhowmik and Demissie 1989). Demissie et al. (2004) estimate that bed material load ranges from 5 to 20 percent of total sediment loads throughout the watershed. Unlike sand, which often deposits as a bar immediately downstream of erosion sites (Odgaard 1984), finer particles remain within the water column and tend to be transported into downstream lakes or floodplains. Because of the dominant influence of fine sediment on a system-wide scale, control of silt and clay particles bound for the river will be a major project focus to reduce the level of suspended sediment transported into the Illinois River floodplain and backwater lakes. Control of sand-sized particles will also have ecosystem benefits in specific locations, such as in rivers or backwater lakes with valuable habitat being filled or covered by materials from direct tributaries, and projects to control sediment delivery in these areas may be developed as well.

The magnitude and characteristics of sediment delivery differ from watershed to watershed. At their confluence, the Kankakee River generally has a much larger flow than the Des Plaines River, and it carries a great quantity of sand as bed material load. The Des Plaines River carries proportionally much less sediment. The Fox, Mazon, and Vermilion Rivers are other major water sources upstream of the Peoria Lake. Numerous small creeks and streams (local tributaries) that drain from bluff line watersheds are often significant sources of fine sediment (silt and clay). Although the local tributaries of Peoria Lake contain only 4 percent of the drainage area, the sediment budget developed by Demissie et al. (2004) indicates that they contribute approximately 31 percent of the sediment delivered to the lake. Data collected in the La Grange Pool similarly indicate that local tributaries contribute a significant portion of the sediment load to the pool (U.S. Geological Survey, unpublished data). The Mackinaw, Spoon and Sangamon Rivers all drain into the La Grange Pool where they transport substantial quantities of materials from the basin. Bluff line tributaries drain directly to the main stem through Alton Pool. Some watersheds have excessive sediment transport from upland sources, others are dominated by in-channel erosion and yet others may be stable in that the sediment transport is at a relatively “natural” rate. Although west-central Illinois watersheds and direct tributaries to the river have the highest sediment production rates (delivery per unit area) in the basin, sediment sources such as unstable stream banks, mining activity, and construction sites occur throughout the Illinois River Basin. Because of this, effective measures to reduce sediment delivery must be developed on a watershed-by-watershed basis and must consider the geomorphologic characteristics of each particular area.

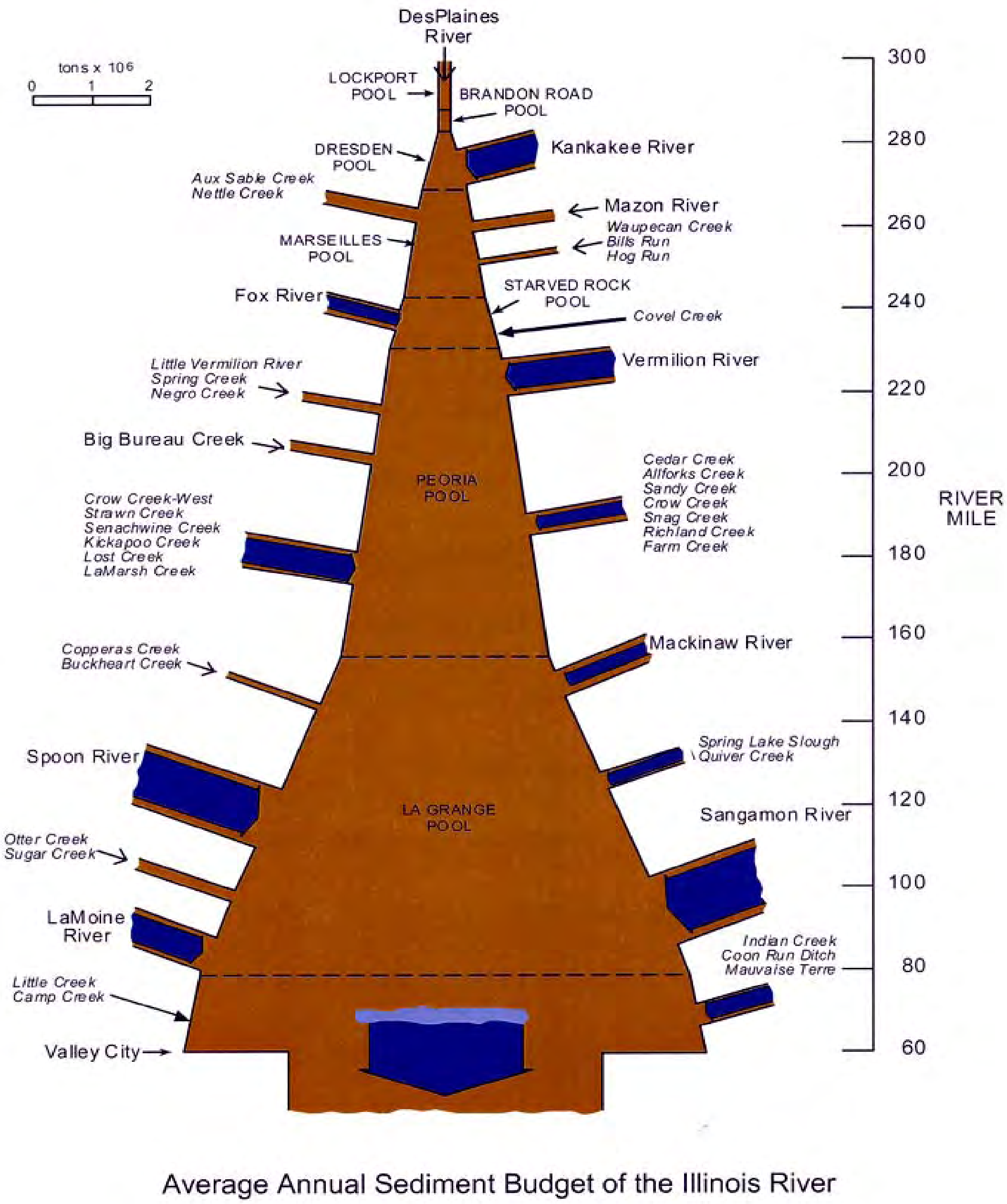


Figure 3-2. Sediment Budget Along the Main Stem Illinois River (Demissie et al. 2004)
Brown shaded areas represent quantity of sediment.

c. Future Without-Project Conditions. Depending on economic and political conditions, the programs that have reduced sediment loading from upland practices may expand or contract in the future. Although far from certain, it is anticipated that the benefits of conservation practices will probably remain constant and possibly increase somewhat in the future. However, there will continue to be significant sediment transported to the Illinois River from areas not addressed by these programs.

Significant sediment sources will continue to arise at points in the basin where sediment control regulations are inadequate or inadequately enforced. It is expected that without this program there would be no overall program to address stream instability throughout the Illinois River Basin and that future channelization projects may destabilize additional stream miles. Without measures to naturalize the sediment transport in these streams, they will continue to incise or migrate into the foreseeable future, contributing sustained high rates of sediment loading to the main stem Illinois River.

Without action, the sediment loading to the Illinois River from unstable streams and other sources in the basin will continue at unacceptably high levels. Sediment loading will continue to degrade vulnerable habitats and impede downstream restoration efforts. Local projects may show site-specific benefits, but the effects of high sediment loading will limit the extent where benefits may be observed.

Among the significant unknowns that will affect future sediment conditions are climate, land use, and land cover conditions. These are generally beyond the influence of the Illinois River Basin Restoration Project. Increases in precipitation could lead to increased sediment loads despite improved watershed conditions; likewise, decreases in precipitation could reduce sediment loads even if no beneficial actions were taken. Land use and land cover changes could similarly increase or decrease sediment delivery from the basin, depending on the nature of the changes. Without additional monitoring, it will be very difficult to determine trends in the sediment transport processes within the Illinois River and its basin or to evaluate systemic benefits of improvement projects.

d. Desired Future Conditions. Under the desired future conditions the rate of sediment transport within the Illinois River Basin and the main stem river, especially the transport of silt and clay particles, would be reduced to a level that will better support ecological processes. At this time the understanding of the interconnections between sediment transport and Illinois River Basin ecosystem processes is insufficient to support definitive numerical targets for ecosystem improvement. In the absence of a scientific model of sediment effects, Corps of Engineers and State of Illinois scientists and managers generally agree that an overall 20 percent reduction of sediment transport to the main stem Illinois River is an appropriate initial long-term target that would demonstrate measurable positive benefits for the system. Monitoring for the Demonstration Erosion Control (DEC) project in the Mississippi River indicated that such a reduction of watershed sediment delivery is possible using proven technology (Watson and Biedenharn 1999). An interim target of 10 percent reduction after 20 years was chosen to represent a measurable improvement and is feasible by treating the most significant sediment sources first. Using the sediment budget developed by Demissie et al. (2004) for WY 1981-2000, 10 percent and 20 percent reductions represent 1.2 and 2.4 million tons per year below current levels, respectively. Slightly smaller reduction targets would arise if the extreme year of 1993 were excluded.

Although these objectives are formulated in terms of sediment delivery to the main stem, the benefits will be achieved nearly exclusively by projects within the tributary basin. These projects would have significant benefits within their particular tributary areas as an overall 20 percent reduction would necessitate higher reductions in the immediate vicinity of each project. It is envisioned that additional ecosystem benefits will be gained by placing the sediment reduction projects in areas likely to benefit high-value downstream habitats.

Achievement of the sediment reduction objectives will require four components: maintaining existing sediment control benefits, identifying and controlling sources of sediment in upland areas, identifying and treating unstable streams, and assessing system response to individual projects. To maintain existing benefits, it will be necessary to ensure that the conservation practices currently installed within the basin remain effective. It is also necessary that existing regulations are enforced and are evaluated to determine if they could better protect the resources within the Illinois River system. Under these conditions, it is assumed that without-project sediment loads would remain constant at WY1981-2000 levels. Additional sediment control practices would be implemented through this project and coordinated efforts based on assessment of sources within specific watersheds.

Recognizing that streams always transport sediment, reduced delivery would be accomplished by implementing projects that reduce bank erosion, allow streams to reach a relatively stable state, or control upland sediment as appropriate based on watershed conditions. To guarantee an accurate understanding of the sediment transport status and trends, assess project success and guide future project development, a basin-wide monitoring network is needed to compile and evaluate sediment data. The systemic understanding gained from the monitoring data will be used to refine basin-wide hydrologic and sediment models so as to forecast system response to additional management activities.

2. Formulation of Alternative Plans. The objectives for this ecosystem goal were formulated to reduce sediment delivery to both the Illinois River and to high-quality areas within the basin. Because of their effects on the river's ecological functions, much of this effort will concentrate on the control of silt and clay particles. Sediment control requires assessing sediment transport on a watershed scale, identifying major sources of erosion as related to downstream sediment delivery, and addressing these sources as feasible. It cannot be overstressed that the benefits achieved through these efforts would be erased if inadequate enforcement of local regulations or unmitigated land-use changes allow large amounts of sediment to enter the river system. The efforts here are designed to augment, and not replace, local and regional sediment control efforts.

Sediment delivery would be reduced using a combination of upland controls and stream stabilization as appropriate for each individual watershed (e.g. White et al. 2003). Information such as that developed for NRCS Erosion and Sediment Investigations can be used to identify the major sources within each watershed and develop treatment measures. Stream stabilization measures would be undertaken using measures that take into account system geomorphological influences (Shields et al. 2003). For each watershed, an alternative analysis would be developed to determine the most cost-effective set of projects to address the sediment delivery issues particular to that watershed.

a. Approach/Assumptions. Although it is unlikely that incremental changes in sediment load will always have directly proportional benefits for ecosystem integrity, there is currently no model to relate these factors on a system-wide level. For the purposes of plan formulation, the study team assumed a direct relationship between sediment load reduction and ecosystem benefits for the range of changes considered. The team also generally agreed that a 20 percent reduction from current levels would lead to significant improvements in ecological integrity within the Illinois River Basin. Because the river was a depositional environment even prior to land clearance (Bhowmik and Demissie 1989), it is expected that a load reduction of that magnitude would not have adverse geomorphic effects.

Systematic alternatives were developed based on strategies to achieve specific reductions (tons per year) in sediment delivery to the river. Due to differences in watershed conditions and restoration potential, basin tributaries were divided into three regions, based on the Physiographic Regions of the Illinois River Basin (Appendix D-1); the tributaries that drain to the river upstream of Peru and also the Mackinaw River are categorized as “eastern,” “southern” tributaries drain to the river from the left bank downstream of the Mackinaw River, and “western” tributaries are the rest, including all direct tributaries to Peoria Lake (figures 3-2 and 3-3). The eastern, western, and southern tributaries contribute approximately 3.8, 5.2, and 3.1 million tons per year, respectively, of sediment to the Illinois River. The percent reduction to be achieved within each tributary region was set by the various alternatives, and the sediment delivery calculated for the Sediment Budget of the Illinois River (Demissie et al. 2004) was used to develop quantitative reduction goals for each region. The differing characteristics between regions led to differences in the effectiveness of sediment control measures and thereby differences in the cost to control sediment delivery.

The maximum attainable delivery reduction for large watersheds was estimated to be 20 percent of current levels. Delivery reduction in the immediate vicinity of stabilization projects, however, tends to be significantly higher, implying that larger reductions are possible when viewed at smaller scales. Applying this to entire watersheds suggests that potential reduction may be a function of watershed area. Figure 3-4 proposes a relationship between watershed size and potential maximum reduction of watershed sediment delivery assuming a threshold maximum at 200 square miles (the size of the larger DEC watersheds) and that delivery reduction is a function of watershed area to the –0.3 power, as suggested in Figure 12.10.4 of Shen and Julien (1993). This relationship is consistent with the experience of state resource managers that significant reductions in sediment delivery are achievable when working with small but highly disturbed watersheds.

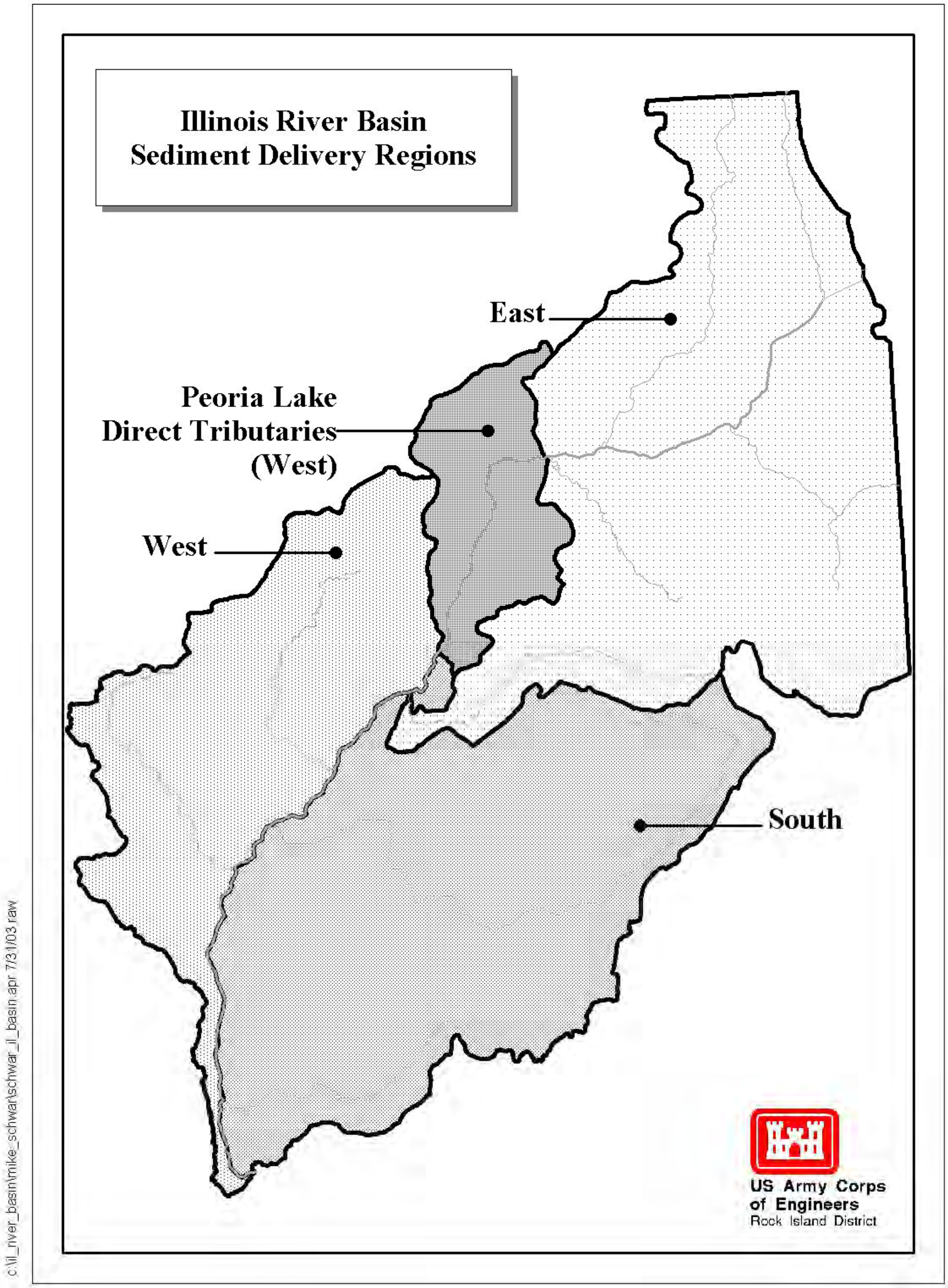


Figure 3-3. Regions Used To Delineate Assumed Tributary Characteristics.
Differing characteristics between regions result in differences in the effectiveness of sediment control measures and thereby differences in the cost to control sediment delivery.

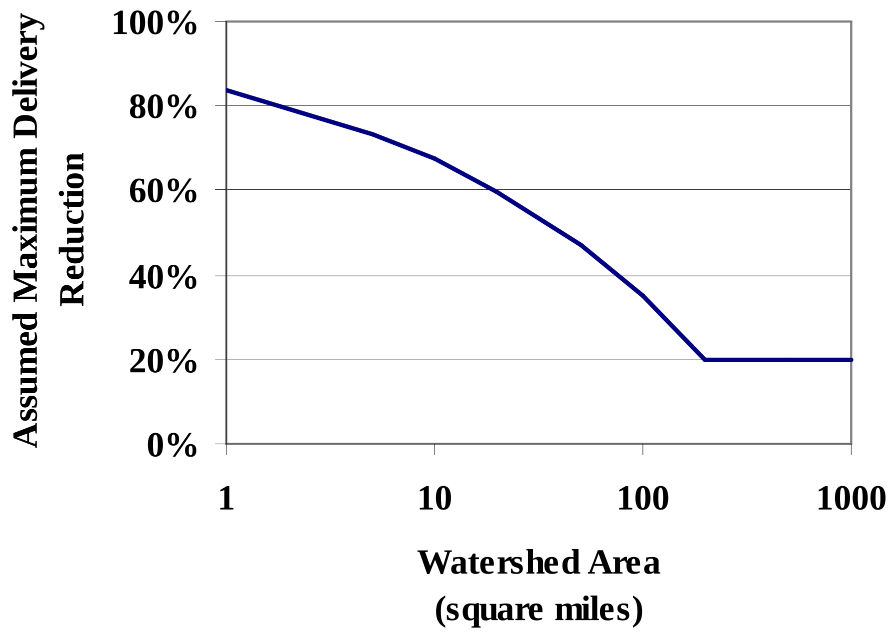


Figure 3-4. Estimated Potential Watershed Sediment Delivery Reduction Relationship

For all of the alternatives, the sediment sources and potential reduction options will be assessed on a watershed basis to preserve or restore systemic geomorphic balance. Out of these assessments, plans encompassing both structural and non-structural actions will be developed. It is expected that existing efforts such as federal and state conservation programs as well as state and local erosion control ordinances will play an important role in delivery reduction, and that the assessments may provide a basis for expanding these efforts.

b. Criteria and Constraints. Benefits for this goal are quantified in terms of annual tons of sediment not delivered to the Illinois River main stem, and are sometimes expressed as a percent reduction from current levels. By quantifying the benefits in this way, the inherent assumption is that each increment of sediment reduction provides the same level of benefit; it is probable that there is some variation in incremental benefits of sediment reduction, but the linkages between reductions and ecological benefits are not understood to a sufficient level to justify a different approach so the simple linear relationship was used here.

Because of the interest in maintaining the quality of Peoria Lake, benefits for each alternative have been calculated at both Peoria Lake and at Valley City. Tributary benefits were not specifically quantified but reductions in sediment delivery to the main stem Illinois River necessitate significantly larger percent reductions at some upstream points in its tributaries. Stabilization of eroding channels has been shown to provide ecological benefits within those channels (Shields et al. 1997) and watershed-based sediment control strategies can be expected to provide significant benefits to areas some distance downstream. Because of this, it is reasonable to expect that significant benefits would also accrue in the tributary systems.

Site-specific conditions will have a large effect on the potential for particular measures to provide benefits, the extent that those measures provide additional ecological benefits, and the cost of implementation. For example, in developing watershed plans, local support and involvement will play a large role in the scope of project implementation. Also, sediment control projects located upstream of vulnerable habitat areas would provide more ecological benefits than the same projects downstream of the same areas. The estimates of costs and benefits developed here attempt to reflect a representative average of a number of projects placed over a large area and so balancing overall effects of site-specific conditions.

c. Measures. Although the precise mix of measures to be applied throughout the Illinois River Basin will be developed on a watershed basis, representative project scenarios were developed based on several potential combinations of an abbreviated suite of cost-effective measures. For the purpose of programmatic estimates, it was assumed that incising channels would be treated with rock riffle structures if possible; otherwise, sheet-pile grade control structures would be used. It was assumed that the preferred method of treating bank erosion was stone barbs, then stone toe, or finally a stone armor blanket if necessary. Bioengineering was incorporated in most of the bank erosion stabilization measures. Upland sediment control measures were assumed to be dry basins for costing purposes. Other measures are likely to be used, but it is assumed that overall cost estimates should not greatly change.

Sediment benefits were defined based on the total quantity trapped or from the reduction in sediment generation. Sediment trapping in upland facilities was estimated using an average capacity of similarly sized sediment basins. Sediment generation from unstable streams was estimated using average stream characteristics and rate of channel movement. Stable streams do transport sediment; for purposes of estimating benefits, it is assumed that sediment delivery from stabilized stream banks or beds would be 25 percent of unstabilized levels. Benefits were annualized as necessary to evaluate the yearly delivery reduction after construction of each suite of projects.

d. Alternatives. Three acceptable geographic distributions of projects were developed:

- The alternatives in the first distribution (Alternatives 1A through 1D, table 3-2) were designed to provide equal treatment to the entire Illinois River Basin by focusing on treating “hot spots” in each watershed.
- The alternatives in the second distribution (Alternatives 1E through 1G, table 3-2) identifies Peoria Lake as a focus and concentrates on reducing inputs equally from the entire area contributing flow to Peoria Lake while addressing sediment delivery from downstream watersheds to a lesser extent.
- The alternatives in the third distribution (Alternatives 1H through 1W, table 3-2) were designed to focus sediment delivery reduction measures in the direct tributary watersheds to Peoria Lake, while treating the rest of the basin, both upstream and downstream of Peoria Lake, to lesser extents. Due to their small watersheds, it should be possible to reduce sediment delivery from Peoria Lake direct tributaries by a higher percentage than is possible in the larger tributary systems. Two levels of treatment for the direct tributaries to Peoria Lake are evaluated: those necessary to reduce sediment delivery rates by 20 percent (Alternatives 1H through 1O) and by 40 percent (Alternatives 1P through 1W) below current levels.

It is important to note that although sediment reduction benefits may accrue from projects designed to meet other goals, most notably Goal 5, those benefits are not incorporated into this analysis.

Table 3-2. Alternatives

Alternative	Total Sediment Delivery Reduction (%)	Sediment Delivery Reduction to Peoria Lake (%)	Sediment Delivery Reduction from Watersheds Upstream of Peoria Lake (%)	Sediment Delivery Reduction from Watersheds Downstream of Peoria Lake (%)	Sediment Delivery Reduction from Direct Tributaries to Peoria Lake (%)
1-0	No Action				
First Distribution – equal treatment to the entire basin					
1A	5.00	5.00	5.00	5.00	5.00
1B	7.50	7.50	7.50	7.50	7.50
1C	10.00	10.00	10.00	10.00	10.00
1D	20.00	20.00	20.00	20.00	20.00
Second Distribution – focus on direct tributaries to Peoria Lake and upstream inputs					
1E	5.00	10.00	10.00	2.00	10.00
1F	7.50	15.00	15.00	3.00	15.00
1G	10.00	20.00	20.00	4.00	20.00
Third Distribution – focus on direct tributaries to Peoria Lake					
1H	5.00	10.00	5.50	2.00	20.00
1I	7.50	10.00	5.50	6.00	20.00
1J	10.00	10.00	5.50	10.00	20.00
1K	10.00	12.50	9.10	8.50	20.00
1L	7.50	15.00	12.80	3.00	20.00
1M	10.00	15.00	12.80	7.00	20.00
1N	2.30	6.30	0.00	0.00	20.00
1O	5.00	6.30	0.00	4.25	20.00
1P	5.00	12.50	0.00	0.50	40.00
1Q	10.00	12.50	0.00	8.50	40.00
1R	7.50	15.00	3.60	3.00	40.00
1S	10.00	15.00	3.60	7.00	40.00
1T	4.27	12.50	0.00	0.00	40.00
1U	10.00	20.00	11.00	4.00	40.00
1V	20.00	20.00	11.00	20.00	40.00
1W	22.00	26.00	20.00	20.00	40.00

3. Evaluation and Comparison of Plans. Depending on the particular watershed conditions, a variety of combinations of sediment reduction measures may be applied within the different watersheds. To estimate the programmatic cost, a representative range of potential project combinations was evaluated, including a number of different project combinations for differing treatment strategies and watershed geomorphic conditions. It is expected that sediment control through in-channel work will account for at least 50 percent of the reduction attained; upland projects are generally not considered to be sufficient to control destabilized channels within an acceptable time period without some in-channel remediation, and it is anticipated that restoring such channels would be a major portion of the sediment control undertaken. The range of potential measures assumed different extents of incision, different project locations (small stream vs. large stream vs. upland) and different combinations of upland vs. in-stream measures. Each strategy was standardized to develop the range of costs required to reduce sediment delivery by one ton per year.

From this analysis, estimates of delivery reduction cost were developed for the three watershed regions from Figure 3-3. Among the key assumptions of these estimates are:

- The incremental cost for sediment delivery reduction is the same for all units; that is, the first ton costs same as final ton for the range analyzed, and
- Corps construction costs include a 35 percent contingency, an additional 30 percent for engineering and design, and 9 percent for supervision and administration. Real estate costs include a 35 percent contingency as well.
- The cost estimates provided in table 3-3 are the initial (not annual) costs for sediment control measures (e.g. rock riffle structures, stone barbs, etc.) that would be designed to reduce sediment delivery to the Illinois River by one ton per year.

The range of cost estimates for the various watershed alternatives is shown in table 3-3. Please note that the initial project costs (also referred to as the initial costs) identified are the cost of construction plus the cost for real estate and as such are not an annual cost of the project. The initial costs were developed with the goal of reducing sediment delivery by one ton per year. Due to the higher levels of sediment delivery arising out of channel erosion in southern and western tributary watersheds, in-channel treatments were much more cost effective in those areas and overall delivery reduction was possible at a lower cost than reduction in eastern tributaries.

Table 3-3. Cost Estimates To Reduce Sediment Delivery to the Illinois River by One Ton Per Year, by Tributary Region

	Average Costs ($/ton)		Initial Project Costs ($/ton)	
	Construction	**Real Estate**	**Average**	**Range**
In-channel only				
East	623	26	649	502 - 776
West	149	7	156	133 - 185
South	138	6	144	125 - 162
Mixed focus (75% in-channel work)				
East	667	46	713	633 - 778
West	312	32	344	295 - 396
South	357	39	396	296 - 596
Mixed focus (50% in-channel work)				
East	708	66	775	721 - 828
West	472	56	528	452 - 607
South	413	48	461	311 - 587

Although in-channel work is the most cost-effective way to reduce sediment delivery, it is likely that there will be some distribution of in-channel and watershed measures, therefore, the average costs for 75/25 mixes of channel/upland projects were used to develop the cost estimates for each of the 24 alternatives identified in table 3-2. The estimated initial cost to reduce sediment delivery in eastern watersheds by one ton per year is approximately $713in western watersheds it is $344, and in the south it is $396. It is apparent that the geographical location of the watersheds chosen for reduction efforts will have a large effect on the overall project costs. Estimates of sediment delivery to the Illinois River were developed for the tributaries flowing directly into Peoria Lake, the area upstream of Peru, and the area downstream of Peoria Lake. These estimates are as follows:

- Approximately 1.4 million tons per year of sediment is delivered to the Illinois River from the direct tributaries to Peoria Lake (all watersheds are located in the western region).
- Approximately 3.1 million tons per year of sediment is delivered to the Illinois River from the area upstream of Peru (all watersheds are located in the eastern region).
- Approximately 7.6 million tons per year of sediment is delivered to the Illinois River from the area downstream of Peoria Lake. Approximately 0.6, 3.8, and 3.1 million tons per year originate in the eastern, western, and southern regions, respectively.

The initial costs estimates were used to develop cost estimates for each of the alternatives identified in table 3-2. Table 3-4 summarizes the estimated benefits and costs for each alternative considered.

Table 3-4. Alternative Comparison

Alternative	Delivery Reduced (100,000 tons/year)						Reduced Delivery (%)		Initial Cost ($ Million)
	Tributaries Upstream of Peru	Peoria Lake Direct Tributaries	Tributaries Downstream of Peoria Lake				to Valley City	to Peoria Lake	
			East Region	West Region	South Region	Total			
1-0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0
First Distribution									
1A	1.6	0.7	0.3	1.9	1.6	3.8	5.00	5.00	288
1B	2.3	1.1	0.5	2.9	2.3	5.7	7.50	7.50	425
1C	3.1	1.4	0.6	3.8	3.1	7.6	10.00	10.00	573
1D	6.2	2.8	1.3	7.6	6.2	15.1	20.00	20.00	1138
Second Distribution									
1E	3.1	1.4	0.1	0.8	0.6	1.5	5.00	10.00	328
1F	4.7	2.1	0.2	1.1	0.9	2.3	7.50	15.00	499
1G	6.2	2.8	0.3	1.5	1.2	3.0	10.00	20.00	662
Third Distribution									
1H	1.7	2.8	0.1	0.8	0.6	1.5	5.00	10.00	276
1I	1.7	2.8	0.4	2.3	1.9	4.5	7.50	10.00	400
1J	1.7	2.8	0.6	3.8	3.1	7.6	10.00	10.00	521
1K	2.8	2.8	0.6	3.2	2.6	6.4	10.00	12.50	555
1L	4.0	2.8	0.2	1.1	0.9	2.3	7.50	15.00	473
1M	4.0	2.8	0.5	2.7	2.2	5.3	10.00	15.00	590
1N	0.0	2.8	0.0	0.0	0.0	0.0	2.30	6.30	96
1O	0.0	2.8	0.3	1.6	1.3	3.2	5.00	6.30	228
1P	0.0	5.7	0.0	0.2	0.2	0.4	5.00	12.50	211
1Q	0.0	5.7	0.6	3.2	2.6	6.4	10.00	12.50	452
1R	1.1	5.7	0.2	1.1	0.9	2.3	7.50	15.00	362
1S	1.1	5.7	0.5	2.7	2.2	5.3	10.00	15.00	487
1T	0.0	5.7	0.0	0.0	0.0	0.0	4.27	12.50	196
1U	3.4	5.7	0.3	1.5	1.2	3.0	10.00	20.00	559
1V	3.4	5.7	1.3	7.6	6.2	15.1	20.00	20.00	1038
1W	6.2	5.7	1.3	7.6	6.2	15.1	22.00	26.00	1238

Alternative cost estimates were developed using the following methodology. Alternative 1V—which plans to reduce delivery from Peoria Lake direct tributaries by 40 percent, from the rest of the upstream basin by 11 percent, and from the areas downstream of Peoria Lake by 20 percent—is used as an example.

$$TC_{PT} = R_{PT} \times S_{PT} \times C_W$$
$$0.4 \times 1.4\text{ M} \times \$344 = \$195\text{ M}$$

$$TC_U = R_U \times S_U \times C_E$$
$$0.11 \times 3.1\text{ M} \times \$713 = \$243\text{ M}$$

$$TC_D = R_D \times (S_{D\text{-}E} \times C_E + S_{D\text{-}W} \times C_W + S_{D\text{-}S} \times C_S)$$
$$0.2 \times (0.6\text{ M} \times \$713 + 3.8\text{ M} \times \$344 + 3.1\text{ M} \times \$396) = \$600\text{ M}$$

$$TC = TC_{PT} + TC_U + TC_D$$
$$\$195\text{ M} + \$243\text{ M} + \$600 = \$1038\text{ M}$$

where:
TC_{PT} = total initial cost of reducing sediment delivery from the direct Peoria tributaries
TC_U = total initial cost of reducing sediment delivery from the area upstream of Peru
TC_D = total initial cost of reducing sediment delivery from the area upstream of Pekin
TC = total initial cost of the alternative
R_{PT} = reduction from the direct Peoria tributaries
R_U = reduction from the area upstream of Peru
R_D = reduction from the area downstream of Peoria Lake
S_{PT} = sediment contributed by the direct Peoria tributaries in tons per year
S_U = sediment contributed by the area upstream of Peru in tons per year
$S_{D\text{-}E}$ = sediment contributed by the area downstream of Peoria Lake from the eastern region in tons per year
$S_{D\text{-}W}$ = sediment contributed by the area downstream of Peoria Lake from the western region in tons per year
$S_{D\text{-}S}$ = sediment contributed by the area downstream of Peoria Lake from the southern region in tons per year
C_W = cost of reducing sediment delivery by one ton per year for the western region
C_E = cost of reducing sediment delivery by one ton per year for the eastern region
C_S = cost of reducing sediment delivery by one ton per year for the southern region
M = million

4. Plans Recommended for System Analysis

a. Restoration Alternatives. The alternatives were compared for cost-effectiveness to achieve sediment reduction benefits at Peoria Lake and Valley City (table 3-4). Two cost-effectiveness analyses were performed, one assuming that the maximum delivery reduction anywhere in the basin would be 20 percent (table 3-5), and the other assuming that it would be possible to effect a 40 percent reduction from the smaller watersheds of the direct tributaries to Peoria Lake (table 3-6). In the first comparison, 1A through 1C and 1E and 1F were found to be not cost effective because the same sediment reduction benefits at both Peoria Lake and the Illinois River can be achieved at lower costs by one of the alternatives 1H through 1L (table 3-5). This emphasizes that under the assumed conditions the most cost-effective way to develop benefits is by maximizing the focus on the direct tributaries to Peoria Lake. If larger reductions were possible on these particular tributaries, the cost-effectiveness would increase further; table 3-6 demonstrates that, by concentrating on those tributaries to maximize their potential reduction, Alternatives 1P through 1S are better buys than Alternatives 1I through 1M and 1O.

Alternatives 1U and 1V increase the efficiency of reducing the load to Peoria Lake, so they are also better buys than Alternatives 1G and 1D, which would concentrate half as much effort on the direct tributaries to Peoria Lake.

Table 3-5. Cost-effective Alternatives
Assumes 20% maximum reduction possible for Peoria Lake direct tributaries

	Reduced Delivery (%)		
Alternative	**to Valley City**	**to Peoria Lake**	**Initial Cost ($ Million)**
1-0	0.00	0.00	0
1N	2.30	6.30	96
1O	5.00	6.30	228
1H	5.00	10.00	276
1I	7.50	10.00	400
1L	7.50	15.00	473
1J	10.00	10.00	521
1K	10.00	12.50	555
1M	10.00	15.00	590
1G	10.00	20.00	662
1D	20.00	20.00	1138

Table 3-6. Cost-effective Alternatives
Assumes 40% maximum reduction possible for Peoria Lake direct tributaries

	Reduced Delivery (%)		
Alternative	**to Valley City**	**to Peoria Lake**	**Initial Cost ($ Million)**
1-0	0.00	0.00	0
1N	2.30	6.30	96
1T	4.27	12.50	196
1P	5.00	12.50	211
1R	7.50	15.00	362
1Q	10.00	12.50	452
1S	10.00	15.00	487
1U	10.00	20.00	559
1V	20.00	20.00	1038
1W	22.00	26.00	1238

Three key assumptions should be kept in mind when evaluating this alternatives analysis. The first is that the benefits are only accounted at two locations, Peoria Lake and Valley City. Work within each tributary will have specific local benefits that are not considered in this analysis. In some areas, these local benefits will be significantly higher than those accrued from work in other areas, but it is expected that the high-value areas are probably spread throughout the Illinois River Basin and would not change the ranking of the alternatives. Also, because the most upstream point analyzed is Peoria Lake, potential benefits (or lack thereof) to river reaches upstream are not considered in the analysis. The second assumption is that the incremental cost of sediment reduction does not change. Since it is likely that there are some relatively straightforward projects that would reduce sediment delivery, the incremental cost probably increases as the percent reduction increases. By not accounting for this, some bias is introduced into the analysis that somewhat overestimates the cost-effectiveness of concentrating projects in one area, specifically the direct tributaries to Peoria Lake. Finally, this analysis does not differentiate between the effects of silt and sand. For this analysis, the benefit is related only to the quantity of sediment reduced and not to the particle size.

b. Selected Alternatives. By consensus of the project study team, it was decided that it should be possible to reduce sediment entering the river from the direct tributaries to Peoria Lake by 40 percent. From the list of cost-effective alternatives (table 3-6), four were chosen as pieces of the seven system plans. Alternative 1N was chosen as the minimum level of effort necessary to show regional benefits for this goal, Alternative 1P was the minimum necessary to maintain current system function, and Alternative 1U was the minimum required to begin to show system-wide improvements. These were included in the system plans as shown in table 3-7. Alternative 1V is the minimum level of effort necessary to fully meet the objectives of this goal and was chosen as part of Plans 6 and 7.

i. Implementation. Although quantifying the sediment control benefits of a particular project will assess how well it addresses the numerical objectives of this goal, prioritization and implementation will help determine how these projects fit into the overall goal of improved ecosystem function. As an ecosystem restoration project, it is envisioned that the measures implemented to meet this goal will be those that best improve overall function, are cost effective, and will not have significant adverse impacts themselves. The following characteristics should be considered when prioritizing which measures to implement:

- Measures that address sources that directly affect vulnerable resources (for example, unstable streams filling backwater lakes) should be given highest priority.
- Significant consideration should be given to reduction measures that provide additional benefits, specifically improvement of stream habitat.
- Delivery is often inversely related to distance from the Illinois River, so proximity to the river should be taken into account.
- Delivery of fines (silts and clays) is problematic system-wide. Projects affecting silts and clays can be generally assumed to have benefits for downstream portions of the Illinois River.
- Delivery of bed material load (sand) can also be a major issue at local or regional levels, specifically the mouths of tributaries (i.e., backwater lakes or Peoria Lake), and should be considered on a case-by-case basis.

A primary assumption of this goal is that future sediment loads remain at approximately the same levels without the project and that the actions taken for the project will result in a net reduction in sediment load. This implies that any existing sediment controls would remain functioning and that the loading from any new sources would be offset by reductions due to other measures. Measures undertaken for this project are expected to have minimal maintenance requirements, and their project lives would be sufficient so that they would all be functioning at the end of the program (50 years). However, at that point the earliest projects would begin to exceed their design life and their sediment reduction capability might decline if they were not maintained. Therefore, the sediment reduction goal would be met in the later stages of the program life, but this success would not necessarily be permanent. Additional maintenance efforts would extend the time that delivery reduction could be maintained, and may also increase the degree of reduction possible (for example, emptying sediment traps would allow more capture).

ii. Systemic Benefits - Benefit Quantification. The benefits for Goal 1 were quantified for each alternative in terms of percent reduction of sediment delivery with an overall goal of a 20 percent reduction (2.4 million tons per year). This target was set based on experience on the Delta Headwaters Project in Mississippi and profession judgment of ERDC and Colorado State University staff. In addition to the percent of goal attainment, these benefits have been adapted to stream miles by considering the practices that would be used to reduce sediment delivery and making assumptions, based on engineering expertise, as to the length of stream that would be affected from these practices. Table 3-8 shows the quantity of stream miles with direct benefits (the length of stream immediately adjacent to the construction activity) and the area of influence (the length of stream, including those areas upstream and downstream, anticipated to benefit from the stabilized reach or sedimentation retention structure) for each alternative, and for the assumptions used to develop those quantities.

The direct benefits and the length of stream influenced from the proposed measures for each of the alternatives were calculated based on engineering expertise as described in the following text. Table 3-9 includes the number of measures proposed for each alternative. It is assumed that riffle structures, drop structures, and sills will be used for grade control. Riffle structures will be built, in most instances, such that there will be three riffles in series separated by a distance (X) equal to the height of the riffle (H) divided by the channel slope (S_o) ($X = H/S_o$). It is also assumed that for a series of riffle structures, the length of stream realizing direct benefits associated with the riffles will extend a distance of X upstream from the most upstream riffle and a distance of 3X downstream from the most downstream riffle. For other types of grade control structures, it is assumed that the length of stream realizing direct benefits will extend a distance of X upstream and 5X downstream from the structure. It is assumed that Direct Structural Measures (i.e. Riprap) and Indirect Structural Measures (i.e. Bendway Weirs, Barbs, Groins, and Spurs) will be used for Bank Stabilization. The length along the stream where riprap is placed is considered to be the stream length with direct benefits. Riprap may be used alone or in conjunction with bioengineering. The length along the stream where bioengineering is placed is considered to be the stream length with direct benefits. Indirect Structural Measures will be applied at frequency of 1 per 100 feet of stream; therefore, it is assumed that the direct benefits for each structure extend 50 feet upstream and 50 feet downstream from the structure. The relationship between Sediment Retention Structure size and stream miles with direct benefits is based on the following assumptions: (1) each acre of sediment retention built will affect 20 acres of watershed and (2) the percentage of total watershed area benefited is equivalent to the percentage of total (perennial and ephemeral) stream miles benefited.

As the streams are stabilized (through the placement of riprap, bendway weirs, etc.), upstream segments of stream will experience reduced downcutting and widening due to erosive forces. Over the 50-year life of this project, it is anticipated that for Alternatives 6 and 7 sediment reduction measures will be installed in half of the sub-basins of the Illinois River Basin; therefore, up to half of the stream miles in the basin (5,500 perennial stream miles and 11,250 ephemeral stream miles, 16,750 total stream miles) will be beneficially influenced through the project measures. The quantity of stream miles influenced for Alternatives 1 through- 5 were determined by prorating the previous total (16,750 stream miles) by the ratio of the stream miles with direct benefits for each alternative to the stream miles with direct benefits for Alternatives 6 and 7. The quantities of stream miles influenced are estimates of the maximum benefits that could be realized over the 50-year life of the project.

iii. Ancillary Benefits. Additional sediment delivery benefits are likely to accrue from projects undertaken for other goals. These include:

- Reductions due to reduced transport and sediment trapping in stream and riparian restoration projects (Goal 3)
- Reductions from reduced stream power under naturalized hydrologic regimes (Goal 5)
- Sediment trapping in water quality facilities (Goal 6) and flood storage areas (Goal 5)

However, there could also be negative impacts from actions that may release sediment, such as some dam removal projects (Goal 4). It is assumed that the sediment delivery benefits or detriments due to those goals will be addressed within the project design.

In addition, the projects enacted under this goal are likely to have ancillary benefits for other goals. Habitat benefits to support Goal 3 will be provided by riffle-pools, stone structures and vegetated banks, although there is a broad range of potential benefits due to the unknown configuration of the eventual watershed projects.

Additional benefits will accrue to Goal 6 as reduced sediment delivery will reduce the transport of nutrients associated with the sediment, most notably phosphorus, into the aquatic systems. Hubbard et al. (2003) cited chemical analyses indicating that soils in the Mississippi contained approximately 200 parts per million phosphorus; assuming that soils in Illinois are comparable, each ton of sediment reduction would amount to a reduction of approximately 0.4 pounds of phosphorus delivery to the river. Other unquantified ecosystem benefits of reduced sediment delivery include:

- Improved aquatic habitat quality in tributaries and backwater areas due to reduced turbidity and sedimentation effects (Overarching Goal and Goals 2 and 3)
- Increased backwater longevity (Goal 2)
- Connectivity benefits in certain riffle-pools (Goal 4)
- Lower flood stages due to stabilized sediment regime (Goal 5)

Non-ecosystem benefits that can also be attributed to reduced sediment delivery are reduced dredging costs and beneficial use of the sediment removed from traps and/or mined deltas. These benefits were not quantified for this study.

Finally, there will be the potential to incorporate additional features into the sediment projects to support other goals. For example, the design of upland measures can be modified to attenuate peak flows or increase baseflows (Goal 5). There is also the potential to incorporate water quality features into upland facilities and bank stability measures (Goal 6). These types of added benefits would generally require additional costs as they require features that would not otherwise be included in the sediment reduction projects.

Table 3-7. Characteristics of Alternatives Selected as Part of System Plans

		Reduced Delivery (%)		Delivery Reduced (100,000 tons/year)				Initial Cost ($ Million)		
System Plan	**Alternative**	**to Valley City**	**to Peoria Lake**	**Tributaries Upstream of Peru**	**Peoria Lake Direct Tributaries**	**Tributaries Downstream of Peoria Lake**	**Total**	**Construction**	**Real Estate**	**Total**
1	1N	2.30	6.30	0.0	2.8	0.0	2.8	87	9	96
2	1P	5.00	12.50	0.0	5.7	0.4	6.0	191	20	211
3,4,5	1U	10.00	20.00	3.4	5.7	3.0	12.1	514	45	559
6,7	1V	20.00	20.00	3.4	5.7	15.1	24.2	950	88	1038

Table 3-8. Benefit Quantification for Goal 1

System Plan	Alternative	Effectiveness (% of desired future conditions)	Stream Length with Direct Benefits Resulting from the Proposed Measures (miles)	Stream Length Influenced by the Proposed Measures (miles)
1	1N	12	106	1,700
2	1P	25	201	3,220
3,4,5	1U	50	598	9,570
6,7	1V	100	1,047	16,750

Table 3-9. Quantity of Features To Be Installed for the Cost-Effective Alternatives

		Feature Quantities			
System Plan	**Alternative**	**Riffle (ea)**	**Bioengineering (mi)**	**Stone Toe (mi)**	**Stream Barbs (ea)**
	1-0	0	0	0	0
1	1N	13-110	7.3-26	4.6-15	200-870
2	1P	28-240	16-57	10-32	450-1900
3,4,5	1U	47-480	60-230	36-120	1800-7600
6,7	1V	91-880	98-370	60-200	2900-12000

c. Risk and Uncertainty. The measures selected for this goal, when correctly designed and applied, are known to effectively reduce the downstream delivery of sediment. The actual sediment delivery reduction for each individual project will vary widely based on site conditions, but it is likely that the assumed benefits for the proposed levels of project implementation are somewhat underestimated. Benefits were based on “average” conditions, while it is expected that most projects will be applied to sites with higher than average sediment delivery and thus greater potential reductions. Thus, it is fairly certain that project implementation as proposed here will in fact reduce sediment delivery to the Illinois River to the expected degree (tons per year). By using the complete time period of 1981-2000 as the baseline, including the extreme year of 1993, there is confidence that the sediment reduction goals, 1.2 million tons per year after 20 years and 2.4 million tons per year after 50 years, represent a conservative estimate of the requirements necessary to enact 10 percent and 20 percent reductions, respectively, from existing conditions.

One item of significant uncertainty is the net effect of outside influences on the sediment regime of the Illinois River in the future. Factors that will affect future sediment conditions are climate, land use, and land cover conditions. Changes in any of these factors could mask the change, or lack of change, brought about by project implementation. The uncertainty regarding this item can be addressed by incorporating monitoring results into evaluations of program effectiveness; by separating project effects from those of outside influences it will be possible to correctly assess project benefits and adapt to changing conditions. The monitoring will have to be sufficient to determine whether background sediment loads have remained at the same level (as assumed for this document), increased, or decreased over the life of the project. It must also inform regarding the influence of any extreme events encountered and allow determination of the ongoing success of the project independent of those extreme events.

Finally, an additional item of uncertainty is the ecological response from the proposed level of sediment delivery reduction. The team is confident that the proposed objectives will provide significant and measurable benefits and that the physical changes will have significant ecological benefits. However, without an adequate framework to relate sediment transport to ecosystem integrity, it cannot be confidently assumed that any particular reduction will be sufficient to maintain a specific level of integrity. Further work is necessary to move beyond the qualitative understanding of system function so that quantitative predictions of ecosystem response are possible, and that the initial target reductions may be revised if necessary.

d. Information and Further Study Needs

- Must define and quantify “excessive” on a system-wide basis (excessive sediment for a given stream may be definable by site-specific project studies).
- Research to determine the quantity of “excessive” sediment loads and sources of sediment in the main stem Illinois and its major tributaries.
- Stream surveys, sediment monitoring, and evaluation of installed practices.
- Basin-wide hydrologic and sediment models.
- Ecosystem response model for sediment.
- Quantitative understanding of the geomorphological evolution of streams in the Illinois River Basin and their response to altered sediment supply and hydrology.

G. GOAL 2: BACKWATERS AND SIDE CHANNELS. Restore aquatic habitat diversity of side channels and backwaters, including Peoria Lakes, to provide adequate volume and depth for sustaining native fish and wildlife communities

Problem. A dramatic loss in productive backwaters, side channels, and islands due to excessive sedimentation is limiting ecological health and altering the character of this unique floodplain river system. In particular, the Illinois River has lost much of its critical spawning, nursery, and overwintering areas for fish, habitat for diving ducks and aquatic species, and backwater aquatic plant communities. A related problem is the need for timely action. If restoration is not undertaken soon, additional productive backwater and side channel aquatic areas will be converted to lower value and increasingly common mudflat and extremely shallow water habitats.

Objectives

- Restore and rehabilitate 19,000 acres of habitat in currently connected areas (1989 data shows approximately 55,000 acres of backwaters during summer low water). Restoration should result in a diversity of depths. For restored backwaters, a general target would be to have the following distributions of depths: 5% > 9 feet; 10% 6 to 9 feet; 25% 3 to 6 feet; and 60% < 3 feet.
- Restore and maintain side channel and island habitats.
- Maintain all existing connections between backwaters and the main channel. (connections at the 50% exceedance flow duration).
- Identify beneficial uses of sediments.
- Compact sediments to improve substrate conditions for aquatic plants, fish, and wildlife.

Anticipated Outputs

Anticipated project outputs include immediately addressing the system limiting lack of overwintering aquatic habitat (UMR-EMP Habitat Needs Assessment, 2000). These effects will benefit the system's fish (paddlefish, bass, bluegill, catfish, and mooneye), diving ducks (canvasback and greater and lesser scaup), invertebrates (mayflies and fingernail clams), aquatic plants, mussels, and other native species. At a completed side channel and backwater restoration project, a comparison of pre- and post-project construction monitoring data showed a dramatic increase in the number and diversity of fish and waterfowl species as well as an increased total number of individuals. This success is anticipated for similar projects. System quality would increase as the number of restored backwaters reaches the desired spacing of a high quality backwater approximately every 5 miles.

1. Inventory Resource Conditions

a. Historic Conditions. Historically, the complexes of backwaters and side channels along the main stem Illinois River have provided incredibly rich habitat for fish and wildlife. Numerous small lakes and ponds rather than large lakes, dominated the floodplain (Bellrose et al. 1983). Early accounts record abundant beds of aquatic plants, attesting to the water clarity and suitable substrates. The fishery was exceptional, with a 200-mile reach of the Illinois River producing 10 percent of the total U.S. catch of freshwater fish in 1908, more than any other river in North America (Sparks 1992).

Glacial history directly shaped the geomorphic conditions of the Illinois River. This history can be used to illustrate the differences between two sections of the Illinois River, the upper and lower river, which are roughly separated at Hennepin, Illinois.

The upper river has an average width of 400 feet and a relatively steep slope of approximately 1 foot per mile. This reach does not contain significant backwater areas. In contrast, the lower river that occupies the former channel of the ancient Mississippi River has a width approaching 1,400 feet near Grafton, Illinois, a much wider natural floodplain, and a very flat slope of 0.1 foot per mile. Since glacial retreat, sediments eroded from steep tributaries have built large alluvial fans and deltas into the lower Illinois River valley, causing the formation of natural constrictions, lakes, and backwaters. The lower Illinois River is characteristically low gradient, aggradational, and has large backwater areas. The sedimentation occurring within this reach has increased significantly since settlement and threatens to convert the backwater areas into mudflats and extremely shallow water areas with decreased habitat value due to hydrologic regimes and turbidity, which essentially exclude vegetation from these areas.

i. Backwaters. Sedimentation of the Illinois River and its backwater areas has been the subject of numerous studies (Lee and Stall 1976; Bellrose et al. 1983, Demissie and Bhowmik 1986, Demissie et al 1992, WEST Consultants, Inc. 2000, Demissie et al. 2004, USACE 2003a, and USACE 2003b). Lee and Stall (1976) concluded that the backwater lake volume was being lost at an annual rate ranging from 0.6 to 1.1 percent over the period of 1903 to 1975.

Recently, the amount of backwater areas has fluctuated significantly. Following significant increases in the backwater surface acreage associated with diversion and dam construction, relatively steady declines have followed. The earliest recorded data comes from a survey conducted by J. W. Woermann between 1902 and 1904 for the U.S. Army Corps of Engineers. However, even by this time the survey reflects an altered system. The construction of dams and flow diversion from Lake Michigan had already raised water levels and increased the area covered by water relative to prior conditions.

Bellrose et al. (1983) estimated total surface acreage of backwaters at approximately 55,000 acres in 1903. Backwater area calculations were based on the 1903 tree line; this corresponds to lower elevations than current conditions. Ultimately, levee construction resulted in the loss or isolation of 31 lakes and approximately 22,000 acres of the original 55,000 acres of backwater area (Bellrose et al. 1983). As water levels on the system were raised through increased diversions of water from Lake Michigan and construction of dams, the total surface area also increased. At the peak of diversion, and prior to levee construction, the total acreage of backwaters is estimated to have exceeded 110,000 acres (Bellrose et al. 1983). By 1969, however, there was a relatively dramatic reduction to approximately 68,000 acres due to the combined effects of levee building, reduction in diversion, and sedimentation. The 1969 calculations were again based on the existing tree line, which were higher than the 1903 elevations due to improvements. Table 3-10 summarizes findings from the analysis. Bellrose et al. (1983) assessed potential future effects associated with sedimentation by estimating that the number of years required for selected lakes to lose half their average depth ranged from 24 to 127 years.

Table 3-10. Estimated Historic Surface Acreage of Connected Backwater Areas

Backwaters	River Mile	Estimated # of Backwaters	1903 Surface Acreage	Actual # of Backwaters	1969 Surface Acreage
Lower 3 Pools					
Peoria Pool		34	17,419	32	32,831
La Grange Pool	73	67	27,877	52	26,981
Alton Pool	77	35	10,366	21	7,881
Total Lower 3 Pools	**80**	**136**	**55,661**	**105**	**67,693**
Total Upper Pools (Dresden, Marseilles, Starved Rock)				**11**	**2,956**

Source: The Fate of Lakes in the Illinois River Valley, Bellrose et al. (1983)

Demissie and Bhowmik (1986) conducted an investigation of the sedimentation characteristics of Peoria Lake, the largest and deepest lake on the Illinois River. Their comparison of limited historic cross sections of the lake demonstrated sediment accumulation of up to 14 feet in various locations of the lake while the navigation channel was relatively stable over the period of record. As of 1985, the lake was estimated to have lost about 68 percent of its 1903 volume. The study concluded that, if sediment input continued at current rates, within 10 to 15 years, the river and lake would reach dynamic equilibrium and net accumulation of sediment in the lake would be zero. They predicted that most of the area outside the channel would become either a mudflat or a marshy wetland area, depending on the ability of vegetation to grow in the lake sediment.

A more recent study of the Peoria Lakes by the USACE (2003b) using data from 1903, 1930s, 1965, 1976, 1988, 1996 and 1999, shows that the off-channel areas (lake area outside of the navigation channel) experienced a volume loss of 60 percent from 1930 to 1999. These reductions correspond to average annual volume losses of approximately 0.87 percent. Over this same time period, the lake surface area decreased by approximately 10 percent, a 0.15 percent annual loss. This relatively slow rate of change in surface area for this large riverine lake likely does not reflect the rate of change occurring in the more isolated backwater lake areas, which probably lose surface area at a much higher rate.

Sedimentation and the related reductions in lake volume have dramatically altered habitat values. As the lake cross sections (Figures 3-5a and 3-5b) and plan view (Figure 3-6) show, lake depth diversity has been greatly simplified. While water levels currently are somewhat higher, the overall effect has been the loss of depth and dramatic reduction in habitat diversity. The lake historically had a mix of shallow and deepwater off-channel areas serving as aquatic habitat. Even the relatively shallow areas are reported to have had firm substrates and been home to large aquatic plant beds.

Demissie (1992) calculated the average capacity loss for selected backwater lakes from 1903 to 1975 (table 3-11). Their study showed an average capacity loss of 72 percent. Higher flow velocities and tow traffic in the channel keep finer sediments suspended in the vicinity of the navigation channel, but low velocities allow sediment to drop out in calmer areas.

This is consistent with results of the Cumulative Effects Study (WEST Consultants, Inc. 2000), which compared 1930s data with 1980s data and found that the main channel of the Illinois River has not changed significantly since the 1930s, even in the downstream reaches of the Illinois River. However, they noted changes in the backwater areas and anticipated further filling.

Table 3-11. Estimated Sedimentation in Selected Backwater Lakes in the Illinois River Valley

Pool	Lake Name	River Mile	Capacity (acre-feet) 1903	1975	1990 [1]	Rate inches/yr	Loss Percent
Alton							
	Swan Lake	5	4,816	2,783	2,359	0.18	51
	Lake Meredosia	72	7,791	4,207	3,460	0.43	56
La Grange							
	Muscooten Bay	89	1,459	184	0	3.12	100
	Patterson Bay	107	271	165	143	0.31	47
	Lake Chautauqua	125	14,293	11,679	11,134	0.33	22
	Rice Lake	133	3,064	1,119	714	0.32	77
	Pekin Lake	153	323	226	206	0.08	36
Peoria							
	Peoria Lake	162	120,000	56,600	29,150	0.79	76
	Babb's Slough	185	1,377	625	468	0.14	66
	Weis Lake	191	450	110	39	0.15	91
	Sawmill Lake	197	2,110	381	21	0.47	99
	Lake Senachwine	199	9,240	2,468	1,057	0.30	86
	Lake DePue	203	2,837	778	349	0.59	88
	Huse Slough	221	253	51	9	0.96	96
Marseilles							
	Ballard's Slough	248	142	36	14	0.91	90

[1]1990 capacity estimated based on sedimentation rate for the period from 1903-1975(Demissie 1992).

A sediment analysis conducted for Pekin Lake, in La Grange Pool, was conducted as part of work on the Pekin Lake Critical Restoration project. This backwater has experienced significant sedimentation during the last century. The earliest detailed survey of Pekin Lake was completed about 1903 by J. W. Woermann. The maps created from that survey depict the lake when the Illinois River was at low water conditions (approximately 432.5 feet NGVD, 1929). Under these conditions, some areas of the lake exhibited water depths in excess of 6 feet. Today, when the river falls to normal summer low-flow levels, what little open water exists is only 0 to 2 feet deep. Rates of sedimentation over the last 100 years were computed for the Pekin Lake area. The average annual sedimentation rate based on the amount of sediment that has deposited between 1903 and the present is 0.23 inches per year in the upper lakes and 0.3 inches per year in the lower lakes and 0.26 inches per year for the entire lake complex.

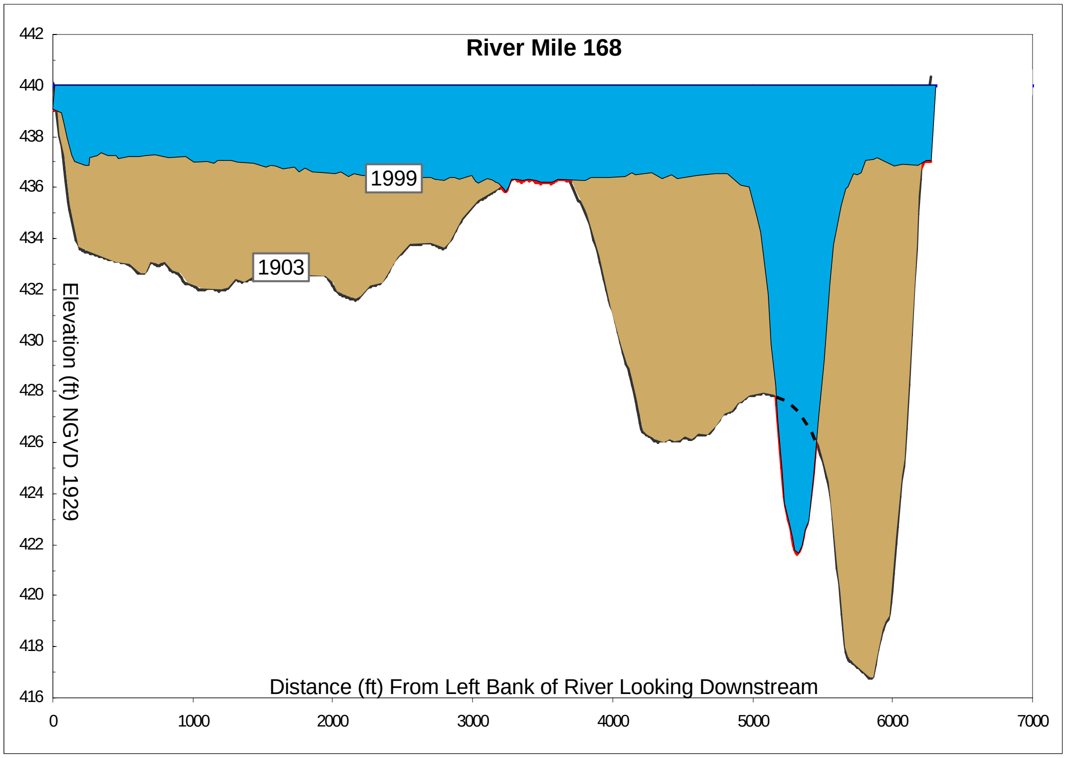


Figure 3-5a. Typical Cross Sections from Peoria Lakes Showing Dramatic Sedimentation Between 1903 and 1999, RM 168

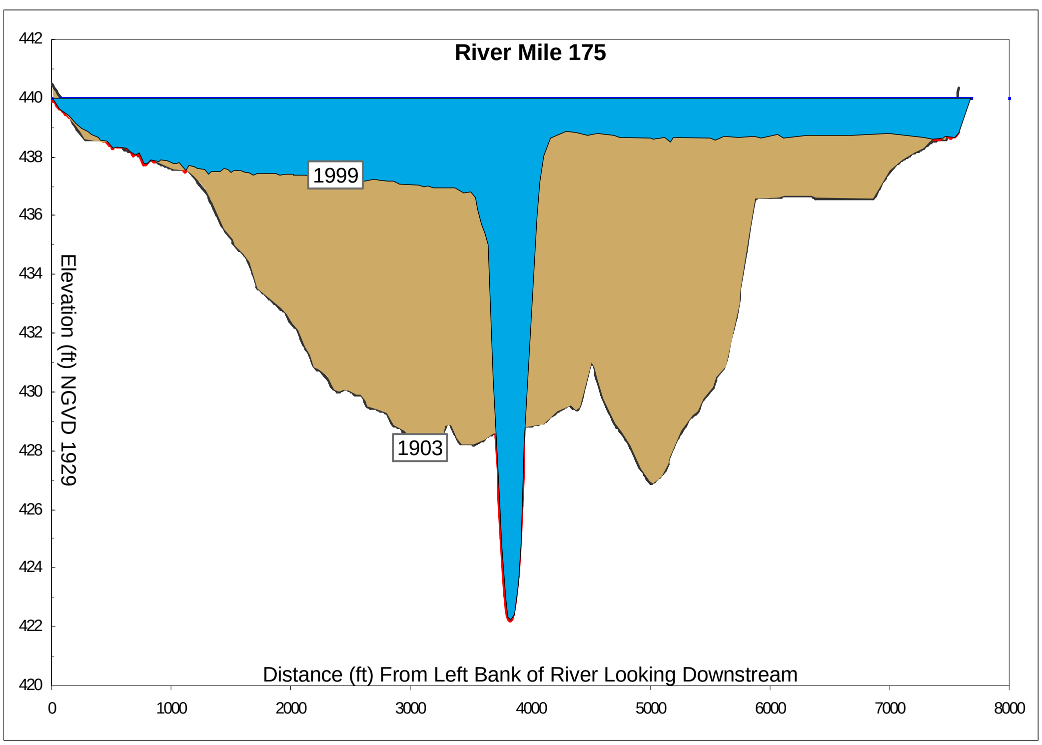


Figure 3-5b. Typical Cross Sections from Peoria Lakes Showing Dramatic Sedimentation Between 1903 and 1999, RM 175

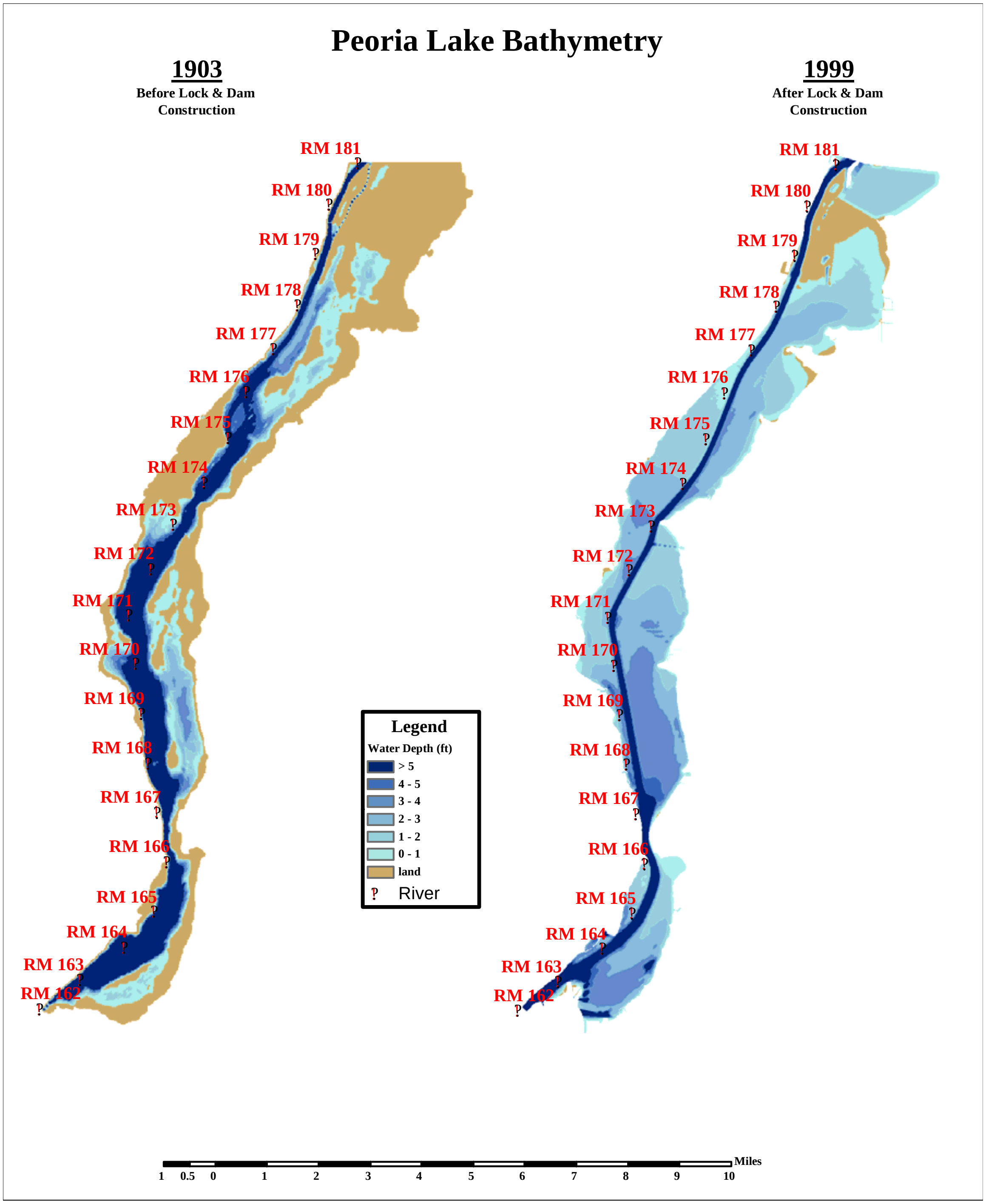


Figure 3-6. Peoria Lake 1-Foot Water Depth Contours
Note loss of numerous islands and side channels between 1903 and 1999. Also, water depths >5 feet currently are only found in the very narrow navigation channel. This loss of bathymetric diversity greatly limits the value of existing habitat within Peoria Lake.

The Corps of Engineers (2003a) conducted an analysis of the rate of loss of backwater capacity and surface area for three backwaters (Babb's Slough-Sawyer Slough, Meadow Lake, and Wightman Lake) in the Peoria Pool (table 3-12 to 3-14). This analysis was based on the comparison of 2001 bathymetry data to data from 1903. Sedimentation rates between 1903 and 2001 for these backwaters ranged from 0.18 inches/year to 0.37 inches/year and the percentage reduction in storage capacity varied from 77.2 percent (0.78 percent/year) to 97.0 percent (0.99 percent/year). In general, deeper areas have filled more quickly than shallow areas resulting in a higher and more uniform bottom surface in 2001 as compared to 1903. The annual rates of capacity loss and sedimentation calculated between 1903 and 2001 compare closely to rates calculated in other publications for the timeframe between 1903 to the mid 1970s, indicating that sedimentation rates and rates of annual percent capacity loss have remained nearly constant in the timeframe since 1975. These recent rates are higher than expected given that the bottom surface has been progressively rising, which would be expected to result in decreased rates of sedimentation. Water elevation duration curves for the 1903 through 1975 timeframe and the 1975 through 2001 timeframe show that more recent water flow rates and corresponding water surface elevations have been higher, promoting continued high rates of sedimentation.

Table 3-12. Change in Storage Capacity of Backwater Lakes [1]

	1903	2001	1903 to 2001	1903 to 2001
Backwater Lake	**Capacity (acre-feet)**	**Capacity (acre-feet)**	**Capacity Loss (%)**	**Capacity Loss (%/Yr)**
Combined Babb's and Sawyer Sloughs	4687	544	88.4	0.90
Meadow Lake	2080	37	97.0	1.00
Wightman Lake	2134	285	87.0	0.89

[1] Capacity based on elevation 440 msl

As would be expected, the changes in depth roughly mirror the loss in capacity (table 3-13). Depths have decreased dramatically, to the point where all four lakes average only a few inches.

Table 3-13. Change in Depth of Selected Backwater Lakes

	1903 [1]	2001	1903 to 2001
Backwater Lake	**Average Depth (feet)**	**Average Depth (feet)**	**Depth Loss (inches/Yr)**
Combined Babb's and Sawyer Sloughs	2.05	0.6	0.18
Meadow Lake	3.2	0.16	0.37
Wightman Lake	3.8	0.59	0.39

[1] 1903 capacity based on elevation 440 msl

The change in surface area has been somewhat less dramatic over time in all but one backwater. The percentage reduction surface area varied from 12.6% (0.13%/year) to 65.3% (0.67%/year) (table 3-14). It is likely that the rate of loss of surface area will increase in the future since little depth remains.

Table 3-14. Change in Surface Area of Selected Backwater Lakes

Parameter	1903 [1] Surface Area (acres)	2001 Surface Area (acres)	1903 to 2001 Surface Area Loss (%)	1903 to 2001 Surface Area Loss (%/Yr)
Combined Babb's and Sawyer Sloughs	2276	875	61.5	0.63
Meadow Lake	652	226	65.3	0.67
Wightman Lake	557	487	12.6	0.13

[1] 1903 capacity based on elevation 440 msl

ii. Side Channels and Islands. While considerably less documentation has been assembled on the side channel and island habitats of the Illinois River, a review of the Woermann Maps (1903) revealed the following estimates of 94 islands with a total length of approximately 75 miles (table 3-15). Since islands separate the main channel from side channels, the island length provides a rough estimation of the amount of side channel habitat.

Table 3-15. Estimated Historic Islands and Side Channels By Pool (Woerman 1903)

Pool	Number of Islands	Length in Miles
Dresden	4	1.5
Marseilles	12	4.5
Starved Rock	8	6.0
Peoria	23	14.5
La Grange	24	25.0
Alton	23	23.0
Total	**94**	**74.5**

b. Existing Conditions. The existing resource conditions related to backwaters and side channels were estimated using available data and are summarized below.

i. Backwaters. Due to the absence of recent survey data of backwater acreage and volume, existing backwaters conditions were estimated using the USGS 1989 Aerial Photo Interpretation. This dataset is the most recent fully analyzed and readily available information, but several features should be kept in mind when comparing these results to historic data.

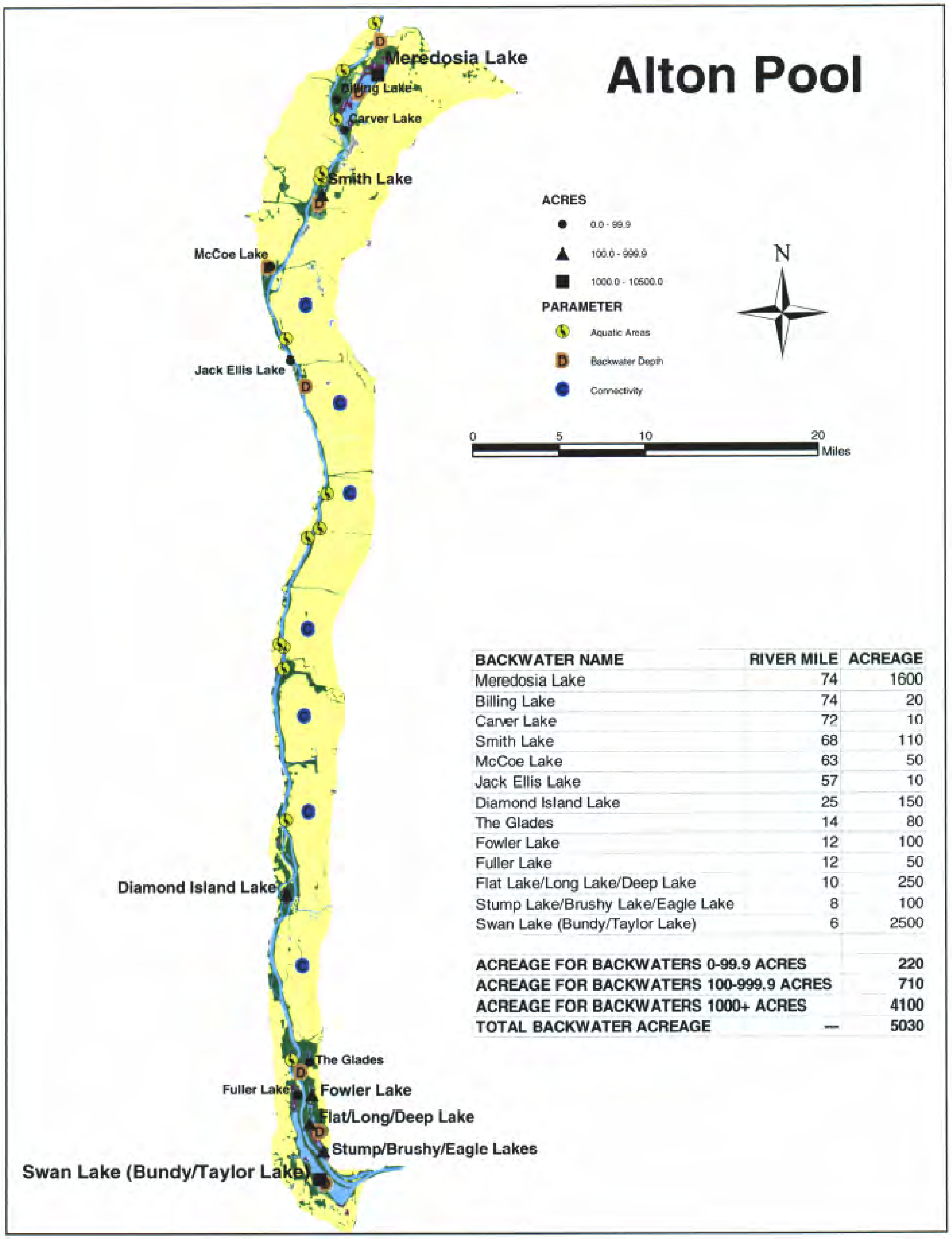
The analysis showed that in the three lower pools of the Illinois River there were approximately 54,000 acres of backwaters during summer low water periods. Table 3-16 and Figures 3-7, 3-8, and 3-9 show the numbers of backwaters and total acreage by pool.

Table 3-16. Estimated Existing Surface Acreage of Connected Backwater Areas
(USGS 1989 Aerial Photo Interpretation)

Reach	Number of Back waters	Surface Acres
Peoria Pool	32	30,325
La Grange Pool	46	18,537
Alton Pool	18	5,030
Total	**96**	**53,892**

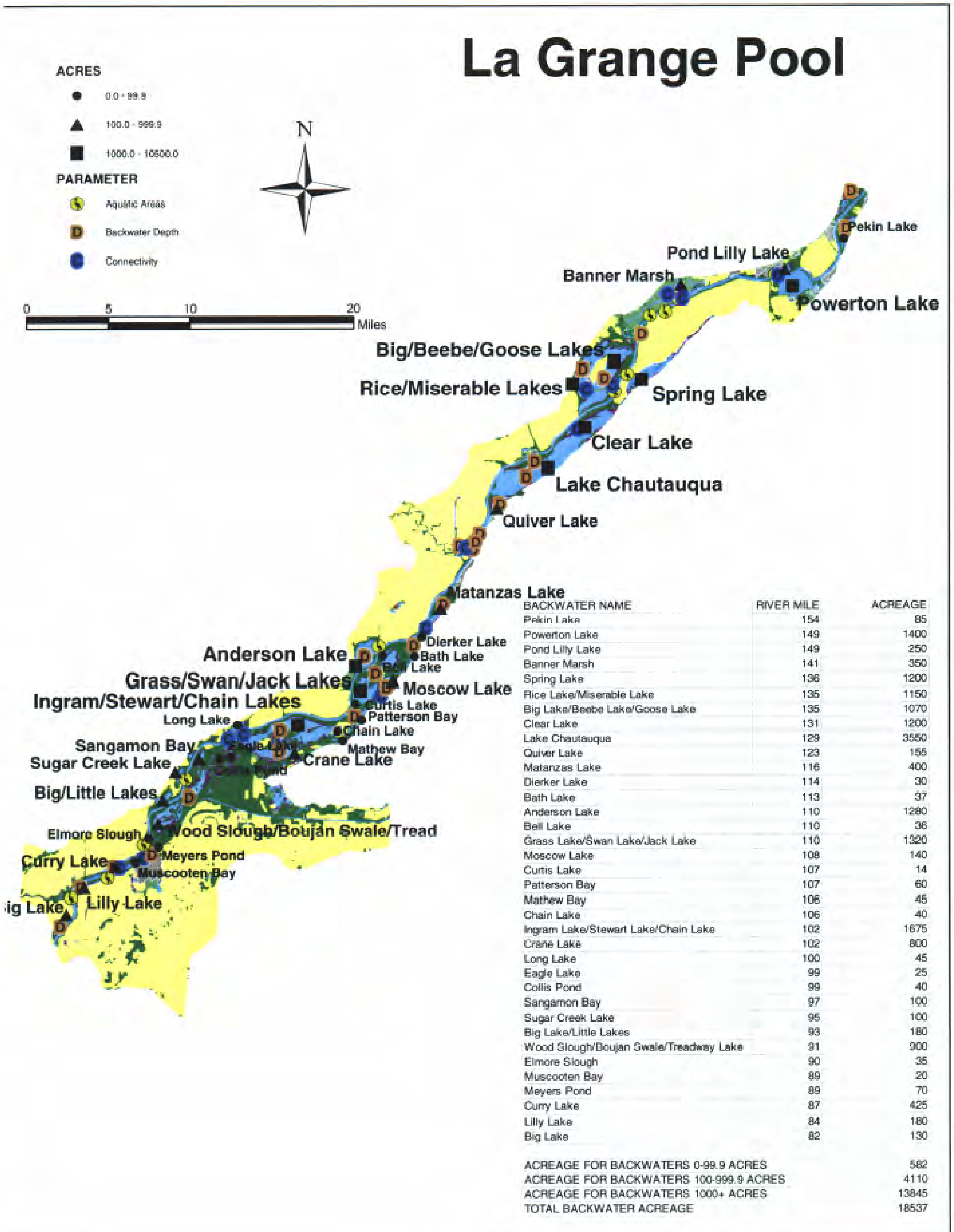
The current quality of the existing backwaters is low due to the relatively shallow depths (less than 1 foot) and relatively uniform bottom surface lacking depth diversity. The near absence of aquatic plants due to current water level regime, turbidity, and unconsolidated sediments further limits habitat values. Sediment accumulation has eliminated most deep water outside the navigation channel. This limits fish overwintering habitat to the channel, which is subject to year-round navigation and higher flow velocities.

Figure 3-10 shows the Upper Illinois River Basin backwaters and total acreage. Although this information is not directly comparable to historic measurements, it provides a baseline of relatively current conditions. While existing volumes for the system have not been surveyed in recent years, the four backwaters surveyed in 2001 and evaluated for filling rates since 1903 showed dramatic losses over time and losses continuing even in recent periods. These are believed to be fairly representative of other backwater areas.



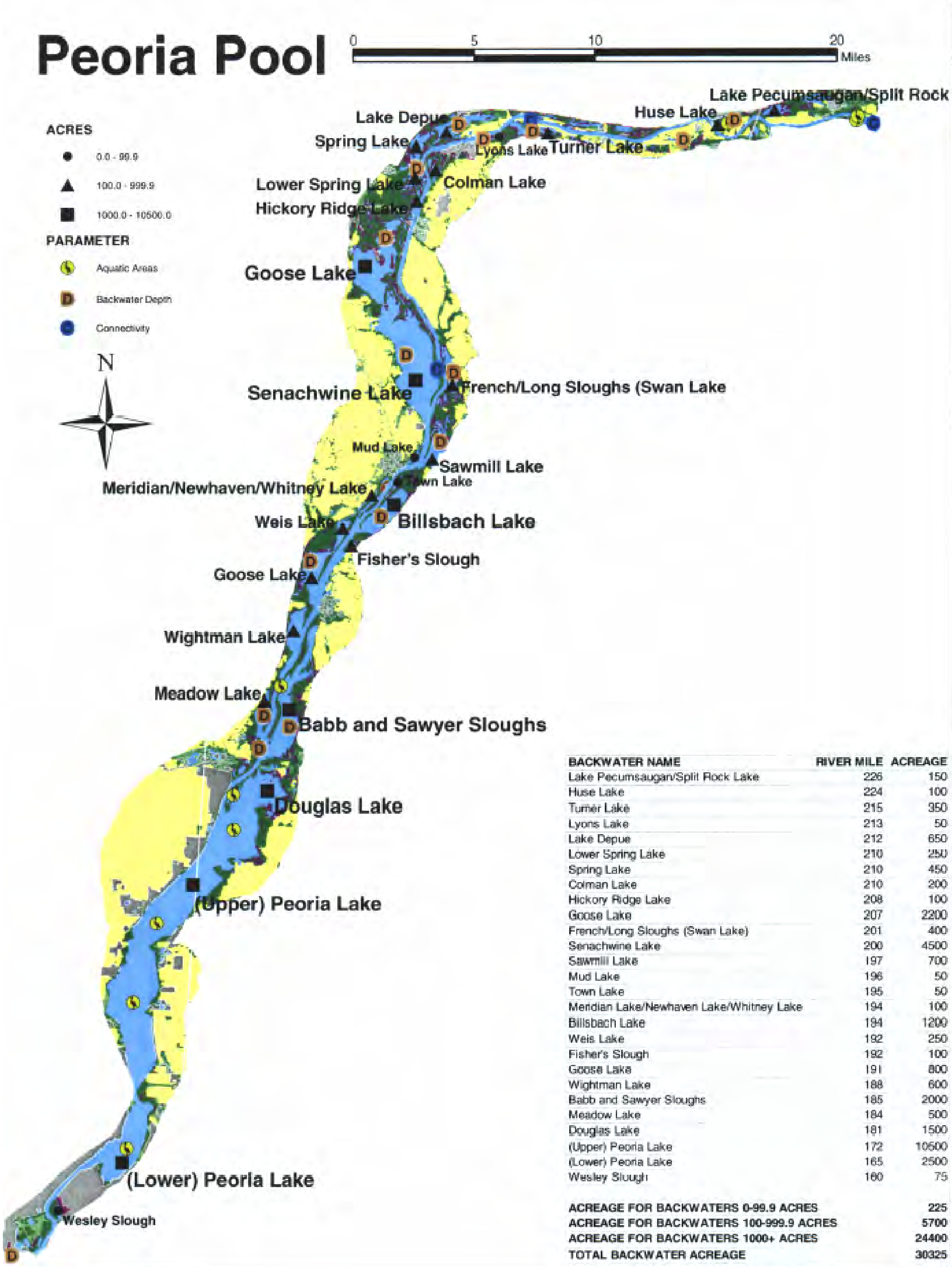
BACKWATER NAME	RIVER MILE	ACREAGE
Meredosia Lake	74	1600
Billing Lake	74	20
Carver Lake	72	10
Smith Lake	68	110
McCoe Lake	63	50
Jack Ellis Lake	57	10
Diamond Island Lake	25	150
The Glades	14	80
Fowler Lake	12	100
Fuller Lake	12	50
Flat Lake/Long Lake/Deep Lake	10	250
Stump Lake/Brushy Lake/Eagle Lake	8	100
Swan Lake (Bundy/Taylor Lake)	6	2500
ACREAGE FOR BACKWATERS 0-99.9 ACRES		**220**
ACREAGE FOR BACKWATERS 100-999.9 ACRES		**710**
ACREAGE FOR BACKWATERS 1000+ ACRES		**4100**
TOTAL BACKWATER ACREAGE	**---**	**5030**

Figure 3-7. Alton Pool Backwaters and Total Acreage



BACKWATER NAME	RIVER MILE	ACREAGE
Pekin Lake	154	85
Powerton Lake	149	1400
Pond Lilly Lake	149	250
Banner Marsh	141	350
Spring Lake	136	1200
Rice Lake/Miserable Lake	135	1150
Big Lake/Beebe Lake/Goose Lake	135	1070
Clear Lake	131	1200
Lake Chautauqua	129	3550
Quiver Lake	123	155
Matanzas Lake	116	400
Dierker Lake	114	30
Bath Lake	113	37
Anderson Lake	110	1280
Bell Lake	110	36
Grass Lake/Swan Lake/Jack Lake	110	1320
Moscow Lake	108	140
Curtis Lake	107	14
Patterson Bay	107	60
Mathew Bay	106	45
Chain Lake	106	40
Ingram Lake/Stewart Lake/Chain Lake	102	1675
Crane Lake	102	800
Long Lake	100	45
Eagle Lake	99	25
Collis Pond	99	40
Sangamon Bay	97	100
Sugar Creek Lake	95	100
Big Lake/Little Lakes	93	180
Wood Slough/Boujan Swale/Treadway Lake	91	900
Elmore Slough	90	35
Muscooten Bay	89	20
Meyers Pond	89	70
Curry Lake	87	425
Lilly Lake	84	180
Big Lake	82	130
ACREAGE FOR BACKWATERS 0-99.9 ACRES		582
ACREAGE FOR BACKWATERS 100-999.9 ACRES		4110
ACREAGE FOR BACKWATERS 1000+ ACRES		13845
TOTAL BACKWATER ACREAGE		18537

Figure 3-8. La Grange Pool Backwaters and Total Acreage



BACKWATER NAME	RIVER MILE	ACREAGE
Lake Pecumsaugan/Split Rock Lake	226	150
Huse Lake	224	100
Turner Lake	215	350
Lyons Lake	213	50
Lake Depue	212	650
Lower Spring Lake	210	250
Spring Lake	210	450
Colman Lake	210	200
Hickory Ridge Lake	208	100
Goose Lake	207	2200
French/Long Sloughs (Swan Lake)	201	400
Senachwine Lake	200	4500
Sawmill Lake	197	700
Mud Lake	196	50
Town Lake	195	50
Meridian Lake/Newhaven Lake/Whitney Lake	194	100
Billsbach Lake	194	1200
Weis Lake	192	250
Fisher's Slough	192	100
Goose Lake	191	800
Wightman Lake	188	600
Babb and Sawyer Sloughs	185	2000
Meadow Lake	184	500
Douglas Lake	181	1500
(Upper) Peoria Lake	172	10500
(Lower) Peoria Lake	165	2500
Wesley Slough	160	75
ACREAGE FOR BACKWATERS 0-99.9 ACRES		225
ACREAGE FOR BACKWATERS 100-999.9 ACRES		5700
ACREAGE FOR BACKWATERS 1000+ ACRES		24400
TOTAL BACKWATER ACREAGE		30325

Figure 3-9. Peoria Pool Backwaters and Total Acreage

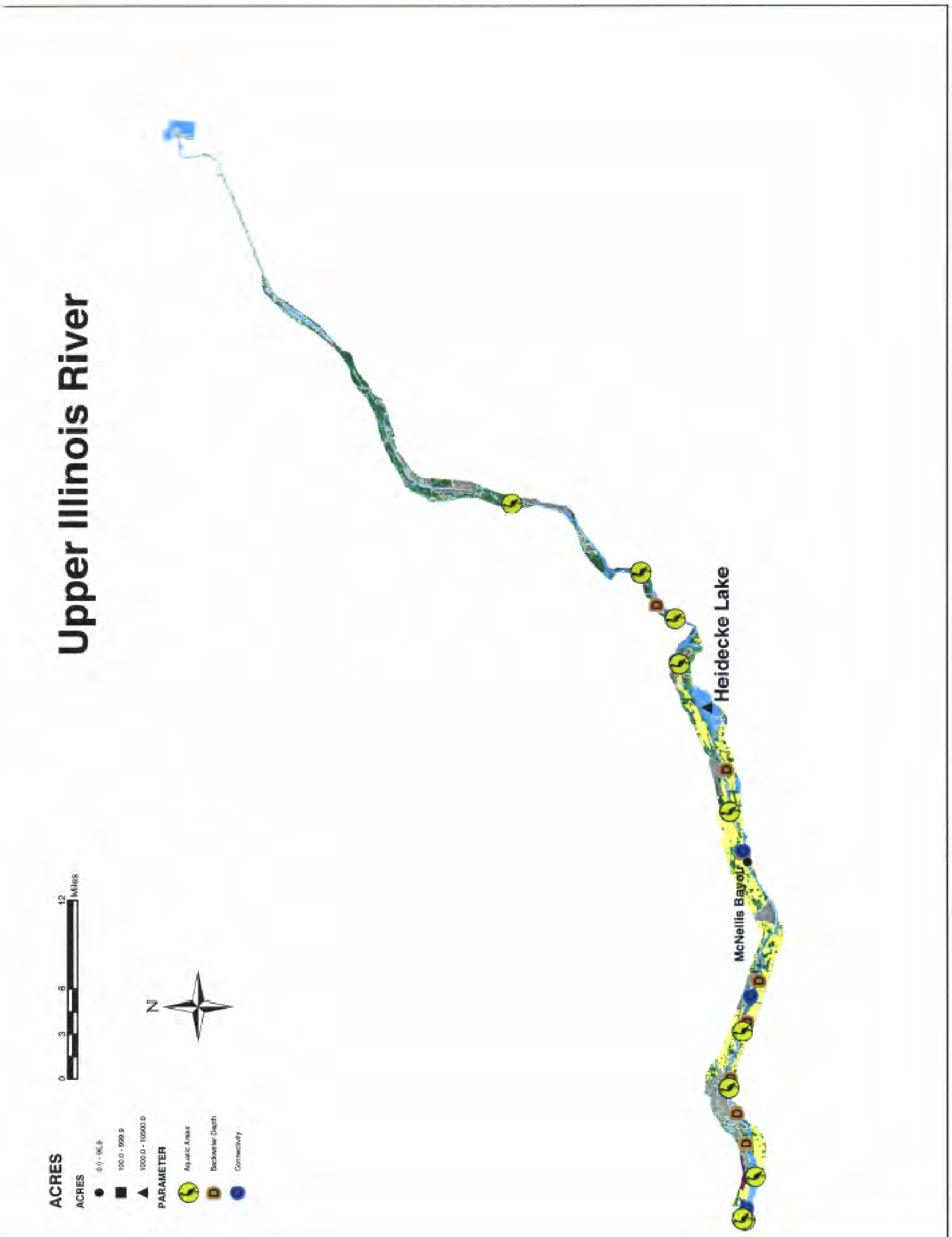


Figure 3-10. Upper Illinois River Backwater Acreage

ii. Side Channels and Islands. *A*reas sheltered from the main river flows provide beneficial resting habitat for aquatic animals. Islands often provide such protection to their side channels, so protection of side channel habitat is tied to the protection of islands. For this study, the amount of side channel habitat was estimated using the Illinois River Navigation Charts. Based on this information, there are approximately 57 islands on the Illinois River that create approximately 54 miles of side channel (table 3-17). While the size and shape vary considerably, on average Illinois River side channels are approximately 1 mile long with widths of roughly 100 feet. This current total represents a relatively dramatic decline from the 94 islands with a total length of approximately 75 miles in 1903. While increases in water level elevations associated with impoundments and diversion are likely a primary cause, it does point to concerns over continued loss.

Table 3-17. Estimated Existing Side Channels by Pool

Pool	Number of Side Channels	Length in Miles
Dresden	3	1.9
Marseilles	6	4.7
Starved Rock	5	5.0
Peoria	12	7.6
La Grange	13	17.7
Alton	18	17.2
Total	**57**	**54.0**

In 2001, Mike Cochran, Illinois DNR (retired), and T. Miller, USACE - St. Louis District conducted a detailed evaluation of the side channels and islands in Alton Pool, the 80 mile reach upstream of the mouth. They found that many of the side channels on the system still provide relatively good habitat value and some have depths reaching 6 to 15 feet. In particular, they found that 14 of 18 islands in Alton Pool (approximately 80 percent) required bank protection to reduce excessive island erosion and loss of island/side channel length. They also found 3 of 18 side channels (approximately 17 percent) filling with sediment to the point that the channels may close completely. The side channels in jeopardy of closing had been reduced to only a few feet of depth on average.

While not directly evaluated as part of the study, Corps of Engineers channel maintenance staff observe that the loss of side channel depths due to sedimentation is a much greater concern in the La Grange Pool. In general, the quality of side channels is diminished from historic levels due to loss of depth diversity and lack of aquatic structure, such as woody debris.

c. Future Without-Project Conditions. The future without geomorphic conditions were evaluated by WEST Consultants, Inc. (2000) as part of the Upper Mississippi River and Illinois Waterway Cumulative Effects Study. The following paragraphs summarize the findings of their evaluation:

> Overall, the future geomorphic conditions of the Illinois River are well defined. The geologic history of the Illinois River created conditions where sedimentation is and will continue to be the predominant geomorphic process. More sediment supplies from tributary areas are deposited within the river valley than are transported through it. However, the rate at which sediments are supplied to the Illinois River and sedimentation occurs is undoubtedly influenced by human activities, such as land use, water regulation, and dredging.

Most of the investigators of the Illinois River agree that significant sedimentation is occurring under current conditions and most backwater areas will be filled with fine sediment within the foreseeable future. According to Demissie and Bhowmik (1986), equilibrium between the sediment supply and transport out of Peoria Lake, the largest and deepest pool along the Illinois River, will be reached within the next few years. The navigation channel has not changed significantly in plan form over the period of record. Higher flow velocities and maintenance dredging along the channel effectively prevent significant change along its length.

In summary, according to previous studies, by the year 2050 the Illinois River is predicted to lose a significant portion of its off-main channel backwater areas under current conditions of sediment supply. The affected contiguous and isolated backwater areas are expected to convert to mud flats (photograph 3-2). The location and area of the main channel is expected to remain relatively constant with the exception that it will become more defined within the various pools along the Illinois River.

Photograph 3-2. Backwater Conversion to Mudflat During Low Water Conditions

i. Backwaters. In the without-project future, it is expected that there would continue to be further loss of both surface area and volume of backwaters and continued low aquatic habitat quality. This will further limit off-channel habitat for fish and other aquatic species. The following tables look at the potential loss of acreage based on various loss assumptions. The consensus of a number of scientists working for the State of Illinois was that due to the increasingly shallow condition of existing areas, even more rapid losses are expected in the future. This resulted in the estimation of a 1 percent loss rate per year as the most likely future condition. If this rate were to continue throughout the 50-year project life, the acreage of backwaters would drop to just 32,605 acres, or a 40 percent loss.

Table 3-18 shows the anticipated future backwater acreages assuming the 1 percent rate of loss and others.

Table 3-18. Estimated Future Without Surface Acres of Backwaters in 2054 at Low Water Conditions Assuming Various Annual Loss Rates of 1989 Area

		Future Without Estimated 2054 Acres			
Pool	**1989 Surface Acres**	**0.50% loss/yr**	**1% loss/yr**	**1.50% loss/yr**	**2% loss/yr**
Peoria Pool	30,325	23,602	18,347	14,243	11,043
La Grange Pool	18,537	14,428	11,215	8,707	6,751
Alton Pool	5,030	3,915	3,043	2,363	1,832
Total Lower 3 Pools	**53,892**	**41,945**	**32,605**	**25,313**	**19,626**

The physical quality of backwaters was also assessed as part of the evaluation process. The assessment was based on an evaluation of the physical parameters, topographic diversity, etc. and did not make assumptions regarding recolonization by aquatic plants, which is dependent on other systemic improvements. Despite continued sedimentation, the increasingly shallow areas are not expected to be able to establish marsh vegetation due to current levels of water level fluctuations, unconsolidated substrates, and turbidity. It was the consensus of an interagency panel that the existing backwaters, which average roughly 500 surface acres and in many cases a depth of less than 1 foot, have a very low level of quality during summer low water and overwintering periods (tables 3-19a and 3-19b). On a scale of 0 to 1, an interagency group rated existing backwaters as having an overall habitat value of 0.1 considering value to all species. This relatively low habitat value was estimated to decrease slightly over time to an estimated value of 0.07 in 50 years. Future habitat value was estimated assuming a 1.0% annual loss in habitat quality for years 1 through 25, and a 0.5% years 26 through 50.

ii. Side Channels and Islands. Some side channel areas are experiencing sedimentation and are anticipated to be lost in the future (approximately 17 percent in the Alton and Peoria Pools and greater in La Grange Pool). Another widespread threat to the side channels is their loss due to erosion of the protective islands photograph 3-3). Based on data collected as part of this study, it is anticipated that without any action some continued loss of side channel length will occur at the rate of approximately 0.25 percent per year if it follows trends from 1903 to the present. This would result in a loss of approximately 6.5 additional miles of side channel habitats if no action were taken (table 3-19).

In the future without, it is anticipated that the quality of side channel areas will continue to remain at relatively low levels. In many areas, there will continue to be further losses of depth diversity due to sedimentation and a lack of adequate structure (woody debris, rock, etc.).

d. Desired Future Conditions. The desired future conditions or objectives resulted from a series of interagency meetings aimed at identifying the restoration needs of the system. The restoration needs were determined largely by looking at the likely future without-project conditions and assessing needs to restore aquatic habitats for fish spawning, nursery, and overwintering habitats.

Photograph 3-3. Erosion of Upstream End of Illinois River Island

Table 3-19. Estimated Future Without Miles of Side Channels in 2054 Given an Approximate Annual Loss Rate of 0.25% Loss/Year

Name	Current Miles	Estimated Miles in 2054
Dresden	1.9	1.7
Marseilles	4.7	4.1
Starved Rock	4.95	4.4
Peoria	7.6	6.7
La Grange	17.7	15.6
Alton	17.15	15.1
Total	**54**	**47.6**

The backwater restoration objective of restoring 19,000 acres had previously been identified in the Habitat Needs Assessment. An interagency team assessing the restoration needs of the entire Upper Mississippi River System, including the Illinois River, conducted the assessment and set the restoration target. Resource managers further identified a general target of depths for backwater restoration by recommending the following distributions of depths: 5% >9 feet; 10% 6 to 9 feet; 25% 3 to 6 feet; and 60% < 3 feet. Since virtually all areas are currently less than 3 feet, restoration of the 19,000 acres could be focused on restoring the relative depth diversity associated with the other three depth categories.

One of the major concerns on the river system is the potential loss of connected off-channel areas. The desired future includes the restoration and maintenance of side channel habitats and the maintenance of all existing connections between backwaters and the main channel (connections at the 50 percent exceedance flow duration).

Backwater restoration success is also related to the quality of sediments. Options should be explored to compact sediments or remove unconsolidated material to improve substrate conditions for aquatic plants, fish, and wildlife. Due the potential for substantial amounts of dredging, additional beneficial uses of sediment should be investigated.

2. Formulation of Alternative Plans

a. Approach/Assumptions. The formulation of alternative plans involves identifying measures and creating alternative plans by using combinations of measures. A range of alternative plans was developed to look at potential ways to reach the desired future conditions identified in the study process. The approach for backwaters included the use of an expert panel to incorporate an assessment of area (including predicted loss rates) and quality into the assessment of various options. The assessment of side channels and island protection focused more directly on various levels of effort associated with previously identified cost-effective approaches to restoration. The formulation of measures and alternatives for the restoration of backwaters and side channels was aided considerably by the fact that a number of projects were previously evaluated and constructed in the Midwest.

b. Criteria and Constraints. The following criteria and constraints were developed for consideration in future issues associated with implementation. The following criteria should be refined and utilized during the implementation process to best identify locations for restoration:

- Proximity to other high quality areas.
- Geographic spacing to maximize benefits to river system should be approximately every 5-10 miles to support fish populations.
- Site selection and design should consider sustainability and anticipated sedimentation rates for particular backwaters and effects of direct tributaries.
- Availability of placement areas near site (land based, island creation, shipments).
- Maintain desirable water quality (DO, turbidity, temperature, ammonia).
- Design projects for habitat diversity (including a range of depths, structure, and plant and animal communities).

The following constraints, which could limit restoration success, were identified:

- Continued excessive sediment delivery and sedimentation.
- Cost limitations of Federal and State partners.
- Corps traditional approach to projects with one time construction and then sponsor O&M. Adaptive management/continuing construction may be needed to make restoration viable.
- Resuspension of sediments by wind, wave action, and rough fish.
- Time – need action soon or additional areas may transition from aquatic to terrestrial.
- Placement locations for material removed.
- A final legal determination has not been made as to the ownership of submerged lands in the Illinois River Basin.
- Potential for areas to contain contaminated sediments.
- Project life.
- Placement in floodplain cannot affect flood heights.
- Habitat values may continue to be limited by other factors (e.g., potential for continued limitations in aquatic plant due to effects of water level fluctuations and turbidity).

c. Measures. The first step in the formulation process was to identify the range of measures to be investigated. Measures were separately identified for backwaters and side channels and are presented in this section. A key consideration in the selection of measures was sustainability. Due to the nature of the system, no backwater dredging will be fully sustainable, instead the intent is to restore habitats in ways that maximize sustainability. Although the descriptions of measures below are relatively generic given the system aspects of the study, the specifics of measures used in implementation will be based on lessons learned from previous projects, analysis using models, and monitoring and adaptive management. These types of information will be used to maximize the sustainability and cost effectiveness of the projects.

Examples of sustainable design considerations include:

- locating dredge cuts away from sediment sources (i.e. tributaries) and secondary channels;
- reducing the sediment load to the dredge cuts by reducing the inflow of sediment-laden water;
- altering local hydrodynamic conditions so that sediment is transported through and out of dredge cuts (addition of rock or timber structures, etc.);
- constructing islands to reduce sediment resuspension due to wind-driven wave action;
- establishing a reoccurring dredging cycle for implementation as a way to address ongoing sedimentation and maintain areas with firm substrates, and
- arranging features to slow conversions of habitat types (i.e. increased depth closer to bank to slow conversion to terrestrial habitats and plant colonization moving in from edges).

i. Backwaters

Sediment Removal (Dredging). The study team looked at various scales of potential restoration for particular backwaters. Based on desires for increased depths, the restoration levels were based on varying percentages of dredging. For restored backwaters, a general target identified by resource managers to provide more optimal habitat for a wide range of species would be to have the following distributions of depths: 5% >9 feet; 10% 6 to 9 feet; 25% 3 to 6 feet; and 60% < 3 feet. For formulation purposes, an average size of 500 acres was assumed per backwater (calculated based on acreage and number of backwaters), but the information is applicable to all sizes based on a percentage basis. The approximate costs are based on a 500 acre backwater lake.

- Level 1 - Dredge 2% - Maintain connection to main stem and create deep entrance channels estimated cost $910,000
- Level 2 - Dredge 10% - Configuration approximating ¼ targets established in objectives estimated cost $4.9 million
- Level 3 - Dredge 20% - Configuration approximating ½ targets established in objectives estimated cost $9.6 million
- Level 4 - Dredge 40% - Configurations following general target established in objectives estimated cost $19.6 million
- Level 5 - Dredge 60% - Configuration exceeding targets established in objectives estimated cost $29.5 million

Sediment Placement. Various placement options follow. However, due to the system scale of the analysis, specific differences were not calculated. It is further assumed that the actual placement option chosen will vary based on site-specific conditions related to placement opportunities and costs. Cost estimates for placement are included with the dredging costs shown above, for placement options near the dredging, additional costs would be incurred for placement options more removed from the dredging area.

- On existing islands (increase elevations in selected areas to increase vegetation diversity and potential for mast trees)
- Creation of new islands (create habitat and potentially reduce sediment resuspension from wind and waves)
- On adjacent agricultural lands
- Beneficial reuse on brownfields, former mined lands, stockpile, gravel pits, etc.

Technologies

- Hydraulic, mechanical, and high solids dredging
- Dewater backwater areas and use conventional equipment
- Reconnect currently isolated backwater areas that have adequate depth

Construction Approach

- Traditional staging (one backwater at a time)
- Multiple backwaters at one time
- Continuous construction (ongoing construction/O&M to address sedimentation)

ii. Side Channels and Islands

Protect Islands. Based on the analysis of Alton Pool that highlighted the loss of island/side channel length, some measures were proposed that would protect the upstream ends and banks of existing islands to maintain and possibly restore some of their historic length. Rock off-bank revetments are more costly, as shown by the cost data for an average 2,100 foot section (protecting 20 percent of the perimeter of a typical 1 mile long island). However, they create unique habitat conditions between the revetment and island. Habitat benefits would be used to evaluate their cost versus benefit relative to the other measures.

- Rock Off-bank revetments – cost estimate $2 million per island.
- Rock Bank protection – cost estimate $745,000 per island
- Timber Off- bank revetments **–** cost estimate $675,000 per island

Create Varying Depths/Maintain Scour. Other options to restore some of the historic depth diversity; to help maintain deep holes and areas for fish; and increase the sustainability of side channels following potential dredging activities included the following types of wood and rock structures that could be placed in side channel areas. Assumes the need for 7 structures per average side channel (approximately 1 mile long). Estimated cost is $127,000 for structures in one side channel.

- Stub dikes/wing dams
- Log piles
- Pile dikes
- Notching existing closing structures

Dredge. In side channel areas that are experiencing sedimentation, typically only a portion is most heavily affected by sediment. It is estimated that in many cased, dredging would only be required for approximately 1/3 of the side channel length to restore historic flow and off-channel aquatic conditions. The estimated cost assuming the dredging of a 1/3 mile, 6 foot deep, 50 foot wide channel was $265,000 per side channel.

d. Alternatives. The following section reviews and discusses the various alternatives developed for the backwater and side channel alternatives.

i. Backwaters. Two interagency assessment meetings were held on May 22 and June 10, 2003, to study backwaters and side channels in detail. The study team looked at various levels of potential restoration for particular backwaters. The levels were based on varying percentages of dredging. For formulation purposes, an average size of 500 acres was assumed per backwater, but the information is applicable to all sizes based on a percentage basis.

Two areas of primary concern in evaluating the levels were assumptions regarding changes in quantity (acreage) and quality (index values). The following tables relate the assumptions developed regarding changes in quantity and quality assuming a one-time construction sequence. Ongoing construction or active operation and management activities would allow the project to remain at levels similar to year 0 throughout the project life.

Losses in the surface acreage of backwaters were anticipated to be 1 percent loss per year. This was based on observations of the historic loss of backwater volume and area. Level 1, dredging of 2 percent (10 acres of a 500-acre backwater), was assumed to make no measurable change in the rate of loss. The other more extensive levels of dredging 10 to 60 percent of lake area, would have a progressively greater effect on reducing the rate of loss assuming proper configuration. Table 3-20 shows the loss rates assumed to be associated with the proposed restoration levels.

Table 3-20. Assumptions on Backwater Acreage Loss Over Time

	Backwater Areas			
Proposed Level	**Year 0**	**Year 25**	**Year 50**	**Assumptions**
Without-Project	500	389	303	1.00%/year loss
Level 1	500	389	303	1.00%/year loss
Level 2	500	414	343	0.75%/year loss
Level 3	500	441	389	0.50%/year loss
Level 4	500	455	414	0.38%/year loss
Level 5	500	470	441	0.25%/year loss

Note: Example is for a 500-acre backwater

Assessments of quality were made using a physical quality index (PQI). Index values range from 0 to 1, with 0 representing no valuable habitat and 1 optimal habitat. This approach is similar to the U.S. Fish and Wildlife Habitat Evaluation Procedure (HEP) developed to estimate the quality of habitat areas. The index values used for the study were determined by expert opinion of resource managers and scientists with experience in fisheries, waterfowl, wildlife, wetlands ecology, hydrology and sedimentation for the without-project and all levels 1-5 for year 0 (immediately following construction).

A simplified approach to estimate quality was used based directly on the proposed physical footprint. It was agreed that the physical quality index would only assess the physical configuration of the backwaters in terms of configurations of habitat (depth and diversity) to maximize value and use by a broad range of plant, fish, and wildlife species. This assessment is a simplification, since actual quality depends on numerous factors: temperature, dissolved oxygen (DO), plant communities, etc.. However, this approach is appropriate, since the dominate process affecting backwaters along the Illinois River is sedimentation. In many cases, the other factors will benefit directly from dredging and show similar trends. Fore example, as larger areas are restored with greater depths more desirable temperatures are anticipated. In other cases the quality can be affected at similar costs for various alternatives, such as introducing some flow to increase DO, etc.

The optimal level of restoration, a value of 1, was assigned to level 4 in year 0. This represents the target established to maximize backwater habitat benefits by providing the following distributions of depths: 5% >9 feet; 10% 6 to 9 feet; 25% 3 to 6 feet; and 60% < 3 feet. Since in most of the cases all of the backwater areas are less than 3 feet deep, actual restoration activities would only need to address the 40 percent targeted for deeper depths. For example, taking a 500-acre backwater, work under level 4 (dredging 40 percent or 200 acres) would result in dredging approximately 25 acres >9 feet, 50 acres 6 to 9 feet; 125 acres 3 to 6 feet; and the 300 acres already less than 3 feet would be minimally affected. It should be noted that while level 5 exceeds the target and as such had a lower PQI in year 0, it actually improves over time as sedimentation brings it closer to the desired configuration. The PQI for all subsequent years was calculated based on assumed changes in quality over time (table 3-21shows year 25 and 50 values). It was felt that for all levels the rate of loss would be highest in the years immediately following construction due to initial sedimentation. This matches observed changes in completed dredging projects where the sedimentation rates were greatest in the years immediately following construction. Ongoing dredging through operation and maintenance could be utilized to eliminate or reduce loss in quality over time.

Table 3-21. Assessment of Physical Quality and Changes Over Time

	Physical Quality				Loss Rate/Yr	
Quality	**Year 0**	**Year 25**	**Year 50**	**Loss Assumption**	**Years 1 - 25**	**Years 25 - 50**
Without-Project	0.1	0.08	0.07	Slow reduction	1.00%	0.5%
Level 1	0.11	0.08	0.07	Slow reduction	1.25%	0.5%
Level 2	0.3	0.18	0.14	Higher rate	2.0%	1.0%
Level 3	0.5	0.30	0.23	Higher rate	2.0%	1.0%
Level 4	1.00	0.60	0.47	Higher rate	2.0%	1.0%
Level 5	0.8	0.76	0.59	Higher rate	2.0%	1.0%

Assume sedimentation rates of 2 in/year in first 25 years, approximately 50 inches.
Assume sedimentation rates of 1 in/year in years 25-50, approximately 25 inches.
Level 5 - 11.5 years to get to 1.00, then decreases at rate of others.

Regarding the physical quality index, the study team was not able to identify a system threshold in terms of total acreage needs based on limited data and system understanding. As a result, the full benefits associated with the restoration of each backwater were applied to varying numbers of backwaters on the system without decreasing benefits, fixed at a maximum of 60 backwaters previously identified by resource managers.

Table 3-22 summarizes the alternatives developed for the backwater analysis. The table relates the number of backwaters to be restored in each level category and summarizes the total acreage to be dredged. For example, Alternative 2A is composed of dredging 60 backwaters to level 1 (2 percent) for a total dredging acreage of 600 acres. This level would involve only limited dredging (averaging 10 acres per backwater) in a large number of areas as a way to maintain the low water connections with the main stem and wide distribution of minimal areas for overwintering. Alternative 3B is composed of combinations of four levels (10 - Level 1; 5 - Level 2; 2 - Level 3; and 3 - Level 4), for a total dredged area of 1,150 acres. The number of backwaters included in the alternatives were formulated in consideration of a past restoration analysis that identified roughly 60 backwaters in need of restoration.

The maximum number of backwaters to address was set at 60 with some alternatives addressing less. The analysis also considered the resulting spacing and the desire for high quality backwater areas every 5 to10 miles. The total number of backwaters included in each of the alternatives 2A to H is shown in table 3-22.

Table 3-22. Backwater Alternatives – Number of Backwaters by Level and Total Acres Dredged

	Number of Backwaters by Category						
Alternative	**Level 1 2%**	**Level 2 10%**	**Level 3 20%**	**Level 4 40%**	**Level 5 60%**	**Total Number of Backwaters**	**Total Acres Dredged**
2A	60	0	0	0	0	60	600
2B	10	5	2	3	0	20	1,150
2C	5	5	5	5	0	20	1,800
2D	10	10	10	10	0	40	3,600
2E	10	20	10	20	0	60	6,100
2F	10	10	0	40	0	60	8,600
2G	0	0	0	60	0	60	12,000
2H	0	0	0	0	60	60	18,000

The costs for the various alternatives are shown in table 3-23. No costs were included for operation and maintenance because approximately 2 feet of overdredging was included and as a result anticipated sedimentation rates will not require additional dredging within the project horizon.

An analysis was made utilizing the estimates of quality and acreage loss over time (table 3-24). For the analysis, it was assumed that implementation of the alterative would take 50 years. As a result, 2 percent of the total restoration was implemented in any given year. The results of this analysis show that for all alternatives, year 0 or the current condition is the existing approximately 55,000 acres and a relatively low quality of 5,500 units (55,000 acres times the quality index value of 0.1). In the without-project condition, acreage is anticipated to be lost at a rate of 1 percent, resulting in 33,275 acres remaining in year 50. The total quality would also be reduced to 2,329 units (33,275 acres multiplied by the reduced quality index value of 0.07). The various alternatives show different reductions in the rate of conversion of backwaters and in many cases dramatic increases in quality based on the number and amount of restoration projects associated with the alternative plan.

For example, the backwater quality units are estimated to be approximately 10 times greater for Alternatives 2G and 2H in year 50, approximately 19,000 – 23,000, versus a value of closer to 2,300 for the without-project.

The values calculated for Alternatives 2A to 2H reflect a gradual 2 percent annual rate of construction of the total restoration proposed. For example, the analysis of Alternative 3G assumed restoration of 12,000 acres over 50 years, 600 acres per year. As the various acreage was restored a higher value of 1.0 was assigned to the restored backwater complexes following construction. The backwater acreage and index value were then lowered following the anticipated loss rates identified by the expert panel.

Table 3-23. Cost of Backwater Restoration Alternatives

Alternative	First Cost Construction 35% Contingency	Planning, Engineering, And Design 30%	Supervision and Administration 9%	Real Estate [1]	Total First Cost
2A	$36,603,000	$10,981,000	$3,294,000	$3,655,000	$54,533,000
2B	$75,173,000	$22,552,000	$6,766,000	$6,988,000	$111,478,000
2C	$117,833,000	$35,350,000	$10,605,000	$10,946,000	$174,734,000
2D	$235,666,000	$70,700,000	$21,210,000	$21,892,000	$349,469,000
2E	$400,823,000	$120,247,000	$36,074,000	$37,053,000	$594,196,000
2F	$567,067,000	$170,120,000	$51,036,000	$52,165,000	$840,389,000
2G	$791,621,000	$237,486,000	$71,246,000	$72,791,000	$1,173,145,000
2H	$1,194,296,000	$358,289,000	$107,487,000	$108,927,000	$1,768,999,000

[1] Real Estate costs do not include acquisition or appraisal costs.

Table 3-24. Summary of Acreage and Physical Quality by Alternative

	Year 0		Year 25		Year 50	
Alternative	Area (ac)	Total Quality	Area (ac)	Total Quality	Area (ac)	Total Quality
2-0	55,000	5,500	42,780	3,422	33,275	2,329
2A	55,000	5,500	42,780	3,622	33,275	2,682
2B	55,000	5,500	42,890	4,315	33,673	3,736
2C	55,000	5,500	42,964	4,874	33,942	4,618
2D	55,000	5,500	43,148	6,326	34,609	6,907
2E	55,000	5,500	43,383	8,432	35,458	10,231
2F	55,000	5,500	43,521	10,766	35,976	14,011
2G	55,000	5,500	43,793	13,831	36,978	18,926
2H	55,000	5,500	44,008	15,237	37,810	22,642

The benefits of the various alternatives were further evaluated by looking at the incremental improvements over the without-project condition and the associated costs, summarized in table 3-25. This analysis revealed that considerable total acreage would be preserved by many of the alternatives ranging from 398 acres with Alternative 2B (33,673 acres in year 50 versus 33, 275 acres in year 50 without the project) to 4,534 with Alternative 2H. This is associated with the fact that restoration activities will slow conversion of many areas to terrestrial habitats. More dramatic than the preservation of backwater acreage is the estimated increase in average annual quality of the remaining acreage. This is generally related to the fact that due to dredging activities remaining acreages will have greater depth and more habitat value and function. The figures in table 3-25 show the average annual amounts, which are the average values over the entire 50-year period of analysis.

Table 3-25. Summary of Incremental Acreage and Physical Quality Changes, Average Annual Total Quality, and Costs by Alternative

	Benefits			Costs ($1,000)	
Alternative	**Area, Year 50 (ac)**	**Total Quality, Year 50**	**Average Annual Total Quality**	**Cost Implementation**	**Cost per Average Annual Quality Unit**
2-0				-	
2A	0	353	185.1	$ 54,500	$294
2B	398	1,407	840.7	$111,500	$133
2C	667	2,289	1,370.2	$174,700	$128
2D	1,333	4,578	2,740.4	$349,500	$128
2E	2,183	7,902	4,730.2	$594,200	$126
2F	2,701	11,681	6,955.6	$840,400	$121
2G	3,702	16,596	9,869.8	$1,173,100	$119
2H	4,534	20,313	11,331.3	$1,769,000	$156

As the analysis shows, the most cost-effective alternative in terms of average annual total quality was 2G. This plan was composed of 60 backwaters restored to the level 4 effort. Based on the assumptions above, a large number of alternatives were run. In general, levels 2 (10 percent), 3 (20 percent), and 4 (40 percent) are relatively equally cost effective. Levels 1 (2 percent) and 5 (60 percent) were less effective. Level 1 did not provide a large enough area of effect to significantly improve the backwater as a whole. Also, based on the small area and proximity to the channel, it would experience relatively rapid loss of much of its depth. Level 5 provided deep-water areas in excess of the optimal targets. This, in essence, represents significant over dredging. While it does provide for higher quality in future years than the other levels, it was not as cost effective.

Traditional cost effectiveness and incremental cost analysis was also preformed on the alternative utilizing Institute of Water Resources (IWR) – Plan software. As figures 3-11 and 3-12 indicate, all plans were cost effective, but cost effectiveness increased and was greatest for plans 2G to 2H Cost effectiveness means that for a given level of benefit, no other plan costs less, and no other plan yields more output for less money. Only alternatives 2G and 2H were identified as best buy plans, which provide the greatest increase in output for the least increase in cost, and received further analysis using incremental analysis.

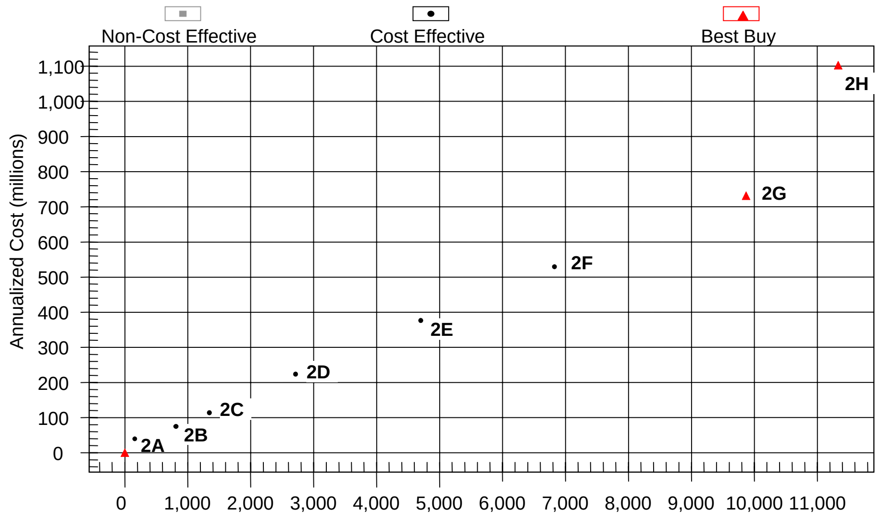


Figure 3-11. Cost Effectiveness of Backwater Restoration Alternative Plans

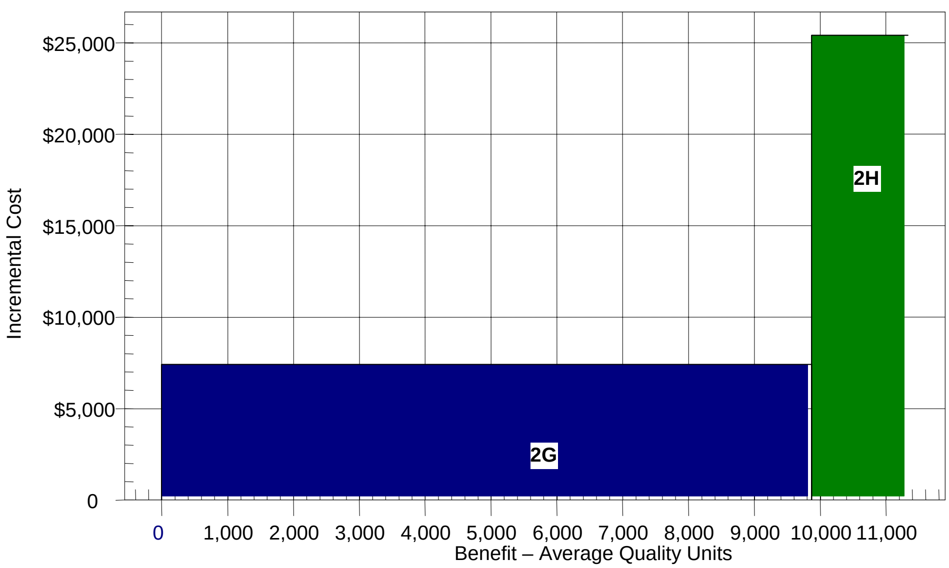


Figure 3-12. Incremental Analysis of Best Buy Plans (Acres of Benefit)

In addition to the analysis of total quality, further analysis was completed to better define the direct and indirect benefit areas. It is widely recognized that the benefits of restoring deep water habitat extend well past the actual dredging footprint. Research has shown benefits to surrounding backwater areas as well as up to a five mile reach of the main stem (Iowa DNR 2000 and Iowa DNR 2003). This is based the travel area of various fish species, which utilized backwaters for spawning, nursery, and overwintering habitat. The areas estimated below are the total indirect benefit area. In these areas the habitat suitability would be improved to varying degrees as a result of the restoration projects. For this analysis the maximum benefit area of an average backwater restoration project was limited to the entire 500 acre backwater, plus up to a five mile reach of the main stem or approximately 515 acres of main stem area (based on an average width of 850 feet). As a result an optimal backwater restoration project could have an indirect benefit area of up to 1,015 acres. The amount of this benefit area associated with each alternative was calculated by multiplying the number of backwaters being worked on, times the percent of the average annual total quality attained by the alternative, times the potential backwater and main stem area. The total backwater and main stem areas where then added together to provide the total indirect benefit area (table 3-26).

ii. Side Channel and Islands Alternative

The study team looked at various scales of potential restoration for side channels and islands. The scales were based on varying amounts of restoration features. For conceptual discussions, a typical 1-mile-long side channel and island was used, but the information is applicable to all sizes based on a percentage basis. Side channel and island widths vary considerably, but average roughly 100 feet.

Island Protection. Island erosion is a natural process that characterizes dynamic rivers; however, it is a problem when it damages important habitats (forested islands and side channels) or archeological resources or under conditions where it occurs at an unsustainable rate (additional natural island creation activity is not keeping pace). Along the Illinois River, island erosion is exacerbated by commercial and recreational boats and by wind-generated waves and in many areas islands are being lost and not replaced by natural processes.

The primary source of information for the analysis was the detailed evaluation of the side channels and islands in Alton Pool, the 80-mile reach upstream of the mouth, conducted by Mike Cochran, Illinois DNR (retired), and T. Miller, U.S. Army Corps of Engineers - St. Louis District. This information was then extrapolated to the rest of the system with the assistance of Rock Island District channel maintenance staff.

Based information from the analysis, restoration measures were proposed for protection of approximately 20 percent of the island perimeter of actively eroding islands to reduce erosion, maintaining island and side channel length. Protection of 20 percent would result in protection of approximately 2,100 feet per average island. Options included constructing these structures from rock as off-bank revetments or bank protection or as timber piles revetments, or a combination of both. For cost purposes, an average of all three costs was utilized. Habitat analysis and adaptive management will be used as part of the site evaluations to determine which of the three methods is preferred.

The protection of existing islands was identified as a relatively low-cost method to maintain existing habitats and avoid future losses of both island and side channel habitats. Island protection projects using off-bank revetments could also provide unique aquatic habitats between the revetments and islands. An additional benefit to the system would be reduced sediment delivery to the river from the island erosion. While island protection would help to reduce sediment delivery to the system, islands are not considered a major source of sediment to the system. As a result of the relative low cost and benefits, just two levels were formulated that would restore a significant portion of the sites identified as degrading/needing protection. Table 3-27 summarizes information on the number of islands protected and the costs involved.

Table 3-26. Summary of Total Benefit Area of Backwater Restoration Projects

Alternative	Number of Backwaters	AA Total Quality	% Quality	Benefit Area Backwaters	Benefit Area Main stem	Total Benefit Area	Cost $1000s	Cost Per Acre
3A	60	185	0.02	90	505	995	$54,500	$54, 800
3B	20	841	0.07	742	764	1,506	$111,500	$74,000
3C	20	1,370	0.12	1,209	1,246	2,455	$174,700	$71,200
3D	40	2,740	0.24	4,837	4,983	9,820	$349,500	$35,600
3E	60	4,730	0.42	12,523	12,903	25,426	$594,200	$23,400
3F	60	6,956	0.61	18,415	18,973	37,388	$840,400	$22,500
3G	60	9,870	0.87	26,130	26,922	53,053	$1,173,100	$ 22,100
3H	60	11,331	1.00	30,000	30,909	60,909	$1,769,000	$29,000

Table 3-27. Potential Island Protection Alternatives

Alternative	Number of Islands Protected	Construction	Real Estate [1]	Total First Cost	Annual O&M
2M	10	$11,449,000	$128,000	$11,577,000	$12,000
2N	15	$17,174,000	$192,000	$17,366,000	$18,800

[1]Real Estate costs do not include acquisition or appraisal costs

The actual direct and indirect benefit area was also calculated to provide an estimate of the area of island and side channel restored by the project. Three separate types of areas would benefit from island protection: reduced loss of island habitat, reduced loss of side channel (which would be lost if the island was eliminated), and reduced loss of habitat value of main channel and main channel border habitats that benefit from proximity to side channels.

The acreage benefits were estimated for a generic island project. However, a detail analysis of the specific individual projects will be undertaken as each site is investigated. The average Illinois River island is approximately 12.1 acres (1 mile long by 100 feet wide) as are the side channels. Based on loss rates over the past 100 years, islands are eroding at a rate of approximately .25 percent per year system-wide. For this analysis it was assumed that since a number of islands are stable, and projects would focused on the most actively eroding, a 1 percent loss rate per year was used. The following table summarizes the benefit areas including the area of island and side channel that would be lost. Based on the 1 percent loss rate approximately 7.7 acres of island and 7.7 acres of side channel would be lost at each proposed site if no action were taken. This would also result in a proportional loss of associated main channel benefits. Other study efforts in the Midwest have estimated the main stem benefit area of a side channel at approximately 100 acres of surrounding main channel and main channel boarder habitats. Based on a loss of 7.7 acres of a 12.1 acre side channel (63.4 percent loss) the loss of surrounding main stem habitat would be 63.4 acres. In total, an island restoration project would benefit approximately 788 acres. Table 3-28 summarizes the total benefit areas for the two alternatives as well as the average annual cost per acre restored.

Side Channel Restoration. In terms of improving the habitat diversity and maintaining depths in side channels, various options to add structure to side channel areas were evaluated. Based on conversations with St. Louis District staff, it was estimated that approximately 7 stub dike structures, each about 25 feet long, would be adequate per mile of side channel. These structures would create aquatic structure and localized areas of increased flow velocity, scour, and eddies, thereby providing a wide range of habitats. Costs were calculated assuming using rock to construct the structures, but timber piles or a combination of both could be used.

In addition to increased structure and diversity, a number of side channels are being affected by sedimentation. Based on available system information, it was assumed that roughly one-third of the side channel area would need some dredging to increase and maintain depths. The stub dike structures would be added following dredging (if needed) to increase sustainability and maintain depths. Hydraulic modeling will occur as part of a site specific project to maximize sustainability and habitat values of features. Table 3-29 summarizes information on the number of side channels restored and the costs involved.

The actual direct and indirect benefit area was also calculated to provide an estimate of the area of side channel and associated main stem habitat restored by the proposed projects. The acreage benefits were estimated for a generic side channel restoration project. However, a detail habitat benefit analysis will be undertaken as any individual projects move forward. The average Illinois River side channel is approximately 12.1 acres (1 mile long by 100 feet wide). Other study efforts in the Midwest have estimated the main stem benefit area of a side channel at approximately 100 acres of surrounding main channel and main channel boarder habitats, due to the beneficial effects of side channels as refuge, nursery, overwintering, and feeding areas. As a result the total benefit area of a side channel project was estimated at 112.1 acres. Table 3-30 summarizes the total benefit areas for the two alternatives as well as the average annual cost per acre restored.

Table 3-28. Summary of Total Benefit Area of Island Protection Projects

Alternative	Number of Islands Protected	Island Acres Protected	Side Channel Acres Protected	Benefit Acres Main stem	Total Benefit Area (Acres)	Total First Cost	Cost Per Acre
2M	10	77	77	634	788	$11,544,000	$14,700
2N	15	115	115	951	1,182	$17,316,000	$14,700

Table 3-29. Potential Side Channel Restoration Alternatives

Alternative	Number of Side Channels Restored	Construction	Real Estate [1]	Total First Cost	Annual O&M
2T	10	$ 3,527,591	$ 450,368	$3,977,959	$1,640
2U	20	$ 7,055,182	$ 900,737	$7,955,919	$3,280
2V	30	$10,582,773	$1,351,105	$11,933,878	$4,920
2W	35	$12,346,569	$1,576,289	$13,922,858	$5,740
2X	40	$14,110,364	$1,801,473	$15,911,838	$6,560

[1] Real Estate costs do not include acquisition or appraisal costs.

Table 3-30. Summary of Total Benefit Area of Side Channel Restoration Projects

Alternative	Number of Side Channels Restored	Acres Dredged	Side Channel Acres	Benefit Acres Main Stem	Total Benefit Acres	Total First Cost	Cost Per Acre
2T	10	30	121	1,000	1,121	$ 3,861,000	$3,400
2U	20	60	242	2,000	2,242	$ 7,722,000	$3,400
2V	30	90	364	3,000	3,364	$ 11,584,000	$3,400
2W	35	105	424	3,500	3,924	$ 13,514,000	$3,400
2X	40	120	485	4,000	4,485	$ 15,445,000	$3,400

3. Evaluation and Comparison of Plans

a. Backwaters. As discussed under the alternatives section, various levels of restoration were assessed on a per-backwater basis. The analysis framework was developed to account for acreage and quality associated with the various alternatives. The analysis revealed that Alternative 2G and 2H were best buy plans. Alternative 2G, the restoration of 60 backwaters to level 5 (40 percent dredging), was the most cost effective on a per unit basis. However, the entire range was cost effective, but the more cost effective plans were 2D to 2H. Only the most effective plans were carried forward for further system evaluation.

b. Side Channels and Islands. The various side channel and island protection options simply represented varying scales of the same cost-effective measures. As a result, all alternatives were carried forward for further system analysis.

4. Plans Recommended for System Analysis

a. Restoration Alternatives. While varying somewhat in cost effectiveness, all of the alternative plans developed are recommended for consideration at the system level, except for backwater restoration Alternative 2A to 2C.

b. Risk and Uncertainty. While a number of backwater restoration projects have been implemented in the Midwest providing valuable information on the performance of various measures and demonstrating significant ecological benefits, restoration of backwater and side channel habitats involves some risk and uncertainty due to a number of factors. Particular areas of risk and uncertainty include determining the scale of projects necessary to achieve optimal benefits, estimating future sedimentation rates to accurately capture costs and estimate sustainability, and assessing ecological responses.

The study team directly addressed various scales of backwater restoration in order to determine the optimal level of restoration activities. Due to uncertainties, future restoration projects should be pursued under an adaptive management framework where various scales of backwater dredging are undertaken and monitored in the initial years of the program to further optimize the amount of dredging and configuration of dredging that produces the greatest ecological responses and sustainability of project features. This framework would also be applied to optimize side channel and island stabilization features.

Sediment delivery from tributaries is being addressed under Goal 1. However, how those reductions in delivery translate to reduced sedimentation rates in the backwaters and side channels will affect the cost of maintaining the habitats.

A final item of uncertainty is the ecological response from the proposed level of backwater, side channel, and island protection projects. The team is confident that the proposed objectives will provide significant and measurable benefits and that the physical changes will have significant ecological benefits. However, some desired biological responses, including increases in aquatic plant and macroinvertebrate communities, depend on improving not only depth diversity and structure, but also the combined effects of more natural water levels and reduced turbidity. In addition, there is the potential for currently unknown limiting factors to reduce the effectiveness of restoration projects.

c. Information and Further Study Needs. The following information and further study needs have been identified.

- Conduct pool plans addressing backwater and side channel needs/priority/etc. throughout the basin.
- Analysis of historic and existing conditions - collecting and using bathymetry data to better assess conditions and sedimentation rates.
- Better characterization of sediments (physical and chemical).
- Better characterization of nitrogen and phosphorus loading.
- Further detailed assessment of the extent to which backwaters represent a limiting factor for fish and other aquatic species.
- Assessment of the effectiveness and sustainability of various backwater restoration configurations
- Hydraulic information along main stem channels and backwater – discharge and velocity data.

H. GOAL 3: FLOODPLAIN, RIPARIAN, AND AQUATIC. Improve floodplain, riparian , and aquatic habitats and functions

Problem. Land-use and hydrologic changes have reduced the quantity, quality, and functions of aquatic, floodplain, and riparian habitats. Flood storage, flood conveyance, habitat availability, and nutrient exchange are some of the critical aspects of the floodplain environment that have been adversely impacted.

Objectives

Illinois River Main Stem. The system objective for the Illinois main stem floodplain and riparian areas is the restoration of approximately 30 percent of the cover types lost since settlement. This amounts to 150,000 acres of isolated and connected floodplain areas.

Illinois River Basin Tributaries. The system objective for the Illinois River Basin Tributary floodplain and riparian areas is the restoration of approximately 18 percent of the habitat areas of the Illinois River tributaries lost since settlement. This amounts to 150,000 acres of isolated and connected floodplain and riparian areas.

Aquatic Habitat. The system objective for the tributary streams of the Illinois River Basin is to restore approximately 33 percent of the streams impaired by channelization in the Illinois River Basin. This amounts to 1,000 miles of aquatic habitat within the tributary streams of the basin.

Anticipated Outputs. A healthy functioning floodplain, riparian and aquatic systems in the Illinois River Basin will result in ecological benefits due to connectivity of the river and floodplain habitats critical to the life stages of numerous native species. In addition, restored riparian and floodplain corridors provide one of the best opportunities for landscape scale restoration and connectivity of remaining resource rich areas in the highly modified Midwestern landscape, improving the viability of sensitive populations and species. In addition to benefiting hundreds of thousands of waterfowl which use the Illinois River as part of the Mississippi River Flyway, numerous other bird species would benefit from the restored floodplain and riparian habitat. These species include the Federally listed bald eagle and Illinois state listed species such as the northern harrier, sandhill crane, yellow-headed blackbird, forester's tern, black tern, and least bittern. Numerous fish species would benefit from restored floodplain, riparian, and aquatic systems including the paddlefish, and State listed darter, redhorse, and minnow species. Other species anticipated to benefit from the projects include river otter, bobcat, the Federally listed Indiana bat and decurrent false aster, and the State listed Blanding's turtle and Illinois chorus frog.

1. Inventory Resource Conditions

a. Historic Conditions. The streams, floodplains, and riparian areas of the Illinois River Basin were once a rich mosaic of habitats that were represented by a variety of aquatic and terrestrial cover types, including prairies, wetlands, and forests. Important factors contributing to this diversity and function were predictable annual hydrologic cycles, including annual high water and dependable summer low flows, wetlands, and prairies that buffered flood flows and slowly released the runoff; fire disturbance that maintained diverse plant communities; and limited human demands. The healthy functioning floodplain system once found in the Illinois River Basin resulted from an un-fractured landscape that integrated the ecological outputs of the hydrologic cycle (rainfall, droughts, and floods) through the complex structure of prairies, wetlands, and forests to produce an abundance of aquatic, insect, wildlife, and plant species. Historic land cover was evaluated to characterize pre-disturbance conditions in the basin.

Prior to settlement, the vegetation found on the floodplains of the major tributaries of the Illinois River Basin was similar to that along the Illinois River main stem, with the notable difference of a higher occurrence of prairies (between 10 and 20 percent) along the tributaries than along the main stem. This difference might be explained by the use of fire within the basin by indigenous peoples; the main stem floodplain served as a larger firebreak than the tributaries and therefore more forest-based cover was able to emerge in the main stem floodplain. For the purposes of this analysis, the land cover distributions along the tributaries were differentiated from those along the main stem.

Before 1900, the floodplain and riparian areas remained connected to the rivers and streams. Following diversion of Lake Michigan water into the Illinois, numerous levee and drainage districts were created. The alternations necessary for agriculture resulted in nearly 50 percent of the main stem floodplain being isolated or disconnected from the river. Levee and drainage projects can be found in all of the major basins, especially the Mackinaw, Spoon, and Sangamon, but none of a scale comparable to the Illinois River main stem.

ii. Illinois River Basin Tributaries. GLO records were analyzed to establish historical cover types within the floodplain for the 19 major sub-basins of the Illinois River Basin (Figure 3-13). They are the Chicago, Des Plaines, Spoon, Upper Sangamon, South Fork Sangamon, Lower Sangamon, Salt Creek, LaMoine, Lower Illinois, Lower Illinois - Lake Chautauqua, Lower Illinois - Lake Senachwine, Macoupin, Upper Fox, Lower Fox, Upper Illinois, Kankakee, Iroquois, Vermilion, and Mackinaw watersheds. While the Illinois River floodplain was dominated by forests, the tributary floodplains had a much more even distribution of cover types. Forest, prairie, and wetland cover types each covered roughly a third of the total acreage.

Figure 3-13. Illinois River Basin Sub-basins

i. Illinois River Main Stem. Forest, prairie (grassland), and wetlands, were the dominant cover types in the historical floodplain. The Illinois River floodplain, within the area of analysis, consists of approximately 500,000 acres. Historically, forests accounted for nearly two-thirds of the Illinois River floodplain (340,000 acres). Wet, mesic, and upland prairies accounted for the balance (160,000 acres) of the floodplain. Wetlands, both forested and non-forested, accounted for perhaps a third (194,000 acres) of the forest and prairie communities found in the floodplain.

Government Land Office (GLO) records from 1804-1859 were analyzed using Geographic Information Systems (GIS) software to establish historical cover types within the floodplain. Separate analyses were conducted for the Marseilles, Starved Rock, Peoria, La Grange, and Alton navigation pools. Navigation pools upstream of Marseilles were not evaluated because of intense urbanization and other limiting factors, but this should not exclude them from consideration for restoration implementation as appropriate opportunities become available.

Prairie stream headwaters are not typically forested, are surface water fed, have warmer water, and have a high level of in-stream primary production because of the lack of shading. Invertebrate grazers are the dominant primary consumer (photosynthesis) and fishes are more characteristic of warm water communities. Prairie streams typically become more forested downstream as flows become more reliable because of increasing groundwater influence and contributing surface area. Riparian corridors develop and the production base shifts from an in-stream basis to one that is nourished by nutrients from upstream and from litter falling from the riparian corridor.

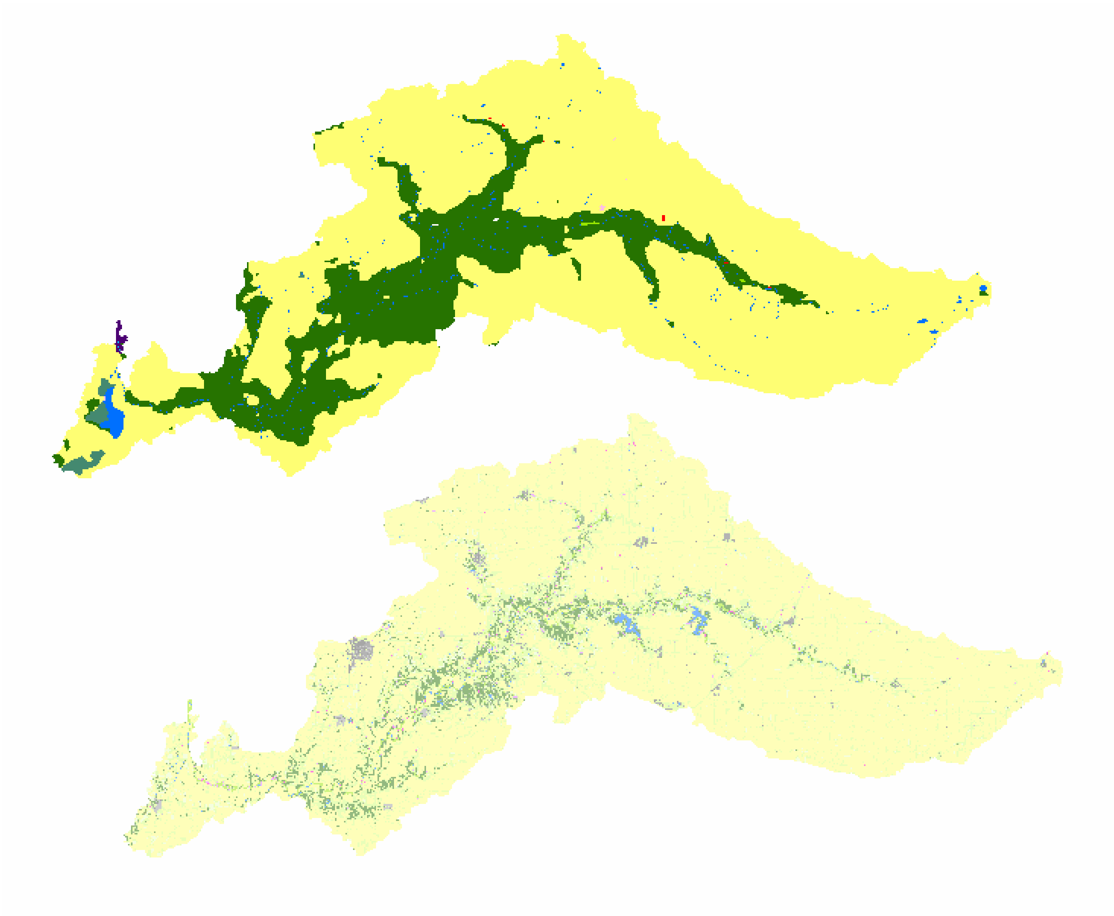


Figure 3-14. Presettlement and Contemporary Land Cover in the Mackinaw River Watershed

b. Existing Conditions. Land-use and hydrologic changes have reduced the quantity, quality, and functions of aquatic, floodplain, and riparian habitats. Flood storage, flood conveyance, habitat availability, and nutrient exchange are some of the critical aspects of the floodplain environment that have been adversely impacted because the Illinois River, and some of its major tributaries have been isolated from the floodplain through levee construction.

i. Illinois River Main Stem. Losses of the major cover types, as illustrated in table 3-31 and Figure 3-15, range from 70 to 80 percent; most dramatic has been the nearly complete elimination of prairie from the floodplain. The nature of the remaining vegetation is different from historic communities. Modern-day grasslands are limited to pasture, levees, and roadside patches with very little species diversity. Remaining bottomland forest species do not provide the ecosystem support functions of the mast-producing tree species of the historic floodplain. Finally, wetlands of all types have been severely impacted by diversion, dam construction to support navigation, and conversion to agriculture due to drainage. Nearly 50 percent of the floodplain has been isolated from the river. Wetlands were not particularly well mapped in the GLO surveys because their methods were coarse and many wetlands were small, isolated units that might have been too small to be captured at this mapping resolution. Therefore, the data in the table should be considered an underestimate. In comparison, hydric soils analyses indicate that throughout the basin about 90 percent of the wetlands have been lost due to conversion or drainage.

Table 3-31. Illinois River Main Stem Floodplain Historic and Existing Land Cover

Illinois River Main Stem Floodplain Land Cover	Forest	Grassland	Forested and Non-Forested Wetlands [1]	Total
Historic	338,680	120,620	42,473	501,773
Existing	85,530	23,245	12,775	121,550
Loss	253,150	97,375	29,698	380,223
Loss %	74.7%	80.7%	69.9%	75.8%
% of Historic Landscape	67.5%	24.0%	8.5%	

[1] This cover type includes three types of wetlands. It combines an equivalent Forest and Prairie cover type value with values indicated in the GLO data. This results from the assumption that approximately 25% of the historical forest and prairie cover type could be characterized as wetlands.

ii. Illinois River Basin Tributaries. Area l coverage of the major habitat types in tributary floodplains has been reduced by 15 to 70 percent from 1804 to 1995 (table 3-32). Tributary floodplains have been less severely impacted by agricultural conversion than the Illinois River main stem. However, the same problems exist of fragmentation and low diversity of habitat types. To counteract the underreporting of wetlands in the GLO records, interagency coordination with experts in the field estimated that approximately 25 percent of the forest and prairie acreage mapped in the GLO dataset was of wetland type. Forested cover types are relatively intact in terms of area, but habitat quality is severely degraded. Grasslands appear to have only lost one-third of their historic areas, but again quality is severely degraded. Wetlands have probably been the most impacted by conversion to other land uses.

Table 3-32. Illinois River Basin Tributary Floodplain Historic and Existing Land Cover

Illinois River Basin Tributary Floodplain Land Cover	Total Acres	Forest	Grassland	Forested and Non-Forested Wetlands [1]
Historic	851,946	422,140	409,957	19,849
Modified Historic Assumption		316,605	307,468	227,873
% of Historic Landscape		37.1	36.1	26.7
Existing	532,122	267,571	196,233	68,318
Loss	319,824	49,034	111,235	159,555
Loss %		-15.5	-36.2	-70.1

[1] This cover type includes three types of wetlands. It combines an equivalent Forest and Prairie cover type value with values indicated in the GLO data. This results from the assumption that approximately 25% of the historical forest and prairie cover type could be characterized as wetlands.

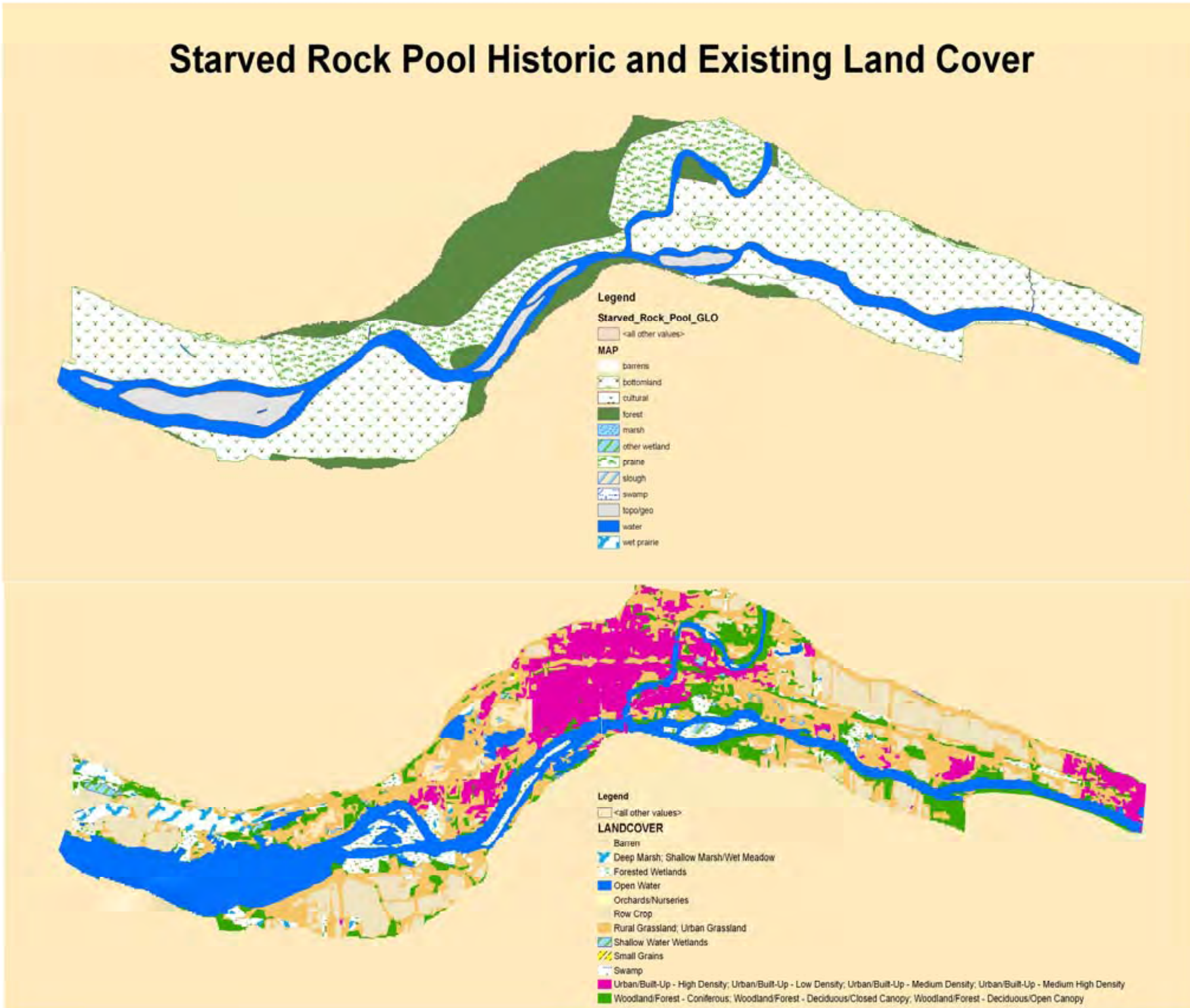


Figure 3-15. Comparison of Historic and Existing Cover Types in the Starved Rock Pool

iii. Aquatic Habitats. Alterations within the watershed have also had a pervasive negative effect on basin stream systems. The IEPA 305(b) report (2002), identified nearly 11,000 miles of perennial streams in the Illinois River Basin with an estimated 20,000 to 25,000 additional miles of ephemeral streams.

Based on the frequency observed in the IEPA analysis, channelization potentially impairs approximately 1,400 of perennial stream miles within the Illinois River Basin. However, unassessed streams tend to be smaller, and CTAP (1994) identified that the smaller streams tend to be channelized to a disproportionately high extent. Lopinot (1972) estimated that 27 percent of streams in the state were channelized at the time of publication; this would correspond to nearly 3,000 stream miles in the Illinois River Basin. To reach this level, approximately 50 percent of the unassessed streams would have to be channelized, a rate that is consistent with the observations in the CTAP report (1994). Therefore, it is estimated that at least 3,000 miles of perennial stream habitat, mostly in small streams, is presently degraded by channelization in the Illinois River Basin.

Channelization of streams shortens overall stream lengths and results in increased velocities, bed and bank erosion, and sedimentation. Modified stream channels often have little habitat structure and variability (life requisites) necessary for diverse and abundant aquatic species. Channelization also disconnects streams from floodplain and riparian areas that are often developed into agricultural or built environments.

Illinois DNR and Illinois EPA managers developed the Biological Stream Characterization Index (BSC) to rank stream quality uniformly across the state. The BSC is a mix of quantitative variables including the Index of Biotic Integrity for fish (Karr et al. 1986), the Macroinvertebrate Biotic Index (Hilsenhoff, 1988), habitat analyses, and qualitative judgments of DNR biologists. Illinois DNR scientists completed a statewide coverage and documented the condition of 6,430 stream miles. Table 3-33 displays the results for the assessed streams in the Illinois River Basin. The Mackinaw watershed had the most unique and highly rated stream miles. Highly valued and moderate stream reaches were the most common, and they were widely distributed throughout the Illinois River Basin. Streams in the urban watersheds of the Des Plaines, Fox, and Chicago Rivers, the agricultural watersheds of the Sangamon River, and the Spoon River watershed were generally of limited quality. Restricted stream reaches largely occur in the Chicago region and were only a small fraction of the total streams assessed. Protection of remaining high-quality areas was identified under the overarching system goal as a prioritization criteria for future restoration.

Table 3-33. Illinois River Sub-Basin Stream Miles Ranked Using the Illinois Department of Natural Resources Biological Stream Characterization (Bertrand et al. 1996, ISIS 1999)

Watershed	Unique	High	Moderate	Limited	Restricted
Des Plaines	11.3	68.8	189.2	260.0	19.5
Upper Fox	0.0	94.6	99.0	46.1	0.0
Chicago	0.0	0.0	64.9	156.7	24.1
Lower Fox	16.5	164.1	310.8	9.4	0.0
Lower Illinois-Senachwine Lake	8.8	124.2	113.4	0.0	0.0
Upper Illinois	45.0	163.4	28.9	0.0	0.0
Kankakee	0.0	228.8	92.6	0.1	0.0
Spoon	0.0	159.2	487.9	130.4	0.0
Vermilion	55.9	223.8	122.0	0.0	0.0
Iroquois	0.0	167.6	33.1	0.0	0.0
Lower Illinois-Lake Chautauqua	0.0	50.1	60.5	0.0	0.0
Mackinaw	156.1	211.5	65.4	1.2	0.0
LaMoine	19.6	176.3	231.9	0.6	0.0
Upper Sangamon	46.2	117.5	250.5	34.1	0.0
Salt	18.7	184.2	234.4	53.6	0.0
Lower Sangamon	0.0	12.8	193.9	36.1	0.0
Lower Illinois	0.0	219.7	33.9	0.0	0.0
South Fork Sangamon	0.0	0.6	116.1	81.8	0.0
Macoupin	0.0	101.2	0.5	0.5	0.0
Total Stream Miles	**378.1**	**2,468.4**	**2,728.9**	**810.6**	**43.6**
Percent of Sampled	**5.9%**	**38.4%**	**42.4%**	**12.6%**	**0.7%**

Channelization, wetland drainage, and snagging were extremely common throughout the Illinois River Basin for the purposes of draining water from croplands and for flood control. The adverse effects of such activities are extensive, ranging from the direct destruction of stream habitat, to the reduction of structure and microhabitat for fishes, aquatic invertebrates, freshwater mussels, and aquatic plants, to the alteration of water conveyance, which increases erosion and sedimentation. The negative effects of channelization and drainage may persist for very long periods and adversely affect habitat many miles away.

c. Future Without-Project Conditions

i. Illinois River Main Stem. The main stem Illinois River study area will likely remain relatively unchanged in terms of land use over the 50-year period of analysis. Some areas of various cover types will be converted to urban uses. However, this is likely to be a small amount due to the high regulatory cost of new development within the main stem floodplain. Habitat quality and ecological functions will likely remain at current degraded levels. Habitat fragmentation and unstable hydrologic regimes will continue to degrade the remaining habitat areas.

The Nature Conservancy and The Wetlands Initiative have made major investments by purchasing levee and drainage districts for the purpose of restoration. In total, they have acquired more than 11,000 acres of Illinois River floodplain and adjacent habitats at Spunky Bottoms, Emiquon, and Hennepin. Some restoration efforts have begun, such as shutting off drainage pumps and planting native species.

The USFWS currently manages four refuges along the Illinois River, totaling approximately 12,000 acres. The recently completed *Illinois River National Wildlife and Fish Refuges Complex Draft Comprehensive Conservation Plan and Environmental Assessment* recommends protection management on an additional 380 acres of native grassland, 200 acres of savanna, 1,300 acres of native forest, and 4,000 acres of wetlands within the focus areas through voluntary partnerships.

Finally, the UMRS-IWW System Navigation Feasibility Study has selected a recommended plan that calls for the restoration of approximately 20,000 acres of Illinois River floodplain. The restoration measures identified under the Navigation Study are consistent with those of this study, and would be considered overlapping if implemented under either study.

ii. Illinois River Basin Tributaries. Overall, the tributary floodplains are also likely to remain in a degraded condition. Urban development is perhaps more likely than on the main stem, particularly near the larger urban areas of Chicago, Bloomington-Normal, Decatur, Peoria, and Springfield. One bright spot is the continued success of the CREP program in Illinois. While focused on sediment, the acreages that have been enrolled and are currently being enrolled are in the floodplain and riparian areas of Illinois River Basin streams. This provides opportunities for increased connectivity of various riparian habitats. However, these benefits may be offset by the continued degradation of aquatic stream and riparian habitats resulting from bed and bank erosion.

iii. Aquatic Habitats. In-stream habitats throughout the basin are likely to degrade over the 50-year period of analysis. Stressors on the stream network include: (1) direct modification of stream channels for urban and rural development, (2) increased impervious land surfaces resulting in increased runoff and higher flow, (3) increased tile-drained agricultural areas, (4) introduction of point and non-point source pollutants into the system, (5) introduction of invasive and exotic species. While numerous programs are in place to address these various stressors, they do not take a systemic approach to restoration and are unable to keep pace with the rate of landscape change occurring in the basin.

d. Desired Future Conditions

i. Illinois River Main Stem. The desired future condition of the Illinois River main stem floodplain is a reversal of historic loss of habitat and floodplain functions and increase in habitat area and quality. This would be accomplished by restoring 150,000 acres of isolated and connected floodplain areas, representing approximately 30 percent of the Illinois River Valley. This level of restoration would provide the necessary building blocks for a sustainable floodplain ecosystem in conjunction with other restoration efforts undertaken as part of this effort, particularly water level, backwaters, and side channels.

ii. Illinois River Tributaries. The desired future condition for the Illinois River Basin tributaries is the restoration of a sustainable level of floodplain and aquatic habitat functions. A portion of this would be accomplished by restoring 150,000 acres of isolated and connected floodplain areas. This represents approximately 18 percent of the Illinois River Basin tributary floodplain and riparian habitat areas. This level of restoration would provide the necessary building blocks for a sustainable floodplain ecosystem within the tributaries in conjunction with other restoration efforts undertaken as part of this effort, particularly sediment delivery.

General conditions for floodplains and riparian areas include terrestrial patch size desires (amount shown or greater). Bottomland hardwood forest would range from 500 to 1,000 acres in size with 3,000 acres needed for some interior avian species. Grasslands would range from 100 to 500 acres in size. Nonforested wetlands require a minimum of 100 acres, spaced 30 to 40 miles apart, and riparian zones for streams require a minimum of 100 feet on each side.

iii. Aquatic Habitats. Approximately 1,000 miles of impaired streams would be restored. This represents approximately one-third of the streams impaired by channelization within the Illinois River Basin. This level of restoration would provide the necessary building blocks for sustainable aquatic environments in the perennial and intermittent streams of the Illinois River Basin.

2. Formulation of Alternative Plans

a. Approach to Formulation and Assumptions. Alternative plan formulation for restoration of aquatic, floodplain, and riparian habitats and functions within the Illinois River Basin was conducted over a period of 6 months in 2003. Monthly meetings of technical and scientific professionals from the U.S. Army Corps of Engineers, the Illinois DNR, and other interested parties led to the development of the criteria, constraints, measures, and alternatives detailed below. Alternative plans were developed for the Illinois River main stem floodplain and the major tributary floodplains separately. This was appropriate due to the differences inherent in large floodplain rivers such as the Illinois and its tributaries. Further, many of the physical characteristics and assumptions developed for the formulation of the Illinois main stem do not apply to tributaries.

b. Criteria and Constraints

- **Flood Protection Policies.** No increase in flood elevations as required by Illinois law – Illinois state law specifies that any action in the floodplain that increases flood heights is not allowable or must be accompanied by mitigation of adverse effects. Due to the potential high cost associated with these actions, efforts will be made to avoid this threshold.

- **Landowner Interests.** Opportunities to implement restoration projects on private lands may be limited. Real estate acquisition is the sponsor's responsibility, but several strategies can be employed to increase landowner interest. Approaches to address this constraint are high levels of stakeholder involvement in project development, education regarding the benefits of restoration projects, and sponsor acquisition of voluntary easements and/or fee title to property as opportunities present themselves. No Federal site investigations (such as surveys or geotech investigations) will be conducted without contacting property owners and obtaining permission to access potential project areas.

- **Existing Altered River Hydrology and Water Quality.** Unnatural water level fluctuations throughout the system make it difficult to restore habitats. Efforts undertaken under system Goal 5 will improve conditions for floodplain habitats, and restoration of large areas of floodplain habitats, in particular wetlands, will help improve hydrologic conditions throughout the system. Design of specific project features can be done so that the unnatural effects of water level fluctuations are minimized and the sustainability of the feature is maximized.

- **Impacts on Local Tax Base.** Implementation of large-scale restoration in the Illinois River Basin floodplain, either through acquisition of land or easements, could have an impact upon local taxing authorities if future owners pay less taxes or none at all. Most of the floodplain is rural in nature and in some cases is a significant portion of a county's tax base. Negative impacts to that tax base would potentially generate public opposition to restoration. However, tax base decline could be offset by revenue generated through consumptive and non-consumptive wildlife uses.

c. Measures. Potential measures for implementation cover a wide range of practices designed to improve aquatic, floodplain, and riparian habitats. The following list shows the potential restoration measures that could be implemented under this program, with those in bold being evaluated for direct restoration benefits and costs. Site-specific investigations will be critical for optimization of project measures to be used. These measures correspond with those found in Section 4.

Aquatic, Floodplain, and Riparian Restoration Measures

- **Riffle Structures**
- **Channelization Remeander**
- In-Stream Structures (rock piles, lunkers, etc.)
- Moist Soil Units
- **Gated Levee**
- **Wetland Restoration**
- Lateral Wetlands
- Levee Setback
- Filter Strips/Contour Buffer Strips
- Riparian Forest Buffer
- **Wetland Plantings**
- **Mast Tree Planting**
- **Prairie Planting**
- Timber Stand Improvement
- Invasive Species Management

d. Alternative Plans. Alternative plans for the Illinois River floodplain and riparian areas are shown in tables 3-34 and 3-35. These plans represent incremental restoration efforts. The assumed distribution of major habitat types is based on the historic land cover distribution. This distribution serves more as a general guide than an absolute definition of what is to be restored; factors influencing the actual distribution of cover types will include availability of restorable land, limiting factors within the navigation pools, site-specific conditions, and cost. Further, suggested restoration levels for each cover type are based on the rate of loss from historical percentages. Due to the varied survey methods employed during the early 1800s, wetlands are significantly underrepresented in the historic data. Therefore, a panel of interagency floodplain experts was tasked with developing a weighting factor that more accurately reflected wetlands on the historical landscape in the main stem and tributary floodplains. As noted in the Forested and Non-Forested Wetlands category in tables 3-34 and 3-35, a percentage of historic forest and grassland was assumed to be wetlands and accounted for here. Finally, it is assumed that, due to the current degraded condition of the ecosystem and the floodplain and riparian components, that any restoration of forested, grassland, and wetlands will provide benefits to the system. Site-specific assessments will have to be conducted in order to optimize benefits versus costs.

Table 3-34. Illinois River Main Stem Floodplain and Riparian Alternatives

Illinois River Main Stem Floodplain Alternatives	Acres Restored	Forest	Grassland	Forested and Non-Forested Wetlands [1]	Total
3MA	0	0	0	0	0
3MB	5,000	1,700	1,200	2,100	5,000
3MC	10,000	3,400	2,400	4,200	10,000
3MD	20,000	6,800	4,800	8,400	15,000
3ME	40,000	13,600	9,600	16,800	40,000
3MF	75,000	25,300	18,000	31,700	75,000
3MG	150,000	50,700	36,000	63,300	150,000

[1] This cover type includes two types of wetlands. It combines an equivalent Forest cover type value with values indicated in the GLO data. This results from the assumption that approximately half of the historical forests cover type could be characterized as wetlands.

Table 3-35. Illinois River Basin Tributary Floodplain and Riparian Alternatives

Illinois River Basin Tributary Floodplain Alternatives	Acres Restored	Forest	Grassland	Forested and Non-Forested Wetlands [1]	Total
3TA	0	0	0	0	0
3TB	5,000	900	900	3,200	5,000
3TC	10,000	1,900	1,800	6,300	10,000
3TD	15,000	2,900	2,700	9,400	15,000
3TE	20,000	3,800	3,600	12,600	20,000
3TF	40,000	7,600	7,200	25,200	40,000
3TG	75,000	13,900	13,500	47,600	75,000
3TH	150,000	27,800	27,000	95,200	150,000

[1] This cover type includes two categories of wetlands. It combines an equivalent Forest and Prairie cover type value with values indicated in the GLO data. This results from the assumption that approximately 25% of the historical forest and prairie cover type could be characterized as wetlands.

Alternative plans for in-stream aquatic habitat restoration were developed on roughly equal intervals of restoration. At this scale and with the level of information available, it is impossible to state with any degree of certainty the specific quantities and types of restoration practices to be implemented. Restoration alternatives were chosen for evaluation based on the desired future condition of 1,000 miles of restored streams. Intervals of miles restored are 25, 50, 100, 250, 500, and 1,000 miles.

3. Evaluation and Comparison of Plans

The plan components developed for the main stem, tributaries, and streams in the basin are listed in table 3-36 with corresponding costs. It is assumed that that benefits can be compared on a per-acre and stream-mile basis; further site-specific analysis will be necessary to optimize project characteristics.

Detailed cost estimates can be found in Appendix E. Further, the Programmatic and Real Estate Cost Estimates for measures used in generating programmatic costs can be found Appendix F. A number of assumptions have gone into the cost estimates found in tables 3-36 through 3-38. For main stem restoration alternatives, costs were generated using the average costs of measures relevant to the major cover type. These costs were $3,900 per acre for forest restoration, $2,000 per acre for grassland, and $8,650 per acre for wetland restoration. Further, it was assumed that while ecosystem improvements would occur on the entire acreage of an alternative, only half of the acreage would be subject to construction activities and associated costs. For example, berm construction and plantings in a portion of the site could benefit the entire site by impacting the hydrology and providing a seed source. The remaining acres would see ecological benefits accrue through natural succession and or restored hydrology. These per-acre costs were multiplied by half of the acreage distributions found in table 3-34. Additionally, its was assumed that at each level of restoration an incremental number of gated levees and rehabilitation of environmental levees would occur. These features range from one set in Alternative 3MB to 16 in Alternative 3MG. The addition of the four measures resulted in a first cost for construction to which a 35 percent contingency was added. Engineering and Design (E&D) during construction was estimated to be 30 percent of adjusted first cost of construction. Supervision and Administration (S&A) for construction contracts was estimated to be 9 percent of first cost for construction. Real Estate estimates assumed fee title acquisition costs of $3,000 per acre. This per acres cost was applied to all of the acres for each restoration alternative. The restoration cost for each alternative is the combination of the first cost of construction, E&D, S&A, and Real Estate costs.

For in-stream aquatic restoration alternatives, costs were generated using the average per-mile costs of riffles and channel remeandering. It was assumed that approximately 75 percent of aquatic restoration would involve riffles while the remaining 25 percent would be dedicated to channel remeander. Estimated costs per mile for riffles are $792,000. Approximately 16.5 percent will be of the larger tributary type shown in the programmatic cost sheet, with the remaining 83.5 percent being of the type constructed on minor tributaries. Depending on the size of the stream, the number of structures required ranges from four per mile for large tributaries to 22 for minor tributaries. Stream remeandering costs are estimated at $2,347,000 per mile. Costs for Real Estate were estimated at $93,200 per mile for riffles and $728,700 per mile for remeandering. Contingency, E&D, S&A and Real Estate contingencies were the same as above. The restoration cost for each alternative is the combination of the first cost of construction, E&D, S&A, and Real Estate costs.

A similar methodology was applied for the estimation of tributary restoration costs shown in table 3-37. Tributary alternative costs are based on average costs per practice distributed according to the acres suggested in table 3-35. No environmental levees or gates are included in this estimate.

Table 3-36. Main Stem Floodplain and Riparian Alternatives Cost Estimate

Illinois River Main Stem Floodplain Alternatives	Acres Restored	First Cost of Construction 35% Contingency	Planning, Engineering and Design 30%	Supervision and Administration 9%	Real Estate Including Contingency [1]	Total First Cost
3MA	0				$0	$0
3MB	5,000	$21,574,000	$6,472,000	$1,942,000	$15,093,000	$45,080,000
3MC	10,000	$43,147,000	$12,944,000	$3,883,000	$30,186,000	$90,161,000
3MD	20,000	$86,295,000	$25,888,000	$7,767,000	$60,372,000	$180,322,000
3ME	40,000	$166,155,000	$49,847,000	$14,954,000	$120,744,000	$351,700,000
3MF	75,000	$301,727,000	$90,518,000	$27,155,000	$226,398,000	$645,799,000
3MG	150,000	$603,133,000	$180,940,000	$54,282,000	$452,797,000	$1,291,152,00

Table 3-37. Tributary Floodplain and Riparian Alternatives Cost Estimate

Illinois River Basin Tributary Floodplain Alternatives	Acres Restored	First Cost of Construction 35% Contingency	Planning, Engineering and Design 30%	Supervision and Administration 9%	Real Estate Including Contingency [1]	Total First Cost
3TA	0	$0	$0	$0	$0	$0
3TB	5,000	$22,268,000	$6,680,000	$2,004,000	$21,910,000	$52,863,000
3TC	10,000	$44,216,000	$13,265,000	$3,979,000	$43,820,000	$105,280,000
3TD	15,000	$66,164,000	$19,849,000	$5,955,000	$65,730,000	$157,697,000
3TE	20,000	$88,432,000	$26,530,000	$7,959,000	$87,640,000	$210,560,000
3TF	40,000	$176,864,000	$53,059,000	$15,918,000	$175,280,000	$421,120,000
3TG	75,000	$332,741,000	$99,822,000	$29,947,000	$328,650,000	$791,160,000
3TH	150,000	$665,483,000	$199,645,000	$59,893,000	$657,300,000	$1,582,321,000

Table 3-38. Aquatic Habitat Restoration Alternatives Cost Estimate

Aquatic Habitat Restoration Alternatives	Stream Miles	First Cost of Construction 35% Contingency	Planning, Engineering and Design 30%	Supervision and Administration 9%	Real Estate Including Contingency [1]	Total First Cost
3SA	0	$0	$0	$0	$0	$0
3SB	25	$40,044,000	$12,013,000	$3,604,000	$6,302,000	$61,964,000
3SC	50	$80,089,000	$24,027,000	$7,208,000	$12,604,000	$123,927,000
3SD	100	$160,178,000	$48,053,000	$14,416,000	$25,207,000	$247,854,000
3SE	250	$400,444,000	$120,133,000	$36,040,000	$63,018,000	$619,635,000
3SF	500	$800,888,000	$240,266,000	$72,080,000	$126,037,000	$1,239,271,000
3SG	1000	$1,601,775,000	$477,495,000	$143,249,000	$252,074,000	$2,478,541,000

[1] Real Estate costs do not include acquisition or appraisal costs.

Annual O&M costs for the alternative plans were estimated and are summarized in table 3-39.

Table 3-39. Annual Operation and Maintenance Costs for Alternative Plans

Illinois River Main Stem Floodplain Alternatives	Acres Restored	Annual O&M
4A	0	
4B	5,000	$162,000
4C	10,000	$324,000
4D	20,000	$648,000
4E	40,000	$1,295,000
4F	75,000	$2,419,000
4G	150,000	$4,843,000

Illinois River Basin Tributary Floodplain Alternatives	Acres Restored	Annual O&M
4A	0	0
4B	5,000	$129,000
4C	10,000	$262,000
4D	15,000	$396,000
4E	20,000	$525,000
4F	40,000	$1,049,000
4G	75,000	$1,951,000
4H	150,000	$3,902,000

Aquatic Habitat Restoration Alternatives	Stream Miles	Annual O&M
4SA	0	
4SB	25	$79,000
4SC	50	$157,000
4SD	100	$314,000
4SE	250	$786,000
4SF	500	$1,572,000
4SG	1000	$3,143,000

4. Plans Recommended for System Evaluation. The alternative plans developed are all recommended for consideration at the system level.

a. Risk and Uncertainties. Reestablishment of large areas of habitat within the floodplains and aquatic systems of the basin will produce significant ecosystem benefit. However, continued water level fluctuations, excessive erosion, and sedimentation will degrade current and future aquatic, floodplain and riparian areas.

Another general consideration for the future is a landscape free of introduced species that can change the look and makeup of an entire system, thereby changing species composition, decreasing rare species, and even changing or degrading the normal functioning of the system. Once the invasive species have been controlled or eliminated and restoration is initiated, ecosystems may see lost components or functions restored.

b. Information and Further Study Needs. At this time, no further investigations other than those identified in the monitoring plan are envisioned.

I. GOAL 4: AQUATIC CONNECTIVITY (FISH PASSAGE). Restore aquatic connectivity on the Illinois River and its tributaries, where appropriate, to restore healthy populations of native species

Problem. There is diminished aquatic connectivity (upstream/downstream) on the Illinois River and its tributaries. Aquatic organisms do not have sufficient access to diverse habitat such as backwater and tributary habitats that are necessary at different life stages. Lack of aquatic connectivity slows repopulation of stream reaches following extreme events such as pollution or flooding and reduces genetic diversity of aquatic organisms.

Objectives

- Restore main stem to tributary connectivity, where appropriate, on major tributaries.
- Restore within tributary connectivity.
- Restore passage for large-river fish at Starved Rock, Marseilles, and Dresden Lock and Dams, where appropriate.

Anticipated Outputs

The dams found throughout the Illinois River Basin block fish movement, but most dams are partially passable under some conditions. For native fish species, fish passage must be available during the appropriate times of the year or life stages, which is often not the case. Expected outputs would include improved fish access to spawning, nursery, and overwintering areas at appropriate times. Connectivity also allows for recolonization and improved genetic diversity of populations of native fish and mussels. While virtually all fish species would benefit, species of particular interest including the State listed river redhorse, greater redhorse, Iowa darter, and numerous shiner species. Freshwater mussels would also benefit, due to the life cycle requirements of utilizing fish species as host to colonize and re-colonize areas. The end result would be greater numbers, health, and species diversity for native fish and mussel populations.

1. Inventory Resource Conditions

a. Historic Conditions. Dam construction is a common disturbance in streams nationwide. Throughout the Illinois River Basin, hundreds of dams, ranging in size from very small weirs to large dams, have been constructed since the early 1800s. During the early development period in the 1800's, dams were constructed to power mills and factories located adjacent to streams. On large rivers such as the Illinois, dams were constructed to aid navigation during the 1840s to 1860s and rebuilt by state and the U.S. Army Corps of Engineers for the current 9-foot navigation channel in the 1930s. Later, dams were constructed along major tributaries for water supply, flood control, and recreation. All along, farmers were building ponds to water livestock and raise fish for food, and other landowners were pooling small streams with weirs for aesthetics. Most recently, ponds, dry dams, and water and sediment control basins (WASCOBS) are being constructed through U.S. Department of Agriculture programs to help reduce water and sediment transport to streams. The U.S. Geological Survey has records of about 140 large dams in the Illinois River Basin. There are hundreds more small dams documented by other agencies and many more that are undocumented. Seven dams on the Illinois Waterway and approximately 467 dams within the basin are considered in this report for fish passage.

b. Existing Conditions. There are numerous dams throughout the Illinois River Basin. The navigation dams on the main stem Illinois River/Illinois Waterway are located at La Grange, Peoria, Starved Rock, Marseilles, Dresden, Brandon Road, and Lockport. Table 3-40 and figure 3-16 identify the locations of the main stem dams. The lower two dams at La Grange and Peoria are wicket dams and allow open river conditions 48 percent and 42 percent of the time, respectively. The remaining dams hinder fish movement, although there is some incidental fish passage through the lock chambers at all the dams. Table 3-40 shows the opportunity for fish passage based on the percent of time the dam gates are out of the water and free passage conditions exist. In addition to dams, in 2001, a temporary electrical barrier was installed at Illinois RM 296.3 in the Lockport Pool to discourage movement of non-indigenous species between Lake Michigan and the Upper Mississippi River System. A permanent electrical barrier is currently under construction immediately downstream.

Table 3-40. Illinois River Main Stem Dams

Dam	River Mile	Hydraulic Height	% Year Free Passage Conditions Exist [1]
La Grange Lock and Dam	80	10 [2]	48%
Peoria Lock and Dam	158	11 [2]	42%
Starved Rock Lock and Dam	231	19 [3]	0%
Marseilles Lock and Dam	247	24 [3]	0%
Dresden Lock and Dam	271	22 [2]	0%
Brandon Road Lock and Dam	286	34 [2]	0%
Lockport Lock and Dam	291	40 [3]	0%

[1] Upper Mississippi River and Illinois Waterway Cumulative Effects Study, West Consultants Inc., Bellevue, Washington, June 2000.
[2] GIS data layer, National Inventory of Dams, FEMA, Corps 1995-1996.
[3] www.towboat.org/lock.htm

The number and impact of dams on the major tributaries vary. Figure 3-16 shows the existing stream miles that are connected to the main stem of the Illinois River. There are no dams on the main stems of the La Moine River and Mackinaw River. A few dams are located on the main stems of the Sangamon River (figure 3-17), Spoon River (figure 3-18), Vermilion River (figure 3-19), Aux Sable Creek (figure 3-21), and Kankakee River (figure 3-22). Numerous dams are found on the main stem of the Fox River (figure 3-20), DuPage River (figure 3-23), Des Plaines River (figure 3-24), and North Branch of the Chicago River (figure 3-25). Table 3-41 reports the number of dams on the major tributaries and distance of the first dam from the Illinois River.

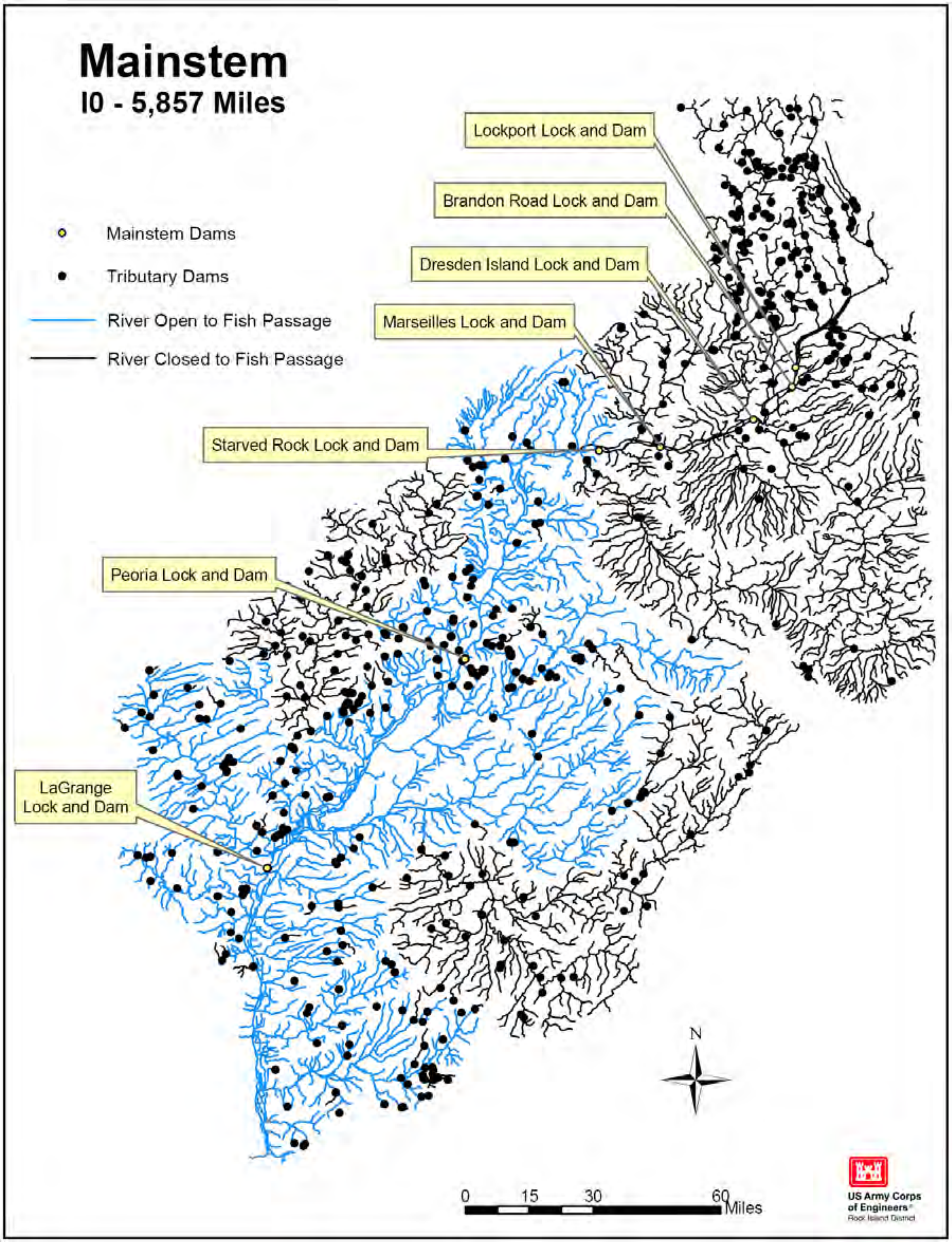


Figure 3-16. Illinois River Existing Connected Stream Segments

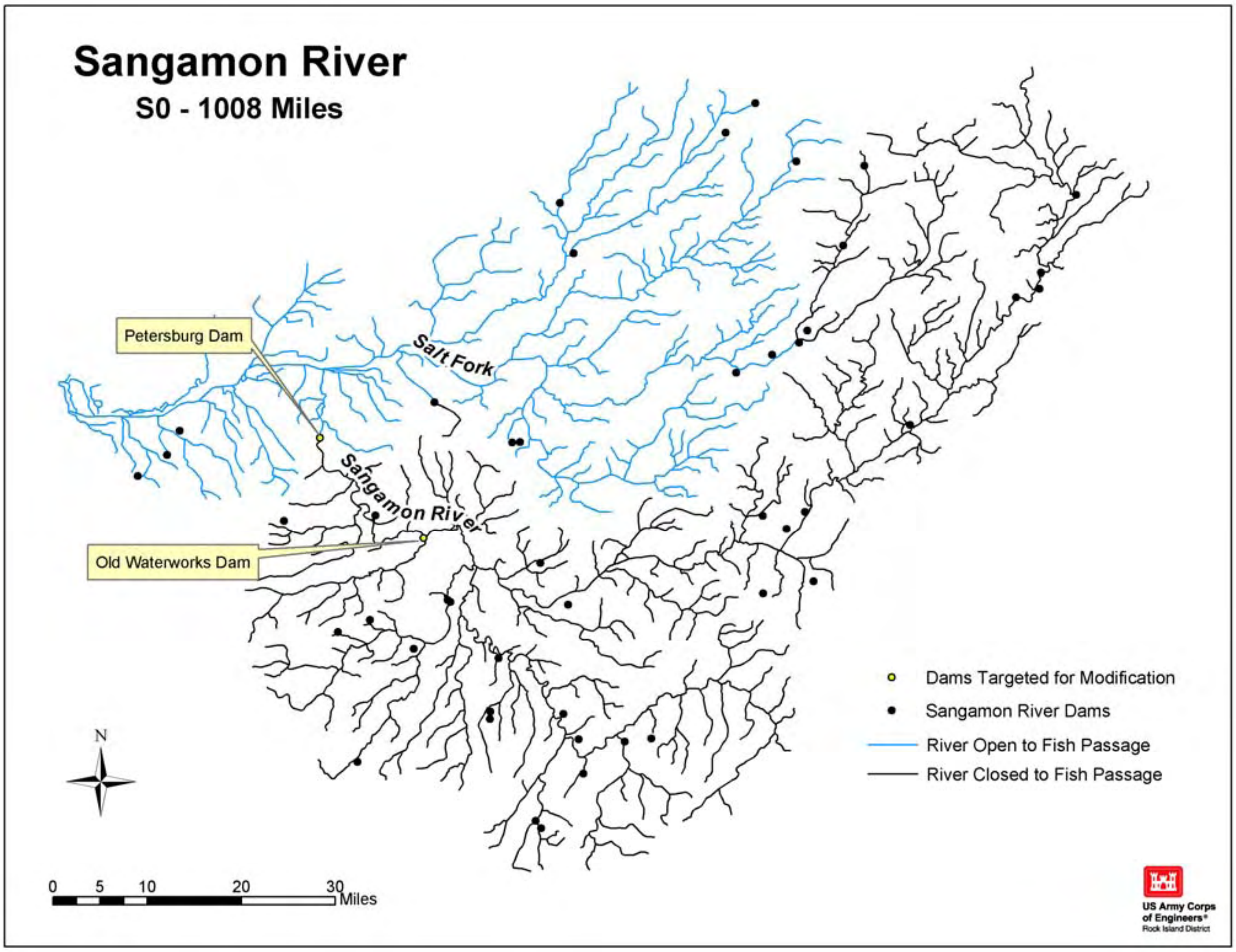


Figure 3-17. Sangamon River Connected Stream Miles

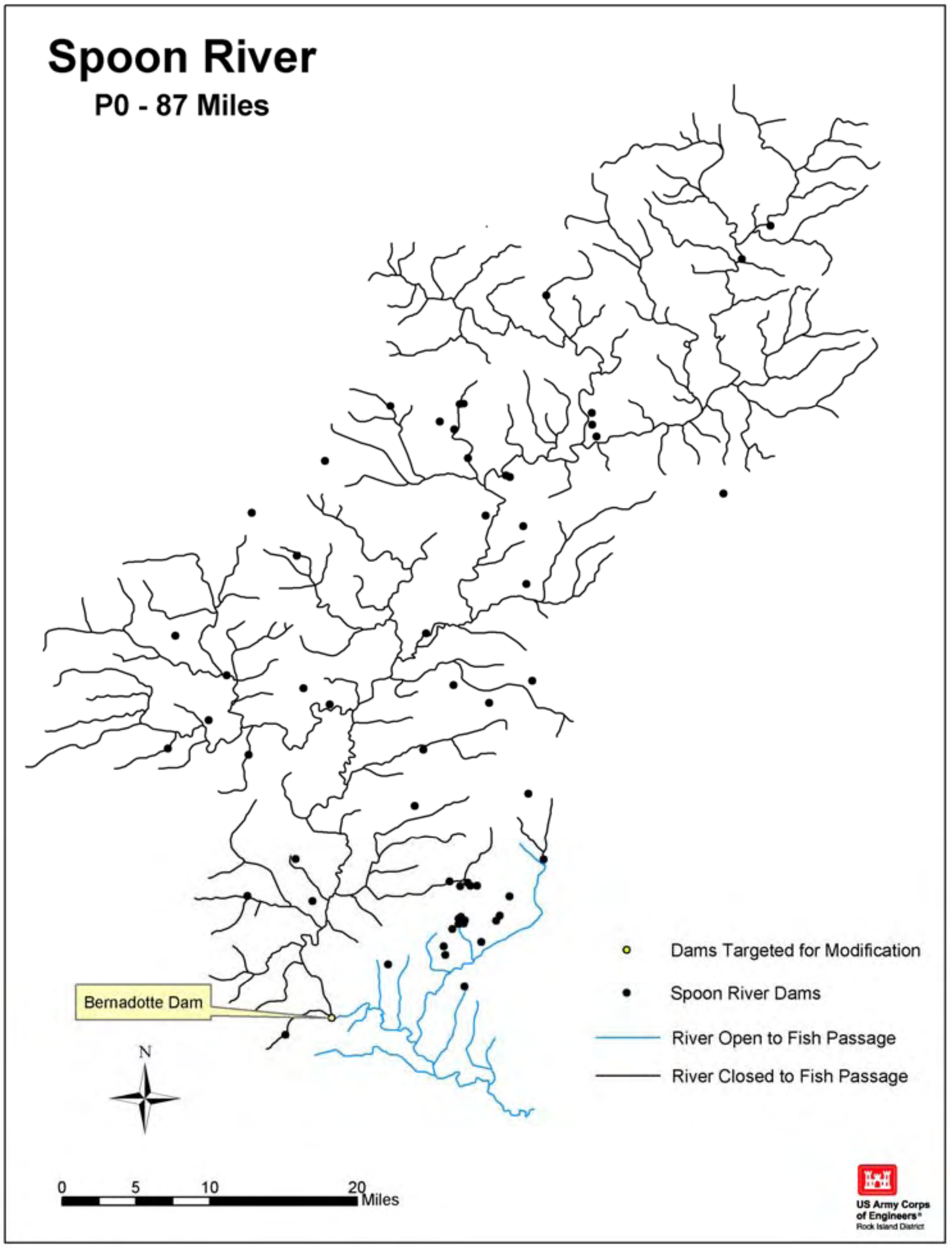


Figure 3-18. Spoon River Connected Stream Miles

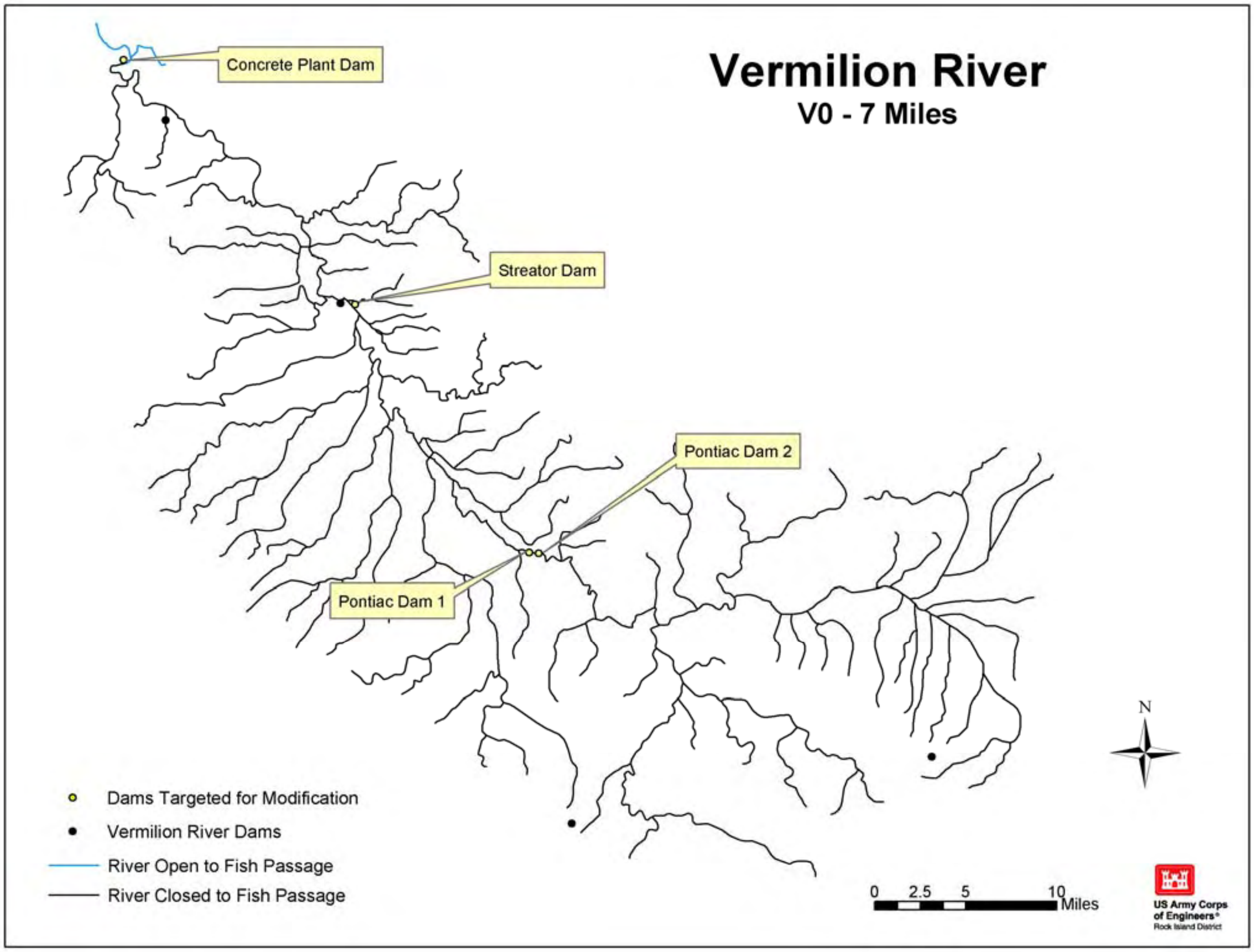


Figure 3-19. Vermilion River Connected Stream Miles

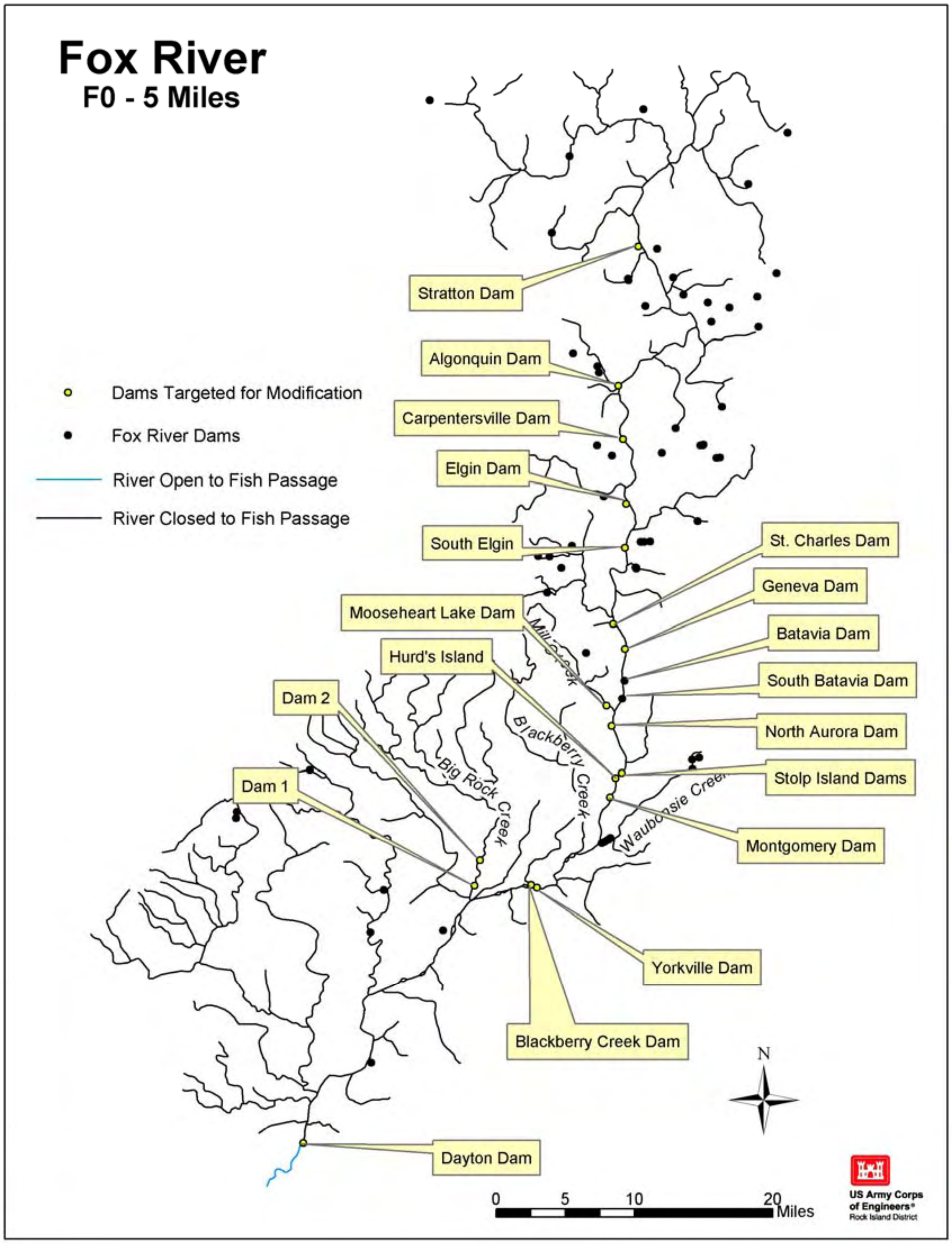


Figure 3-20. Fox River Connected Stream Miles

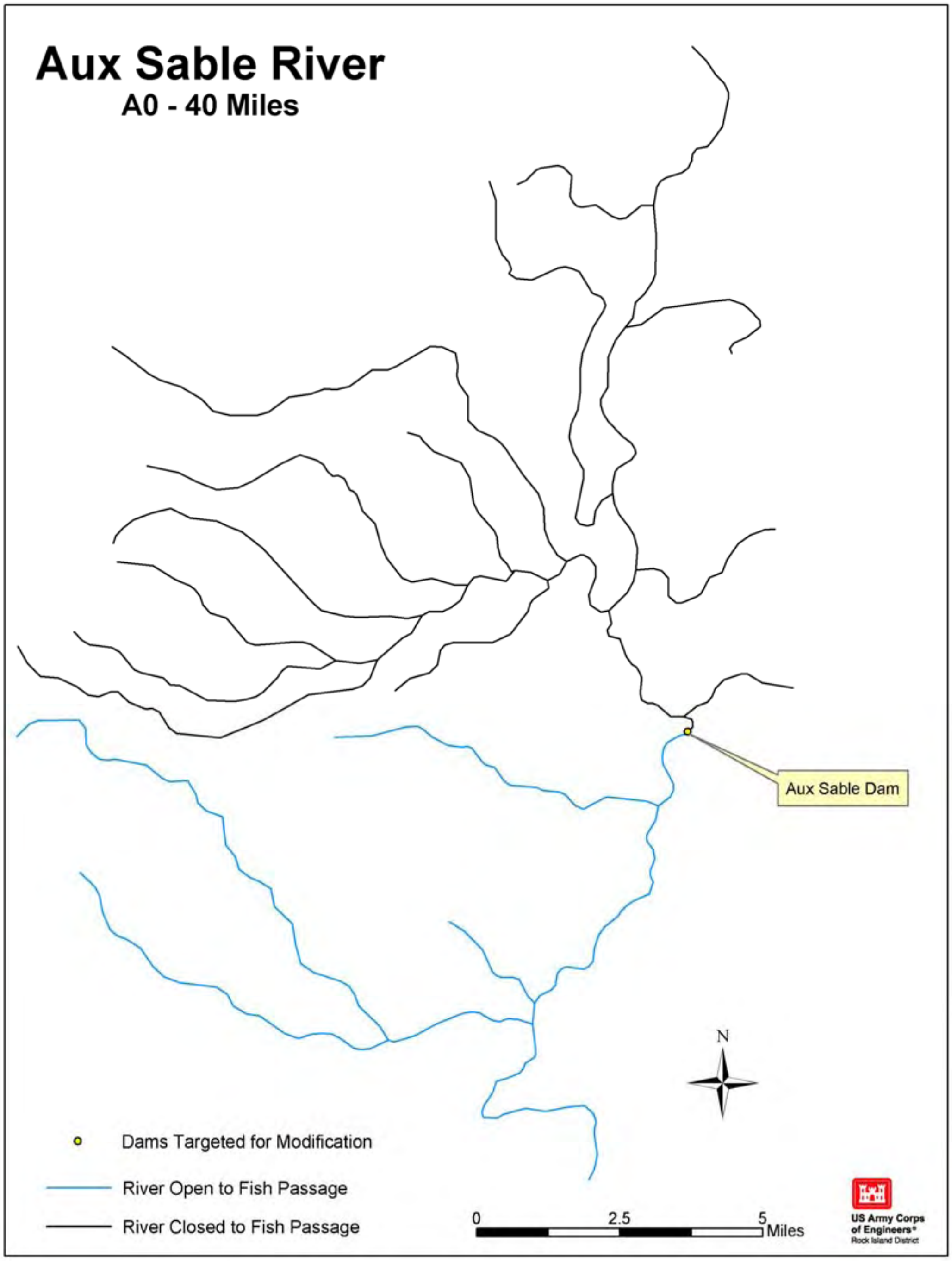


Figure 3-21. Aux Sable Creek Connected Stream Miles

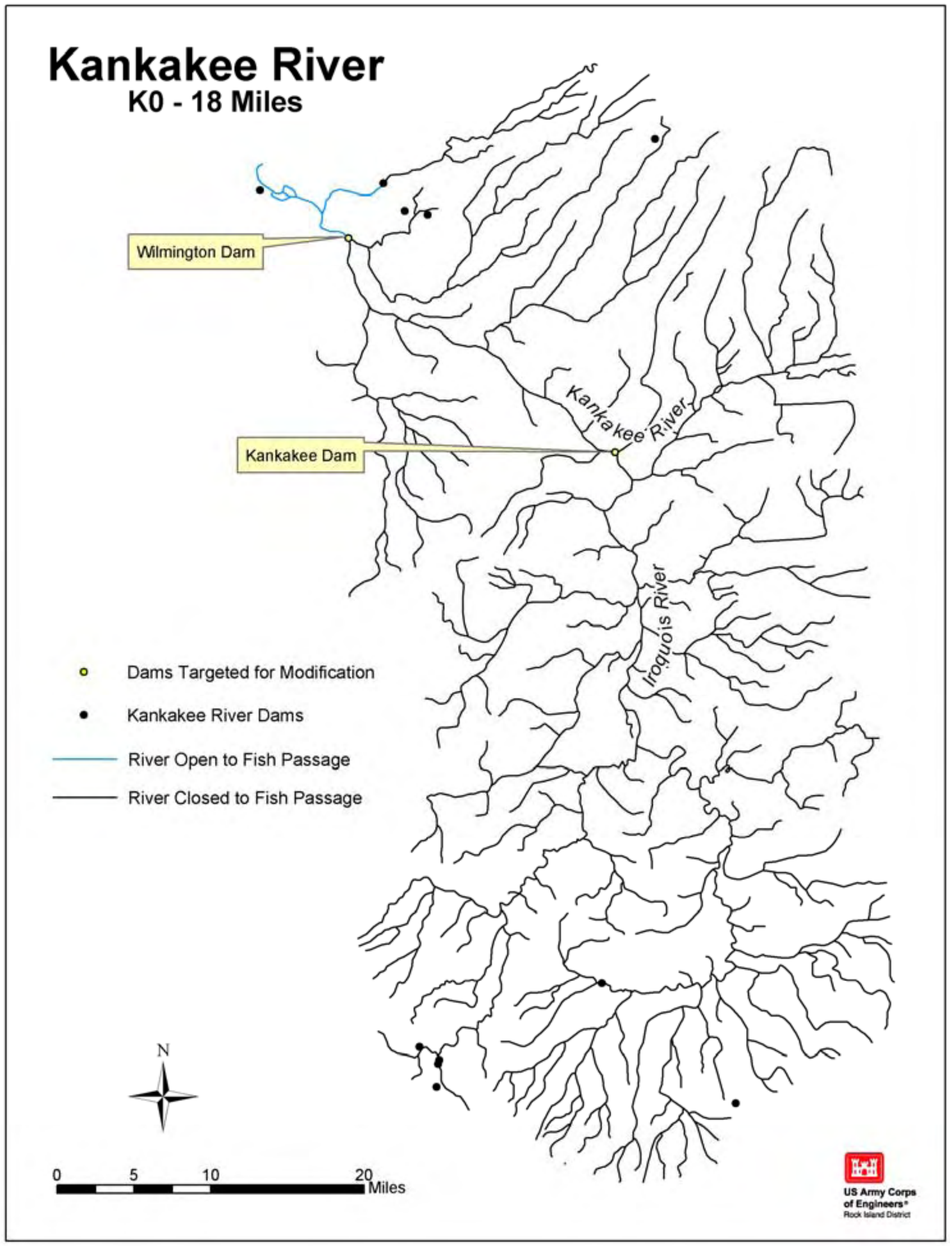


Figure 3-22. Kankakee River Connected Stream Miles

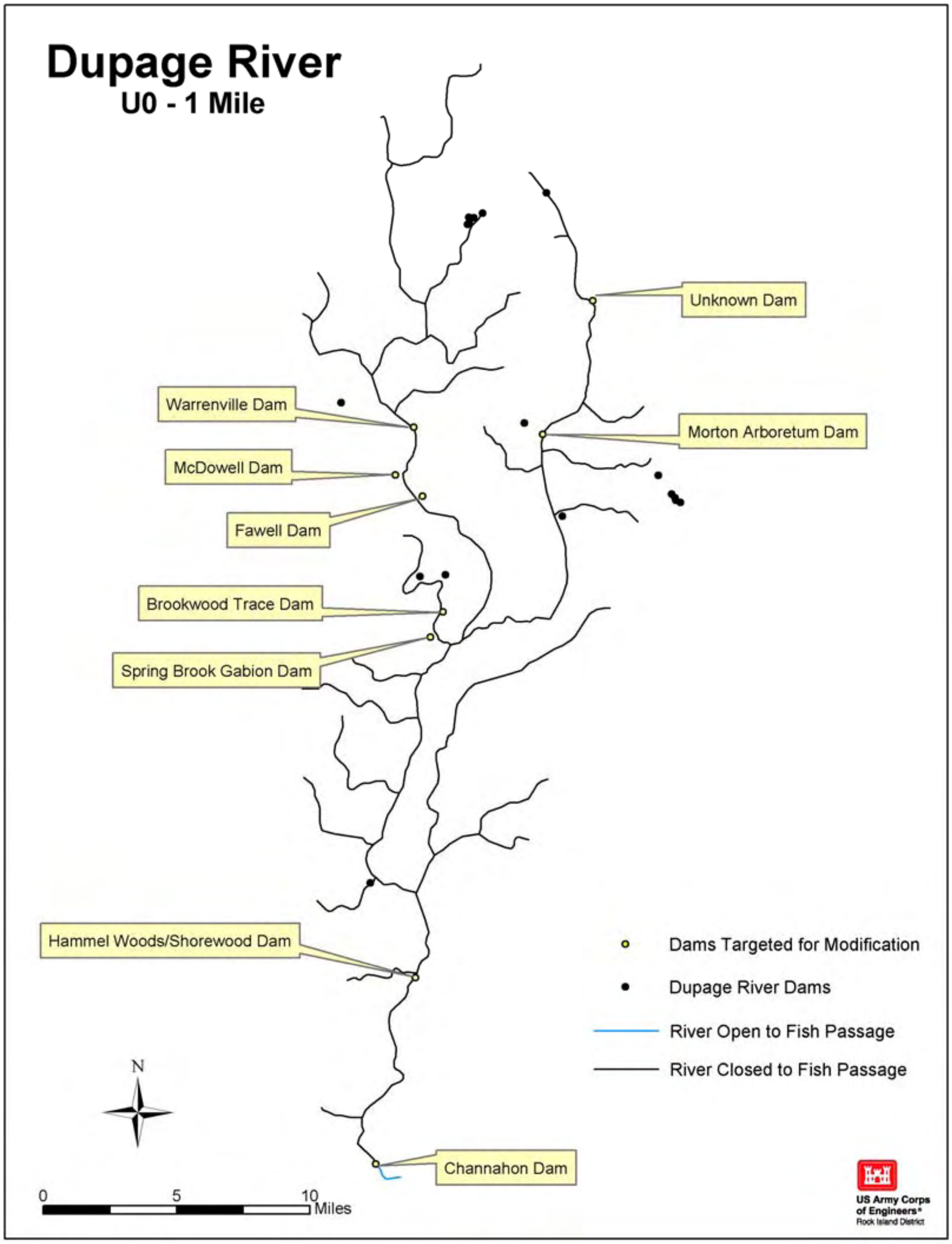


Figure 3-23. DuPage River Connected Stream Miles

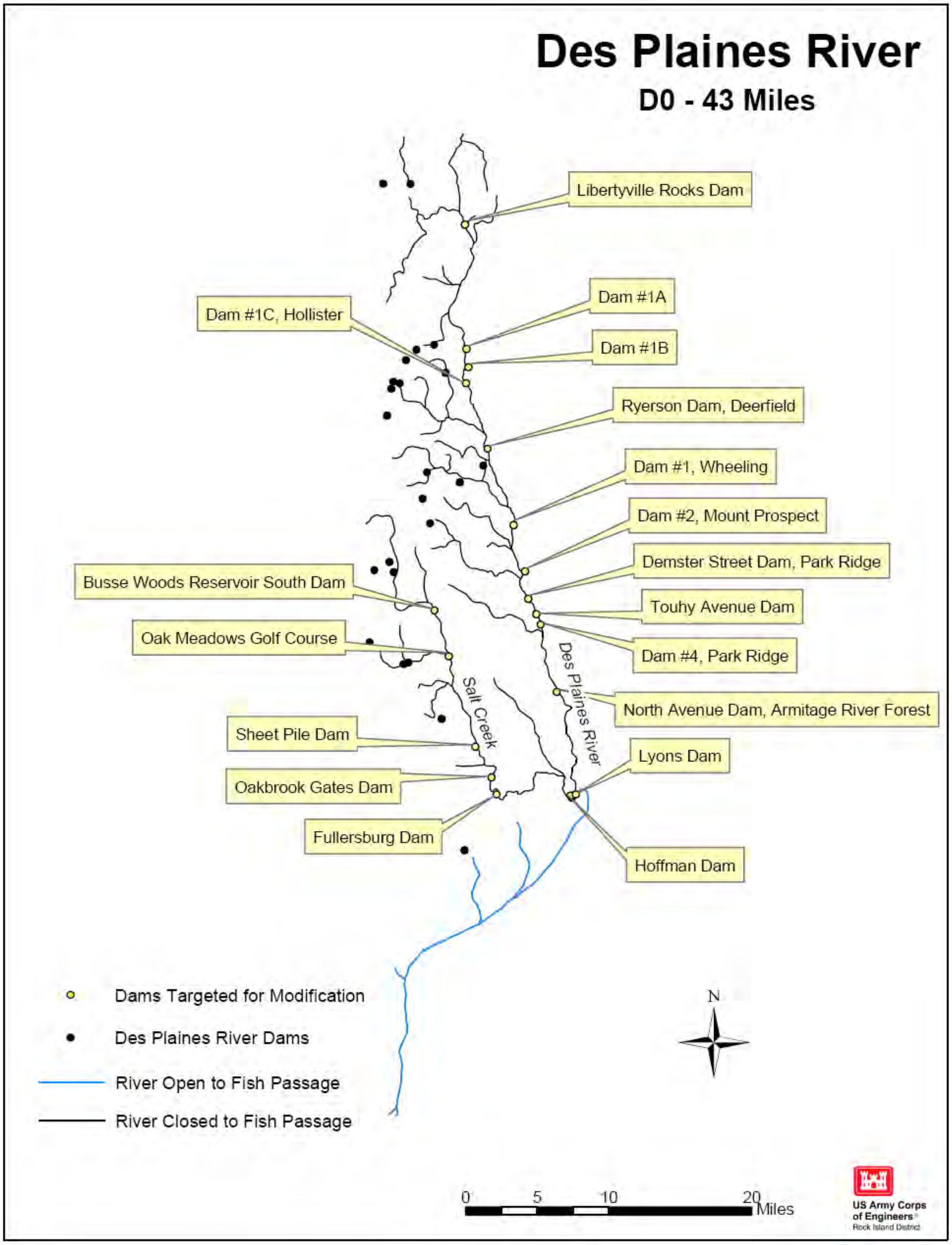


Figure 3-24. Des Plaines River Connected Stream Miles

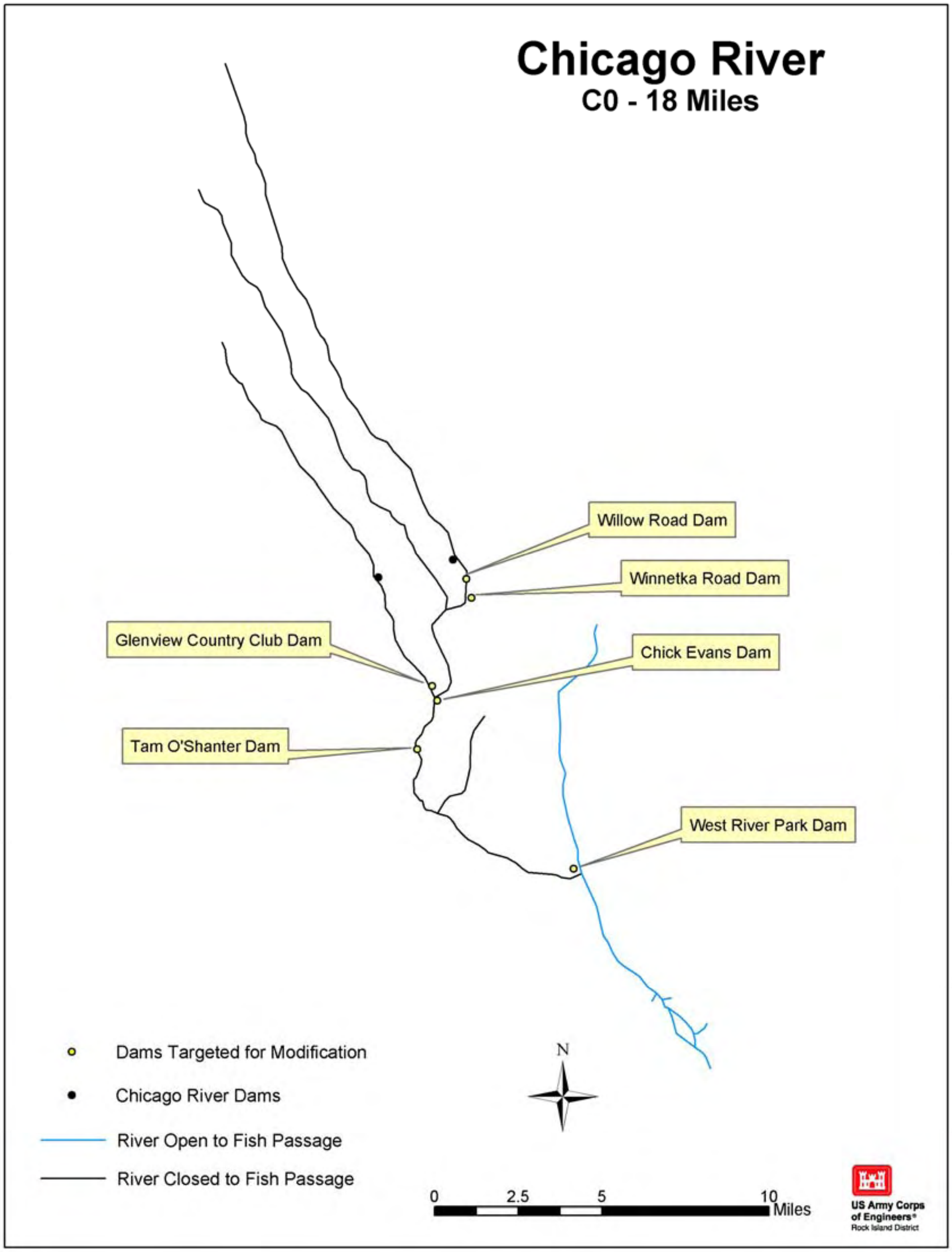


Figure 3-25. Chicago River Connected Stream Miles

Table 3-41. Illinois River Tributaries With First Dam Details

		First Tributary Dam		
Tributary Name	**Dams on Main stem**	**Name**	**Height (ft)**	**RM from Confluence with Illinois River**
Macoupin Creek	N			
Sandy Creek	N			
McKee Creek	N			
La Grange L/D				
LaMoine River	N			
Sangamon River	Y	Petersburg	2-3	42
Salt Fork	Y	Clinton Lake Dam	65	76 [1]
Spoon River	Y	Bernadotte Dam	2-3	27 [1]
Mackinaw River	N			
Peoria L/D				
Vermilion River	Y	Concrete Plan Dam	3-5	6
Starved Rock L/D				
Fox River	Y	Dayton Dam	29.6 [2]	5.7[2]
Marseilles L/D and Dresden L/D				
Kankakee River	Y	Wilmington Dam	5	9.5
DuPage River	Y	Channahon Dam	10	1.5
Brandon Road L/D				
Des Plaines River	Y	Lyons Dam	2	43

Data from National Inventory of Dams - (http://crunch.tec.army.mil/nid/webpages/nid.cfm) – except as noted:
[1] Illinois Streams Information System, Illinois DNR.
[2] Data from Vic Santucci, Max McGraw Wildlife Foundation.

c. Future Without-Project Conditions. Without the project, lack of aquatic connectivity (fish passage) will continue to negatively affect species and populations of aquatic organisms in the Illinois River Basin.

Additional dams may be constructed in the future. The need for potable water for increasing populations in northeastern Illinois may result in construction of dams or modification of existing dams for water supply purposes. It is anticipated that new dams may be constructed to accommodate fish passage; however, any new dams would likely have some impact on connectivity.

It is likely that some of the dams would be removed in the future. Dam removal would be municipality driven and would be related to the costs of continued operation and maintenance as well as safety concerns. Municipalities would weigh the benefits and services provided by the dam with the costs of reconstruction, repair, and continued operation and maintenance. The Illinois DNR Office of Water Resources is evaluating dam modification or dam removal on State-owned dams.

Fish passage at the Illinois River main stem dams was evaluated under the Upper Mississippi River - Illinois Waterway System Navigation Study, but was not determined to be a high priority on the Illinois River (Wilcox et al. 2004). The low to medium priority ranking was related to the relatively high cost to construct fishways at these sites and the relatively low access to tributary habitat when compared to the Upper Mississippi River dams. Restoration of fish passage at Starved Rock Lock and Dam, Marseilles Lock and Dam, and Dresden Lock and Dam was included in the alternative plan with the maximum amount of ecosystem restoration (USACE 2004b). Restoration of fish passage at Brandon Road Lock and Dam, Lockport Lock and Dam, and T. J. O'Brien Lock and Dam was not considered as this could facilitate dispersal of nonindigenous fish between the Upper Mississippi River System and the Great Lakes.

The success or failure of non-indigenous species barriers will affect connectivity in the future. Construction of a permanent electrical barrier 1,000 feet downstream of the temporary electrical barrier in the Lockport Pool began in 2004.

d. Desired Future Conditions. The desired future condition is a river system that provides connected habitats for native aquatic species, allowing them to utilize critical habitats at critical time periods and recolonize areas after extreme events or disturbance. This connectivity occurs at three scales; major tributary to main stem, within the major tributary basin, and within the main stem of the Illinois River.

The desired future condition is significant connectivity restoration between the main stem and the appropriate major tributaries. The main stem Illinois River would be connected to the majority of its tributaries including the Sangamon, Spoon, Fox, Kankakee, and DuPage Rivers.

The desired future condition is to restore within-tributary connectivity in the major tributary basins. Connectivity along the main stem of the Fox River would be reestablished, and connections would be restored to a few of the Fox River tributaries. Within-tributary connection also would be restored along the main stem of the DuPage, Des Plaines, Kankakee, Vermilion, Sangamon, and Spoon Rivers. Fish passage would be strongly advised for any new dam construction in order to maintain the current degree of connectivity.

The desired future condition is passage of 100 percent of large-river fish on the Illinois River main stem up to RM 286 at Brandon Road Lock and Dam. This would require improved passage at Starved Rock, Marseilles, and Dresden Lock and Dams. The Lockport and Brandon Locks and Dams would continue to block fish movement, thus limiting dispersal of non-indigenous aquatic species between the Upper Mississippi River System and the Great Lakes. Additional study is needed to assess the desirability of facilitating passage at the Brandon Road Lock and Dam. Restored connectivity between the main stem at Brandon Road Lock and Dam and the Des Plaines River is desirable, but this would need to be balanced with the desire to limit dispersal of non-indigenous species.

Restoring aquatic connectivity to aquatic systems restores a measure of ecological integrity to an area. By allowing access to habitats that supply different life requisites for fish species, the future of those species is more likely. In addition, transport of mussel glochidia (freshwater mussel larvae that attach to a vertebrate host for continued life cycle development) by different fish species ensures that mussel communities and species have access to appropriate habitats. Finally, by restoring this component to the ecosystem, some of the building blocks for a healthy and functioning system are restored.

2. Formulation of Alternative Plans

a. Approach/Assumptions. Expert panels and GIS maps were used to formulate and evaluate alternative plans. The GIS maps of dams and stream segments were analyzed to assess relative connectivity within the system. An expert panel of Illinois fisheries biologists from throughout the basin formulated restoration measures for the main stem and each major tributary. The GIS analysis was used to calculate the stream miles connected for each measure. The expert panel then evaluated the relative benefit of restoring connectivity in the various tributaries. The expert panel utilized total stream miles connected and relative benefit information to formulate alternative plans from the measures.

b. Criteria and Constraints. A number of criteria should be considered when formulating plans to restore aquatic connectivity. The magnitude of negative impacts that are caused by the dams was considered. It was assumed that tributaries with high dams, high numbers of dams, or dams close to the confluence with the Illinois River were more negatively impacted. The quality and amount of habitat upstream of the dams was also considered.

Design of site-specific projects to improve connectivity should consider criteria such as swimming speeds and seasonal movement patterns of targeted fish species.

Restoration of connectivity is constrained by the existing use of the dams and their impoundments. Some of the dams provide sufficient water depth for commercial and recreational navigation or hydropower production. This use may also constrain the methods to restore connectivity. Another constraint is the willingness of the dam owners and surrounding communities. Potential contamination of sediments accumulated upstream of the dam may be an issue at some dam locations, constraining potential dam removal.

Restoration of connectivity within tributaries should not increase dispersal of non-indigenous species. Dispersal from the Illinois River to Lake Michigan or from Lake Michigan to the Illinois River is a concern, as well as from the Illinois River to the major tributaries. Non-indigenous species can affect fish and aquatic community diversity by displacing native species and/or modifying their habitat. The Illinois River main stem dams and the electrical barrier currently provide a partial barrier between the Upper Mississippi River System and Lake Michigan. To limit dispersal of non-indigenous species, fish passage should not be restored at Lockport Lock and Dam or the T. J. O'Brien Lock and Dam, which is located on the Calumet-Sag Channel connecting the Illinois River to Calumet Harbor, Lake Michigan. Maintaining these dams does not prevent dispersal of non-indigenous species entirely as they can be transferred to other water bodies through human means such as in bait buckets, live wells, and other accidental means. Non-indigenous species issues should also be considered when reconnecting tributaries to the main stem of the Illinois River.

c. Measures. Fish passage can be accomplished through a variety of techniques. Only the most common methods are discussed here, however, all appropriate techniques should be considered during the site-specific evaluations.

i. Dam Removal. This alternative would consist of the removal of the existing dam (photograph 3-4). This removal would restore 100 percent fish passage at the site. However, many existing dams are highly valued by the surrounding communities, even when there is no longer a specific function for the dam. This measure will be used for ecosystem restoration purposes solely, and should accomplish objectives and produce benefits related to ecological restoration. This measure should not be used to meet regulatory or dam safety requirements. This measure also include significant water quality benefits by removing the often stagnant, shallow pools that form behind dams, thereby increasing dissolved oxygen levels, reducing water temperature, and restoring the flow of gravel, woody debris, and nutrients. This measure would also restore the fish species composition from primarily lacustrine (lake) species back to primarily riverine species.

Photograph 3-4. Before and After Photographs of Dam Removal of Woolen Mills Dam, Wisconsin
www.americanrivers.org

ii. Rock Ramp. Construction of a rock ramp fishway involves placement of stone on the downstream face of the dam to provide a relatively flat 3 to 5 percent gradient (photograph 3-5). Strategic placement of various sized fieldstone would convert the spillway to a more natural looking system of rapids. The roughened chute could be implemented completely across the spillway, converting the entire spillway to a rapids system, or limited to only a portion of the spillway. Pools and eddies would be implemented into the design to slow water velocities and allow resting spots for fish as they travel upstream. Water velocities of 1.5 feet per second or less should be provided throughout the fishway. Besides allowing upstream and downstream fish passage, the rocky bed would create habitat for fish and other aquatic organisms. The mixing action as water passes over and around rocks oxygenates the water, improving water quality. The fishway should be designed to operate under flows equating to the 10- to 90-percent duration range during the months of March, April, and May. During these months, native species such as: walleye, sauger, smallmouth and largemouth bass, northern pike, and channel catfish will be using the fishway to reach suitable upstream spawning grounds. A roughened chute reduces the drowning hazard by eliminating the problem of a downstream hydraulic roller; requires minimal maintenance, minimal real estate acquisition; and is aesthetically pleasing.

Photograph 3-5. Rock Ramp- Otter Tail River, Minnesota

iii. Bypass Channel. The construction of a channel consisting of a series of pool and riffle structures around of the dam is another alternative. A staircased rock and boulder riffle structure would gradually reduce the water level differential between the head and tailwaters of the dam. While this alternative solves the problem of fish passage, the safety risk associated with the hydraulic roller on the downstream face of the dam still exists.

iv. Denil Fishway. Denil Fishways are rectangular chutes or flumes with baffles extending from the sides and bottoms which point upstream (photograph 3-6). The internal roughness created by the baffling controls flow for fish passage. The preferred site would be on the side of the dam where fish tend to congregate. While this alternative solves the problem of fish passage, the safety risk associated with the hydraulic roller on the downstream face of the dam still exists.

Photograph 3-6. Denil Structure at Ipswich Mills Dam, Ipswich, Massachusetts
http://www.mass.gov/dfwele/dmf/publications/tr17_anad_p3_appendix.pdf

d. Alternatives. The study team identified dams throughout the basin that block or inhibit fish migration. Alternatives were developed for the main stem and each tributary basin to increase stream miles of connectivity.

Conditions on the main stem of the Illinois River were evaluated. Because the wicket gates at Peoria and LaGrange Lock and Dams are out of the water 48 percent and 42 percent of the time, respectively, fish passage was not considered necessary at these locations. The main stem dams remaining for consideration as alternatives are Starved Rock, Marseilles, and Dresden Lock and Dams. Adding fish passage at Starved Rock Lock and Dam provides access to the Fox River basin. No major tributaries enter the Marseilles pool; therefore, it was grouped with Dresden Lock and Dam, providing access to the Kankakee and DuPage basins. Finally, the addition of fish passage at Brandon Road Lock and Dam, which provides access to the Des Plaines River, was eliminated at this time in order to continue to block migration of nonindigenous fish between the Upper Mississippi River System and the Great Lakes. The risk associated with and potential benefits of fish passage at this location require further study and may be re-evaluated at a later time.

Tributary restoration alternatives were developed for the Sangamon River, Spoon River, Vermilion River, Fox River, Aux Sable Creek, Kankakee River, DuPage River, Des Plaines River, and North Branch of the Chicago River. Alternatives were developed by grouping specific dams targeted for fish passage. Table 3-42 presents the detailed connectivity alternatives considered. Connected stream miles and incremental gain in stream miles are reported for the various alternatives.

Table 3-42. Detailed Fish Passage Alternatives for the Illinois River Basin

	# of Dams	Stream Miles Connected	Net Increase in Stream Miles Connected
Main Stem		13130[1]	
I0 – No action		5990	
I1 – Fish Passage at Starved Rock	1	6090	100
I2 – Fish Passage at Starved Rock, Marseilles, and Dresden [2]	3	6730	640
Sangamon River		2604[1]	
S0 – No action		1008	
S1 – Fish Passage at Petersburg	1	1808	800
Spoon River		963[1]	
P0 – No action		87	
P1 – Fish passage at the Bernadotte Dam [2]	1	883	796
Vermilion River		715[1]	
V0 – No action		7	
V1 – Fish passage at Concrete Plant	1	144	137
V2 – Fish passage at Concrete Plant and Streator Dams	2	430	286
V3 – Fish passage at Concrete Plant, Streator and Pontiac Dams	4	711	281
Fox River		806[1]	
F0 – No action		5	
F1 – Fish Passage at all main stem dams	12	568	563
F2 – Fish Passage at all main stem dams and 4 tributaries [2]	17	702	134
Aux Sable River		131[1]	
A0 – No action		40	
A1 – Fish passage at Aux Sable Dam [2]	1	131	91
Kankakee River		1308[1]	
K0 – No action		18	
K1 – Fish Passage at Wilmington Dam	1	298	316
K2 – Fish Passage at Wilmington and Kankakee Dams [2]	2	1267	969
DuPage River		170[1]	
U0 – No action			
U1 – Fish passage at all dams on West Branch	5	149	
U2 – Fish passage at all dams on West and East Branch and 1 tributary (Springbrook) [2]	8	168	
Des Plaines River		267[1]	
D0 – No action		43	
D1 – Fish passage at Lyons, Hoffman, and Armitage Dams and 1 tributary (Salt Creek)	7	108	65
D2 – Fish passage at all main stem dams and 1 tributary (Salt Creek) [2]	17	248	140
Chicago River		81[1]	
C0 – No action		18	
C1 – Fish passage at 6 main stem dams	6	55	37

[1] Alternatives do not reconnect all stream miles due to additional dams on tributary systems. Stream miles estimated from GIS coverage (Illinois River Restoration Needs Assessment GIS, Scott A. Tweddale, Construction Engineering Research Laboratory (CERL)).
[2] Denotes system alternative plan

3. Evaluation and Comparison of Plans

Alternatives were evaluated, both qualitatively and quantitatively, and this information was used to formulate the alternative plans.

a. Tributaries. The study team developed the matrix in table 3-43 to qualitatively evaluate and compare potential benefits of restoring fish passage on the major tributaries. The study team used professional judgment based on field experience to estimate the relative negative impacts caused by dams. Biological Stream Characterization (BSC) data for the tributaries was used to estimate stream quality. These two categories were used to assess the relative potential benefits of restoring connectivity on a given tributary and assign a priority for restoring connectivity. Tributaries with low negative fisheries impacts had low to medium priority depending on the stream quality. The Sangamon River was identified as having low impacts due to the single low-head dam that separates two large reaches of river. Tributaries with medium negative fisheries impacts were rated as having medium priority unless stream quality was low. Streams with high negative fisheries impacts were given a high priority. For example, the Fox River has a large number of dams along the main stem and has a high fish species diversity. Restoring connectivity on the Fox, DuPage and Des Plaines Rivers was estimated to have a high potential benefit and was given a high priority. Restoring connectivity on the Spoon, Aux Sable and Kankakee Rivers was estimated to have a medium potential benefit and was assigned a medium priority. Restoring connectivity on the Sangamon, Vermilion, and Chicago Rivers was estimated to have a lower potential benefit and was assigned a low priority.

Table 3-43. Evaluation of Benefits of Fish Passage for the Major Tributaries

River	Negative Fisheries Impacts Caused by Dams	Stream Quality [1]	Priority for Fish Passage
Sangamon	L	M	L
Spoon	M	M-H	M
Vermilion	L	M-H	L
Fox	H	M-H	H
Aux Sable	M-H	H	M
Kankakee	L	H	M
DuPage	H	M	H
Des Plaines	H	M	H
Chicago River	M	L	L

[1] Estimated from Biological Stream Characterization data (Bertrand et al. 1996, ISIS 1999)

The tributaries were grouped by the relative benefits of fish passage to form system connectivity alternatives (table 3-44 and figure 3-26). The cost estimates for tributary passage were based on rock ramp construction. Table 3-44 provides the estimated costs and benefits of the system connectivity alternatives. Benefits are shown in total connected stream miles. The first tributary alternative, 4A, addresses restoring connectivity on the tributaries with a high priority—those tributaries that have been most negatively impacted by dams and with medium to high stream quality. This alternative includes restoring connectivity at all main stem dams and a few tributaries of the Fox River; restoring connectivity at all main stem dams on the DuPage and West Branch of the DuPage River; and restoring connectivity at all main stem dams on the Des Plaines River (figure 3-26). Alternative 4A would reconnect 916 stream miles at an estimated total cost of $52 million.

The second tributary alternative, 4B, includes Alternative 4A with the addition of the dams with medium priority—the main stem dams on the Spoon, Kankakee, and Aux Sable Rivers (figure 3-26). Alternative 4B would reconnect a net 3,052 stream miles.

The third tributary alternative, 4C, includes Alternative 4A+4B, with the addition of restored connectivity on main stem dams of the remaining major tributaries—the Sangamon, Vermilion, and North Branch of the Chicago Rivers (figure 3-26). Alternative 4C would reconnect a net 4,593 stream miles. In spite of the relatively low costs, the study team did not recommend that Alternative 4C be carried forward to the final array of alternatives. Impacts of the Petersburg Dam, on the Sangamon River, are thought to be minimal as the dam is higher up in a large watershed and is passable under some flow conditions. The impacts of the Vermilion River dams are lower as the dams are passable under some flow conditions. Low habitat quality and low water quality on the Chicago River currently limit the potential restoration benefits of fish passage.

b. Main Stem. The main stem alternatives carried forward for evaluation were renamed as follows: I1 and I2 (table 3-42) become 4X and 4Y (table 3-44 and figure 3-26) and reconnect 100 and 740 river miles, respectively. Table 3-44 reports the estimated costs and benefits of the connectivity alternatives.

The study team felt that restoring connectivity *within* tributary basins provided more benefits to the natural resources of the Illinois River Basin than restoring main stem connectivity. The study team did not recommend Alternative 4X that would provide passage only at Starved Rock, which would restore connectivity only to the Fox River. Alternative 4Y, which includes passage at Starved Rock, Marseilles, and Dresden Lock and Dams, was recommended for inclusion in the maximum system alternative plan.

4. Plans Recommended for System Analysis

a. Recommended Alternatives. A cost effectiveness/incremental cost analysis was conducted on the plans outlined in table 3-44 and combinations thereof, resulting in eight possible plans, shown in figure 3-27. Costs for the main stem alternatives were high compared to the amount of connectivity provided, and passage at these dams only became cost effective when combined with tributary connectivity plans. This analysis resulted in four cost effective plans, two of which were also best buys.

Of the two cost effective plans, Alternative 4B+X only provides connectivity to the Starved Rock pool and the Fox River; only 100 tributary steam miles would be reconnected at a cost of approximately $80 million. This alternative was not included into the final array for system alternatives. Alternative 4A, also cost effective, includes streams that are both good quality and highly impacted by dams, therefore given highest priority for fish passage. This alternative plan was recommended as the base plan for system alternatives. Both best buy plans were also recommended for the final array of system alternatives. Table 3-45 shows the final array of alternatives to be carried forward in developing comprehensive system restoration plans.

All system plans would include Blackberry and Waubonsie Creek projects already underway as Critical Restoration Projects. These projects were not included in this analysis.

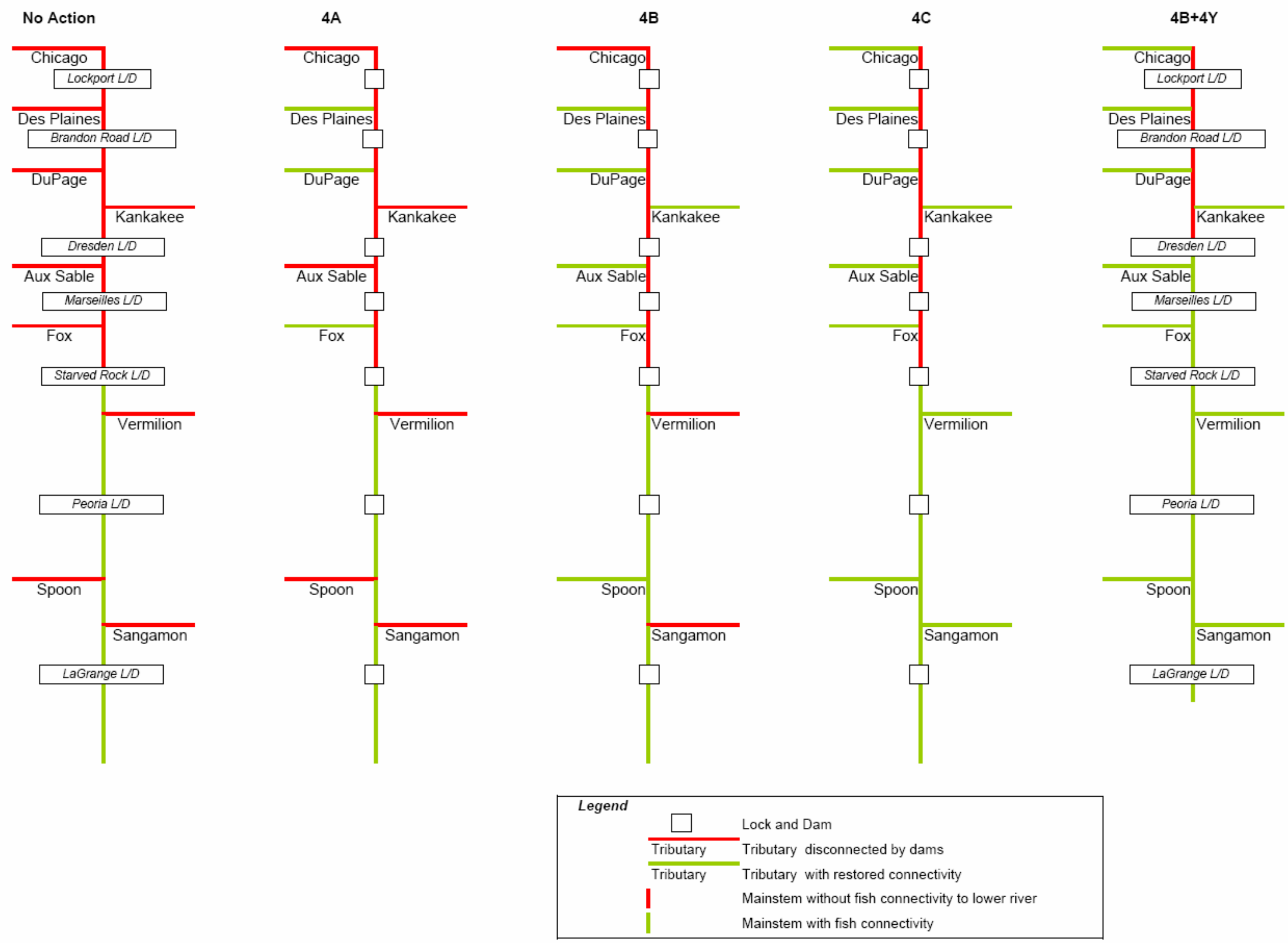


Figure 3-26. Schematic Diagram of Fish Passage Alternatives

Table 3-44. Connectivity Alternatives Evaluated for the Illinois River Basin

	Description	Alternatives From Table 3-42	Number of Dams	Total Connected Stream Miles [1]	Net Connected Stream Miles [2]	Cost [3]	Cost per Connected Stream Mile
Tributary Alternatives							
4A [4]	Fox, DuPage, Des Plaines	F1, U1, D2	34	2,143	916	$52 M	$57,000
4B [4]	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	F1, U1, D2, K2, P1, A1	38	4,279	3,052	$55 M	$18,000
4C	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable, Sangamon, Vermilion, Chicago	F1, U1, D2, K2, P1, A1 S1, V3, C1	49	5,820	4,593	$61 M	$ 13,000
Main Stem Alternatives							
4X	Starved Rock	I1	1	6,090	100	$80 M	$800,000
4Y [4]	Starved Rock, Marseilles, Dresden	I2	3	6,730	740	$235 M	$317,600

[1]Includes total tributary stream miles for Sangamon, Spoon, Vermilion, Fox, Kankakee, DuPage, Des Plaines, and Chicago Rivers. Also used to express beneficial effects from increased connectivity.
[2]Used to express **direct** benefits from increased connectivity.
[3]Includes construction, 35% construction contingency, 30% Planning Engineering and Design, 9% Supervision and Administration, and Real Estate
[4] Denotes system alternative plan

b. Risk and Uncertainty. There are at least 15 introduced fish species in Illinois. Some of these are U.S. natives whose range has been expanded or are species from other parts of the world. There has been a great nationwide increase in the total number of species introduced since 1950, and the proportion on non-U.S. species has also increased significantly (Chick and Pegg 2001). The greatest proportion of non-U.S. species is coming from Asia and South America. The mode of introduction is shifting from intentional releases of food or sport fishes to accidental releases of aquarium fish, aquaculture species, and those carried in international shipping ballast water.

When any fish passage project is proposed, the risk of introducing non-native fish into an area must be considered. The dams found throughout the Illinois River Basin block fish movement, but most dams are partially passable at some time. For native fish species, fish passage must be available during the appropriate times of the year or life stages, which is often not the case. Non-native fish tend to be stronger swimmers than many native species and, because of this, may be able to negotiate sub-optimal passage conditions that would impede more weakly swimming species. Many river fisheries biologists believe that most dams in the basin currently allow non-native species to pass but block native fish species (Sallee, 2004) . Only a very few dams in the basin currently are 100 percent impassable under natural conditions. The risks of introducing non-native species to these areas must be carefully considered. However, even in these areas, people may accidentally release non-native species.

In addition to blocking movement of non-indigenous species, existing dams also retain sediment. While the capacity of many older impoundments to retain sediment has been filled, any dam removal actions may mobilize the stored sediments downstream. For any proposed dam removal, examination of sediment retention benefits, as well as the potential addition of sediment to the system, must be weighed against fish passage benefits. This will be dependent on the volume and nature of the sediment. This issue will be examined on a case by case basis as projects are considered in the future.

c. Information and Further Study Needs

- Tagging studies to better determine movements, timing, habitat use, and design consideration.
- Further discussion, study and consideration of conflicts between restoring connectivity for native fish and mussels and maintaining barriers to limit dispersal of non-indigenous species
- Risk and uncertainty of non-indigenous species
- Community concerns over dam removal

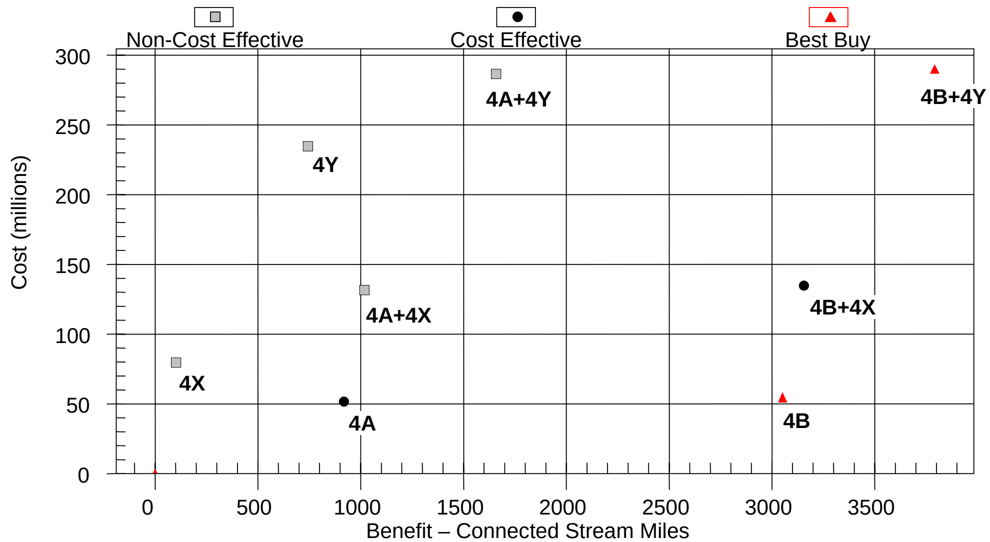


Figure 3-27. Cost Effectiveness of Alternative Plans

Table 3-45. Plans Recommended for System Alternative Plans

Alternative	Tributary	Total Construction Cost [1]	Total Real Estate Cost [2]	Total Estimated Costs	Annual O&M Costs
4A	Fox, DuPage, Des Plaines	$51,147,043	$337,1000	$51,484,143	$152,463
4B	Fox DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	$54,968,125	$372,400	$55,340,525	$156,691
4B + 4Y	Fox DuPage, Des Plaines, Kankakee, Spoon, Aux Sable, Starved Rock, Marseilles, Dresden	$289,733,287	$854,500	$290,587,787	$494,483

[1] Includes 35% construction contingency; 30% Planning, Engineering and Design; and 9% Supervision and Administration.
[2] Includes a contingency, but does not include acquisition or appraisal costs.

J. GOAL 5: HYDROLOGY AND WATER LEVELS. Naturalize Illinois River and tributary hydrologic regimes and conditions to restore aquatic and riparian habitat

Problem. Basin changes and river management have altered the water level regime along the main stem Illinois River, stressing the natural plant and animal communities along the river and its floodplain. Land use changes, the construction of the locks and dams (which create relatively flat navigation pools), and isolation of the river main stem from its floodplain have all impacted the water level regime to varying extents. Two of the most critical results from the basin changes and river management, are the increased frequency and increased magnitude of water level fluctuations, especially during summer and fall low water periods. The lack of the ability to mimic natural hydrologic regimes in areas upstream of the navigation dams is also a problem. Increased flow variability has reduced ecological integrity in tributary areas as well.

Objectives

- Reduce low-water fluctuations along the main stem Illinois River where possible, concentrating on the months of May through October and using pre-1900 water level records as a reference.
- Reduce peak flows from the major Illinois River tributaries by 2 to 3 percent for 2- to 5-year recurrence storm events by 2023. This would help to reduce peak flood stages and reduce high-water fluctuations along the river. Long term, reduce tributary peak flows by at least 20 percent for these events.
- Reduce the incidence of low-water stress throughout the basin by increasing tributary baseflows by 50 percent.
- Reduce the significant water level changes associated with operation of wicket dams at Peoria and La Grange.
- At an appropriate resolution (approximately 1 square mile in urban areas, 10 square miles in rural areas) identify and quantify the land alterations that contribute to unnatural fluctuations and flow regimes.
- Draw down the pools at Peoria and La Grange for at least 30 consecutive days at least once every 5 years.

Anticipated Outputs

Anticipated project outputs for this goal include: naturalizing tributary flow regimes by reducing peak flows and increasing base flows; reducing water level fluctuations on the main stem Illinois River; and exposing main stem areas by pool drawdown. These project outputs would provide a more desirable level of ecosystem function by providing critical habitat and more favorable habitat conditions for aquatic plant and animal (including fish and macroinvertebrates) species.

Pool drawdown would allow for the reestablishment of emergent vegetation (i.e. arrowhead, bulrush, and sedges) in some areas that are currently inundated and/or unable to support aquatic vegetation. Sediment compaction would also result, potentially reducing turbidity. As water levels are raised following the drawdown, these newly vegetated areas would provide food and cover for migratory waterfowl, fish, and macroinvertebrates.

Reducing water fluctuations would allow for the reestablishment of emergent plants (which serves as a food base for fish and waterfowl) in the shallow water areas of the lower three pools. Fewer and smaller fluctuations could reduce the probability that fish using the backwaters and side channels for spawning would become trapped. Fish species anticipated to benefit from reduced water level fluctuations include: largemouth bass, bluegill, gizzard shad, and emerald shiners.

1. Inventory Resource Conditions

Hydrology is a primary driver of aquatic ecosystem processes (Poff and Ward 1989, Poff and Allan 1995). The magnitudes, timing, durations, and rates of change of flows and water levels often regulate the nature of chemical and biological functions in aquatic systems. Hydrologic regimes are largely determined by landscape conditions and subsequently so are the resulting ecosystem characteristics (Sparks 1992). Headwater streams in the Illinois River Basin experience short duration floods nearly every year in response to rainfall; animals in such streams are adapted to either avoid or endure these events by either migrating or finding shelter. These streams also experience extended low flows during the summer and fall. In larger streams and rivers, the average annual hydrologic regime is smoothed somewhat due to larger drainage areas and a greater influence of groundwater on summer low flow, or baseflows, and the relative difference between the flood and low-flow discharge is not so great. This reduced variability in flow conditions allows more organisms to take advantage of the aquatic habitat; the number of fish species, for example, generally increases in downstream areas in large part due to the addition of new species, as opposed to the replacement of species (Horwitz 1978). In the main stem river, a pronounced spring flood generally extends through the early summer and many organisms are able to take advantage of these high water events because they last longer and are more predictable (Sparks et al. 1990). Urban and agricultural development in the Illinois River Basin has altered the basin’s landscape, which has led to changes in the hydrologic regime of the tributaries and main stem. Altered hydrologic regimes can limit ecosystem function in any portion of the landscape when the frequency or magnitude of high or low water conditions vary significantly from those previously experienced and under which native systems have developed (Resh et al. 1988, Poff 1992).

a. Historic Conditions. Prior to 1900, when significant development and hydrologic modification began, much of the Illinois River experienced a cyclical regime in which water levels gradually rose from the late fall through the spring and then fell to stable low levels in the summer (Sparks 1995). This cyclical regime is illustrated in figure 3-28 which shows water levels at four gage locations on the Illinois River for multiple water years. Figure 3-29 shows the locations of the gages referred to in figure 3-28. Both historical (illustrated using black squares) and existing (illustrated using gray lines) water levels are shown in this figure. Existing water levels will be discussed in the next section. Historical observations and measurements of flows from undisturbed areas indicate that stormflows rates from Illinois River watersheds prior to European settlement were probably much lower than current rates. Much of the Illinois River Basin was prairie, savannah, and marshland that effectively retained rainfall. Prairie plants are very effective at transpiring water from the soil into the atmosphere, likely removing large quantities of water from the basin. Many current streams or ditches were historically ephemeral channels, wetland swales, or simply did not exist (Larimore and Smith 1963, Rhoads and Herricks 1996). As urban and agricultural areas developed throughout the watershed, the basin transformed from an infiltration based system, where water enters the soil at the ground surface and flows away from the ground surface, to a runoff based system, where water remains on or flows across the ground surface.

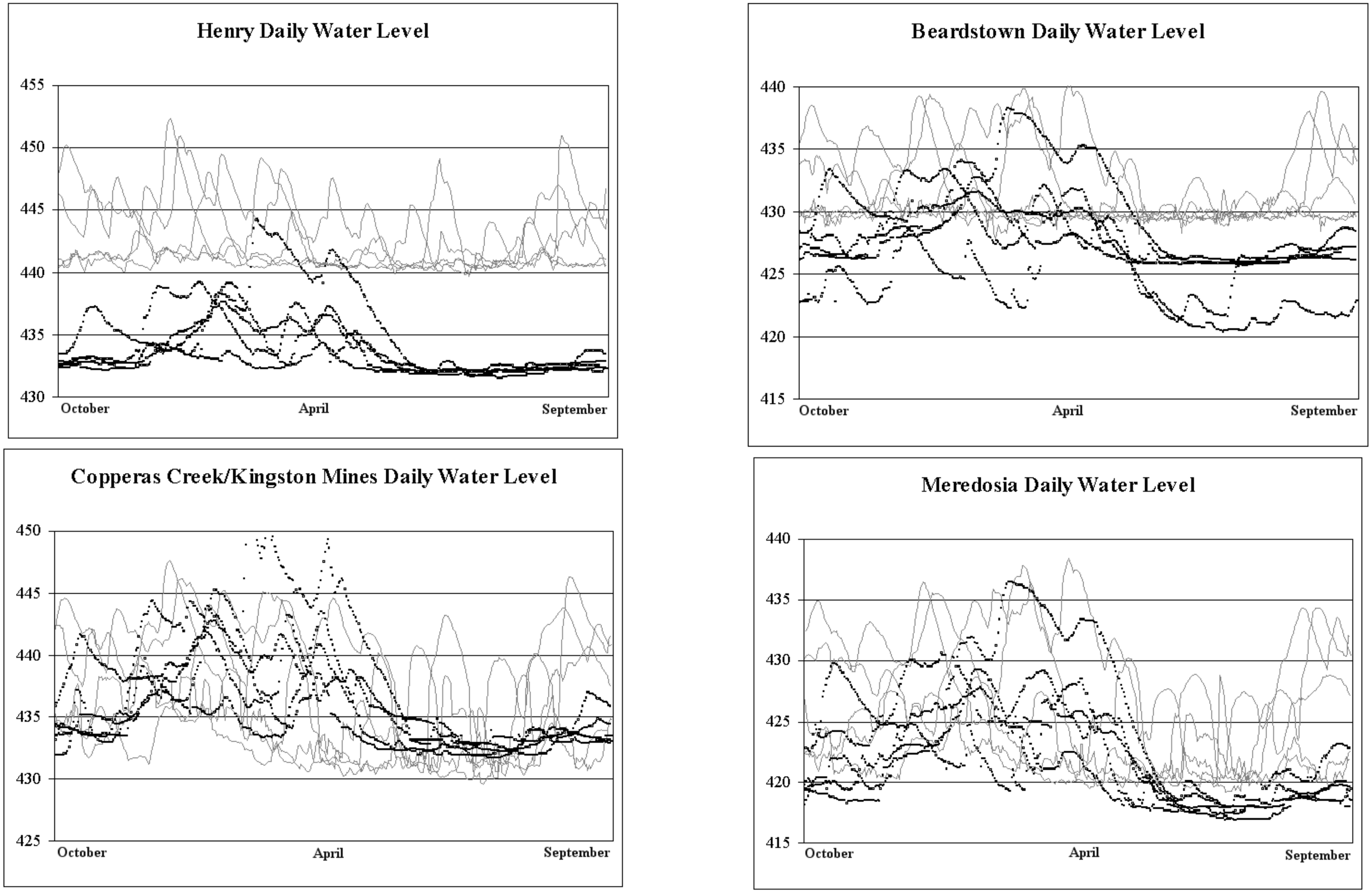


Figure 3-28. Daily Water Levels at Long-term Illinois River Gages, Water Years 1888-1892 (black dashes) and 1988-1992 (gray lines). Water years run from October 1 through September 30.

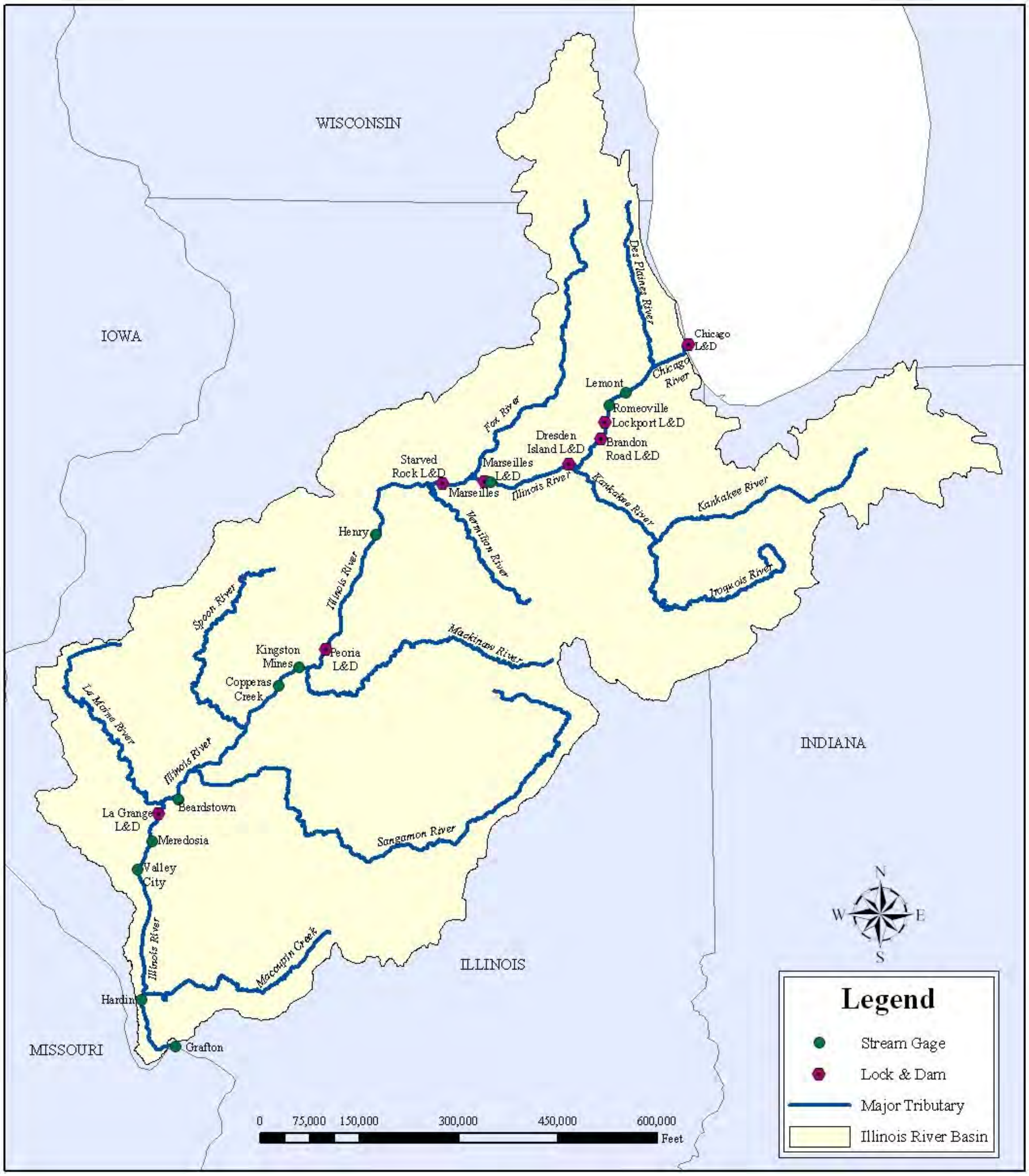


Figure 3-29. Gage Locations

To increase agricultural efficiency, land throughout the Illinois River Basin was cleared and drained. Tilled soil generally tends to create more runoff than vegetated soils (Sartz 1970), so land clearance and drainage in the Midwest increased the movement of water from the land surface and created conditions that resulted in larger storm flows (Knox 2002) and contributed to reduced low flows (Larimore and Smith 1963, Meek 1892, Quick in Menzel et al. 1984, Shriner and Copeland 1904). Although flows from tile drains have led to sustained low flows at some locations (Rhoads and

Herricks 1996), drainage generally reduces low flows by lowering groundwater levels and intercepting through flow, thereby increasing stream flow variability. For example, Larimore and Smith (1963) observed that the Sangamon River at Monticello displays less constant flow than it did before 1928. They noted that land drainage in the watershed led to quicker responses to precipitation and droughts with higher floods and reduced low flows. These changed conditions led to changes in fish distributions, specifically the loss of intolerant species. Smith (1971) noted that reduced summer low flows became more noticeable statewide after 1930 and that these had definite negative effects on headwater and creek fish species.

Hydrologic regime changes also came about due to urbanization and stream channelization. The construction associated with cities and towns leads to increases in impervious area and efficient systems to remove runoff. These led to large increases in the volume of stormwater carried to downstream streams and rivers, especially for small storms that would not cause runoff under more natural conditions, and higher peak flows. Likewise, channelization increases peak flows as it allows flood waves to pass more quickly through the basin (Campbell et al. 1972). The relative effects of hydrologic changes tend to be greatest in small streams, steep basins, and during fairly frequent events (Knox 1977).

The changes in the tributary hydrologic regimes translated downstream into a more uneven delivery of water to the Illinois River, especially for flows associated with storm events. Additionally, the construction of navigation dams and diversion of flows from Lake Michigan increased the river water surface elevation and have altered the nature of the flooding regime along certain reaches of the river. The diversion flows, as well as the possible increase in tributary flow volumes from a reduction in basin-wide annual evapotranspiration rates, lead to the probability that river flow volume increased. Between 1902 and 1928, levees were constructed to increase human use of the floodplain; these levees changed the hydrologic nature of the river system by preventing out-of-bank flows from expanding across significant portions of the floodplain, subsequently changing flood profiles and recession rates along the river (Mulvihill and Cornish 1929 in Havera and Bellrose 1985, Sparks 1995).

It should be noted that changes in rainfall patterns have also contributed to changes in Illinois River Basin hydrologic regimes (Ramamurthy et al. 1989). The CTAP (1994) noted that higher precipitation in the period 1966 to 1991 led to 13 to 20 percent higher average flows and 50 percent higher peak flows at many northern Illinois stream gaging stations. Agricultural landscapes tend to be particularly sensitive to climatic variability (Knox 2001) and so potential climatic shifts must be considered when evaluating hydrologic regime changes.

b. Existing Conditions. Changes in the Illinois River Basin have led to increased variability in most aspects of the hydrologic regimes experienced by the river and its tributaries. In general, stormflows in the basin are currently higher than occurred under pre-development conditions due to land use changes and increased efficiency brought about by channelization, drainage, and urbanization. High flows lead to increased physical stress on organisms, decreased habitat quality, and increased transport of sediment to the river. Low-flow conditions have also become more ecologically stressful, especially in smaller streams. These small streams are often unstable aquatic environments because of extreme water level fluctuations and desiccation during dry periods; for example, stagnant pools in small streams commonly experience temperatures exceeding 90 degrees Fahrenheit (Larimore and Smith 1963, Rhoads and Herricks 1996). Some exceptions occur in streams fed by relatively steady effluent discharges (CTAP 1994) or certain tile drain outlets (Rhoads and Herricks 1996).

The loss of connectivity between the main stem river and its floodplain has also affected the hydrologic regime of the river. Levees were constructed along the river to protect valuable urban and agricultural land from flood, but in doing so, the main stem river has been isolated from its floodplain in certain areas. This isolation, or lack of connectivity, is addressed further under Goal 4. Hydrologic variability on the main stem river is most evident in its water level records. For the purpose of this report, water level fluctuations (or "bumps") are defined as having the following characteristics:

- Elevation differences of 0.5-foot or greater,
- Occur within either 6-hour, 24-hour, or 5-day time periods, and
- Can be characterized as either increases or decreases.

Please note that during our analysis, water level fluctuations were characterized using both 2-hour and daily water level data. The frequency of the source data will be noted in the following discussion.

The ecological impact of these fluctuations is based on the time of year in which the fluctuation occurs; therefore, the fluctuations for any given year are categorized by season. For this analysis, the "summer" occurs from July 1 through November 15 (also referred to as the "growing season"), the "spring" is evaluated from March 1 through May 15, and the remaining portion of the year is referred to as the "winter." Both the "summer" and "winter" time periods encompass a limited amount of time outside of "summer" or "winter." These definitions will be used throughout this section.

The magnitude and frequency of water level fluctuations have notably increased in portions of the river since daily water level monitoring began in the 1880's . This difference is especially pronounced during the growing season (July 1 to November 15) as indicated in figure 3-37. During the pre-1900 growing seasons at all four gages in figure 3-37, there were very few fluctuations larger than 5 feet and the water levels were relatively low compared to the rest of the year. By examining the 1988 to 1992 flow data, it can be seen that large fluctuations occur throughout the year, which indicates that the flow regime has changed throughout the basin. It is possible that some of the changes in water level fluctuations are due to alterations in land cover throughout the basin.

The quantities of historical, observed, and modeled water level fluctuations of 0.5-foot or greater between daily readings, or over periods of up to five consecutive daily readings, during the growing season are compared in table 3-46. Data used in the table are from the Illinois River Ecosystem Restoration Water Level Management Analysis (USACE 2004a). The number of tributary induced fluctuations at each gage was determined using a hydraulic model of the Illinois River main stem with the observed flows but simulating the removal of the influence of the navigation dams. The hydraulic model is discussed in the section on the "Formulation of Alternative Plans."

Table 3-46. Comparison of Historical Water Level Fluctuations (Pre-1900) With Observed and "Tributary Induced" Water Level Fluctuations (WY 1990 to 1997) During the Growing Season Using Daily Data

	24-Hour Fluctuations			**5-Day Fluctuations**		
		Current Conditions			**Current Conditions**	
Gage Location	**Pre-1900**	**Observed**	**Tributary Induced**	**Pre-1900**	**Observed**	**Tributary Induced**
Marseilles	no data	33	20	no data	34	26
Henry [1]	3	4	4	6	10	12 [2]
Peoria L&D (pool)	no data	8	3	no data	13	11
Copperas Creek/ Kingston Mines	2	19	7	5	21	15
Havana	2	12	5	7	19	13
Beardstown	1	8	3	5	13	9
La Grange L&D (pool)	no data	9	5	no data	13	10
Meredosia	4	15	7	7	22	15

[1] Observed Data for this gage are from water years 1990 to1996.
[2] The number of tributary induced water level fluctuations at the Henry gage is greater than the number of observed water level fluctuations possibly because tributary induced water level fluctuations were obtained using a computer model of the system or our operations are attenuating the natural fluctuations experienced on the main stem.

One source of water level fluctuation on the main stem is the episodic input of stormflows from the drained and developed watersheds of tributary streams feeding the river (Sparks et al. 2000). The altered tributary flow regimes contribute to rapidly rising and falling water levels and more uneven delivery of flows to the Illinois River. Table 3-46 displays a model estimate of the increase in river fluctuations that can be attributed to the altered tributary flow regimes. Flow changes arising out of growing season storm events cause water levels to quickly rise along the main stem river. Once the storm event is over, flow rates decrease and the water levels also fall. Storm water from Chicago has the potential to significantly impact water level fluctuations in the upper areas of the Illinois River.

Another potential fluctuation source is water level management activity (Appendix C). Management-related water level fluctuations are generally most evident in the upper regions of the pool including the tailwater of the upstream dam. These fluctuations are often attributable to gate adjustments at navigation dams (Pegg 2001, Koel and Sparks 2001). While the fluctuations resulting from management activities at all the dams along the main stem are important, the water level fluctuations associated with the wicket dams at the Peoria and La Grange Lock and Dams are distinct.

Photograph 3-7 shows the wicket dam at Peoria and photograph 3-8 shows the construction of a similar wicket dam on the Ohio River. Wicket dams are operated so that during periods of high water levels, the "wickets" lie on the bottom of the river and water flows unimpeded over them (this is referred to as "open pass"). Open pass conditions are purely a function of flow. As water levels decrease, the "wickets" are manually raised and the navigation pool is created. This is done to ensure that the nine-foot depth required for river navigation exists. When wicket dams are raised and lowered, it is possible that significant water level fluctuations may result. The response to wicket dam operations is less noticeable in the pool than it is in the tail water (below the dam). As the wicket dam is raised, the tail water drops significantly. The computed induced fluctuations in the tail water at Peoria and La Grange are 2.3 and 3.0 feet, respectively.

Photograph 3-7. Existing Wicket Dam at Peoria Lock and Dam

Photograph 3-8. Construction of Wicket Dam on the Ohio River

Figure 3-30 shows the pool and tailwater water levels at Peoria for water year 1995. Please note the abrupt changes in water levels during the wicket operations. During Water Years 1979 to 2000, there were approximately 194 wicket operations (either raising or lowering) at Peoria and 168 at LaGrange. This results in an average of 8.4 and 7.3 wicket operations per year at Peoria and LaGrange, respectively. A single tainter gate was installed at each dam in the early 1990s (photograph 3-9). The tainter gates were not designed to affect the frequency of wicket operations; they were installed to make it easier to operate the wicket dam and adjust the flow through the structure, thereby providing better control over the dam releases (USACE, 2005).

Photograph 3-9. Existing Tainter Gate at Peoria Lock and Dam

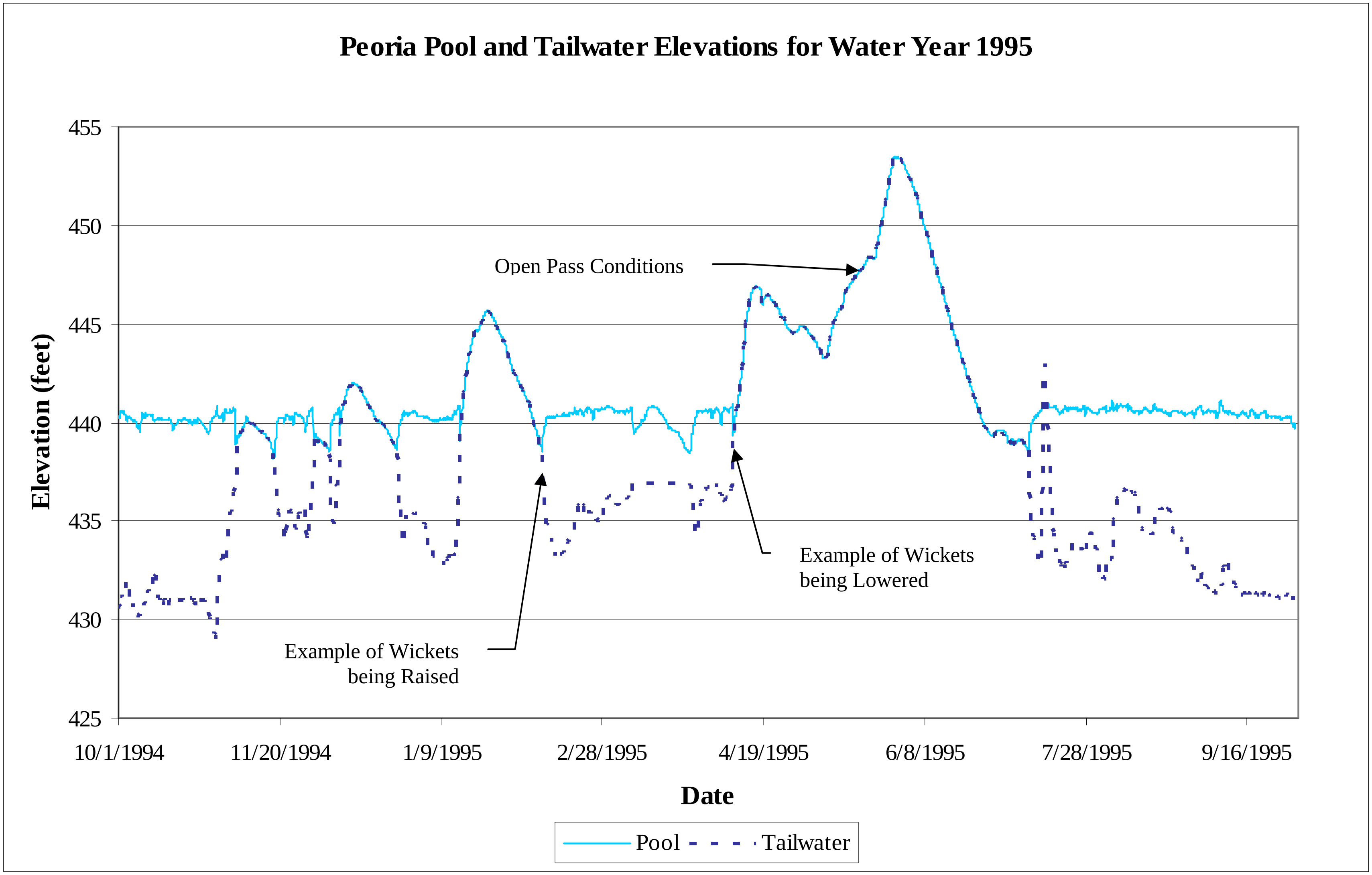


Figure 3-30. Water Level at Peoria Lock and Dam

Water level fluctuations during any part of the year have the potential to strand Illinois River fish or force them to move to avoid stranding (Koel and Sparks 2001, Raibley et al. 1997). Summer water level fluctuations can be especially stressful on aquatic plants (Sparks et al. 1998). Koel and Sparks (2001) found that the increased fluctuation rate seems to favor non-native fish species. Water level fluctuations also have the potential to drown moist soil plants which become established in mid to late June. To serve as a food base and cover for numerous species, these plants must not be inundated for a period long enough to produce seeds (approximately 70 days).

Researchers have noted that more gradual water level rises and falls would benefit a number of organisms. For example, Koel and Sparks (2002) indicate that water level changes should not exceed 0.13 to 0.17 feet per day to minimize fisheries impacts. Also, Atwood et al. (1996) recommend that water level rises not exceed 0.2 feet per day to avoid drowning out emergent vegetation.

Although the increased hydraulic variability has negatively affected the ecological function of some portions of the river, the reduction of hydrologic variability upstream of the dams has had negatively impacts on the ecological function of certain floodplain areas. Each dam keeps the water level in the pool upstream high enough to ensure a 9-foot navigation channel, and, as a result, the floodplains immediately upstream of each dam are far more continuously inundated than they would be under undammed conditions (Sparks 1992). The lack of a flood cycle in these areas acts as a disturbance for the river-floodplain system (Sparks et al. 1990).

These stable water levels limit the consolidation of sediment, leading to higher potential for resuspension, and prevent many native plant species from revegetating. This eliminates the seasonal drying of the sediments that favored the establishment of vegetation in these areas (Sparks et al. 2000). A decrease in the number and regeneration of mast trees has been observed in the areas upstream of the dams. However, the annual flooding regime at the upper end of the pools, where inundation effects are diminished, is often similar to that experienced under undammed conditions (Sparks 1995).

c. Future Without-Project Conditions. Several factors, most notably potential changes in land cover, land use, and climate, play major roles in the future hydrologic regimes throughout the Illinois River Basin. The flows from agricultural lands will be influenced by the extent to which conservation practices are implemented. With the exception of conservation practices, the usage of land in agricultural areas has been fairly constant recently because all suitable areas are being utilized. Tiling projects are expected to continue being implemented in the foreseeable future, while the development of new channelization projects is expected to decrease.

Tributary hydrologic regimes will continue to exhibit high peak flows and low baseflows that stress aquatic biota. These conditions will likely become more stressful in areas that experience increased urbanization. Without site-specific water level manipulation (drawdown), certain backwater and floodplain areas are likely to either continue to degrade or maintain relatively low levels of ecological function.

The current lack of aquatic connectivity between the main stem and its floodplain is likely to remain the same. Some studies are currently underway investigating limited connectivity in several locations. The amount of urbanized land in the basin will continue to increase, and the ecological benefits from stormwater controls are likely to be limited, especially on the main stem, unless efforts are made to control volume by implementing a large number of infiltration practices. While it is impossible to predict changes in climatic conditions, it is possible that some changes may lead to more extreme hydrologic regimes that could drive ecological processes to and over thresholds.

The successful implementation of planned stormwater control projects like the Tunnel and Reservoir Project (TARP) and the Chicago Underflow Project (CUP), may reduce some of the peak flows entering the river from northeastern Illinois, but increased development, even with peak flow control requirements, may increase the volume of storm water entering and the high water fluctuations of the Illinois River Diversions from Lake Michigan are expected to continue.

d. Desired Future Conditions. The desired future conditions would naturalize the water level conditions that would restore ecological function in the Illinois River Basin. This does not necessarily require a return to any particular prior state, but rather creating conditions that allow ecosystem functions to sustain themselves at an acceptable level given the constraints of multiple uses throughout the basin. Rhoads and Herricks (1996) describe this concept as “naturalization.”

In regard to tributary flows, the current state of knowledge suggests that flow regimes with reduced peak flows and increased baseflows would provide more desirable levels of ecosystem function than currently occur. The Lieutenant Governor’s Task Force (Kustra 1997) identified an initial goal of reducing tributary peak flows by 2 to 3 percent. The reductions necessary to meet this goal are shown in table 3-47.

Table 3-47. Tributary Peak Flows Estimated From USGS Flow Records

			Approximate Flow Recurrence (cfs)					
			Historical Averages		2.5% Reduction		20% Reduction	
Tributary	**Record**	**Years**	**2-yr**	**5-yr**	**2-yr**	**5-yr**	**2-yr**	**5-yr**
Des Plaines River at Riverside	1914-2001	88	4070	5500	102	138	814	1100
Fox River at Dayton	1915-2001	86	13900	18100	348	453	2780	3620
Kankakee River near Wilmington	1915-2001	87	24600	37500	615	938	4920	7500
Mackinaw River near Green Valley	1922-2001	79	8030	16000	200.8	400	1606	3200
Macoupin River near Kane	1921-2001	74	10200	17500	255	438	2040	3500
Sangamon River near Oakford	1910-2001	84	24100	36300	603	908	4820	7260
Spoon River at Seville	1916-2001	85	12700	20700	318	518	2540	4140
Vermilion River at Lenore	1931-2001	71	13000	20800	325	520	2600	4160

Although the precise relationships between regime components and ecosystem functions have not been fully developed, it was decided that a peak flow reduction exceeding 20 percent would be necessary to sufficiently modify the flow conditions that are currently degrading tributary ecosystems based on expert opinion. Likewise, a significant baseflows increase, 50 percent above the current levels, is desired to reduce low-flow stress to stream organisms. As a basis for project implementation, it is necessary to document and analyze the factors that lead to undesirable hydrologic conditions, and assess these factors basin-wide.

Although there is a significant desire to moderate the rate of rise and fall along the main stem Illinois River, the storage available within the system is very small relative to the flows in the river (USACE 2004a). Although the lack of storage makes it difficult to affect the hydrologic regime of the main stem, the desired future conditions include a reduction in the incidence and speed of water level changes.

Reducing the number of water level fluctuations would likely provide multiple benefits to native biological communities. These benefits would be especially significant during the time of year beginning after the recession of the spring flood in May and extending through the late growing season in October. The objective identified is to reduce the number of daily water level fluctuations exceeding 0.5 feet to levels observed in the 1890s during both growing season and winter time periods. One specific measure that would reduce fluctuations is a reconstruction of the wicket dams so that the dramatic water level changes associated with their operation can be removed. Another specific measure that would reduce the magnitude of water level fluctuations near the lock and dam structures at Peoria and LaGrange is to install an additional tainter gate at each of these locations. Although the addition of a single tainter gate at these structures would probably not decrease the number of fluctuations, it would minimize the effects of raising and lowering the wickets downstream of the dam. Reconnecting the river mainstem to its floodplain may also reduce the number and magnitude of water level fluctuations along the main stem. Future study is required in this area.

Temporarily lowering water levels in the Illinois River navigation pools would provide ecological benefits to areas of the pools that are continually inundated under current conditions, allowing sediments to consolidate and encouraging reestablishment of vegetation. Significant consolidation and benefits to plant growth have been observed in drawdowns in Illinois River and Mississippi River backwaters (Dalrymple 2000, Edwards 1988) and elsewhere (Fox et al. 1977). The desired future condition would be a successful drawdown lasting at least 30 days once every 5 years in the Peoria Pool, and once every five years in the La Grange Pool.

2. Formulation of Alternative Plans

a. Approach/Assumptions. Restoring basin-wide hydrologic regimes requires a systematic approach because of the downstream propagation of flow conditions and impact on sediment transport and channel stability. Illinois River tributaries influence ecosystem characteristics throughout the basin, and tributary flows significantly affect main stem conditions. As such, any attempt to restore the Illinois River hydrology would require a considerable amount of work to improve tributary conditions. At the same time, analysis has indicated that it would be prohibitively expensive, if not impossible, to restore conditions along the Illinois River main stem solely by improving tributary conditions, so improvement along the main stem would require management along the river itself. The final restoration plan; therefore, must include a mix of tributary and main stem measures.

As has been noted elsewhere, this program is being proposed to augment existing efforts and not to replace them. For example, urbanization will continue to increase the instability of tributary and main stem hydrologic regimes if stormwater management strategies that control volumes as well as peak flow levels are not implemented for future development activities. Projects within the Illinois River Basin Restoration program will be developed from ongoing and future watershed planning efforts that identify the suite of practices necessary to benefit hydrologic conditions in each particular watershed. To the extent possible, these projects will be coordinated with work being accomplished under other programs to support the overall basin restoration goal. The alternatives detailed in this report identify the potential measures to be constructed under this program as a part of the overall restoration effort.

Implementing projects to promote more favorable hydrologic regimes would require a number of planning tools developed at the program level (above and beyond the work detailed in these alternatives). Project evaluation will rely on a well-calibrated watershed hydrology model for the entire basin linked to an unsteady-state hydraulic model of the main stem river; this will be used to assess expected benefits and compare the cost effectiveness of various alternative configurations. The basis for the watershed model has already been developed using the USEPA's Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) model, and it is expected that sediment modeling capability would also be incorporated into the model. One of the major components of BASINS that was used in the analysis of various storage and infiltration scenarios is the Hydrological Simulation Program – Fortran (HSPF). A program called One-Dimensional Unsteady Flow Through a Full Network of Open Channels (UNET) was used to develop a basic hydraulic model for the main stem Illinois River. A FORTRAN program was written to calculate the number of water level fluctuations for the observed data and the various alternative scenarios studied.

In some cases, hydrologic changes may have the potential to lead to downstream sedimentation issues, so sediment transport issues must be addressed in the design of all of the measures implemented for this goal. Ongoing flow and water level monitoring at appropriate locations is also necessary to evaluate projects and adapt project objectives based on changing conditions. The need for flow monitoring on small tributaries is crucial to evaluating basin-wide conditions due to the large percentage of the basin that drains directly to low-order streams. Also, implementation would use the computerized inventory and analysis system developed for this project to evaluate potential projects and determine the benefits of constructed projects.

b. Criteria and Constraints There are several constraints that must be considered when formulating plans to influence water levels on the Illinois River, the first of which is that there is very little floodplain storage available on the Illinois River main stem, as was discussed earlier in this goal. Another constraint is that the 9-foot navigation pool must be maintained throughout the entire year. This influences the level to which pool drawdowns may be attempted. Most of the land adjacent to the Illinois River and its tributaries is in private ownership, which can limit where restoration measures are constructed. The levees which exist along the main stem isolate the river from its floodplain and can limit the effect of restoration efforts. The diversion of water from Lake Michigan into the Chicago Sanitary and Ship Canal, which then flows into the Illinois River, is an additional constraint that must be considered. The storm flow from the Metropolitan Water Reclamation District is another constraint.

c. Measures

i. Tributaries. Two systematic approaches were evaluated to meet the tributary objectives of reducing peak flows and increasing base flows. The first approach is to increase the volume of stormwater storage available within each tributary watershed so that runoff from relatively small events, including those expected to occur every 2 five years or more frequently, is temporarily retained before being released downstream. This storage might take various forms, including tile management, detention structures, or expanded riparian areas that provide ecological benefits in addition to flood storage. The second approach is to direct runoff to areas where it can infiltrate into the soil and recharge groundwater. Infiltration requires the proper soil and subsoil conditions; but if conditions are appropriate, it could be incorporated within tile management, conservation practices such as filter strips, or structures consisting of grassed fields enclosed within a berm. Infiltration can also be distributed throughout watersheds using practices that reduce runoff generation or allow runoff to infiltrate close to the point it is generated; the potential for such practices in an urbanizing area is discussed in the Blackberry Creek Watershed Alternative Futures Analysis (2003).

ii. Main Stem. Several measures were evaluated to determine the potential benefits they might provide to main stem water level regimes. Some of the tributary storage and infiltration measures evaluated in the previous section may reduce fluctuations, and other measures implementable on the river itself may also provide benefits. Different river management scenarios were studied, including “optimal” management. Reconfiguring the wicket gates and pool drawdowns at the Peoria and LaGrange lock and dams were also analyzed. This is discussed further in the following section.

d. Alternatives. Alternatives were developed using measures to address five types of hydrologic change: dam management, stormwater storage, infiltration, wicket dam modification, and pool drawdown. Measures that affect stormwater storage and infiltration would take place on the tributaries while measures that affect dam management, wicket dam modification, and pool drawdown would focus on the main stem. The measures were grouped to form plans that met the objectives for this goal to varying degrees. Implementation of these plans would rely on planning tools developed for this program but not budgeted here, specifically the computerized data inventory and analysis system and a fully calibrated hydrology and sediment model for the Illinois River Basin. Successful implementation also requires the continuation of conservation activities being undertaken under existing Federal and State authorities, as well as stormwater controls under the mandate of local authorities; expansion of these other efforts would increase the potential benefits to Illinois River Basin hydrologic regimes.

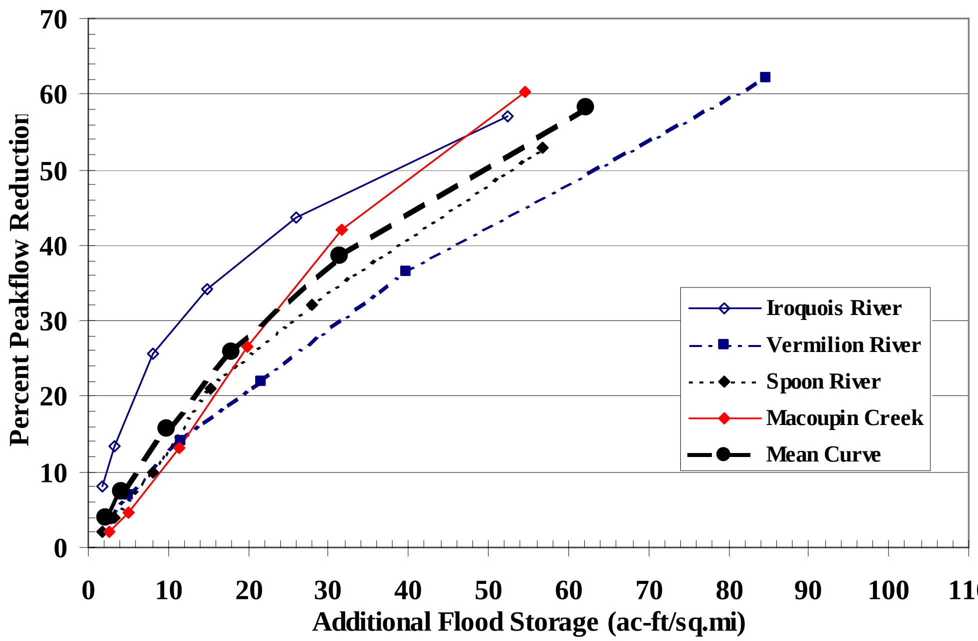
i. Tributaries. Alternatives that address tributary storage and infiltration are designed to reduce peak flows and increase baseflows. Since relatively common flood events are ecologically significant, it is appropriate to evaluate the change in intensity of 2- and 5-year events, as identified by the Lieutenant Governor’s Task Force. Tributary peak flow benefits for this study were quantified as the percent reduction in the 2- and 5-year events attributable to the measures. The benefits for improving tributary baseflows were quantified using the effect of the measures on the 90 percent exceedence flow (the level that average daily flows will meet or exceed over the long-term) expressed as a percent increase.

The various levels of storage and infiltration were evaluated by modifying the BASINS model of the Illinois River prepared by the Illinois State Water Survey (ISWS) (Appendix C-3). Model representations of several tributaries were modified to represent the hydrologic effects of either storage or infiltration, and predicted change in hydrologic conditions was evaluated by comparing simulated flows for these tributaries using the meteorological input data from the years 1970 to 1995 with the simulated flows for the same period without added storage or infiltration. The mean response from the selected tributaries was used to estimate the general basin response, and alternatives were generated assuming a similar response if the practices were applied to the approximately 30,000 square miles of the Illinois River Basin. Further model refinement will allow for more meaningful results.

The additional basin storage was simulated within the BASINS model as volume adjacent to basin streams but at an elevation slightly higher than the non-storm water level. Water depths during the range of flow events were used to determine the actual storage volume utilized during those events. This floodplain-like storage is expected to be a relatively efficient way to reduce peak flows, and so the storage-flow reduction relationships obtained represent a condition of fairly optimal storage distribution throughout the watershed; more volume may be required to meet the flow reduction goals if storage is distributed in a different manner. The infiltration scenarios were modeled, using the BASINS model, by routing the runoff from a portion of the land area to special land segments that soaked in most of their inflow and discharged primarily through groundwater. This type of approach would not discriminate between infiltration methods (constructed facilities, filter strips, etc.) For modeling purposes, each acre of infiltration area received runoff from 19 acres of basin area, in addition to the precipitation falling on the infiltration area itself. There was no attempt to verify that appropriate areas were available either for the floodplain-like storage or for infiltration. Because of the setup of the ISWS BASINS model, changes in the Des Plaines watershed were modeled for neither storage nor infiltration. Also, because of difficulties with the model, the infiltration alternatives were not modeled in the Kankakee-Iroquois watershed.

The effectiveness of storage on reducing 2- and 5-year peak flows is shown in figure 3-31, and the effectiveness of infiltration is shown in figure 3-32. The mean curves in figure 3-32 represent the average peak flow reductions, in percent, for storage within the Iroquois River, Vermilion River, Spoon River, and Macoupin Creek watersheds. Although there is some variation, with the largest benefits in the Iroquois watershed, the mean curve indicates that an additional 3.0 acre-feet of storage per square mile of basin area would reduce 5-year peak flows by approximately 5 percent. This relatively small amount of storage is effective largely because it does not take a large volume of storage to shave the peaks off relatively frequent events. Figure 3-32 demonstrates that the percent reduction of peak flows would be nearly proportional to, but slightly less than, the percent of area treated by infiltration. The model results for the Vermilion, Spoon, and LaMoine River watersheds show very similar peak flow reductions.

(a) Reduction of 2-year flows



(b) Reduction of 5-year flows

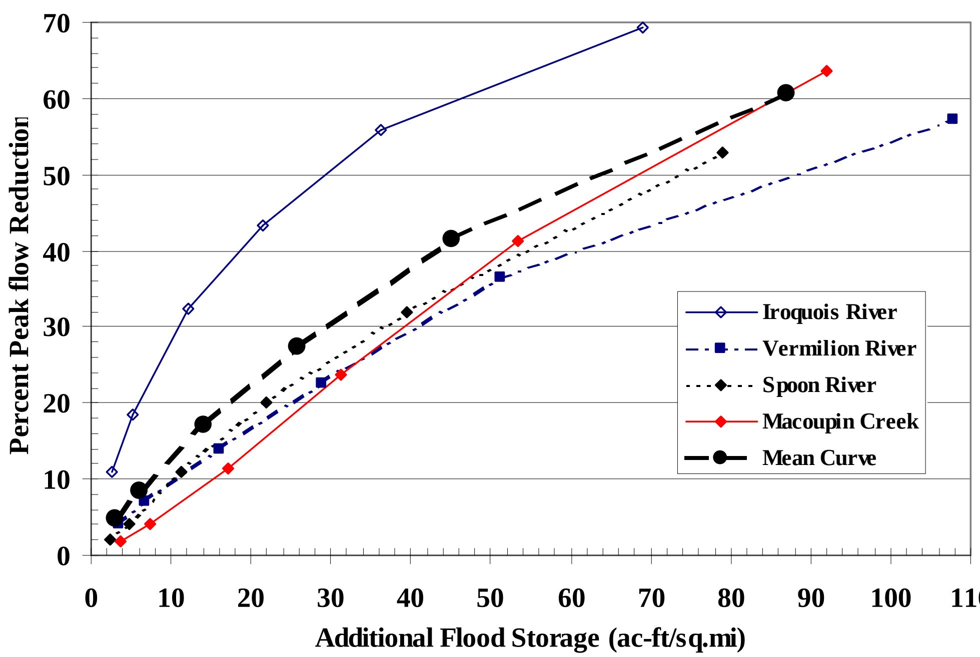
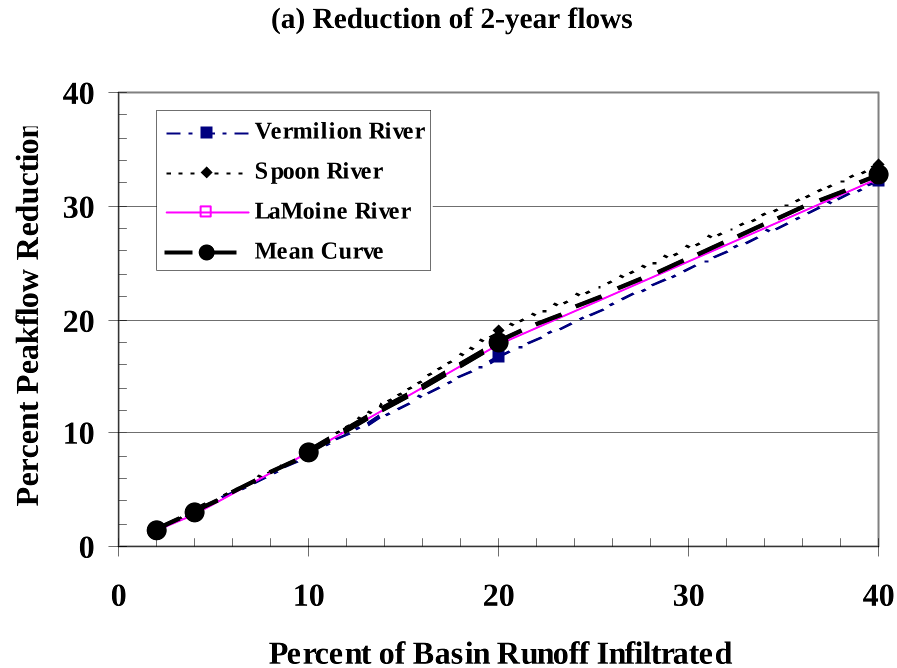


Figure 3-31. Potential Tributary Peak Flow Reduction for the (a) 2-Year and (b) 5-Year Flow Events With Additional Flood Storage Within Their Watersheds



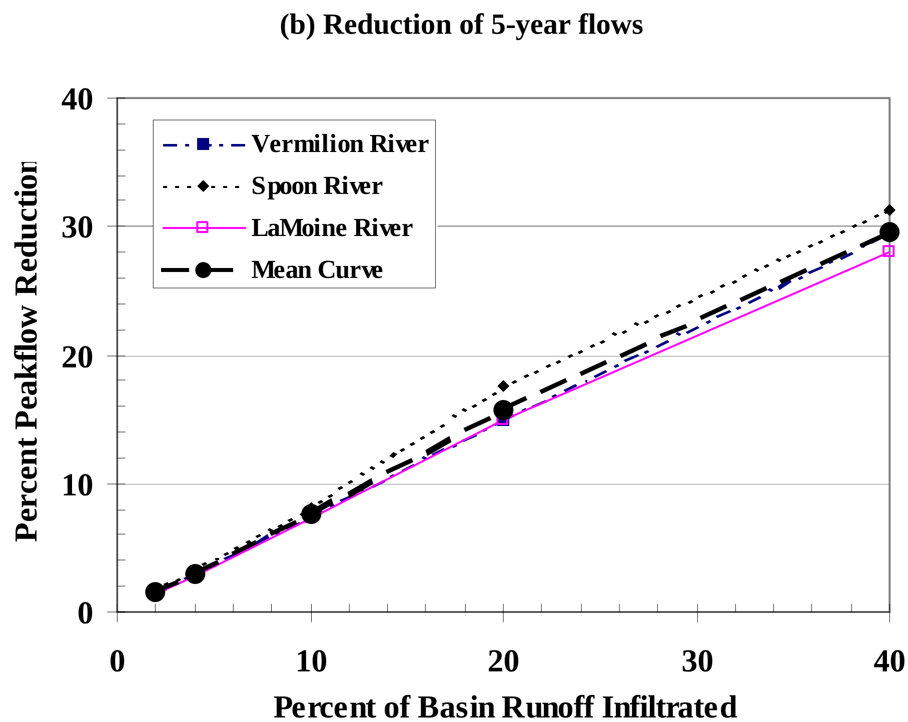


Figure 3-32. Potential Tributary Peak Flow Reduction for the (a) 2-Year and (b) 5-Year Flow Events With Additional Infiltration Within Their Watersheds

The values for the mean curves in figures 3-31 and 3-32 were used to calculate the benefits for various levels of program, implementation; figure 3-41 compares the relative effectiveness of infiltration and storage at reducing peak runoff flows. Using the assumptions that the infiltration facilities would be approximately 5 percent of their contributing areas and the floodplain wetlands are inundated to a depth of 1.5 feet during the 5-year event, the mean curves from figures 3-31 and 3-32 were adjusted to reflect the area required for each practice. Figure 3-33 shows that both practices are effective but that on a project footprint basis infiltration would provide a somewhat greater benefit per unit area than would flood storage. It should be noted that the relative effectiveness of each practice may change if designed under different assumptions, say infiltration facilities at 10 percent of their contributing basin or inundation depths of 2 feet. However, figure 3-33 is adequate to provide a basis for planning-level analysis. The two treatments should not be considered interchangeable because they may not be equally applicable in a given area; infiltration would not be available in basins with inappropriate soil conditions, and available land may limit the application of floodplain storage projects.

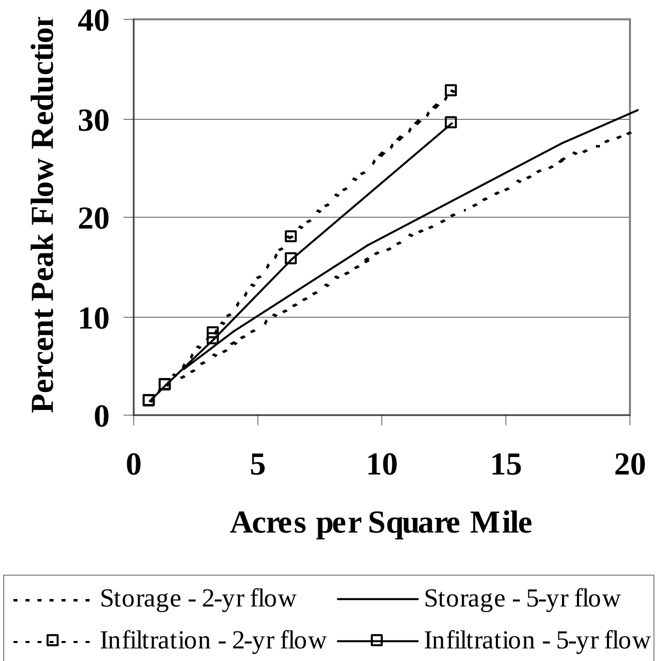


Figure 3-33. Comparison of Relative Peak Flow Reduction Effectiveness of Infiltration and Floodplain Storage Assumes storage depth of 1.5 feet during 5-year event and contributing area ratio of 20:1 for infiltration measures.

Figures 3-34, 3-35, and 3-36 illustrate the degree to which storage volume and infiltration lead to increased baseflows. Infiltration tends to be much more effective than storage at baseflows support. The per unit benefits of infiltration tend to decrease for scenarios exceeding 10 percent of basin runoff infiltrated. It should be noted that the Iroquois River, which showed the greatest baseflows benefits from storage, was not modeled for the infiltration scenarios due to problems representing infiltration areas in the model. It is likely that if benefits from that system were included, the mean curve in figure 3-43 and the infiltration curve in figure 3-44 would be somewhat higher.

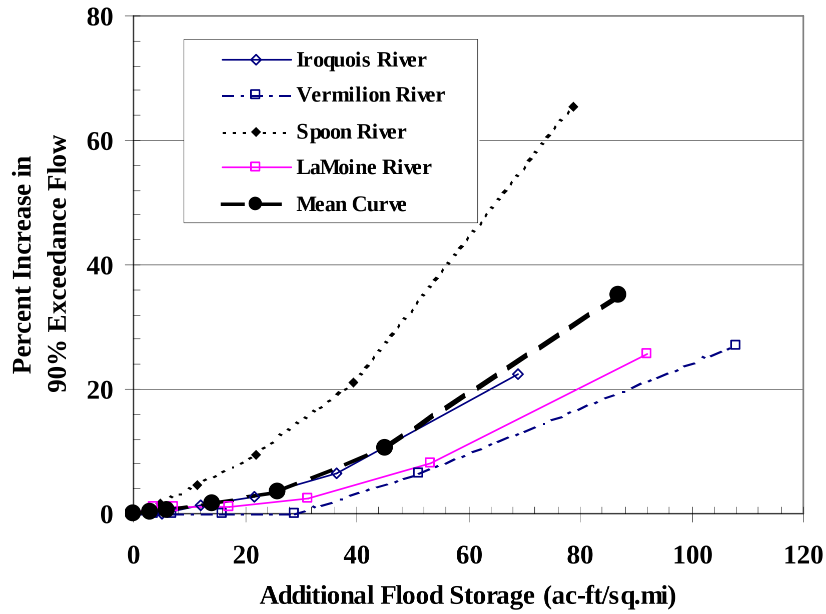


Figure 3-34. Potential Tributary Baseflow Increases With Additional Flood Storage Within Their Watersheds

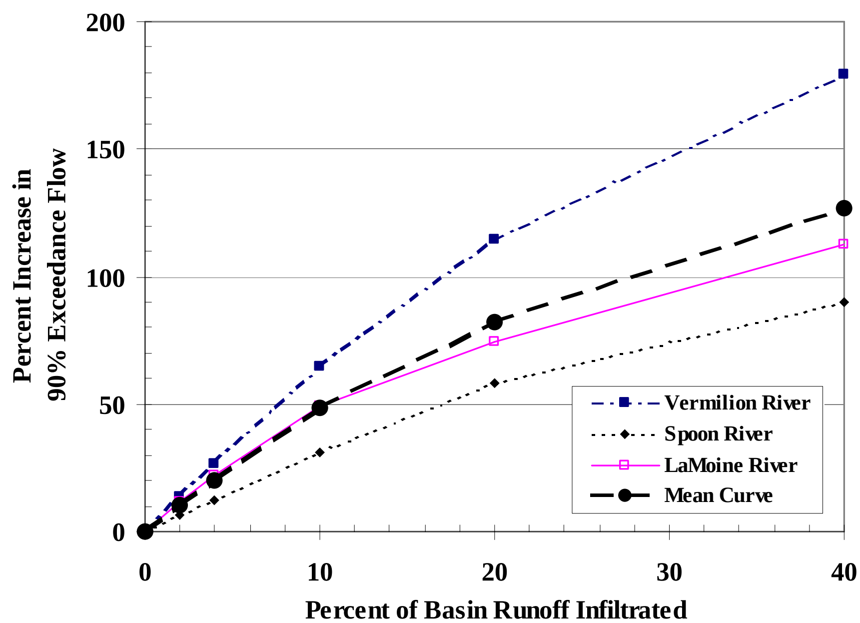


Figure 3-35. Potential Tributary Baseflow Increases With Additional Infiltration Within Their Watersheds

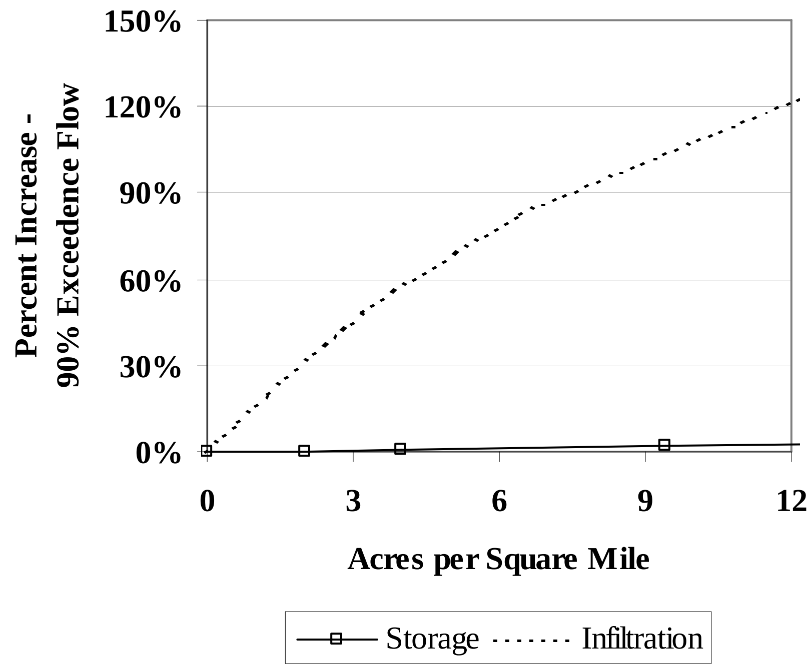


Figure 3-36. Comparison of Relative Tributary Baseflow Support Effectiveness of Infiltration and Floodplain Storage Assumes storage depth of 1.5 feet during 5-year event and contributing area ratio of 20:1 for infiltration measures.

Alternatives employing various levels of stormwater storage and infiltration area were developed using the above analysis.

ii. Stormwater Storage. Increasing the area available to retain peak flows along the tributaries would reduce the flashiness of tributary water regimes and may also provide benefits to the main stem. Five levels of basin-wide stormwater storage creation were considered for this program and are identified in Table 3-48 (Plan R0 is the No-Action Alternative). The watershed model developed by the ISWS for the Illinois River Restoration Study was modified to represent storage areas adjacent to channels that capture low-level overflows. Figures 3-39 and 3-42 were used to determine the tributary peak flow reduction and the base flow increase, respectively, for each alternative.

iii. Infiltration. Infiltration represents another means to affect tributary hydrologic regimes, and in addition to proving effective at peak flow reduction, infiltration provides the additional benefit of augmenting low flows in the tributaries. Five levels of basin-wide implementation were considered for this program and are identified in Table 3-49 (Plan I0 is the No-Action Alternative). Figures 3-40 and 3-43 were used to determine the extent to which the various alternatives would reduce the tributary 5-year peak flows and increase the tributary base flows, respectively.

Table 3-48. Stormwater Storage Alternatives

Plan ID	Additional Storage Created [1] (acre-feet)	Storage Area[2] (acres)	Storage Area[2] (miles)	Tributary Peak Flow Rate Reduction (%)	Tributary Base Flow Increase (%)
R0	NA	NA	NA	NA	NA
R1	27000	18000	28	1.5	0.1
R2	45000	30000	47	2.5	0.1
R3	90000	60000	94	5	0.3
R4	160000	107000	167	8	0.6
R5	375000	250000	391	16	1.6

[1] During a storm event with a 5-year recurrence interval.
[2] Assuming an average depth of 1.5 feet

Table 3-49. Infiltration Area Alternatives [1]

Plan ID	Area from which Runoff Is Infiltrated ($miles^2$)	% of Basin from which Runoff Is Infiltrated	Infiltration Area Required [3] (acres)	Infiltration Area Required [3] ($miles^2$)	Tributary Peak Flow Rate Reduction (%)	Tributary Base Flow Increase (%)
I0	NA	NA	NA	NA	NA	NA
I1	300	1	9600	15	0.8	5.2
I2	600	2	19200	30	1.5	10.4
I3	1200	4	38400	60	3.0	20.4
I4	3000	10	96000	150	7.6	48.5
I5	6000	20	192000	300	15.8	82.4

[1] During a storm event with a 5-year recurrence interval.
[2] Assuming an average depth of 1.5 feet.
[3] Assuming that infiltration facilities are developed with a 1:20 ratio of facility area to drainage area.

3. Main Stem. On the main stem Illinois River, alternatives were formulated to address dam management, wicket dam modification, and pool drawdown. Alternatives will be analyzed in terms of the following benefits: reduced fluctuations and area exposed by drawdown.

a. Fluctuations. The water level fluctuation effects of the alternative measures proposed for this goal were summarized in terms of fluctuations that occur in the three different portions of the year under the Existing Conditions section (please refer to that section for the characteristics of "water level fluctuations" as used here). For each time period, fluctuations that occur within 6-hours, 1-day, and 5-days were evaluated. Although for some measures, the water level changes may occur over a longer period of time than 1-day, thereby reducing the number of changes within 6-hour or 1-day time windows, the consensus of the study team is that such a "reduction" may not be very meaningful if the change still occurs within a 5-day period.

i. River and Dam Management. The current dam management strategy in place on the Illinois River is to control the navigation pools within a set band. The Water Level Management Analysis identified that a large percentage of small fluctuations downstream of dams arise because the current management strategy does not prevent significant flow changes at the locks and dams. This translates into water level fluctuations in the Illinois River. Improvements to allow lockmasters to monitor flows entering and within their pools, coupled with an ability to make smaller gate setting changes at more frequent intervals, would allow an increased degree of water level management. This was found to significantly reduce small water level fluctuations within the river. Once such an increased management strategy is in place, additional benefits may accrue from coordinated storm response.

Hydraulic modeling for the Illinois River Ecosystem Restoration Water Level Management Analysis (Appendix C-2) suggests that a number of management changes could reduce the number of short-term fluctuations occurring along the Illinois Waterway. Model results for a "optimal" management scenario indicated that the total number of fluctuations observed along the river would significantly decline. In many locations, such a management strategy would remove nearly all of the fluctuations not induced by inflows from the watershed. "Optimal" management includes increasing the frequency of dam gate changes (every two hours) and ideal knowledge of flows within and inflows to the river. Although ideal knowledge of flows and inflows is not feasible at this point in time and gate changes every two hours is impractical, "optimal" management has been used in this analysis as a planning tool while they system is being studied.

The reduction of water level fluctuations under "optimal" management would accrue almost entirely during low-water periods. Fluctuations due to higher flows or storm events would generally not be affected by this measure. Using the UNET model results (Appendix C-1), it is possible to develop quantitative estimates of potential benefits for this measure. Costs to implement include extra gaging, equipment upgrades to allow more frequent changes of gate settings, and the development of new regulation manuals.

"Optimal" management is used in this analysis even though it is an idealized situation and it is unlikely that it could be completely realized using today's technology. There are several limitations of the computer models that were used to analyze water level fluctuations under "optimal" management. These limitations include the inability to replicate the effects of wind and tow boats and the use of lockage water (the water required to transport water craft through the lock chamber at a lock and dam site). Tow boats can produce a localized wave of up to 1.08 feet and drawdown of up to 0.69 feet

(Bhowmik et al, 1982). A 50-year wind with a 6-hour duration can produce a wave of up to 1.6 feet on the Illinois River (Bhowmik et al, 1982).

The Water Level Management Analysis investigated the potential to use available storage within the system to reduce fluctuations. Such a management measure would require the measures described for "optimal" management, such as ideal knowledge of inflows and gate changes every two hours, as well as centralized control of the locks and dams along the river and a computerized system to optimize storage on a real-time basis. At this time, the software routines required for the complex system optimization at real-time have not been developed, and only Peoria Pool has a large enough volume-to-flow ratio to provide the required storage area to significantly affect fluctuations. Using the small amount of storage available in Peoria Pool to reduce fluctuations in the Illinois River system may increase local fluctuations within Peoria Pool, which may not be desirable. As the technology becomes available to conduct real-time optimization, this management strategy may be able to provide some downstream benefits.

Stormwater control may have the potential to reduce the larger fluctuations associated with storm events in the reaches immediately downstream of the stormwater facilities. The Tunnel and Reservoir Project (TARP) and the Chicago Underflow Project (CUP), currently under construction in the upper parts of the basin, will likely provide stormwater benefits downstream, with the magnitude and timing of these benefits depending on the specifics of project operations. Preliminary modeling indicates that the TARP/CUP operations will likely reduce fluctuations to some degree as far downstream as Starved Rock. To be fully successful, stormwater controls would have to be implemented throughout the basin, as rapidly fluctuating downstream inflows can mask upstream improvements. Also, the flat slope of the river from Henry downstream reduces the effectiveness of stormwater control practices because it increases the time that stormflows have to be held back to eliminate fluctuations.

Figures 3-37 and 3-38 show the average number of water level fluctuations for historical, existing, and modeled scenarios for both the growing season (figure 3-45) and the winter (figure 3-46). Winter effects are analyzed for the following two time periods: November 16 through February 28 and May 16 through June 30. Systemic averages were determined from daily (pre-1900 data) and two-hour gage records and synthetic (UNET) gage records for Peoria Pool (the pre-1900 data uses the gage at Henry instead of Peoria Pool), Kingston Mines, and Meredosia. Daily pre-1900 records were divided by 0.7 to account for resolution effects when comparing to two-hour gage records. Changes to tributary inflows for each of the modeled scenarios were developed using the BASINS hydrologic model for water years 1990 to 1995 which were then used as input to the UNET hydraulic model of the main stem Illinois River. The unmanaged scenario represents the effects of current tributary flows independent of main stem water level management activities. "Optimal" management implies gate setting changes every two hours and ideal knowledge of flows within and inflows to the river. As discussed earlier, it is improbable that "optimal" management could be realized using today's technology, nonetheless, it is useful as a planning tool. "Optimal" management is a part of every management scenario because the UNET model uses that management strategy to predict the hydraulic effects of changes in basin conditions. High storage represents an additional 423,000 acre-feet of basin storage, while moderate storage represents an additional 90,000 acre-feet of basin storage. High infiltration represents infiltration of 20 percent of basin runoff, and moderate infiltration represents infiltration of 4 percent of basin runoff.

"Optimal" management would eliminate most of the fluctuations generated by water level management activities and reduce fluctuation levels to those caused by basin inflows alone. Increased tributary storage at levels of 10 acre-feet or more per square mile of watershed area would result in some reduction in fluctuations along the river, but even the highest levels proposed for this project are not sufficient to reduce fluctuations to pre-1900 levels. Infiltration at the proposed levels does not significantly reduce 5-day fluctuations along the main stem beyond the potential reduction due to water level management changes. In some cases, the number of water level fluctuations increase when infiltration areas are added to the system. This may be due to the way infiltration areas tend to extend the time period in which stormwater flows are released from the basin, which could influence the number of water level fluctuations resulting from consecutive storm events. Although increasing tributary storage volume and infiltration areas shows little or no effect in reducing short-term, minor water level fluctuations on the main stem, it is believed that local tributary benefits would result from both measures. Further study is required in this area.

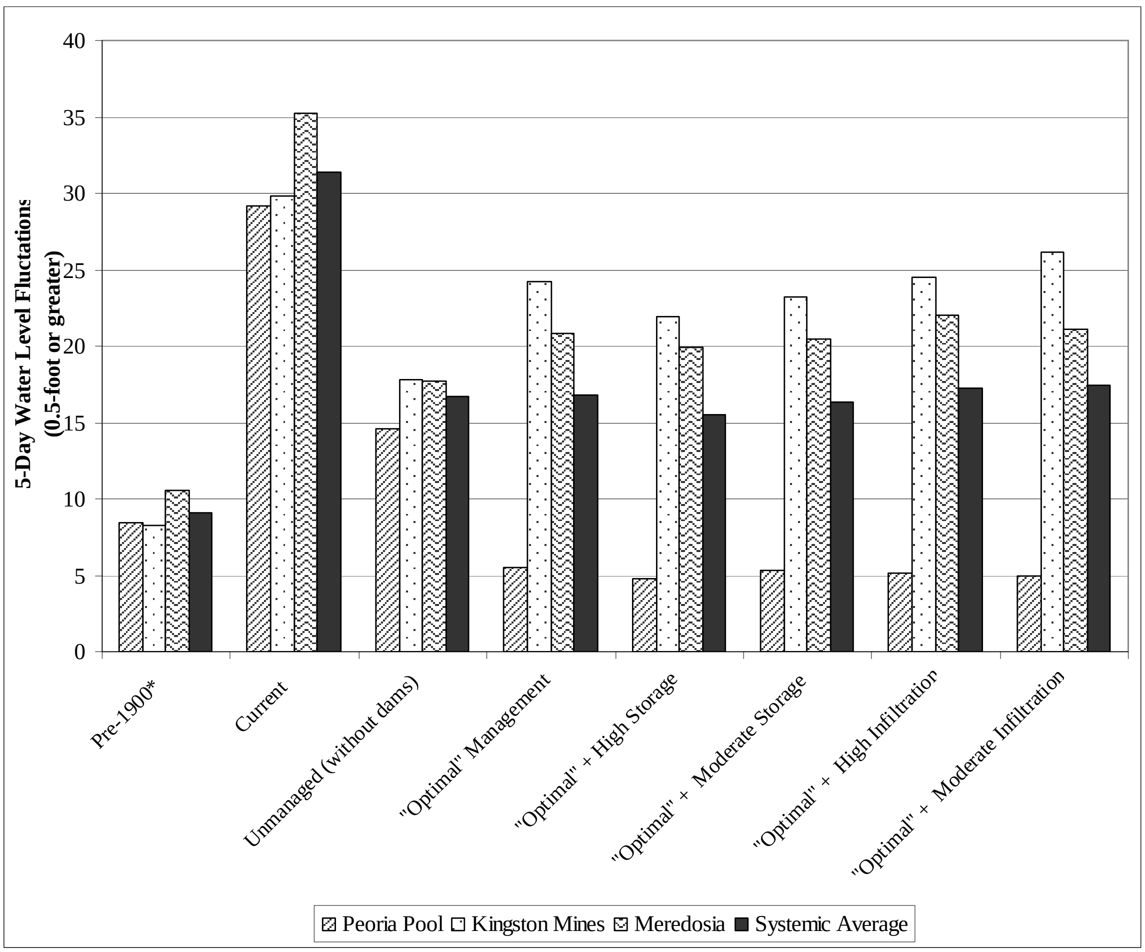


Figure 3-37. Growing Season Fluctuations Over 5-Day Windows Under Various Modeled Scenarios

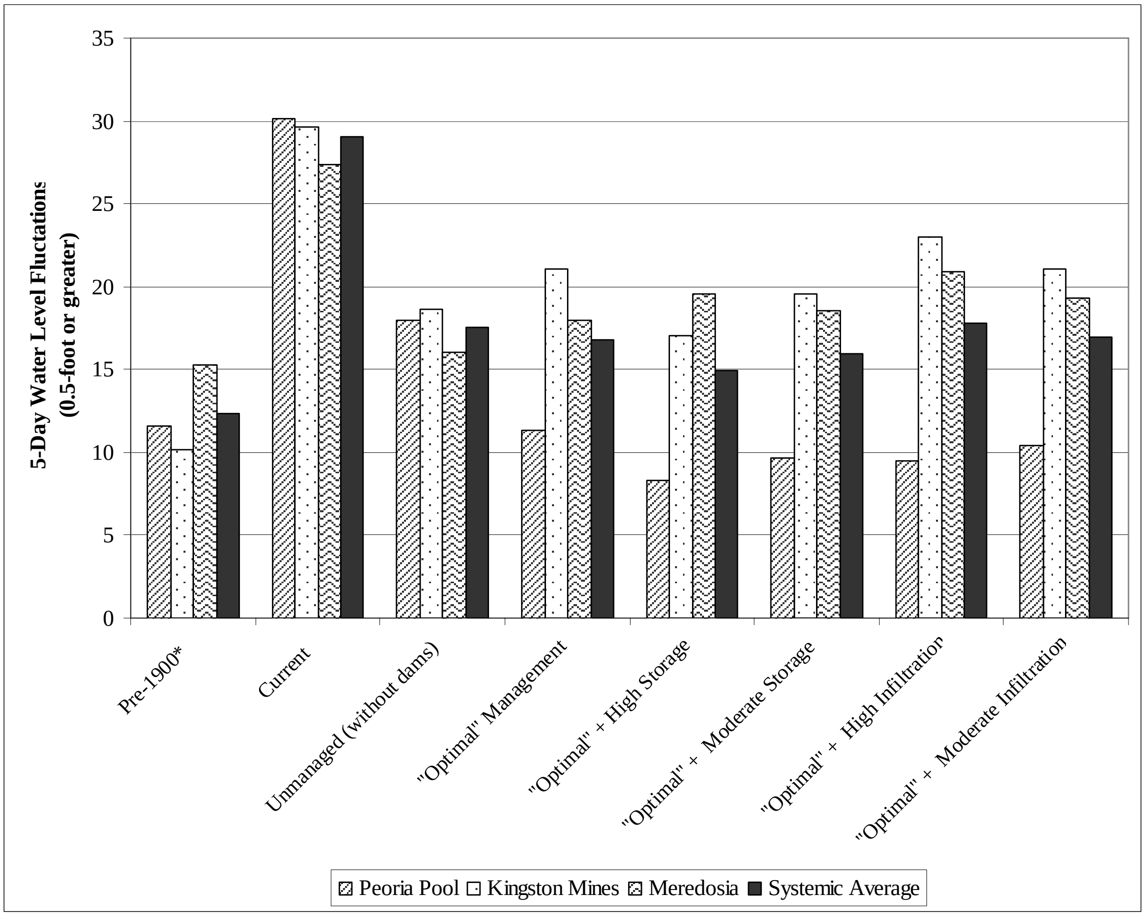


Figure 3-38. Winter Fluctuations Over 5-Day Windows Under Various Modeled Scenarios

The benefits shown in figures 3-37 and 3-38 are to some extent affected by the chosen benefit metric. The storage and infiltration measures are more effective at reducing the number of fluctuations within 24-hour time periods and at reducing the number of large fluctuations (one foot and greater), but the incidence of 5-day fluctuations of 0.5 foot or greater was felt to be a more stringent and accurate estimate of ecological benefit. These results strongly suggest that the landscape changes have changed the nature (and possibly the volumes) of the flows to the river to the extent that the hydraulic effects cannot be completely addressed by feasible watershed projects. The Illinois River is especially susceptible to such changes because its low slope accentuates water level changes under changing inflows. Therefore, under the levels considered here, the primary benefits from the infiltration and storage measures would accrue in the tributaries, not along the main stem. It is important to note that the "optimal" management scenarios represent a potential benefit, but it is likely that the actual benefit will be somewhat less because of the limitations imposed by real-world conditions. It is also likely that under somewhat less than "optimal" conditions there would be fluctuation benefits derived from infiltration or storage measures that would offset the non-optimal management conditions but cannot be recognized in this analysis due to the modeling limitations.

Three alternatives for dam management were considered for this program and are identified below:

- M0 – No action
- M1 – Increase frequency of dam gate changes with the aim of reducing low-water fluctuations; requires new regulation manuals, improved gage network (10) and increased capacity of operators to make gate changes (i.e. "Optimal" management)
- M2 – M1 + enact coordinated water control with the aim of minimizing fluctuations induced by storm events (i.e. centralize water control)

ii. Wicket Dam Modification. The operation of the wicket dams at Peoria and LaGrange induce significant water level fluctuations, both when the wickets are raised and when they are lowered. Totally eliminating these large fluctuations would likely require replacing the wickets with permanent structures, which would eliminate the ability to have open pass during periods of high water levels. Altering the method of wicket operation is not likely to significantly reduce the occurrence of these fluctuations. Although adding another tainter gate at either Peoria and LaGrange would probably not decrease the frequency of wicket operations at the dams, it would most likely reduce the magnitude of water level fluctuations that result from wicket operations. The computed induced water level fluctuations at Peoria and La Grange Lock and Dams with the addition of a single tainter gate at each dam are 0.5 and 1.1 feet, respectively (USACE, 2005). This represents a computed reduction in the magnitude of the water level fluctuations of 1.8 and 1.9 feet at Peoria and La Grange, respectively. Reconstruction of the dams, and replacement of all the wickets with tainter gates, could further smooth the fluctuations that currently occur during wicket operations and so would accrue benefits in the upper portions of the La Grange and Alton Pools.

The potential benefits from adding tainter gates would be a reduced intensity of the water level drops associated with gate raises because of the reduced need to hold back flows to build pool. Although adding a single tainter gate at Peoria and La Grange would not reduce the number of water level fluctuations (consequently the benefits in terms of water level fluctuations do not change), the reduction in magnitude of water level changes is significant and beneficial. Reconstructing the dams as permanent structures (i.e. replacing the wicket gates with tainter gates) may provide the opportunity to smooth water level changes enough to eliminate the fluctuations that would have occurred due to raising wicket gates. The benefits would occur at Kingston Mines and Meredosia, with maximum average reductions of 1.5 and 1.7 fluctuations per growing season, respectively, and 0.7 and 0.5 fluctuations per winter season, respectively. Effects due to the pulses from wicket lowering would be attenuated as well, but the benefits are not likely to be observable in the fluctuation metric because the rising water levels would generally induce fluctuations during a 5-day time window regardless.

The following six alternatives for wicket dam modification were considered for this program:

- WP0 – No action at Peoria dam
- WP1 – Add additional tainter gate at Peoria
- WP2 – Reconstruct wicket dam at Peoria to allow continuous dam operations
- WL0 – No action at La Grange dam
- WL1 – Add additional tainter gate at La Grange
- WL2 – Reconstruct wicket dam at La Grange to allow continuous dam operations

iii. Floodplain Storage. Potential fluctuation reduction benefits were investigated for floodplain management activities in the Peoria and La Grange Pools (please see Appendix C-4). Because of the historical loss of connected floodplain area, changes in flow are more restricted and these likely lead to a less stable water level regime than would occur if the additional area were available. Floodplain elevation is a key determinant of the nature of the benefits expected; to affect the water level changes occurring during low water, it is necessary for the available floodplain to be at or near flat pool elevations. Because of the interest in mitigating such low water fluctuations, the floodplain management analyses concentrated on scenarios that focused on making area available when the water level was relatively low.

The Hennepin Drainage & Levee District at RM 206 is the only significant contiguous area of disconnected floodplain within the Peoria Pool. That area is 2,900 acres protected from the river by an agricultural levee system. The UNET modeling indicated that making use of the leveed area to attenuate high flows could reduce maximum water levels at Henry, approximately 7 miles downstream, by as much as 0.5 foot, although all benefits depend on the design of the structure that would be used to divert flows into the district. Hydraulic modeling indicates that the area would be most effective at reducing fluctuations if its inlet weir is set just above level pool elevation (440 feet NGVD). With this design, the HDLD would reduce 5-day fluctuations downstream to the Peoria Lock and Dam (RM 158) by approximately 5 percent. Upstream reductions would be less (2 percent at Starved Rock Tail, RM 231), and downstream of the Peoria Lock and Dam the river would display 1 percent reductions or less. These benefits would be roughly additive when combined with work to restore tributary hydrologic regimes; if storage is added in the basin at levels of 10 acre-feet per square mile or greater, additional fluctuation benefits can be expected, but combinations with infiltration alternatives or low levels of storage are unlikely to display additional benefits beyond those attributable to the HDLD alone.

Modeling of floodplain storage in the La Grange Pool indicates somewhat smaller reductions in water level fluctuations from added storage area than the modeling of the HDLD. For this report, the Illinois State Water Survey used the UNET model to simulate a number of scenarios wherein different combinations of floodplain areas in the La Grange Pool were made available to attenuate low-level fluctuations, in the same way that the HDLD was modeled in Peoria Pool. Changes in the water level fluctuation regime were quantified at Kingston Mines, Copperas Creek, Havana, and Beardstown. The results of this effort suggest that although location-specific effects are significant, the fluctuation reductions due to the storage areas are roughly additive. The effects also diminish quickly with distance, and are much greater downstream from the added storage than upstream. Figure 3-39 summarizes the relationships developed from this analysis. Please note that the percent reduction in 5-day fluctuations is based on the average reduction under “optimal management” conditions based on UNET hydraulic modeling conducted by the Illinois State Water Survey.

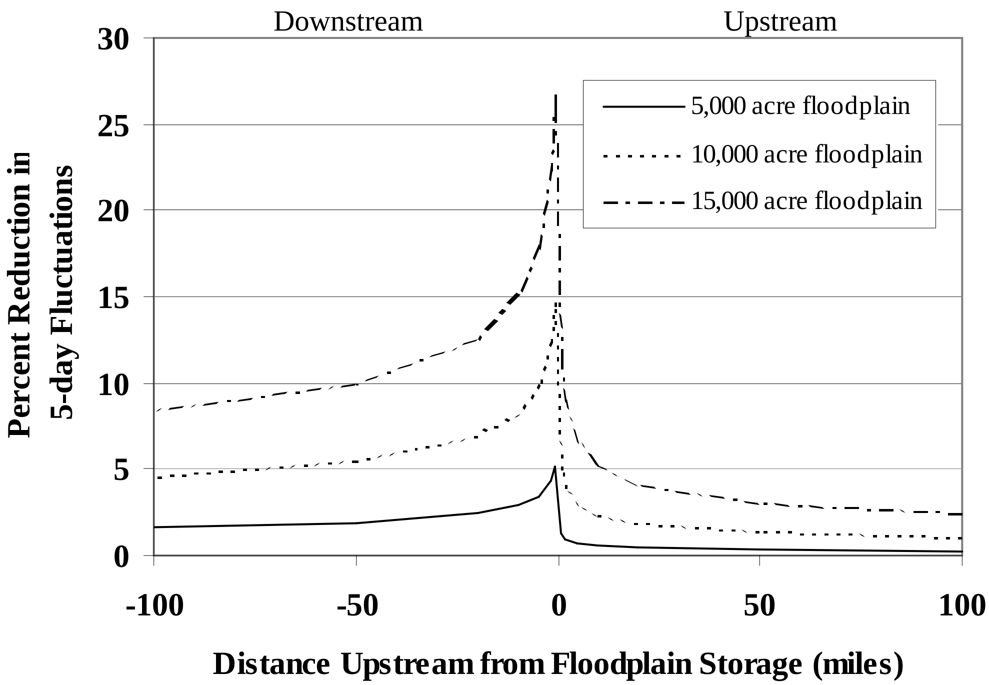


Figure 3-39. Expected Reduction in La Grange Pool Water Level Fluctuations Upstream and Downstream of Added Floodplain Storage

As figure 3-39 indicates, the incremental addition of floodplain storage areas in the La Grange Pool can have a large effect on local water level conditions, and there is sustained benefit downstream but benefits do not transmit a long distance upstream. For example, the addition of 15,000 acres at pool level would reduce fluctuations by 10 percent or more, under modeled conditions, for 50 miles downstream, but the fluctuation 10 miles upstream would be less than 5 percent. Locations with 5,000 acres or less would not be expected to reduce fluctuations anywhere by more than 5 percent. Large benefits can be expected only in the immediate vicinity of the floodplain projects, and to some degree downstream, and only if the total area exposed at low water is greater than about 10,000 acres.

No floodplain projects are recommended as part of this Goal for two reasons, (1) they are already addressed in Goal 3 and (2) the benefits realized from floodplain projects tend to influence only the local area. Some ancillary hydrologic benefits will be attained when floodplain projects are implemented to meet Goal 3. Some floodplain management activities may be considered as part of the effort to improve local conditions in the vicinity of other projects. For example, open areas of the floodplain could be created across the river from a habitat restoration project in an attempt to attenuate fluctuations. As part of a systematic effort, these results suggest that floodplain areas in the upper reaches of the pool may provide the most benefits; downstream areas would have little upstream benefits and it is likely that most of the fluctuation benefits do not pass downstream of the dams, when they are in operation. The Corps of Engineers has done some analysis of the effects of levee removal on the Mississippi and Illinois Rivers as part of the *Upper Mississippi River Comprehensive Plan for Systematic Flood Damage Reduction and Associated Environmental Sustainability* report which is still under review. Early results have shown that completely removing agricultural levees from the system could provide some reduction in water levels on the Illinois River in some locations. No analysis on water level fluctuations was performed as part of this study. Further study is required in this area.

b. Pool Drawdown. Several factors combine to determine the effects of a drawdown event, including:

- the duration of the event,
- the depth to which the water level is drawn down,
- the area of sediment exposed, and
- the month or season of drawdown.

Increased drawdown depth and implementation of added dewatering measures can increase sediment consolidation. It has been noted that 70 consecutive days with sustained low water conditions between July 10 and October 1 are required for optimal growth and establishment of moist soil plants (Bellrose et al. 1983), but benefits have been observed with drawdowns of lesser duration (Atwood et al. 1996). Seasonality is critical to the benefits achieved; drawdown during the winter may provide the benefit of sediment compaction, although it would not permit vegetation to establish.

Analyses for the UMR Navigation Study evaluated the potential for pool-wide drawdowns along the Illinois River. In that analysis, very little benefit was found in drawing down the river at points upstream of Starved Rock. Benefits were found at Peoria and La Grange, but a low probability of success was assigned to attempted drawdowns in those pools because flow conditions would prevent maintenance of a 2-foot drawdown for 60 continuous days between May and August in more than 50 percent of years. The Water Level Management Analysis conducted additional analyses of the potential for drawdown in the Peoria and La Grange Pools. Flow conditions during 30-day and 70-day time windows throughout the year were analyzed to determine the probability of maintaining drawdown during the entire window or for 30 consecutive days within each 70-day window. The values determined from this analysis are given in Tables 3-48 and 3-49 as the “Full Success Rate” for the attempted drawdowns.

Main stem benefit analysis concentrated on the Illinois River from Henry to Meredosia. This reach contains most of the ecologically significant areas on the main stem, and downstream of Meredosia the river hydrologic regime becomes dominated by the backwater effects of the Mississippi River. Fluctuation benefits were generated for each pool, with the percent reduction at the Peoria Pool, Meredosia, and Kingston Mines gages representing Peoria Pool, Alton Pool, and La Grange Pool, respectively. The benefits at the three pools were averaged to develop a measure of systemic benefit.

Drawdown benefits were determined based on expected acres of exposure (the sum of the area exposed multiplied by the probability of success). Timing is crucial to ecological benefits of drawdowns, so a seasonal factor was used to adjust the benefits based on time of year. Drawdowns occurring between June 1 and September 1 were accorded a value of “1.0,” with the value of drawdown decreasing linearly to “0.2” on December 1 (figure 3-40). This factor is referred to as the “suitability” of the drawdown season.

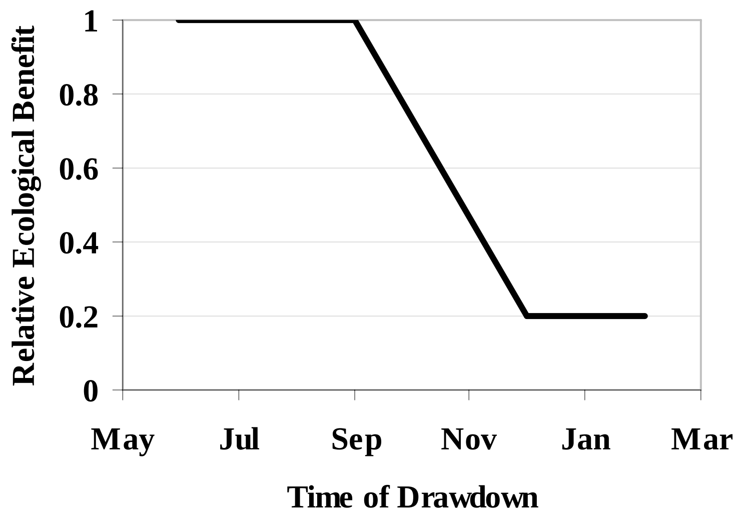


Figure 3-40. Assumed Seasonal Value of Drawdown Along Main Stem Illinois River

The probability of success combined with the suitability of the drawdown season and length of sustained drawdown provides a quality-weighted expected benefit factor of the drawdown. These values were calculated for the most favorable times of the year (Tables 3-50 and 3-51). Combining these values with the average area of exposure, calculated using hydraulic modeling, provides the total expected benefits for the various drawdown scenarios (figures 3-41 and 3-42). Note that the uncontrolled scenario refers to the hypothetical situation in which main stem water level management activities have been removed from the system (i.e. no dams). The benefits quantified for the Peoria Pool used modeled exposed area: 3,000 acres for 1-foot drawdown, 8,000 for 2-foot drawdown, and 24,000 for uncontrolled drawdown. The values for La Grange use the modeled area exposed in the vicinity of the channel plus additional contiguous off-channel aquatic area identified for the Navigation Study totaling 4,300 acres for 1-foot drawdown, 8,600 for 2-foot drawdown, and 15,200 for uncontrolled drawdown.

The following formulas further explain this process:

Expected Benefit Per Acre = Suitability * Full Success Rate * Duration of Drawdown

Expected Drawdown Benefits = Expected Benefit Per Acre * Area Exposed by Drawdown

Table 3-50. Benefit Calculations for Peoria Pool Drawdowns

Starting Date		**June 1**	**July**	**Aug 1**	**Sep 1**	**Oct 1**	**Nov 1**	**Dec 1**
Suitability (30-day)		1.0	1.0	1.0	0.8	0.6	0.4	0.2
Suitability (70-day)		1.0	0.97	0.86	0.66	0.46	0.29	0.2
30-day attempt	Full success rate	0.15	0.3	0.6	0.65	0.65	0.55	0.4
	Expected benefit (per acre)	**4.5**	**9**	**18**	**15.6**	**11.7**	**6.6**	**2.4**
70-day attempt	Full success rate	0.1	0.2	0.45	0.45	0.4	0.3	0.2
	Expected benefit (per acre)	**7**	**13.6**	**27.1**	**20.8**	**12.9**	**6.1**	**2.8**
	30-day but not 70-day rate	0.4	0.6	0.4	0.4	0.4	0.4	0.55
	Expected benefit (per acre)	**12**	**18**	**12**	**9.6**	**7.2**	**4.8**	**3.3**

Table 3-51. Benefit Calculations for La Grange Pool Drawdowns

Starting Date		**June 1**	**July 1**	**Aug 1**	**Sep 1**	**Oct 1**	**Nov 1**	**Dec 1**
Suitability (30-day)		1.0	1.0	1.0	0.8	0.6	0.4	0.2
Suitability (70-day)		1.0	0.97	0.86	0.66	0.46	0.29	0.2
30-day attempt	Full success rate	0.1	0.25	0.4	0.65	0.6	0.55	0.4
	Expected benefit (per acre)	**3**	**7.5**	**12**	**15.6**	**10.8**	**6.6**	**2.4**
70-day attempt	Full success rate	0.0	0.15	0.3	0.45	0.4	0.25	0.2
	Expected benefit (per acre)	**0**	**10.2**	**18.1**	**20.8**	**12.9**	**5.1**	**2.8**
	30-day but not 70-day rate	0.4	0.55	0.55	0.35	0.35	0.3	0.35
	Expected benefit (per acre)	**12**	**16.5**	**16.5**	**8.4**	**6.3**	**3.6**	**2.1**

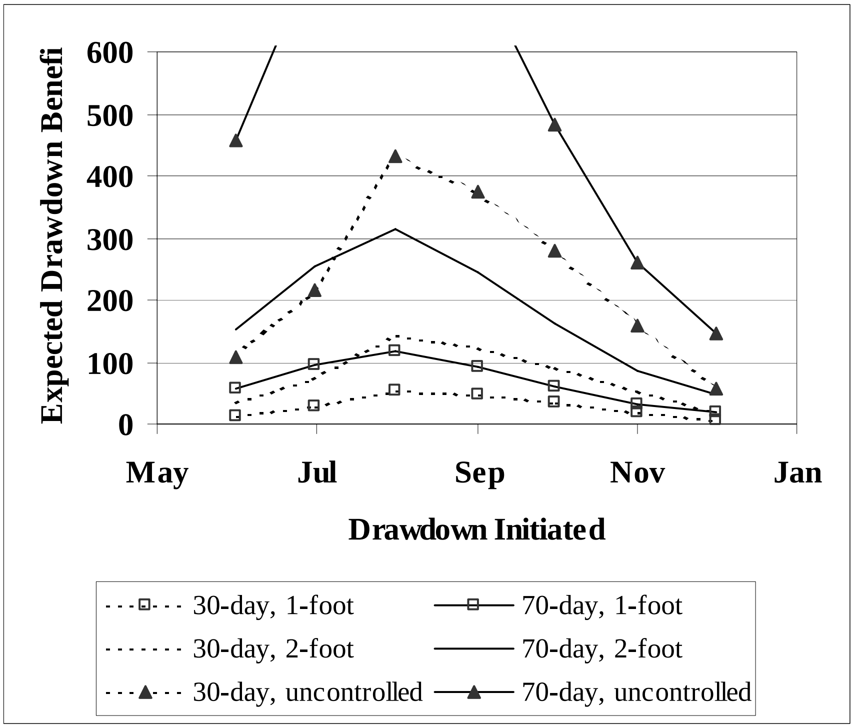


Figure 3-41. Expected Drawdown Benefits in Peoria Pool. Units are thousand quality acre-days.

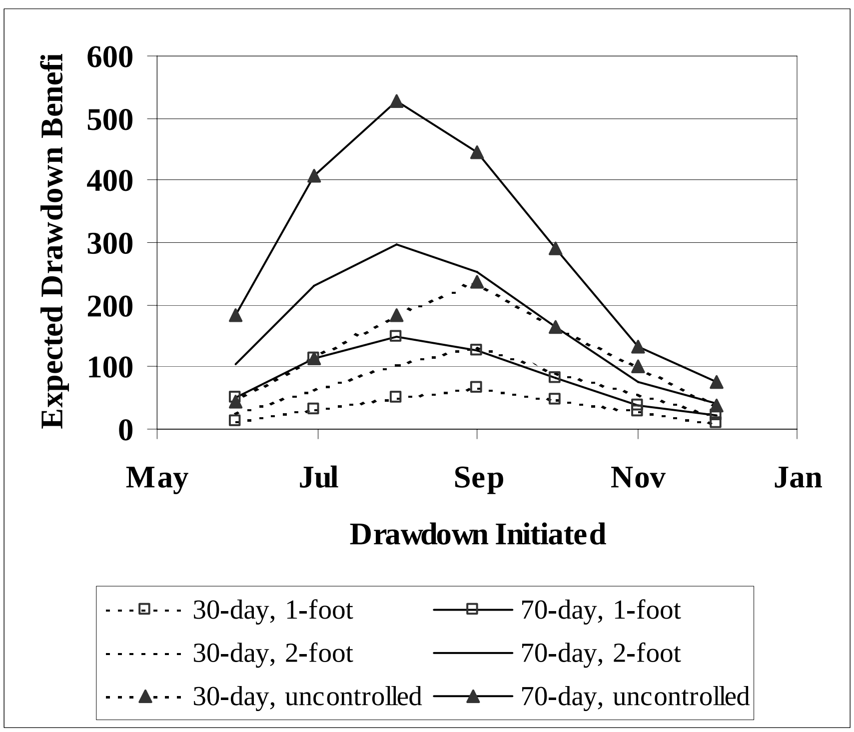


Figure 3-42. Expected Drawdown Benefits in La Grange Pool. Units are thousand quality acre-days.

Since the cost of drawdown is estimated using the long-term dredging requirements to maintain navigation with lower water levels, there is no incremental cost per drawdown attempt. For Peoria Pool, 2-foot drawdowns were chosen, but because of the likelihood of high dredging requirements, only a 1-foot drawdown was chosen for La Grange Pool. The individual measures were chosen based on the number of attempts to maintain at least 30 consecutive days of drawdown 10 times over 50 years.

Five alternatives for pool drawdown were considered for Peoria Pool (P) and seven alternatives for pool drawdown were considered for La Grange Pool (L). These alternatives are identified below:

- P0 – No Peoria Pool drawdown
- P1 – Attempt a 2-foot drawdown of Peoria Pool 2 years out of every 3 from Jul 1-30
- P2 – Attempt a 2-foot drawdown of Peoria Pool every 3 years from Aug 1-30
- P3 – Attempt a 2-foot drawdown of Peoria Pool 2 years out of every 5 from Jun 1- Aug 9
- P4 – Attempt a 2-foot drawdown of Peoria Pool every 4 years from Aug 1- October 9

- L0 – No La Grange Pool drawdown
- L1 – Attempt a 1-foot drawdown of La Grange Pool 4 years out of every 5 from Jul 1- 30
- L2 – Attempt a 1-foot drawdown of La Grange Pool every other year from Aug 1- 30
- L3 – Attempt a 1-foot drawdown of La Grange Pool 3 times every 10 years from Sep 1- 30
- L4 – Attempt a 1-foot drawdown of La Grange Pool every other year from Jun 1- Jul 9
- L5 – Attempt a 1-foot drawdown of La Grange Pool 2 years out of every 7 from Jul 1- Sep 9
- L6 – Attempt a 1-foot drawdown of La Grange Pool 6 times every 25 years from Aug 1- Oct 9

3. Evaluation and Comparison of Plans

A range of plans was developed by combining alternatives developed for dam management, stormwater storage, infiltration, wicket dam modification, and pool drawdown. The costs and benefits for these plans were estimated to allow evaluation of how well these plans meet the objectives of this goal and their relative cost-effectiveness. Based on this analysis, effective plans of different levels of effort were chosen for inclusion in the proposed system-level plans.

a. Costs. Costs for each of the alternatives were developed assuming a 50-year project life. Where possible, these costs were estimated using previously constructed projects or from other planning efforts, such as the Restructured Upper Mississippi-Illinois Waterway System Navigation Study. All construction costs include a 35 percent contingency, 30 percent for planning, engineering, and design, 9 percent for contract supervision and administration, and estimated real estate costs. Costs shown are in 2003 dollars.

Dam Management

M1 – Management improvements require three upgrades – initial cost $3.7M

- Place remote controls on rest of Illinois River dams (Marseilles already installed) – $5,629,500.
- Revise regulation manuals (7 total) - $108,000 each, for a total of $756,000.
- Install and maintain additional gages (10 total) - USGS initial cost $20,250 each, for a total of $202,500.

M2 – Navigation Study estimates $7,000,000 over 50 years. Assume initial cost of $1,000,000.

Storage (R1-R5)

Assume that each storage area would be on the order of 5 acres or more and a depth (during the design event) of 1.5 feet. Based on the cost estimate of a similar project, the construction cost for a floodplain pond was estimated to be approximately $6300 per acre-foot. Operations and maintenance costs are estimated to be $5.00 per acre-foot per year.

Infiltration (I1-I5)

There are a variety of potential ways to develop infiltration facilities – assume half upland structures, half filter strip. Assume that each upland infiltration structure would be on the order of 5 acres or more. An upland structure/ filter strip project was estimated to cost $13,825 per acre, with annual operations and maintenance costs of $6.75 per acre.

Wicket Dam Modification

Wicket dam modification would consist of replacing either 26 of the wickets with one tainter gate or all of the wickets (108 at Peoria and 109 at La Grange) with 4 tainter gates. One tainter gate was estimated to cost $26 million, with an annual estimated operations and maintenance cost of $30,000. Replacing the entire wicket structure with four tainter gates was estimated to cost a total of $300 million. The Navigation Study estimates that installing an additional tainter gate at either Peoria or La Grange (without removing any of the wickets) would cost approximately $13.9 million (USACE, 2005).

Drawdown

The Navigation Study estimated the cost to conduct drawdowns as the cost to dredge to maintain minimum channel conditions and access to facilities. This management would allow any number of drawdowns over the course of the project life. Preliminary estimates for Peoria Pool and La Grange Pool indicated that an additional 47,000 and 204,000 cubic yards of dredging would be required every 10 years to maintain navigation during 1.5-foot drawdowns of these two pools, respectively.

Because dredging needs were not determined for 2-foot drawdowns of Peoria Pool, it was assumed that such a drawdown would require twice as much dredging as the 1.5-foot drawdown. Likewise, it was assumed that the quantities required for a 1-foot drawdown of La Grange Pool would be the same as the dredging for a 1.5-foot drawdown. These assumptions lead to added channel maintenance dredging requirements of 470,000 cubic yards of material in Peoria Pool and 1,021,000 cubic yards in La Grange Pool over a 50-year time period.

Additional dredging would also be required to maintain facility access. USACE 2004a identified 12 marinas and 20 industrial facilities that would be affected by a drawdown in Peoria Pool and so would have to be dredged an additional 5 times over 50 years. The final cost estimate is $14.6 million to maintain 2-foot drawdown conditions in Peoria Pool and $22.9 million to maintain 1-foot drawdown conditions in La Grange Pool.

It should be noted that these costs do not reflect additional economic costs such as loss of recreation due to lower water levels. Also not quantified is the potential benefit from reduced future maintenance dredging. These issues will be addressed further in the project design phase.

b. Benefits. Quantifying hydrologic benefits under this goal requires consideration of multiple independent factors. Although the current understanding of Illinois River Basin ecosystem processes allows identification of several important aspects of the hydrologic regime, this understanding is not sufficient to determine many critical thresholds that are known to influence ecosystem integrity. In the absence of knowledge regarding thresholds, benefits are generally assumed to be directly associated with reduction of unfavorable conditions or increase of favorable conditions; that is, a 10 percent reduction in an unfavorable condition is interpreted as a 10 percent improvement in that aspect of the hydrologic regime. This is not altogether consistent with the importance of thresholds; for example, reducing unfavorable conditions may or may not achieve a proportional benefit because the reduced level may still be too unfavorable for ecosystem response. However, in the absence of a more detailed understanding, the assumption of a linear response is the best available. Where possible, it is better to compare the hydrologic regime to conditions that maintained a more desirable state.

One of the most important considerations in evaluating hydrologic benefits is that all of the significant aspects of the altered regime must be captured. Many of these aspects are independent and not directly comparable, so dissimilar benefits should not be lumped together before evaluation. In other words, providing additional benefits to one aspect of the hydrologic regime (e.g., peak flows) would not necessarily offset the effects of a different aspect (e.g., low flows). Because there is currently no accepted index that combines the aspects of the Illinois River Basin hydrologic regime into a single value for comparison, it is not possible to develop a single estimate of regime "quality." Therefore, in this section the different alternatives were compared by individually accounting for the various relevant hydrologic regime benefits.

i. Tributary Benefits. Tributary benefits were quantified as reduced 2- to 5-year peak flows and increased baseflows. These two aspects of the hydrologic regime are generally acknowledged to provide independent benefits to stream and river communities. Reduced peak flows for these relatively common events are assumed to correlate with less extreme conditions during runoff events and so are related to other beneficial improvements during high water conditions. Baseflow levels are commonly directly related to ecosystem support during drought conditions.

The benefits for these two aspects were expressed directly as the modeled improvements shown in Figures 3-39 through 3-44, and are shown in Table 3-50. This formulation assumes the proportional relationship between hydrologic improvements and ecosystem benefits described previously and does not identify any benefit thresholds. Where both storage and infiltration measures were used in an alternative, the benefits were assumed to be additive.

ii. Main Stem Benefits. Two types of benefits were identified that would independently improve main stem Illinois River hydrologic regimes: reduced fluctuations and bottom area exposed during sustained drawdown. Using the main stem fluctuation index defined as the average annual number of 5-day fluctuations exceeding 0.5 foot at the Peoria Pool, Kingston Mines, and Meredosia gages, main stem fluctuation benefits have been defined using:

$$\text{Benefit} = (\text{Current-Alternative})/(\text{Current} - \text{pre-1900})$$

The values for the fluctuation index for Water Years 1990 - 1997 ("Current") are 31.4 for the growing season and 29.0 for the winter. Pre-1900, this index is estimated to be 9.0 for the growing season, 12.3 for the winter. Using these values, fluctuation benefits can be estimated using the following formulas:

$$\text{Growing Season Benefit} = (31.4 - \text{Alternative})/22.4, \text{ and}$$
$$\text{Winter Benefit} = (29.0 - \text{Alternative})/16.7$$

The assumptions for this benefit calculation are that the fluctuations of 0.5 foot or more occurring over 5 days or less and measured using 2-hour data correlate with the conditions that are adversely affecting ecosystem function in the main stem Illinois River; that the average of these three locations accurately reflects overall river conditions; that the conditions observed in the 1890's are near-optimal for the current system; and that there is a proportional improvement in condition with each change that moves total fluctuation numbers closer to pre-1900 levels. The assumed fluctuation benefits for the various alternatives are shown in Table 3-52.

Table 3-52. Tributary and Main Stem Alternative Hydrologic Regime Benefits

	Initial Cost ($M)			**Tributaries**		**Reduced Main Stem Fluctuations**	
Alternative	**Construction**	**Real Estate**	**Total**	**Reduced Peak Flow**	**Increased Baseflow**	**Growing Season**	**Winter**
R0, I0, M0, WP0, WL0	0	0	0	0	0	0%	0%
M1	6.6	0	6.6	0	0	65%	73%
M2	7.6	0	7.6	0	0	65%	73%
R1	**108**	**62**	**170**	**1.50%**	**0.1%**	**0%**	**0%**
R2	180	104	284	2.50%	0.1%	0%	0%
M1, R2	187	104	291	2.50%	0.1%	65%	73%
M1, R3	367	207	574	5%	0.3%	65%	73%
M1, R4	647	368	1015	8%	0.6%	66%	73%
M1, R5	1508	863	2371	16%	1.6%	67%	78%
I1	100	33	133	0.80%	5%	0%	0%
M1, I2	207	65	272	1.50%	10%	67%	73%
M1, I3	407	131	538	3%	20%	65%	73%
M1, I4	1008	326	1334	7.60%	50%	65%	73%
M1, I5	2009	653	2662	16%	80%	65%	73%
R1, I1	**208**	**95**	**303**	**2.30%**	**5%**	**0%**	**0%**
M1, R1, I1	**215**	**95**	**310**	**2.30%**	**5%**	**65%**	**73%**
M1, R3, I3	**767**	**338**	**1105**	**8%**	**20%**	**65%**	**73%**
M1, R4, I3, P4, L6	**1047**	**499**	**1546**	**11%**	**20%**	**66%**	**73%**
M1, R5, I4	2509	1189	3698	23%	50%	67%	78%
M1, R5, I4, WP2	2809	1189	3998	23%	50%	70%	79%
M1, R5, I4, WL2	2809	1189	3998	23%	50%	70%	79%
M1, R5, I4, WP2, WL2, P4, L6	**3109**	**1189**	**4298**	**23%**	**50%**	**72%**	**80%**

Key:
(R) - storage in tributary areas
(I) - infiltration in tributary areas
(M) - dam management
(WP) - modification of Peoria wicket dams
(WL) – modification of La Grange wicket dams
Bold type - alternative combinations that were used as system plans

Drawdown benefits were calculated using

$$\text{Expected benefit per attempt} = n * P * Q * A$$

as described above, where n is the desired length of drawdown, P is the probability of n consecutive days with appropriate flow conditions (Appendix C), Q is the quality factor that relates to the benefits accrued from the season the drawdown is taking place (figure 3-38) and A is the bottom area exposed by drawdown. This formulation assumes that there is no benefit unless the drawdown is maintained for at least n days. Expected benefits were formulated for n = 30 and 70 days, and expected benefits for the 70-day drawdown attempts included both the benefits from a 70-day drawdown and the benefits from drawdowns that last at least 30 days but not the full 70 days within that time period (Tables 3-48 and 3-49). Total benefits are the expected benefits per attempt multiplied by the number of attempts over the course of the project (Table 3-53). Alternatives were developed with the intent of one successful drawdown every 5 years, so drawdowns in less favorable seasons would be expected to require some attempts in additional years to attain the desired number of successes. For this reason, Table 3-53 lists the expected benefits based on the number of days that the pool is expected to be drawn down over the 50-year project life. Drawdown benefits are quantified as quality acre-days, representing the area exposed for at least 30 consecutive days, with quality reflecting seasonal benefits as shown in figure 3-38. Expected number of days drawn down are 30 and 70 for fully successful 30- and 70-day drawdowns, respectively, and 15 and 35 for drawdown attempts that are not fully successful.

4. Plans Recommended for System Analysis

a. Restoration Alternatives. The alternatives described above were combined to represent plans with different levels of effort, each adding increments onto the previous plans and with benefits corresponding to the various system-level alternatives. It is assumed that each is cost-effective because the most cost-effective measures will be used in the implementation of each plan. Characteristics of each plan are summarized in Table 3-54.

5A – R1. Create an additional 27,000 acre-feet of storage during 5-year event. Reduces tributary peak flows by 1.5 percent and provides an initial level of benefit to tributary areas.

5B – R1, I1. Create an additional 27,000 acre-feet of storage during 5-year event and infiltrate runoff from 300 square miles. Provides tributary benefits by reducing peak flows by 2.3 percent, thereby meeting Lt. Governor's goal and increasing low flows by 5 percent.

5C – M1, R1, I1. Create an additional 27,000 acre-feet of storage during 5-year event, infiltrate runoff from 300 square miles, and increase intensity of water level management at Illinois Waterway locks and dams. Provides tributary benefits by reducing peak flows by 2.3 percent, thereby meeting Lt. Governor's goal and increasing low flows by 5 percent. Also provides significant reduction in low-flow water level fluctuations on main stem river.

5D – M1, R3, I3. Create an additional 90,000 acre-feet of storage during 5-year event, infiltrate runoff from 1,200 square miles, and increase intensity of water level management at Illinois Waterway locks and dams. Provides significant tributary benefits by reducing peak flows by 8 percent, thereby exceeding Lt. Governor's goal and increasing low flows by 20 percent. Also provides significant reduction in low-flow water level fluctuations on main stem river..

Table 3-53. Drawdown Alternative Benefits

Alternative	Cost ($M)	Number of Attempts (50 yr)	Expected Benefit per Attempt (acre-days)	Expected Days Drawn Down	Total Benefit (acre-days)	Benefit per Day Drawn Down
P0, L0	0	0	0	0	0	
P1	14.6	33	72	495	2376	4.8
P2	14.6	17	144	405	2448	6
P3	14.6	20	152	1040	3040	2.9
P4	14.6	13	313	665	4069	6.1
L1	22.9	40	32.25	750	1290	1.7
L2	22.9	25	51.6	525	1290	2.5
L3	22.9	15	67.1	375	1007	2.7
L4	22.9	25	51.6	875	1290	1.5
L5	22.9	14	114.8	560	1607	2.9
L6	22.9	12	148.8	560	1786	3.2

Key:
P - Peoria Pool drawdowns
L - La Grange Pool drawdown

Table 3-54. Characteristics of Alternative Plans Selected As Part of System Plans

		Tributary Benefits		Main Stem Benefits			Initial Cost ($M)			
System Plan	Alt. Plan	Peak Flow Reduction	Base Flow Increase	Growing Season Reduced Fluctuation	Winter Reduced Fluctuation	Expected Drawdown (Peoria/La Grange)	Construction	Real Estate	Total	O&M ($K/yr)
1	5A	1.50%	0%	0%	0%	no/no	108	62	170	135
2	5B	2.30%	5%	0%	0%	no/no	208	95	303	200
3	5C	2.30%	5%	66%	75%	no/no	215	95	310	325
4,5	5D	8%	20%	66%	75%	no/no	767	338	1105	835
6	5E	11%	20%	66%	75%	yes/yes	1085	499	1584	1185
7	5F	23%	50%	73%	81%	yes/yes	3147	1189	4336	2650

5E – M1, R4, I3, P4, L6, WP1, WL1. Create an additional 160,000 acre-feet of storage during 5-year event, infiltrate runoff from 1,200 square miles and increase intensity of water level management at Illinois Waterway locks and dams, and reconstruct portions of the Peoria and La Grange dams to include an additional tainter gate at each dam. Provides significant tributary benefits by reducing peak flows by 11 percent, thereby exceeding Lt. Governor's goal and increasing low flows by 20 percent. Also provides significant reduction in low-flow water level fluctuations on main stem river. Provides additional infiltration and storage on the tributaries which would influence the tributary flow regime and provide associated benefits. Drawdowns of Peoria and La Grange Pools would expose bottom areas for at least 30 consecutive days during 1 year out of 5, with potential exposure for up to 70 consecutive days, consolidating sediment and encouraging plant growth during the late growing season. The additional tainter gates would decrease the magnitude of water level fluctuations associated with wicket operations

5F – M1, R5, I4, P4, L6, WP2, WL2. Create an additional 375,000 acre-feet of storage during 5-year event, infiltrate runoff from 3,000 square miles, increase intensity of water level management at Illinois Waterway locks and dams, and reconstruct Peoria and La Grange dams to remove effects of wicket operations. Considerably improves tributary hydrologic regimes, reducing peak flows by 23 percent, thereby exceeding Lt. Governor's goal and increasing low flows by 50 percent. Also provides significant reduction in water level fluctuations on main stem river, increased management, wicket removal and tributary basin improvements contributing to more stable water levels. Provides additional infiltration and storage on the tributaries which would influence the tributary flow regime and provide associated benefits. Drawdowns of Peoria and La Grange Pools would expose bottom areas for at least 30 consecutive days during 1 year out of 5, with potential exposure for up to 70 consecutive days, consolidating sediment and encouraging plant growth during the late growing season.

b. Risk and Uncertainty. Because of the likely sensitivity of the Illinois River Basin hydrologic regime to climate impacts (Knox 2001), it is necessary to develop alternatives that are robust to the range of potential climate variation likely to be expected over the life of the project. Extreme events and climatic cycles are also significant aspects of the hydrologic regime. In the last century, the Illinois River Basin has experienced both extreme drought and extreme floods. Temporal changes in climatic or hydrologic conditions will be reflected as changes in the hydrologic regimes of the streams and rivers within the Illinois River Basin. The design of individual projects should be robust enough to function under potential hydrologic regime and sediment delivery conditions.

The measures selected for this goal, when correctly designed and applied, would improve the hydrologic regime characteristics of rivers and streams in the Illinois River Basin. The extent and degree of improvements for each individual project would depend on project design and watershed conditions, but sophisticated hydrologic and hydraulic modeling provides confidence that the benefits for the proposed levels of project implementation are reasonable. The model results have uncertainty associated with them, and the achieved benefits may be somewhat more or less than the current modeling suggests. In addition, there is uncertainty in the realizable benefits from the proposed management improvements; hydraulic modeling indicates a potential level of benefit under a certain management scheme, but it is yet to be seen how closely "real-world" management can come to the optimal level.

One item of significant uncertainty is the net effect of outside influences on the hydrologic regime of the Illinois River in the future. Factors that will affect future hydrologic conditions are climate, land use and land cover conditions. Changes in any of these factors could mask some of the change, brought about by project implementation. The uncertainty regarding this item can be addressed by incorporating monitoring results into evaluations of program effectiveness; by separating project effects from those of outside influences it will be possible to correctly assess project benefits and adapt to changing conditions.

Finally, an additional item of uncertainty is the ecological response from the proposed level of hydrologic regime change. The team is confidant that the proposed objectives would provide significant and measurable benefits, and that these changes would have significant ecological benefits. However, in the absence of a complete model to relate ecosystem integrity and hydrologic regime, it cannot be confidently assumed that all of the hydrologic characteristics required to maintain a specific level of integrity have been addressed. Further work is necessary to move beyond the qualitative understanding of system function so that quantitative predictions of ecosystem response are possible, and that the initial objectives may be revised if necessary.

c. Additional Benefit Quantification. Originally, the benefits for Goal 5 were quantified for each alternative in terms of: percent reduction in tributary peak flow (TPF) for the 5-year event, percent increase in tributary base flow (TBF), percent decrease in main stem fluctuations (MSF), and whether pool drawdowns and wicket dam reconstruction would be attempted. The benefits for Goal 5 have been further quantified in terms of stream miles and acres, as to the length of stream and the watershed area that would be affected by the measures included in a particular alternative. Table 3-55(a) show the main stem areas with direct benefits (the area adjacent to the sites with proposed management changes).

Table 3-55 (a). Additional Benefit Quantification for Goal 5

		Main Stem Area with Benefits Resulting from the Proposed Measures (acres)			
System Plan	**Alternative Plan**	**Main Stem Water Level Management Changes**	**Navigation Pool Drawdown**	**Wicket Dam Modification**	**Total Acres**
1	5A	0	0	0	0
2	5B	0	0	0	0
3	5C	8,600	0	0	8,600
4,5	5D	8,600	0	0	8,600
6	5E	8,600	12,300	0[1]	20,900[1]
7	5F	8,600	12,300	2,800	23,700

[1] System Plan 6 /5E - Further analysis is required to more completely quantify the benefits from the addition of a tainter gate at Peoria and La Grange dams.

Tables 3-55(b) and 3-55(c) show the watershed and stream length influenced (the reach or area that potentially experiences benefits from the proposed management changes or construction activities) for each alternative.

The direct benefits and the watershed area and length of stream influenced from the proposed measures for each of the alternatives were calculated based on engineering expertise. There are approximately 11,000 perennial stream miles (approximately 33,000 total stream miles in the basin) and 300 sub-watersheds in the Illinois River Basin. It is assumed that a proportional percentage of stream miles lie in specified percentage of sub-watersheds (i.e. 50 percent of the stream miles (5,500 miles) lie in 50 percent of the sub-watersheds (150 sub-watersheds).

It is assumed that the Main Stem Water Level Management Changes proposed for Alternatives 3 through 7 will provide benefits to approximately one-fourth of the pool area downstream of the dams based on consideration of the geography of the downstream pools. For this analysis, the average water surface area in Brandon Road, Dresden Island, Marseilles, Starved Rock, Peoria, and La Grange pools was assumed to be approximately 270 acres, 1,510 acres, 2,170 acres, 2,660 acres, 20,050 acres, and 7,840 acres, respectively, based on information obtained from the HEC-RAS models of the Illinois River developed by the Rock Island District. The total potential area benefited from water level management changes (i.e. “optimization”) is approximately 8,600 acres [table 3-55(a)].

The potential direct benefits resulting from the proposed Navigation Pool Drawdown were calculated by watershed modeling described in earlier in this report. The potential area benefited from a 2-foot drawdown at Peoria Pool is 8,000 acres and the potential area benefited from a 1-foot drawdown at La Grange is 4,300 acres.

It is assumed that the Wicket Dam Modification (total reconstruction of the dams at Peoria and La Grange – alternative 7) will benefit approximately one-tenth of the pools downstream of Peoria and La Grange dams based on consideration of the geography of the downstream pool. The total area that will potentially be benefited from the wicket dam reconstruction is approximately 2,800 acres. The addition of a tainter gate at Peoria and La Grange dams (Alt 6 / 5E) will benefit the area downstream by reducing the magnitude of water level changes. Further analysis is required to more completely quantify the benefits that will result from the addition of tainter gates at Peoria and La Grange.

The main stem area with beneficial effects from main stem water level management, navigation pool drawdown, and wicket dam modification proposed under Goal 5 have been added because the main stem area will be benefited in different ways for the three measures.

Stormwater storage volume (SV) and infiltration area (IA) measures will be implemented in half of the watersheds in the Illinois River Watershed for Alternative 6/5E; therefore, half of the perennial stream miles (5,500 stream miles) and sub-watersheds (150) will realize beneficial effects [table 3-55(b)].

Table 3-55 (b). Additional Benefit Quantification for Goal 5

			Number of Sub-Watersheds with:		Percentage of the Illinois River Watershed with:		Potential Number of Stream Miles Benefited from (miles)	
Alternative Plan	**Proposed Add'l Storage Volume (acre-feet)**	**Proposed Add'l Infiltration Area (acres)**	**Add'l Storage Volume**	**Add'l Infiltration Area**	**Add'l Storage Volume**	**Add'l Infiltration Area**	**Add'l Storage Volume**	**Add'l Infiltration Area**
5A	27,000	0	25	0	8%	0%	920	0
5B	27,000	9,600	25	38	8%	13%	920	1,390
5C	27,000	9,600	25	38	8%	13%	920	1,390
5D	90,000	38,400	84	150	28%	50%	3,080	5,500
5E	160,000	38,400	150	150	50%	50%	5,500	5,500
5F	375,000	96,000	300[1]	300[1]	100%	100%	11,000	11,000

[1] Alternative 5F would include restoration measures in all watersheds.

For Alternative 6, 160,000 acre-feet of additional SV and 38,400 acres of IA would be created. The amount of SV and IA created in each sub-watershed are given below:

SV_s = stormwater storage volume per sub-watershed
$SV_{Alternative\ 6}$ / 150 sub-watersheds = 160,000 acre-feet / 150 watersheds
= 1067 acre-feet per watershed

IA_s = infiltration area per sub-watershed
$IA_{Alternative\ 6}$ / 150 sub-watersheds = 38,400 acres / 150 watersheds
256 acres per watershed

The stream miles with beneficial effects from additional stormwater SV and IA for Alternatives 1 through 5 are based on the following assumptions: (1) there are approximately 300 sub-watersheds in the Illinois River Basin, (2) the additional SV developed for each sub-watershed (SV_s) is 1,067 acre-feet, (3) the additional IA developed for each sub-watershed (IA_s) is 256 acres.

The additional SV and IA proposed for Alternatives 1 through 5 was divided by SV_s and IA_s, respectively, to obtain the number of sub-watersheds affected. The number of subwatersheds with additional SV and IA were divided by 300 to determine the approximate percentage of the Illinois River Basin with additional SV and IA (and the potential length of stream with beneficial effects for each), respectively. The percentage of the Illinois River Basin with additional SV and IA was multiplied by the total number of perennial stream miles in the Illinois River Basin to obtain the number of stream miles benefited for each alternative. It is assumed that the stormwater storage and infiltration measures proposed for Alternative 7 will indirectly benefit the entire Illinois River Watershed and all the perennial streams within the Illinois River Watershed. The stream lengths with beneficial effects from the increased stormwater storage volume and infiltration area proposed under Goal 5 have been added because the streams will be benefited in different ways for the two measures [table 3-55(c)].

Table 3-55 (c). Additional Benefit Quantification for Goal 5

		Stream Length Influenced by the Proposed Measures (miles)		
System Plan	**Alternative Plan**	**Stormwater Storage**	**Increasing Infiltration**	**Total Miles**
1	5A	920	0	920
2	5B	920	1,390	2,310
3	5C	920	1,390	2,310
4,5	5D	3,080	5,500	8,580
6	5E	5,500	5,500	11,000
7	5F	11,000	11,000	22,000

d. Ancillary Benefits. Additional hydrologic regime benefits are likely to accrue from projects undertaken for other goals. These include:

- Reduced fluctuations and additional hydrologic benefits from floodplain and riparian restoration projects (Goal 3)
- Flow attenuation due to stream restoration, especially re-meandering projects (Campbell et al. 1972, Goal 3)
- Some flow attenuation as water passes through water quality facilities (Goal 5) and sediment control facilities (Goal 5)

In addition, the projects enacted under this goal are likely to have ancillary benefits for other goals.

- Some floodplain benefits to support Goal 3, including habitat, would be provided by the constructed storage areas
- Sediment delivery would be reduced due to trapping in storage areas and pretreatment for infiltration areas (Goal 1)
- Reduced stream power due to hydrologic benefits would reduce streambank and bed erosion in tributary areas (Goal 1), and reduce overall sediment transport (figure 3-43) subsequently reducing the transport of nutrients (Goal 6)
- Nutrients would be trapped and transformed in storage areas (Goal 6).

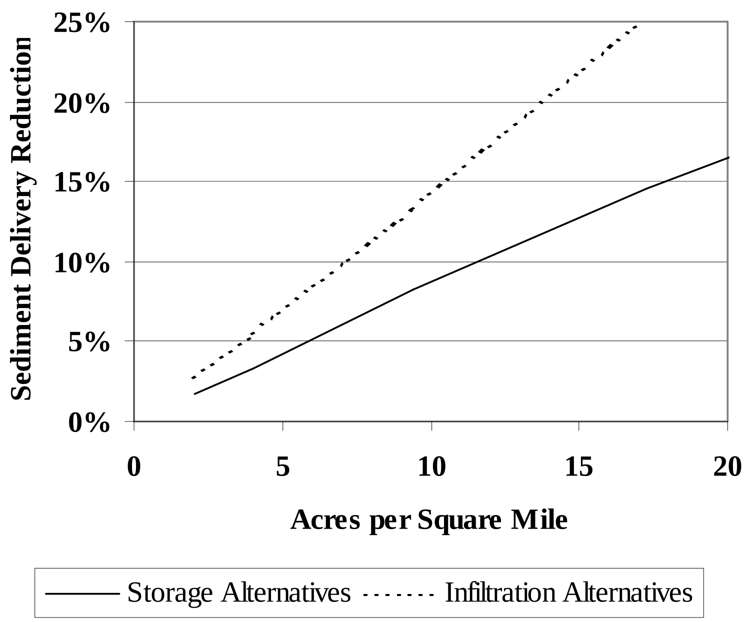


Figure 3-43. Estimated Sediment Delivery Reduction Due to Hydrologic Regime Improvements.
Hydrologic benefits estimated using BASINS model developed by Demissie et al. (2003a) as described in Measures, Tributary section of Goal 5. Relationships between daily flow and daily sediment load for Iroquois, LaMoine, Spoon and Vermillion Rivers in Demissie et al. (2003b). Sediment delivery reduction estimated by comparing loads for each alternative calculated using modeled daily flows for Water Years 1972-1995 and computing average reduction for the four modeled tributaries.

Non-ecosystem benefits that can also be attributed to hydrologic regime projects are reduced maintenance dredging costs and beneficial use of the sediment removed from the pools in preparation for pool drawdowns. These benefits were not quantified for this study.

Finally, there would be the potential to incorporate additional features into the hydrologic regime projects to support other goals. For example, the design of storage areas can be modified to more efficiently trap sediment (Goal 1). There is also the potential to incorporate water quality features into storage facilities (Goal 6). These types of added benefits would generally require additional costs as they require features that would not otherwise be included in the hydrologic regime projects.

e. Information and Further Study Needs. There are several additional study needs related to Goal 5, which could take place in the form of special studies. Further studies need to be performed on the:

- effects of implementing infiltration and storage together on the tributaries and the main stem,
- reduction of the magnitude of water level fluctuations due to storm events,
- effects of additional tainter gates at Peoria and La Grange,
- effects of reconnecting the main stem to its floodplain (i.e. levee removal, etc.),
- effects of model refinement, and
- response of the entire system to the combined effect of all restoration measures related to Goal 5.

K. GOAL 6: WATER AND SEDIMENT QUALITY. Improve water and sediment quality in the Illinois River and its watershed.

Problem. Water resources in the Illinois River Basin are impaired due to a combination of point and non-point sources of chemical pollution as well as physical, structural and hydrological changes within the basin. Although effective regulatory efforts have reduced contributions from point sources, non-point sources of water quality impairment, such as sediments and nutrients, continue to degrade the surface waters.

Objectives

- Achieve full use support for aquatic life on all surface waters of the Illinois River Basin by 2025.
- Achieve full use support for all uses on all surface waters of the Illinois River Basin in 2055.
- Remediate sites with contaminant issues that affect habitat.
- Achieve Illinois EPA nutrient standards by 2025, following standards to be established by 2008. Until then (2008), work to minimize sedimentation as a cause of impairment as defined by 305(b).
- Work to minimize sedimentation as a cause of impairment as defined by 305(b) by 2035.
- Maintain waters that currently support full use or can be considered pristine waters.

1. Inventory Resource Conditions

a. Historic Conditions. Many changes have occurred within the Illinois River Basin that have significantly impacted upon the river. During the 1850-1965 period, the number of people living in the basin increased from 500,000 to over 10,500,000. This rapid growth resulted in vast quantities of industrial wastes and human sewage being produced. Communities along the Illinois River released untreated sewage directly into the river.

By 1908, fish production of the Illinois River began to decline sharply as its waters could no longer assimilate the tremendous volume of sewage it received. As increased quantities of sewage entered the Illinois River, the effect was devastating. Upper stretches of the river were depleted of oxygen and became toxic. Mayflies, which are indicators of clean water and are an important food of many species of fish, and fingernail clams virtually disappeared from the river above Beardstown after 1950.

In addition, the increased production of row crops has resulted in a greater use of herbicides, insecticides, and fertilizers. Eroded soil also contributes to water quality impairments by transporting adsorbed compounds, such as the nutrient phosphorus, in addition to impairments from increased sediment. The upper basin has the highest yield of total phosphorus (190.5 $kg/km^2/yr$); the primarily agricultural lower Illinois River Basin has an estimated yield of 69 $kg/km^2/yr$. David and Gentry (2000) estimated that 70 percent of the phosphorus in the Illinois River was from sewage effluent. Within tributary basins without significant point source contributions, the primary source of phosphorus is cropland runoff. Phosphorus is transported in both the particulate form (adsorbed to eroded soil) and dissolved in runoff water. Recent research indicates that, if soil phosphorus concentrations are excessively high, phosphorus may also leach through soils and be transported by tile-drainage systems (Xue et al. 1998). In the Iroquois River, particulate phosphorus concentrations have decreased in the last 15 years, probably because of adoption of conservation tillage systems (used on approximately 45 percent of cropland in the Illinois River Basin). However, during the same period, dissolved phosphorus concentrations have increased.
During this same time period, the landscape was being altered significantly. In many parts of the state, wetlands were being drained or filled. The loss of wetlands has adversely impacted the rate at which water was delivered to rivers and creeks. This resulted in higher velocities of these streams, thus increasing channel erosion and allowing greater quantities of sediment to be carried. Nutrient concentrations also increased with the loss of wetlands due to the loss of wetland plants being available to use the nutrients and hold the water for longer periods of time.

In the Illinois River Basin, the primary form of nitrogen found in streams is nitrate. Nitrate does not tend to come from fields as surface runoff, but leaches through the soil and reaches high levels in outflow from tile-drainage systems. Although nitrogen is not usually the limiting nutrient for algal production and eutrophication of streams and lakes in Illinois, it has been identified as one of the principal causes of the hypoxic zone in the northern Gulf of Mexico. The U.S. Geological Survey has estimated the average annual total nitrogen flux from the Illinois River Basin, during the period 1980-1996, at 144,320 metric tons per year. The upper part of the basin, above Marseilles, which includes the metropolitan Chicago area, was estimated to have the highest total nitrogen yield in the Mississippi River basin (3,120 $kg/km^2/yr$).

Many of the agricultural chemicals used are persistent in nature and toxic to fish. Over the past 30 years, numerous agricultural chemical-caused fish kills have been documented within the Illinois River Basin and its tributary streams. Fish kills have also been caused by numerous discharges from industrial and manufacturing operations, which discharge toxic heavy metals, ~~-~~inorganic and organic chemicals, and oxygen demanding organic waste such as wood pulp fibers, canning, and dairy and food processing wastes.

Oxygen depletion has become a problem in the backwater areas of the lower river as wind-generated waves resuspend materials from the shallow lake bottoms, exerting an oxygen demand and removing dissolved oxygen from the water. Elimination of the summer low water periods prohibits compaction of sediments. Therefore, suspended sediments settle only loosely to the lakebed, creating a soft bottom in which aquatic plants cannot take root. During periods of high turbidity, aquatic plant growth is limited, since suspended sediments interfere with light penetration into the water.

b. Existing Conditions. One of the most noticeable improvements in the environmental conditions within the Illinois River system has been improved water quality associated with national and regional efforts to meet the goals of the Clean Water Act (CWA). It is expected that water quality will continue to improve in the future because of implementation of CWA Combined Sewer Overflow and Stormwater Management requirements, and local conservation efforts, and that improved water quality will translate into improvements in other ecosystem components. For example, fish and freshwater mussel populations in the main river channel have recently shown improvements that can be attributed to better water quality.

Improvements in chemical water quality, however, have not resulted in recovery of physical and biological health of the river system. Due to several factors including the combination of water level fluctuations, loss of floodplain areas, and increased sedimentation and turbidity, aquatic vegetation has not returned to the Illinois River. Excessive amounts of sediment continue to fill backwater and side channel habitats, and fish and aquatic populations have not improved markedly in these areas as they have in the upper reaches of the main stem of the river. Resources for migratory waterfowl will continue to be degraded through a combination of problems, including sedimentation, water level fluctuations, urbanization, and industrial, agricultural, and domestic pollution.

Water Supply. The Illinois River also serves as one of the sources for the public water supply system serving Peoria, which also uses three well fields. The cities of Aurora, Elgin, Kankakee, Pontiac, Streator, Decatur, Taylorville, Springfield, Jacksonville, and Canton use water from tributaries of the Illinois River. Moreover, the Commonwealth Edison Company uses Illinois River water for cooling purposes.

Wastewater Disposal. The Illinois River is a major conduit for the transport of treated wastewater throughout Illinois. It is estimated that 2,109 outfalls are located in the Illinois River Basin today. Illinois has taken significant steps to obtain compliance for effluent limitations by dischargers in the basin. From the municipal facility perspective, approximately $5.6 billion in Federal grant dollars has been expended for treatment facility construction in the Illinois River Basin through the Construction Grants Program. It can be safely estimated that several hundred million dollars have also been expended by industrial dischargers. Although the Illinois River ranks among Illinois' top recreational resources, it has also been a primary channel for the transport of human, animal, industrial, and agricultural wastes.

Assessing the Quality of the State's Waters and Prioritizing Improvements: Clean Water Act 305(b) and 303 (d) List. As required by the Federal Clean Water Act, the Illinois EPA assesses the conditions of the State's surface and groundwater resources when new data or information regarding the waterbody status is attained. Monitoring and assessments are scheduled for each waterbody, based on its designated use(s). The assessments are reported biennially in the "Illinois Water Quality Report" (also referred to as the 305(b) report). For rivers, streams, and lakes, the Illinois EPA utilizes biological, chemical, and habitat data collected as part of several monitoring programs. Additional water quality data are obtained through agreements and contracts with other agencies and organizations.

Water quality conditions are described in terms of the level of attainment for designated use categories including aquatic life, wildlife, primary contact (swimming, water skiing), secondary contact (boating, fishing), agricultural, industrial, food processing, and drinking water uses. Each designated use category has established water quality standards for protecting these uses. Individual use assessments are then aggregated into an overall use attainment category. In addition, the Illinois EPA identifies causes (toxics, nutrients, sedimentation, etc.) for those water bodies not fully attaining designated uses and sources (point and non-point) of pollutants contributing to the problem. For purposes of this document, water quality stresses are considered to be those causes resulting in less than full support of overall use as identified in the "Illinois Water Quality Report, 2000-2001."

Water Quality Assessment for the Illinois Basin. The Illinois drainage basin is comprised of the Illinois, Sangamon, Des Plaines, Kankakee, Lamoine, Spoon, Vermillion, Mackinaw and Fox River basins. As part of the "Illinois Water Quality Report, 1990-1991," overall use support was assessed for 5,670.7 stream miles and 257 lakes within the Illinois Drainage Basin. Of the 5670.7 stream miles assessed, 44.3 percent fully support overall use (no water quality impairments). Streams with less than full support include: 44.4 percent partial support with minor impairments; 9.3 percent partial support with moderate impairments; and 2.0 percent not supporting overall use. Of the 257 lakes assessed, 11.3 percent fully supported overall use. Lakes with less than full support include: 26.5 percent partial support with minor impairments; 26.5 percent partial support with moderate impairments; and 35.7 percent not supporting overall use.

Causes (stresses) and sources of identified water quality impairments for the Illinois drainage basin are depicted in table 3-53. Major causes of impairment for streams and lakes include nutrients, siltation, suspended solids, bacteria, dissolved oxygen, metals, and changes in the hydrology of rivers and streams.

Sources of impairment are predominately from non-point sources, or pollution from diffuse, intermittent runoff. Non-point sources include agricultural runoff, urban runoff, silviculture, construction , resource extraction, land disposal, hydrologic modification, habitat modification, marinas, and recreational boating. Table 3-56 provides a detailed summary of the sources contributing to water quality impairments for lakes and streams.

Table 3-56. Summary of Sources Contributing to Water Quality Impairments in the Illinois Drainage Basin

Stream Category	Miles Major Impairment	Miles Moderate/Minor Impairment
Industrial Point Source	3.8	378.2
Municipal Point Source	198.4	1,220.6
Combined Sewer Overflows	37.4	398.0
Unspecified Agriculture	572.8	1,090.2
Non-irrigated Crop Production	23.5	852.4
Irrigated Crop Production	2.0	0.2
Pasture Land	35.1	590.4
Feedlots - All Types	1.7	4.5
Animal Holding Areas	0	7.3
Urban Runoff/Storm Sewers	24.6	734.5
Resource Extraction	0	173.2
Unspecified Hydrologic/Habitat Modification	0	147.7
Channelization	104.4	972.1
Flow Regulation/Modification	0.6	267.9
Removal of Riparian Vegetation	0	319.5
Streambank Modification	0	356.0
Dredging	0	14.2
Dam Construction	0	157.2
Highway/Road Construction	0	49.6
Land Development	0	424.7
Highway Runoff	0	91.3

Lake Category	Acres Major Impairment	Acres Moderate/Minor Impairment
Industrial Point Source	524	10,762
Municipal Point Source	256	11,224
Unspecified Non-point Source	4,442	23,178
Agriculture	159,392	4,811
Construction	1,325	12,793
Urban Runoff/Storm Sewers	2,708	28,819
Resource Extraction	155	708
Land Disposal	5,887	16,611
Hydrologic Modifications	1,339	58,999
In-Place Contaminants	42,638	27,963
Recreational Activities	5,974	12,987
Atmospheric Deposition	0	4,040
Waterfowl	200	2,995
Highway Runoff	15	614
Upstream Impoundment	202	1,231
Unknown	0	5,011
Combined Sewer Overflows	0	225
Waste Storage Tank Leaks	0	10

The Illinois drainage basin is a very diverse system, which includes highly urbanized areas in the Des Plaines River basin, to intensive agricultural uses in the Sangamon River Basin. Causes of water quality impairment (stresses) and sources vary considerably within the river basins comprising the Illinois drainage basin

Total Maximum Daily Load Program (TMDLs). The Clean Water Act Section 303(d) provides a coordinated framework between states and the U.S. EPA to systematically track and address impaired waters throughout the state and nationwide. Although much success has been achieved through the NPDES permitting program in reducing pollutants discharged to waterways by municipal treatment works and industrial discharges, some impaired waterways are not expected to recover through the application of technology-based effluent treatment alone.

States are required to list impaired waters every 2 years and to prioritize each water body for an in-depth analysis of pollutant sources and the reductions necessary so that they attain all of the uses that they are assigned (or "designated" in CWA terminology). The in-depth analysis is called a Total Maximum Daily Load or "TMDL." A stream can have many different segments within a stretch and numerous impairments representing a variety of needed improvements in its chemical, physical, and biological state.

The most recent TMDL list for the State of Illinois was approved in November 2004. The list can be found at Illinois EPA's website, http://www.epa.state.il.us/. Information for this list is in the process of geospatial referencing, therefore, a summary for the Illinois River for the 2004 list is not available as of this printing; however, the 2002 summary is available.

On the Illinois 1998 TMDL list, there were 342 segments in the Illinois River basin listed for siltation and suspended solids. Another 269 segments were listed as being impaired by excess nutrients. [1]

The five basins in the Illinois River having more than 100 total impairments are listed below.

Basin	**Total Impairments**	**Largest Number of Segments Impaired for:**	**Second Largest Number of Segments Impaired for:**
Des Plaines	266	Nutrients	Sediments
Upper & Lower Illinois Main stem	219	Sediments	Nutrients
Sangamon	171	Sediments	Nutrients
Chicago Calumet	129	Dissolved Oxygen	Nutrients
Fox River	117	Sediments	Dissolved Oxygen

The pollutant reductions called for in TMDLs may require voluntary actions and the cooperation of many programs such as the CWA 319 program, CREP program, and ecosystem restoration actions recommended in this document in order to realize the water quality improvements called for in the TMDL and realize the water quality goals of the Clean Water Act.

[1] In some cases, more than one listing occurred in a segment, and actual listings occur for a sub-segment. New Illinois 303(d) list was finalized in November 2004.

Other Water Quality Programs. Under the authority of the Water Quality Act of 1987, Illinois operates a coordinated program of regulation and technical assistance for the effective management of urban stormwater. Section 405 of the Act requires some Illinois industries and municipalities to apply for stormwater NPDES permits. Municipalities with populations greater than 100,000 must apply for permits for their storm sewer systems. NPDES permits are also required from a wide variety of industrial activities defined in the regulations that could result in stormwater runoff. Some construction site activities are included in this definition, and permits are required for such stormwater dischargers.

The December 8, 1999, Storm Water Phase II Rule expanded the number of municipalities located in urban areas that are required to obtain NPDES permit coverage for discharges from their municipal separate storm sewer systems (MS4s). Municipalities located outside of urbanized areas may need to comply with some requirements as determined by the delegated NPDES Permitting Authority.

In addition, beginning on March 10, 2003, municipalities with a population under 100,000 were no longer exempt from the construction site storm water requirements and the industrial storm water requirements. Waste Water Treatment Plants with a discharge of 1.0 million gallons per day (mgd) or more need a General Storm Water Permit for Industrial Activities.

Industrial Activity General Permits require a pollution prevention plan, considered to be one of the most important requirements of the General Permit. A list of the 11 categories is found at: http://cfpub.epa.gov/npdes/stormwater/swcats.cfm**.** Each facility covered by this permit is required to develop a plan, tailored to the specific conditions and with the primary goal of controlling pollutants that may be discharged into storm water runoff.

Each storm water plan must include a site map and a description of the measures and controls that will be used to prevent and/or minimize pollution of storm water. Among other things, the plan must contain storm water management controls and measures to remove significant pollutants from stormwater as well as identify areas that have high potential for erosion of soil and the methods to be employed to reduce such erosion.

Complementing the NPDES stormwater permit program, Illinois offers various forms of technical and financial assistance for water quality protection through the proper management of urban runoff. Under Section 319 of the Act, grants are made available to fund projects that effectively demonstrate non-point source pollution control techniques. In addition to directly improving water quality, such projects promote wider application of urban stormwater management practices. Together with Section 319, Section 208 establishes a comprehensive State strategy for controlling urban runoff.

c. Future Without-Project Conditions. Water resources in the Illinois River Basin are impaired due to a combination of point and non-point sources of pollution. Although effective regulatory efforts have reduced contributions from point sources, non-point sources of water quality impairment (such as sediments and nutrients) continue to degrade the surface waters. Continued improvement in chemical water quality will be insufficient to prevent further degradation of many aspects of the Illinois River ecosystem. Without further reduction of sediment entering the system from degraded tributaries and management of sediment already within the system, backwater areas will continue to rapidly fill and aquatic vegetation beds will not recover.

In addition to turbidity, the quality of the sediments, particularly in the main stem, may limit macroinvertebrates such as fingernail clams. Ammonia, an agricultural fertilizer, is found in the upper layers of the sediments, sometimes in toxic amounts. Minor improvements in water quality may be made due to regulation and improvements in best management practices (BMPs). The EPA's programs to reduce nonpoint source pollution and its Targeted Watersheds Grant Program will continue to provide some improvements in general water quality and provide information on the management of physical impacts of tile drainage.

d. Desired Future Conditions. The desired future for water quality would include all of the following: achieve full use support for aquatic life on all surface waters of the Illinois River Basin by 2025; achieve full use support for all uses on all surface waters of the Illinois River Basin in 2055; remediate sites with contaminant issues that affect habitat; achieve Illinois EPA nutrient standards by 2025, following standards to be established by 2008; work to minimize sedimentation as a cause of impairment as defined by 305(b) by 2035; and maintain waters that currently support full use or can be considered pristine waters.

2. Formulation of Alternative Plans

No specific measures or alternatives were formulated for this goal specifically. However, alternatives that address or benefit water and sediment quality are discussed in previous goals for this study. It is believed that proposed actions to reduce sedimentation and nutrient loads to the basin and to attenuate the flow extremes will help to return impaired segments to their designated uses.

Constraints

- Several limiting factors to improved water quality exist such as ammonia, dissolved oxygen levels, or nitrates. An improved understanding of these factors in impaired waters is required in designing projects and measuring success.
- Expense and technical feasibility of addressing (legacy) contaminated sediments.
- Changes to the hydrology within the Illinois River drainage basin.
- Practices that address water quality may negatively impact sediments and vice versa.
- Funding availability.
- Adequate monitoring to make determination of needs/improvements.
- Permit review process.

Criteria for Prioritization

- It is believed that water quality improvements will be realized throughout the basin through implementation of many of the types of projects being proposed at the programmatic level. Future watershed assessments should consider basin water quality information at small watershed level. Those waters that do not achieve full use support will be considered an important criterion in the watershed prioritization process.
- Water bodies that meet standards, but are declining/under threat, should be given greater focus.
- Waters that are better than their designated use need to be protected to assure that they do not degrade below current conditions.

Considerations and Assumptions

- Implementation will require coordination with the Illinois EPA and US EPA, as well as other State and Federal agencies and non-governmental organizations.
- Goals and objectives with metric(s), and water quality assessment and tracking systems that support the CWA 305(b) water quality report to Congress already exist for some EPA programs and could be considered and used to reinforce project tracking and measurement of success.
- State prioritization and scheduling of TMDL development and implementation. prioritization and process.
- Load reduction targets developed and implementation of plans for federally approved TMDLs.
- U.S. EPA and the Upper Mississippi River States are developing monitoring and assessment methodologies for biological standards and criteria.
- Results of tile drain management research from EPA Targeted Watershed Project in the Sangamon River watershed

Information Needs

- Assemble and review Illinois (and other Upper Mississippi River States) EPA guidelines and available research on sediments/phosphorus/turbidity. (e.g., greater than 35 percent fine sediments in transect, turbidity TSS 116 mg/l in 1 sample in 3 years, or other appropriate number developed in future). (Info on website under 305(b).
- Information on sedimentation rates/transects.
- Base flows need to be established for all streams in the Illinois River.
- Quantification of pollutant and nutrient removal efficiencies, and changes in hydrology resulting from large-scale riparian wetland restoration.
- Assemble information on vulnerability of specific areas to sedimentation and pollutants transport to water bodies and analyze potential to ensure that correct BMP and restoration measures are being used to mitigate.
- More information is needed about the endpoints or targets for physical habitat parameters to correct biological impairments.

L. SYSTEM EVALUATIONS

1. Formulation of Alternative Plans

The system team developed various alternatives to restore systemic ecological integrity and fish and wildlife habitat. This portion of the report discusses the alternatives formulation.

The Comprehensive Plan is guided by the overarching goal of restoring ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them. This overarching goal directed the formulation of alternative plans for each of the six goals, specifically formulated to address the system limiting factors in the basin. Each of these goals contains specific, measurable objectives which have been developed to optimize the ecological integrity of the basin.

These objectives were developed by the interagency System Team, resource managers, and stakeholders, and represent a desired future condition or virtual reference condition for the Illinois River Basin.

The System Team formed subgroups to formulate goals, measures and alternatives plans to address the identified problems for each goal. This process was described in each of the goals presented in the previous portion of this section. The subgroups studied the existing conditions and developed scenarios for the future without project conditions. Each of these subgroups then developed lists of measures to address these problems. For each of the measures, the relative cost and system benefits were identified. This information was then used to develop various alternative plans for each goal (i.e., combining benefits and costs for a certain amount of bed and bank stabilization, water and sediment retention basins, etc., in developing a plan for sediment reduction). At this level of analysis, the various measures were evaluated, comparing their costs and benefits. The screening resulted in the alternatives being developed from cost-effective measures. These cost effective restoration measures were then combined into several alternative plans, representing a range of levels of effort and varying degrees of achieving the desired future condition for each goal over the 50-year planning horizon.

In total, eight alternative plans (including the No Action alternative) were formulated to provide a range of restoration options for consideration. These were generally assembled by increasing levels of effort and cost, with some plans representing relatively equal amounts of work under each of the goals and some alternatives emphasizing various goals more heavily. In particular, a number of the alternatives were formulated to provide specific frames of reference relating to the restoration of habitat (acres of various habitat types, etc.) and ecological integrity (structural and functional elements that support and maintain a balanced, integrated, adaptive community). Figure 3-44 was developed for illustrative purposes only, but shows conceptually the estimated benefits of the various plans relative to restoration objectives (desired future) for system ecological integrity. All alternatives, with the exception of the No Action alternative, provide regional habitat and ecological integrity benefits by slowing, stabilizing, or reversing the current decline of ecological integrity over the 50-year planning horizon.

The Illinois River Basin has been significantly altered over the course of the past 150 years. The combined effects of habitat losses through changes in land use, human exploitation, habitat degradation and fragmentation, water quality degradation, and competition from aggressive non-indigenous species have significantly reduced the abundance and distribution of many native plant and animal species in the Illinois River Basin. In addition, human alterations of Illinois River Basin landscapes have altered the timing, magnitude, duration, and frequency of habitat forming and seasonal disturbance regimes. The cumulative results of these complex, systemic changes are now severely limiting both the habitats and species composition and abundance in the Illinois River Basin. Because of the magnitude of these past changes to the basin and the continuing landscape alteration, the levels of restoration provided by Alternatives 1-4 do not reverse the decline in systemic ecological integrity throughout the life of the project. However, these alternatives represent improvements in ecological integrity to the Illinois River Basin, primarily at the local or regional scale . It is not until the level of restoration associated with Alternative 5 that system-wide ecological integrity is predicted to stabilize or improve. Alternatives 6 and 7 represent the only alternatives to significantly reverse the current system decline of ecological integrity, increasing ecological integrity toward the desired future condition throughout the 50-year project life, by prescribing sufficient levels of ecosystem restoration to restore the system, both habitats and processes, to a more naturalized and sustainable state.

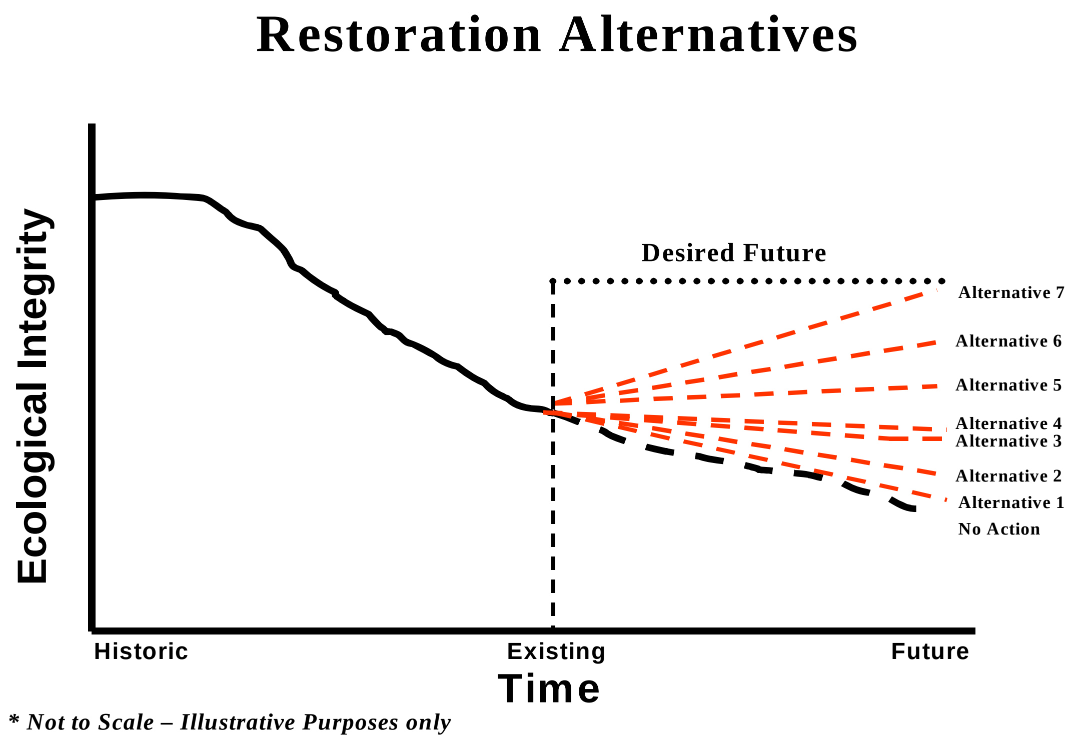


Figure 3-44. Conceptual Restoration Benefits of Alternatives

The eight system alternative plans are listed below; describing the predicted response to restoration by goal and the resulting response in ecological integrity over the 50–year planning horizon. A summary matrix of the system benefits is included as table 3-57. In addition, table 3-58 shows a similar matrix of total first costs. Finally, annual O&M costs are described in table 3-59 for a fully implemented program. All restoration projects would be cost-shared 65 percent Federal and 35 percent non-Federal sponsor. The cost estimates are based on unit costs for construction of various restoration measures. In addition, costs for program management, monitoring, adaptive management, and further special studies have been included. These additional program components are described more fully in Section 6, *Plan Implementation*.

a. Description of System Alternatives. The following descriptions explain the system alternatives by describing the benefits associated with each goal.

No Action – (Anticipated future condition, assuming no new efforts are undertaken as a result of this study.)

- **Ecological Integrity.** Continue the decline in system ecological integrity and populations of native species, resulting from the continuation of habitat loss and fragmentation, the altering of natural disturbance regimes, and the continuation of non-indigenous species colonization.

- **Sediment Delivery.** Some increase in sediment delivery due to the continuation of landscape alterations, increases in impervious surfaces and resulting runoff, and the continuation of channel instability due to prior alterations.
- **Backwaters and Side Channels.** Continue to lose backwaters at an annual rate of approximately 1 percent of volume and surface area, or a 40 percent loss of backwaters over 50 years. Further degradation of side channels due to island erosion and channel sedimentation.
- **Floodplain, Riparian, and Aquatic.** Relatively minor changes in floodplain areas with some increase in the degradation of riparian and aquatic habitats due to urbanization and land-use changes.
- **Connectivity.** No significant change in the number of dams blocking fish and aquatic species migration. Some local fish passage initiatives are currently underway.
- **Water Level.** Small increase in the number of fluctuations in tributary and main stem water level regimes due to continued land-use changes.
- **Water Quality.** Minor improvements in water quality due to regulation and improvements in best management practices (BMPs).

Alternative 1

- **Ecological Integrity.** Continue the decline in system ecological integrity and populations of native species. However, in areas of focused restoration efforts, there would be regional improvements to both habitat and regional ecological integrity.
- **Sediment Delivery.** Reduction in the delivery from direct Peoria Lakes tributaries exclusively. Sediment delivery would be reduced by approximately 20 percent from these watersheds. System benefits include reduced delivery of 6.3 percent to Peoria Lakes and 2.3 percent system wide.
- **Backwaters and Side Channels.** Restoration of 3,600 acres in 40 of the approximate 100 backwaters. Dredging of 10-200 acres per backwater, with 10 backwaters dredged to the optimal level (40 percent of backwater area). This would create overwintering habitat spaced approximately every 7 miles along the system and optimal areas every 28 miles. Restoration of 10 side channels and protection of 10 islands. In total, these efforts would benefit an estimated 14,300 acres.
- **Floodplain, Riparian, and Aquatic.** Restoration of 5,000 acres of main stem floodplain (approximately 1 percent of total main stem floodplain area) including approximately 2,100 acres of wetlands, 1,700 acres of forest, and 1,200 acres of prairie; tributary restoration of 5,000 acres (approximately 0.6 percent of total tributary floodplain area), approximately 3,200 acres of wetlands, 900 acres of forest, and 900 acres of prairie; and aquatic restoration including 25 miles of tributary streams (0.8 percent of the approximately 3,000 miles of channelized streams) with a mix of improved in-stream aquatic habitat structure and channel remeandering. Indirect benefits would extend to an additional 25 miles of stream.
- **Connectivity.** No change; same as without project.
- **Water Level.** Reduction in the fluctuations in tributary areas due to the creation of 18,000 acres of storage area at an average depth of 1.5 feet. Reduces the 5-year peak

flows in tributaries by 1.5 percent but does not discernibly reduce fluctuations along the main stem Illinois River. Providing benefits to an estimated 920 miles of tributary streams.

- **Water Quality.** Local improvements in water quality due to the implementation of measures to reduce sediment delivery. Sediment and nutrient inputs to the river, such as phosphorus and nitrogen, will not measurably decline at the system level.

Alternative 2

- **Ecological Integrity.** Current habitat conditions will be maintained. However, some decline in system ecological integrity would continue to occur, especially for populations of native species that are currently declining or sensitive to continued habitat fragmentation, such as area-sensitive species.
- **Sediment Delivery.** Reduction in the delivery from direct Peoria Lakes tributaries with some efforts on tributaries downstream. On average, sediment contributions decline by 40 percent from the Peoria Lakes tributaries and 0.5 percent in the downstream tributaries. System benefits include a reduction in the delivery of 12.5 percent to Peoria Lakes and 5 percent system wide.
- **Backwaters and Side Channels.** Restoration of 6,100 acres in 60 of the approximate 100 backwaters on the system. Dredging of 10-200 acres per backwater, with 20 backwaters dredged to the optimal level (40 percent of backwater area). This would create overwintering habitat spaced approximately every 5 miles along the system and optimal areas every 14 miles. Restoration of 20 side channels and protection of 15 islands. In total, these efforts would benefit an estimated 30,950 acres.
- **Floodplain, Riparian, and Aquatic.** Restoration of 5,000 acres of main stem floodplain (approximately 1 percent of total main stem floodplain area) including approximately 2,100 acres of wetlands, 1,700 acres of forest, and 1,200 acres of prairie; tributary restoration of 10,000 acres (approximately 1.2 percent of total tributary floodplain area) including approximately 6,300 acres of wetlands, 1,900 acres of forest, and 1,800 acres of prairie; and aquatic restoration including 50 miles of tributary streams (1.6 percent of the approximately 3,000 miles of channelized streams) with a mix of improved in-stream aquatic habitat structure and channel remeandering. Indirect benefits would extend to an additional 50 miles of stream.
- **Connectivity.** No change; same as without project.
- **Water Level.** Reduction in the fluctuations in tributary areas due to the creation of 18,000 acres of storage area at an average depth of 1.5 feet and 10,000 acres of infiltration area. Results include a 2.3 percent reduction in the 5-year peak flows in tributaries, an overall average of 5 percent increase in tributary base flows, but no discernable reduction in fluctuations along the main stem Illinois River. Providing benefits to an estimated 2,310 miles of tributary streams.
- **Water Quality.** Some additional improvements in water quality at the local or regional level due to a reduction in sediment and phosphorus delivery resulting from sediment delivery reduction measures.

Alternative 3

- **Ecological Integrity.** Improvements in habitat conditions at the system level, with a focus on system ecological integrity, particularly in impacts of excessive sedimentation. This plan would increase backwater habitat, reduce sediment delivery, and restore additional main stem and tributary floodplain areas.
- **Sediment Delivery.** Reduction in sediment delivery from direct Peoria Lakes tributaries by 40 percent, other tributaries upstream of Peoria Lakes by 11 percent, and tributaries downstream of Peoria Lakes by 4 percent. System benefits include reduced delivery of 20 percent to Peoria Lakes and 10 percent system wide.
- **Backwaters and Side Channels.** Restoration of 8,600 acres in 60 of the approximate 100 backwaters on the system. Dredging of 10-200 acres per backwater, with 40 backwaters dredged to the optimal level (40 percent of backwater area). This would create overwintering habitat spaced approximately every 5 miles along the system and optimal areas every 7 miles. Restoration of 30 side channels and protection of 15 islands. In total, these efforts would benefit a total of 42,240 acres.
- **Floodplain, Riparian, and Aquatic.** Restoration of 20,000 acres of main stem floodplain (approximately 7.9 percent of total main stem floodplain area) including approximately 8,400 acres of wetlands, 6,800 acres of forest, and 4,800 acres of prairie; tributary restoration of 20,000 acres (approximately 2.3 percent of total tributary floodplain area) including approximately 12,600 acres of wetlands, 3,800 acres of forest, and 3,600 acres of prairie; and aquatic restoration including 100 miles of tributary streams (3.3 percent of the approximately 3,000 miles of channelized streams) with a mix of improved in-stream aquatic habitat structure and channel remeandering. Indirect benefits would extend to an additional 100 miles of stream.
- **Connectivity.** Restore fish passage at all main stem dams on the Fox River (12 dams), all dams on the West Branch of the DuPage River (5 dams), and all main stem dams and one tributary (Salt Creek) of the Des Plaines River (17 dams).
- **Water Level.** Reduction in fluctuations in tributary areas due to the creation of 18,000 acres of storage area at an average depth of 1.5 feet and 10,000 acres of infiltration area. Also, a reduction in fluctuations on the main stem due to increasing intensity of water level management at navigation dams using electronic controls and increased flow gaging. Results include a 2.3 percent reduction in the 5-year peak flows in tributaries, an overall average 5 percent increase in tributary base flows, and up to 65 percent reduction in the occurrence of half foot or greater fluctuations during the growing season in the main stem Illinois River. Providing benefits to an estimated 2,310 miles of tributary streams.
- **Water Quality.** Some additional improvements in water quality due to reduced sediment, phosphorus, and nitrogen delivery. These improvements would primarily result from sediment delivery reduction measures, with some benefits from water level management measures.

Alternative 4

- **Ecological Integrity.** Improvements in habitat conditions at the system level, with a focus on tributary ecological integrity and secondary effects to main stem habitats. This plan would result in sediment delivery reduction, tributary floodplain and stream restoration, increased fish passage, and more naturalized water levels.

- **Sediment Delivery.** Reduction in sediment delivery from direct Peoria Lakes tributaries by 40 percent, other tributaries upstream of Peoria Lakes by 11 percent, and tributaries downstream of Peoria Lakes by 4 percent. System benefits include reduced delivery of 20 percent to Peoria Lakes and 10 percent system wide.
- **Backwaters and Side Channels.** Restoration of 6,100 acres in 60 of the approximate 100 backwaters on the system. Dredging of 10-200 acres per backwater, with 20 backwaters dredged to the optimal level (40 percent of backwater area). This would create overwintering habitat spaced approximately every 5 miles along the system and optimal areas every 14 miles. Restoration of 20 side channels and protection of 15 islands. In total, these efforts would benefit a total of 30,950 acres.
- **Floodplain, Riparian, and Aquatic.** Restoration of 5,000 acres of main stem floodplain (approximately 1 percent of total main stem floodplain area) including approximately 2,100 acres of wetlands, 1,700 acres of forest, and 1,200 acres of prairie; tributary restoration of 20,000 acres (approximately 2.3 percent of total tributary floodplain area) including approximately 12,600 acres of wetlands, 3,800 acres of forest, and 3,600 acres of prairie; and aquatic restoration including 100 miles of tributary streams (3.3 percent of the approximately 3,000 miles of channelized streams) with a mix of improved in-stream aquatic habitat structure and channel remeandering. Indirect benefits would extend to an additional 100 miles of stream.
- **Connectivity.** Restore fish passage at all main stem dams on the Fox River (12 dams), all dams on the West Branch of the DuPage River (5 dams), all main stem dams and one tributary (Salt Creek) of the Des Plaines River (17 dams), Wilmington and Kankakee Dams on the Kankakee River, Bernadotte Dam on the Spoon River, and the Aux Sable Dam.
- **Water Level.** Create 60,000 acres of storage area at an average depth of 1.5 feet and 38,400 acres of infiltration area. Increase intensity of water level management at navigation dams using electronic controls and increased flow gaging. Results include an 8 percent reduction in the 5-year peak flows in tributaries, an overall average 20 percent increase in tributary base flows, and up to a 65 percent reduction in the occurrence of half-foot or greater fluctuations during the growing season in the main stem Illinois River. Providing benefits to an estimated 8,580 miles of tributary streams.
- **Water Quality.** Anticipate improvements in water quality due to reduced sediment, phosphorus, and nitrogen delivery. These improvements would result from sediment delivery reduction measures and water level management measures.

Alternative 5

- **Ecological Integrity.** Improves the amount of current habitats and their functions at the system level. No further declines in system ecological integrity are foreseen at this level of restoration. System health and ecological integrity are stable or improving.
- **Sediment Delivery.** Reduction in sediment delivery from direct Peoria Lakes tributaries by 40 percent, other tributaries upstream of Peoria Lakes by 11 percent, and tributaries downstream of Peoria Lakes by 4 percent. System benefits include reduced delivery of 20 percent to Peoria Lakes and 10 percent system wide.

- **Backwaters and Side Channels.** Restoration of 8,600 acres in 60 of the approximate 100 backwaters on the system. Dredging of 10-200 acres per backwater, with 40 backwaters dredged to the optimal level (40 percent of backwater area). This would create overwintering habitat spaced approximately every 5 miles along the system and optimal areas every 7 miles. Restoration of 30 side channels and protection of 15 islands. In total, these efforts would benefit a total of 42,240 acres.
- **Floodplain, Riparian, and Aquatic.** Restoration of 40,000 acres of main stem floodplain (approximately 7.9 percent of total main stem floodplain area) including approximately 16,800 acres of wetlands, 9,600 acres of forest, and 13,600 acres of prairie; tributary restoration of 40,000 acres (approximately 4.6 percent of total tributary floodplain area) including approximately 25,200 acres of wetlands, 7,200 acres of forest, and 7,600 acres of prairie; and aquatic restoration including 250 miles of tributary streams (8.3 percent of the approximately 3,000 miles of channelized streams) with a mix of improved in-stream aquatic habitat structure and channel remeandering. Indirect benefits would extend to an additional 250 miles of stream.
- **Connectivity.** Restore fish passage at all main stem dams on the Fox River (12 dams), all dams on the West Branch of the DuPage River (5 dams), all main stem dams and one tributary (Salt Creek) of the Des Plaines River (17 dams), Wilmington and Kankakee Dams on the Kankakee River, Bernadotte Dam on the Spoon River, and the Aux Sable Dam.
- **Water Level.** Create 60,000 acres of storage area at an average depth of 1.5 feet and 38,400 acres of infiltration. Increase water level management at navigation dams using electronic controls and increased flow gaging. Results include an 8 percent reduction in the 5-year peak flows in tributaries, an overall average 20 percent increase in tributary base flows, and up to a 65 percent reduction in the occurrence of half-foot or greater fluctuations during the growing season in the main stem Illinois River. Providing benefits to an estimated 8,580 miles of tributary streams.
- **Water Quality.** Anticipate improvements in water quality due to reduced sediment, phosphorus, and nitrogen delivery. These improvements would result from sediment delivery reduction measures and water level management measures.

Alternative 6

- **Ecological Integrity.** Restoration would provide a measurable increase in level of habitat and ecological integrity at the system level.
- **Sediment Delivery.** Reduction in sediment delivery from direct Peoria Lakes tributaries by 40 percent, other tributaries upstream of Peoria Lakes by 11 percent, and tributaries downstream of Peoria Lakes by 20 percent. System benefits include reduced delivery of 20 percent to Peoria Lakes and 20 percent system wide.
- **Backwaters and Side Channels.** Restoration of 12,000 acres in 60 of the approximate 100 backwaters on the system. Dredging an average of 200 acres per backwater, the optimal level of 40 percent of the approximate 500-acre average backwater area. This would create optimal backwater and over-wintering habitat spaced approximately every 5 miles along the system. Restoration of 35 side channels and protection of 15 islands. In total, these efforts would benefit a total of 56,020 acres.

- **Floodplain, Riparian, and Aquatic.** Restoration of 75,000 acres of main stem floodplain (approximately 14.9 percent of total main stem floodplain area) including approximately 31,700 acres of wetlands, 25,300 acres of forest, and 18,000 acres of prairie; tributary restoration of 75,000 acres (approximately 8.8 percent of total tributary floodplain area) including approximately 47,600 acres of wetlands, 13,900 acres of forest, and 13,500 acres of prairie; and aquatic restoration including 500 miles of tributary streams (16.6 percent of the approximately 3,000 miles of channelized streams) with a mix of improved in-stream aquatic habitat structure and channel remeandering. Indirect benefits would extend to an additional 500 miles of stream.

- **Connectivity.** Restore fish passage at all main stem dams on the Fox River (12 dams), all dams on the West Branch of the DuPage River (5 dams), all main stem dams and one tributary (Salt Creek) of the Des Plaines River (17 dams), Wilmington and Kankakee Dams on the Kankakee River, Bernadotte Dam on the Spoon River, and the Aux Sable Dam.

- **Water Level.** Create 107,000 acres of storage area at an average depth of 1.5 feet and 38,400 acres of infiltration. Increase water level management at navigation dams using electronic controls and increased flow gaging. Results include an 11 percent reduction in the 5-year peak flows in tributaries, an overall average 20 percent increase in tributary base flows, and up to 65 percent reduction in the occurrence of half-foot or greater fluctuations during the growing season in the main stem Illinois River. This alternative also would see benefits accrue from drawdowns in La Grange or Peoria Pools. Providing benefits to an estimated 11,000 miles of tributary streams.

- **Water Quality.** Anticipate improvements in water quality due to reduced sediment, phosphorus, and nitrogen delivery. These improvements would result from sediment delivery reduction measures and water level management measures.

Alternative 7

- **Ecological Integrity.** Restoration would provide a measurable increase in level of habitat and ecological integrity at the system level, at or near the vision for the Illinois River Basin. This level of effort was developed to provide an upper limit of potential restoration (or desired future condition) considering current political, social, and fiscal constraints.

- **Sediment Delivery.** Reduction in sediment delivery from direct Peoria Lakes tributaries by 40 percent, other tributaries upstream of Peoria Lakes by 11 percent, and tributaries downstream of Peoria Lakes by 20 percent. System benefits include reduced delivery of 20 percent to Peoria Lakes and 20 percent system wide.

- **Backwaters and Side Channels.** Restoration of 18,000 acres in 60-90 of the approximate 100 backwaters on the system. Dredging of 200-300 acres per backwater. This would create backwater and overwintering habitat spaced approximately every 3 to 5 miles along the system. Restoration of 40 side channels and protection of 15. In total, these efforts would benefit a total of 66,580 acres.

- **Floodplain, Riparian, and Aquatic.** Restoration of 150,000 acres of main stem floodplain (approximately 29.9 percent of total main stem floodplain area) including approximately 63,300 acres of wetlands, 50,700 acres of forest, and 36,000 acres of prairie; tributary restoration of 150,000 acres (approximately 17.6 percent of total tributary floodplain area) including approximately 95,200 acres of wetlands, 27,800 acres of forest, and 27,000 acres of prairie; and aquatic restoration including 1,000 miles of tributary streams (33.3 percent of the approximately 3,000 miles of channelized streams) with a mix of improved in-stream aquatic habitat structure and channel remeandering. Indirect benefits would extend to an additional 1000 miles of stream.

- **Connectivity.** Restore fish passage at all main stem dams on the Fox River (12 dams), all dams on the West Branch of the DuPage River (5 dams), all main stem dams and one tributary (Salt Creek) of the Des Plaines River (17 dams), Wilmington and Kankakee Dams on the Kankakee River, Bernadotte Dam on the Spoon River, Aux Sable Dam, and Starved Rock, Marseilles, and Dresden Locks and Dams on the Illinois River main stem (3 dams).
- **Water Level.** Create 250,000 acres of storage area at an average depth of 1.5 feet and 96,000 acres of infiltration area. Increase water level management at navigation dams using electronic controls and increased flow gaging. Results include a 23 percent reduction in the 5-year peak flows in tributaries, an overall average increase of 50 percent in tributary base flows, and up to a 73 percent reduction in the occurrence of half-foot or greater fluctuations during the growing season in the main stem Illinois River. This alternative also would see benefits accrue from drawdowns in La Grange or Peoria Pools and replacement of wickets at Peoria and La Grange with automatic gate dams to eliminate wicket-related fluctuations. Providing benefits to an estimated 22,000 miles of tributary streams.
- **Water Quality.** Anticipate improvements in water quality due to reduced sediment, phosphorus, and nitrogen delivery. These improvements would result from sediment delivery reduction measures and water level management measures.

b. Alternative Costs. The following tables summarize the system alternative costs, if fully implemented, over the full 50 year time horizon. The first cost estimates are based on unit costs for construction of various restoration measures. In addition, costs for program administration, monitoring, adaptive management, and further special studies have been included. All restoration would be cost-shared 65 percent Federal and 35 percent non-Federal sponsor. The costs of attaining the Overarching Goal Ecological Integrity and Goal 6 Water Quality will be addressed through the activities undertaken associated with the other goals and through the prioritization process and restoration specifications.

The costs of construction were calculated first, based on attaining the desired level of ecological benefits. The construction cost estimates include all costs related to the implementation of restoration projects including a 35 percent contingency; 30 percent for planning, engineering, and design; 9 percent construction oversight; and real estate estimates. However, total program costs require the inclusion of administration, monitoring, etc. Average system management costs are estimated to range from $600,000 to $1.25 million per year based on level of effort associated with each alternative plan. These funds are anticipated to cover both the Corps on Engineers staff time as well as the in-kind services of the sponsor. A technologies and innovative approaches component addressing items called for in the legislation, was estimated to require funding of approximately 12.5 percent of the construction costs. The program also seeks to utilize an adaptive management framework and, as such, includes 7.5 percent of the construction costs for this purpose. Special studies are anticipated to further define watershed issues and address specific questions regarding various resource issues; the various plans allow from $500,000 to $1 million per year for these activities based on the level of effort associated with the overall plans.

The systemic operations and maintenance (O&M) costs are the responsibility of the non-Federal sponsor. Estimates of O&M were developed based on the specific practices recommended under each category and developed into a single system-wide cost. Table 3-59 summarizes the anticipated annual O&M costs associated with each of the alternatives assuming full implementation. This level of O&M, ranging from $613,271 to $16,179,318 annually, would be associated with the fully implemented plan. The actual annual O&M costs in years leading up to full implementation would be proportional to the percent of the restoration activities undertaken.

Table 3-57. System Plan – Benefits Summary

	Overarching Goal	Goal 1	Goal 2	Goal 3	Goal 4	Goal 5	Goal 6
Alternative	**Ecological Integrity**	**Sediment Delivery**	**Backwaters and Side Channels**	**Floodplain, Riparian, and Aquatic**	**Connectivity**	**Water Level Management**	**Water Quality**
No Action	decline	some increase delivery	decline 1%/ yr	No Change	potential improvement	more fluctuations	minor improvement
1	regional improvements	0% upper Tribs 20% Peoria Tribs 0% lower Tribs	3,600 BW acres 10 side channel 10 island protect	5,000 acres MS 5,000 acres Trib 25 stream miles		-1.5% TPF 0% TBF 0% MSF	minor regional improvements
2	maintain current habitat at system level	0% upper Tribs 40% Peoria Tribs 0.5% lower Tribs	6,100 BW acres 20 side channel 15 island protect	5,000 acres MS 10,000 acres Trib 50 stream miles		-2.3% TPF +5% TBF 0% MSF	regional improvement
3	begin system improvements - sediment focus	11% upper Tribs 40% Peoria Tribs 4% lower Tribs	8,600 BW acres 30 side channel 15 island protect	20,000 acres MS 20,000 acres Trib 100 stream miles	Fox, DuPage, Des Plaines	-2.3% TPF +5% TBF 66% MSF	some system improvement
4	begin system improvements - tributary focus	11% upper Tribs 40% Peoria Tribs 4% lower Tribs	6,100 BW acres 20 side channel 15 island protect	5,000 acres MS 20,000 acres Trib 100 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	-8% TPF +20% TBF 66% MSF	some system improvement
5	ecosystem integrity stable	11% upper Tribs 40% Peoria Tribs 4% lower Tribs	8,600 BW acres 30 side channel 15 island protect	40,000 acres MS 40,000 acres Trib 250 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	-8% TPF +20% TBF -66% MSF	some system improvement
6	measurable increase at system level	11% upper Tribs 40% Peoria Tribs 20% lower Tribs	12,000 BW acres 35 side channel 15 island protect	75,000 acres MS 75,000 acres Trib 500 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	-11% TPF +20% TBF -66% MSF	some system improvement
7	reasonable upper bound to system improvements	11% upper Tribs 40% Peoria Tribs 20% lower Tribs	18,000 BW acres 40 side channel 15 island protect	150,000 acres MS 150,000 acres Trib 1000 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable, 3 Main Stem Dams	-23% TPF +50% TBF -73% MSF	some system improvement

Overarching Goal – Ecological Integrity will be addressed by the other goals through prioritization and specifications on restoration measures.
Goal 1 - Sediment delivery benefits are expressed in percentage reductions in tributary delivery resulting from in-channel stabilization and upland practices.
Goal 2 - Backwater (BW) Benefits are expressed in acres dredged, but will benefit larger reaches. Side Channel benefits associated with increased structure and some dredging.
Goal 3 - Main stem (MS) floodplain and riparian (trib) areas are expressed as acreages. Aquatic areas are expressed in stream miles.
Goal 4 - Connectivity (Fish Passage) lists reaches to be addressed. Main stem passage is at Starved Rock, Marseilles, and Dresden Island.
Goal 5 - TPF and TBF are tributary peak flow and base flow, respectively. MSF is the change in the main stem fluctuation regime, representing an average of 5-day windows in the lower river fluctuations over the course of the average growing season. Auto gates allow increased management to smooth flow releases and are included in Alternatives 6 and 7. Wicket dam replacements are considered for the Peoria and La Grange pools in Alternative 7.
Goal 6 - Water quality issues will be addressed through other goals. Greatest benefits likely associated with Goals 1 and 3.
Only rough benefits estimations are included in table; see write-up for additional details.

Table 3-58. First Costs by Goal Category Over 50-Year Implementation

	Overarching Goal	Goal 1	Goal 2	Goal 3	Goal 4	Goal 5	Goal 6	Cost ($ Millions)	
Alternative	**Ecological Integrity**	**Sediment Delivery**	**Backwaters and Side Channels**	**Floodplain, Riparian, and Aquatic**	**Connectivity**	**Water Level Management**	**Water Quality**	**Construction Total [1]**	**Total Program [2]**
No Action	–	–	–	–	–	–	–		
1	Achieved through other goals	$95	$365	$160	–	$135	Achieved through other goals	$790	$1,005
2	Achieved through other goals	$210	$620	$275	–	$305	Achieved through other goals	$1,410	$1,755
3	Achieved through other goals	$560	$870	$640	$50	$310	Achieved through other goals	$2,430	$2,990
4	Achieved through other goals	$560	$620	$505	$55	$1,105	Achieved through other goals	$2,845	$3,490
5	Achieved through other goals	$560	$870	$1,390	$55	$1,105	Achieved through other goals	$3,980	$4,875
6	Achieved through other goals	$1,040	$1,205	$2,675	$55	$1,625	Achieved through other goals	$6,600	$8,025
7	Achieved through other goals	$1,040	$1805	$5,350	$290	$4,325	Achieved through other goals	$12,810	$15,485

Note: Overarching Goal Ecological Integrity and Goal 6 Water Quality will be addressed under other goals through prioritization and practice specifications.
[1] Construction cost estimates include: 35% contingency, 30% planning, engineering, & design, and 9% construction oversight. Real Estate estimates are included.
[2] Total program calculations include:
Management = $600k to $1.25 million/year based on level of effort (approx 2/3 Corps 1/3 in-kind services)
Technologies and Innovative Approach components costs are approximately 12.5% of construction total
Adaptive Management costs are approximately 7.5% of construction total
Special Studies and Watershed Studies ($500k to $1 million based on level of effort)
Excludes O&M Costs - which are shown separately

Table 3-59. Annual O&M Costs Assuming Full Implementation

	Overarching Goal	Goal 1	Goal 2	Goal 3	Goal 4	Goal 5	Goal 6	
Alternative	**Ecological Integrity**	**Sediment Delivery**	**Backwaters and Side Channels**	**Floodplain, Riparian, and Aquatic**	**Connectivity**	**Water Level Management**	**Water Quality**	**Annual O&M Costs**
No Action	–	–	–	–	–	–	–	
1	Achieved through other goals	$97,000	$11,990	$369,281	$0	$135,000	Achieved through other goals	$613,271
2	Achieved through other goals	$212,000	$18,805	$581,363	$0	$200,000	Achieved through other goals	$1,012,168
3	Achieved through other goals	$645,000	$20,445	$1,486,525	$152,463	$325,000	Achieved through other goals	$2,629,433
4	Achieved through other goals	$645,000	$18,805	$1,000,825	$156,691	$835,000	Achieved through other goals	$2,656,321
5	Achieved through other goals	$645,000	$20,445	$3,130,213	$156,691	$835,000	Achieved through other goals	$4,787,329
6	Achieved through other goals	$1,125,000	$21,265	$5,941,525	$156,691	$1,185,000	Achieved through other goals	$8,429,481
7	Achieved through other goals	$1,125,000	$22,085	$11,887,750	$494,483	$2,650,000	Achieved through other goals	$16,179,318

2. Evaluation and Comparison of Plans

Description of the Evaluation and Comparison Process

The purpose of the evaluation and comparison steps is to determine to what extent the various plans achieve ecosystem goals and objectives and reasonably maximize ecosystem benefits to the Nation. The evaluation of each alternative consists of measuring or estimating the ecosystem benefits (acres of habitat, stream miles restored, tons of sediment not delivered to the system, etc.) and the resulting effect on ecological integrity, costs, and determining the difference between the without- and with-project conditions. In particular, each alternative is formulated and evaluated in relationship to five criteria: completeness, effectiveness, efficiency, acceptability, and risk and uncertainty. The effectiveness and efficiency of each alternative is determined based on percent attainment of the desired future (represented by Alternative 7) and area benefited (acres or stream miles).

- **Completeness** is the extent to which the alternative plans provide and account for all necessary investments of other actions to ensure the realization of the planning objectives, including actions by other Federal and non-Federal entities.
- **Effectiveness** is the extent to which the alternative plans contribute to achieve the planning objectives.
- **Efficiency** is the extent to which an alternative plan is the most cost-effective means of achieving the objectives.
- **Acceptability** is the extent to which the alternative plans are acceptable in terms of applicable laws, regulations, and public policies.
- **Risk and uncertainty** is the identification of the areas of sensitivity where actual outcomes are uncertain due to unpredictable biological or economic elements.

The selection of a recommended plan requires that individual alternative plans be compared against the without-project condition and against one another. Alternative plan comparisons were largely driven by the evaluation of information generated during the formulation of the alternatives (e.g., costs, ecosystem benefits, extent of achieving objectives, etc.). Additional information regarding alternative completeness, sustainability and level of risk and uncertainty also were assessed.

The primary criteria used by the Corps of Engineers for ecosystem restoration projects is cost effectiveness and incremental analysis. The National Ecosystem Restoration (NER) plan is selected from the cost-effective plans as the alternative that reasonably maximizes ecosystem restoration benefits compared to costs. The selected plan is chosen after considering the cost-effectiveness and incremental costs of other plans.

a. Completeness. All of the plans formulated provide relatively equal levels of completeness. All plans could be fully attained through an expanded authorization under this authority; however, considerable opportunities exist for partnerships with other Federal and State agencies. The extent of these partnerships will depend on future authorizations and appropriations for the various partner agencies.

b. Effectiveness. The effectiveness of alternative plans is related to the extent to which they achieve the planning objectives or desired future conditions. Ecosystem restoration project benefits are typically non-monetary outputs expressed in terms of increased quality and quantity of habitat. These outputs are typically measured as annualized habitat units (combination of acreage and habitat suitability). However, it was not feasible to quantify annualized habitat benefits using a formal Habitat Evaluation Procedures (HEP) approach over the 30,000-square-mile project area given the range of habitat types and limiting factors being addressed by the system alternatives. The defined outputs varied by goal category and included acres, stream miles, reductions in sediment delivery, and improved hydrologic regimes. As a result, a complete cost effectiveness and incremental cost effectiveness analysis based on habitat units could not be conducted.

Early on in the study process, detailed objectives were identified for each goal category by the system team, resource managers, and stakeholders. These objectives represent a desired future condition of ecological condition for the Illinois River Basin.

The best quantifiable measure of system output that provides comparability across all goal categories was the percentage attainment of restoration objectives (desired future). However, the benefit area was also able to be quantified in terms of acres and stream miles. These measures of benefits allow for the completion of a cost effectiveness-incremental cost analysis for five of the seven goal categories (Goals 1 through 5). The outputs for the Overarching Goal and Goal 6 could not be fully quantified and, as a result, were assessed qualitatively.

As part of future site-specific restoration projects, detailed and complete cost effectiveness and incremental cost analysis will be conducted.

The remainder of this section highlights the values identified for effectiveness. By examining the number, type, and potential results of restoration alternatives, the effectiveness of ecosystem alternatives was quantitatively and qualitatively assessed. This process included identifying the extent to which the alternative plan:

- Maintains or exceeds the existing condition
- Accounts for planning objectives (desired future conditions)
- Affects ecosystem integrity (EOPs, sustainability).

Overarching Goal: Ecosystem Integrity

The goal of ecosystem restoration is to restore and sustain ecosystem integrity by protecting native biodiversity and the ecological and evolutionary processes that create and maintain that diversity. Ecological integrity is the overarching goal for this restoration program and should drive the identification, development, and selection of all restoration measures and alternatives; all alternatives and objectives formulated under all of the other program goals would contribute toward restoring the ecological integrity of the Illinois River Basin.

Ecological integrity is defined as a system's wholeness or "health," including presence of all appropriate elements, biotic and abiotic, and occurrence of all processes that generate and maintain those elements at the appropriate rates (Angermeier and Karr 1994). The environmental quality of the restoration alternatives was evaluated by examining how they contribute to the Illinois River Basin ecosystem integrity. The parameters, compared to the existing conditions at both the regional and system scale, were:

1) Maintain or exceed the existing condition,
2) Increase the amount of quality habitat and,
3) Improve the ecological integrity (habitat, biodiversity, function, and sustainability).

The proposed ecosystem restoration alternatives address increasing amounts of quality habitat through restoration and preservation. Some alternatives address restoration of ecosystem function, and thus increasing levels of sustainability. In this evaluation, all of the alternatives, except no action, were presumed to positively affect the habitat and ecological integrity, either at the regional or system level or both, with varying degrees of effectiveness. A summary of the effectiveness of the alternatives on ecosystem integrity is shown in table 3-57. Ecosystem integrity can be achieved at the regional scale or system scale and is a function of the level of restoration and project placement (i.e., concentration in a watershed). As ecological integrity is improved, particularly through sediment reduction and water level management, habitats and projects become more sustainable.

No Action (anticipated future condition without project). Continue the decline in system ecological integrity and populations of native species, resulting from the continuation of habitat loss and fragmentation, the altering of natural disturbance regimes, and the continuation of non-indigenous species colonization.

Alternative 1. Continue the decline in system ecological integrity and populations of native species. However, in areas of focused restoration efforts, there would be regional improvements to both habitat and regional ecological integrity.

Alternative 2. Current habitat conditions will be maintained. However, some decline in system ecological integrity would continue to occur, especially for populations of native species that are currently declining or sensitive to continued habitat fragmentation, such as area-sensitive species.

Alternative 3. Improvements in habitat conditions at the system level, with a focus on system ecological integrity, particularly in impacts of excessive sedimentation. This plan would increase backwater habitat, reduce sediment delivery, and restore additional main stem and tributary floodplain areas.

Alternative 4. Improvements in habitat conditions at the system level, with a focus on tributary ecological integrity and secondary effects to main stem habitats. This plan would result in sediment delivery reduction, tributary floodplain and stream restoration, increased fish passage, and more naturalized water levels.

Alternative 5. Improves the amount of current habitats and their functions at the system level. No further declines in system ecological integrity are foreseen at this level of restoration. System health and ecological integrity are stable or improving.

Alternative 6. Restoration would provide a measurable increase in level of habitat and ecological integrity at the system level.

Alternative 7 (desired future condition). Restoration would provide a measurable increase in level of habitat and ecological integrity at the system level, at or near the vision for the Illinois River Basin. This level of effort was developed to provide an upper limit of potential restoration considering current political, social, and fiscal constraints.

Sustainability is the ability of the ecosystem to maintain its structure and function and to remain resilient in order to continue to give and support life. The sustainability of the various plans was measured as a way to address the extent to which the various alternatives address the system ecological integrity. In general, it will take extensive work to reach an increased level of sustainability of ecological processes and functions. Significant increases in sustainability are anticipated with Goals 6 and 7.

Goals 1 through 5

For Goals 1 through 5, the effectiveness of the various alternatives in attaining the study objectives could be expressed in two ways: (1) percentage of the desired future condition and (2) area benefited (acres or stream miles).

1. Percent Attainment of the Desired Future Condition. Benefits were first quantified as a percentage of the desired future condition established as part of the study and expressed in Alternative 7. The following paragraphs and table 3-61 briefly summarize the reference for each goal category in terms of the benefit measures shown and percent attainment. The various percentages were averaged (e.g. given equal weighting) in order to provide some understanding of the system level of attainment of the study objectives. Across all categories, the range of effectiveness in attaining the system objectives ranged from a low of 7 percent for Alternative 1 to a high of 97 percent for Alternative 7.

Goal 1. The sediment delivery restoration objective calls for a 20 percent reduction system-wide. Each of the alternatives has an estimated reduction, (i.e., Alternative 1 - 2.3 percent system reduction) which can be converted to a percentage of the objective (12 percent of the system goal of 20 percent). This is only a summary since the regional benefits associated with some of the smaller plans are lost, because only the overall system reduction was calculated.

Goal 2. Backwater and Side Channel restoration alternatives were evaluated under three different criteria. These included backwater restoration measures against the system objective of 19,000 acres and side channel restoration measures against the system objective of 40 areas (established by the UMR-IWW System Navigation Study objectives database). The formulation also included island protection projects, but because the levels are nearly the same for all alternatives and the affected area is very small, this measure was not included in the effectiveness matrix.

Goal 3. The effectiveness was best measured by looking at the performance by alternative against the three separate restoration objectives. The actual numbers were calculated by again looking at each alternatives percentage attainment of the objectives: main stem floodplain with an objective of 150,000 acres, tributary floodplain with an objective of 150,000 acres, and aquatic stream restoration with an objective of 1,000 miles.

Goal 4. Connectivity (fish passage) was not as easily converted to a percentage basis, since no single system stream mile objective was developed. The total stream miles connected by alternative was divided by the maximum number of stream miles—3,792—connected under Alternative 7. This does not clearly reflect the total value of various individual projects, since the extent to which various dams block migrations varies considerably by dam site. However, it does provide a sense of the relative magnitude. It was also noted by those working directly on the fish passage issues that given Midwest fish communities, in many cases addressing long stretches separated by only a single dam may not represent as great of benefits as addressing more closely spaced dams that are more completely limiting habitat in a tributary or stream reach. This was the basis for addressing the Fox, Des Plaines, and DuPage in the first increment of passage.

Goal 5. The naturalization of water levels to more closely match ecosystem needs is one of the most complex areas of study. The actual physical processes are complex and the biological responses are not precisely understood. However, the outputs of the various alternative plans were able to be measured in three different fashions to address progress toward the study objectives. Main stem benefits were measured in terms of percent reductions in 1-foot fluctuations, tributary benefits measured in terms of increases in base flow (based on a maximum of 50 percent reduction shown as 100 percent attainment of the objective), and peak flow reductions (based on a maximum of 23 percent again shown as 100 percent attainment of the objective).

Table 3-60. Alternative Effect on Ecosystem Integrity

	No Action	Alternative. 1	Alternative. 2	Alternative. 3	Alternative. 4	Alternative. 5	Alternative. 6	Alternative. 7
Quality Habitat Improvement	decline	regional only	maintain current	minor	minor	minor	major	major
Ecosystem Integrity Regional Scale	decline	improve	improve	improve	improve	improve	improve	improve
Ecosystem Integrity System Scale	decline	decline	decline	sediment improve	tributary improve	improve	improve	improve
Sustainability	no	low	low	low/mod	low/mod	moderate	high	high

Table 3-61. Summary of the Effectiveness of Alternatives as Percent of Desired Future Conditions

Effectiveness	No Action	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Goal 1 - Sediment Reduction (20% reduction)	0%	12%	25%	50%	50%	50%	100%	100%
Goal 2 - Backwaters (19,000 acres)	0%	19%	32%	45%	32%	45%	63%	95%
Goal 2 - Side Channels (40 no.)	0%	25%	50%	75%	50%	75%	88%	100%
Goal 3 - Main Stem Floodplain (150k acres)	0%	3%	3%	13%	3%	27%	50%	100%
Goal 3 -Tributary Floodplain (150k acres)	0%	3%	7%	13%	13%	27%	50%	100%
Goal 3 - Aquatic Restoration (1k miles)	0%	3%	5%	10%	10%	20%	50%	100%
Goal 4 - Fish Passage (miles)	0%	0%	0%	23%	78%	78%	78%	100%
Goal 5 - Water Level - Main Stem % reduction 1-foot fluctuations)	0%	0%	0%	65%	65%	65%	65%	73%
Goal 5 - Water Level – Tributary (% increase in base flow) (max 50%)	0%	0%	10%	10%	40%	40%	40%	100%
Goal 5 - Water Level - Tributary (% reduction in peak flow) (max 25%)	0%	7%	10%	10%	35%	35%	48%	100%
Combined Goals (equal weighting)	0%	7%	14%	31%	38%	46%	63%	97%

2. Area Benefited (acres or stream miles). In addition to the percent attainment quantification, the system team also determined the area of beneficial influence in terms of stream miles and acres. Some individual goals produce benefits in one category or both while system alternative plans produce a mixture of both benefit categories (table 3-62).

Goal 6. Water and Sediment Quality

Similar to the Overarching Goal, no specific restoration was planned to directly address Goal 6 Water and Sediment Quality. However, benefits are anticipated to result from the practices included under the other goals (table 3-63). In particular, the reduction of sediment will address one of the key impairment to many reaches. The nutrient phosphorus is adsorbed to sediment, and reductions are anticipated associated with any sediment reductions. Similarly, reductions in nitrogen are anticipated as a result of wetland restoration and improved riverine corridors and buffers. The benefits are not likely to be more than regional with Alternatives 1 and 2. The levels associated with Alternatives 3 through 5 should provide some system improvements. However, more significant system improvements are anticipated with the levels associated with Alternatives 6 and 7, which more fully address sediment delivery and floodplain and riparian restoration.

c. Efficiency. For ecosystem restoration studies, efficiency is measured in terms of cost effectiveness. The National Ecosystem Restoration (NER) plan is the plan that reasonably maximizes ecosystem restoration benefits compared to costs, considering the cost effectiveness and incremental cost of implementing other restoration options. Corps of Engineers guidance requires the use of incremental cost analyses to select the NER plan. Two analytical processes are conducted to meet these requirements. First, a cost-effectiveness analysis is conducted to ensure that the least cost solution is identified for each possible level of ecosystem output. Cost effectiveness means that no plan can provide the same benefits for less cost or more benefits for the same cost. Then, incremental cost analysis of the least cost solutions is conducted to reveal changes in costs for increasing levels of environmental outputs. Plans that provide the greatest increase in benefits for the least increase in costs are identified as "best buy" plans. In the absence of a common measurement unit for comparing the non-monetary benefits with the monetary costs of ecosystem restoration plans, cost effectiveness and incremental analysis are valuable tools to assist in decision making.

1. Percent Attainment of the Desired Future Condition. The traditional Corps of Engineers ecosystem restoration project evaluations include an assessment of increases in ecosystem quality and quantity (often habitat), as well as a cost effectiveness-incremental cost analysis (CE/ICA). For a project that encompasses more than 30,000 square miles and multiple habitat types, it was not feasible to conduct habitat evaluation procedures. In addition, the benefits differed across the goals and were not directly comparable. The percent attainment measure of benefits allowed for the completion of a cost effectiveness-incremental cost analysis for five of the seven goal categories (Goals 1 through 5). Table 3-64 shows the combined percent attainment of the system objectives using an equal weighting of the various outputs. The outputs for the Overarching Goal and Goal 6 could not be fully quantified and, as a result, were separately assessed qualitatively.

Table 3-62. Acreage and Stream Mile Benefits of System Alternatives

	Alternative 1 Sediment Delivery (Miles)	Alternative 2 Backwaters and Side Channels (Acres)	Alternative 3 Floodplain, Riparian and Aquatic (Acres)	Alternative 3 Floodplain, Riparian and Aquatic (Miles)	Alternative 4 Connectivity (Miles)	Alternative 5 Water Level Mgmt (Acres)	Alternative 5 Water Level Mgmt (Miles)
No Action	0	0	0	0	0	0	0
Alt 1	1,700	14,300	10,000	50	0	0	920
Alt 2	3,220	30,950	15,000	100	0	0	2,310
Alt 3	9,570	42,240	40,000	200	2,140	8,600	2,310
Alt 4	9,570	30,950	25,000	200	4,280	8,600	8,580
Alt 5	9,570	42,240	80,000	500	4,280	8,600	8,580
Alt 6	16,750	56,020	150,000	1,000	4,280	20,900	11,000
Alt 7	16,750	66,580	300,000	2,000	6,730	23,700	22,000

Table 3-63. Alternative Effect on Water and Sediment Quality

Effectiveness	No Action	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Goal 6 - Water Quality	None	Low	Low	Moderate	Moderate	Moderate	Mod/High	Mod/High

Table 3-64. Cost Effectiveness - System Benefits (Percent of Desired Future) and System Costs

Efficiency	No Action	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Combined Goals 1 through 5 (equal weighting)	0%	7%	14%	31%	38%	46%	63%	97%
Total First Cost ($ million)	-	$1,005	$1,755	$2,990	$3,490	$4,875	$8,025	$15,485
Cost Effectiveness. - Goals 1 through 5 (cost per % improvement, $ million)	-	$141	$124	$95	$92	$106	$127	$160

Figures 3-45 and 3-46 and table 3-65 show the output of the cost effectiveness-incremental cost analysis using the percentage attainment of the desired future condition and total first cost. As figure 3-45 illustrates, all plans formulated for the study were cost effective and were built only from cost effective measures. Four plans in addition to the No Action Alternative were identified as best buys: Alternatives 4, 5, 6, and 7. These plans provide the greatest increase in benefits for the least increase in cost (lowest incremental costs).

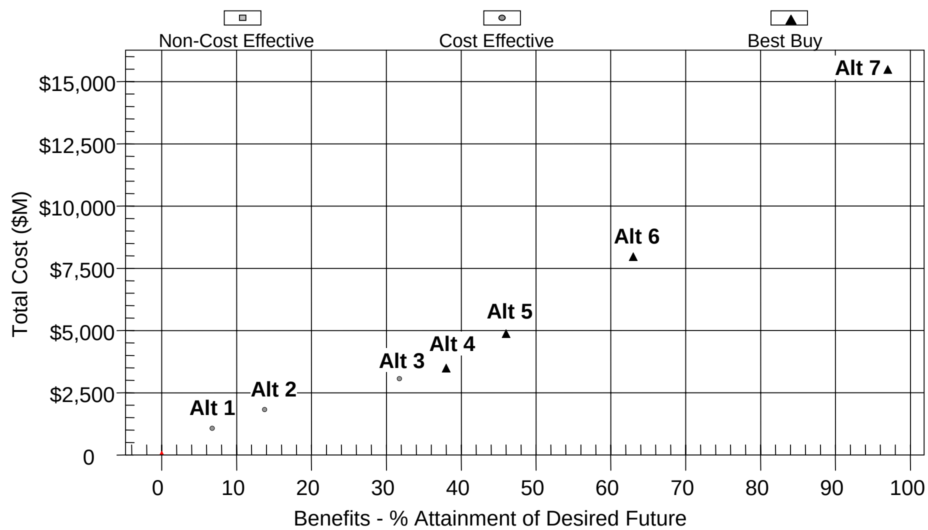


Figure 3-45. Cost Effectiveness of Plans

Table 3-66 and figure 3-46 highlight the results of the incremental cost analysis of the best buy plans. As the figures show, Alternative 4 provides restoration at a cost effectiveness of $92 million per percent of the desired future attained for the first 38 percent. Alternative 5 provides a gain of an additional 8 percent attainment of objectives for an additional $1.4 billion investment, at an incremental cost of $163 million per percent. A similar incremental cost of $185 million per percent is incurred in moving from Alternative 5 to Alternative 6. However, in order to attain the final 34 percent increase in objective benefits, an additional, $7.5 billion would be required at an incremental cost of $220 million per percent.

Table 3-65. Summary of Incremental Cost Analysis

Alternative	Cost ($ Millions)	% Attainment of Desired Future	Incremental Cost	Incremental Benefit	Incremental Cost Per Output
Alternative 0	$0	0	$0	0	$0
Alternative 4	$3,490	38	$3,490	38	$92
Alternative 5	$4,875	46	$1,385	8	$163
Alternative 6	$8,025	63	$3,150	17	$185
Alternative 7	$15,485	97	$7,460	34	$220

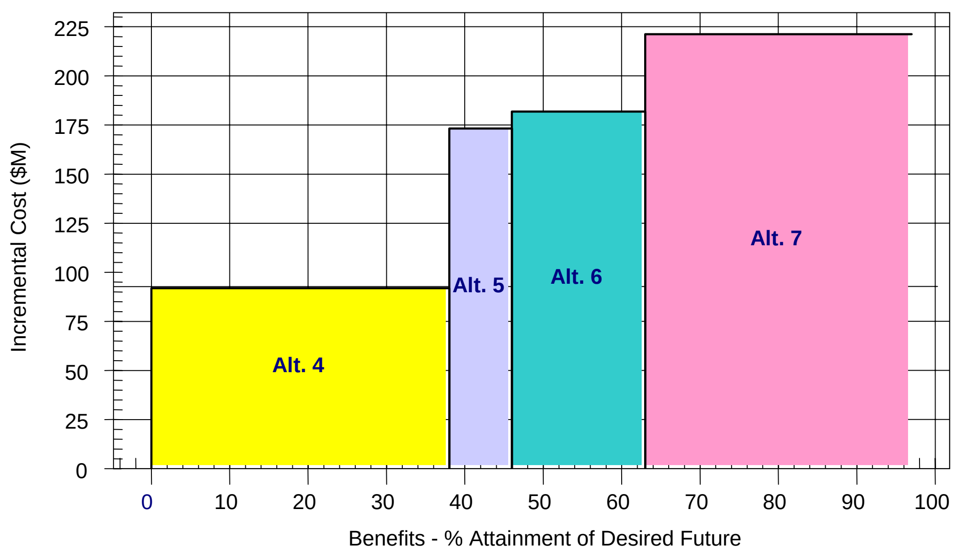


Figure 3-46. Incremental Cost of Best Buy Plans

2. Acres Benefited (acres or stream miles). In addition to the percent of goal attainment analysis, cost effectiveness and incremental costs analysis (CE/ICA) was also conducted to evaluate the area of influence benefits, in acres and stream miles. The CE/ICA looks separately at the benefits produced by each alternative plan in terms of acres and stream miles. The result is an analysis that identified the most efficient or "best buy" system alternatives for each benefit category at the goal and system level.

The alternatives developed and analyzed by goal were built from cost effective practices and therefore the range of alternatives within each Goal category were all considered cost effective. The purpose of this analysis is to show which system alternatives have the largest share of best buy components across the goal categories. Those system alternatives composed of "best buy" levels of restoration for acres, stream miles, and percent of goal attainment are considered to be more effective system restoration alternatives.

Table 3-66 summarizes the acres and stream mile benefits of the proposed system alternatives by goal and alternative. All alternatives are cost effective; in addition, figures in bold indicate "best buy" alternatives.

The results of the cost effectiveness analysis for the system alternative plans showed that all alternative plans were cost-effective plans. Cost effectiveness means that no plan can provide the same benefits for less cost or more benefits for the same cost. Alternative 6 exhibited the lowest cost per unit of all alternatives, $683 per acre of benefit (table 3-67). Alternative 3 exhibited the lowest cost per unit of all cost effective alternatives, $5,080 per stream mile of benefit.

Table 3-66. Cost Effective Summary of Acreage and Stream Mile Benefits

System Alternative	Alternative 1 Sediment Delivery (miles)	Alternative 2 Backwaters & Side Channels (acres)	Alternative 3 Floodplain, Riparian & Aquatic (acres)	Alternative 3 Floodplain, Riparian & Aquatic (miles)	Alternative 4 Connectivity (miles)	Alternative 5 Water Level Management (acres)	Alternative 5 Water Level Management miles)
No Action	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Alt 1	**1,700**	14,300	10,000	50	**0**	**0**	920
Alt 2	3,220	**30,950**	15,000	100	**0**	**0**	2,310
Alt 3	9,570	**42,240**	40,000	200	2,140	**8,600**	2,310
Alt 4	9,570	**30,950**	25,000	200	**4,280**	**8,600**	**8,580**
Alt 5	9,570	**42,240**	80,000	500	**4,280**	**8,600**	**8,580**
Alt 6	**16,750**	**56,020**	150,000	**1,000**	**4,280**	**20,900**	**11,000**
Alt 7	**16,750**	**66,580**	**300,000**	**2,000**	**6,730**	**23,700**	**22,000**

All alternatives are cost effective; figures in bold indicate "best buy" alternatives.

Table 3-67. System Alternative Plans Evaluation

Alternative	Plan Total Benefit (acres)	Plan Total Benefit (miles)	Acres – Total First Cost of Construction ($millions)	Miles – Total First Cost of Construction ($ millions)	Acres – Annualized Cost ($ 1,000s)	Miles - Annualized Cost ($ 1,000s)	Annualized Cost/System Acre ($ dollars)	Annualized Cost/System Mile ($ dollars)
No Action	0	0	$0	$0	$0	$0	$0	$0
Alt 1	24,300	2,670	$463	$328	$26,845	$19,015	$1,104	$7,122
Alt 2	45,950	5,630	$770	$638	$44,645	$36,990	$971	$6,570
Alt 3	90,840	14,220	$1,268	$1,246	$73,520	$72,245	$809	$5,080
Alt 4	64,550	22,630	$883	$2,046	$51,195	$118,630	$793	$5,242
Alt 5	130,840	22,930	$1,650	$2,418	$95,670	$140,195	$731	$6,114
Alt 6	226,920	33,030	$2,676	$3,958	$155,155	$229,485	$683	$6,947
Alt 7	390,280	47,480	$5,312	$7,585	$307,995	$439,780	$789	$9,262

Note: Some acres and stream mile benefits may be double counted within a particular alternative if some of the same areas would be addressed by more than one goal.

For both acres and stream mile benefit categories, "best buy" plans were identified (table 3-68 and figure 3-47). These plans provide the greatest increase in benefits for the least increase in costs. For system alternatives producing acres of habitat benefits, Alternative 6 provides 226,920 acres of habitat benefit to the Basin at an annualized incremental cost of $683 per acre of habitat benefit. Alternative 7 provides an additional 163,360 acres of habitat benefit at an annualized incremental cost of $935 per acre of habitat benefit.

Table 3-68. Incremental Cost Analysis of Best Buy System Alternative Plans (Acres of Benefit)

Alternative Plan	Acre Output [1]	Annualized Cost [2]	Incremental Cost	Incremental Output Acres	Incremental Cost/Acre of Benefit
No Action	0	$0	$0	0	$0
Alternative 6	226,920	$155,156,124	$155,156,100	226,920	$683
Alternative 7	390,280	$307,993,023	$152,836,900	163,360	$935

[1]Outputs are calculated as Acre of Benefit.
[2]Annualized cost is initial construction cost, based on a 50-year period of analysis, .05375% interest rate.

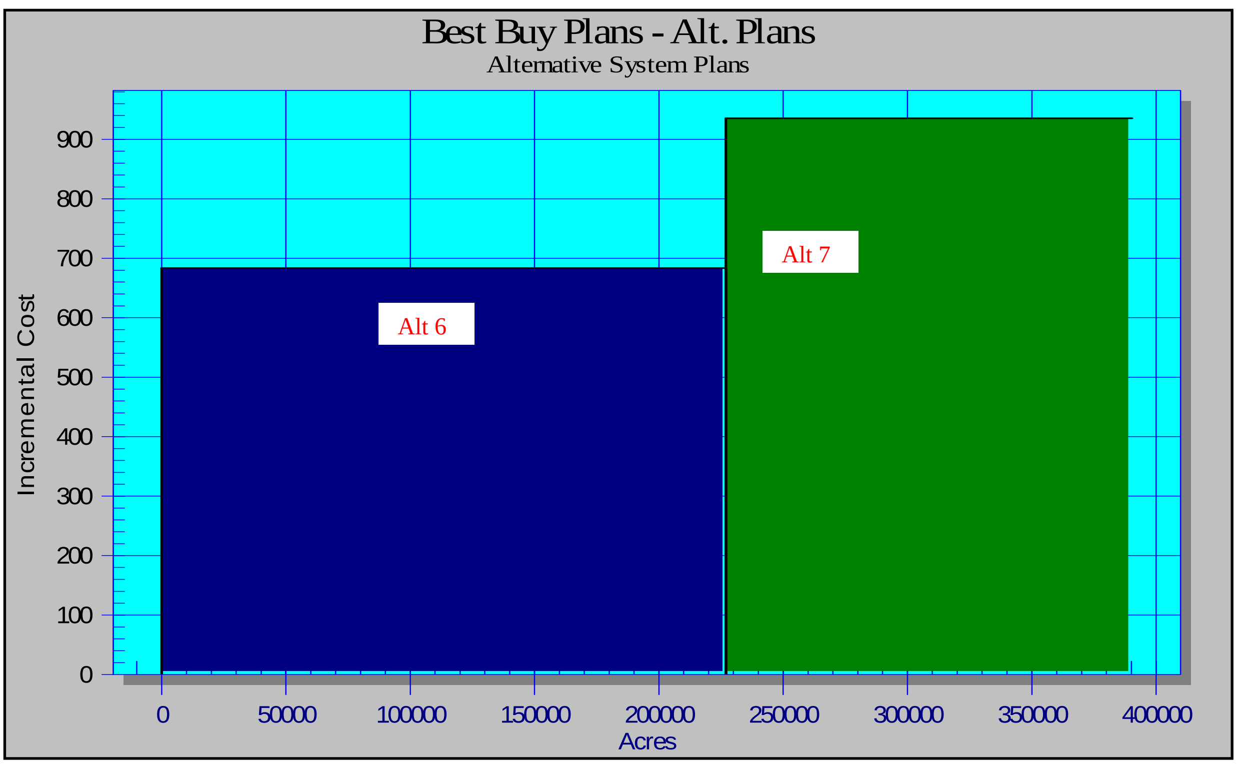


Figure 3-47. Incremental Analysis of Best Buy Plans (Acres of Benefit)

For system alternative producing stream miles of habitat benefits, there were four best buys; Alt 3, 4, 6, and 7 (table 3-69 and figure 3-48). Alternative 3 provides 14,220 miles of habitat benefit to the Basin at an annualized incremental cost of $5,080 per mile of habitat benefit. Alternative 4 provides an additional 8,410 miles of habitat benefit at an annualized incremental cost of $5,515 per mile of habitat benefit. Alternative 6 provides an additional 10,400 miles of habitat benefit at an annualized incremental cost of $10,659 per mile of habitat benefit. Finally, Alternative 7 provides an additional 14,450 miles of habitat benefit at an annualized incremental cost of $14,553 per mile of habitat benefit. While incremental costs increase significantly between Alt 4 and Alt 6, Alternative 6 adds considerably more benefits by addressing sediment delivery along the lower Illinois River and adding 800 miles of instream aquatic habitat restoration. The major addition in moving from Alt 6 to Alt 7 is an additional 1,000 miles of instream aquatic habitat restoration and providing fish passage on the main stem Illinois River.

Table 3-69. Incremental Cost Analysis of Best Buy System Alternative Plans (Miles of Benefit)

Alternative Plans	Miles Output [1]	Annualized Cost [2]	Incremental Cost	Incremental Output Miles	Incremental Cost/Mile of Benefit
No Action	0	$0	$0	0	$0
Alternative 3	14,220	$72,243,845	$72,243,850	14,220	$5,080
Alternative 4	22,630	$118,628,337	$46,384,490	8,410	$5,515
Alternative 6	33,030	$229,487,271	$110,858,900	10,400	$10,659
Alternative 7	47,480	$439,782,959	$210,295,700	14,450	$14,553

[1]Outputs are calculated as Acre of Benefit.
[2]Annualized cost is initial construction cost, based on a 50-year period of analysis, .05375% interest rate.

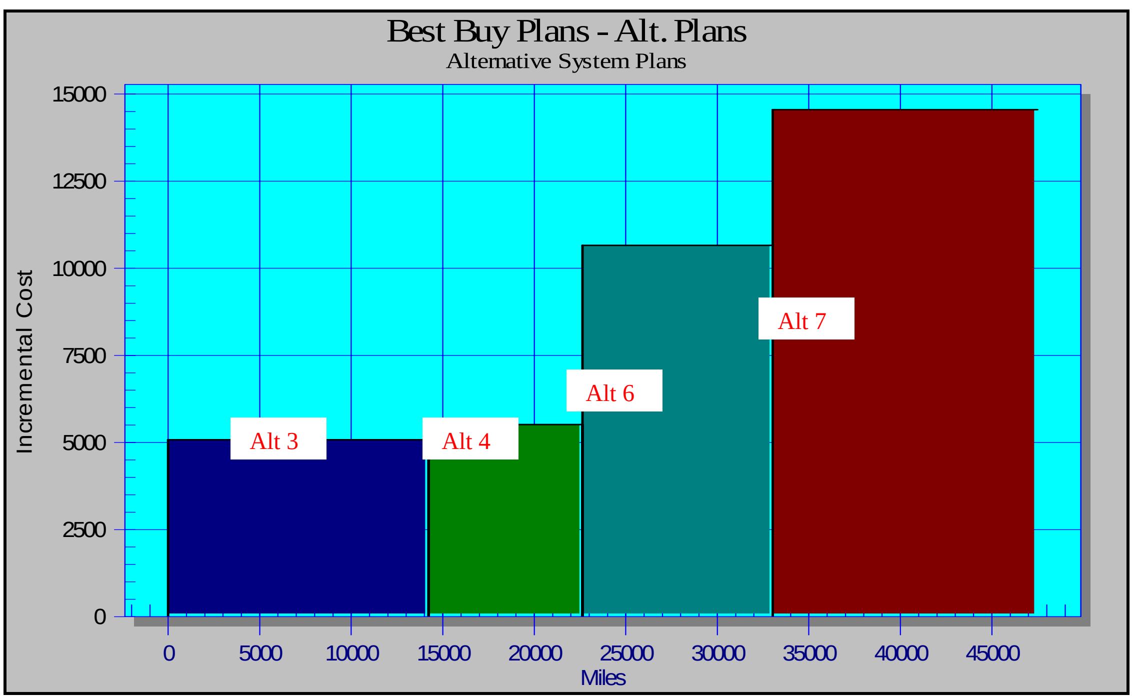


Figure 3-48. Incremental Analysis of Best Buy Plans (Miles of Benefit)

The most efficient alternatives, or best buy plans, varied somewhat by analysis acres, stream miles, and percent attainment. In total, they included the No Action and Alternatives 3, 4, 5, 6, and 7 (table 3-70). Alternative 3 was a best buy only in terms per cost per stream mile at $5,080 per stream mile. Alternative 4 was a best buy in terms of stream miles and percent attainment of goals. It provides restoration at a cost effectiveness of $5,515 per mile and $92 million per percent of the desired future condition attained for the first 38 percent. Alternative 5 was a best buy only for percent of goal attainment, providing a gain of an additional 8 percent, at an incremental cost of $163 million per percent. Only, Alternative 6 and 7 were best buy plans under all three forms of system analysis.

Table 3-70. Best Buy Plans from All System Analysis Methods

Alternative	Incremental Annual Cost/Acre	Incremental Annual Cost/Mile	Incremental Cost Per % Goal Attained (Millions)
No Action	**$0**	**$0**	**$0**
Alternative 1	$1,104	$7,122	$141
Alternative 2	$971	$6,920	$124
Alternative 3	$809	**$5,080**	$95
Alternative 4	$793	**$5,515**	**$92**
Alternative 5	$731	$71,883	**$163**
Alternative 6	**$683**	**$10,659**	**$185**
Alternative 7	**$935**	**$14,553**	**$220**

Note: Best Buy Plans are shaded. Incremental costs are shown from previous best buy plan.

d. Acceptability. Acceptability is the workability and viability of the alternative plan with respect to acceptance by Federal, State, and local entities; the general public; and compatibility with existing laws regulations and public policies [*Principles and Guidelines for Water and Related Land Resources*, Section VI.1.6.2(c)(4)]. To be acceptable, a plan has to have a perceived value, cost effectiveness, and a high probability of success. Many factors can render a plan infeasible in the minds of individuals. These factors can generally be categorized as technical (engineering or natural world limitations), economic, financial, environmental, social, political, legal and institutional.

While a wide range of comments was recorded during the study public meetings in December 2003, many comments supported plans that provide measurable system improvements in habitat and ecosystem integrity. These comments would be consistent with Alternatives 3 through 7 in considering habitat, but more specifically Alternatives 5 through 7 when considering ecological integrity.

e. Risk and Uncertainty. Risk and uncertainty are inherent in water resources planning and ecosystem restoration. Planners, resource managers, and decision makers rarely have all the information needed to make necessary public investment decisions. They often do not know how much confidence to place in the information they have; and must make decisions in an uncertain political, social, and economic environment. In addition, human intervention in natural processes involves unpredictable economic and biological elements.

Principles and Guidelines for Water and Related Land Resources, dated March 10, 1983, states that “the planner’s primary role in dealing with risk and uncertainty is to identify the areas of sensitivity and describe them clearly so that decisions can be made with knowledge of the degree of reliability of available information.” The alternatives and their effects should be examined to determine the uncertainty inherent in the data or various assumptions of future economic, demographic, social, public, environmental, and technological trends.

Risk and uncertainty was addressed as part of the formulation of measures and alternatives under each goal category. While there are uncertainties associated with some of the practices and approaches proposed in the Comprehensive Plan, the measures used to develop alternatives have been implemented at a number of locations and demonstrated to provide the desired benefits. Based on the approach of building all alternatives from similar measures, there are similar levels of risk and uncertainty associated with each alternative. As a result, risk and uncertainty does not represent a direct selection criterion in choosing among alternatives.

At the system level, however, risk and uncertainty is inherent in a study of a large basin, particularly in regard to ecological thresholds. Of concern is determining the thresholds associated with reductions in sediment delivery and reductions in water level fluctuations that will produce desired biological responses, such as increased aquatic plant growth and increased populations of macroinvertebrates. Since these thresholds cannot be known with certainty, the proposed approach is to implement restoration actions using sound site-specific project planning, adaptive management, long-term systemic monitoring, project-specific monitoring, and additional studies to address the uncertainties present during the implementation of the project components. As a result, these elements have been included as part of the implementation framework for this restoration project and are described in greater detail in the following sections. Further specific studies will be developed to provide additional information needed for detailed design and refinement of specific components of the Comprehensive Plan.

The data collected and experiences learned through executing the restoration activities are recommended to be periodically reviewed and summarized for decision makers. This evaluation would provide the basis for potential identification of improved techniques or approaches; revised sediment reduction targets; improved hydrologic modifications; new restoration approaches; and modifications to the monitoring and adaptive management framework. It is likely that new technologies and techniques will emerge during the implementation process. New technologies and techniques for ecosystem restoration offer the possibility of improving the Comprehensive Plan over and above the measures identified to date. The implementation process will allow flexibility to consider and include new technologies as they become available.

3. Selection of the Recommended Plan

By reviewing the various alternative plan qualitative and quantitative outputs in comparison to the criteria of completeness, effectiveness, efficiency, acceptability (and risk and uncertainty), the relative benefits of the various alternative plans become clearer. Table 3-71 and the following sections provide additional explanation of the selection of the recommended plan in regards to completeness; effectiveness in achieving objectives; and efficiency - Cost Effectiveness (NER).

Table 3-71. Summary of Evaluation Criteria of Best Buy Plans

Completeness						
	No Action	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6**	**Alt 7**
	-	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Effectiveness						
	No Action	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6**	**Alt 7**
Overarching Goal - Habitat	decline	minor	minor	minor	major	major
Overarching Goal - Ecosystem Integrity Region	decline	improve	improve	improve	improve	improve
Overarching Goal - Ecosystem Integrity System	decline	sediment improve	tributary improve	improve	improve	improve
Overarching Goal - Sustainability	no	low/mod	low/mod	mod	high	high
Goal 6 - Water Quality	-	mod	mod	mod	mod/high	mod/high
Combined Goals (equal weighting)	0%	31%	38%	46%	63%	97%
Acres Benefited	-	90,840	64,550	130,840	226,920	390,280
Stream Miles Benefited	-	14,220	22,630	22,930	33,030	47,480

Efficiency						
	No Action	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6**	**Alt 7**
Project Cost ($ in millions)	-	$2,990	$3,490	$4,875	$8,025	$15,485
Best Buy Plans Percent Attainment	Yes	-	Yes	Yes	Yes	Yes
Best Buy Plans Acres Restored	Yes	-	-	-	Yes	Yes
Best Buy Plans Stream Miles Restored	Yes	Yes	Yes	-	Yes	Yes

In terms of completeness, all plans were essentially equal.

In terms of effectiveness in addressing the overarching goal of restoring ecological integrity and Goal 6, Alternatives 3 and above provide improvements in terms of improving system habitats compared to existing conditions. However, only Alternatives 5 and above fully address the study vision for a system sustainable by natural processes and the overarching goal of restoring and maintaining ecological integrity. Evaluation of the ecosystem alternative contribution to the planning objectives determined that Alternatives 6 and 7 most directly achieve the planning goals and objectives. Therefore, they received the highest ranking. While less defined, water and sediment quality improvements are also anticipated to be the greatest with Alternatives 6 and 7.

The most efficient alternatives, or best buy plans, varied somewhat by analysis (acres), stream miles, and percent attainment. In total, they included the No Action and Alternatives 3, 4, 5, 6, and 7. Alternative 3 was a best buy only in terms per cost per stream mile at $5,080 per stream mile. Alternative 4 was a best buy in terms of stream miles and percent attainment of goals. It provides restoration at a cost effectiveness of $5,515 per mile and $92 million per percent of the desired future condition attained for the first 38 percent. Alternative 5 was a best buy only for percent of goal attainment, providing a gain of an additional 8 percent, at an incremental cost of $163 million per percent. Only, Alternative 6 and 7 were both best buy plans under all three forms of system analysis.

Acceptability also points to the strong desire to see plans that result in significant system improvements (i.e. Alternatives 5, 6, and 7). Since all plans have similar levels of risk and uncertainty, it did not provide a basis for selecting a particular plan.

Since all plans include similar levels of risk and uncertainty, it did not provide a basis for selecting a particular plan.

Based on an assessment of all evaluation criteria, Alternative 6 was selected as the recommended plan. Alternative 3 and 4 were not selected since they do not provide enough restoration to make systemic ecological integrity improvements over current conditions, especially in relation to system ecological thresholds. Alternative 6 was selected over Alternative 5, since it was a best buy in terms of both cost per acre and stream miles, while Alternative 5 was not. Alternative 6 also provides a higher level of attainment of the desired future (63 percent) than Alternative 5 (46 percent) with similar incremental costs. Alternative 6 is anticipated to result in achievement of desired system outputs including restoration above threshold levels required for the return of aquatic plants and diving ducks and addressing system limiting factors allowing for improvements in fish, waterfowl, and threatened and endangered species populations. As shown in the summary table of the best buy plans (table 3-71), only Alternatives 6 and 7 achieved significant improvements to ecosystem integrity over current conditions and high levels of sustainability. Alternative 7, while also a best buy under all three benefit evaluations and attaining near 100 percent achievement of the desired future, was also not preferred due to the relatively large increase in incremental and total cost per stream mile, acre, and percent attainment, with fewer benefits per dollar than the components in Alternative 6. Alternative 7 is not anticipated to reach new thresholds, but would increase the likelihood that the desired levels would be reached and maintained, and would provide greater areas of high quality habitat outputs. Alternative 6 includes 63 percent of the quantifiable desired future condition at roughly 51 percent of the cost of Alternative 7. The interagency System Team believes that the level of restoration achieved by Alternative 6 best meets the Federal Objective of contributing to increases in the net quantity and quality of desired ecosystem restoration.

Alternative 6, if fully implemented over the next 50 years, would provide a measurable increase in system ecological integrity. Specifically, this alternative would reduce systemic sediment delivery by 20 percent, restore 12,000 acres of backwaters, restore 35 side channels, protect 15 islands, restore 75,000 acres of main stem floodplain, restore 75,000 acres of tributary floodplain, restore 1,000 stream miles of aquatic habitat, provide fish passage along the Fox, DuPage, Des Plaines, Kankakee, Spoon, and Aux Sable Rivers, produce an 11 percent reduction in the 5-year peak flows in tributaries, increase tributary base flows by 20 percent, produce a 66 percent reduction in half-foot or greater water level fluctuations along the main stem during the growing season, and provide system level improvements in water quality. In total, this plan would provide benefits to approximately 225,000 acres and 33,000 stream miles. In addition to direct restoration activities, the plan includes components for system management and a technologies and innovative approaches component that includes (monitoring, computerized inventory and analysis, innovative dredging and beneficial use technologies, and special studies). Sections IV and VI describe these aspects of the plan in greater detail.

Due to the scope of the recommended plan and the long time period for implementation, a tiered implementation approach is recommended. Corps of Engineers cost shared restoration efforts would begin with $153,850,000 ($100,000,000 Federal funds) in restoration funds through 2011 (Tier I) with the potential to expand to $384,615,000 ($250,000,000 Federal funds) in restoration efforts through 2015 (Tier II). The funding and activities would begin significant restoration consistent with eventual implementation of Alternative 6. These initial phases are proposed to demonstrate the benefits of the various practices and project components prior to seeking additional funding.

Tier I efforts would be cost shared 65 percent Federal ($100 million) and 35 percent non-Federal ($53.85 million). This funding level would provide approximately $127.0 million for planning, design, construction and adaptive management of restoration projects; $24.1 million for the technologies and innovative approaches component; and $2.75 million for system management. The estimated annual Operation and Maintenance cost of projects constructed under Tier 1 features are in place, is $125,000. If funding is available, a report to Congress will be submitted in the 2011 timeframe, documenting the project successes and the results from approximately the first $153.85 million ($100 million Federal) in restoration efforts. The implementation of this plan is more fully described in Section 6 of the report.

4. DESCRIPTION OF THE RECOMMENDED PLAN

Part A of this section summarizes the recommended plan, provides some basic descriptions of measures that would be used to achieve the desired goals, and provides a summary of costs and operations and maintenance considerations for individual measures. The recommended plan, Alternative 6, was selected because it achieves a balance between increasing system-wide benefits and cost effectiveness. Part B summarizes costs associated with the recommended implementation of Tier I through 2011 and Tier II through 2015. and includes the technologies and innovative approaches component of the recommended plan.

Goals of Alternative 6 include:

1. **Ecological Integrity.** Restoration would provide a measurable increase in level of habitat and ecological integrity at the system level. Implementation of Alternative 6 would provide benefits to approximately 225,000 acres and 33,000 stream miles.

2. **Sediment Delivery.** Reduce sediment delivery from direct Peoria Lake tributaries by 40 percent, other tributaries upstream of Peoria Lake by 11 percent, and tributaries downstream of Peoria Lake by 20 percent. System benefits include reduced delivery of 20 percent to Peoria Lake and 20 percent system wide. A reduction in sediment would benefit approximately 16,750 stream miles.

3. **Backwaters and Side Channels.** Restore 12,000 acres in 60 of the approximate 100 backwaters on the system. Dredging an average of 200 acres per backwater, the optimal level of 40 percent of the approximate 500-acre average backwater area. This would create optimal backwater and over-wintering habitat spaced approximately every 5 miles along the system. Restoration of 35 side channels and protection of 15 islands. Restoration measures would benefit approximately 56,020 acres.

4. **Floodplain, Riparian, and Aquatic Restoration.** Restore 75,000 acres of main stem floodplain (approximately 14.9 percent of total main stem floodplain area) including approximately 31,700 acres of wetlands, 25,300 acres of forest, and 18,000 acres of prairie; tributary restoration of 75,000 acres (approximately 8.8 percent of total tributary floodplain area) including approximately 47,600 acres of wetlands, 13,900 acres of forest, and 13,500 acres of prairie; and aquatic restoration including 500 miles of tributary streams (16.6 percent of the approximately 3,000 miles of channelized streams) with a mix of improved instream aquatic habitat structure and channel remeandering. Restoration measures would benefit approximately 150,000 acres and 1,000 stream miles.

5. **Connectivity.** Restore fish passage at all main stem dams on the Fox River (12 dams), all dams on the West Branch of the DuPage River (5 dams), all main stem dams and one tributary (Salt Creek) of the Des Plaines River (17 dams), Wilmington and Kankakee Dams on the Kankakee River, Bernadotte Dam on the Spoon River, and the Aux Sable Dam. Restoration measures would result in benefits to approximately 4,280 stream miles.

6. **Water Level.** Create 107,000 acres of storage area at an average depth of 1.5 feet and 38,400 acres of infiltration. Increase water level management at navigation dams by using electronic controls, increased flow gaging, and installing new tainter gates at Peoria and LaGrange Dams. Results include an 11 percent reduction in the 5-year peak flows in tributaries, an overall average 20 percent increase in tributary base flows, and up to 66 percent reduction in the occurrence of half-foot or greater fluctuations during the growing season in the main stem Illinois River. This

alternative also would see benefits accrue from drawdowns in La Grange or Peoria Pools. Water level management would result in benefits to approximately 20,900 acres and 11,000 stream miles.

7. **Water Quality.** Anticipate improvements in water quality due to reduced sediment, phosphorus, and nitrogen delivery. These improvements would result from sediment delivery reduction measures and water level management measures.

A. COMPONENT MEASURES IN RESTORATION PROJECTS

The following summarizes the types of measures planned for each goal as part of restoration projects. The measures described could be used in conjunction with other measures, or singly, to achieve critical restoration project goals. These projects fall under each of the goal categories. Projects and measures would be selected to optimize ecosystem integrity benefits. Project selection criteria would be developed to optimize ecosystem integrity within the framework of project objectives (Section 3, *Plan Formulation*). Costs were developed based on data from previous Rock Island District projects, other Corps projects, and, where no Corps data were available, other agencies. A detailed cost breakdown to achieve 50-year program goals is presented in Appendix E. All estimated construction costs assume a 35 percent contingency. Additionally, planning engineering and design costs were assumed to be 30 percent of construction costs, while contract supervision and administration costs were assumed to be 9 percent of construction cost. Estimated costs to acquire real estate were also included in the construction cost.

Many of the measures would address multiple goals but some are specific to individual goals. While the measures described are not an exhaustive list, they represent proven and common techniques that could be used to achieve the desired restoration goals. The restoration measures listed reflect the suggestions and input received from other Corps Districts and partnering agencies. Refinement and location of measures would occur during site-specific planning activities, adhering to the implementation framework.

1. **Overarching Goal - Ecological Integrity.** The overarching goal of restoration efforts is to increase the ecological integrity of the Illinois River Basin. Projects formulated under all of the other program goals would contribute towards this goal; therefore, no specific projects or alternatives were formulated for this goal.

2. **Goal 1 - Sediment Delivery.** Reducing sediment delivery to the Illinois River and its tributaries would be achieved through implementation of in-stream and upland measures. This part of the recommended plan would reduce sediment delivery in the Illinois River to Valley City by 20 percent. The major focus of the sediment reduction plan would be on direct tributaries to Peoria Lake, reducing sediment delivery by 40 percent. Implementation of the plan would also result in a sediment delivery reduction of 11 percent from the remainder of the basin upstream of Peoria Lake to Peoria Lake and a reduction of 20 percent from the rest of the basin downstream of Peoria Lake to Valley City. Sediment control through in-channel measures is expected to account for 75 percent of the reduction obtained. Local site conditions and project objectives will dictate specific measures to be implemented and detailed analyses of the geomorphic impacts of the sediment control measures would be conducted during project design. As indicated in Section 3 of this report, in-channel measures are likely to be most cost-effective in the southern and western portions of the watershed. For this reason, project costs were estimated based on the assumption that 75 percent of the work in the western and southern regions would consist of in-stream measures (e.g., grade control and bank stability), while the other 25 percent would consist of upland measures. In the eastern portion of the watershed, an even mix of upstream versus upland measures to control sediment delivery was assumed.

a. Grade Control. Grade control refers to any alteration that produces a more stable streambed. There are two basic types of grade control structures. The first is essentially a bed control structure, using a hard point in the stream or river for protection against the water's erosive forces. The second type is designed to reduce the energy slope in the area of concern such that the water is no longer capable of scouring the bed. The type, location, spacing of structures, and size of structures all are important considerations when designing a grade control structure(s). Rock riffles are the preferred method of grade control (photograph 4-1).

Photograph 4-1. Riffle Structure for Grade Stabilization

Rock riffles act as bed control elements, provide habitat benefits, and require little, or relatively inexpensive, operation and maintenance. Pool and riffle units provide a diverse range of hydraulic and biological niches that are critical to sustaining thriving river habitats. An assessment of channel stability should be conducted such that causes of current instability can be identified (e.g., land use changes leading to increased discharge) and remedial measures and their location can be identified. Upstream and downstream hydraulic and sediment regimes may be impacted through addition of riffle structures; therefore, careful planning should be undertaken to consider these potential ramifications. Priority would be given to areas exhibiting highly degraded habitat in the form of excessive bank erosion and head cutting with no existing pool and riffle habitats. Riffle structure design should accommodate habitat and migration needs of aquatic species.

The cost of riffle structures was estimated based on similar projects performed by the Rock Island District and then adapted to typical dimensions encountered in Illinois River tributaries. The estimated construction cost for a rock riffle structure on a major tributary was estimated to be $210,500, while the estimate for a small tributary was estimated to be $45,500. The main factor affecting the cost difference was the assumed stream width (200 feet for a major tributary, 41 feet for a minor tributary). Operations and maintenance (O&M) costs were developed based on the assumption of 5 percent replacement over a 50-year project life, which would amount to $150 per year on a major tributary and $30 per year on a minor tributary.

b. Bank Stabilization. A range of measures may be implemented to increase river or stream bank stability. Direct (e.g., riprap revetment, photograph 4-2) or indirect (e.g., barbs, bendway weirs) structural measures, generally constructed of riprap, may be used alone or in conjunction with plants, such as willow post plantings. This combination is often referred to as a bioengineered or biotechnical measure (photograph 4-3).

Photograph 4-2. Rock Revetment Used for Bank Stabilization

Photograph 4-3. Bioengineered Stone Toe Protection and Vegetation Used for Bank Stabilization (Univ. of Illinois- Urbana Champaign Water Quality Department: www.wq.uiuc.edu/Pubs/Streambank.pdf

When stream banks are directly exposed to high-velocity flows, directly placing riprap on banks can be used to prevent erosion. Another direct bank protection measure that is likely to be utilized is stone toe protection. One of the advantages of stone toe protection is that it can be placed without grading the bank line, while minimizing tree loss and construction impacts and cost. The upper portion of the bank normally revegetates on its own (resulting in further cost savings). Bendway weirs and stone toe protection can be placed riverward of the existing bank to encourage deposition and floodplain formation (also acting to trap sediment). Stream barbs are low rock sills that project out from a stream bank to redirect flow away from the bank and towards the channel centerline. Geomorphic analysis of the site conditions should be conducted prior to design and construction.

Bioengineered measures are often used in conjunction with other structural measures. As the plants grow, their roots strengthen the soil matrix. The result of using bioengineered methods often provides greater erosion protection than using plants or a structural practice alone and is generally more aesthetically pleasing than a structural practice. Costs associated with each bank stabilization measure are presented in table 4-1. The costs are separated based upon whether the measure would be applied to the main stem or a major or minor tributary. Sediment reduction benefits assume that each practice would perform at design levels. Biedenharn et al. (1997) provided a comprehensive review of stream stabilization practices and design considerations.

Table 4-1. Estimated Construction and O&M Cost for 100 Feet of Streambank Stabilization

Measure	USACE Construction Cost [1]	Estimated Annual O&M Cost
Live Planting (willow posts)		
Main stem	$21,400	$208
Major	$17,700	$171
Minor	$14,000	$134
Stone armor		
Main stem	$39,300	$ 25
Major	$32,400	$ 21
Minor	$25,400	$ 16
In-stream barb/groin/spur [2]		
Main stem	$62,100	$ 80
Major	$18,100	$ 23
Minor	$ 9,800	$ 12
Longitudinal stone toe		
Main stem	$19,900	$ 12
Major	$16,400	$ 10
Minor	$12,900	$ 8

[1] Assumes an additional 35% construction contingency, 30% Planning, Engineering, and Design, 9% Supervision and Administration, and estimated Real Estate costs
[2] Measure applied at 1 per 100 feet

No single technique or streambank restoration measure is applicable in all situations. Selection of appropriate measures would be determined based on evaluation of the engineering, economic, and environmental factors at each site.

c. Sediment Retention Structure. Sediment retention structures store runoff that is transporting suspended sediment and bed material (photograph 4-4). These structures may be designed to be self-dewatering or permanent pond.

Photograph 4-4. Sediment Retention Structure

The major factors controlling the degree of sediment retention include: physical characteristics of the transported sediment; hydraulic characteristics of the basin; inflow time distribution of sediment and water; basin geometry; and water and sediment chemistry. The cost of sediment retention structures was based on the anticipated size of the basin. The basin size is dictated by factors affecting the required storage volume, including drainage area, soils, hydrology, and topography. Design guidance can be found in the Natural Resources Conservation Service's (NRCS) National Engineering Handbook. Costs for small (1 acre), medium (5 acres), and large (150 acres) sediment retention structures were estimated to be $59,200, $195,000, and $6,616,000, respectively. Anticipated O&M costs would be associated with inspection, mowing, potential riprap replacement, and debris and sediment removal. Constructed wetlands can also be used to treat runoff water, though not as a primary settling system, since operation and maintenance require periodic clean out which would severely degrade biological functions.

d. Filter Strips. Though not used for cost estimating purposes, filter strips could serve as an important plan component. It is recommended that the use of filter strips be expanded to applicable areas by other agencies. Filter strips reduce sediment delivery by reducing overland flow velocity, which permits deposition of entrained sediment (photograph 4-5).

Photograph 4-5. Filter Strips Trap Sediment and Pollutants Before Entering a Body of Water

Solids are removed by three primary mechanisms. First, bed material load is deposited as decreased flow velocities reduce transport capacity of the flow. Second, suspended solids become trapped in the litter of the filter strip. Suspended solids trapped in the litter at the soil surface would not as readily become resuspended. However, trapping efficiency would decrease as the litter becomes inundated with sediment and may require maintenance to perform at design levels. Finally, suspended material that moves into the soil matrix along with infiltrating water can become trapped. This is the primary means by which suspended colloidal particles are trapped. Along with the sediment itself, sediment-bound nutrients and chemicals would also be deposited, resulting in better water quality for receiving bodies of water. The cost per acre of filter strips was estimated to be 50 percent of the cost of prairie plantings, as less specialized seed would be required, for a cost of $1,350 per acre. Operations and maintenance costs were estimated to be $5 per acre per year, primarily for inspection.

3. Goal 2 - Backwaters and Side Channels. Backwater and side channel restoration would be accomplished through dredging to restore and maintain deepwater aquatic habitat; island protection to maintain current islands; and measures to improve habitat diversity and depths in side-channels.

a. Dredging. The recommended plan calls for dredging 60 of the approximate 100 backwaters in the system. Currently, most backwaters on the system have very shallow depths and an average surface area of approximately 500 acres per backwater. Of the 500 acres in a typical backwater, 5 percent of the area would be dredged to a depth of at least 9 feet; 10 percent to between 6 and 9 feet; 25 percent to between 3 and 6 feet; and 60 percent would require no dredging, resulting in a total dredged area of 200 acres, or 40 percent of a typical backwater. The cost of this dredging configuration would be $19.6 million per backwater. No operations and maintenance costs would be associated with this practice as the backwater would be overdredged to account for sedimentation. Conventional dredging techniques, such as mechanical and hydraulic dredging, in addition to innovative dredging technologies would be used to achieve project goals. Design guidance for traditional dredging techniques is provided in Engineering Manual (EM) 1110-2-5025 (USACE 1983); EM 1110-2-5026 (USACE 1987a); and EM 1110-2-5027 (USACE 1987b). In addition to these standard methods, opportunities to use high-solids dredging and the use of geotechnical tubes (geotubes) would also be considered, as site conditions warrant.

Traditional hydraulic dredging and mechanical dredging with clamshells (photograph 4-6) or draglines have several limitations. These include resuspension of sediments at the point of excavation and free water entrainment in sediments, which require extensive, and potentially expensive, dewatering and return water treatment (Duke et al. 2000).

Photograph 4-6. Island Creation Utilizing a Clamshell Bucket To Mechanically Dredge Sediment

A high-solids dredging technology (photograph 4-7) could be used in place of, or in addition to, more traditional dredging technologies. This type of dredge incorporates a sealed clamshell, which removes sediment at its *in situ* moisture content. The material is then fed into a hopper of a positive displacement pump where it is pumped through a pipe to its discharge location. The discharge has the consistency of toothpaste.

Photograph 4-7. High-Solids Dredging Technology Used Where Fine-grained Sediments Are Prevalent

Specific site conditions as well as defined project objectives would dictate placement sites of dredged material. Where conditions and project objectives permit, dredged material may be used to create islands that would be of habitat value. Other potential uses of dredged sediment are placement on nearby agricultural fields, building up existing islands, or restoration of brownfields, former mined lands, gravel pits, etc. Islands create off-channel areas that are sheltered from river currents and waves. These characteristics create conditions in backwaters that are ideal for a variety of aquatic plants and animals. In addition, islands can serve as either upland or wetland habitat.

The Peoria Lake Enhancement project, part of the Environmental Management Program (EMP), was a successful project constructed in the mid-1990s (photograph 4-8). Since construction, the barrier island has reduced wave action on a portion of the lake, thereby reducing sediment resuspension and turbidity. While the improved water quality has not stimulated the growth of submergent and emergent aquatic vegetation on the lee side of the island because of undesirable water level fluctuations, the site is utilized by migratory waterfowl and the dredged channel has benefited native fish.

Photograph 4-8. Aerial View of Peoria Lake Habitat Rehabilitation and Enhancement Project

It was assumed that any design involving island creation would incorporate measures to prevent erosion of the island; therefore, there were no O&M costs directly associated with island creation.

b. Island Protection. The recommended plan calls for adding protection to 15 of the 56 existing islands on the Illinois River. For cost estimating purposes, it was assumed that each island was 1-mile long and 100-foot wide. Twenty percent of the island perimeter would be protected. Three different measures and methods— off-bank revetments, bankline revetments, and timber piles (photograph 4-9)—were evaluated to provide the 20 percent perimeter protection. Based on this assumed distribution, a representative cost for each island protection was estimated to be $1,150,000. Annual O&M costs associated with island protection were estimated to be $1,035, under the assumption that 15 percent of the off-bank and 8 percent of the bank revetment would need to be replaced over the 50-year project life. No O&M costs would be associated with timber piles.

Photograph 4-9. Timber Piles Used to Provide Structural Depth Diversity and Island Protection

Island protection is a measure utilized to protect an existing or newly created island. Protecting islands from the effects of accelerated erosion, caused by commercial and recreational navigation and wind-fetch, is important where important habitat, private property, or archeological resources are adversely impacted. Protection of the upstream ends and banks of existing islands to maintain, and potentially restore, their historic length would be accomplished through the use of off-bank revetments (photograph 4-10) (rock or timber), bank armoring (riprap, articulating concrete blocks, A-Jacks), or groins. The advantage of articulating concrete blocks or A-Jacks is that not all of the treated surface area is covered with material, permitting vegetation to grow amongst the protection, which can offer additional stabilization and is more aesthetically pleasing. The opportunity to utilize bioengineered island protection measures where they meet project goals and objectives will be pursued.

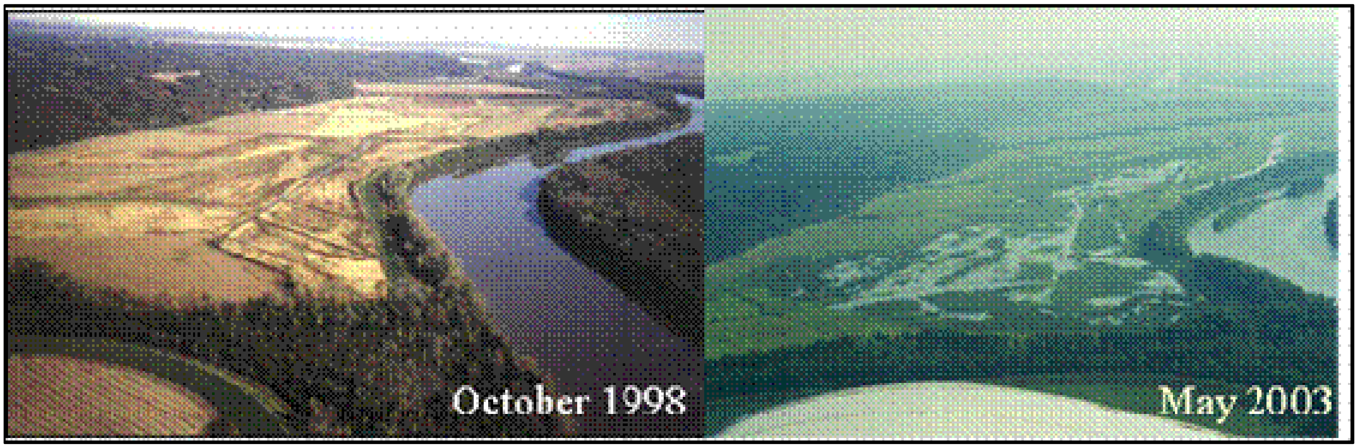
c. Side Channel Restoration. Under the recommended plan, 35 of the 56 side channels in the Illinois River would be restored. Each side channel would be restored through a combination of off-bank structures and dredging. For purposes of cost estimation, it was assumed that stub dikes would be used to create structural depth diversity and to promote suitable hydraulic conditions in the side channel. Stub dikes are constructed of rock built nearly perpendicular to the shoreline, and extending from the shoreline approximately 30 to 40 feet. Seven stub dikes for each mile-long side channel would be used. The cost for adding stub dikes to an individual side channel was estimated to be $127,000. Operations and maintenance costs were estimated to be $164 per year, based on the assumption that 15 percent of the rock would need to be replaced over the 50-year life of the project. Creation of depth diversity could be accomplished through the use of stub dikes, wing dams, log piles, or pile dikes. Wing dams are submerged structures that are constructed perpendicular to an island or bank. Their historic purpose was to reduce flow velocity in the area of the wing dam, inducing deposition, which lead to channelization of the main channel. These flow regulating structures could be modified to increase connectivity between the main channel and off-channel areas.

Photograph 4-10. Off-Bank Revetments Used To Provide Erosion Protection on Islands

4. Goal 3 - Floodplain, Riparian, and Aquatic. The recommended plan includes the restoration of 75,000 acres of mainstem and 75,000 acres of tributary floodplain and riparian habitats and 500 miles of aquatic stream restoration. The 75,000 acres of floodplain to be restored on the main stem would be distributed according to approximate historical cover types as follows: 31,700 acres of wetlands, 25,300 acres of forest, and 18,000 acres of prairie. The distribution of the restored floodplain in the tributary areas would be 47,600 acres of wetlands, 13,900 acres of forest, and 13,500 acres of prairie. Five hundred miles of the approximately 3,000 miles of channelized streams of tributary streams would be restored.

a. Floodplain. A total of 150,000 acres of floodplain (75,000 acres mainstem, 75,000 acres tributary), would be restored under the recommended plan. Measures that were considered to improve floodplain ecological function were divided among forest, grassland (prairie), and wetland, based on historical cover type. Forest restoration would be achieved through timber stand improvement and planting mast trees. Timber stand improvement costs an estimated $8,200 per acre, with an associated annual O&M cost of $2 per acre. Tree planting would be accomplished at a tree density of 50 trees per acre at a cost of $6,100 per acre, with an associated annual O&M cost of $65 per acre. Prairie or grassland restoration would be accomplished through improvement of site conditions to benefit targeted plant species and planting desirable vegetation. The estimated cost of prairie restoration is $5,500 per acre, with an estimated annual O&M cost of $5 per acre. Wetland habitat would be created or rehabilitated through the creation of Moist Soil Management Units (MSMUs), wetland planting, and/or reconnection of floodplain areas to backwater areas. An example of a floodplain restoration project is shown in photograph 4-11.

Moist soil management units are shallow-water impoundments created by low-height levees. They incorporate water control structures to flood the impoundment during the fall and winter while reducing water levels and limiting fluctuations in the impoundment during the late spring and summer. Inundated conditions provide suitable habitat for migrating waterfowl and other animals. Summer drawdown promotes germination and growth of plants suited to moist or somewhat flooded conditions. Location of the MSMU relative to the waterfowl flyway, water source, soil type, topography, impoundment size, number of units, levee design, and design of the water control structure are important considerations in MSMU design. The estimated cost per acre of MSMU is $15,000. Estimated annual O&M costs are $20 per acre. More information on the design details of MSMUs can be found in Olin et al. (2000) and Lane and Jensen (1999). Wetland plantings would cost an estimated $8,800 per acre, with O&M costs of $7 per year per acre.



Photograph 4-11. Before and After Photographs of Floodplain Restoration at Spunky Bottoms on the Illinois River, a Project Sponsored by the Nature Conservancy

Riparian buffer strips provide much of the same functions as upland grass filter strips (see discussion of Goal 1, page IV-2). When buffer strips are created using mast trees, the strips can provide shade, which reduces water temperature; provide riparian wildlife habitat; protect fish habitat; maintain aquatic species diversity; and provide wildlife movement corridors. Photograph 4-12 shows a typical forest riparian buffer. In addition, vegetation nearest the stream or water body provides litter fall and large woody debris important to aquatic organisms. Woody roots increase the resistance of streambanks to erosion caused by high water flows and waves. The estimated cost of riparian forest buffers was estimated to be $6,100 per acre, the same as planting mast trees.

Photograph 4-12. Forest Riparian Buffer

b. Aquatic Restoration. To accomplish the goal of 500 miles of stream restoration, a combination of riffle structures and stream re-meandering would be used. A brief description of riffle structures can be found in this section under Goal 2, page IV-7. The construction and O&M costs for riffle structures can also be found under Goal 2. Approximately 20 percent of the riffle structure would be constructed in major tributaries with the remainder in minor tributaries. The density (number per mile) of riffle structure partly depends on stream width. For this reason it was assumed that four structures per mile would be required for major tributaries, while minor tributaries would require 22 structures per mile.

Channel re-meandering is a complex subject. Historic and present land use, geology, hydrology, hydraulics, and sediment transport must be considered. Restoring meander planform geometry can be accomplished by analyzing historical maps or meander scars left on the floodplain (Soar and Thorne 2001). However, this method is applicable only if historic hydrologic and sediment regimes are deemed to be representative of the restored channel. Changes in land use may have altered the hydrologic and sediment regimes such that they no longer support a historic meander planform. Soar and Thorne (2001) detail the considerations and design procedure for channel restoration. The cost of channel re-meandering depends greatly on channel dimensions. For major tributaries, it was estimated to cost $177,000 per 100 feet of channel, or $9,350,000 per mile. For minor tributaries, the cost was estimated to be $97,000 per 100 feet of channel, or $5,125,000 per mile. Operations and maintenance costs were estimated to be $713 and $365 for major and minor tributaries, respectively.

5. Goal 4 – Connectivity. Connectivity would be restored by providing fish passage at all dams on the Fox River, all dams on the west branch of the DuPage River, all dams on the Des Plaines River, at Salt Creek (a tributary of the Des Plaines River), the Wilmington and Kankakee Dams on the Kankakee River, the Bernadotte Dam on the Spoon River, and the Aux Sable Dam on the Aux Sable River. These locations were selected because they would provide significant benefit. However, should opportunities to restore connectivity at other locations arise, they would be explored. This portion of the recommended plan is estimated to cost $35 million. The total cost was estimated by adding a rock ramp for fish passage. Any decision regarding dam removal would require considerable planning, not only to account for physical impacts, but also cultural impacts.

Dams may be removed for several reasons. They may be structurally or economically obsolete or pose an unnecessary safety concern. In addition, a dam may be removed for ecological restoration (Heinz Center 2002). Under this program, the primary reason for dam removal would be for ecosystem restoration. Dam removal carries with it potential physical, chemical, ecological, economic, and social considerations. Physical effects on the system are hydrology, sediment, and geomorphology; because of the importance of sediment delivery in this system, geomorphological changes and sediment stabilization must be addressed in the design of potential dam removal projects. Negative chemical effects could occur downstream of a removed dam if contaminated sediments are located at the site. Dam removal generally has a positive ecological effect, as fish and other aquatic organisms are able to access more areas of a river; however, invasive species may also become more widespread. Social and economic effects include aesthetics of the dam site and surrounding areas that are impacted by dam removal, potential changes in property values, loss a of culturally significant site, and other economic factors depending on the use and state of the dam.

Several types of fish passage are available and can be classified into vertical slot, Denil, weir, and culvert fishways (Katopodis 1992). Excavated bypass channels backfilled with rock and formed into sills or weirs are also utilized to pass fish and other aquatic organisms around a dam. A rock ramp (photograph 4-13) from the face of a dam to the downstream channel bottom can be used as an alternative to an excavated channel bypass. The most important factors to be considered in fishway design are the hydraulic characteristics of the fishway and the swimming ability and behavior of the fish species to be passed. Fishway efficiency depends on attracting fish to the fishway and providing adequate passage conditions through the fishway and at its exit. Entrance conditions at fishways are critical for attracting fish. Most fish swim in a burst and rest pattern (Katopodis 1992); therefore, it is important to ensure that any fishway is designed such that it has suitable resting spots, as in a pool and riffle design, and that velocities and the lengths over which the velocities occur, do not exceed the targeted species capabilities.

Photograph 4-13. Rock Ramp on the Otter Tail River, Minnesota

6. Goal 5 - Water Levels

a. Stormwater Storage. The recommended plan calls for the addition of 160,000 acre-feet of stormwater storage. Tributary hydrologic regimes would be modified by increasing the volume of stormwater storage available within each tributary watershed so that runoff from relatively small events, including those expected to occur every 2 years or more frequently, would be temporarily held back before being released downstream. This storage might take various forms including tile management, detention structures or expanded riparian areas that provide ecological benefits in addition to flood storage. The estimated cost for stormwater storage was based on the assumption of an impoundment constructed to hold water at a depth of 1.5 ft. This cost was estimated at $2,880 per acre-feet with an O&M cost of $5 per acre-feet per year. Since these will be designed to address small events they may have little or no effect on large events; this study does not claim any flood damage reduction benefits from this storage.

b. Increasing Infiltration. This portion of the recommended plan would create 38,400 acres of infiltration area. Another approach to improve tributary hydrologic conditions is directing runoff to areas where it can infiltrate into the soil. Infiltration requires the proper soil and subsoil conditions, but if conditions are appropriate, infiltration could be accomplished using tile management or conservation practices, such as filter strips or structures consisting of grassed fields enclosed within a berm. Infiltration can also be increased throughout watersheds using practices that reduce runoff generation or allow runoff to infiltrate close to the point it is generated. Conservation practices on agricultural land that result in more infiltration are conservation tillage and no-till farming. The cost per acre of infiltration practice was estimated to be $7,500, which represents an average of $14,500 per acre of upland pond and $500 per acre of grass filter strip. Average O&M costs are estimated to be $7 per acre.

c. Main Stem Water Level Management. Components of this part of the recommended plan would upgrade the controls on dams, revise seven dam regulation manuals, and install 10 flow gages. More intense water level management at the main stem locks and dams, that is, more frequent small gate changes based on a more complete knowledge of pool inflows, would reduce the number of water level fluctuations along the river, especially immediately downstream of the dams. Additional management changes may further reduce fluctuations. To enable this more intense management, dam gate equipment will be upgraded to allow changes to be made more frequently without increasing manpower requirements. These estimated costs are $3,000,000 for new equipment and $756,000 for revision of dam regulation manuals. Tainter gates would be constructed at Peoria and LaGrange Locks and Dams at an estimated cost of $26.6 million each. Also, additional gages would be maintained along the river and significant tributaries to support real-time management decisions, at a cost of $20,250 per gage, with annual O&M costs of $12,500 per gage.

d. Navigation Pool Drawdown. The Upper Mississippi River- Illinois Waterway Navigation Study estimated the cost to conduct drawdowns as the cost to dredge to maintain minimum channel conditions and access to facilities. This cost would create conditions to allow multiple drawdowns over the course of the project life. Preliminary estimates for Peoria Pool and La Grange Pool indicated that an additional 47,000 and 204,000 cubic yards, respectively, of dredging would be required every 10 years to maintain navigation during 1.5 foot drawdowns of these two pools. Assuming that drawing down Peoria Pool by 2 feet would require twice this amount and that the quantities required for a one-foot drawdown of La Grange Pool would be the same, this leads to additional maintenance dredging of 470,000 cubic yards of material in Peoria Pool and 1,020,000 cubic yards in La Grange Pool. Additional dredging would be required to maintain facility access: Appendix C identifies 12 marinas and 20 industrial facilities that would be affected by a drawdown in Peoria Pool and would have to be dredged an additional five times over 50 years.

Using $8 per cubic yard dredging and placement costs (and assuming that placement areas are available), and $25,000 per facility dredging event (from Navigation Study), the added cost to maintain these conditions in Peoria Pool is approximately $14.6 million. Assuming that a similar number of facilities would be impacted in the La Grange Pool, the preliminary cost for maintaining drawdown conditions in that pool can be estimated as $22.9 million. It should be noted that these costs do not reflect additional economic costs such as loss of recreation due to lower water levels. Occasional temporary pool drawdowns would allow sediment to compact and would encourage aquatic plant growth in areas that are currently inundated continuously. During moderate to low-flow periods water levels can be maintained at lower levels at the Peoria and La Grange Locks and Dams but the successful drawdown requires that higher flow conditions, such as due to extensive thunderstorms in the basin, do not occur during the drawdown period. Drawdowns are most likely to be successful in the late summer or fall but would be most beneficial in late spring or early summer, so timing is a key consideration. Also, lower water levels have the potential to adversely affect recreational navigation and water supply uses.

7. Goal 6 - Water and Sediment Quality. Measures to address water quality are described in the previous goals. Those measures targeting sediment reduction would also have a positive impact on increased water clarity. Additionally, a reduction in sediment-bound nutrients and chemicals would be expected, contributing to enhanced water quality.

8. Adaptive Management. An active adaptive management program is recommended in conjunction with construction and monitoring programs to ensure the attainment of restoration outputs and seek opportunities to reduce overall project costs below the current estimates. The systematic process of modeling, experimentation, and monitoring would compare the outcomes of alternative restoration or management actions. Based on the large study area, the complexity of the ecosystem restoration, and the opportunities for increased cost effectiveness, Illinois River Basin Restoration projects should include funding for adaptive management of up to 7.5 percent of the construction implementation costs. If, over time, less adaptive management funding is needed, these funds would be applied to implementing other restoration projects. The adaptive management component is described in more detail in Section 6 of this report, *Plan Implementation.*

9. Technologies and Innovative Approaches. A Technologies and Innovative Approaches component would address the other three components called for in Sec 519 (b)(3)—a long-term resource monitoring program; a computerized inventory and analysis system; and a program to encourage innovative dredging technology and beneficial use of sediments. Monitoring is particularly important due to the complexity and scale of the Illinois River Basin. Feedback from the monitoring effort will be necessary to determine if adjustments are needed to the goals and restoration approaches to maximize the cost effectiveness of activities. The outputs of all monitoring efforts would be closely coordinated with project teams and adaptive management efforts to maximize the effectiveness of restoration activities.

a. **System-Level & Goal Level Monitoring.** System-level monitoring would be designed to develop a snapshot of the overall system health using system indicators. Goal-level monitoring would integrate and build on existing monitoring data to evaluate the progress in each of the supporting goals, thereby indicating progress for each particular system-limiting factor identified by the project team (reducing sediment delivery, improving backwater habitats, etc.).

b. **Project Level Monitoring.** Project-specific monitoring is critical to validating and refining the approach to system restoration. Monitoring results provide information on the need for adaptive management and help direct future restoration efforts to the most cost effective techniques helping to guide design improvements to better meet ecosystem goals.

c. **Computerized Inventory and Analysis (CIA) System.** A CIA would be developed to inventory and analyze monitoring information. All monitoring data will be posted to a CIA.

d. **Special Studies.** These efforts would be directed at efforts to improve the understanding of the condition of the system and improve the analysis techniques available.

e. **Innovative Sediment Removal and Beneficial Use Technologies.** Technologies would be evaluated and tested to evaluate more ecologically sound, cost effective, and beneficial ways to dredge and place material. These efforts would be closely coordinated with ongoing Corps activities related to dredging and regional sediment management. Potential efforts include demonstrations of various methods to build islands and utilize sediments on farmland as a soil amendment. Funding would be drawn from special studies or incorporated in construction activities.

B. IMPLEMENTATION THROUGH 2011 AND 2015

The Comprehensive Plan recommendations call for continuing restoration efforts under the existing authority of Section 519. Corps of Engineers cost shared restoration efforts would begin with $153.85 million in funding through 2011 (Tier I), increasing to $384.6 million in restoration efforts through 2015 (Tier II).

Implementation of the Comprehensive Plan would include three major elements:

1) System Management
2) Critical Restoration Projects
3) Technologies and Innovative Approaches
    a. System-Level, Goal Level, and Site-Specific Monitoring
    b. Computerized Inventory and Analysis (CIA) System
    c. Special Studies
    d. Innovative Sediment Removal and Beneficial Use Technologies

Each of these components is described in more detail in Section 6 of this report

The recommendation for the 7-year authorization, or Tier I, (Table 4-2) includes extending the current authorization through 2011 and increasing the total funding authorization to $153.8 million. This funding level would provide approximately $127.0 million for restoration projects; $24.1 million for developing technologies and innovative approaches (includes $12.5 million for system monitoring, $8.7 million for site-specific monitoring, $957,000 for a computerized inventory and analysis system, and $2 million for special studies); and $2.75 million for system management. Restoration efforts would be cost shared 65 percent Federal, or $100 million, and 35 percent non-Federal, or $53.8 million. The annual O&M costs for features constructed through Tier 1 (2011) are estimated to be $125,000.

Table 4-2. Program First Costs Through Implementation of Tier I
(October 2003 Price Levels)

Lands and Damages	$ 436,000
Fish and Wildlife Facilities	$ 91,000,000
Planning, Engineering, and Design	$ 27,331,000
Construction Management	$ 8,190,000
Technologies and Innovative Approaches	$ 24,140,000
System Management	$ 2,750,000
Total Program Costs	**$153,847,000**

The recommendation for the 11-year authorization, or Tier II, (Table 4-3) includes extending the current authorization through 2015 and increasing the total funding authorization to $384.6 million. This funding level would provide approximately $321.9 million for restoration projects, $56.9 million for developing technologies and innovative approaches (includes $28.5 million for system monitoring, $22.3 million for site-specific monitoring, $2.2 million for a computerized inventory and analysis system, and $4 million for special studies), and $5.75 million for system management. Restoration efforts would be cost shared 65 percent Federal, $250 million, and 35 percent non-Federal, $134.6 million. The annual O&M costs for features constructed through Tier II (2015) are estimated to be $201,000.

The following sections highlight the types of efforts to be accomplished under each of the three major elements—System Management, Critical Restoration Projects, and Technologies and Innovative Approaches. Cumulative component costs for both Tier I and Tier II are presented in Table 4-3, and annual component costs are presented in Table 4-4. Section 6, *Plan Implementation*, includes additional detailed information about implementation of the selected plan.

1. System Management. Considerable management and coordination efforts would be required to manage the comprehensive ecosystem restoration program. Efforts associated with management include direct costs for Corps of Engineers Project Management and Illinois DNR staff. Management costs would correspond with the size of the program, and are estimated to be approximately $750,000 in 2011 and 2015.

2. Critical Restoration Projects. The majority of the funding, roughly 82 percent or $126.96 million (including $7.75 million in adaptive management if required) of the initial $153.85 million would be targeted to address component 3.B of Section 519 (WRDA 2000) calling for the development and implementation of a program to plan, design, and construct restoration projects. By 2015, approximately 84 percent , or $322 million, of the $384.6 million program would be used to construct restoration projects. While all goal categories are important and would be addressed to some extent in efforts through 2015, initial activities will emphasize the most critical restoration issues: reduce sediment delivery (Goal 1), restore side channels and backwaters (Goal 2), and reduce water level fluctuations (Goal 5). The following priority areas will be addressed initially, with potential for more depending on actual costs. The descriptions below describe restoration efforts through 2011 and 2015.

a. **Small Watersheds.** Specific projects would address sediment delivery, riparian restoration, and water level fluctuations. Activities would seek 20 to40 percent reductions in sediment delivery from these areas, 11 percent decreases in 5-year peak flow, and 20 percent increase in base flow on the assumption of a continuation of 1970-2000 climatic conditions. Roughly one third of these tributaries would be direct tributaries to the Peoria Pool and two thirds spread throughout the basin.

   i. **Tier I (2011).** Complete restoration activities in eight small watersheds with drainage areas of roughly 100 square miles each. The Illinois River Basin contains approximately 300 areas of this size. Start or complete feasibility investigation for an additional five small watersheds. Estimated costs through 2011: $59.54 million.

   ii. **Tier II (2015).** Complete or start restoration of 20 small watershed projects and completed feasibility investigations for four additional small watersheds. Estimated costs through 2015: $171.9 million.

b. **Major tributaries.** Focuses would include sediment reduction; floodplain, riparian, and aquatic restoration; and fish passage.

   i. **Tier I (2011).** Restore two reaches of the eight major tributaries and start restoration of one additional reach. Estimated costs through 2011: $12.1 million.

   ii. **Tier II (2015).** Restore three reaches and start restoration of one additional reach. Estimated costs through 2015: $23.2 million.

c. **Mainstem.** Efforts would address backwater and side channel degradation and restore system limiting aquatic and floodplain habitat. Projects would be divided approximately equally among the three lower pools (Peoria, LaGrange, and Alton).

i. **Tier I (2011)-** Complete restoration of two backwater, start construction on one additional backwater, and complete feasibility investigation on one additional backwater- $29.8 million. Start construction of four side channel/ island restoration projects in two pools- $8.73 million. Restore one floodplain area and start feasibility one additional floodplain area - $7.2 million. Complete feasibility investigation for one pool drawdown in one mainstem pool- $1.8 million. Estimated total costs through 2011: $47.53 million.

ii. **Tier II (2015).** Complete restoration of four backwaters and complete planning and design of two additional backwaters- $59.7 million. Complete construction of four side channel/ island restoration projects in two pools and start construction of four additional projects- $13.7 million. Restore two floodplain areas- $11.6 million. Complete pool drawdown in one mainstem pool- $20.5 million. Estimated total costs through 2015: $105.5 million.

3. Technologies and Innovative Approaches. Approximately 16 percent, or $24.1 million, of the $153.85 million authority would be utilized to conduct a Technologies and Innovative Approaches component. By 2015, approximately 14.8 percent, or $56.9 million of the $384.6 million dollar program would be used for technologies and innovative approaches.

a. **System-Level & Goal Level Monitoring.** Estimated costs through 2011: $12.5 million. Estimated costs through 2015: $28.5 million.

b. **Project Level Monitoring.** Estimated costs through 2011: $8.7 million. Estimated costs through 2015: $22.3 million.

c. **Computerized Inventory and Analysis (CIA) System.** Estimated costs through 2011: $957,000. Estimated costs through 2015: $2.2 million.

d. **Special Studies.** Estimated costs through 2011: $2 million. Estimated costs through 2015: $4 million.

e. **Innovative Sediment Removal and Beneficial Use Technologies.** Funding would be drawn from special studies or incorporated in construction activities.

Table 4-3. Comprehensive Plan Cumulative Component Costs

Illinois River Basin Restoration Comprehensive Plan Cumulative Component Costs (in 000's of Dollars)													
							TIER I					TIER II	
Component	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**		**Year 8**	**Year 9**	**Year 10**	**Year 11**	
Technologies and Innovative Approaches	**$0**	**$75**	**$931**	**$5,164**	**$10,867**	**$17,417**	**$24,140**	**15.7%**	**$32,323**	**$40,037**	**$48,256**	**$56,943**	**14.8%**
System Monitoring	$0	$0	$0	$2,500	$5,500	$8,500	$12,500	8.1%	$16,500	$20,500	$24,500	$28,500	7.4%
Site-Specific Monitoring	$0	$75	$931	$2,014	$4,010	$6,760	$8,683	5.6%	$12,066	$14,980	$18,399	$22,286	5.8%
Computerized Inventory and Analysis System	$0	$0	$0	$150	$357	$657	$957	0.6%	$1,257	$1,557	$1,857	$2,157	0.6%
Special Studies	$0	$0	$0	$500	$1,000	$1,500	$2,000	1.3%	$2,500	$3,000	$3,500	$4,000	1.0%
System Management	**$0**	**$100**	**$200**	**$800**	**$1,400**	**$2,000**	**$2,750**	**1.8%**	**$3,500**	**$4,250**	**$5,000**	**$5,750**	**1.5%**
Critical Restoration Projects	**$711**	**$4,426**	**$15,833**	**$31,368**	**$59,976**	**$99,388**	**$126,956**	**82.5%**	**$175,446**	**$217,204**	**$266,221**	**$321,922**	**83.7%**
Sub Watershed (Minor Tributary)	$73	$1,062	$3,670	$7,704	$23,774	$51,515	$59,540	38.7%	$78,406	$96,675	$125,423	$171,948	44.7%
Major Tributary	$433	$867	$1,614	$2,398	$6,509	$8,872	$12,096	7.9%	$16,040	$16,599	$18,806	$23,183	6.0%
Floodplain Restoration (Main Stem)	$16	$37	$1,788	$5,232	$6,975	$7,093	$7,211	4.7%	$7,446	$8,180	$11,589	$11,595	3.0%
Pool Drawdown (LaGrange Pool)	$0	$0	$0	$0	$435	$870	$1,816	1.2%	$10,386	$19,732	$20,511	$20,511	5.3%
Backwater Restoration (Dredging)	$189	$2,269	$8,316	$13,960	$17,795	$20,141	$29,812	19.4%	$39,693	$49,367	$59,266	$59,680	15.5%
Side Channel Restoration/ Island Protection	$0	$191	$445	$990	$1,408	$5,068	$8,728	5.7%	$12,339	$12,600	$13,157	$13,650	3.5%
Adaptive Management	$0	$0	$0	$1,084	$3,080	$5,829	$7,753	5.0%	$11,136	$14,049	$17,469	$21,355	5.6%
TOTAL	**$711**	**$4,601**	**$16,964**	**$37,332**	**$72,243**	**$118,805**	**$153,847**	**100.0%**	**$211,269**	**$261,490**	**$319,478**	**$384,615**	**100.0%**
Federal Share of Total	$462	$2,991	$11,026	$24,266	$46,958	$77,223	**$100,000**		$137,325	$169,969	$207,661	**$250,000**	
Operations and Maintenance	$0	$0	$0	$0	$1	$28	**$93**		$218	$344	$493	**$694**	

Table 4-4. Comprehensive Plan Annual Component Costs

Illinois River Basin Restoration Comprehensive Plan													
Annual Component Costs (in 000's of Dollars)													
							TIER I				TIER II	TOTAL	
Component	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Years 1-11**	**% of Total**
Technologies and Innovative Approaches	**$0**	**$75**	**$856**	**$4,234**	**$5,703**	**$6,550**	**$6,723**	**$8,183**	**$7,713**	**$8,220**	**$8,686**	**$56,943**	**15**
System Monitoring	$0	$0	$0	$2,500	$3,000	$3,000	$4,000	$4,000	$4,000	$4,000	$4,000	$28,500	7
Site-Specific Monitoring	$0	$75	$856	$1,084	$1,996	$2,750	$1,923	$3,383	$2,913	$3,420	$3,886	$22,286	6
Computerized Inventory and Analysis System	$0	$0	$0	$150	$207	$300	$300	$300	$300	$300	$300	$2,157	1
Special Studies	$0	$0	$0	$500	$500	$500	$500	$500	$500	$500	$500	$4,000	1
System Management	**$0**	**$100**	**$100**	**$600**	**$600**	**$600**	**$750**	**$750**	**$750**	**$750**	**$750**	**$5,750**	**1**
Critical Restoration Projects	**$711**	**$3,715**	**$11,407**	**$15,534**	**$28,608**	**$39,413**	**$27,568**	**$48,490**	**$41,758**	**$49,018**	**$55,701**	**$321,922**	**84**
Adaptive Management	$0	$0	$0	$1,084	$1,996	$2,750	$1,923	$3,383	$2,913	$3,420	$3,886	$21,355	6
Sub Watershed (Minor Tributary)	$73	$990	$2,608	$4,034	$16,070	$27,741	$8,026	$18,865	$18,269	$28,748	$46,525	$171,948	45
Major Tributary	$433	$433	$747	$784	$4,112	$2,362	$3,224	$3,945	$559	$2,207	$4,377	$23,183	6
Floodplain Restoration (Main Stem)	$16	$22	$1,751	$3,444	$1,743	$118	$118	$235	$735	$3,408	$6	$11,595	3
Pool Drawdown (LaGrange Pool)	$0	$0	$0	$0	$435	$435	$946	$8,570	$9,347	$779	$0	$20,511	5
Backwater Restoration (Dredging)	$189	$2,080	$6,047	$5,644	$3,835	$2,346	$9,671	$9,881	$9,674	$9,898	$415	$59,680	16
Side Channel Restoration/ Island Protection	$0	$191	$254	$545	$418	$3,660	$3,660	$3,611	$261	$557	$493	$13,650	4
TOTAL	**$711**	**$3,890**	**$12,363**	**$20,368**	**$34,911**	**$46,562**	**$35,041**	**$57,423**	**$50,221**	**$57,988**	**$65,137**	**$384,615**	**100**
Federal Share of Total	$462	$2,529	$8,036	$13,239	$22,692	$30,266	$22,777	$37,325	$32,644	$37,692	$42,339	**$250,000**	**65**
Operations and Maintenance	$0	$0	$0	$0	$1	$27	**$65**	$125	$126	$149	**$201**	**$694**	

5. ENVIRONMENTAL IMPACTS/EFFECTS

Section 519 of Water Resources Development Act (WRDA) 2000 defines the Illinois River Basin as the Illinois River, Illinois, its backwaters, its side channels, and all tributaries, including their watersheds, draining into the Illinois River. Small portions of this program area are located outside the Illinois State boundaries, and include an area in extreme southeastern Wisconsin and the northeastern corner of Indiana. The original coordination efforts for this project did not include any area outside the boundaries of Illinois. In the event that future projects associated with this Comprehensive Plan are proposed for these two areas outside Illinois, individual coordination with appropriate Federal and State agencies would be required for compliance with National Environmental Policy Act (NEPA) and other Federal laws and policies applicable to all plans recommended for implementation.

The NEPA documentation and required coordination for this systemic program are documented in the integrated Environmental Assessment (EA) within this report. Subsequent NEPA documentation and coordination, whether the project occurs within or outside the State of Illinois, will be represented by individual, site-specific EAs and will be compiled for all future ecosystem restoration projects after they have been identified.

This systemic ecosystem restoration program would result in positive impacts to numerous aspects/components of the environment.

SYSTEM RECOMMENDATIONS

A. Environmental Impacts of the Selected Alternative

1. Natural Resources. Basic to all ecosystem restoration projects is the premise that ecological integrity would improve if the project(s) were to be implemented. In some cases, this improvement could be represented by simply slowing the rate of ecological decline. Implementation of the recommended alternative for this program (Alternative 6) represents a level of restoration that would provide a measurable increase in the level of ecological integrity at the system level, moving towards the desired future condition, in the most cost-effective manner.

All types of projects, including ecosystem restoration, result in the alteration or conversion of one habitat type to another. When this happens, invariably, some organisms benefit to the detriment of others. This trade-off is inevitable whether this conversion is the result of natural processes or human induced ones, such as this program. Such a trade-off could be illustrated by an example where a historically deep backwater lake has filled in over the years and become a willow thicket with only a very small, shallow, ephemeral open water portion. Beavers and shore birds could be negatively impacted if the backwater was deepened. These two species could be replaced by fish and waterfowl. The inevitable trade-offs that would result from implementation of this program is considered to be beneficial over-all to restoring and maintaining ecological integrity and the processes that maintain them.

Because of the tiered nature of this systemic program and the associated, somewhat generic analysis, there is not enough detailed information available at this time to fully evaluate site-specific impacts to natural resources resulting from implementation and construction of management measures specific to each future project. Important, sensitive resources that may be adversely affected by construction include, but are not limited to, fisheries, mussel assemblages, Federal and State endangered and threatened species, bottomland forests, wetlands, rookeries, fish spawning areas, and recreational use areas. Despite this potential adverse impact from construction activities, the overall impact to ecological components, both biotic and abiotic, would improve through time.

This Comprehensive Plan describes preliminary assessments for natural resources that may be impacted by this systemic program. Impacts to resources will be investigated in greater detail when EAs are conducted for each site prior to construction. Additional habitat analysis, hydraulic modeling, endangered and/or threatened species evaluations, mussel surveys, fishery impact assessments, recreation impact assessments, and contaminant risk assessments will be needed to fill data gaps. Interagency coordination and cooperation will be required during completion of each EA so that impacts of concern can be properly recognized and evaluated and appropriate measures to reduce potential impacts can be identified and implemented, if warranted.

The intent of any ecosystem restoration program and project is to improve the environment compared to the future without project condition. Implementation of the preferred alternative for this program would accomplish that. This is illustrated in figure 5-1 as a line graph depicting trends in ecological integrity in the Illinois River Basin through time, including a prediction of the trend if Alternative 6 were to be implemented to the full funding level recommended. Alternative 6 is the first alternative where significant increases in sustainability of ecological processes and functions are anticipated.

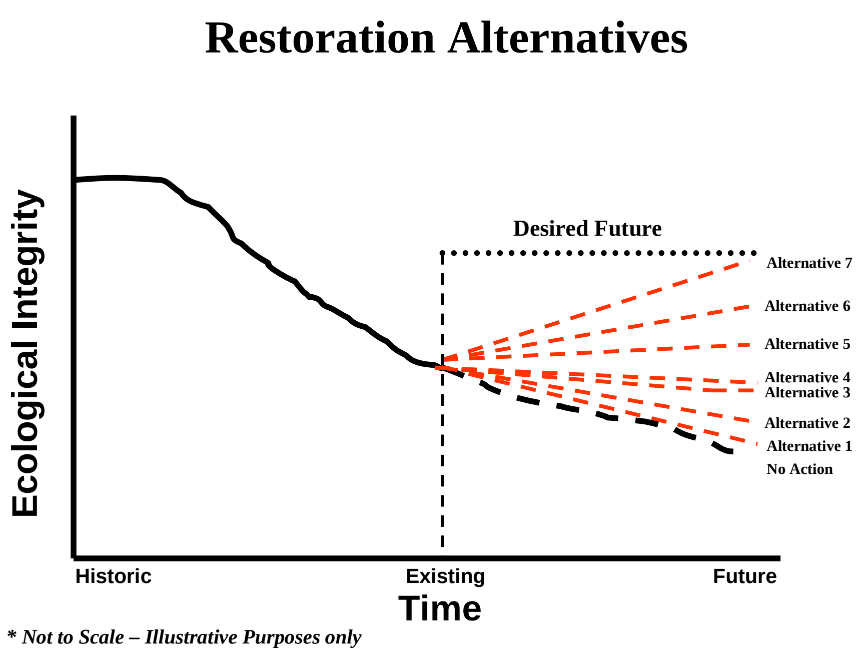


Figure 5-1. Conceptual Restoration Benefits of Alternatives

As discussed earlier in this Comprehensive Plan, Section 3, *Plan Formulation*, subsections E through K, the individual goal write-ups list species or groups of organisms that would benefit from implementation of the great variety of management measures intended to achieve each goal. These are the types of natural resource components that would be impacted (positively) from implementation of Alternative 6.

2. Threatened and Endangered Species. Only when future site-specific ecosystem restoration projects and their associated EAs are identified by specific location, magnitude, and objectives, with details on the management measures proposed to meet the objectives, will it be possible to identify which sensitive resource (e.g., wetlands, backwater lakes, threatened and endangered species, natural areas, high quality woodlands, mussel populations, bat roost trees, etc.) may be impacted and how to avoid or minimize impacts to those resources. This systemic ecosystem restoration program should lead to improved conditions for sensitive resources.

The U. S. Fish and Wildlife Service (USFWS) responded to the District's NEPA coordination letter by listing the current distribution of federally-listed threatened and endangered species in Illinois. This initial coordination response did not provide information on federally-listed species in Indiana or Wisconsin that occur within the Illinois River Basin. From that information on Illinois, the following subset of species could occur in the Illinois River Basin: bald eagle, gray bat, Indiana bat, Higgins' eye pearly mussel, clubshell mussel, prairie bush clover, leafy prairie clover, lakeside daisy, Mead's milkweed, decurrent false aster, eastern prairie fringed orchid, Pitcher's thistle, Hine's emerald dragonfly, Karner blue butterfly, and eastern massasauga rattlesnake. Some of these species would have a low to nonexistent likelihood of being impacted by any future site-specific ecosystem restoration project under this systemic program (e.g., Pitcher's thistle, Karner blue butterfly, Higgins' eye pearly mussel, Mead's milkweed). Direct actions/activities of this program are not likely to negatively impact any federally-listed threatened or endangered species.

In the Final Coordination Act Report (CAR) dated May 2004, the USFWS states the District must complete a programmatic Biological Assessment (BA) to comply with the Endangered Species Act (ESA). The CAR states the District has chosen to fulfill ESA Section 7 consultation with a programmatic BA at some point following authorization of the Illinois River Ecosystem Restoration Study (IRERS). Following extensive discussion within the District, and following the receipt of a letter from the USFWS, dated August 10, 2005 (see Section 7.B.), on this subject, the District has decided that completion of a programmatic BA would not be the most efficient way to satisfy ESA Section 7 compliance for this project.

Biological Assessments are intended to help Action Agencies (in this case the Rock Island, Chicago, Detroit, and St. Louis Districts) if a formal consultation with the USFWS is necessary. Biological Assessments also help to determine if a proposed action is likely to adversely affect a listed species or critical habitat. Formal consultations determine whether a project is likely to jeopardize the continued existence of a listed species or destroy or adversely modify critical habitat. Biological Assessments are required for early consultations on prospective projects that are major construction activities, which are defined as construction projects which are major Federal actions significantly affecting the quality of the human environment.

The general investigation Comprehensive Plan for the Illinois River Basin Restoration cannot yet identify future specific restoration project locations; specific restoration project goals, the nature and extent of the specific restoration activity. The District believes this lack of site specific project details makes the completion of a programmatic BA of limited utility. Because of this inability, at this time, to package specific suites of activities, the District believes the most effective and efficient way to accomplish compliance with the ESA for the IRERS is to complete site specific and species specific

BAs when enough information on specific ecosystem restoration project locations and restoration measures have been finalized. These species specific BAs would be completed before any contract for construction is entered into and before construction is begun. These BAs would accompany future site specific Environmental Assessments.

The Coordination Act Report from the USFWS for this project can be seen in appendix G of this report and the conclusions and recommendations are reproduced here:

Conclusions

- The Illinois River ecosystem has been so severely degraded by human activities during the last 100 years that its ecological integrity and ability to recover from disturbance have been greatly diminished. Sedimentation problems continue to pose serious threats to backwater areas in the lower pools that currently provide habitat for a number of fish and wildlife species. A collaborative and adaptive management strategy involving implementation of conservation measures, rehabilitation projects, and long-term monitoring is needed to improve the condition of this ecosystem. Management decisions and actions at both the watershed and more localized levels will ultimately determine the future fate of this once highly productive river resource.

- In cooperation with the Illinois Department of Natural Resources (DNR), we believe that the Corps has done a good job of identifying system-wide environmental needs and establishing an implementation process to address many of these issues. However, significant coordination is still needed to establish the appropriate level of government, non-government, and private cooperation to successfully restore the Illinois River Basin.

- Because of sedimentation and human-induced alterations to the floodplain ecosystem, aquatic and terrestrial habitats throughout the Illinois River will continue to decline at spatially variable and largely unquantified rates. Prioritization schemes should be implemented at the project fact sheet level to insure that limited dollars are applied most efficiently.

- The main channel of the Illinois River will remain stable, but backwaters will continue to decline from sedimentation. In coordination with the Navigation Study and EMP restoration efforts, critical backwater areas within each pool should be identified and restored as expeditiously as possible.

- Main channel fish populations are expected to remain healthy, but fish species requiring backwater habitats for any life requirements will likely decline. An anticipated rapid response to backwater restoration efforts will likely be seen among fish guilds requiring backwater habitat.

- During the fall, State natural resource agencies, the USFWS national wildlife refuges, and many privately-owned duck clubs artificially manipulate water levels in several management areas along the Illinois River. These moist soil units enhance growth of aquatic vegetation and supplement natural sources of food. Unmanaged backwater areas that currently provide dabbling duck food resources are likely to decline in future years as backwaters diminish. There may be opportunities to work with private landowners and establish partnerships to enhance the management of these areas and potentially the integrity of the Illinois River.

- The quality of bottomland hardwood forest habitat will decline. Associated species that depend upon mast and mature/over-mature stands will decline due to lack of regeneration.

- As they are currently funded or structured, we do not believe that the current ecosystem restoration efforts within the basin can reverse the system-wide decline in fish and wildlife habitat without a more intense coordination among agencies. Future IL 519, EMP, Navigation Study, etc., habitat projects must be able to address the systemic driving variables as well as the localized symptoms of habitat decline.

Recommendations

- All management actions (both Federal and State) such as those implemented under EMP, IL 519, Navigation Study, USDA, USFWS and other restoration efforts along the main stem of the Illinois River and the main stem floodplain need to be coordinated with one another to ensure efficient and successful management of the Illinois River Basin. This coordination may be best met through specific institutional arrangements and the formation of a management triad consisting of: (1) River Council, (2) Science Team, and (3) Regional Management Team.

- Several similar recommendations have become apparent during the coordination of this project and in light of strides made by the Upper Mississippi River-Illinois Waterway (UMR-IWW) System Navigation Study to implement environmental restoration as a key component of that study's alternative matrix. It is strongly recommended that the IL 519 and the Navigation Study be more closely coordinated with one another and potentially integrated as part of each another. Much like the Mississippi River, the Illinois River has paid a significant environmental price for structures that allow and improve navigation. Environmental alternatives that mitigate navigation impacts on the Illinois River need to be coordinated with projects funded through the IL 519 authorization.

- As the primary regulator of Section 404 permits, the Regulatory Branch of the Rock Island District plays an important role in the success of this restoration initiative. It appears that many beneficial projects could be targeted through contacts made by the Regulatory Branch through Section 404 permit applications. Interested and willing landowners could be directed to contact key members of regional teams for assistance in projects such as stream restoration (as opposed to channelization) or wetland protection (as opposed to draining). Wetland, stream, and forest mitigation as outlined in the Corps recent "draft mitigation guidelines" could be emphasized for the most important areas within each tributary watershed of the Illinois River Basin.

- We encourage the Corps to investigate opportunities to assist in the funding of specific U.S. Department of Agriculture-type programs where landowner contacts have been made and prime project sites are identified to address one or more of the seven environmental restoration goals. In addition to government-led efforts, there may also be opportunities to work with various non-government organizations to accomplish many of the basin goals as well. These types of partnerships could reduce planning efforts and present more efficient “on the ground” projects.

- Alternative features, predominantly regarding sediment reduction techniques, which are untested for their ecological integrity function (i.e., riffle structures, bendway weirs, etc.) should be implemented through a cautious and scientific approach to identify ecological reactions. Opportunities should be sought to collaborate with state and/or private universities to study the biological interactions of these features.

- Adaptive management techniques should be established that would allow the Corps and the Illinois DNR to redirect focus of the IL 519 authority if future conditions of the Illinois River turn out to be less desirable than predicted, especially regarding sediment delivery assumptions into the Illinois River Basin.

3. Historic Properties. Archeological site and survey geographic information systems (GIS) data were queried in order to summarize the study area within the State of Illinois by county (table 5-1). GIS historic properties by county for the States of Wisconsin and Indiana were not available for this Comprehensive Plan. Therefore, site location data for historic properties within these states will be provided on a case-by-case, site-specific project basis.

As of May 2004, there were 24,808 previously recorded archeological sites within the study area in Illinois. Approximately 4,800 separate surveys have been conducted over an area covering approximately 984,000 acres or roughly 6.2 percent of the study area. Data concerning cultural affiliation and archeological site types are available for more than 23,000 of the recorded sites. Cultural components span the entire known occupation of North America including Paleo Indian through Historic Native American and Euro American traditions. A brief cultural history for the Illinois River Basin, focusing on the Illinois River Valley, can be found in appendix I, *Cultural History*. Documented archeological site types include prehistoric mounds and rock shelters, prehistoric/historic period habitations, cemeteries, and burials, and historic period farmsteads, industrial/commercial complexes, schools, and churches.

Since 6.2 percent of the study area contains 24,808 previously recorded archeological sites, the potential for undocumented archeological sites in the unsurveyed portion of the study area is expected to be relatively high, although it varies considerably according to landscape position and associated landform sediment assemblage (LSA) unit. Research conducted for the Corps in support of the operation and maintenance of the Illinois Waterway project has defined and mapped LSA units covering approximately 787,000 acres of the current study area (table 5-2). LSA units are geologic features that define Late Wisconsinan and Holocene alluvial fills. Each LSA unit has an ordered structure of development with predictable ages that have proven effective in determining the likelihood for near-surface and/or deeply buried archeological sites.

In general, approximately one archeological site has been documented for every 76 acres of land that has been surveyed within the LSA subset of the study area. The totals differ somewhat between landscape categories and component LSA units. Table 5-2 illustrates this range of variability.

Clearly greater site frequencies are documented for LSAs like alluvial fans (1 site per 43 acres), colluvial slopes (1 site per 22 acres), and Bath terraces (1 site per 50 ac) over other LSAs such as crevasse splays (1 site per 142 acres) or paleochannels (1 site per 151 acres). Likewise landscape site frequencies suggest a settlement preference for eolian (1 site per 31 acres), valley margin (1 site per 41 acres), and catastrophic flood landscapes (1 site per 57 acres) over floodplain landscapes (1 site per 205 acres). These numbers most likely reflect a settlement preference for certain higher, drier landforms, although this may be misleading. The higher numbers may have been augmented by the fact that these landforms have limited deposits of recent alluvium so that sites are more easily discovered near the present ground surface using traditional archeological surface survey techniques.

Conversely, the lower site frequencies for other landforms may be due in part to improper surface surveys conducted over deep recent alluvial deposits. The LSA model underscores the fact that geomorphological analysis is necessary both to assess the archeological potential of a given landform within the study area and to identify the proper field investigation technique for archeological site discovery.

Table 5-1. Summary Archeological Survey and Site Frequency Data Identified by All Counties Within the Study Area (2004 data)

Illinois County	County Acreage in Study Area	Archeological Surveys*	Acreage Surveyed	Percentage Surveyed	Recorded Archeological Sites**
Adams	163469	44	4783	2.9%	98
Brown	196647	58	18197	9.3%	441
Bureau	389658	39	11648	3.0%	184
Calhoun	81394	29	3488	4.3%	319
Cass	246027	91	9920	4.0%	912
Champion	146558	26	1202	0.8%	95
Christian	444382	68	15443	3.5%	456
Cook	587244	541	52060	8.9%	957
Dekalb	149203	11	400	0.3%	32
Dewitt	259766	33	1159	0.4%	382
Dupage	215998	393	31014	14.4%	479
Ford	192947	4	366	0.2%	26
Fulton	565307	241	40080	7.1%	2984
Greene	350228	105	69898	20.0%	617
Grundy	276326	129	36809	13.3%	260
Hancock	232347	44	7626	3.3%	518
Henderson	9855	0	0	0.0%	1
Henry	35521	6	576	1.6%	7
Iroquois	701838	18	1124	0.2%	208
Jersey	174168	50	11037	6.3%	368
Kane	243448	422	45657	18.8%	654
Kankakee	434009	103	14737	3.4%	550
Kendall	206861	210	56558	27.3%	469
Knoz	378563	20	877	0.2%	217
Lake	264366	649	48596	18.4%	605
Lasalle	736359	176	22145	3.0%	979
Lee	57876	0	0	0.0%	4
Livingston	661688	30	2166	0.3%	165
Logan	395386	42	1132	0.3%	452
Macon	363417	67	5879	1.6%	222
Macoupin	424162	66	31998	7.5%	247
Marshall	255688	40	5693	2.2%	173
Mason	360456	41	5611	1.6%	244
Mcdonough	377668	130	18928	5.0%	1163
Mchenry	195639	225	23298	11.9%	231
Mclean	760918	134	14387	1.9%	440
Menard	202651	50	4305	2.1%	181
Montgomery	86452	12	548	0.6%	37
Morgan	366877	124	23759	6.5%	377
Moultrie	44	0	0	0.0%	0
Peoria	403627	132	27898	6.9%	570
Piatt	170578	20	1124	0.7%	209
Pike	173998	57	18084	10.4%	666
Putnam	110353	17	1606	1.5%	65
Sangamon	562459	278	32161	5.7%	1292
Schuyler	282539	103	29959	10.6%	1111
Scott	161846	32	65145	40.3%	438
Shelby	56361	13	530	0.9%	23
Stark	184786	1	4	0.0%	32
Tazewell	421704	95	7252	1.7%	430
Vermillion	34350	1	20	0.1%	1
Warren	147808	5	71	0.0%	86
Will	542776	1096	146805	27.0%	2761
Woodford	347963	35	10578	3.0%	370
Total	15792558	6356*	984339	6.2%	24808**

* Some surveys include multiple counties, so only the individual survey counts by county are accurate.
** Archeological site totals include all sites recorded in the study area, many of which fall outside of the surveyed areas represented in this table.

Table 5-2. Summary Archeological Site Frequency Data Identified by Landscape Category and Landform Sediment Assemblage Unit Within the Illinois Waterway Portion of the Study Area (based on Hajic, 2000)

LANDFORM SEDIMENT ASSEMBLAGE (LSA) UNITS	ILLINOIS WATERWAY LANDSCAPE CATEGORIES														GRAND TOTAL BY LSA UNIT		AVERAGE SURVEYED ACREAGE PER ARCHEOLOGICAL SITE BY LSA UNIT
	CATASTROPHIC FLOOD		DISTURBED AREAS		EOLIAN		FLOODPLAIN		VALLEY MARGIN		TRIBUTARY		VALLEY TERRACE				
	Sites	Acreage Surveyed	Sites	Acreage Surveyed	Sites	Acreage Surveyed	Sites	Acreage Surveyed	Sites	Acreage Surveyed	Sites	Acreage Surveyed	Sites	Acreage Surveyed	Sites	Acreage Surveyed	
Alluvial Fan	0	0	0	0	0	0	0	0	212	8932	0	111	0	0	212	9043	43
Bar	32	3359	0	0	0	0	5	240	0	0	0	0	0	0	37	3599	97
Colluvial Slope	0	0	0	0	0	0	0	0	12	268	0	0	1	12	13	280	22
Channel Belt	0	0	0	0	0	0	0	0	0	0	68	4800	0	0	68	4800	71
Crevasse Splay	0	0	0	0	0	0	3	409	0	0	0	17	0	0	3	426	142
Dune	0	0	0	0	7	215	0	20	0	0	0	152			7	387	55
Erosional Residual	92	3861	0	0	0	0	0	0	0	0	0	0	0	0	92	3861	42
Floodplain Undifferentiated	0	0	0	0	0	0	8	594	0	0	20	1378	0	0	28	1972	70
Floodplain, Type B	0	0	0	0	0	0	1	325	0	0	0	0	0	0	1	325	325
Floodplain, Type C	0	0	0	0	0	0	5	546	0	0	0	0	0	0	5	546	109
Floodplain, Type D	0	0	0	0	0	0	9	1689	0	0	0	0	0	0	9	1689	188
Floodplain, Type E	0	0	0	0	0	0	12	1644	0	0	0	0	0	0	12	1644	137
Floodplain, Type S	0	0	0	0	0	0	6	391	0	0	0	0	0	0	6	391	65
Island	0	0	0	0	0	0	0	38	0	0	0	0	0	0	0	38	#DIV/0!
Floodplain Lake	0	47	0	106	0	0	2	6804	0	0	0	55	0	2	2	7014	3507
Marginal Channel	133	7525	0	0	0	0	0	0	0	0	0	0	0	0	133	7525	57
Natural Levee	0	0	0	0	0	0	35	4639	0	0	0	34	0	0	35	4674	134
Overbank Belt	0	0	0	0	0	0	0	0	0	0	12	1307	0	0	12	1307	109
Paleochannel	2	575	0	0	0	0	1	36	0	0	5	578	0	24	8	1212	151
Active River Channel	0	0	0	0	0	0	5	1477	0	0	0	0	0	0	5	1477	295
Strath Terrace	27	2129	0	0	0	0	0	0	0	0	3	51	0	0	30	2180	73
Bath Terrace (Youngest)	138	6816	0	0	0	0	0	0	0	0	21	682	5	690	164	8188	50
Manito Terrace (Next Youngest)	10	539	0	0	0	0	0	0	0	0	0	0	3	74	13	613	47
Unknown	0	0	6	5286	0	0	0	0	0	0	0	0	0	0	6	5286	881
GRAND TOTAL BY LANDSCAPE CATEGORY	434	24852	6	5392	7	215	92	18853	224	9200	129	9165	9	802	901	68479	76
AVERAGE SURVEYED ACREAGE PER ARCHEOLOGICAL SITE BY LANDSCAPE CATEGORY	57		899		31		205		41		71		89		76		

Architectural sites (exposed "above ground" superstructures or components versus "buried" archeological sites) within the Illinois River Basin are extremely common, varied, and important in the cultural history representing the occupation of the program area (appendix I). Architectural sites are predominately European or Euro-American and consist of buildings, structures, complexes, and districts.

Architectural historic properties can also exist as remnants of water retention dams and other early hydropower structures. The Illinois Waterway (IWW), as well as many of its tributaries, exhibit navigational and hydroelectric structures important to 19th and 20th century commerce. The present IWW system 9-foot Navigation System was initiated when Congress passed the River and Harbor Act of 1927 that authorized funds for its improvement from Utica, Illinois to St. Louis, Missouri. This legislation was modified in 1930 to include the State of Illinois initiated project from Utica to Lockport, and further modified in 1935 to increase the lower portion to its present 300-foot width. Extending for approximately 333 miles, the IWW links Lake Michigan with the Mississippi River and connects with the Atlantic Ocean via the Great Lake Region, St. Lawrence Seaway, and Inland Coastal Waterway. The IWW extends from the mouth of the Chicago River on Lake Michigan, then proceeds through the Chicago Sanitary and Ship Canal, the lower Des Plaines River, and the Illinois River to the Mississippi River at Grafton, Illinois. The Chicago Sanitary and Ship Canal, with a depth of 22 feet, was completed in 1900. Cal Sag Channel was completed in 1922 and later modified, including widening in 1960. Its Calumet channel branches southeast from the waterway and provides an important link with the Calumet industrial region along the Illinois-Indiana border. Principal cargoes carried by barges are coal, petroleum, and grain products. The IWW system has long been identified as a significant system relative to the historical, engineering, and economical development of the State of Illinois and City of Chicago, as well as to the nation.

Adjacent to the IWW, the Illinois and Michigan Canal was designated as a National Historic Landmark in January 1964 and listed on the National Register of Historic Places in October 1966. The Illinois and Michigan Canal was designated the Illinois and Michigan Heritage Canal Corridor in 1984. T. J. O'Brien Lock, the Chicago Sanitary and Ship Canal, Lockport Lock, Brandon Road Lock and Dam, Dresden Island Lock and Dam, Marseilles Lock, Dam, and Canal, and Starved Rock Lock and Dam are within the canal corridor boundaries.

In July 1993, the Illinois Historic Preservation Agency (IHPA) and the Rock Island District Corps of Engineers (Rock Island District) determined that portions of the IWW Navigation Channel, from mile 80.2 to 327.0, were eligible for listing on the National Register of Historic Places. In October 1996, the Rock Island District surveyed 331 buildings and structures and identified eight historic districts, eligible to the National Register of Historic Places (NRHP) as the "Multiple Property Chicago to Grafton, Illinois, Navigable Water Link, 1839-1945." The Corps' *Architectural and Engineering Resources of the Illinois Waterway Between 130th Street in Chicago and La Grange, Volumes I and II,* documents the 72 contributing resources within the 8 historic districts, consisting of the seven lock and dam facilities and the Illinois Waterway Project Office.

As part of the recently completed Navigation Study, the final NRHP Nomination Registration Form was accepted by the Illinois Historic Preservation Agency in January 2002. The significant portions of the IWW are formally designated as the "Historic Resources of the Illinois Waterway Navigation System, 1808-1951." With the endorsement of Corps Washington Headquarters, the Historic Resources of the Illinois Waterway Navigation System, 1808-1951 nomination forms have been formally submitted to the National Park Service for evaluation and listing.

Submerged historic properties are completely or partially inundated during most of the year. These can include structures, boats and other water vessels, water retention dams, prehistoric and historic occupations, and other sites typically found at terrestrial, archeology sites. Typically, the submerged historic properties cannot always be accurately located within the IWW by documentation alone, but often require remote sensing methods and underwater testing. For a list of documented submerged shipwrecks, see table 5-3.

The Corps and the Illinois DNR have determined that implementation of the Illinois River Basin Restoration may have an effect upon archeological, architectural and/or submerged properties listed on, or eligible for listing on, the NRHP, and consulted with the Advisory Council on Historic Preservation (ACHP), the State Historic Preservation Officer (SHPO), and other consulting parties, as required by Section 106 and Section 110 of the NHPA. The Corps and the Illinois DNR have previously invited the SHPO, ACHP, Tribal Historic Preservation Officers (THPOs), and any other interested parties to participate in the consultation process and in the development of a Programmatic Agreement (PA) for the Illinois River Basin Restoration. There is the potential for adverse effects to significant historic properties and cultural resources. Such effects would be mitigated under the stipulations of the executed *Programmatic Agreement Among the Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers, the State of Illinois Department of Natural Resources, the Illinois State Historic Preservation Officer, and the Advisory Council on Historic Preservation, Regarding Implementation of the Illinois River Ecosystem Restoration* (appendix A). A copy of the PA will be included in all NEPA reports and referenced in appropriate correspondence. If program activities occur which have the potential to affect historic properties as indicated by previously reported sites or documented research, the Corps will conduct a survey in accordance and coordinate with the appropriate State Historic Preservation Officer and other consulting parties promulgated under the NHPA.

Table 5-3. Submerged Boat Sites on the Illinois Waterway (Custer and Custer 1997:163).

Name	Mile	Location	Disposition	Disposition Date
America	Unknown	Unknown	Snagged	1836
Jessie Bill	88.5	Beardstown	Wrecked	1906
Alphonse de	110.5	Bath	Burned	1849
Beardstown	110.5	Bath	Exploded	1854
Young America	112	Bath	Snagged	1855
Minnesota Belle	128	Liverpool	Snagged	1862
Obion	128	Liverpool	Collision	1856
Tuttle	145	Kingston Mines	Wrecked	1918
Wyoming	152.8	Pekin	Burned	1853
Prairie State	152.9	Pekin	Exploded	1852
Columbia	159.5	Kickapoo Bend	Sank	1918
Emma Harmon	162	Peoria	Ice	1857
Helen Mar	162	Peoria	Exploded	1836
Illinoian	162	Peoria	Snagged	1836
Avalanche	162	Peoria	Burned	1853
Birdie B.	162	Peoria	Lost	1920
Celeste	162	Peoria	Abandoned	1924
Duchess	162	Peoria	Abandoned	1925
Fox	162	Peoria	Foundered	1920
Jennie	162	Peoria	Burned	1922
Nettie	162	Peoria	Abandoned	1925
Nina	162	Peoria	Abandoned	1920
Peoria	162	Peoria	Snagged	1834
Revenue	162	Peoria	Burned	1847
Fred Swain	166	Averyville	Burned	1909
Peerless	172	Mossville	Foundered	1911
Beder	189.2	Lacon	Burned	1918
Wave	222.5	Peru	Burned	1837
Revolution	223	Peru	Burned	1849
R. M. Bishop	223	Peru	Snagged	1867
D & G	243.5	Ottawa	Burned	1932
Altair	252.7	Seneca	Sank	1943
E. S. Conway	293	Lockport	Collision	1938
Andy Wood	293.5	Lockport	Sank	1917
Luster Loomis	301.5	Lemont	Burned	1913
Carrie A. Ryerson	308.9	Willow Springs	Burned	1921
B & C	315.5	Summit	Collision	1912
James Hay	318.5	Chicago	Burned	1925
Coyote	324.8	Chicago	Lost	1921
Lobo	325	Chicago	Burned	1919
Red Crown 2	325	Chicago	Lost	1923
China	325.6	Chicago	Sank	1896
Doris	325.8	Chicago	Burned	1934
Dispatch Boat #1	326	Chicago	Exploded	1935
Harvey	326	Chicago	Burned	1925
Oscar F. Mager	326	Chicago	Collision	1925
Rembha	326.8	Chicago	Sank	1917
D'Artagnan	330.8	Chicago	Lost	1920

4. Created Resources. The proposed program area is almost entirely influenced by humankind, in one fashion or another. Most of the area may be considered a created resource since it is natural resources modified by humans, for a variety of purposes. The Illinois River Basin has been modified and/or used for a myriad of reasons, including but not limited to: commercial waterborne transportation, locks, dams, and regulating structures for navigation; refuges for fish and wildlife management; levees and riprapping for food production and erosion control; highway and railroad embankments, as well as bridges, for transportation; beaches and marinas for recreation; cities; barge terminals; land use changes for urban and agricultural uses; and an endless list of activities designed to provide people with a place to live, work, and play in the basin.

Future ecosystem restoration projects will likely entail impacting some aspect of created resources, whether they involve manipulation of the dams, channel regulating structures, agricultural fields, levees, etc. Those future projects will more specifically identify which aspect of all the created resources could be impacted based on the location, magnitude, and extent of management measures proposed for each project. Some of these physical resources may overlap with historic properties. These potential impacts would be assessed in future site-specific, project planning documents with NEPA compliance.

B. Socioeconomic Effects Recommended Ecosystem Restoration Alternative 6

This assessment addresses the anticipated basin-wide socioeconomic impacts of the recommended Ecosystem Restoration Alternative 6 in support of the study vision for “a naturally diverse and productive Illinois River Basin that is sustainable by natural ecological processes and managed to provide for compatible social and economic activities.” The scope of this social assessment covers the 50-year planning horizon for implementation of the recommended measures and is intended to provide decision-makers with information regarding the various potential basin-wide impacts that could occur as a result of the proposed preferred Ecosystem Restoration Alternative 6. Alternative 6 includes measures that would address restoration needs over the entire 50-year period of analysis. The cost estimate based on an initial 6-year implementation period would invest $153.85 million in ecosystem restoration increasing to $384.6 million over 11 years, bringing corresponding economic and social benefits to areas throughout the region.

Alternative 6 includes six goals for restoration, preservation, and protection of the ecosystem of the Illinois River Basin, under the Overarching Goal to restore and maintain ecological integrity: (1) reduce sediment delivery; (2) restore backwaters and side channels; (3) restore floodplain and riparian habitats; (4) increase fish passage; (5) improve water level management; and (6) improve water and sediment quality. The following is a discussion of potential socioeconomic impacts that could occur following the implementation of the restoration measures recommended in Alternative 6.

1. Community and Regional Growth. No significant long-term impacts to the growth of the community or region would be expected to result from implementation of the recommended alternative. For the measures that would involve some type of construction, be it small or large projects, there would be direct construction expenditures resulting in indirect impacts in the economy of the river basin. However, most of the construction benefits would be site-specific as they would accrue to the cities or counties located adjacent to the construction sites.

2. Community Cohesion. Overall, no significant adverse impacts on community cohesion throughout the river corridor would be expected from the environmental restoration measures in Alternative 6. Environmental restoration would not result in permanent changes to the population of any community, segment, or separate parts of the communities or neighborhoods; change income distribution; cause relocation of residents; or significantly alter the quality of life.

The proposed environmental restoration measures could positively impact community cohesion by attracting visitors and recreationists from other communities to the restored wildlife areas. The potential increase in recreation activities would not adversely impact area property owners. As stated in the Executive Summary for this Comprehensive Plan, the acquisition of lands, easements, and rights-of-way would only be obtained from willing landowners, thereby avoiding adverse impacts. No significant public opposition to the enhancement measures would be anticipated on a basin-wide level.

Any further assessment of specific impacts to urban policy resulting from ecosystem restoration would be addressed in a site-specific analysis.

3. Displacement of People. On a systemic basis, displacement of people is not a significant issue. Residential relocations are not expected to occur in any of the areas involved with the restoration measures. Any potential displacement of people resulting from a future project would be evaluated within a supplemental NEPA document. To the extent possible, such actions would be avoided.

4. Property Values and Tax Revenues. Overall, none of the measures included in Alternative 6 are projected to have major, long-term direct impacts on property values or tax revenues in any of the counties throughout the basin. Any long-term effects would be related to community and regional growth, which is not expected to occur. The Illinois River Basin provides billions of dollars in revenue annually from the millions of visitors that hunt, fish, boat, sightsee, or visit the river, and the potential exists for some increase in local sales tax revenue through purchases of goods and services for these activities. The river system also generates thousands of jobs and millions of dollars in taxes for the State and Federal governments.

Increases or decreases in property values could occur because of the potential for land acquisitions associated with the restoration measures. Such actions could affect revenues for the taxing district. Assessment of any potential impacts would be evaluated in a site-specific evaluation.

Presently, not all of the indirect and induced effects of this alternative, as they relate to property values, are known. Changes in the viewshed and any potential resulting impacts on property values and tax revenues for property owners adjacent to the river or restoration area cannot be determined at this time. Any increase in recreational visitors that may result would likely mean more dollars spent in local retail establishments, resulting in an increase in tax revenues for the surrounding community. The extent of impacts from the floodplain restoration measure cannot be determined at this time since it is unknown if, or how much, agricultural land could be taken out of production.

5. Public Facilities and Services. The Illinois River system is a vital component of the national transportation infrastructure and with timely and appropriate improvements, it will continue to serve recreational, commercial, and environmental interests over the long term. The system, as a whole, is a vast resource used by thousands of recreationists every year, and the restoration measures of Alternative 6 could indirectly improve recreation experiences throughout the river corridor. The area provides vast opportunities for boating, waterfowl hunting, fishing, swimming, wildlife observation, photography, plus activities that are enhanced by proximity to water such as hiking, picnicking, bird watching, camping, and water sports. Public access to these recreational activities throughout the river basin would not be hindered or interrupted by the recommended restoration measures of Alternative 6. Some increases in recreational opportunities could be anticipated if this project were implemented. These increases would be welcome but incidental to achieving the overarching goal of restoring and maintaining ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them.

For the basin area as a whole, positive impacts to public facilities and services would be expected to result from the enhancement of recreational opportunities associated with improvements included in the preferred alternative. There would be no significant adverse impact on the 9-foot channel navigation project on the Illinois Waterway.

Any potential site-specific impacts to public facilities and services involving the use of public parks, boat ramps, river terminals, water supply, tourism events and attractions, marinas, and recreational areas would be addressed in the site-specific assessments.

The topic of energy conservation at Federal facilities is not applicable to this study.

6. Life, Health, and Safety. Adverse impacts to life, health, or safety generally would not be expected to result from the implementation of the restoration measures recommended in Alternative 6. A hazardous, toxic, and radioactive waste (HTRW) compliance assessment would be conducted prior to the implementation of any measure for a site-specific project and, if deemed necessary, would be addressed in a supplemental document.

7. Business and Industrial Development. Impacts to business and industrial development are generally evaluated in terms of economic impacts to local and regional economy. Direct impacts are those that produce immediate measurable changes, and indirect impacts are those that result in some measurable net change in economic activity over time as a result of the project.

A small increase in business and industrial activity would occur throughout the river basin during construction activities associated with Alternative 6. Development associated with this environmental restoration alternative is not likely to cause displacement of businesses or industries. The most likely long-term impacts to business activity would be related to tourism and recreational activities where increases in visitations and activity by recreationists could serve as a catalyst for the development of small retail businesses that would serve the site users.

All restoration measures included in Alternative 6 requiring some temporary construction activity would result in a short-term increase in business and industrial activity in the areas surrounding the project. A portion of the increase would be attributable to the purchase of materials and supplies, and the remaining increase would result from purchases made by construction workers (e.g., meals, lodging, etc.). These impacts would be evaluated on a site-by-site basis within any supplemental NEPA document. No long-term impacts are anticipated.

8. Employment and Labor Force. For any restoration measures requiring construction, there would be a temporary increase in area employment at the individual site locations. Workers would likely be hired through local labor pools to fill project-related jobs, having little effect on employment throughout the entire basin. Increased employment at construction sites brings spending to the area, creating increases in local income. Direct construction expenditures result in indirect impacts in the local economy as money spent on construction activity, labor and materials generates additional income and employment in a multiplier fashion

Any long-term impacts to employment and labor force would likely be related to business and industrial growth resulting from indirect positive impacts of potential increases in recreation and tourism in the study area. Overall, changes in regional employment would be minor because of implementing the recommended restoration Alternative 6.

9. Farm Displacement. Achieving the study's overall goal of increasing the Illinois River Basin biological diversity and ecological integrity will likely necessitate the conversion of agricultural land to non-agricultural uses. Restoration measures requiring the acquisition of lands, easements or rights-of-way would be pursued with the consent and participation of willing landowners. Also, efforts would be made to minimize the unnecessary conversion of prime farmland to non-agricultural uses. It is anticipated that if any farmland would be removed from production, the total acres impacted would affect a small portion of the total amount of farmland within the study area. Such impacts would be analyzed on a site-specific basis and would be addressed within any supplemental NEPA documentation.

10. Noise Levels. Overall, no significant long-term impacts to noise levels in the study area would result from the implementation of Alternative 6. Construction activities would be site specific and only those locations would experience a temporary increase in noise levels. Any potential elevation of noise levels resulting from increased recreational activities would also be site-specific; however, most recreational activities would probably take place away from heavily populated or residential areas. All site-specific impacts would be further addressed in supplemental documents.

11. Aesthetics. Aesthetics relates to potential visual impacts resulting from a proposed project. Essentially, the restoration features recommended would be planned and constructed to augment the natural areas and open space, to be aesthetically pleasing, and to enhance the overall viewscape.

The project areas that could be designated for ecosystem measures would mostly be rural in nature with limited development, and would result in fairly minor impacts to the aesthetic resources of the areas. Construction activities would negatively impact the viewscape in most areas during the short-term project construction phase.

The recommended Alternative 6 restoration measures would be expected to created long-term positive aesthetic impacts that would enhance scenic beauty and other natural amenities, provide for public wildlife-oriented recreation and education opportunities, restore and enhance a mosaic of riverine wetlands and riparian habitats, and create a vibrant ecosystem.

No long-term adverse impacts to the aesthetics of the river corridor are anticipated, and it is expected that the proposed restoration measures would not diminish the viewscape of most public areas or local communities.

C. Cumulative Impacts

A cumulative impact is defined as the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (from the Council on Environmental Quality, Regulations for Implementing the Procedural Provisions of the NEPA, 40 CFR Parts 1500-1508).
A U.S. Environmental Protection Agency (EPA) report states that cumulative impacts of an action can be viewed as the total effects on a resource, ecosystem, or human community of that action and all other activities affecting the resource no matter what entity (Federal, non-Federal, or private) is taking the actions (USEPA 315-R-99-002).

This report will focus on the cumulative impacts of actions relating to the overarching goal of ecological integrity and the six goals/resource categories for this project: (1) sediment delivery, (2) side channels and backwaters, (3) floodplain, riparian, and aquatic habitats, (4) connectivity (fish passage at dams), (5) water levels, and (6) water and sediment quality.

This project should result in improved environmental conditions for various habitats and increase ecological health in the basin.

Overarching Goal – Restore and Maintain Ecological Integrity, Including Habitats, Communities, and Populations of Native Species, and the Processes that Sustain Them

Ecological integrity within the Illinois River Basin has been degraded by development within its watershed, the river, and its floodplain. The Illinois River Basin ecosystem has been degraded by human activities during the last 150 years and its ecological integrity and ability to recover from disturbances have been diminished. Development of the Illinois River Basin has affected nearly every acre of land in the basin in one way or another. The combined effects of habitat losses, through changes in land use, human exploitation, habitat degradation and fragmentation, water quality degradation, and competition from aggressive invasive species have significantly reduced the abundance and distribution of many native plant and animal species in the Illinois River Basin. In addition, human alterations of Illinois River Basin landscapes have altered the timing, magnitude, duration, and frequency of habitat forming and seasonal disturbance regimes. The cumulative results of these complex, systemic changes are now limiting both the habitats and species composition and abundance in the Illinois River Basin. A cooperative effort among all levels of government and private entities, with an adaptive management strategy, involving implementation of ecosystem restoration projects is needed to improve the condition of the ecosystem.

1. Goal/Resource Category #1 – Reduce Sediment Delivery to the Illinois River from Upland Areas and Tributary Channels with the Aim of Eliminating Excessive Sediment Load.
Historically, land use changes to agriculture and urbanization have increased sediment delivery to the Illinois River Basin. Effective erosion control due to the implementation of conservation practices and programs have reduced the average rate of erosion from croplands relative to earlier rates. There continues to be significant amounts of sediment transported to the Illinois River Basin from areas not addressed by these practices and programs. Without action, excessive erosion will arise from numerous points within the Basin and sediment loading to the Illinois River will continue at unacceptably high levels for the foreseeable future and will continue to degrade vulnerable habitats and impede downstream restoration efforts. Without additional monitoring, it will continue to be very difficult to determine trends in the sediment transport process within the Illinois River and its basin or

to evaluate systemic benefits of improvement projects. If this project is implemented, in 20 years the rates of sediment transport within the Illinois River Basin and the main stem river, especially the transport of silt and clay particles, would be reduced to a level that will better support ecological processes. In order to maintain existing benefits, it will be necessary to ensure that the conservation practices currently installed within the basin remain effective. Recognizing that streams always transport sediment, reduced delivery would be accomplished by implementing projects that reduce bank erosion, allow streams to reach a graded state or control upland sediment as appropriate based on watershed conditions.

2. Goal/Resource Category #2 – Restore Aquatic Habitat Diversity of the Side Channels and Backwaters, including Peoria Lakes, to provide Adequate Volume and Depth for Sustaining Native Fish and Wildlife Communities. Since glacial retreat, sediments eroded from steep tributaries have built large alluvial fans and deltas into the lower Illinois River valley causing the formation of natural constrictions and numerous lakes and backwaters. Historically, the complexes of backwaters and side channels along the main stem Illinois River provided incredibly rich habitat for fish and wildlife. However, the lower Illinois River is low gradient and as a result has been aggrading for years. Sedimentation occurring within this reach has increased significantly, since settlement and now threatens to convert many backwater and side channel areas into mudflats and marshes with decrease habitat value due to hydrologic regimes and turbidity, which essentially exclude vegetation from these areas. In many areas, backwater lakes have been reduced from several feet in average depth in 1900 to inches to a couple feet today.

The WEST Consultants, Inc. (2000) found that according to previous studies, significant sedimentation is occurring and by the year 2050 the Illinois River is predicted to lose a significant portion of its off-main channel backwater areas under current conditions of sediment supply.

In the future without-project, it is expected that there would continue to be further loss of both surface area and volume of backwaters and continued low aquatic habitat quality. This will further limit off-channel habitat for fish and other aquatic species. The consensus of a number of scientists working for the State of Illinois was that due to the shallow condition of existing areas and increasing willow colonization an approximately 1 percent loss rate per year represented the most likely future condition. If this rate were to continue throughout the 50-year project life, the acreage of backwaters would drop to just 32,605 acres a 40 percent loss. It is anticipated in the future without project that the quality of side channel areas will continue to remain at relatively low levels. In many areas there will continue to be further loss of side channel length due island erosion, further loss of depth diversity due to sedimentation, and continued lack of adequate structure (woody debris, rock, etc.). However, with full implementation of Alternative 6, not only would habitat quality increase dramatically, but the loss rate would be cut in approximately half for the roughly 60 backwaters were work is planned. The recommended plan would also result in the restoration for islands and side channels most in need of restoration. With the restoration of 12,000 acres in combination with reduced sediment delivery and side channel restoration, the mix of depth diversity critical to the historical ecology of the system will be maintained throughout the program life. The direct restoration of these acres is anticipated to preserve and maintain additional surrounding acreage from conversion to other uses as well. This will greatly increase backwater area and value over anticipated without project conditions.

3. Goal/Resource Category #3 – Improve Floodplain, Riparian, and Aquatic Habitats and Functions. The healthy functioning floodplain system found in the Illinois River Basin resulted from an unfractured landscape that integrated the ecological outputs of the hydrologic cycle (rainfall, droughts, and floods) through the complex structure of prairies, wetlands, and forests to produce an abundance of aquatic, insect, wildlife, and plant species. Land use and hydrologic change, and channelization have reduced the quantity, quality, and functions of aquatic, floodplain and riparian habitats, in the Illinois River main stem and its tributaries. Flood storage, flood conveyance, habitat availability, and nutrient exchange are some of the critical aspects of the floodplain environment that have been adversely impacted. Channelization, wetland drainage, and snagging were extremely common throughout the Illinois River Basin for the purpose of draining water from croplands and for flood control. The adverse effects of such activities are extensive, ranging from the direct destruction of stream habitat, to the reduction of structure and microhabitat for fishes, aquatic invertebrates, mussels, and aquatic plants, to the alteration of water conveyance, which increases erosion and sedimentation. The negative effects of channelization and drainage may persist for very long periods and adversely affect habitat many miles away. The habitats and ecological functions within the Illinois River main stem floodplain and the aquatic, floodplains and riparian areas of the basin tributaries are likely to further degrade in the future if conditions remain as is. The desired future condition of the Illinois River main stem floodplain is a reversal of historic loss of functions and increase in habitat area and quality. The desired future condition can be approached by the implementation of Alternative 6. The level of restoration of Alternative 6 would provide the necessary building blocks for sustainable aquatic environments in the perennial and intermittent streams and the main stem of the Illinois Basin, as we work towards the desired future condition.

4. Goal/Resource Category #4 – Restore Aquatic Connectivity (fish passage) on the Illinois River and its Tributaries, where Appropriate, to Restore or Maintain Healthy Populations of Native Species. During the early development periods in the 1800s, dams were constructed to power mills and factories located adjacent to streams; this is another reason that development occurred along waterways. On large rivers such as the Illinois, dams were constructed to aid navigation during the 1840s to 1860s, and rebuilt in a large fashion by the Corps, in the 1930s. Later, dams were constructed along major tributaries for water supply, flood control, and recreation.

There is a lack of aquatic hydrologic connectivity on the Illinois River and its tributaries. Aquatic organisms do not have sufficient access to diverse habitat such as backwater and tributary habitat that are necessary at different life stages. There are seven dams on the main stem Illinois River/Illinois Waterway at La Grange, Peoria, Starved Rock, Marseilles, Dresden Island, Brandon Road, Lockport, and T. J. O'Brien. The number and impact of dams on the major tributaries varies.

Additional dams may be constructed in the future. The need for potable water for increasing populations in northeast Illinois may result in construction of dams or modification of existing dams for water supply purposes. It is anticipated that new dams may be constructed to accommodate fish passage; however, any new dams would likely have some impact on connectivity. It is likely that some existing dams will be removed in the future. Dam removal will be municipality driven and will be related to costs of continued operations and maintenance. The success or failure of invasive species barriers will affect connectivity in the future.

The desired future condition is a river system that provides connected habitats for native aquatic species allowing them to utilize critical habitats at critical time periods and re-colonize areas after extreme events or disturbance.

The desired future condition is restoring significant connectivity between the main stem and the appropriate major tributaries. The main stem Illinois River would be connected to the majority of its tributaries including the Sangamon River, Spoon River, Fox River, Kankakee River, and DuPage

River. Restored connectivity between the main stem and the Des Plaines River is desirable, but this will need to be balanced with the desire to limit dispersal of invasive species.

The desired future condition is to restore within-tributary connectivity in the major tributary basins. The desired future condition is passage of 100 percent of large-river fish on the Illinois River main stem up to river mile (RM) 286 at Brandon Road Lock and Dam. This would require improved passage at Starved Rock, Marseilles and Dresden Lock and Dams. The Lockport, Brandon, and T.J. O'Brien Locks and Dams would continue to block fish movement, thus limiting dispersal of invasive aquatic species between the Upper Mississippi River System and the Great Lakes.

5. Goal/Resource Category #5 – Naturalize Illinois River and Tributary Hydrologic Regimes and Conditions To Restore Aquatic and Riparian Habitat. Hydrology is a primary driving force for aquatic ecosystem processes. The magnitudes, timing and duration of flows and water levels often regulate the nature of chemical and biological functions in these systems. Because of this, unfavorable hydrologic regimes can prevent desirable levels of ecosystem function; by changing such regimes so that a more desirable range of hydrologic conditions are provided, benefits to a wide range of ecosystem functions can be expected. Historical observations and measurements of flows from undisturbed areas indicate that storm flow rates from Illinois River watersheds prior to European settlement were probably much lower than current rates. Higher tributary flows can be attributed to land use changes, tile drainage, and increased hydraulic efficiency brought about by channelization. The construction of navigation dams and diversion of flows from Lake Michigan have generally increased the river water surface elevation and have altered the nature of the flooding regime along certain reaches of the river. The magnitude and frequency of water level fluctuations have notably increased in portions of the river since daily water level monitoring began in the 1880's. Reducing the amount of water level fluctuation would likely provide multiple benefits to native biological communities. Several unknown factors, notably potential changes in land cover, land use and climate, play major roles in the future hydrologic regimes throughout the Illinois River Basin.

The future with-project condition minimizes the water level conditions that degrade ecological function in the Illinois River Basin. This does not necessarily require a return to any particular prior state, but rather creating conditions that allow ecosystem functions to sustain themselves at an acceptable level given the constraints of multiple uses throughout the basin. In regard to tributary flows, the current state of knowledge suggests that flow regimes with reduced peaks and increased baseflows will provide more desirable levels of ecosystem function than currently occurs. Along the main stem Illinois River, the future with-project conditions include a reduction in the incidence and speed of water level changes; gradual water level rises and falls would benefit a number of biological functions.

6. Goal/Resource Category #6 – Improve Water and Sediment Quality in the Illinois River and Its Watershed. Natural processes, geomorphology and human activities influence water quality. A number of factors including domestic sewage, industrial wastes, and agricultural land use practices have adversely affected water quality in the Illinois River Basin during the past 100 years. In the past 30 years, improvements in water quality have taken place with implementation of the Clean Water Act. However, runoff from industrialized and urbanized areas, and from agricultural fields in the basin, continue to transport sediment, fertilizers, and pesticides into the waters of the watershed. Waves generated by wind and commercial tows re-suspend fine sediments in the main stem, resulting in ongoing poor water clarity. Sedimentation is perhaps the most serious problem threatening the Illinois River Basin today. The Illinois River Basin has not yet fully recovered to an ecologically sustainable condition. State, Federal, and local natural resource agencies must continue to promote efforts aimed at restoring water quality throughout the Illinois River Basin. This would require basin-wide cooperation with many partners, habitat restoration projects, ecological monitoring and data gathering, and changes in land use practices. Attainment of water quality improvements would not only promote the survival of aquatic organisms, but would also protect public health.

Summary. The estimated projections of the environmental/ecosystem benefits from each Goal/Resource category are based on the assumption that not only will this program be implemented, but that it will be implemented to the full funding amount represented in Alternative 6. Section 3 of this report describes areas of risk and uncertainty associated with this program. One of those areas of uncertainty is funding, at the Federal and/or State level. If that uncertainty becomes a reality at some point in the future, at either level, the assumption made in arriving at the estimated predictions of future ecosystem benefits and trends will have been overstated. Lowered funding levels, and consequential levels of effort compared to what is required to achieve full benefit from implementation of Alternative 6 would result in lower ecosystem benefits than those predicted in the cumulative impact sections above.

Future monitoring results and consequential adaptive management measures could result in new, different cumulative impacts for the future.

D. Environmental Impacts of the Non-Preferred Alternatives

Figure 5-1 depicts the estimated trends, through time, in ecological integrity relative to the eight alternatives evaluated for this program. Alternative 6 is the recommended alternative and Alternative 7 reflects the level of effort/commitment required to achieve the desired future condition for this program.

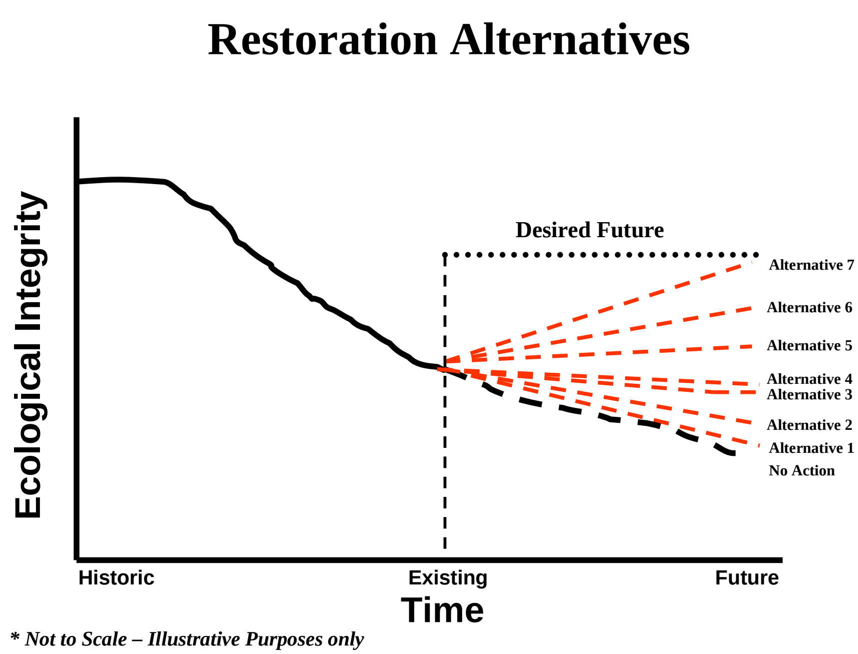


Figure 5-1. Conceptual Restoration Benefits of Alternatives

1. No Action. This alternative represents a continuation of environmental management activities and rehabilitation efforts at current levels. Under this alternative ecosystem integrity/environmental degradation would continue and the habitat loss projected in the Cumulative Effects Study (WEST Consultants, Inc 2000) and the Habitat Needs Assessment (Theiling et al. 2000) would be realized. While the ongoing efforts to protect, maintain, and restore habitat and ecosystem health would be beneficial, the current level of effort would not be sufficient to counteract the cumulative impacts affecting river resources. This alternative does not promote a sustainable system.

Table 5-3 illustrates what level of effort for each goal would be undertaken for each of the eight alternatives.

The numbered alternatives generally represent incrementally higher levels of effort per goal. This is not a strict rule, but a generality. That is, the higher the alternative number, the more the level of effort would be implemented, (e.g., more backwater acres restored, more side channels restored, more acre-feet of stormwater storage constructed, etc) in future restoration projects.

2. Alternatives 1 through 4, if implemented, represent improvements compared to the No Action Alternative, but still show the ecological integrity trend line declining into the future. The difference between Alternatives can be summarized by the differing rates of slowing the decline, (the higher the Alternative number, the slower the rate of decline).

3. Alternative 5 is the first alternative evaluated, where the level of restoration effort would result in stable or improving system ecological integrity.

4. Alternative 7 represents the desired future condition mentioned throughout this report. The desired future was based on the expert opinion of resource managers as to what the system should look like in the future to restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them. This level of effort was developed to provide an upper limit of potential restoration considering current political, social, and fiscal constraint. The implementation of Alternative 7 would result in greater positive natural resource impacts to the river basin than the preferred Alternative 6. Alternative 7 is the second alternative where significant increases in sustainability of ecological processes and functions could be expected.

Table 5-3. System Plan – Benefits Summary

	Overarching Goal	Goal 1	Goal 2	Goal 3	Goal 4	Goal 5	Goal 6
Alternative	**Ecological Integrity**	**Sediment Delivery**	**Backwaters and Side Channels**	**Floodplain, Riparian, and Aquatic**	**Connectivity**	**Water Level Management**	**Water Quality**
No Action	decline	some increase delivery	decline 1%/ yr	No Change	potential improvement	more fluctuations	minor improvement
1	regional improvements	0% upper Tribs 20% Peoria Tribs 0% lower Tribs	3,600 BW acres 10 side channel 10 island protect	5,000 acres MS 5,000 acres Trib 25 stream miles		-1.5% TPF 0% TBF 0% MSF	minor regional improvements
2	maintain current habitat at system level	0% upper Tribs 40% Peoria Tribs 0.5% lower Tribs	6,100 BW acres 20 side channel 15 island protect	5,000 acres MS 10,000 acres Trib 50 stream miles		-2.3% TPF +5% TBF 0% MSF	regional improvement
3	begin system improvements - sediment focus	11% upper Tribs 40% Peoria Tribs 4% lower Tribs	8,600 BW acres 30 side channel 15 island protect	20,000 acres MS 20,000 acres Trib 100 stream miles	Fox, DuPage, Des Plaines	-2.3% TPF +5% TBF 66% MSF	some system improvement
4	begin system improvements - tributary focus	11% upper Tribs 40% Peoria Tribs 4% lower Tribs	6,100 BW acres 20 side channel 15 island protect	5,000 acres MS 20,000 acres Trib 100 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	-8% TPF +20% TBF 66% MSF	some system improvement
5	ecosystem integrity stable	11% upper Tribs 40% Peoria Tribs 4% lower Tribs	8,600 BW acres 30 side channel 15 island protect	40,000 acres MS 40,000 acres Trib 250 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	-8% TPF +20% TBF -66% MSF	some system improvement
6	measurable increase at system level	11% upper Tribs 40% Peoria Tribs 20% lower Tribs	12,000 BW acres 35 side channel 15 island protect	75,000 acres MS 75,000 acres Trib 500 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable	-11% TPF +20% TBF -66% MSF	some system improvement
7	reasonable upper bound to system improvements	11% upper Tribs 40% Peoria Tribs 20% lower Tribs	18,000 BW acres 40 side channel 15 island protect	150,000 acres MS 150,000 acres Trib 1000 stream miles	Fox, DuPage, Des Plaines, Kankakee, Spoon, Aux Sable, 3 Main Stem Dams	-23% TPF +50% TBF -73% MSF	some system improvement

Overarching Goal – Ecological Integrity will be addressed by the other goals through prioritization and specifications on restoration measures.
Goal 1 - Sediment delivery benefits are expressed in percentage reductions in tributary delivery resulting from in-channel stabilization and upland practices.
Goal 2 - Backwater (BW) Benefits are expressed in acres dredged, but will benefit larger reaches. Side Channel benefits associated with increased structure and some dredging.
Goal 3 - Main stem (MS) floodplain and riparian (trib) areas are expressed as acreages. Aquatic areas are expressed in stream miles.
Goal 4 - Connectivity (Fish Passage) lists reaches to be addressed. Main stem passage is at Starved Rock, Marseilles, and Dresden Island.
Goal 5 - TPF and TBF are tributary peak flow and base flow, respectively. MSF is the change in the main stem fluctuation regime, representing an average of 5-day windows in the lower river fluctuations over the course of the average growing season. Auto gates allow increased management to smooth flow releases and are included in Alternatives 6 and 7. Wicket dam replacements are considered for the Peoria and La Grange pools in Alternative 7.
Goal 6 - Water quality issues will be addressed through other goals. Greatest benefits likely associated with Goals 1 and 3.
Only rough benefits estimations are included in table; see writeup for additional details.

E. Probable Adverse Environmental Impacts Which Cannot Be Avoided

When future site-specific ecosystem restoration projects are proposed, planned and ultimately implemented, some of them will have the potential to convert agricultural land to non-agricultural uses. This conversion is regrettable, but probably necessary if the overarching goals of increasing Illinois River Basin biological diversity and overall ecological integrity are to be achieved. Six goals are described in Section 3 of this report. Some specific management measures under certain goals could be implemented and could result in the conversion of agricultural land.

Important, sensitive resources, which may be adversely affected by construction include, but are not limited to fisheries, mussel assemblages, Federal and State endangered and threatened species, bottomland forests, wetlands, rookeries, fish spawning areas, and recreational use areas. Despite this potential adverse impact from construction activities, the overall impact to ecological components, both biotic and abiotic would improve through time.

Following a determination of adverse effect, the Corps will attempt to avoid the archeological, architectural, underwater or other historic object or property.

Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA) and its implementing regulations 36 CFR Part 800: “Protection of Historic Properties,” establishes the primary policy, authority for preservation activities, and compliance procedures. The NHPA ensures early consideration of historic properties preservation in Federal undertakings and the integration of these values in to each agency’s mission. The Act declares Federal policy to protect historic sites and values in cooperation with other nations, states, and local governments. The Corps shall, prior to the approval of the expenditure of any Federal funds on the undertaking, take into account the effect of the undertaking of any district, site building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places. The Corps shall afford the Advisory Council on Historic Preservation a reasonable opportunity to comment with regard to such undertaking. In the event that adverse impacts to historic properties occur as a result of implementing the site-specific ecosystem restoration projects that are proposed, planned and ultimately implemented avoidance measure will be discussed and the benefits of the project will be studies relative to the significance of the historic properties, as set forth by Section II of the executed PA (appendix A).

Efforts will be made to minimize the unnecessary and irreversible conversion of prime farmland to non-agricultural uses. Also, efforts will be made to: (1) identify and take into account the adverse effects on the preservation of prime farmland; (2) consider alternative actions, as appropriate, that could lessen adverse effects to prime farmland; and (3) to ensure to the extent practicable, the project is compatible with State and units of local government and private programs to protect prime farmland.

Future site-specific planning documents (EAs) will provide specific amounts of agricultural land, both prime and non-prime, proposed for conversion based on those projects specific goals, system goals, and resultant management measures designed to fulfill those goals.

The only other significant resource that may be adversely impacted is bottomland hardwoods (BLH). It is possible, but not necessarily probable, that some BLH could be adversely impacted if certain management measures were to be implemented. For example, when implementing backwater dredging to deepen and/or enlarge a historic backwater to restore/provide habitat for migratory waterfowl and/or fish, some amount of BLH may need to be removed. Any effort to estimate how much BLH could eventually be adversely impacted—without any precise location of where or which management/restoration measure would be implemented—would carry with it a high degree of uncertainty. When individual projects are developed, more precise estimates of adverse impacts to any significant resource would be analyzed and declared.

The management measures and potential impacts, by goal, are as follows:

Goal 1: Reduce Sediment Delivery

Management Measures

Stream Stabilization. Although most stream stabilization work would consist of work within the channel to establish geomorphically stable conditions, in some cases existing streambanks may be overly steep and require regrading for stability. These instances may require removal of farmland commensurate with the width necessary to grade streambanks to a stable slope.

Upland Sediment Facilities. In specific locations, downstream sediment delivery may be significantly reduced by installation of upland sediment control facilities, such as water and sediment control basins (WASCOBs) or other sediment traps. Areas in agricultural production could be impacted through outright removal from production or acquisition of temporary or seasonal flowage, and flooding easements.

Filter Strips. These practices would be implemented in areas adjacent to tributary streams to filter sheet flow runoff, stabilize streambanks and reduce sediment delivery to receiving waters. This practice would require removal of farmland commensurate with the strip width necessary to achieve reduction goals.

Goal 2: Restore Aquatic Habitat Diversity of Side Channels and Back Waters

Management Measure

Dredging of Backwaters and Side Channels – In association with dredging to restore depth diversity in backwaters and side channels, areas would need to be identified for the placement of dredged materials. To the extent possible the materials would be used to create additional program benefits: restoration of island habitat, increasing topographic diversity on existing islands, and beneficially as cover for brownfield and strip mine sites. Additionally, locations may be identified where dredged material could be stockpiled for beneficial use for any number of purposes if demand can be identified. It is anticipated that there may be locations were the only available placement option would be on current agricultural lands of willing landowners. While the potential exists to use fine sediments as a soil additive to improve yields of sandy soils, placement on current agricultural land could result in some conversion.

Goal 3: Improve Floodplain, Riparian, and Aquatic Habitats

Management Measures

Riparian Buffer. These practices would be implemented in areas adjacent to tributary streams to filter sheet flow runoff, stabilize streambanks, improve habitat function, and reduce sediment delivery to receiving waters. This practice will require removal of farmland commensurate with the strip width necessary to achieve sediment reduction and ecosystem goals.

Wetland Plantings. Wetland plantings as a stand-alone measure will not normally require conversion of farmland. However, two instances associated with their use may result in farmland conversion impact. The first would be when a larger wetland complex is being constructed within a floodplain area that is currently in production. In the second instance, farmed wetlands could be planted with wetland species.

Prairie Plantings. Restoration of areas of native prairie within the Basin and tributary floodplain is considered to be of major importance to restoration of the ecological integrity of the system. Areas of idled pastureland, active pastureland, and cropland could potentially be impacted by this restoration measure.

Managed Moist Soil Units. Impacts to farmland because of this management measure would potentially include removal of adjacent farmland from production or acquisition of temporary or seasonal flowage and flooding easements.

Wetland Restoration. Restoration of wetland areas with associated native plant species within the Basin is considered to be of major importance to restoration of the ecological integrity of the system. Areas in agricultural production could be impacted through outright removal from production or acquisition of temporary or seasonal flowage, and flooding easements.

Tile Drainage Water Management. This practice could impact farmland by regulating outflows from existing tile-drained areas. While the potential exists for adverse impacts to accessibility and crop yields, the professional literature suggests that these impacts can be mitigated through sound management guidelines.

Tile Removal. This practice may impact farmland by diminishing average yields over time.

Goal 5: Naturalize Illinois River and Tributary Hydrologic Regimes and Conditions To Restore Aquatic and Riparian Habitat

Management Measures

Tributary Stormwater Storage Areas. Providing stormwater storage volume in tributary areas would reduce the adverse geomorphic and ecological effects of high flows in basin rivers and streams, with potential benefits from reduced fluctuations in the main stem Illinois River. These are likely to be a combination of ponds and expanded floodplain benches. Areas in agricultural production could be impacted through outright removal from production or acquisition of temporary or seasonal flowage, and flooding easements.

Tributary Stormwater Infiltration Areas. Increasing infiltration throughout the Illinois River Basin would reduce the adverse geomorphic and ecological effects of high flows in basin rivers and streams, with potential benefits from reduced fluctuations in the main stem Illinois River, and would provide increased low flows between storm events. In some instances infiltration might be increased without changing existing land uses, but in other cases areas may have to be dedicated as infiltration areas or filter strips. Areas in agricultural production could be impacted through outright removal from production or acquisition of temporary or seasonal flowage, and flooding easements.

It is anticipated that no other significant environmental resource would suffer probable adverse impacts from implementation of the systemic project.

F. Any Irreversible or Irretrievable Commitments of Resources if the Selected Alternative Is Implemented

While not directly tied to the recommended plan, Congress study and construction of Critical Restoration Projects in Section 519 of WRDA 2000. Since funding of this section in Federal Fiscal Year 2001, funds have been expended on the study of eight site-specific project locations. Plans and Specifications for the first four of these sites are being prepared with the potential for construction of these projects. All future NEPA requirements for restoration projects, under this program, will be addressed through stand-alone Environmental Assessments and their Findings of No Significant Impacts. If implemented prior to the completion and final approval of this report, it would represent a commitment of Federal resources to the restoration of the Illinois River Basin. For a listing and summary of the authorized critical restoration projects, see Section 6.

No irreversible or irretrievable commitment has occurred which would have the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative. No commitment of resources has occurred that would prejudice the selection of any alternative before making a final decision on this program.

G. Relationship of the Selected Alternative to Land Use Plans

Given the magnitude of this program, both in the large array of management measures that could be employed in any given project, but also the geographic size of the Illinois River Basin (approximately 30,000 square miles), determining the precise relationship between any future ecosystem restoration project within the basin and any existing land use planning document is not possible. It is likely that future alterations in land use or habitat type may result from implementation of management measures at ecosystem restoration project sites. These alterations may be in conflict with existing land use, whether they exist in a planning document or not. For example, if some future restoration project dredged out a side channel, placing the dredged material on a nearby agriculture field would represent a change in the previous land use for the placement site. Future site-specific planning documents will accurately assess impacts of proposed ecosystem restoration measures to land use.

H. Compliance with Environmental Quality Statutes

National Environmental Policy Act of 1969, as amended. The compilation of this EA, describing systemic ecosystem restoration as a result of future separate restoration projects throughout the entire basin, fulfills the NEPA obligation for the program. All separate, site-specific future restoration projects under this Comprehensive Plan's authority, would compile individual NEPA documents fully disclosing project alternatives and the environmental impacts of that proposed project. Future site-specific NEPA documents would address compliance with all appropriate environmental quality statutes including, but not limited to, those listed below.

National Historic Preservation Act of 1966, as amended. The Illinois River Basin Restoration is in compliance with the National Historic Preservation Act of 1966, amended through 2000 (NHPA, Public Law 89-665; 16 U.S.C. 470 et seq.). The NHPA and its implementing regulations 36 CFR Part 800: "Protection of Historic Properties," establishes the primary policy, authority for preservation activities, and compliance procedures. The NHPA ensures early consideration of historic properties preservation in Federal undertakings and the integration of these values in to each agency's mission. The Act declares Federal policy to protect historic sites and values in cooperation with other nations, states, and local governments. The head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally-assisted undertaking shall, prior to the approval of the expenditure of any Federal funds on the undertaking, take into account the effect of the undertaking of any district, site building, structure, or object that is included in or eligible for inclusion in the NRHP. The head of any such Federal agency shall afford the Advisory Council on Historic Preservation a reasonable opportunity to comment with regard to such undertaking.

The construction of the Site Specific Projects and associated maintenance, operation, and monitoring shall address historic property and cultural resource compliance promulgated by the NHPA and concerns in NEPA documents and related correspondence. Adverse effects would be mitigated under the appropriate stipulations of the PA.

As evidence of compliance, this documentation will be coordinated with those on the final Consulting Parties List (appendix A) and be placed into the permanent files of the signatories of the PA.

Pursuant to Section 800.3 of the ACHP's regulations and to meet the responsibilities under the NEPA, the Corps and the Illinois DNR developed a preliminary consulting parties list and invited participation in the development and review of a draft PA by letter dated July 12, 2004. Those on the preliminary consulting parties list, comprised of 325 parties, including 47 federally-recognized Tribes, were provided an opportunity to comment on a draft of the PA by letter dated October 5, 2001 (appendix A). Since the Corps remains unaware of any lands held in Federal trust or of any Federal trust responsibilities for Native American Indians within the Illinois River Basin, the Corps requested any information concerning our Federal trust responsibilities by the October 5, 2001, letter.

The Corps is concerned about impacts to those traditional cultural properties and sacred sites recognized by Native Americans, tribes, ethnic and religious organizations, communities, and other groups as potentially affected by the Illinois River Basin Restoration. Presently, the Corps is unaware of any traditional cultural properties or sacred sites within the Illinois River Basin. The Corps is unaware of any Native American lands or tribal lands held in trust within the Illinois River Basin. No Federal trust responsibilities are known in the Illinois River Basin. If there are concerns or potential effects known or identified, those on the preliminary consulting parties lists were requested to complete a "Traditional Cultural Property and Sacred Site Form" by the October 5, 2001 letter (appendix A). To facilitate Tribal coordination, the Corps asked those on the preliminary consulting parties list to refer to the National Park Service, NRHP Bulletin 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties*, available for internet viewing at http://www.cr.nps.gov/nr/publications/bulletins.htm.

Locations of traditional cultural properties or sacred sites, consisting of architecture, landscapes, objects, or surface or buried archaeological sites, identified in this coordination effort, can be considered to be sensitive information, pursuant to Section 304 of the NHPA. Upon request from any consulting parties not to disclose locations, the Corps and the Illinois DNR will secure this information from the public.

Various versions of the draft PA, the executed PA by the signatories, final consulting parties' lists and supporting correspondence is found in Corps letters dated October 16, 2002, December 4, 2002, and February 7, 2003 (appendix A). Those on the list were asked to comment on earlier drafts of this PA and submit a request to be placed on the final consulting parties list. The Corps received comments on the Illinois River Basin Restoration, the draft PA, a completed Traditional Cultural Property and Sacred Site Form, and requests for inclusion in the final consulting parties list (appendix A). The Corps received comments on the Illinois River Basin Restoration, the draft PA, a completed Traditional Cultural Property and Sacred Site Form, and requests for inclusion in the final consulting parties list and attached to the October 16, 2002 letter (appendix A).

Due to the necessity in executing rights-of-entry, curatorial agreements, real estate actions, and etc., for implementing the Illinois River Basin Restoration, the Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers, the Illinois DNR, the SHPO, and the ACHP executed a PA entitled: *Programmatic Agreement Among the Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers, the State of Illinois Department of Natural Resources, the Illinois State Historic Preservation Officer, and the Advisory Council on Historic Preservation, Regarding Implementation of the Illinois River Ecosystem Restoration*. The executed PA by the signatories forms a partnership for the purposes of implementing the Illinois River Basin Restoration, authorized by Section 216 of the 1970 Flood Control Act and Section 519 (Illinois River Basin Restoration) of the WRDA of 2000 and is found in the February 7, 2003 Corps correspondence (appendix A).

Those on the final consulting parties list (appendix A, letter dated October 16, 2002, Enclosure 3) will be provided with study newsletters, public meeting announcements, special releases, and notifications of the availability of report(s), including all draft agreement documentation, as stipulated by 36 CFR Part 800.14(b)(ii) of the NHPA. Consulting parties may request correspondence on future topics relevant to compliance concerning the Illinois River Basin Restoration and to provide comments. Comments on the Illinois River Basin Restoration program or projects received by the Corps and the Illinois DNR will be taken into account when finalizing plans for the Illinois River Basin Restoration, as promulgated by the NHPA.

The PA allows for determining effects to significant historic properties from both site specific and systemic impacts from the proposed alternatives. Supporting investigations will be conducted in a phased-approach consisting of Phase I survey, Phase II testing, and Phase III treatment. Phase III treatment of a historic property may include preservation, avoidance, or mitigation of the loss of the property through some form of data recovery such as, but not limited to complete excavation of an archeological site or the detailed documentation of a standing structure. This information would be documented in each of the site-specific project NHPA documents.

Where measures and alternatives under consideration for the Illinois River Basin Restoration site-specific projects that consist of corridors or large land areas, or where access to properties is restricted, the Corps may use a phased process to conduct identification and evaluation efforts. The PA was executed pursuant to Sec. 800.14(b) and to comply with the NEPA pursuant to Sec. 800.8 relative to issues of real estate and curation. Also, the programmatic process shall establish the likely presence of historic properties within the area of potential effects for each alternative or inaccessible area through background research, consultation and an appropriate level of field investigation, taking into account the number of alternatives under consideration, the magnitude of the undertaking and its likely effects, and the views of the SHPO/THPO and any other consulting parties. As specific aspects or locations of an alternative are refined or access is gained, the Corps shall proceed with the identification and evaluation of historic properties in accordance with paragraphs (b)(1) and (c) of section 800.4 of the NHPA and the PA.

The Corps and the Illinois DNR executed the PA, promulgated under 36 CFR Part 800.14(b)(ii) of the NHPA to afford protection to known and unknown historic properties accorded by the NHPA (appendix A). As regulated by in 36 CFR Part 800.8(c)(1), the executed PA will be used within reports promulgated under the NEPA. It is the opinion of the Corps and the DNR that the PA is appropriate for the Illinois River Basin Restoration compliance promulgated under NHPA and the protection of any unreported or recorded historic properties.

Pursuant to Subpart C-Program Alternatives, Section 800.14(b) of the NHPA, the PA was negotiated and executed to govern the implementation of the Illinois River Basin Restoration relative to the complex project situations or multiple undertakings. Compliance with the NHPA will be address in each of the site-specific NEPA documents, where the restoration measures and locations can be specifically defined to delineate the area of potential effect. Those on the Final Consulting Parties List (appendix A) will be notified of the proposed restoration project, coordination, and consulting effort by distribution and reporting.

Compliance with the NHPA will be available for consulting parties for public review and comment by distribution of appropriate correspondence, phased historic property reports, and NEPA reports, and ancillary and supporting documentation. All consulting parties must be aware that the specific locations of historic and archaeological properties are subject to protection through nondisclosure under Section 304 of the National Historic Preservation Act. No maps subject to public review/access shall contain any information on archeological sites. This information is not to be released in order to protect the resources at the sites. Any requests for site (significant historic properties) location information should contain formal comment, referencing the correct log number or Corps contract number, from the Illinois Historic Preservation Agency, Springfield, Illinois.

Although the Corps PA assures NHPA compliance, consultation concerning all historic property findings, and that any determination of effects have been identified and documented within the area of potential affect and the Corps has taken into account all historic properties relative to the planning process through consultation and coordination. If any previously undiscovered historic properties are identified or encountered during the undertaking, the Corps will discontinue construction activities and resume coordination with the appropriate SHPOs, THPOs, Tribes, other consulting parties to identify the significance of the historic property and determine potential effects as executed by the PA.

Archaeological and Historic Preservation Act of 1974 (16 U.S.C. § 469). It is the purpose of sections 469 to 469c-1 of this title to further the policy set forth in sections 461 to 467 of this title, by specifically providing for the preservation of historical and archeological data (including relics and specimens) which might otherwise be irreparably lost or destroyed as the result of (1) flooding, the building of access roads, the erection of workmen's communities, the relocation of railroads and highways, and other alterations of the terrain caused by the construction of a dam by any agency of the United States, or by any private person or corporation holding a license issued by any such agency or (2)any alteration of the terrain caused as a result of any Federal construction project or federally-licensed activity or program.

Protection and Enhancement of the Cultural Environment [Executive Order (EO) 11593]. The Federal Government shall provide leadership in preserving, restoring and maintaining the historic and cultural environment of the Nation. Agencies of the executive branch of the Government (hereinafter referred to as 'Federal agencies') shall (1) administer the cultural properties under their control in a spirit of stewardship and trusteeship for future generations, (2) initiate measures necessary to direct their policies, plans and programs in such a way that federally-owned sites, structures, and objects of historical, architectural or archaeological significance are preserved, restored and maintained for the inspiration and benefit of the people, and (3), in consultation with the Advisory Council on Historic Preservation 16 U.S.C. 470(i), institute procedures to assure that Federal plans and programs contribute to the preservation and enhancement of non-federally-owned sites, structures and objects of historical, architectural or archaeological significance.

Preserve American (EO 13287). This EO states policy for the Federal Government to provide leadership in preserving America's heritage by actively advancing the protection, enhancement, and contemporary use of the historic properties owned by the Federal Government, and by promoting intergovernmental cooperation and partnerships for the preservation and use of historic properties. The contemporary historic properties within the Illinois River Basin, consist primarily of the Illinois Waterway lock and dam facilities. The historic resources of the Illinois Waterway Navigation Facilities consist if seven multiple property historic districts, and was signed by the Illinois State Historic Preservation Officer on December 10, 2002. The NRHP form delineates the 7 district boundaries, categorizes the 35 contributing and 18 noncontributing resources, and evaluates each District's contribution to patterns of transportation, maritime history, engineering, commerce, conservation, military, politics, economics, labor, and social history from 1905 to 1952.

To fulfill the requirements of the certification procedure, the Corps' Rock Island and St. Louis Districts forwarded both NRHP nomination forms for the Illinois Waterway Navigation Facilities to the Corps Headquarters in Washington, DC, which were certificated by the Deputy Historic Preservation Officer (DHPO). The NRHP nomination forms were formally submitted to the National Park Service Keeper of the National Register of Historic Places in January 2004 for evaluation and potential certification for listing. This evaluation is ongoing. If the UMR and IWW are listed on the NRHP, they will achieve much-deserved international attention. The Corps' contribution to the Nation's engineering history will be ensured for our significant waterways.

It is not expected that any ecosystem measures will affect the National Register of Historic Places eligibility of the Illinois Waterway Navigation Facilities. If any site-specific ecosystem projects are located near ant of the seven multiple property historic districts the Corps will comply with the goals and intent of EO 13287

Archaeological Resources Protection Act, as amended (16 U.S.C. 470aa et seq.). This Act requires a permit for excavation or removal of archaeological resources from publicly held or Native American lands. Excavations must further archaeological knowledge in the public interest, and the resources removed are to remain the property of the United States. If a resource is found on land owned by a Native American tribe, the tribe must give its consent before a permit is issued, and the permit must contain terms or conditions requested by the tribe. Requirements of the Archaeological Resources Protection Act would apply to any project excavation activities that resulted in identification of archaeological resources.

Locating Federal Facilities in Historic Properties in our Nation's Central Cities (EO 13006). Artifacts, reports, samples, and any ancillary data generated by the excavation or removal of archaeological resources from publicly held lands in Illinois and one copy of all final reports will be curated at Illinois State Museum Society, Springfield, Illinois.

Abandoned Shipwreck Act of 1987 (43 U.S.C. 2101-2106). The Abandoned Shipwreck Act asserts the ownership of the United States over any abandoned shipwreck in State waters and submerged lands. The act provides federal protection to any shipwreck that meets the criteria for eligibility for inclusion in the National Register for Historic Places, therefore dredging, dredged disposal, or other ancillary disturbances on or near vicinity of such wrecks may require determinations of effect, archaeological surveys and investigations and coordination with consulting parties. The Corps conducted an archival search for historic properties following the "Policy and Procedures for the Conduct of Underwater Historic Resource Surveys for Maintenance Dredging and Disposal Activities" (DGL-89-01, 1989) to assist in avoidance of significant impacts to these types of resources. The Corps has also contracted the report *An Investigation of Submerged Historic Properties in the Upper Mississippi River and Illinois Waterway* (Custer and Custer 1997). Final copies are located in the permanent files of the Illinois Historic Preservation Agency and the Corps.

American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996). The American Indian Religious Freedom Act reaffirms Native American religious freedom under the First Amendment and establishes policy to protect and preserve the inherent and constitutional right of Native Americans to believe, express, and exercise their traditional religions. This law ensures the protection of sacred locations and access of Native Americans to those sacred locations and traditional resources that are integral to the practice of their religions. Further, it establishes requirements that would apply to Native American sacred locations, traditional resources, or traditional religious practices potentially affected by the construction and operation of the proposed project. In compliance with this Act, the Corps letter dated October 5, 2001 (appendix A) was send via Distribution lists that contained a Consulting Parties List, comprised of 325 parties, including 47 federally-recognized Tribes. This correspondence also contained a "Traditional Cultural Property and Sacred Site Form," to facilitate tribal coordination, the Corps requested the consulting parties List to refer to the National Park Service, NRHP Bulletin 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties*, available for Internet viewing at (http://www.cr.nps.gov/nr/publications/bulletins.htm).

Locations of traditional cultural properties or sacred sites, consisting of architecture, landscapes, objects, or surface or buried archaeological sites, identified in this coordination effort, can be considered to be sensitive information, pursuant to Section 304 of the NHPA. Upon request from any consulting parties not to disclose locations, the Corps and the Illinois DNR will secure this information from the general public.

Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001 et seq). The Native American Graves Protection and Repatriation Act provides for the protection of Native American cultural items, and establishes a process for the authorized removal of human remains, funerary objects, sacred objects, and objects of cultural patrimony from sites located on lands owned or controlled by the federal government. Major actions to be taken under this law include (1) the establishment of a review committee with monitoring and policymaking responsibilities, (2) the development of regulations for repatriation, including procedures for identifying lineal descent or cultural affiliation needed for claims, (3) the oversight of museum programs designed to meet the inventory requirements and deadlines of this law, and (4) the development of procedures to handle unexpected discoveries of graves or grave goods during activities on federal or tribal land. The provisions of the Act would be invoked if any excavations led to unexpected discoveries of Native American graves or grave artifacts. The Corps, the THPOs and the SHPOs have entered an agreement to address the potential applicability of the Native American Graves Protection and Repatriation Act to artifacts collected during site characterization activities.

If human remains, funerary objects, sacred objects, or objects of cultural patrimony are encountered or collected, the Corps will comply with all provisions outlined in the appropriate state acts, statutes, guidance, provisions, etc., and any decisions regarding the treatment of human remains will be made recognizing the rights of lineal descendants, Tribes, and other Native American Indians and under consultation with the State Historic Preservation Officer/Tribal Historic Preservation Officer(s) and the other consulting parties, designated Tribal Coordinator, and/or other appropriate legal authority for future and expedient disposition or curation. When finds of human remains, funerary objects, sacred objects, or objects of cultural patrimony are encountered or collected from Federal lands or federally-recognized tribal lands, the Corps will coordinate with the appropriate federally-recognized Native American Tribes, pursuant to the Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001 *et seq*.) and its implementing regulations (43 CFR Part 10).

Antiquities Act (16 U.S.C. 431 *et seq.*). The Antiquities Act protects historic and prehistoric ruins, monuments, and objects of antiquity (including paleontological resources) on lands owned or controlled by the Federal Government. If historic or prehistoric ruins or objects were found during the construction or operation of facilities associated with this project, the Corps would have to determine if adverse effects to these ruins or objects would occur. If adverse effects would occur, the Secretary of the Interior would have to grant permission to proceed with the activity (36 CFR Part 296 and 43 CFR Parts 3 and 7).

Indian Sacred Sites (EO 13007). This EO directs federal agencies, to the extent permitted by law and not inconsistent with agency missions, to avoid adverse effects to sacred sites and to provide access to those sites to Native Americans for religious practices. The Order directs agencies to plan projects to provide protection of and access to sacred sites to the extent compatible with the project. To preserve, conserve, and encourage the continuation of the diverse traditional prehistoric, historic, ethnic, and folk cultural traditions within the Illinois watershed, the Illinois River Basin Restoration will be implemented in compliance with EO 13007, specifically:

In order to preserve, conserve, and encourage the continuation of the diverse traditional prehistoric, historic, ethnic, and folk cultural traditions along UMR and IWW, the Navigation Study will be in compliance with Executive Order No. 13007, specifically:

> *Section 1. Accommodation of Sacred Sites*. (a) In managing Federal lands, each executive branch agency with statutory or administrative responsibility for the management of Federal lands shall, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and (2) avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies shall maintain the confidentiality of sacred sites.
>
> The Secretary of the Interior's Standards and Guidelines for Federal Agency Historic Preservation Programs pursuant to the National Historic Preservation Act states that a:
>
> *Traditional Cultural Property* is defined as a property that is associated with cultural practices or beliefs of a living community that (1) are rooted in that community's history, and (2) are important in maintaining the continuing cultural identity of the community.

In compliance with this Act, a Corps letter dated October 5, 2001 (appendix A) was sent via Distribution lists that contained a Consulting Parties List, comprised of 325 parties, including 47 federally-recognized Tribes or Tribal contacts. This correspondence also contained a *Traditional Cultural Property and Sacred Site Form,*" to facilitate tribal coordination, the Corps requested the consulting parties List to refer to the National Park Service, NRHP Bulletin 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties*, available for Internet viewing at (http://www.cr.nps.gov/nr/publications/bulletins.htm). Locations of traditional cultural properties or sacred sites, consisting of architecture, landscapes, objects, or surface or buried archaeological sites, identified in this coordination effort, can be considered to be sensitive information, pursuant to Section 304 of the NHPA. Upon request from any consulting parties not to disclose locations or traditional cultural properties or sacred sites, the Corps and the Illinois DNR will secure this information from the general public.

No Consulting Parties, including Tribes identified traditional cultural properties or sacred sites within the Illinois River Basin within the State of Illinois and no *Traditional Cultural Property and Sacred Site Form* was completed and returned to the Corps. Therefore, the Illinois River Basin Restoration is perceived to have no potential to affect tribal lands, interfere with Federal trust responsibilities, or affect sites or areas of religious and cultural significance to any Native American Tribes. It is the intent of the Corps to accommodate and comply with Native American Tribes' access rights, maintain confidentiality, and avoid adversely affecting sacred sites and traditional cultural properties.

Consultation and Coordination with Indian Tribal Governments (EO 13175). This Executive Order directs Federal agencies to establish regular and meaningful consultation and collaboration with tribal governments in the development of Federal policies that have tribal implications, to strengthen United States government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates on tribal governments. The Corps and the Illinois DNR developed a preliminary Consulting Parties List. Those on the preliminary Consulting Parties List, comprised of 325 parties, including 47 federally-recognized Tribes or Tribal contacts, were provided an opportunity to comment on a draft of the PA by letter dated 5 October 2001 (appendix A). Although the Illinois River Basin Restoration predominantly lies within the State of Illinois, consulting parties from elsewhere in the United States are given equal and due consideration. Since the Corps remains unaware of any lands held in Federal trust or of any Federal trust responsibilities for Native American Indians within the Illinois River watershed, the Corps requested any information concerning our Federal trust responsibilities by 5 October 2001 letter**.** During this coordination, consulting parties were asked to participate in the development of a final consulting parties list (appendix A). Anyone, other consulting parties, Tribes, or Tribal Contacts can be included on the Final Consulting Parties upon request.

Allowing for tribal review and comment contributes to fulfilling obligations as set forth in the NHPA (PL 89-665), as amended**;** the National Environmental Policy Act of 1969 (PL 91-190)**;** EO 11593 for the "Protection and Enhancement of the Cultural Environment" (Federal Register, May 13, 1971)**;** the Archaeological and Historical Preservation Act of 1974 (PL 93-291)**;** the ACHP "Regulations for the Protection of Historic and Cultural Properties" (36 CFR, Part 800)**;** and the applicable National Park Service and Corps regulations.

Illinois Compiled Statutes: Human Skeletal Remains Protection Act (20 ILCS 3440/ 0.01 through 3440/ 3). This act declares that there is an immediate need to protect the graves of prehistoric and historic Indians, pioneers and Civil War veterans from persons engaged for personal or financial gain in the mining of such graves and to assure that all human burials be accorded equal treatment and respect for human dignity without reference to ethnic origins, cultural backgrounds or religious affiliations. Requires a person who discovers human skeletal remains to notify the coroner within forty-eight hours. Declares that a person who fails to do so shall be guilty of a class C misdemeanor, unless the person has reasonable cause to believe that the coroner had already been notified. Directs the coroner to notify promptly the Historic Preservation Agency prior to the removal of any human skeletal remains that appear to be from an unregistered

Illinois Compiled Statues: Human Skeletal Remains Protection Act: permits; remains and artifacts held in trust; regulations; exemptions (20 ILCS 3440/13 through 3440/16). This act directs the Historic Preservation Agency to develop regulations, in consultation with the Illinois State Museum, for the issuance of permits for the removal of human skeletal remains and grave artifacts from unregistered graves or the removal of grave markers. Requires each permit to specify all terms and conditions under which the removal of human skeletal remains, grave artifacts or grave markers shall be carried out. Directs that all costs accrued in the removal of such materials shall be borne by the permit applicant. Requires the permit holder to submit a report of the results to the Historic Preservation Agency. Declares that all human skeletal remains and grave artifacts in unregistered graves are held in trust for the people of Illinois by the state and are under the jurisdiction of the Historic Preservation Agency. Directs that all materials collected under this act shall be maintained, with dignity and respect, for the people of the state under the care of the Illinois State Museum. Directs the Historic Preservation Agency to promulgate regulations to carry out the purposes of this act. Exempts from permitting requirements under this act or any law, rule or regulation adopted thereunder activities reviewed by the Historic Preservation Agency pursuant to Section 106 of the National Historic Preservation Act and activities permitted pursuant to the Federal Surface Mining Control and Reclamation Act of 1972.

Illinois Compiled Statues: Archeological and Paleontological Resources Protection Act (20 ILCS 3435/7). This statute requires all materials and associated records to remain the property of the state to be managed by the Illinois State Museum, Springfield, Illinois.

Clean Air Act of 1972, as amended. It is not anticipated that specific ecosystem restoration projects, planned and implemented under this systemic program document, would result in either short- or long-term violations to air quality standards. It is not anticipated that the outdoor atmosphere would be exposed to contaminants/pollutants in such quantities and of such duration as may be or tend to be injurious to human, plant, or property, or which unreasonably interferes with the comfortable enjoyment of life, or property, or the conduct of business. It is anticipated future projects would be in full compliance.

Clean Water Act of 1972 (Sections 401 and 404), as amended. Any and all specific ecosystem restoration projects, implemented under this systemic program, would address the impacts of placing dredged and/or fill material into the waters of the United States on an individual, site-specific basis in a separate NEPA document. State Water Quality Certification (Section 401) would be received prior to any specific project implementation.

Endangered Species Act of 1973, as amended. Coordination with appropriate Federal and State natural resource agencies for this report has resulted in an extensive list of endangered, threatened, or special concern species within the Illinois River Basin. Within the NEPA documents of all future ecosystem restoration projects under this authority, a full discussion of the project features and their potential impact on endangered, threatened, or special concern species would appear.

Fish and Wildlife Coordination Act of 1958, as amended. This Comprehensive Plan has been coordinated with the USFWS and the Illinois DNR. The District coordination letter (March 24, 2003) to the appropriate Federal and State agencies and all responses can be found in Section 7 of this report.

Any/all future restoration projects under this authority would accomplish compliance with the Fish and Wildlife Coordination Act within a separate NEPA document, specific to that project.

Rivers and Harbors Acts, as amended. It is not anticipated that future restoration projects would place any obstruction across navigable waters or place obstructions to navigation outside established lines. For any/all future restoration projects under Section 519, WRDA 2000 authority, compliance with all Sections of the River and Harbor Acts would be documented separately.

Wild and Scenic Rivers Act of 1968, as amended. The National Rivers Inventory (NRI) is used to identify rivers, or sections of rivers that may be designated by Congress to be component rivers in the National Wild and Scenic Rivers System. The following rivers/river sections or streams are listed in the National Rivers Inventory (NRI): Fox River, (Wisconsin) Elgin to W. Dundee dam, Algonquin to Wilmot dam, Wedron to Yorkville; Illinois River (Illinois), Pekin to Kickapoo Creek, Woodford-Tazewell County line to Chillicothe; Kankakee River, (Indiana) 12d boundary to Indiana State line; Mackinaw River, (Illinois) from confluence with Illinois River to Colfax; Mazon River, (Illinois) mouth to source; Sangamon River, (Illinois) nine sections (too numerous to mention); Spoon River, (Illinois) confluence with Iroquois River to 3 miles south of Onarga; Sugar Creek, (Indiana and Illinois) from confluence with Iroquois River, upstream approximately 36 miles to where channelization begins.

Executive Order 11988 (Flood Plain Management). Implementation of any/all future site-specific ecosystem restoration projects would avoid, to the extent possible, long- and short-term adverse impacts associated with the occupancy and modification of the base floodplain. They also would avoid direct and indirect support of development or growth (construction of structures and/or facilities, habitable or otherwise) in the base floodplain wherever there is a practicable alternative. In the separate NEPA documents associated with future site-specific restoration projects, additional evaluations would be performed to identify any changes to the 100-year flood profile. The Corps would obtain and adhere to all stipulations of the floodplain permit from the appropriate State agency prior to implementation of any/all site-specific restoration projects.

Executive Order 11990 (Protection of Wetlands). Any/all future restoration projects associated with this authority would address potential impacts to wetlands resulting from project features in a separate NEPA document. One of the primary objectives of any ecosystem restoration project(s) is to cause betterment to the environment (including wetlands). It is anticipated that any future site-specific ecosystem restoration project would not cause an overall degradation to wetlands.

Farmland Protection Policy Act, of 1981. It is well understood the prominent role that agriculture plays in the Illinois River Basin. It is important that all future restoration projects be designed and implemented in a manner that is as compatible as practicable with the agricultural community. Balancing environmental restoration goals with protecting the integrity of agricultural operations should be one of the guiding principles as we proceed with implementation of this Comprehensive Plan. Future site-specific restoration projects would be closely coordinated with agricultural groups and organizations. Unwarranted destruction and unnecessary conversion of farmland, particularly prime farmland, would be avoided. Any/all future site-specific projects that propose conversion of farmland would compile NEPA documents where appropriate Federal, State, and local agencies tasked with protecting farmland are consulted.

Federal Water Project Recreational Act, of 1965. Effort was not made to identify opportunities for recreational development or aspects of the alternatives conducive to recreational development. Recreational opportunities may result from implementation of this program, but would be incidental to the achievement of the overarching goal of restoring and maintaining ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them. Should these opportunities be identified for future projects, they would be discussed in those projects' site-specific planning document with NEPA compliance.

Invasive Species (EO 13112). Efforts to monitor the introduction and spread of listed harmful and invasive species in the Illinois River basin are ongoing. The implementation of fish passage measures at dams could facilitate the spread of invasive species. Exotic fish considerations will be further coordinated as new information becomes available. Any future site-specific project that has management features that could lead to violations of the EO would be discussed in that projects planning document with NEPA compliance.

Administrative Procedures Act, of 1946. The Illinois River Basin Restoration project has complied with the provisions of this act through public meetings, newsletters, coordination, and the NEPA review process.

Safe Drinking Water Act. The Illinois River Basin Restoration project, if implemented, should result in improvements in water quality. This program should not degrade the basin's sources of drinking water, and should protect public health to the extent practicable.

Migratory Bird Treaty Act, as amended. The USFWS will review this Comprehensive Plan and future site-specific project planning documents with NEPA compliance, to determine whether any project's activities would comply with or violate the requirements of this Act.

Bald Eagle Protection Act, as amended. The USFWS will review this report and all subsequent planning documents of this Illinois River Basin Restoration report to determine whether any project's activities would violate this Act.

National Wildlife Refuge System Administration Act, of 1966. The USFWS will review the Illinois River Basin Restoration report and all site-specific project planning documents with NEPA compliance to determine compliance with this Act.

Responsibilities of Federal Agencies to Protect Migratory Birds (EO 13186). Numerous aspects of this ecosystem restoration program and subsequent site-specific project features should enhance migratory bird habitat and lead to positive impacts to bird populations.

Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (EO 12898). Potential impacts of the alternative plans are not expected to result in a disproportionate burden, or benefit, on minority or low-income communities in the study area.

6. PLAN IMPLEMENTATION

A. IMPLEMENTATION OVERVIEW

The Illinois River Basin Restoration Comprehensive Plan (Comprehensive Plan) identifies the vision, goals, objectives, and recommended level of effort needed to restore the basin. The success of the Comprehensive Plan will be a reflection of its implementation over a period of up to 50 years. It will take a well-coordinated strategy to be the driving force behind the sequence and pace at which specific project features are undertaken.

To carry out the recommendations, an implementation framework for the Illinois River Basin Restoration was developed. This section addresses the implementation assumptions and strategies, cooperative conservation and collaborative planning approach, and details on the identification, selection, study and implementation of Critical Restoration Projects and other specific components. In a relatively short time, and in specific areas, Critical Restoration Projects will begin to reverse the pattern of ecological degradation that has been occurring for decades. As a result of Tier I and II restoration effort, areas within the Illinois River Basin will be ecologically healthier by the years 2011 and 2015.

Implementation will require integration of many related projects and tasks. The Comprehensive Plan comprises an overarching goal, six specific goals, and hundreds of small projects that need to be integrated with each other and with other Federal, state and local programs and projects. Implementation will require an innovative and collaborative project management and organizational effort. This section describes the project implementation process and the near term schedule developed to implement the recommended Comprehensive Plan.

1. Tiered Implementation Approach. The recommendations call for continuing restoration efforts under the existing authority of Section 519. Corps of Engineers cost shared restoration efforts would begin with $153.85 million in funding through 2011 (Tier I), increasing to $384.6 million in restoration efforts through 2015 (Tier II). The funding and activities would begin significant restoration consistent with eventual implementation of Alternative 6 (Recommended Plan). The initial phases are proposed to demonstrate the benefits of the various measures and project components prior to seeking additional funds. While some work will occur throughout the basin, restoration efforts would focus on the upper watershed and, in particular, the Peoria Pool and tributaries and the Kankakee River Basin. These are two of the high value resource areas and, due to their location in the upper reaches of the basin, have potential to more rapidly demonstrate the effectiveness of the various projects.

The restoration efforts undertaken in partnership with the Corps of Engineers would be cost shared 65 percent Federal and 35 percent non-Federal. Funding would be allocated into three major categories: (1) planning, design, construction and adaptive management of Critical Restoration Projects; (2) technologies and innovative approaches component; and (3) system management. If funding is available, a report to Congress will be submitted in the 2011 timeframe, documenting the project successes and the results from Tier I restoration efforts, estimated at $153.85 million (table 6.1).

Table 6-1. Estimated Projects and Cost Breakdowns

	TIER COMPONENTS			TOTAL COSTS	
	Projects	**Technologies & Innovative Approaches**	**Management**	**Federal Costs (65%)**	**Non-Federal Costs (35%)**
Tier I $ 153.85 million through 2011	$127.0 million • 8 small watersheds • 2 reaches of major tributaries • 3 backwaters, 4 side channels/islands, 1 floodplain areas on mainstem Illinois River	$24.1 million	$2.75 million	$100 million	$53.85 million
Tier II $384.6 million through 2015	$321.9 million • 20 small watersheds • 4 reaches of major tributaries • 4 backwaters, 8 side channels/islands, 2 floodplain areas on mainstem Illinois River	$56.9 million	$5.75 million	$250 million	$134.6 million

	Projects	Technologies & Innovative Approaches	Management	Total Costs
Alternative 6 $8 billion through 2055	$7.2 billion • 150 small watersheds • 88 reaches of major tributaries • 60 backwaters, 35 side channels/islands, 150 floodplain areas on mainstem Illinois River	$700 million	$55 million	$8 billion - cost shared among numerous Federal, State, and local agencies and programs

2. Implementation Framework Goals. The purpose of the implementation framework includes:

- To ensure that Illinois River Basin Restoration projects address system ecological needs and system goals at sub-watershed, watershed, pool segment, pool, and system scales by coordinating all planning, restoration, and monitoring efforts.

- To ensure the system prioritization criteria used for watershed and project identification sustainability.

- To enhance public understanding and trust in the decision-making process by making Illinois River Basin Restoration evaluation criteria explicit and consistent.
  To ensure interagency coordination and matching of potential projects with appropriate Federal and State restoration and management programs or other restoration initiatives.

- To retain the flexibility necessary to ensure efficient, effective program execution and to apply adaptive management principles to project planning, design, and implementation.

3. Assumptions and Strategy for Initial Efforts

a. Authorization. The following section summarizes the existing Section 519 of WRDA 2000 authorization and presents assumptions regarding additional authorization in the future.

- *Planning, Design, and Construction of Critical Restoration Projects* was authorized in Section 519. This authorization is ongoing and limited only by the specific yearly appropriations. The Assistant Secretary of the Army for Civil Works [ASA(CW)] approves Critical Restoration Projects.

- The Section 519 authorization, sub-sections (b)(6) Additional Studies and Analyses, allows planning of additional restoration projects over the $5 million Federal per project limit, but the Feasibility reports would need to go to Congress for authorization.

- For the purposes of this Comprehensive Plan , it is assumed that recommended modifications to the existing authorization will be approved by 2007. These recommendations include:

  i. The per project Federal cost limit for Critical Restoration Projects, be increased from $5 million to $20 million. Replace the specific criteria for Critical Restoration Projects found in Section 519 with a requirement that restoration projects follow an implementation framework and include interagency coordination.

  ii. Authorization for implementation of a Technologies and Innovative Approaches Component be provided as a complement to the Critical Restoration Project activities. Activities would include initiatives called for in Section 519 (b)(3)(A),(C), and (D) calling for the development and implementation of dredging and beneficial use technologies; long term resource monitoring; and a computerized inventory and analysis system.

  iii. Authorization be provided allowing the development of cooperative agreements and fund transfers between the Corps of Engineers and the State of Illinois: scientific surveys at the University of Illinois; and units of local government: counties, municipalities, and Soil and Water Conservation Districts to facilitate more efficient partnerships.

iv. Authorization be provided for the Chief of Engineers to enter into cooperative agreements with the Natural Resources Conservation Service for services to be performed by contract, grant or agreement, or by any other instrument or resource available to and consistent with the authorities of the Natural Resources Conservation Service.

v. Authorization be expanded to allow non-profit organizations to serve as sponsors and sign Project Cooperation Agreements (PCAs) for restoration projects implemented under the Illinois River Basin Restoration Project.

vi. That the Secretary of the Army, in consultation with the State of Illinois, submit a report to Congress every 6 years describing the accomplishments of the programs and discussing issues that need to be adjusted.

b. Funding. The annual cost shared execution capability of the Corps of Engineers Districts and non-Federal sponsors is estimated to reach approximately $40 million per year by 2011 and increase to approximately $65 million per year by 2015.

If significant multi-agency progress is going to be made on implementing the Comprehensive Plan, other Federal and State agencies would also need funding expanded beyond current levels. A more detailed discussion of other agencies' potential roles in implementation is included in section 4.b. of this report, *Interagency Missions, Programs, and Authorities.*

c. Strategy. Because of the large number of complex features that will be developed over a long period of time and the benefits that will be gained, the strategy for implementation of the recommended Comprehensive Plan will be pursued as a program. Approaching implementation as a program will allow flexibility in the management of program scheduling and funding. To ensure continued progress in implementing the Comprehensive Plan, a project implementation process is needed to allow for additional studies that would support project development and future Congressional authorizations. Key assumptions regarding agreements that are necessary to proceed with implementation of the Comprehensive Plan are as follows:

- A collaborative planning approach will utilize the expertise, missions, programs, and funding of other Federal, State, and local agencies, and also non-Governmental Organizations (NGOs).
- In FY06 and FY07, feasibility planning of Critical Restoration Projects would continue using GI funding under the original Feasibility Cost Sharing Agreement.
- In FY 07 or FY08 (depending on authorization and funding), an agreement will be signed covering the elements of system management, restoration planning, and technologies and innovative components. Cost sharing would be 65/35 Federal/non-Federal.

- Other implementation of Critical Restoration Projects will occur following the current process: (1) Division Endorsement of report to Headquarters, U.S. Army Corps of Engineers (HQUSACE), and (2) HQUSACE and ASA(CW) review and approval. After Division Endorsement, Plans and Specifications (P&S) can be initiated at 100 percent Federal costs. The total project cost for P&S and construction will be cost shared 65/35 Federal/non-Federal , following signing of the PCA.

- In the future, the Districts will request the approval of projects be delegated to the Division Commander.

4. Cooperative Conservation

a. Organizational Framework. The Comprehensive Plan was formulated to address system restoration needs and was not specific to Corps of Engineers and Illinois Department of Natural Resources (DNR) activities. As a result, the total restoration costs include a relatively large portion of work for other agencies. The process of identifying agency missions and programs has been initiated and documented in the following section, but the process of full multiple agency implementation will continue to develop over the initial years of the program. This section presents the organizational framework for continued coordination and implementation of projects. It is acknowledged that there are funding challenges for all agencies, which highlights the need to partner in the implementation of the Illinois River Basin restoration. This continued agency coordination will be done in the spirit of cooperative conservation, where the resources of numerous agencies are focused on solving a resource problem.

Since the Comprehensive Plan formulation addresses total needs, some recommended measures could potentially be conducted by more than one agency. Estimates of the allocation of effort by agency were developed, but represent only rough approximations due to funding uncertainties for each agency. This funding uncertainty is a key reason for the proposed interagency coordination and adaptive implementation framework for the restoration activities. Restoration and monitoring activities will be conducted under the organizational structure shown in Figure 6-1.

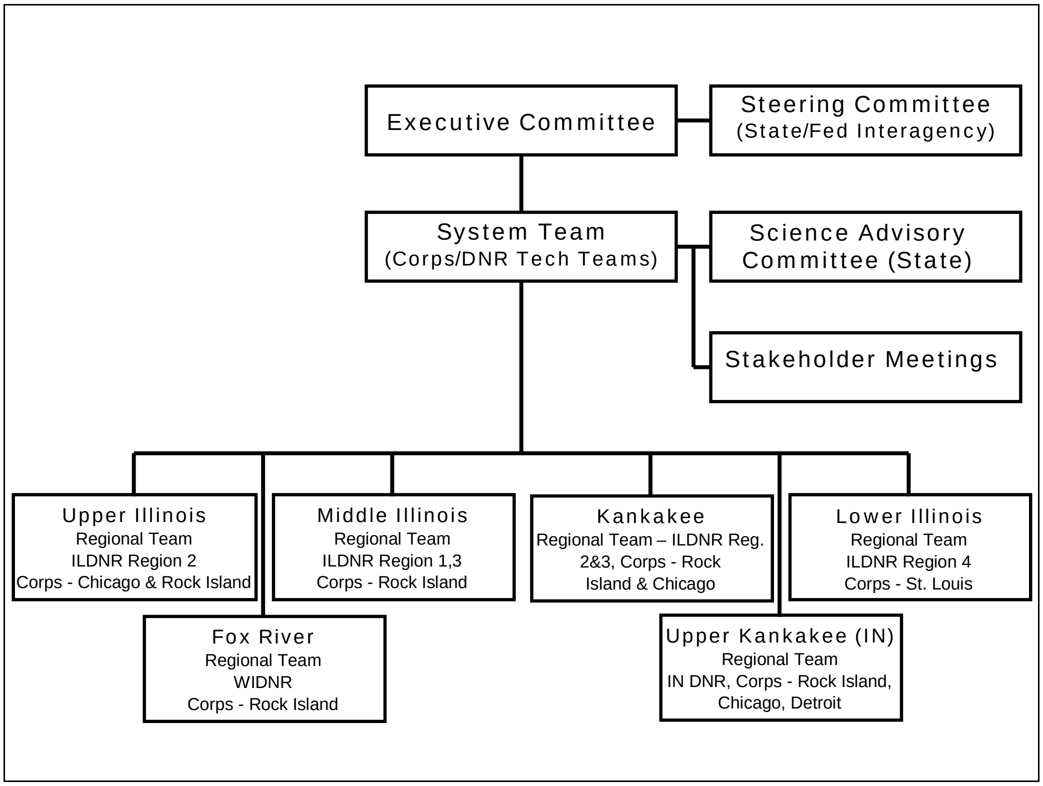


Figure 6-1. Study Organizational Structure

i. Executive Committee. The Committee will have representatives from two Corps Regional Headquarters (Mississippi Valley Division, MVD, and Great Lakes and Ohio River Division, LRD); four Corps Districts (Rock Island, St. Louis, Chicago, and Detroit); and the non-Federal sponsors (Illinois DNR and representatives from the States of Indiana and Wisconsin). The Executive Committee will be chaired by the MVD. It will be responsible for oversight of the management and implementation of the project, including decisions on project funding. The Executive Committee will meet approximately twice a year, with meeting schedules timed to synchronize receipt or provision of input from other committee meetings as needed.

Members of this committee will sit on the Navigation and Ecosystem Sustainability Programs (NESP), River Resources Illinois Team (RRIT) to assure consistence and coordination between the Illinois River Basin Restoration (Section 519) efforts and any restoration work resulting from the Upper Mississippi River-Illinois Waterway System (UMR-IWW) Navigation Study (if authorized).

ii. Steering Committee. The Steering Committee will be the interagency group responsible for coordinating the Illinois River Basin and Ecosystem Restoration efforts. It will be co-chaired by the Corps of Engineers and the Illinois DNR, and will be composed of State and Federal agency representatives. This Committee will meet approximately twice a year to exchange views, information, and advice to ensure coordination among various agency programs.

iii. System Team. The System Team will be composed of the multi-disciplinary technical staff primarily from the Corps of Engineers and State DNRs. Additional team members may be selected. This team will have primary responsibilities for overall project delivery and system evaluations. The team will incorporate the expertise of scientists and technical staff as necessary. Team size is anticipated to be approximately 10 members with suggested disciplines to include:

- Geomorphology
- Limnology
- Fish ecology/management
- Forestry
- Hydrology
- Wildlife ecology/management
- Wetlands
- Engineering

iv. Science Advisory Committee. The existing State of Illinois Science Advisory Committee (SAC), a sub-committee of the Illinois River Coordination Council, can exchange views and provide information to the System Team.

v. Regional Teams. Organizing efforts by geographic region allows for the more efficient accomplishment of project activities. Six regions established for the basin are Upper Illinois, Fox River, Kankakee, Upper Kankakee, Middle Illinois, and Lower Illinois. Each regional team, consisting of Corps of Engineers and State DNR personnel, will have primary responsibilities for the evaluation and implementation of Critical Restoration Projects. Regional Team meetings will provide a forum for groups—with detailed information on resource concerns—to exchange views and information regarding areas in need of assessment and potential Critical Restoration Projects, evaluate the proposed site-specific projects, and facilitate the detailed study of these projects.

Invited attendees include the Illinois Environmental Protection Agency (EPA); Illinois Department of Agriculture; representatives from the States of Indiana and Wisconsin; USDA Natural Resources Conservation Service (NRCS) and Farm Service Administration (FSA); U.S. Fish and Wildlife Service (USFWS); USEPA; U.S. Geological Survey (USGS); Ecosystem Partnership Groups; Soil and Water Conservation Districts (SWCDs); NGOs; Levee and Drainage Districts; and Local Governments.

vi. Stakeholder Meetings. Stakeholder meetings will provide a forum to present study status and information on implementation and management to all interested Federal, State, and local agencies, as well as NGOs. Stakeholder meetings will be held approximately once a year in each of the six regions or as interim products are completed. Their primary focus will be public involvement, information sharing, and dialog among all groups and interests.

b. Interagency Missions, Programs, and Authorities. The Plan effort has been an open, collaborative process with participation from Federal and State agencies, local governments, and non-governmental organizations. The interagency team approach will continue throughout the implementation period to coordinate the development, review, evaluation and adaptive management of the Plan. These efforts will be carried out in a manner consistent with the August 26, 2004 Executive Order on Facilitation of Cooperative Conservation.

The mission, programs, and authorities of the Corps of Engineers and other Federal and State agencies are briefly presented below.

i. U.S. Army Corps of Engineers (USACE). The mission of USACE is to provide quality, responsive engineering services to the nation including "… planning, designing, building and operating water resources and other civil works projects (Navigation, Flood Damage Reduction, Ecosystem Restoration, Disaster Response, etc.)." As it relates to Illinois River Basin Restoration activities, the Corps has a number of programs and authorities that can be utilized for ecosystem restoration and other purposes in addition to the Section 519 authority.

Programs and Authorities

Upper Mississippi River - Environmental Management Program (EMP). The EMP established in 1986 is comprised of two elements—Habitat Rehabilitation and Enhancement Projects (HREPs) and the Long Term Resource Monitoring Program (LTRMP). This ongoing system program provides a combination of monitoring and habitat restoration activities. Restoration activities under the EMP are limited to the Mississippi River and navigable portions of its tributaries (which includes the Illinois River) and their adjacent floodplains.

The HREPs employ a variety of restoration measures to address the unique circumstances of a particular area in order to protect, preserve, and enhance fish and wildlife habitat in the Upper Mississippi River System (UMRS). As of February 2004, 73 HREPs are in various stages of planning, design, construction, and post-construction evaluation, and more than 40 HREPs have been completed. On the Illinois River, the EMP has undertaken seven projects with five completed, one under construction, and one scheduled for construction in 2008. Project planning, engineering, construction, and monitoring approaches applied to HREPs have evolved with the program and have resulted in improved efficiency, productivity, and responsiveness.

The LTRMP provides resource managers and decision makers with information necessary for maintaining the UMRS as a sustainable multiple-use large river ecosystem. The goals of the LTRMP include: (1) developing a better understanding of the ecology of the UMRS and its resource problems; (2) monitoring resource changes; (3) developing alternatives to better manage the UMRS; and (4) providing for the proper management of LTRMP information. The LTRMP work in the LaGrange and Alton Pools of the Illinois River will serve as a basis for further monitoring under Section 519.

Navigation and Ecosystem Sustainability Program (NESP). This effort encompasses the subsequent planning and design efforts related to the Upper Mississippi River - Illinois Waterway System Navigation Feasibility Study completed in September 2004. These efforts address the need for navigation improvements and ecosystem restoration in an area which includes 854 miles of the Upper Mississippi River—with 29 locks and dams between Minneapolis/St. Paul and the mouth of the Ohio River—and 327 miles of the Illinois Waterway—with eight locks and dams. Restoration activities would be limited to the mainstem rivers and adjacent floodplains. The study area lies within portions of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. Recommendations awaiting authorization include:

- $2 billion in navigation improvements over 15 years. (50/50 funding with the Inland Waterway Users Trust Fund)
    - Mooring facilities at Lock and Dams 12, 14, 18, 20, 22, 24, La Grange
    - Switchboats at Lock and Dams 20, 21, 22, 24, and 25
    - 1,200' chambers at locks 20, 21, 22, 24, and 25, Peoria, and La Grange

- $1.5 billion of ecosystem restoration over 15 years (100 percent funding for projects on Federal lands, 65/35 cost share on non-Federal lands)
  - Fish passage at UMR dams 4, 8, 22, and 26
  - Changes in water-level control at UMR dams 25 and 16
  - 225 projects of less than $25 million each: island building, water-level management, backwater/side-channel restoration, wing dam/dike alterations, island shoreline protection
  - 35,000 acres floodplain restoration

While no authorization for construction has been provided, subsequent study and design efforts were initiated in 2005 for a number of navigation and ecosystem restoration components for the entire UMRS-IWW.

Peoria Riverfront Development (Ecosystem Restoration) Study, Illinois. This project is located within Peoria and Tazewell Counties, Illinois, between Illinois River Miles 162 and 167. The feasibility study was conducted by the Corps of Engineers and Illinois DNR (non-Federal sponsor) to investigate Federal and State interest in ecosystem restoration within Peoria Lake and the Farm Creek Watershed. Its principal goal is to enhance aquatic habitats through the restoration of depth diversity and to reduce sediment delivery and deposition; ancillary benefits are expected for recreational boating and fishing. The recommended plan includes dredging and island creation. Specific authority for conducting the Peoria Riverfront Development Study is contained in Resolution 2500 of the Committee on Transportation and Infrastructure, adopted May 9, 1996. The report was completed in March 2003, and Planning, Engineering, and Design were initiated in January 2004 to prepare plans and specifications. In 2004, approval was given to initiate dredging and construct the first of three islands under Section 519 authority.

Upper Mississippi River Comprehensive Plan. The Comprehensive Plan Study was authorized by Section 459 of WRDA 1999 to:

> "… develop a plan to address water resource and related land resource problems and opportunities in the Upper Mississippi and Illinois River basins from Cairo, Illinois, to the headwaters of the Mississippi River, in the interest of the systemic flood damage reduction by means of
>
> (1) Structural and nonstructural flood control and floodplain management strategies;
> (2) Continued maintenance of the navigation project;
> (3) Management of bank caving and erosion;
> (4) Watershed nutrient and sediment management;
> (5) Habitat management;
> (6) Recreation needs; and
> (7) Other related purposes.

The study focuses on the 500-year floodplains of the reach of the UMR between Anoka, Minnesota, and Thebes, Illinois, and the reach of the Illinois River between its confluence with the Mississippi and the confluence of the Kankakee and Des Plaines Rivers. Although the development of the Plan will be at Federal expense, any feasibility studies resulting from development of the plan will be subject to cost sharing under Section 105 of WRDA 1986 (33 U.S.C. 2215).

The Plan embraces the dual overarching national goals of flood damage reduction and associated environmental sustainability. The study focuses on development and evaluation of multiple systemic alternative plans composed of various combinations of structural and nonstructural measures that, if implemented, would result in reduced flood damage potential and net improvements to floodplain habitat conditions. An integrated study approach in developing ecosystem goals and objectives has been accomplished with the UMRS Navigation Study. The Navigation Study addressed goals and objectives related to the navigation system, and the Upper Mississippi River (UMR) Comprehensive Plan is addressing those goals and objectives related to flood damage reduction. The UMR Comprehensive Plan will be completed in Fiscal Year 2006, with any recommendations for implementation being forwarded to the Committee on Transportation and Infrastructure of the House of Representatives and the Committee on Environment and Public Works of the Senate.

Kankakee River Basin Feasibility Study. The Kankakee River Basin drains an area of approximately 5,200 square miles in Illinois and Indiana. Recurrent flooding causes damages to agriculture and infrastructure. The flooding is the result of several factors, including increased runoff from development, loss of river capacity due to channelization and sediment buildup, and loss of wetlands to retain water. A study by the Chicago District of the U.S. Army Corps of Engineers is investigating opportunities within the basin for flood damage reduction, sediment reduction, and ecosystem restoration. The non-Federal project sponsors are the Indiana and Illinois DNRs and the Kankakee River Basin Commission. The feasibility study is cost shared equally between the Federal Government and non-Federal sponsors and is currently on hold.

Environmental Continuing Authorities Program (CAP). The Environmental CAP encompasses ongoing Corps of Engineers Authorities to perform various small ecosystem restoration projects with non-Federal Sponsors, including.

- **Section 206 of the 1996 Water Resources Development Act - Aquatic Ecosystem Restoration.** These projects are for improving the quality of the environment by restoring habitat for fish and wildlife. A project is approved for construction after investigation shows engineering, economic and environmental feasibility. These projects are cost-shared 65 percent Federal and 35 percent non-Federal. Each project is limited to a Federal cost of $5 million. Such projects will usually include manipulation of the hydrology in and along bodies of water, including wetlands and riparian areas. Deep water dredging to improve habitat conditions for the over-winter survival of fish in an otherwise shallow lake area is an example of this type of project.

- **Section 1135 of the 1986 Water Resources Development Act - Project Modification for Improvement of the Environment.** These projects are for modifications to an existing Corps project and/or its operations. The work must improve the quality of the environment by restoring habitat for fish and wildlife. Justification is based on a comparison of monetary and non-monetary costs vs. benefits. These projects are cost-shared 75 percent Federal and 25 percent non-Federal. Each project is limited to a Federal cost of $5 million. An example of this type of project might be to construct water control structures within a wetland to better optimize conditions for the production and availability of waterfowl-preferred food plants near an existing Corps project.

- **Section 204 of the 1992 Water Resources Development Act - Beneficial Use of Dredged Material.** These projects protect, restore and create aquatic and/or wetland habitats associated with dredging for authorized Federal navigation projects. A project is constructed after investigation shows engineering, economic and environmental feasibility. These projects are cost-shared 75 percent Federal and 25 percent non-Federal. Placing dredged material from the maintenance of a navigation channel at a specific location is an example of this type of project.

Potential Role in Implementing the Comprehensive Plan. The EMP and NESP authorities are anticipated to be utilized for many of the projects on the mainstem (i.e. backwaters, side channels, islands, and mainstem floodplain restoration efforts) and provide funding for a significant portion of the mainstem monitoring. See the next section for more detailed assumptions. Close coordination among all three programs will assure the best use of Federal and non-Federal sponsor resources. In addition, there is the potential for Environmental CAP to be used to conduct some aquatic ecosystem projects throughout the basin.

ii. U.S. Department of Agriculture (USDA). The mission of the USDA is to "provide leadership on food, agriculture, natural resources, and related issues based on sound public policy, the best available science, and efficient management." The USDA provides funding through the Natural Resources Conservation Service (NRCS) and the Farm Service Agency (FSA), to agricultural producers in support of environmental objectives on lands with a crop history.

Programs and Authorities

The **Environmental Quality Incentives Program (EQIP)** provides technical, financial, and educational assistance to farmers and private landowners who are faced with serious threats to soil, water, and related natural resources. Processing approximately 490 contracts within the Illinois River Basin, NRCS has expended approximately $5.1 million for financial assistance to treat natural resources concerns on cropland, confined livestock, and grazing lands in Fiscal Year (FY) 2005.

The **Wildlife Habitat Incentive Program (WHIP)** provided approximately $64,754 of financial assistance to develop and improve wildlife habitat on private lands within the Illinois River Basin in FY 2005.

The **Wetland Reserve Program (WRP)** increases wildlife habitat and improves water quality by providing additional wetland habitat, slowing overland flow, and providing natural pollution control. Since 1994, approximately $14.4 million has been spent in the Illinois River Basin to restore 9,927 acres of habitat on 23 properties.

The **Conservation Reserve Program (CRP)** and **Conservation Reserve Enhancement Program (CREP)** enrollments provide additional in-place conservation practices facilitating resource management in the Illinois River Basin. From 1998 to 2004, the State of Illinois provided $51 million to leverage $271 million in Federal funds to enroll 110,000 acres in Federal CRP easements and 73,000 acres in State CREP easements. Private landowners can enroll in conservation easements (CRP) with the USDA through a 15-year Federal contract. The lands enrolled in the Federal portion are then eligible for a voluntary 15-year or 35-year state contract extension, or a state permanent conservation easement (CREP).

Approximately 45,000 acres of the State easements are on lands where there is a Federal contract. The State also acquired State-only easements on numerous adjacent areas and now holds roughly 28,000 acres in these State-only easements. There is the potential for an additional $242 million in Federal funds through December 31, 2007 to enroll approximately 123,000 more acres in the basin if State leveraging funds are provided. In August 2005, the State of Illinois announced its budget for the upcoming year which includes $10 million to leverage $40 million in Federal funds, allowing for CREP easements on approximately 15,000 more acres.

In April 1997, the USDA officially launched the National Conservation Buffer Initiative and pledged to help landowners install 2 million miles of conservation buffers by the year 2002. The initiative is led by the NRCS in cooperation with the Agricultural Research Service, Farm Service Agency; Forest Service; Cooperative State Research, Education, and Extension Service; state conservation agencies; conservation districts; and numerous other public and private partners. The National Conservation Buffer Initiative encourages farmers and ranchers to understand the economic and environmental benefits of buffer strips and use these practices through the various programs of the conservation tool kit. Programs used for this effort include the continuous CRP signup, as well as EQIP, WHIP, WRP, Stewardship Incentives Program, and Emergency Watershed Protection Program.

The **Conservation Security Program (CSP)** is a voluntary conservation program that supports ongoing stewardship of private agricultural lands by providing payments for maintaining and enhancing natural resources. CSP identifies and rewards those farmers and ranchers who are meeting the highest standards of conservation and environmental management on their operations. The Farm Security and Rural Investment Act of 2002 (2002 Farm Bill) (Pub. L. 107-171) amended the Food Security Act of 1985 to authorize the program. The CSP is offered only in selected watersheds across the Nation. The Upper Sangamon, a watershed within the Illinois River Basin, was selected as a CSP area for 2006.

Potential Role in Implementing the Comprehensive Plan. The USDA has the mission and programs to implement many of the projects in the upper reaches of watershed and along the tributaries. In particular, efforts to restore floodplain wetlands, improve riparian buffers along streams, and improved farm practices directly relate to implementing the restoration plan. However, funding for these programs would need to expand to meet the needs identified in the restoration plan.

iii. U.S. Environmental Protection Agency (USEPA). The mission of the USEPA is to “protect human health and the environment.” The five goals of the USEPA’s Strategic Plan are based air and global climate change; water; land; communities and ecosystems; and compliance and environmental stewardship. USEPA programs related to the Illinois River Basin Restoration include water, watershed management, and wetlands. USEPA Region 5 oversees USEPA activities in the Illinois River Basin. Major activities ongoing in the basin include nutrient mapping, targeted watersheds grant program, and State List of Illinois Water Quality Impairments, summarized below. In addition, USEPA has delegated activities under Section 319 (Non-Point Source Grant Program) of the Clean Water Act and Total Maximum Daily Loads (TMDL) to the Illinois EPA.

Programs and Authorities

Nutrient Mapping of the Upper Mississippi. The USEPA Region 5 provides assistance and opportunities for multi-state collaboration to delegated Clean Water Act State programs in the Upper Midwest. One area of focus is the Upper Mississippi River Basin, which includes the Illinois River Basin. Nutrients have been linked to localized water quality impairments throughout the Upper Mississippi Basin, as well as in the Gulf of Mexico.

The USEPA is exploring ways to rank watersheds based upon their contribution of nutrients to the Gulf of Mexico. This effort could be utilized in the future to focus EPA's nutrient reduction activities to maximize reductions achieved with available resources. The study consists of a basin-scale, landscape analysis of existing water quality data to determine statistically significant factors that define an area's potential to contribute phosphorus to the waters of the Upper Mississippi Basin.

Targeted Watersheds Grant Program. Through this program, the USEPA provides grants to local groups working to protect and restore watersheds. In 2004, the Sangamon River Basin was one of 14 watersheds nationally that was selected to apply for EPA's *Targeted Watersheds Grant Program.* The selected watersheds will apply for grants between $700,000 and $1,300,000. This competitive grant program provides needed resources to watershed organizations whose restoration plans set clear goals and objectives. Special consideration is given to proposals which emphasize water quality monitoring, innovation, public education and strong community support. For the 2004 grants, a programmatic emphasis was placed on proposals that incorporated market-based incentives, or related to nutrient loading in the Mississippi River basin contributing to hypoxia (dead zone) in the Gulf of Mexico. The Upper Sangamon River Watershed Committee will devote Targeted Watershed funds to three interrelated projects to improve water quality locally, regionally, and in the Gulf of Mexico by reducing unnecessary nutrient discharges from agricultural areas.

2004 State List of Illinois Water Quality Impairments. Section 303(d) of the Clean Water Act provides a coordinated framework between states and the USEPA to systematically track and address impaired waters both statewide and nationwide. Under Section 303(d), the Illinois EPA must submit a list of water quality impaired waters in the state, and USEPA must review and approve or disapprove the list. The Illinois 2004 Section 303(d) list (or Total Maximum Daily Load Program list) was approved by the USEPA in October, 2004. The list is available on the Illinois EPA website, http://www.epa.state.il.us/water/tmdl/303d-list.html.

Total Maximum Daily Load Program (TMDLs). Although much success has been achieved through the 303(d) process and NPDES permitting program in reducing pollutants discharged to waterways by municipal treatment works and industrial discharges, some impaired waterways are not expected to recover through the application of technology-based effluent treatment alone.

States are required to list impaired waters every 2 years and to prioritize each water for an in-depth analysis of pollutant sources and the reductions necessary so that they attain all of the uses that they are assigned (or "designated" in CWA terminology). The in-depth analysis is called a *Total Maximum Daily Load* or *TMDL*. A stream can have many different segments within a stretch, as well as and numerous impairments representing a variety of needed improvements in its chemical, physical, and biological state.

The most recent TMDL list for the State of Illinois was approved in November 2004. The list can be found at the Illinois EPA website, http://www.epa.state.il.us/. The pollutant reductions called for in TMDLs may require voluntary actions and the cooperation of many programs such as the CWA 319 program, CREP program, and ecosystem restoration actions recommended in this document in order to realize the water quality improvements called for in the TMDL and realize the water quality goals of the Clean Water Act.

Potential Role in Implementing the Comprehensive Plan The EPA has the mission and programs to implement many projects in the upper reaches of watershed and along the tributaries. In particular, the Section 319 grant program and Targeted Watersheds efforts have the potential to provide restoration funding to improve water quality. In addition, the EPA's current and probable future monitoring has the potential to meet a portion of the systemic monitoring needs. However, funding for these programs would need to expand to meet the needs identified in the restoration plan.

iv. U.S. Fish and Wildlife Service (USFWS). The mission of the USFWS is "working with others to conserve, protect and enhance fish, wildlife and plants and their habitats for the continuing benefit of the American people." Key functions of the USFWS include: enforcing Federal wildlife laws, protecting endangered species, managing migratory birds, restoring nationally significant fisheries, conserving and restoring wildlife habitat, helping foreign governments with their international conservation efforts, and overseeing the Federal aid program that distributes money to State fish and wildlife agencies.

Programs and Authorities.

Refuges. The USFWS manages four National Wildlife Refuges along the Illinois River and throughout the basin, encompassing 17,696 acres. The refuges include:

- Calhoun and Gilbert Lake Divisions of Two Rivers Refuge near the confluence of the Illinois and Mississippi Rivers;
- Meredosia Refuge at the north end of the Alton Pool;
- Chautauqua and Emiquon Refuges near Havana in the La Grange Pool; and
- Cameron/Billsbach Division south of Henry in the Peoria Pool.

These refuge lands are managed primarily to provide for the needs of wetland-dependent migratory birds, threatened species such as the bald eagle and decurrent false aster, and for native fish. When new lands are acquired, wetlands, prairie, and forest habitats are restored as needed. In some cases, water levels are manipulated in wetlands to provide optimum habitat diversity for numerous species of waterfowl, shorebirds, wading birds, and fish. The refuges provide opportunities for wildlife-oriented recreation such as hunting, fishing, wildlife observation, photography, interpretation, and environmental education when and where such activities are compatible with refuge objectives. Refuge goals, objectives, and management direction are outlined in the draft *Comprehensive Conservation Plans for the Illinois River National Wildlife and Fish Refuge Complex and for the Mark Twain National Wildlife Refuge Complex*. The refuges also actively support the Partners for Wildlife and Fish program described below.

The **Partners for Fish and Wildlife (PFW) Program** has been utilized to restore numerous basins consisting of thousands of acres of natural habitats on private lands, typically non-cropped, within the State of Illinois. The program focuses on Federal trust resources, migratory birds, Federal threatened and endangered (T&E) species, and proximity to as well as benefits to refuge lands. Although not all the following restored acreage is within the Illinois River Basin, the information provided outlines the USFWS' PFW conservation efforts within the State of Illinois (Fischer, 2005).

Wetland basins	1987-2003, PFW restored 376 wetland basins consisting of 7,581
Upland	1991-2003, PFW restored 46 upland areas consisting of 1,603
During FY 2003	PFW restored 20 basins totaling 2,015 acres

This program, administered by the Illinois Private Lands Office, is a very effective and efficient way of restoring habitat, and should be considered in future goal attainment calculations. During FY 2003 alone, the PFW program restored approximately 2,015 acres of habitat within the state. The number of projects and acres can be highly variable, but typically range in size from 10 to 15 acres. In addition, the PFW is complementary with USDA programs and actively works with interested landowners to satisfy their interests through either USDA farm programs or PFW. The USFWS biologists within the PFW program have formed integral relationships with NRCS district conservationists, state biologists, and many other conservation authorities throughout the state. Through the combination of the effectiveness of the program and the partnering relationships that have formed among natural resources managers, the program has become very successful.

The **Landowner Incentive Program (LIP)** supports collaborative efforts with private landowners interested in conserving natural habitat for species at risk, including federally- listed endangered or threatened species and proposed or candidate species, on private land while these individuals continue to engage in traditional land-use practices. The Landowner Incentive Program, funded through competitive grants with money from the Soil and Water Conservation Fund, establishes or supplements existing landowner incentive programs that provide technical or financial assistance to private landowners. All grants need to be matched at least 25 percent from a non-Federal source. The State of Illinois received a grant in 2005 to develop a pilot project on the Lower Sangamon to improve threatened and endangered species habitat primarily on CREP lands.

Potential Role in Implementing the Comprehensive Plan. The USFWS has the potential to implement a number of tributary projects through the PFW and LIP programs. In addition, the USFWS is prepared to assume operation and maintenance (O&M) responsibilities for restoration sites at its Refuge sites. However, funding for these programs would need to expand to meet the needs identified in the restoration plan. At current levels, the PFW program receives $60,000 to $80,000 in habitat restoration on the Middle and Lower Illinois Rivers. This roughly translates into 15 to 25 projects annually, restoring or improving from 50 to as many as 1,500 acres in the Illinois River watershed.

v. U.S. Geological Survey (USGS). The mission of the USGS is to serve the Nation "by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life." The USGS Illinois Water Science Center (IWSC) performs various activities in the Illinois River Basin as part of specific studies and special networks and programs.

Programs and Authorities

Under the **Basic Data Collection Program**, the USGS IWSC operates eight streamflow gaging stations on the Illinois River (five continuous discharge and three stage-only stations) and numerous other stations on tributaries. The IWSC operates three sediment stations on the main stem. As part of the Lake Michigan diversion accounting (a part of the Supreme Court Decree), the IWSC is applying Acoustic Doppler Current Profilers (ADCP) and Acoustic Velocity Meters (AVMs) to measure flows from Lake Michigan to the Illinois River system at various locations in the Chicago area. All data collected are made available in the IWSC Digital Annual Data Report, and the discharge and stage data are available on a near real-time basis.

The **USGS National Water-Quality Assessment (NAWQA) Program** is a long-term program with goals to describe the status and trends of water quality conditions for large, representative parts of the Nation's ground and surface water resources. Assessment activities are being performed in 42 study units (major watersheds and aquifer systems) that account for a large percentage of the Nation's water use. A wide array of chemical constituents is measured in ground and surface water, streambed sediments, and fish tissue. In Illinois, two NAWQA study units (the upper and lower Illinois River Basin study units) have been operational since 1986 with the beginning of a pilot study in the upper basin. Work on the lower basin began in 1994 and was reestablished on the upper basin in 1997. Various data sets and reports are available as part of the studies in both basins. Funding for the NAWQA Program in the Illinois River Basin is expected to be as shown in table 6-2.

Table 6-2. NAWQA Funding by Federal Fiscal Year

Fiscal Year	Funding
2006	$626,400
2007	$620,000
2008	$449,000
2009	$1,157,000
2010	$881,000
2011	$600,000
2012	$440,000
2013	$440,000
2014	$440,000
2015	$440,000

The IWSC has numerous other activities in the Illinois River Basin, many carried out as part of the Water Cooperative Program, whereby local or State governments pay a portion of the study/data collection cost and the USGS pays no more than 50 percent of the cost. The IWSC collects continuous streamflow and rainfall data in the rapidly developing suburban counties of metropolitan Chicago. These data are used to calibrate USGS models of watershed runoff response to rainfall, which then are used to simulate runoff and flooding associated with a variety of land-use conditions and storms. Stream restoration, dam removal, and geomorphic analysis studies have been conducted on numerous locations in the Illinois River Basin. Numerous other site-specific studies have been and are being conducted on groundwater flow and quality in the basin, as well as work on the dissemination of a variety of hydrologic information through an Internet Map Server concerning source waters for the state. The IWSC also compiles and distributes water use information for the state on a 5-year basis.

USGS activities in the Illinois River Basin involving other USGS disciplines (geology, geography, and biological resources) include involvement in a network of monitoring sites as part of the National Atmospheric Deposition Program/National Trends Network that provide continuous measurement and assessment of the chemical constituents in precipitation throughout the United States, glacial and bedrock mapping throughout Illinois and nearby states as part of the Great Lakes Mapping Coalition, coal availability and recovery, and various mapping initiatives, including partnerships with various agencies to update topographic maps and aerial photography throughout the state.

Potential Role in Implementing the Comprehensive Plan. The USGS has the mission and programs to contribute significantly to systemic and site specific monitoring. In addition, the USGS also has capabilities to assist with watershed assessments and project planning. However, funding for these programs would need to expand to meet the needs identified in the restoration plan.

vi. Illinois Department of Natural Resources (DNR). The mission of the Illinois DNR is to manage, protect and sustain Illinois' natural and cultural resources; provide resource-compatible recreational opportunities; and promote natural resource-related issues for public safety and education. In addition to serving as the primary sponsor for Section 519, the DNR has a number of other ongoing programs with the potential to restore portions of the basin over the next 50 years.

Programs and Authorities

The Illinois DNR is the lead State agency working with USDA and the Illinois Department of Agriculture on the Conservation Reserve Enhancement Program (CREP). These efforts are summarized as part of the programs of the USDA above.

In 1995, the State initiated and funded a $100 million **Conservation 2000 (C2000) Program** to protect and manage Illinois' natural resources. The program is authorized through the year 2009 and is subject to annual appropriations. The nine programs funded under C2000 are administered by three State agencies—Illinois DNR, Illinois Department of Agriculture, and Illinois EPA.

The largest C2000 Program administered by the Illinois DNR is the Ecosystems Program. The Ecosystems Program provides financial and technical support for maintaining, restoring, and enhancing ecological and economic conditions in key watersheds throughout the Illinois River Watershed and the rest of the state. The C2000 Program is delivered through ecosystem partnerships, which are coalitions of local stakeholders who develop and implement natural resources plans that include a broad array of projects for restoration, protection, enhancement, monitoring, and education. The partnerships apply for competitive grants and have been awarded funding for projects that are directly related to Illinois River Restoration. As of 2001, the value of all C2000 Ecosystem projects totaled $43,487,865. The C2000 Program contribution was $16,583,458, with matching funds of $26,904,408. These projects provide for streambank stabilization, wetland restoration, prairie restoration, riparian buffers, vegetative covers on construction sites, and restoration of oxbows in tributaries of the Illinois River.

The Illinois DNR currently manages 51 conservation sites, encompassing approximately 101,013 acres. Twelve State of Illinois conservation areas totaling 26,568 acres can be found along with two State forests of 3,673 acres. State Fish and Wildlife Areas can be found at 12 locations totaling

18,138 acres. Finally, the Illinois DNR operates 25 State Parks within the Basin with 42,138 acres dedicated to conservation and recreation.

Potential Role in Implementing the Comprehensive Plan: The Illinois DNR is the primary sponsor of the Plan and current Critical Restoration Projects. It will provide funding and in kind services to match Federal funding on many of the projects. In addition, it will need to continue ongoing restoration, monitoring, and management activities and programs to maintain their current restoration efforts. Furthermore, funding will need to expand above existing levels to meet the needs identified in the restoration plan.

vii. Illinois Department of Agriculture. The mission of the Illinois Department of Agriculture is to be an advocate for Illinois' agricultural industry and provide the necessary regulatory functions to benefit consumers, agricultural industry, and natural resources. The agency will strive to promote agri-business in Illinois and throughout the world.

Programs and Authorities

During the reporting period of June 1, 2003 to September 1, 2005, the **C2000 Program** funded $2.2 million worth of upland soil and water conservation practices in the 39 counties that have significant land in the Illinois River Watershed. Administered by the Department and County Soil and Water Conservation Districts (SWCDs), this program provides 60 percent of the cost of constructing conservation practices that reduce soil erosion and protect water quality. Eligible conservation practices include terraces, grassed waterways, water and sediment control basins, grade stabilization structures and nutrient management planning. Approximately 1,330 individual conservation projects were completed in the Illinois River Watershed, bringing soil loss to tolerable levels on over 20,894 acres of land. This translates to over 113,914 fewer tons of soil loss each year.

In FY 2004, the State of Illinois, through the Department of Agriculture, provided over $3.3 million to 51 county SWCD offices in the Illinois River Watershed. Funds were used to provide financial support for SWCD offices, programs, and employees' salaries. Employees, in turn, provided technical and educational assistance to both urban and rural residents of the Illinois River Watershed. Their efforts are instrumental in delivering programs that reduce soil erosion and sedimentation and protect water quality.

In an effort to stabilize and restore severely eroding streambanks that would otherwise contribute sediment to the Illinois River and its tributaries, the Department of Agriculture is administering the **Streambank Stabilization and Restoration Program (SSRP).** The SSRP, funded under C2000, provides funds to construct low-cost vegetative or bio-engineered techniques to stabilize eroding streambanks. In FY 2004, 40 individual streambank stabilization projects, totaling $386,681 were constructed in 19 counties within the Illinois River Watershed. In all, over 24,746 linear feet of streambank, or more than 4.6 miles, have been stabilized to protect adjacent water bodies.

Another environmentally-oriented C2000 Program administered by the Department of Agriculture is the **Sustainable Agriculture Grant Program.** Grants are made available to agencies, institutions, and individuals for conducting research, demonstration, or education programs or projects related to profitable and environmentally safe agriculture. In FY 2004, over $347,000 was awarded to 17 grant recipients with programs or projects in the Illinois River Watershed to investigate such areas as alternative crops, nitrogen rate studies, riparian management, integrated pest management, and residue management.

Potential Role in Implementing the Comprehensive Plan. Along with the Illinois DNR, the Illinois Department of Agriculture is involved with the preparation of the Comprehensive Plan and could serve as the sponsor for future Critical Restoration Projects. The department could provide funding and in-kind services to match Federal funding on some Critical Restoration Projects. In addition, it will need to continue ongoing restoration and management activities and programs to maintain their current restoration efforts. Furthermore, funding will need to expand above existing levels to meet the needs identified in the restoration plan.

viii. Illinois Environmental Protection Agency (EPA). The mission of the Illinois EPA is to safeguard environmental quality, consistent with the social and economic needs of the State, so as to protect health, welfare, property and the quality of life.

Programs and Authorities

Through programs it administers, such as **Section 319 (Non-Point Source Grant Program) of the Clean Water Act**, the Illinois EPA has completed over 130 projects to reduce non-point source pollutants to Illinois waters since 1990, and over 35 projects are ongoing. Projects include watershed planning, installation of Best Management Practices, development of educational materials, and CREP assistance.

Section 303(d) of the Federal Clean Water Act requires states to identify waters that do not meet applicable water quality standards or do not fully support their designated uses. States are required to submit a prioritized list of impaired waters, known as the 303(d) List, to the USEPA for review and approval. The CWA also requires that a Total Maximum Daily Load (TMDL) be developed for each pollutant of an impaired water body. The Illinois EPA is responsible for carrying out the mandates of the Clean Water Act for the State of Illinois.

The establishment of a TMDL sets the pollutant reduction goal necessary to improve impaired waters. It determines the load, or quantity, of any given pollutant that can be allowed in a particular water body. A TMDL must consider all potential sources of pollutants, whether point or nonpoint. It also takes into account a margin of safety—which reflects scientific uncertainty—as well as the effects of seasonal variation.

Potential Role in Implementing the Comprehensive Plan: Along with the Illinois DNR, the Illinois EPA is involved with the preparation of the Comprehensive Plan and could serve as the sponsor for future Critical Restoration Projects. The agency may provide funding and in kind services to match Federal funding on some projects and monitoring activities. In addition, it will need to continue ongoing restoration, monitoring, and management activities and programs to maintain their current restoration efforts. Furthermore, funding will need to expand above existing levels to meet the needs identified in the restoration plan.

ix. States of Indiana and Wisconsin. The States of Indiana and Wisconsin are exploring options to participate in future restoration efforts under Section 519. If they decide to become full sponsors, the missions, programs, and roles of the various State agencies will be further defined.

c. Allocation of Recommended Section 519 Projects. As a collaborative planning study effort, this Plan not only recommends actions for the Corps of Engineers, but includes restoration efforts and components that would best be implemented by other Federal, State, and local agencies. By bringing together the expertise and programs of all the appropriate agencies, collaborative planning will solve problems at the proper scale, integrate solutions, and leverage funds.

The following is a conceptual breakdown of the estimated $8 billion in restoration needs over an anticipated 50-year period by Federal agency. While the notes and associated chart focus on Federal Agency, there would be local and state cost share funding associated with most of these programs. In order to estimate the breakdown, each area of potential work was evaluated relative to the agency and program missions to identify the most likely areas. However, it should be noted that the actual funding for all agencies is subject to further agency coordination and the level of annual appropriations made by the Administration and Congress.

Assumptions on future funding by Federal agency are shown in Figure 6-2 (State and local matches are included as part of the associated Federal funds they leverage) In many cases, the local cost sharing match equals 25 to 50 percent of the total shown for each Federal agency.

- **Sediment Delivery.** Assumed 40 percent Corps of Engineers cost shared efforts with a focus on instream efforts, 40 percent USDA with a focus on detention areas, 20 percent USEPA-319 funds with a focus on water quality
- **Backwaters.** Assumed all Corps of Engineers work, majority 75 percent Navigation and Ecosystem Sustainability Program/Upper Mississippi River-Environmental Management Program (NESP/EMP) and 25 percent Illinois River Basin Restoration (Sec 519)
- **Side Channels.** Assumed all Corps of Engineers work, 75 percent NESP/EMP and 25 percent Sec 519
- **Island Protection.** Assumed all Corps of Engineers work, 75 percent NESP/EMP and 25 percent Sec 519
- **Mainstem Floodplain.** Assumed Corps of Engineers would lead effort to restore 20,000 acres under the NESP/EMP authorities out of tentative selected plan level of 75,000 total. Of the remaining 55,000 acres, it is assumed that roughly 50 percent or 27,500 acres would be funded out of Illinois River Basin Restoration Sec 519 authority and 27,500 acres would be funded through USDA's WRP and CRP program.
- **Tributary/Floodplain/Riparian.** Assumed 40 percent Corps focus on areas tied to wetland and instream structures, 40 percent USDA focus on corridor and buffers, 15 percent USEPA-319 funds, 5 percent USFWS Partners for Fish and Wildlife
- **Tributaries - Instream.** Assumed 40 percent Corps of Engineers with a focus on instream efforts, 40 percent USDA with a focus on detention areas, 20 percent USEPA-319 funds
- **Connectivity.** Assumed of the Federal funding, 100 percent Corps of Engineers 519 funding for fish passage. The potential exists that Illinois DNR – Office of Resource Conservation may implement up to 25 percent of the fish passage projects on their own, without Corps of Engineers cost share.

- **Water Level - Tributaries.** Assumed 40 percent Corps of Engineers, 40 percent USDA, 15 percent USEPA-319 funds, 5 percent USFWS Partners for Fish and Wildlife
- **Water Level - Gates.** Assumes these features will be put in place under the Corps of Engineers - NESP
- **Pool Drawdown.** Assumes 100 percent Corps of Engineers O & M Funded
- **Other Components/Monitoring.** Assumes some monitoring tasks covered by EMP/NESP ~20 percent, USGS ~7.5 percent, and USEPA ~5 percent

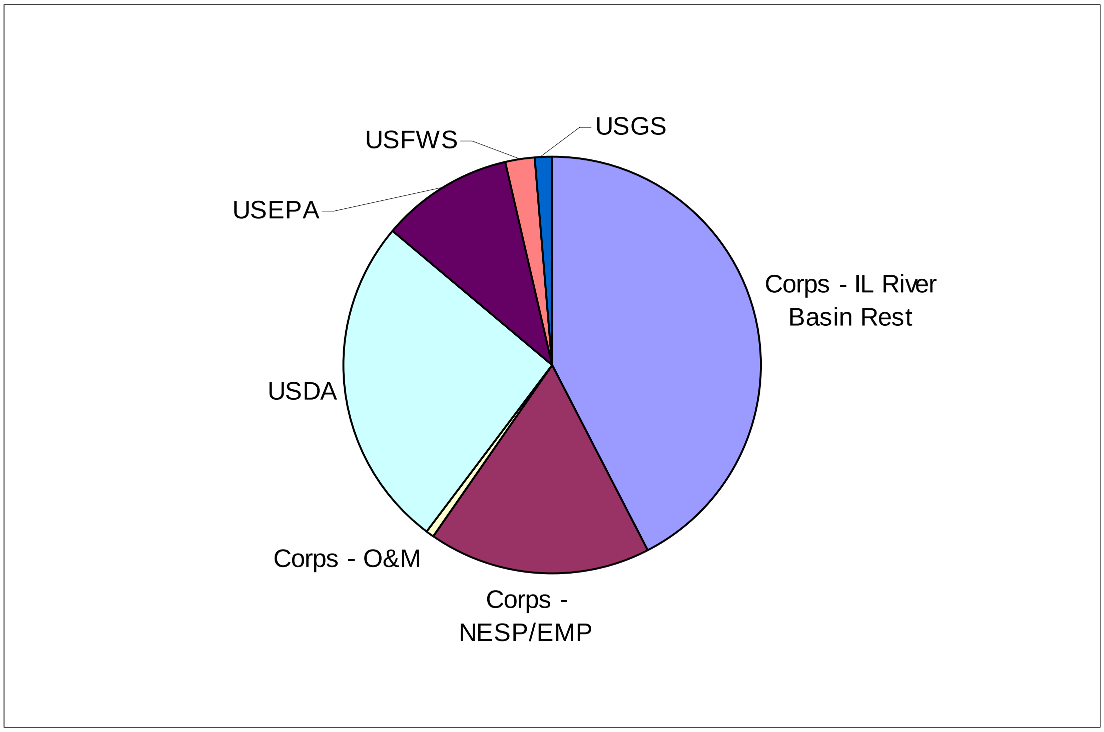


Figure 6-2. Conceptual Breakdown of Recommended Plan Funding by Federal Agency
Note: Most Federal funded projects will require non-Federal sponsor matching (state or local).

d. Regulatory Activities. In addition to interagency coordination of restoration activities, careful consideration will be given to ongoing regulatory activities in the Illinois River Basin. The implementation framework will be developed to identify constraints and tradeoffs among new projects, existing projects, and other planning and regulatory decisions that affect the implementation and effectiveness of restoration efforts. Any procedures for successful restoration of streams, wetlands, and riparian areas resulting from this restoration program will be shared with regulatory agencies and local communities for consideration in future permit and land use actions.

Despite efforts to address this important provision, it is acknowledged by many stakeholders that a more thorough and comprehensive effort is needed to ensure consistency throughout the basin. It is further recognized that the Plan is an appropriate vehicle for initiating such an effort. Potential steps towards such consistency in implementing the Plan could include:

- "Basin Consistency" reviews held approximately annually. Members of the System Team and regulatory staff could meet to review the locations of Critical Restoration Projects as well as recent and significant regulatory actions. Tracking regulatory actions using the Operations and Maintenance Business Information Link Regulatory Module (O.R.M.) database and Critical Restoration Projects using geographic information systems (GIS) would allow for joint analysis as a way of identifying opportunities for joint efficiencies and avoiding inconsistent actions.
- Early coordination between the States, Corps, and other Federal agencies through the Steering Committee and Regional Teams for projects in the basin that have potential impacts upon restoration activities.
- As the primary regulator of Section 404 permits, the Regulatory Branch of the Corps plays an important role in the success of this restoration initiative. The Regulatory Branch is frequently contacted by landowners interested in stream and wetland modifications. Interested and willing landowners could be directed to contact key members of regional teams for assistance in projects such as stream restoration (as opposed to channelization) or wetland protection and restoration (as opposed to draining/development). Wetland, stream, and forest mitigation as outlined in the Corps' recent "draft mitigation guidelines" could be emphasized for the most important areas within each tributary watershed of the Illinois River Basin.
- Special Area Management Plans (SAMPs) be developed for key areas of the basin where considerable planning and restoration activities occur. With SAMPS, the Corps of Engineers undertakes a comprehensive review of aquatic resources in an entire watershed. This approach is more environmentally sensitive than the traditional project-by-project process. The traditional approach may lead to the cumulative loss of resources over time. With the SAMP approach, potential impacts are analyzed at the watershed scale in order to identify priority areas for preservation, identify potential restoration areas, and determine the least environmentally damaging locations for proposed projects. The goal of SAMPs is to achieve a balance between aquatic resource protection and reasonable economic development. SAMPs are designed to be conducted in geographic areas of special sensitivity. These comprehensive and complex efforts require the participation of local, State, and Federal agencies.

B. IMPLEMENTATION FRAMEWORK

The following plan implementation process specifically addresses how activities proposed for funding through the Corps of Engineers would be conducted. The approach of utilizing multi-agency regional teams to review project submissions and the involvement of higher level staff from other agencies in an Illinois River Basin Steering Committee will provide a sound basis for matching proposed restoration with the authorities and funding of various agencies. Implementation activities will involve three areas: program management, Critical Restoration Projects, and technologies and innovative approaches.

1. Program Management. Management efforts would include funding for both the Corps of Engineers Districts and non-Federal sponsors for project management and coordination activities. Specifically this funding would address: (1) briefing and interaction with the Executive Committee, Steering Committee, System Team, and Regional Teams, (2) active participation at Illinois River related task forces, committees, work groups, conferences and meetings, (3) development and negotiation of programmatic cooperative agreements, (4) initial meetings and site visits for prospective projects, (5) program agreements and administration, (6) program budgets, (7) responding to program data calls, (8) program information and project solicitation, (9) annual reporting, and (10) preparation of formal documents and related support functions.

A certain level of annual funding would be necessary in order to cover system management costs. The estimated cost assumes the initial project funding increases to approximately $750,000 annually, or approximately 1.8 and 1.5 percent of the initial project costs through years 2011 and 2015, respectively. These costs include estimates of the management costs incurred by the non-Federal sponsors, which could be creditable as in-kind services.

2. Critical Restoration Projects. Section 519 currently authorizes the planning, design, and construction of Critical Restoration Projects with a current per project limit of $5 million Federal and $7.7 million total. The specific criteria and prioritization process for Critical Restoration Projects are as follows:

a. Criteria

i. Section 519 of WRDA 2000 specifies that if a restoration project for the Illinois River basin will produce independent, immediate, and substantial restoration, preservation, and protection benefits, the Corps of Engineers shall proceed expeditiously with the implementation of the project.

ii. Additional criteria have been developed as part of the Plan, including giving priority to projects that improve quality and connectivity of habitats; providing habitat for regionally significant species; reducing sediment delivery; naturalizing hydrology; maximizing sustainability; considering and addressing threats; improving water quality; considering other agency activities; and having public support.

b. Prioritization Process. The proposed assessment and implementation process seeks to create a systemic, comprehensive approach that is accessible to project partners and stakeholders. The ecological merits of proposed projects will be the most important selection factor. Other factors to be considered will include goal-specific factors, public interest and acceptability, and administrative issues. It is important to emphasize that project implementation will not proceed rigidly in strict order of numerical rankings. Flexibility is essential, and the Corps of Engineers, working with the Illinois DNR and other sponsors, and in consultation with the other agencies and stakeholders, will exercise reasonable judgment to resolve unexpected issues, respond to unforeseen opportunities, and ensure efficient program execution. Regulatory agencies will be included in the assessment and feasibility phases to better identify areas of concern as a watershed approach is taken during implementation of the program.

The four-part general implementation process is described as follows and is summarized in Figure 6-3. The steps include assessment process, feasibility process, implementation/construction process, and post-construction evaluation process. The implementation process will have four separate decision phases – initiation of assessments, initiation of Project Reconnaissance Reports (PRRs); initiation of feasibility study phase (Project Implementation Report); and identification of a recommendation and start of design/construction sequence.

It is anticipated that decisions on which projects will proceed into each of these phases will be made annually, based on funding issues. Decisions to move forward with the program at each decision phase will be made by the Executive Committee. For the Corps, the Assistant Secretary of the Army (Civil Works) [ASA (CW)] will approve the project feasibility report. The MVD working with LRD will retain responsibility for decisions regarding project submissions to Corps HQUSACE and the ASA (CW) on all programming and budgetary decisions. Ultimately, some delegation of approval authority to MVD and the Districts for projects is anticipated.

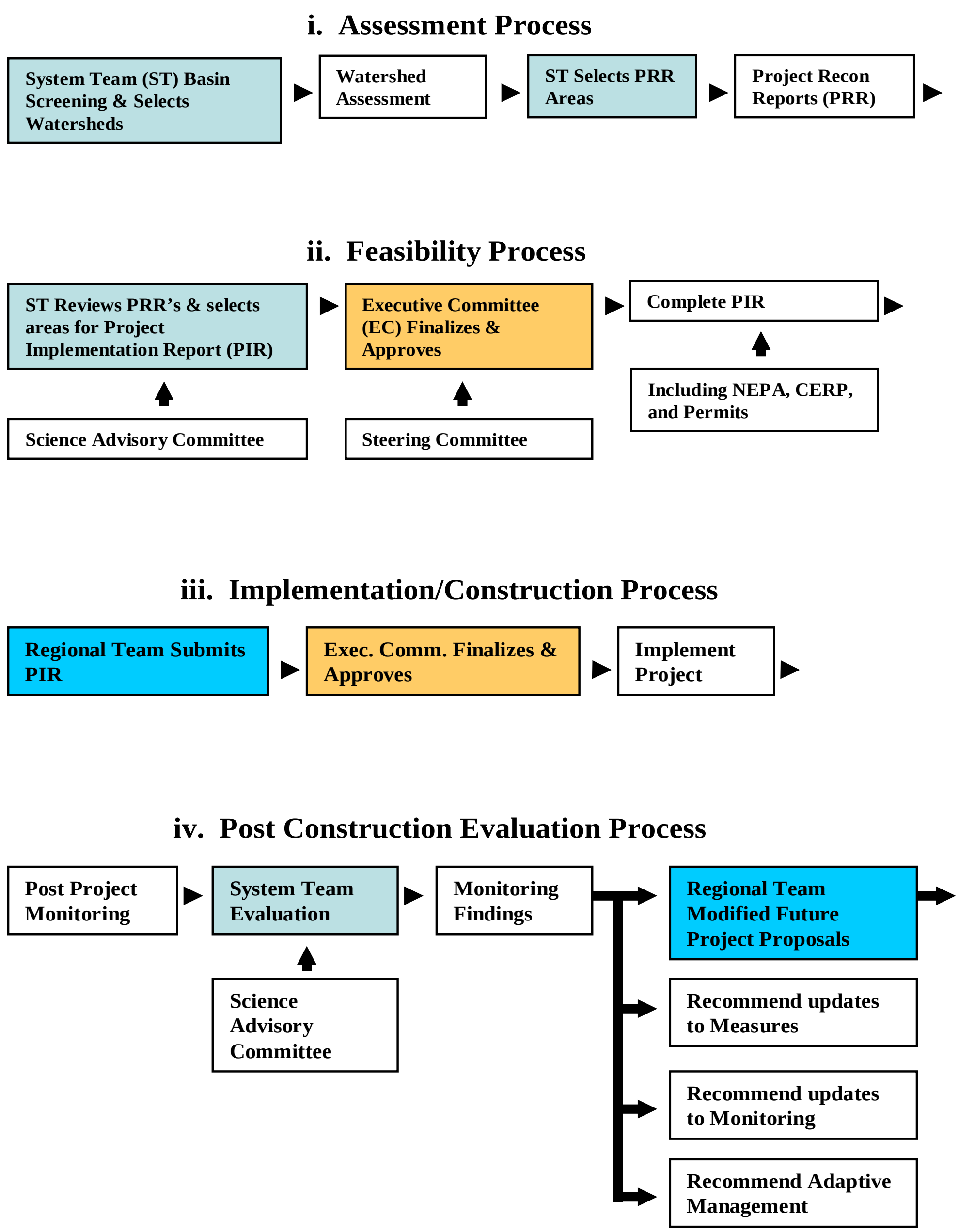


Figure 6-3. Process Diagrams for Project Implementation Phases

i. Assessment Process

Basin Screening. The initial identification and selection of the watersheds and pools for assessment will be conducted by the System Team using the system prioritization criteria, with input from the regions and other study committees. The System Team will perform an initial screening of subwatersheds in the basin using existing information, and will rely heavily on GIS data. Mainstem Illinois River evaluations will be coordinated closely with the activities of the NESP and EMP programs. Screening will specify problems and restoration opportunities, and identify specific areas (sub-watershed or pool segments) in need of a more detailed assessment. The primary criteria are shown on Table 6-3 and include: improve quality and/or increase area/connectivity of high quality habitat areas, sediment reduction to the Illinois River, presence of threats (population increase, water quality), other agency efforts, and public support (local plan/partnership group). The most promising watersheds identified at this level will be recommended for Watershed Assessments.

An initial screening was conducted in 2005 to identify additional Critical Restoration Projects. Due to the current time and funding constraints, only those basin areas specifically nominated for consideration by the Illinois DNR or other potential sponsors were considered. However, future basin screening efforts would include the entire basin.

Table 6-3. Basin, Watershed, and Project Prioritization Process

Criteria Description	Basin Screening	Watershed Assessment
Location in IL River basin	Priority/greater initial weighting will be placed on watershed draining into Peoria Pool and upstream, then Alton & LaGrange pools	
Reduce sediment delivery to Illinois River	Existing data from past reports and system study on delivery	Field verification of Phase I factors. Field investigation of geomorphological attributes—i.e. locating headcuts and monitoring erosion of banks.
Improve quality and/or increase area/connectivity of Biologically Significant Areas (BSA)/Resource Rich Areas (RRA)	Office assessment of existing biological and GIS data from Corps, DNR, TNC, EPA. Contiguous habitat.	Field verification of Phase I factors. Field investigation of biological attributes (ability to meet system patch size, spacing, connectivity, etc. goals).
Improve, protect and expand habitat for regionally significant species (including T & E), patch size and spacing	Number of threatened/ endangered species	Identification of specific species and potential to benefit.
Increase base flows and/or decrease peak flows	Preliminary Assessment	More detailed analysis
Threats to Ecological Quality/Integrity	Consider population density, pop. Growth rates, percent impervious cover, and water quality (303d)	Field verification of Phase I factors. Land use changes, increased isolation, invasive species
Other Agency Efforts	Identify known areas of other agency restoration activity	Identify specific other agency actions and potential to collaboratively address problems.
Public support	Existence of local plan or ecosystem partnership group	Identified support in progress, landowner interest
Sustainability		Assessment of potential to be self sustaining/add to system self sustaining.

Watershed Assessment. The first step in initiating site specific work in the basin will be to conduct detailed Rapid Watershed Assessments and Pool Assessments for portions of the basin evaluating ecologic, geomorphologic, and hydraulic conditions (typically at the small/sub watershed level ~100 square mile basins). These areas will be selected based on a basin screening conducted by the System Team using system prioritization criteria, with input from the regions and other study committees. The emphasis of the assessments will be on evaluating and more clearly defining the more localized areas where system restoration should be accomplished and types of measures needed throughout the basin. As a result, Watershed Assessment Reports will be submitted on each area evaluated, verifying the basin screening criteria; identifying problems, opportunities, and potential projects; and relating potential projects to the program goals. Table 6-3 outlines the screening prioritization criteria. In addition, these reports will gather more specific data allowing further project definition and selection of reconnaissance areas. Regional Teams will be asked to submit existing assessments from other sources to assist in the process. As they are completed, the Watershed Assessments will be shared with other agencies through the Steering Committee and Regional Teams to evaluate which agencies are best able to address the needs identified.

The Watershed Assessment Reports will be evaluated by the System Team. Projects identified through the watershed assessment to proceed as CRP's under the Corps 519 authority will move into the next phase; preparation of a Project Reconnaissance Report (PRR). The System Team will propose areas for PRR investigation and will solicit input and recommendations from the State Surveys and/or Science Advisory Committee (SAC). The Watershed Assessments will be used to scope projects to fit the current project dollar cap ($5 million Federal; $7.7 million total). Multiple projects may result from one assessment, or several assessments may be combined for one project. The Executive Committee will review and approve these as part of setting the annual work plan.

Project Reconnaissance Reports (PRR). The final step in the assessment of projects is the development and submission of Project Reconnaissance Reports (PRRs) for the selected areas to better define the extent, cost and benefits. Project Reconnaissance Reports (PRRs) will be prepared primarily by Corps and Illinois DNR staff in coordination with the Regional Teams, including the involvement of watershed partnerships, local governments, and non-governmental organizations NGOs. The PRRs will result in well developed project concepts. They will include information on problems, opportunities, future without project conditions, alternatives, costs, and an assessment of how the project meets site-specific, sub-watershed, watershed, pool segment, pool and system goals. A cost-sharing sponsor must be ready to support the project for it to be considered for feasibility.

ii. Feasibility Process (Project Implementation Report)

Selection of Projects for Feasibility. The feasibility process will be initiated on the most promising projects following review of the PRRs. The System Teams will conduct a system-level evaluation and sequencing of the projects based on the data in the PRRs. The purpose of the system evaluation will be to propose which projects best meet system ecological needs and goals. In addition to the prioritization criteria outlined in Table 6-3, additional system criteria will consist of the following, but may be modified with the concurrence of the System Team:

- Measures of how well the project meets system goals as identified in the system study, and watershed and pool assessments, monitoring trend data, and other pertinent databases
- Consistency with other habitat goals such as those identified in master plans, the North American Waterfowl Management Program, U.S. Shorebird Conservation Plan's Upper Mississippi Valley/Great Lakes Regional Shorebird Conservation Plan, Partners in Flight Bird Conservation Plan, State watershed and river programs, national hypoxia/nutrient plans, etc.
- Natural process considerations, such as hydrology, sedimentation, flow distribution, floodplain connectivity, fire, etc.
- Sequencing of projects on the basis of their anticipated ecological and geomorphic interrelationships
- Focus on the quality of the habitat and habitat patch size, spacing criteria, connectivity
- Focus on the presence of threats to the ecological integrity
- Considerations of the project's habitat sustainability and long-term viability
- Risk and uncertainty of project success
- Public support

Once the system evaluation is complete, the highest rated projects will be presented to the Executive Committee. The Executive Committee will review the information collected to date and consider other factors relating to policy and administrative issues (e.g. partnership opportunities, funding availability, and mix of projects). This step will end with recommendations from the Executive Committee on which projects should proceed into the feasibility phase and develop site-specific recommendations.

Feasibility Study. Each Critical Restoration Project selected for further study will be evaluated through a separate decision document (Project Implementation Report). The evaluations will define benefits such as habitat units created, stream miles of connectivity, tons of sediment reduced, and other measures. Cost Effective and Incremental Cost analyses will be used to evaluate the benefits and costs of various project alternatives and to identify a recommended plan. For any recommended plan, the evaluations must show that the outputs of each project outweigh its respective costs. The feasibility phase will be cost shared 65/35 with the sponsor.

iii. Implementation/Construction Process. As feasibility study efforts are completed, the reports will go through a formal HQUSACE approval process (Section c, *Corps Procedures for Processing Critical Restoration Project.*) the local sponsors will also review the reports. Once approved, the recommended plans will be forwarded to the Executive Committee to identify a preferred implementation/ construction sequencing. Included in the implementation phase is the actual implementation construction, monitoring, and adaptive management.

If more projects are awaiting implementation than funding allows, it is reasonable to shift the evaluation criteria to the question of which administrative mix of projects is appropriate to meet long-term ecological sustainability of the Illinois River Basin and maintain public interest and participation. The Corps and Illinois DNR will develop a proposed "Illinois River Basin

Restoration Program Plan" based upon the high priority ecological projects resulting from the previous two-stage ecological screening process and other factors relating to policy and administrative issues. The Corps and State Program Managers will lead the Program Planning effort for the Executive Committee.

In selecting the sequenced ecological projects, a variety of policy and administrative considerations will be considered to determine an optimal project mix. These considerations will include:

- Ability to provide system benefits
- Combination of innovative and proven techniques, considering applicability of innovations to future projects and replicability
- Variety in types of measures
- Geographic distribution
- Yearly funding
- Maintaining minimum district delivery capability
- Cost sharing
- Public support
- Readiness (NEPA, permits, land availability)
- Leveraging non-IRBR funds
- Compatibility with other river uses
- O&M requirements

The program plan will be provided to the Steering Committee for review and comment. Coordination will also occur with other groups including the Regional Teams, System Team, Stakeholders, and others regarding various factors affecting project implementation.

Future PCAs will be modeled after the Peoria Riverfront Development – Upper Island PCA, approved in September of 2005. Overtime, it is anticipated that a model PCA will be developed for the program from the initial projects, allowing delegation of PCA approval in future years.

iv. Post-Construction Evaluation Process. Following actual construction, any planned post-construction monitoring would be conducted. The results of this monitoring will be provided to the System Team to assess the overall success of various types of projects and measures, assess the monitoring approach, and recommend adaptive management actions if necessary. The System Team will provide results to the regional teams to consider in modifying future projects.

c. Corps Procedures for Processing Critical Restoration Projects. Future actions necessary for project approval, budgeting, and implementation are summarized below. MVD will provide overall management and budgeting for the program, in accordance with the Memorandum of Understanding executed January 4, 2006 by the Executive Committee. The Comprehensive Plan establishes a process for prioritization of projects, program management, and processing. Reports, Project Cooperation Agreements (PCAs), and other submissions to higher authority will be processed through the division where the project is located (MVD or LRD). The MVD as the overall program lead and the Rock Island District as the Regional Program Lead should be kept aware of the status of In Progress Reviews (IPR) and HQUSACE issues on projects in LRD.

i. As project reports near completion, an IPR will be scheduled with HQUSACE and the appropriate division to discuss report findings. An information package similar to that provided for an Alternative Formulation Briefing will be prepared for the meeting. This requirement may be waived as experience is gained in the program.

ii. The final report will be provided to the appropriate division to conduct a policy compliance review. For initial project reports submitted, the division will conduct this review prior to review by HQUSACE. As experience is gained through the program, concurrent review will be conducted with HQUSACE.

iii. Upon completion of the policy compliance review and endorsement by the appropriate division, the report will then be submitted to HQUSACE for submission to the Office of the ASA(CW) for approval.

iv. Plans and specifications can be initiated upon issuance of the division endorsement to HQUSACE, or as further noted in this paragraph. When concurrent review with HQUSACE is put in place, the appropriate division can provide instructions for initiation of Plans and Specifications when it is satisfied that policy and procedural requirements are met prior to full completion of the review process. Actual Plans and Specifications initiation will be subject to funding availability, which shall be coordinated with the Rock Island District as the Regional Program Lead for inclusion in the annual work plan and approval by the Executive Committee.

v. Subsequent to report approval by ASA(CW) and Construction General funding being provided by the Congress, a PCA must be negotiated and executed with the non-Federal sponsor. The PCA describes the project, the items of local cooperation, and the responsibilities of the Government and the non-Federal sponsor in the cost sharing, financing and execution of the project.

vi. The Corps can submit a budget request for Construction General funds for any projects approved by ASA(CW) by August 1 of the program year less 2 years. The initial new start submission is made by June 1 each year, with changes possible until August 1. There are no construction funds in the FY 06 budget for this program. In the case of FY 07, construction funds could be budgeted for projects approved by August 1, 2005 (Peoria Riverfront Development, Upper Island).

vii. The Corps will complete final design and Plans and Specifications for the project construction.

viii. The non-Federal sponsor will be required to provide all lands, easements, rights-of-way, relocations and disposal areas necessary for project construction and OMRR&R.

ix. Bids for construction will be advertised and contracts awarded upon approval of the report by ASA(CW), appropriation of CG funding, and execution of the PCA.

xi. Upon completion of construction, the project will be turned over to the non-Federal sponsor, who will be responsible for OMRR&R in accordance with guidelines in the PCA and the OMRR&R manual as furnished by the Corps.

3. Status of Critical Restoration Projects. Restoration of the Illinois River Basin requires the identification and implementation of projects within the watershed and along the course of the river that repair past and ongoing ecological damage so that a more highly functioning, self-sustaining ecosystem can develop within the basin. Critical Restoration Projects will produce immediate ecological benefits, will help evaluate the effectiveness of various restoration methods before system wide application, and make best use of the current local and State interest in ecosystem restoration within the basin. Construction of Critical Restoration Projects will allow sponsors and the public to see immediate results that will help to provide broad support for future projects. The Corps of Engineers will implement these Critical Restoration Projects in collaboration with the non-Federal sponsor and other Federal and local agencies.

Feasibility level investigations for six site-specific projects were initiated under the Illinois River Ecosystem Restoration Study. The list was expanded to eight following further evaluation at Pekin Lake, which identified two separate study efforts and inclusion of the first separable increment of the Peoria Riverfront Development Project. These projects will produce independent, immediate, and substantial restoration, preservation, and protection benefits and are being completed and implemented as the initial Critical Restoration Projects of the Illinois River Basin Restoration Project. Eight additional projects were added in 2006 (figure 6-4). These projects are being developed as stand alone documents with separate evaluation and coordination of environmental and cultural effects. Future Critical Restoration Projects will be tiered from the programmatic Environmental Assessment contained in this document.

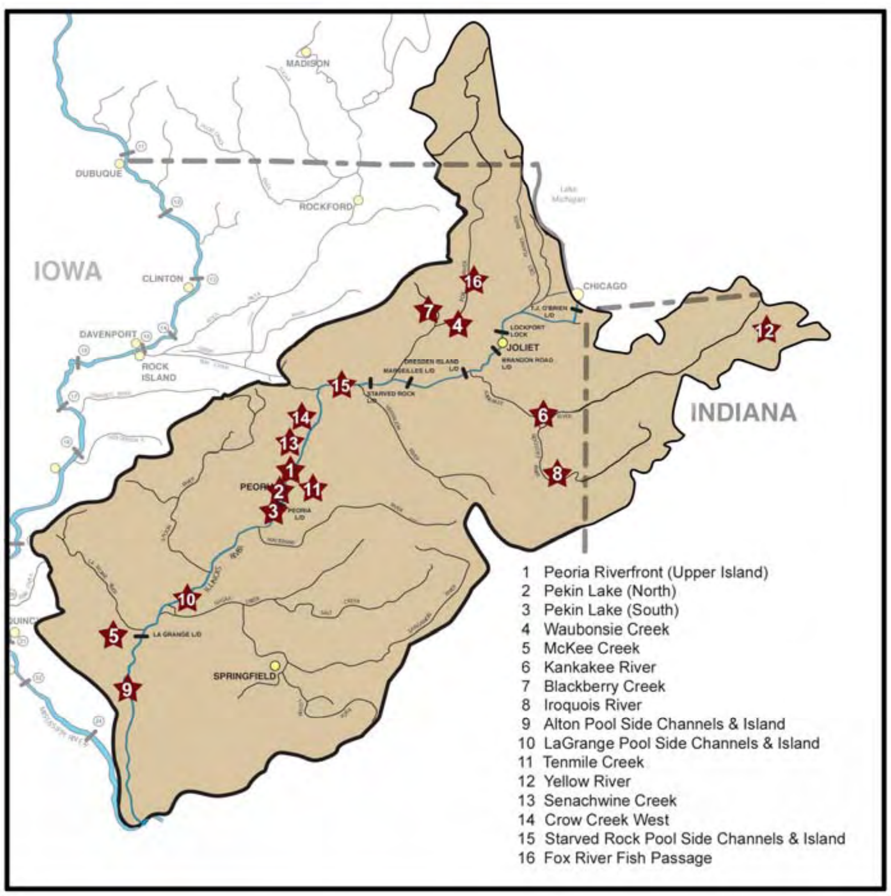


Figure 6-4. Critical Restoration Project Locations

a. Peoria Riverfront Development - Upper Island. The project area includes upper portions of Lower Peoria Lake, RM 166 and is adjacent to the Cities of Peoria and East Peoria. Peoria Lake is the largest bottomland lake in the Illinois River Valley and has experienced loss of depth similar to other Illinois River backwater lakes. Loss of aquatic habitat due to sedimentation is the greatest threat to the healthy function of Peoria Lake. The principal goal is to improve depth diversity enhancing aquatic habitat in Peoria Lake with ancillary recreational benefits. The recommended plan for the Upper Island includes dredging approximately 54 acres within Lower Peoria Lake to create deepwater habitats and constructing one 21-acre island. The project costs are estimated at $7.5 million. This effort is consistent with system goals of restoring aquatic habitat diversity of side channels and backwaters, and improving floodplain and habitats and functions. The expected benefits clearly outweigh the investment cost. The feasibility phase is complete, and design is nearing completion.

b. Pekin Lake Northern Unit. Pekin Lake Northern Unit is the northern portion of a backwater lake complex located adjacent to the Illinois River at RM 153-156. The backwater lakes and side channels once provided large areas of deep and shallow water habitat, sloughs, and forested and non-forested wetland habitats. Sedimentation and willow invasion have significantly reduced aquatic and wetland plant production. The project will allow for management of water levels for habitat and remove large areas of willow trees to increase moist soil plant production. The improved wetland will provide a reliable food source and critical stopover along the internationally significant Mississippi River Flyway. The project will maintain a historic heron rookery and slow the anticipated loss of the backwater lake. The project costs are estimated at $6.9 million. This effort is consistent with system goals of restoring aquatic habitat diversity of side channels and backwaters; improving floodplain, riparian and aquatic habitats and functions; and restoring hydrologic regimes on 681 acres. The feasibility phase is complete, and design is nearing completion.

c. Pekin Lake South. Pekin Lake Southern Unit is the southern portion of a 1,200-acre backwater lake complex located adjacent to the Illinois River at RM 153-156. The area once provided fish over wintering habitat that has since been degraded by excess sedimentation from the Illinois River. Currently, there are no existing overwintering fish habitats within approximately 20 miles of Pekin Lake State Fish and Wildlife Area. Higher water levels throughout the system have nearly eliminated the mast producing hardwood forests in the Illinois floodplain, and completely at Pekin Lake. The project will address the lack of over wintering fish habitat and the declines in diverse bottomland forest areas. The alternatives considered include dredging for overwintering habitat with the placement of some of the dredged material onsite to create suitable areas for mast producing trees. The project costs are currently estimated at $7.6 million. This effort is consistent with system goals of restoring aquatic habitat diversity of side channels and backwaters; and improving floodplain, riparian and aquatic habitats and functions on 390 acres. The feasibility phase is complete, and design is nearing completion.

d. Waubonsie Creek. Waubonsie Creek is located in northeastern Illinois. The creek has a number of low-head dams that prevent movement of fish from the Fox River into approximately 7 miles of potential spawning and nursery habitat in Waubonsie Creek. The project will restore fish access to quality spawning habitat, allow fish recolonization of the creek following high flow, restore riparian wetlands, improve aquatic habitat, and provide off-channel refuge for fish during high flow events. Total project costs are estimated at $2.2. This effort is consistent with system goals of improving floodplain, riparian and aquatic habitats and functions; and restoring longitudinal connectivity on the tributaries. The feasibility phase is complete, and design has been initiated.

e. Kankakee River - Main Stem. The Kankakee River is a high quality river located in northeastern Illinois and northwestern Indiana. The Kankakee River carries an excessive sediment load, and habitat quality in the river is expected to decline due to sedimentation. Side channel and pool areas in this reach are expected to continue to lose depth and habitat diversity as cobble and gravel substrates become covered by sand. The project will restore and maintain deep-water and high quality riffle habitat critical to many state-protected species along 30 miles of the Kankakee River. Total project costs are estimated at $6.5 million. This effort is consistent with system goals of reducing sediment delivery to the Illinois River and improving floodplain, riparian and aquatic habitats and functions. The feasibility phase is ongoing.

f. Iroquois River. The Iroquois River is located in eastern Illinois and western Indiana and is a tributary to the Kankakee River. Modifications of tributaries through ditching and straightening have increased velocities, bed and bank erosion, and the sediment load delivered to the Iroquois River and eventually the Illinois River. Once the fine sediment is mobilized, it remains suspended until much lower flow velocities occur. It is transported into the Illinois River and drops out in backwater lake areas. The sedimentation of these highly productive backwater lakes is recognized as the greatest threat to the Illinois River ecosystem. Channel instability also negatively affects the habitat value of the tributary stream and its riparian corridor. The project will reduce delivery of sediment to the Illinois River, stabilizing a portion of the Iroquois river basin by addressing a head cut on one of its tributaries, Sugar Creek. The project will maintain aquatic habitat in 10 miles of tributary stream by preventing degradation associated with upstream progression of channel incision. Stream stabilization structures will be designed to provide in-stream habitat. Total project costs are estimated at $6 million. This effort is consistent with system goals of reducing sediment delivery to the Illinois River; improving floodplain, riparian and aquatic habitats and functions; and improving water and sediment quality in the Illinois River and its watershed. The feasibility phase is on hold pending funding.

g. McKee Creek. McKee Creek is a direct tributary to the Illinois River located in west-central Illinois. Modifications of McKee Creek and its tributaries through ditching and straightening have increased velocities, bed and bank erosion, and the sediment load delivered directly to the lower Illinois River. The stream has incised channels and high rates of lateral migration. The lower 30-mile reach erodes an estimated 100,000 tons of bank material per year. The project will prevent delivery of an estimated 2.5 million tons of sediment to the Illinois River over the project life by stabilizing head cuts on the lower 10 miles of McKee Creek. The project will maintain and improve aquatic habitat in over 30 miles of stream by preventing degradation associated with upstream progression of channel incision, widening, and bank collapse. Stream stabilization structures will be designed to provide in-stream habitat. Total project costs are estimated at $6.3 million. This effort is consistent with system goals of reducing sediment delivery to the Illinois River; improving floodplain, riparian, and aquatic habitats and functions; restoring hydrological regimes; and improving water and sediment quality in the Illinois River and its watershed. The feasibility phase is on hold pending funding.

h. Blackberry Creek. Blackberry Creek is located in northeastern Illinois and is a tributary of the Fox River. Currently, the stream has high quality habitats, but a 10-foot dam near the confluence with the Fox River severely limits fish, mussel, and macroinvertebrate access to this habitat. The project will restore fish passage at the Blackberry Creek Dam at an estimated total cost of $6.3

million. The project will restore access to 30 miles of quality stream habitat and allow fish recolonization of the creek following high flow events. This effort is consistent with system goals of improving floodplain, riparian, and aquatic habitats and functions and restoring longitudinal connectivity on the tributaries. The feasibility phase is on hold pending funding.

i. **Additional Critical Restoration Projects.** Recently approved projects include:

- small watershed restoration on Senachwine Creek, Crow Creek West, Tenmile Creek, and Yellow River
- a major tributary reach of the Fox River
- side channel and island restoration in Starved Rock, La Grange, and Alton Pools of the main stem Illinois River

4. Initial Project Schedules through 2011(Tier I) and 2015 (Tier II). The Plan recommendations call for continuing restoration efforts under a tiered approach utilizing the existing authority of Section 519. The Corps of Engineers cost shared restoration efforts would begin with $153.85 million in funding through 2011 (Tier I) increasing to $384.6 million in restoration efforts through 2015 (Tier II).

This section provides additional detail on proposed Tier I efforts. The purpose of this tier is to begin restoration efforts and demonstrate the benefits of the various measures and project components prior to seeking additional funds. The System Team worked with the sponsors and other agencies to identify the projects, technologies and innovative approaches components, and management efforts that would make up the first $153.85 million in restoration efforts ($100 million Federal funds). Depending on project progress and Federal and State funding, Tier I is anticipated to cover work on the program from now until the first Report to Congress is completed in the 2011 timeframe. Tier II will be developed in greater detail in the coming years based on the lessons learned from Tier I.

Tier I restoration efforts will include the original eight Critical Restoration Project along with a number of newly identified projects. Areas of work were selected based on the project implementation framework and basin screening criteria. Appendix E presents a proposed implementation schedule for planning, design, and construction of Critical Restoration Projects as well as program management and other specific components. While some work will occur throughout the basin, restoration efforts will focus on the upper watershed and, in particular, the Peoria Pool and tributaries and the Kankakee River Basin. These high value resource areas were selected due to their quality and location in the upper reaches of the basin, which has the potential to more rapidly demonstrate the effectiveness of the various projects.

5. Adaptive Management Principles. It is expected that implementation of the Plan components will provide restoration outputs as planned. However, due to the uncertainties inherent in ecosystem restoration, adaptive management is an essential strategy. The U.S. Army Corps of Engineers recognizes the need for adaptive management as one of the tools for successfully developing projects in the aquatic ecosystem restoration mission area. Engineering Circular (EC) 1105-2-210 (21) (a) dated 1 June 1995, states, "*Because of the relative newness of restoration science and uncertainty in ecosystem restoration planning, theories, and tools, success can vary due to a variety of technical and site specific factors. Recognizing this uncertainty, it is prudent to allow for contingencies to address restoration problems during, or after, project construction. To accomplish this, a technique called 'adaptive management' should be considered for inclusion in restoration projects recognized during planning to have the* *potential for uncertainty in achieving restoration objectives."*

In addition, current planning guidance from Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, (April 2000) states, *"For complex specifically authorized projects that have high levels of risk and uncertainty of obtaining the proposed outputs, adaptive management may be recommended."*

Initial measures implemented for the Illinois River restoration will be based on scientific research and lessons learned from past efforts on the Illinois and other river systems. However, knowledge of ecosystem function is frequently inadequate to provide clear answers to restoration and management problems. Adaptive management should be used to help reduce the uncertainty and risk of ecosystem recovery actions and to increase the knowledge about ecosystems. Adaptive management requires that all ecosystem recovery actions be viewed, implemented, and monitored as tests of hypotheses about ecosystem responses to restoration actions. Under adaptive management, reducing uncertainty becomes an objective of management, the ecological effects of restoration are monitored, and policies are adapted depending on observations. Adaptive management has the added benefit of integrating science and resource management, ensuring applied science is well directed and scientific advances are transferred to managers.

The success of an adaptive management approach will require an open management process that includes partners and stakeholders during the planning and implementation stages. Project-specific monitoring should be designed and implemented so that information returned can be used to make changes in the existing project. Information on the success of ecosystem recovery actions should be used to design future projects. Adaptive management should be used to revise and update restoration goals and objectives. Environmental thresholds or triggers are essential in adaptive management. These must be agreed upon ahead of time, must be measurable, and must be unequivocally linked to goals of the ecosystem recovery action or program. Science, monitoring, and management institutions should be engaged in adaptive management. In addition, scientists, managers, and policy makers must be prepared to accept that some actions will not go as expected.

One of the main benefits of adaptive management is the development of an iterative and flexible approach to management and decision-making. The results of the restoration activities can be monitored and future management decisions can be informed by the outcomes of previous decisions. Another important benefit of adaptive management lies in the opportunity for scientists and managers to collaborate in the design of state-of-the-art solutions to meet the challenges of managing complex and incompletely understood ecological systems. Alternative management actions can be stated as hypotheses and addressed from the perspectives of rigorous experimental design and decision analysis. The probable outcomes of management alternatives and the values of such outcomes can be estimated in relation to management goals and objectives. The adaptive approach recognizes that uncertainty is unavoidable in managing large-scale ecological systems. Importantly, uncertainty can be analyzed and exploited to identify key gaps in information and understanding. The results of such analyses of uncertainty can be used to efficiently allocate limited management resources to new research or monitoring programs.

The adaptive management process is a six-step cycle (Figure 6-5) and emphasizes that successful adaptive management requires managers to complete all six steps.

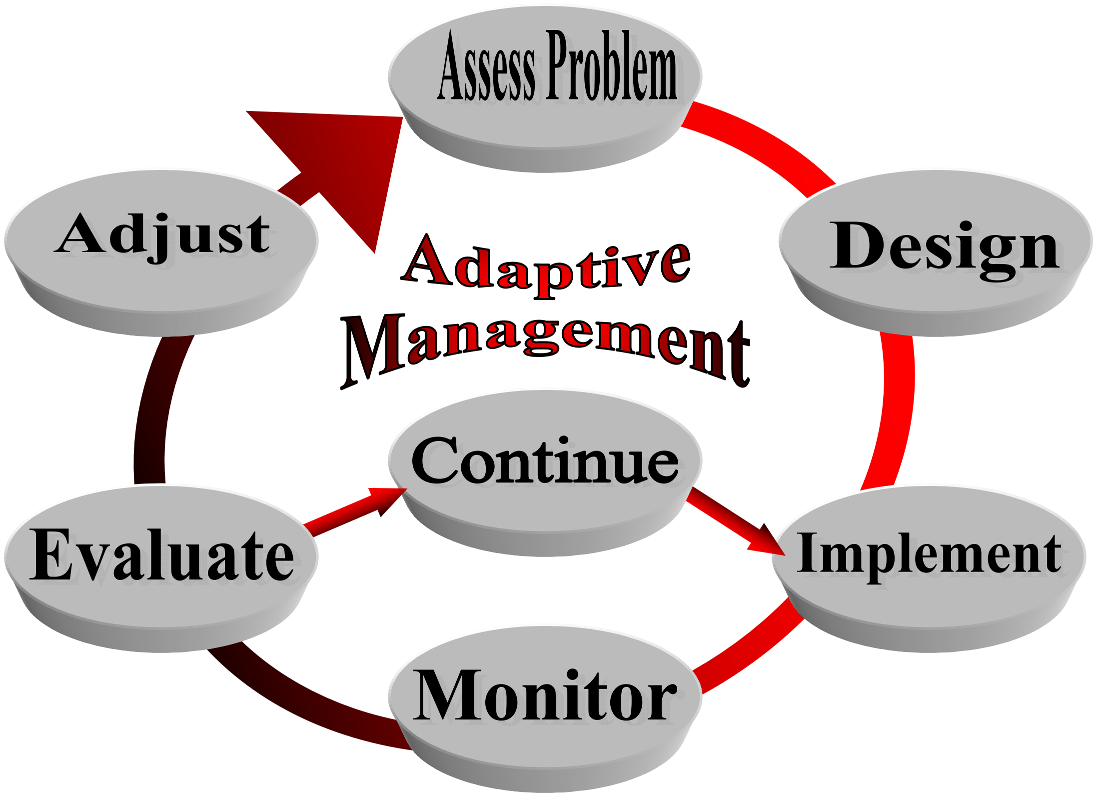


Figure 6-5. Adaptive Management Process

Some of the differentiating characteristics of adaptive management include:

- acknowledging uncertainty about what policy or practice is "best" for the particular management issue;
- thoughtfully selecting the policies or practices to be applied (the assessment and design stages of the cycle);
- carefully implementing a plan of action designed to reveal the critical knowledge that is currently lacking;
- monitoring key response indicators;
- analyzing the management outcomes in consideration of the original objectives; and
- incorporating the results into future decisions.

Within the scientific community, ecosystem restoration is viewed as an evolving science. Since such projects deal with living organisms, there is both risk and uncertainty regarding the outcome. There is less certainty of performance than in other mission areas, such as flood damage reduction. This uncertainty requires the organization to accept, plan, and manage for risk, even risk that may result in failure. This allowance for risk is not a substitute for good planning or avoidance of requirements, but is the assessment of taking risks to test methods that may yield better outcomes than current approaches. Monitoring and adaptive management allow the adjustments that reduce the risk of failure and provide "insurance" for the monetary investment. When the objective of the restoration project is to increase biodiversity, there may not be an obvious best course of action, particularly if there is not prior ecosystem management experience to utilize. Monitoring and adaptive management then provide the background information that is needed to move the project towards the most appropriate and effective solution.

Incremental implementation allows testing of hypotheses (e.g. extent to which the identified system goal are the limiting factors and additional detail on their interrelationships), thus providing an essential means for learning more about ecological cause and effect relationships with much greater certainty than is possible with ecological models. Incremental implementation also provides opportunities to refine plans to more effectively meet overall program objectives. An incremental process is required for the Illinois River Basin Restoration Program because of the large and complex nature of the ecosystem and its problems, and because of the uncertainties regarding the ecological responses that will occur as more natural hydrological and sediment conditions are established. These uncertainties are inherent where major alterations in the region's spatial scale and landscape have substantially changed ecological relationships among species, habitats, and communities throughout the region. If an unexpected response occurs, it becomes the basis for reviewing and revising the operating set of hypotheses, which results in an ever-improving focus on the actions required to meet the ultimate restoration objectives.

Recommendation

Based on the large study area, complexity of the ecosystem restoration, and the opportunities for increased cost effectiveness over the long duration of the program, adaptive management for the Illinois River Basin Restoration Project should be 7.5 percent of the initial construction costs through 2015, which is approximately 5 percent of total program costs through 2011 and 5.6 percent through 2015. It is anticipated that this adaptive management approach will decrease project costs in the long run, improve ecosystem outputs, protect Federal investments, and provide valuable information to make higher quality future projects more cost effective. The cost share for adaptive management is the same 65 percent Federal and 35 percent non-Federal cost share as the original project. This recommendation will be reviewed periodically throughout the life of the program and will be adjusted accordingly.

The intent of this program will be to use active adaptive management and the systemic and project-specific monitoring programs to reduce overall project costs below the current estimates. This systematic process of modeling, experimentation, and monitoring will compare the outcomes of alternative restoration or management actions and make modifications as needed to ensure project success. Specifically adaptive management is recommended to: (1) ensure projects are functioning as designed and providing the maximum benefit to the ecosystem, (2) provide the ability to undertake state-of-the-art approaches and ensure their success, (3) take into account the results of project monitoring in order to improve future restoration projects, and (4) result in long term savings to future projects by determining the most effective restoration methods. For example, monitoring and adaptive management of backwater restoration projects are anticipated to help determine the best configuration and extent of restoration to provide the most sustainable projects. This will provide an approach to evaluate and more precisely identify the necessary level of restoration, potentially providing millions of dollars in implementation and O&M cost savings over the life of the project. Various methods would be compared in their effectiveness, the bio-response generated, and long-term sustainability for each measure. Specific areas for adaptive management include:

- **A variety of measures to reduce sediment delivery.** For example, riffle-pool structures are perceived as the most environmentally beneficial measure to reduce sediment delivery in unstable streams. However, other options may provide similar stabilization with greater habitat benefits.
- **Different dredging configurations and scales, and placement options for backwater restoration.** During alternative plan formulation, based on current scientific research, it was assumed that dredging 40 percent of each backwater area was most ecologically beneficial as well as being more sustainable. However, a variety of scales should be evaluated to test potentially less costly but more or equally beneficial options.
- **A variety of measures to restore floodplain areas.** Measures to consider include controlling non-indigenous and invasive species, utilizing the existing seed bank, and, where necessary, using various scales and densities of planting to maximize benefits and reduce implementation costs, as well as options to reconnect the floodplain to the river for floodplain restoration.
- **Modify in-stream aquatic restoration to compensate for changes in land use within the watershed that may affect hydrology.** Improving the design of channel structures could also be a high priority area for adaptive management and subsequent cost savings, drawing on Section 32 of the Streambank Erosion Control Demonstration Program (USACE 1981).

C. TECHNOLOGIES AND INNOVATIVE APPROACHES COMPONENT

The Plan recommends authorization to begin implementation of the specific components called for in Section 519 (WRDA 2000)(b)(3). The specific components include: (1) development and implementation of a program for sediment removal technology, sediment characterization, sediment transport, and beneficial uses of sediment, (2) development and implementation of restoration projects, (3) the development and implementation of a long-term resource monitoring program, and (4) the development and implementation of a computerized inventory and analysis system. Component B is addressed through the ongoing Critical Restoration Project authority and proposed modifications to the per project limits, etc. Authorization of the other three components is proposed as part of a single Technologies and Innovative Approaches Component. The following section describes the need for these components and recommendations for implementation.

1. Illinois River Basin Monitoring Program (IRBMP). The purpose of the Illinois River Basin Monitoring Program (IRBMP), which includes both the long-term resource monitoring program and the supporting computerized inventory and analysis system, is to evaluate the status of the Illinois River system in relation to the goal of "*a naturally diverse and productive Illinois River Basin that is sustainable by natural ecological processes and managed to provide for compatible social and economic activities*" and provide insight into mechanisms affecting achievement of that goal. This purpose drives the design and implementation of the program so that monitoring efforts are able to communicate ecosystem status and provide input to guide ongoing project implementation.

Specific objectives of the IRBMP are to:

a. improve understanding the Illinois River Basin ecosystem, including establishing a pre-project reference state and establishing variability for each of the performance measures;

b. measure, by the use of data collected, responses as projects are constructed and implemented;

c. monitor trends and effects on selected resources;

d. provide a basis for identifying options for improvements in the design and operation of projects and components (for use in adaptive management);

e. support scientific investigations designed to increase ecosystem understanding, establish cause and effect relationships, and interpret unanticipated results; and

f. develop reports on the status and trends of the Illinois River Basin ecosystem and restoration progress for the public, stakeholders, agencies, the State of Illinois and Congress.

In summary, the IRBMP is designed to help establish the framework for measuring and understanding system responses to restoration, to help determine how well the program is meeting its goals and objectives, and to help identify opportunities for improving the performance of the program where needed. The monitoring identified in the IRBMP relies and builds on monitoring already being conducted by multiple agencies and identifies new monitoring required for a complete interpretation of ecosystem responses.

Successful implementation of the IRBMP is dependent on two key assumptions:

- Existing monitoring will continue with existing funding sources (i.e., the IRBMP should not replace ongoing agency efforts that are essential to the plan implementation including the UMR-EMP and State of Illinois monitoring efforts)

- Partnering agencies will contribute funding and/or will participate in implementation of the IRBMP (e.g. particularly the USGS and USEPA).

a. Plan Structure. The conceptual model for the Illinois River Basin Restoration Program is based on the understanding that there are a number of specific factors that are currently undermining or limiting the integrity of the ecological systems within the Illinois River Basin. Conceptually, in order to restore or improve the ecosystem function, all of these system-limiting factors must be addressed to some degree, and it follows that, if these are sufficiently addressed, overall ecosystem function will improve. Since construction of individual projects is the mechanism by which goals are addressed, project-specific monitoring is required to evaluate the effectiveness of various project attributes to advance each goal. A second level of monitoring (goal-level monitoring) would evaluate the progress in each of the supporting goals, indicating progress for each particular system-limiting factor identified by the project team. Since ecological integrity is the overarching goal that is supported by the other goals, evaluating the progress toward systemic integrity suggests overall program success (Figure 6-6). Such system-level monitoring would be designed to develop a snapshot of the overall system health. Finally, the program should recognize the need for limited-duration focused studies to evaluate specific issues that arise. These may include efforts to better understand particular system-limiting factors and their interrelationship, evaluate restoration measure effectiveness, refine monitoring needs and techniques, and develop and refine models.

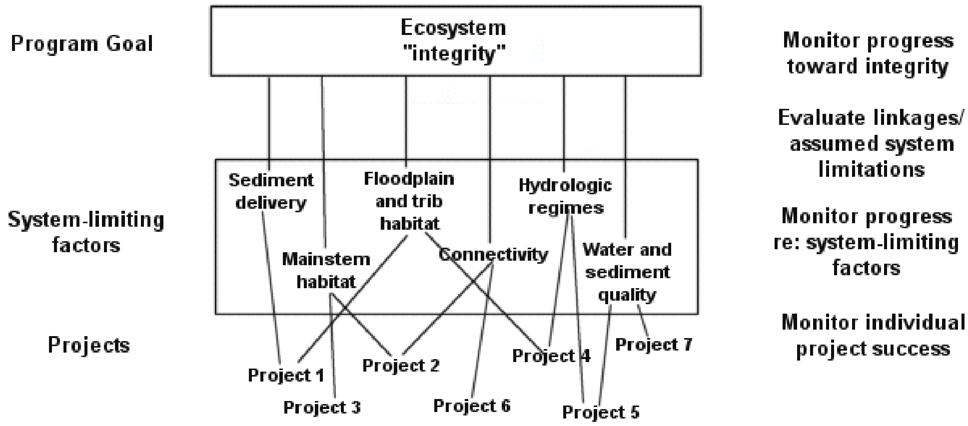


Figure 6-6. Conceptual Model of Illinois River Basin Restoration Project with Monitoring Requirements

i. Project-Level Monitoring. The purpose of this level of monitoring is to determine if the implemented projects are providing the intended physical and biological benefits. For example, this monitoring should determine if sediment projects are reducing excess sediment delivery and if backwater projects are improving ecological functions in backwaters. Monitoring results will be utilized for adaptive management by guiding design improvements to better meet ecosystem goals.

ii. Goal-Level Monitoring. Each goal is associated with a set of measurable objectives. Goal-level monitoring accounts for the progress toward each objective and thereby assesses the degree to which goals are being attained. The metrics to be monitored are therefore drawn directly from the objectives (e.g. sediment delivery, water level fluctuations, and acreage restored). If it is discovered that objectives are being met but that comparable improvements are not observed in system-level indicators, it may be necessary to reevaluate either the system indicators, the assumed system-limiting factors, or identify other critical factors.

iii. System-Level Monitoring. System-level monitoring must provide a holistic evaluation of the state of the ecosystem using a number of performance indicators that span all of the relevant features of the desired ecosystem state ("integrity"). This level of monitoring would encompass information from throughout the basin—main stem and tributary areas. Rather than evaluating individual aspects of integrity, such as richness, resilience, resistance, etc., the evaluation can look for indications that the desirable ecosystem is reemerging or that undesirable aspects of the system are declining (e.g. aquatic plants, diving ducks, etc.). The monitoring program must accurately represent all of the processes crucial to ecosystem health with the most economical set of indicators possible. If the evaluation is designed correctly, it could be assumed that ecosystem health is improving if all of the indicators are showing improvement. That would suggest that the appropriate system-limiting factors are being addressed and that progress is being made toward the goal.

Restoration success must be measured in time scales that relate to the species and systems being managed, and to the periodicity of extreme environmental conditions characteristic of the region. Measures of restoration success must be done within spatial scales that relate to a whole ecosystem, and success must be measured at the ecosystem level with long-term evaluation (Zedler 1988). This requires ecologically meaningful and measurable indicators that mark progress toward ecosystem management and restoration goals (Richter et al. 1996).

iv. Computerized Inventory and Analysis (CIA) System. A CIA will be developed to inventory and analyze monitoring information. All monitoring data will be posted to a CIA system within one year of collection with summaries provided every 5 years. Efforts will also be made to share results of models and analysis tools. The estimated cost is $1.9 million.

v. Focused Research Efforts. Specific targeted special studies are proposed to improve planning, design, and construction of the restoration projects and improve success of the overall program. These efforts would be directed at efforts to improve the understanding of the condition of the system, and improve the analysis techniques available. Initial special studies will focus on the following areas. The estimated cost is $4 million.

a. **System Ecology.** Efforts would include developing a composite system metric similar to the Chesapeake Bay (www.cbf.org). This would address items such as key species abundance, invasive species abundance, macroinvertebrate analysis, range expansion of indicator species, etc. to determine program success and remaining needs. Additional research will focus on the scalability of ecosystem metrics to develop representative characterizations of aspects of the ecosystem and provide cost efficiencies in data collection. Also, a critical aspect of the planning and evaluation of restoration projects is benefit quantification. A tool, such as Hydro Geomorphic Method (HGM) approach for basin wetlands, would be developed in order to improve project planning and the accuracy and efficiency of the benefit quantification of potential restoration projects.

b. **Aquatic Ecology.** Two issues key to the restoration of ecosystem function along the main stem river are the use of different types of habitat by fish and the factors that currently limit vegetation growth. Focused research is proposed to provide greater understanding of these issues, both of which are anticipated to contribute to refinements of management practice, restoration location needs, and evaluation of habitat restoration effectiveness.

c. **Terrestrial Ecology.** Several research efforts have been suggested to augment ongoing ecological monitoring. Specifically, studies of shorebirds, furbearers, marsh birds and bats would allow greater application of data collected by resource managers. Studies of avian reproduction and amphibian reproduction are potential indicators of habitat suitability and fragmentation, and hydrology and water quality, respectively. Focused research would evaluate the use of these functions as system indicators.

d. **Hydrology and Sediment.** Three special studies are proposed to better monitor and model the sediment dynamics in the Illinois Basin. One would evaluate the use of automated samplers—a technique that would reduce the cost of monitoring sediment—and determine methods to compare results from such sampling to historic sampling results, allowing the use of both historical data and new data to assess trends in sediment transport. The second monitoring study would focus on developing methods to better estimate bed loads in the system. A third special study would develop a systemic sediment transport model that would integrate monitoring data to evaluate basin-wide trends and transfer information from the areas being monitored to those that will not be monitored. The model would also be used to evaluate the effectiveness of different alternatives for reducing sediment delivery.

e. **Geomorphology.** Initial efforts would focus on means to improve resolution of impervious cover class in land cover and land use data sets and to evaluate slope at different data scales. These would provide improvements to landscape-scale evaluation of geomorphic processes which would thereby improve assessment of basin conditions at multiple scales.

b. Plan Design. Each element of the monitoring plan must be evaluated for relevance, technical merit, and practicality to see if it is the proper way to evaluate progress toward "endpoints" identified for its particular level of monitoring. Statistical considerations are extremely important; the issues of uncertainty and detecting change will strongly influence the number and types of sampling locations required to evaluate the anticipated effects. Data quality, anticipated measure response, and natural variability must be considered so that proposed sampling strategies and techniques are adequate to detect the changes expected from program implementation; without the statistical power to detect change it may not be worth the effort to monitor. Appropriate monitoring methodologies are efficient, produce accurate, reasonable and replicable data, and satisfy time and cost constraints.

Existing monitoring efforts provide some of the information required for the monitoring plan; where appropriate, this information will be used and augmented to provide the level of detail and coverage necessary to meet the monitoring requirements of this plan. Also, an effort was made to maximize the inter-disciplinary connections of monitoring, and to design the program to make the information usable at a number of scales (site-specific, watershed, system-wide).

c. Proposed Plan. For each goal, potential indicators of success were developed through consideration of direct measurements of objective completion, additional physical and biological measures of success, and the requirements of adaptive management. These indicators were translated into specific monitoring plan elements (Table 6-4). The monitoring plan proposal developed by the Illinois Natural History Survey team (Appendix H) provides specific measures, techniques, and strategies to monitor these elements at the main stem, sub-basin, and project levels. These overlap with the monitoring requirements in that the monitoring to evaluate ecological integrity at the main stem and sub-basin level will be used to satisfy the system-level monitoring, that the monitoring to evaluate the other goals at the main stem and sub-basin level will satisfy the goal-level monitoring, and that the project-level monitoring levels are directly comparable. The proposed system- and goal-level monitoring would amount to approximately $4 million per year. The contract report also suggests a number of focused research items for budgetary consideration. Based on scientific and stakeholder input, research efforts will be prioritized and the list of potential research projects will be refined over time to reflect changing system understanding and project needs.

d. Recommendations. A systemic long-term resource monitoring program is justified to provide additional information on the status of the ecological integrity of the system and to identify success of restoration efforts. Three levels of monitoring are recommended to best evaluate the system and effectiveness of restoration efforts. At the system-level, it is recommended that monitoring would be designed to develop a snapshot of the overall system health using system indicators. A second level of monitoring (goal-level monitoring) would evaluate the progress in each of the supporting goals, indicating progress for each particular system-limiting factor identified by the project team (e.g. reducing sediment delivery, improving backwater habitats, etc.). Since construction of individual projects is the mechanism by which goals are addressed, project-specific monitoring is also required to evaluate the effectiveness of various project attributes to advance each goal. The outputs of all monitoring efforts will be closely coordinated with project teams and form the basis for adaptive management efforts to maximize the effectiveness of restoration activities. Finally, the program should include funding to address the need for limited-duration focused studies to evaluate specific issues that arise over the course of the program, such as implications of and means to address system-limiting factors, monitoring needs and techniques, or restoration design features. The proposed system- and goal-level monitoring would amount to approximately $4 million per year. The level of site-specific project monitoring would be scaled based on the level of construction activity. Based on the large study area, complexity of the ecosystem restoration, and the opportunities for increased cost effectiveness, the funding level for the Illinois River Basin Restoration Project should be up to $4 million annually for systemic monitoring and up to 7.5 percent of the construction costs for site specific monitoring, which would equal approximately 13 percent of total program costs through 2011 and 2015. The IRBMP shall include funds for the provision of a data repository publicly accessible via the internet.

Since systemic and goal level monitoring is not currently authorized for implementation, only site specific monitoring is anticipated to be completed until 2008. Once authorized, it is anticipated that the monitoring will be phased in over approximately a 5-year period and be in full effect by 2015. Based on estimated funding levels, it is anticipated that in the initial years approximately $1 million will be available for system and goal level monitoring tasks.

The initial focus will be on filling gaps in the existing condition (baseline) data. Four goals have been established to help provide logic for sequencing the implementation of the various IRBMP components:

- Establish monitoring stations and components necessary to measure stressors identified in the conceptual ecological models
- Close the gaps in biologic, hydrologic, and water quality monitoring components in existing programs
- Initiate priority baseline research to address uncertainties in system response
- Initiate priority baseline monitoring components

While some refinements in the plan are anticipated, it is estimated that in the initial years approximately 60 percent would be used to fund physical parameter monitoring (water, sediment, and geomorphic efforts), and approximately 40 percent would be used for ecological monitoring.

Proposed focus areas for water and sediment monitoring included the Peoria Pool tributaries, Kankakee, Spoon, and LaMoine Rivers. The Spoon and LaMoine were mentioned due to potential benefits associated with more detailed monitoring activities of the state in those basins. Ecological monitoring would look at Peoria Pool, Peoria tributaries, and potentially the Kankakee and LaMoine Basins.

Table 6-4. Proposed Illinois River Basin Restoration Monitoring Program

		Monitoring Program		
Goal	**Objectives**	**Main Stem**	**Sub-Basin**	**Project**
Ecosystem Integrity	Address limiting factors, conserve and restore critical prime habitats, establish existing and reference conditions	Fish, macroinverts, aquatic vegetation, zooplankton, water quality, mussels, land use/land cover (digitized, refined and verified), waterfowl, wading birds, shorebirds, reptiles, mammals and amphibians		GIS – project type and location
Sediment Delivery	Reduce sediment delivery to Illinois River by 20%	Gaging network, backwater TSS, river surveys	Gaging network, stream channel dynamics	Channel geomorphology, project gaging
Backwaters and Side Channels	Restore 12,000 acres of backwater, protect 15 islands, restore 35 side channels	Bathymetry, sediment characterization, sedimentation rates, hydrodynamics		Fish overwintering, waterfowl, water quality, macroinvert, vegetation
Floodplain, Riparian, and Stream Habitats	Create additional 150,000 acres of wetland, prairie and forest combined on main stem floodplain and tributary riparian areas. Reduce effects of channelization on 500 miles of streams.	Land use/land cover (digitized, refined and verified)	Land use/land cover (digitized, refined and verified)	HGM, FQI, IBI, birds, amphibians, avian and amphibian reproduction
Longitudinal Connectivity	Connect tributaries to main stem, connection within tributary areas, connection along main stem			Fish, mussels, effective passage, velocities
Water Levels	Reduce fluctuations, increase baseflow, decrease peakflow, document sources of instability, drawdown	Survey of basin impervious, stream power, gaging network, annual report of basin water conditions	Annual report of tributary water conditions	Aquatic. plants, fish communities, project gaging, substrate and aerial drawdown photos
Water and Sediment Quality	Reduce adverse water quality conditions	Augment existing programs		Water quality sampling as part of biological assessments

2. Sediment Removal and Beneficial Use. Another aspect of the Technologies and Innovative Approaches component called for in Section 519 was the development and implementation of a program for sediment removal technology, sediment characterization, sediment transport, and beneficial uses of sediment. This section describes the general need for this component; various technologies and beneficial use options that are available and have been tested in the basin; further technologies, testing, and applications that should be explored; and ends with recommendations regarding further work. Much of the restoration effort will involve dredging outside of the navigation channel for environmental enhancement and will, therefore, differ in some respects from the more traditional navigation dredging.

The U.S. Army Corps of Engineers Dredging Operations and Environmental Research (DOER) Program conducts research that is designed to balance operational and environmental initiatives and to meet complex economic, engineering, and environmental challenges of dredging and disposal in support of the navigation mission. Research results provide dredging project managers with technology for cost-effective operation, evaluation of risks associated with management alternatives, and environmental compliance. The Corps of Engineers also operates the Regional Sediment Management (RMS) program. The RMS program is focused on managing sediment regionally in a manner that saves money, allows use of natural processes to solve engineering problems, and improves the environment. The Illinois DNR has worked to develop dredging and beneficial use techniques suitable for Illinois River Restoration, including projects with the Corps under the Section 519 authority.

It is anticipated that Illinois DNR will continue as a partner in future efforts under this Illinois River Basin Restoration component, and that the efforts will be coordinated with the DOER and RMS program.

a. Background. Illinois River restoration efforts will require the removal and placement of several million cubic yards of sediment. There is great variation in the size and physical setting of the many backwaters (including side channels and the Peoria Lakes) within the floodplain. These factors make it necessary to consider innovative dredging techniques, innovative methods of handling and transport, and beneficial use options and techniques in addition to conventional methods.

Conventional hydraulic dredging is an efficient and cost-effective method of removing sediment where suitable sites exist for constructing diked areas to dewater and store sediment. Mechanical dredging is commonly used for small jobs and projects where the dredged material can be placed within the reach of a crane or excavator arm, or where construction of a dewatering containment facility is not desired. Additional steps such as loading and unloading barges or trucks, mechanical dewatering, and transport from drying beds and mixing with other soil components all add costs to sediment management efforts.

Most Illinois River sediment washes from streambeds and banks, bluffs and farmland. Heavier sand and gravel particles that enter the floodplain tend to form deltas at stream mouths or move down the main channel. Backwater sediment is largely composed of fine-grained silt and clay particles that are carried farther and settle in slow moving backwaters. Thus, much of the sediment in the backwaters and side channels is similar in physical characteristics to native topsoil. It should, therefore, be possible to use these sediments as soil barring contamination.

A large number of placement and use options in various combinations could be used to accommodate millions of cubic yards of dredged sediment over the next 50 years. Some can be readily implemented with conventional dredging equipment, while others require innovative applications of new or existing equipment. An ideal development would be a device that could remove and transport sediment as readily as hydraulic dredges and place it with the consistency and water content of mechanical buckets. Given that areas outside the main channel are often a foot or less deep and the desired depth of much of the restoration is 3 to 6 feet, the ability to operate in shallow water is also desirable. Another factor is the fine-grained nature of most of the sediment that requires removal.

Innovative approaches to design and implementation are as necessary as innovative technology in a restoration project of this magnitude. The river system has degraded over more than a century, and several feet of sediment has accumulated in most areas.

b. Summary of Potential Areas of Evaluation. This section briefly summarizes areas of potential investigations of sediment characteristics, beneficial use options, and innovative dredge technology. A brief summary of some analyses conducted as part of the Illinois River Basin Restoration planning and recent State of Illinois activities is given, but additional detail is provided in Appendix D.

i. Innovative Use of Hydraulic Dredging. Hydraulic dredges could be used in a number of innovative ways. It is possible to pump material for miles if suitable areas are not available near the dredging location. A pipeline over 20 miles long was used when the White Rock Reservoir was dredged in Dallas to deposit material in an old mining pit. When quantities are great enough, such distances are not out of the question along the Illinois River. Corridors could follow existing highways, railways, streams, storm sewers, and the river itself. Such a system could deliver dredged material to a number of mined areas in Illinois. It may also be possible to use out-of-service gas or oil pipelines to transport slurried dredged material.

Several companies have used mechanical dewatering systems in conjunction with hydraulic dredges. The systems separate most of the water from the sediment and then run it through a belt press. It can then be placed directly into trucks or stockpiles. These systems could be used to dewater sediment piped from miles away for island construction, loading into barges or trucks, placing on fields or other purposes. Polymers can be used in the mechanical processes to speed thickening in the tanks or in dewatering ponds. Among other things, the polymers allow the discharge to meet regulatory standards with less holding time.

ii. Sediment Handling and Transport Technology

a. Conveyors. Conveyor belts have the potential to effectively extend the reach of excavator and crane mounted clamshell buckets. Backwater sediment excavated be placed on islands, on shore, or in trucks that are within reach of the excavator. In order to use large buckets in backwaters, it is necessary to dig deep enough to bring in a floating crane. If material is to be moved beyond the arm's reach, it must generally be loaded onto a barge that may require additional depth. A floating conveyor could operate in shallow water and transport material considerable distances to islands, the shore or barges in the channel.

Some trial demonstrations were conducted to evaluate this transport and handling option (Marlin 2003a and Marlin 2003b). These demonstrations show that backwater sediment can be conveyed with conventional equipment. A system dedicated to sediment should have some modifications from the concrete system. Such features as the hopper and transfer points could have more clearance and splatter could be better controlled.

Floating conveyors over 2,000 feet long are used in the sand and gravel industry and presumably could be designed for use on the Illinois River backwaters. Given the shallow nature of the backwaters, the floating conveyor would be most useful if it drew a foot or less of water. Pipe conveyors are another option. These systems use additional rollers to fold the conveyor belt over itself so that material is contained inside. It unfolds at each end for loading and discharging. These conveyors can curve without using a transfer point.

b. Positive Displacement Pumps. Positive displacement pumps are commonly used for handling concrete and various slurries. They have been used for to handle sediment in several situations. Their main advantage is the ability to deliver sediment without adding large volumes of water. Large pumps can handle over 500 cubic yards per hour and pumping distances in excess of 2,500 yards are attainable. The quantity pumped generally decreases with distance. Two demonstrations of these pumps were conducted with Illinois River sediment in 2002 (Marlin 2002) and (Marlin 2003a). These demonstrations showed the promise of these technologies.

For use in backwater restoration, existing concrete pumps could be placed on floats or work barges and fed with an excavator or crane. The material could then be pumped onto an island, to shore, into geotextile tubes, or into barges or trucks. A placing boom could be mounted on a barge or on shore to place the sediment in a specified pattern and depth. Equipment of this type could provide great operational flexibility, especially where shallow depths are desired and building containment berms is not an option.

c. Barge Transport. Sediment was barged to a Chicago landfill site in the fall of 2002 in order to evaluate the feasibility of moving backwater sediment long distances using conventional equipment (Marlin 2003b). Nine hundred tons of material dredged from Lower Peoria Lake was placed in a barge with a clamshell bucket. The bucket was heaped to minimize the amount of free water placed in the barge. The barge was towed 163 miles to a Chicago dock on the waterway and unloaded into trucks for the 1-mile trip to the landfill. The material presented no serious handling difficulty and the trucks and barge cleaned normally after the project.

In 2004, the State of Illinois moved 68 barge loads of Peoria Lake sediments to the Chicago Lake front to restore a portion of the 100 acre former U.S. Steel site as part of the State's "Mud to Parks" demonstration. This project further demonstrated the potential feasibility of transporting river sediment relatively long distances to utilize these sediments as a resource.

iii. Placement Options. In many restoration projects dredged material is used to create islands or increase existing land elevations. However, due to the scale of restoration needs, only a limited amount of material can be used to develop islands, increase existing island elevations, and create wind and wave breaks in backwaters. Such structures will restore some of the features of the original system that were lost when water levels were increased during the last century, including: adequate elevations to support native floodplain hardwood trees; relatively isolated areas for wildlife to rest, forage, or nest; and structure to break waves reducing sediment re-suspension.

Sites capable of holding large quantities of dredged sediment either permanently or for later use exist in the basin, but not always in proximity to backwaters needing restoration. Potential placement options include gravel pits, strip mines, and fields. The material can be dewatered behind a dike or dried and piled to any desired shape. A mound could be several stories high and as long and wide as desired.

The bulk of the material in the backwaters is quite similar to topsoil. Clean sediment could be used for landscaping, landfill cover, restoration of mine land and industrial sites, amending agricultural soil, and as bagged soil. Some sediment is suitable for use as construction fill, levee repair, and other projects depending upon its physical properties. If options with commercial value are found, it may be possible to offset all or part of the cost of some restoration dredging.

One technology the State of Illinois has evaluated on a limited scale is geotubes. Four 15-foot-circumference tubes were placed in shallow water in Upper Peoria Lake in conjunction with the Drydredge ™ demonstration in May of 2001. They were filled with the DryDredge™. They formed an island about 50 feet on a side that was filled with sediment at near *in situ* moisture content.

iv. Beneficial Use

a. Dredged Sediments as Soil. Landscaping soil is a potential beneficial use of large quantities of sediment removed from water bodies, and the chemical and physical properties of the dredged material will largely determine its suitability. Sediment from the Illinois River valley has properties that indicate that it would make excellent landscaping soil. Much of the sediment found in the Illinois River valley originated from eroded fertile rural areas. Consequently, it contains less pollution in the form of heavy metals and other chemical contaminants than is typically found in sediments from urban or industrial areas. Some compounds found in sediments, such as ammonia, that are often toxic in an aquatic environment, may be beneficial to plants when placed on land. A variety of tests have shown that the germination and growth of a variety of plants in sediment and central Illinois topsoil was essentially equivalent (Darmody and Marlin 2002, Darmody et al, 2004 in press). The conclusion is that sediments can serve as well as natural, high quality topsoil as a plant growth medium in the greenhouse.

b. Amendment to Sandy Agricultural Soil. Crop production on sandy soil amended with Illinois River sediment is under study by University of Illinois soil scientist Dr. Robert Darmody with funding from the state. Preliminary results indicate that sediment moderates fluctuations in soil temperature and significantly improves moisture-holding capacity in sandy soil. Seed germination and plant growth were also greater on sediment plots. During the 2003 season corn yields were greater on all sediment plots. Plots with 6 to 12 inches of sediment produced over 3.5 times the yield of untreated sandy soil plots. Soybean yields were not as dramatic, although the 6-inch treatments produced statistically higher yields than the controls or other sediment plots. The 6-inch incorporated plots produced 1.6 times the yield of the controls.

Sandy soils are found in several counties bordering the Peoria and La Grange Pools. Given the nearness of some fields to the river and backwaters, it may be feasible to pump sediment directly to fields or transport it short distances by other means. Further study will help determine whether sediment will improve soil conditions enough to warrant placement onto sandy fields. Placing a 6-inch layer on a 100-acre field would require about 80,600 cubic yards of sediment.

c. Sediments Used for Greenhouse Applications. In terms of standard agronomic parameters such as plant growth, results confirm previous work that established that sediments from the Peoria Lakes reach of the Illinois River make excellent topsoil material. Both legume and grass plants grew well in all sediment mixtures and improved the plant growth potential of unleached biosolids. Addition of biosolids to sediment mitigates some of the problem with growing plants directly in sediments or biosolids. Pure sediments may have poor physical characteristics, at least initially under some field conditions. Pure biosolids have excessive salts that inhibit plant growth, particularly legumes, as evidenced by the death of some snapbean plants on 100 percent biosolids. The sediments may experience improved tilth and higher plant nutrient content under field conditions when mixed with biosolids.

c. Recommendations. Innovative Sediment Removal and Beneficial Use Technologies will be evaluated and tested to evaluate more ecologically sound, cost effective, and beneficial ways to dredge and place material. These efforts would be closely coordinated with ongoing Corps activities related to dredging and regional sediment management. Potential efforts include summaries of lessons learned from past dredging projects, demonstrations of various methods to build islands, use of geotextile tubes and other means of forming narrow windbreaks to reduce wave action and re-suspension of sediments, utilize sediments on farmland as a soil amendment, transport options (pumps, pipeline, rail, barge, etc.) and evaluate various innovative technologies and methods.

Another concept to be explored involved project and construction sequencing. A promising implementation option may involve a contractor removing incremental amounts of sediment from several locations in a river reach at different times during the first year and repeating the process over several years until the desired depths are met. This would allow the material at the placement sites to consolidate or be removed for use in more manageable quantities. It would likely require less land and construction at the placement site. This approach is similar in principle to some maintenance dredging contracts that cover river reaches.

In regard to beneficial use, the chemical and agronomic character of deposited sediment and the underlying original bottom in backwaters should be determined in order to identify restoration sites where beneficial use is a viable option. The initial work should require a few samples for chemical contamination and a larger number for characterization of suitability for use as soil or fill. A market analysis for sediment by itself or mixed with other material as a bagged or bulk soil would be useful. The material on the deltas is sandy and is likely to be useful as fill or in some cases commercial sand. Cores of this material should be taken and evaluated. There is a need for such material at construction and brownfield redevelopment sites near the river and in the Chicago area. The feasibility of moving these deposits by barge, rail and truck needs to be investigated. In addition, sediment could be used as the basis for flowable fill, to be used in utility, road repair, and other construction applications.

Additional testing and use of innovative technologies and beneficial use options are recommended. This is justified based on the fact that restoration of depth diversity within the Illinois River Basin is a major goal that will require dredging and placement. In addition, a wide range of potential technologies and uses exist that merit further exploration.

D. DIVISION OF PLAN RESPONSIBILITY

This section presents the requirements for implementing the Recommended Plan, including Federal and non-Federal cost sharing, and the division of responsibilities between the Federal Government and the non-Federal sponsor, the Illinois DNR and potentially others. It also lists the major milestones necessary for project approval, and a schedule of milestones associated with designing and constructing the Recommended Plan.

1. Recommended Plan Cost Sharing. Federal and non-Federal cost sharing for the Recommended Plan is in accordance with Section 210 of WRDA 1996, which establishes the cost-sharing rules for projects authorized after October 12, 1996, and Section 519 of WRDA 2000, with cost-sharing provisions for this project. Section 519 specifies that the non-Federal share of the cost of projects and activities shall be 35 percent, with no more than 80 percent of the non-Federal share from in-kind services. The Non-Federal Sponsors will provide 100 percent of any lands, easements, rights-of-way, relocations of utilities or other existing structures, and disposal areas (LERRD). The value of LERRD will be included in the non-Federal 35 percent share. Where the LERRD exceed the non-Federal Sponsor's 35 percent share, the sponsor will be reimbursed for the value of the LERRD that exceed the 35 percent non-Federal share. The non-Federal Sponsor is also responsible for 100 percent of the costs for operation, maintenance, repair, rehabilitation, and replacement (OMRR&R) of project features. Table 6-6 breaks out these estimated program costs.

Table 6-6. Summary of Tier I Cost Sharing - $153.85 million ($100 million Federal)

Illinois River Basin Restoration		**Non-Federal**		**Federal**	
Project Feature	**Cost**	**%**	**Cost**	**%**	**Cost**
First Cost of Construction	$126,960,000	35	$44,440,000	65	$82,520,000
Program Cost	$26,890,000	35	$9,410,000	65	$17,480,000
Total Restoration Program	$153,850,000	35	$53,850,000	65	$100,000,000
LERRD Credit	$30,000,000	100	$30,000,000	0	$0
Cash	$123,850,000	100	$23,850,000	0	$100,000,000
OMRR&R (average annual)	$125,000	100	$125,000	0	$0

2. Federal Responsibilities. The Federal Government would provide 65 percent of the first cost of implementing the Recommended Plan, including a restoration implementation program, a technologies and innovative approaches component, and system management, which is estimated to total $100 million. In addition to its financial responsibility, the Federal Government would:

a. Complete assessments, project reports, plans and specifications, and construction of the Recommended Plan.

b. Implement the Technologies and Innovative Approaches Component including

1. Illinois River Monitoring Program (including Long Term Resource Monitoring, Special Studies, and Computerized Inventory and Analysis System) to evaluate system trends and performance of restoration projects.
2. Evaluate innovative dredging technology and beneficial use options.

c. Administer and manage contracts for construction and supervision of the program after authorization, funding, and execution of a Project Cooperation Agreement with the Illinois DNR.

3. Non-Federal Responsibilities. The Illinois DNR and other local sponsors would be responsible for providing 35 percent of the First Cost of implementing the Recommended Plan. The 35 percent share of the project cost includes the Illinois DNR's and other sponsors responsibility for providing all LERRD. The estimated non-Federal costs are $53,850,000, which includes $23,850,000 in cash with $30,000,000 in LERRD credit.

The Illinois DNR and other local sponsors would also be responsible for OMRR&R of project features.

The Illinois DNR and other local sponsors also would be required to provide certain local cooperation items based on Federal law and policies. The items of local cooperation are:

a. Provide a minimum of 35 percent of total project costs as further specified below:

1. Provide, during the first year of construction, any additional funds needed to cover the non-federal share of design costs;
2. Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Federal Government to be necessary for the construction, operation, and maintenance of the project;
3. Provide or pay to the Federal Government the cost of providing all retaining dikes, wasteweirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for the construction, operation, and maintenance of the project; and
4. Provide, during construction, any additional costs necessary to make its total contribution equal to 35 percent of total project costs;

b. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement;

c. Do not use Federal funds to meet the non-Federal Sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized;

d. Operate, maintain, repair, replace and rehabilitate the project, or functional portion of the project, including mitigation, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

e. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal Sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the Non-Federal Sponsor of responsibility to meet the Non-Federal Sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance;

f. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the United States or its contractors;

g. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the Non-Federal Sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction;

h. Assume, as between the Federal Government and the non-Federal Sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project;

i. Agree that, as between the Federal Government and the Non-Federal Sponsor, the Non-Federal Sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that will not cause liability to arise under CERCLA;

j. Prevent obstructions of or encroachments on the project (including prescribing and enforcing regulations to prevent such obstruction or encroachments) which might reduce the level of protection it affords, hinder operation and maintenance, or interfere with its proper function, such as any new developments on project lands or the addition of facilities which would degrade the benefits of the project;

k. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as will properly reflect total costs of construction of the Project, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

l. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5), and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

m. Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army", and all applicable Federal labor standards and requirements, including but not limited to 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act(formerly 40 U.S.C. 327 *et seq.*) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c *et seq.*); and,

n. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, necessary for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

E. INSTITUTIONAL REQUIREMENTS

1. Sponsorship Agreement. Prior to the start of construction for each restoration project, the Illinois DNR will be required to enter into a Project Cooperation Agreement (PCA) with the Federal Government and satisfy State laws and all applicable regulations. In general, the items included in the PCA have been outlined in the previous paragraphs.

2. Local Cooperation. The Illinois DNR provided a letter of intent on June 30, 2004, indicating their support for the Recommended Plan and their willingness and intent to execute PCAs for the Critical Restoration Projects including providing the non-Federal required assurances.

3. Project Management Plan. A Project Management Plan (PMP) for implementation of the Recommended Plan will be prepared for the final report. The PMP will describe activities, responsibilities, schedules and costs required for the continuation and implementation of the project.

4. Plan Implementation. Future actions necessary for authorization and construction of the recommended plan are summarized below:

a. The U.S. Army Corps of Engineers, Mississippi Valley Division Commander will review the final report.

b. This report will be submitted for review by the Headquarters of the U.S. Army Corps of Engineers, Washington D.C. and the Civil Works Review Board will be convened to determine if the report is releasable for state and agency review.

c. The 30-day state and agency review, to seek comments from the state of Illinois and interested Federal agencies, and coordination of the Environmental Assessment will be ongoing concurrently during the HQ USACE review.

d. Following State and agency review, a Director's Report will be prepared and it, along with the report will be sent to the Assistant Secretary of the Army for Civil Works.

e. Upon approval of the Assistant Secretary, the report will be forwarded to the Office of Management and Budget to obtain the relationship of the project to programs of the President. Prior to the transmittal of the report to the Congress, the non-Federal sponsor, the State of Illinois, interested Federal agencies, and other parties will be advised of any significant modifications made to the recommendations and will be afforded an opportunity to comment further.

f. The Director's Report will then be forwarded by the Assistant Secretary of the Army for Civil Works to Congress.

g. Congressional review of the feasibility report/comprehensive plan and possible modification to the existing authorization of the project would follow, generally as part of a WRDA.

h. Pending continued authorization for construction; the Chief of Engineers could include funds, where appropriate, in his budget requests for continuation of the project and construction.

i. Following existing implementation guidance, planning, preconstruction engineering, and design for restoration projects would be initiated and surveys and detailed engineering designs would be accomplished.

j. Following completion of plans and specifications for each Critical Restoration Project, formal assurances of local cooperation would be required from non-Federal interests.

k. The Illinois DNR will be required to provide all real estate requirements for project implementation.

l. Bids for construction would be initiated and contracts awarded.

m. Upon completion of construction, the project will be turned over to the Illinois DNR or other sponsors, who will be responsible for OMRR&R in accordance with guidelines provided by the Corps of Engineers.

5. Project Implementation Schedule. The schedule for the Plan is for the final report to be forwarded to the Mississippi Valley Division in April 2006 and for the Director's Report to be issued in August 2006. Execution of the PCAs for the initial Critical Restoration Projects are expected in FY 2006 and 2007. Work to be accomplished includes continuing Critical Restoration Projects as part of a restoration implementation program and adding a technologies and innovative approaches component and system management. Completion will depend on annual funding and the timing of construction authorization. A Report to Congress describing the accomplishments of the programs and any need for adjustments will be prepared in 2011.

6. Views of Non-Federal Sponsor(s) and Any Other Agencies with Implementation Responsibilities. The Non-Federal Sponsor the State of Illinois, acting through the Illinois DNR, is in support of the draft recommended plan and is interested in continuing efforts to proceed to construction on the initial Critical Restoration Projects. In addition the Indiana DNR and Kankakee River Basin Commission have expressed interest in participating in projects within their jurisdiction.

The State of Illinois, Office of the Governor, provided a letter of intent on June 30, 2004. The letter extends the State's full support for Alternative 6 and recommendation set forth in this Plan document. The letter also requests that work continue to proceed towards construction with the signing of Project Cooperation Agreements (PCAs) for the initial Critical Restoration Projects including Peoria Riverfront Development – Upper Island, Pekin Lake Northern Unit, and Pekin Lake Southern Unit.

In addition to the State of Illinois, the potential exists for both the States of Indiana and Wisconsin to participate in projects within their portions of the watershed as well as other potential local sponsors. The Indiana DNR submitted a letter on September 16, 2004 expressing interest in serving as a sponsor in restoration efforts under this authority. The Kankakee River Basin Commission, consisting of 24 members from eight Indiana Counties in the drainage basin submitted a letter on September 10, 2004 expressing interest in potential partnerships along the Kankakee and Yellow Rivers.

Note: Other letters and comments received during the public review period will be added prior to distribution of the final report.

7. SUMMARY OF COORDINATION, PUBLIC VIEWS, AND COMMENTS

This section provides a summary of the public views and comments associated with efforts to educate and involve individuals and groups with an interest in the study. The section concludes with a summary of National Environmental Policy Act (NEPA) coordination and correspondence.

A. PUBLIC VIEWS AND COMMENTS

1. Public Involvement. This section discusses activities undertaken to involve the public throughout the development of the Illinois River Basin Restoration Comprehensive Plan (Plan). The public includes the study's cost-sharing partner, the Illinois Department of Natural Resources (DNR); elected congressional representatives; Federal, State, county, and city governmental agencies; environmental groups/organizations; farm bureaus; levee and drainage districts; businesses; media; and the unaffiliated general public. The scoping process, that is, the effort to discover the significant issues of any given project, associated with the Corps planning process was also applied to the National Environmental Policy Act (NEPA) scoping requirement at the appropriate level. Informal discussions concerning this program have taken place with the appropriate points of contact of the States of Wisconsin and Indiana. In addition, States of Wisconsin and Indiana will be provided the Plan for review and comment during the public review process.

Throughout any planning effort, the Corps of Engineers (Corps) strives to inform, educate, and involve the many groups who may have an interest in the plan. This coordination is paramount to assuring that all interested parties have the opportunity to be part of the planning process.

One process used for coordination is the public involvement process. Public involvement is the exchange of information with various segments of the public, designed to reduce unnecessary conflict and achieve consensus. The goal is to open and maintain channels of communication in order to fully consider public views and information in the planning process.

An effective public involvement program must identify and respond to as many affected publics as possible throughout the study process and consider their input in the study's decision-making process. Content analysis is the method employed to identify public opinion, study concerns, and potential controversy. It ensures that the public involvement plan is responsive to the level of interest and concern expressed by the public, and it assesses the effectiveness of the public involvement techniques.

The main avenues for providing information to and receiving feedback from all of the publics were through the study's newsletters, open houses, and public meetings. Newsletters provided points of contact for the publics' questions and comments. The open houses and public meetings allowed for an information exchange between the attendees and the study team. The public also was made aware of study activities via the study website (www.mvr.usace.army.mil/ILRiverEco/default.htm).

The following is a discussion of the two major public involvement efforts—Study Initiation Open House and Public Meetings—that were conducted during the study process.

2. Study Initiation Open Houses. In November 2000, a study newsletter was mailed to over 1,600 addresses notifying the public of the study's initiation and inviting them to attend a cost-sharing signing ceremony and a public open house following the ceremony. The newsletter also described the study area; provided the study background; discussed coordination efforts; invited the public to attend one of six additional public open houses scheduled throughout the study area; and listed the Corps and Illinois DNR points of contact for comments or questions. In addition, three news releases to media outlets (television, radio, and newspaper) in the study area provided information about the cost-sharing signing ceremony and the public open houses. The cost-sharing signing ceremony and first open house were held in Peoria, Illinois, on November 29, 2000. The ceremony, sponsored by Congressman Ray LaHood (IL-18), formally signified the partnership formed by the Rock Island District of the Corps of Engineers and the Illinois DNR to execute this study.

Six additional open houses were scheduled to be held in December 2000; however, due to inclement weather, three of the meetings were rescheduled for February 2001. A supplemental newsletter and news release announcing the rescheduled meetings were issued in January 2001.

Copies of the newsletter, supplemental newsletter, and news releases are attached in Appendix A. The newsletters also are available on the study's website. The following table shows the dates and locations of the open houses.

Date	Location
November 29, 2000	Gateway Center Peoria, IL
December 4, 2000	Interstate Center Bloomington, IL
December 5, 2000	Kankakee Civic Auditorium Kankakee, IL
December 6, 2000	Beecher Community Building Yorkville, IL
February 20, 2001	Pere Marquette State Park Lodge Grafton, IL
February 26, 2001	Starved Rock State Park Lodge Utica, IL
February 27, 2001	Western IL University Union Macomb, IL

a. Purpose. The purpose of the open houses was to provide the public with the opportunity to learn about the ecosystem restoration study; to discuss, on a one-to-one basis, information on the range of alternatives for restoring the environment in the Illinois River watershed; and to gather comments on the alternatives and problems in the area. The open house format allowed ample opportunity for the public to visit the displays at their convenience, and to talk with Corps and Illinois DNR study team members.

b. Displays. The Corps provided three display with study information—maps, photographs, and graphic—on Illinois River Ecosystem Restoration Study, Illinois River Watershed Restoration Efforts, and Illinois River Ecosystem Restoration Study Efforts.

The Illinois DNR provided several displays explaining river modeling, sediment budget, Conservation Reserve Enhancement Program (CREP), Watershed Conservation 2000, dredging, and plants and sediment block. A video entitled *Constructing Riffles and Pools for Stream Rehabilitation* also was available for viewing. The Illinois State Water Survey provided extensive material on a summary of research on the Illinois River and Peoria Lake.

c. Attendance. Total open house attendance for all locations was 195. The numbers were smaller than anticipated; however, attendees did spend considerable time viewing the displays and discussing relevant topics with study team members. Attendance at each location is as follows:

Location	Attendance
Peoria	72
Bloomington	14
Kankakee	37
Yorkville	8
Grafton	17
Utica	32
Macomb	15

d. Public Comments. Open house attendees were asked to complete a comment sheet at each session. Sixty-one percent of the attendees completed comment sheets. Overall, comments were very favorable regarding the open house format, displays, and the goals of the study. The table below summarizes the responses from study-specific question on the comment sheets. As some statements were not answered, not all rows total 100 percent.

Statement	Agree	Neutral	Disagree
I support ecosystem restoration efforts along the Illinois River and its tributaries.	94%	5%	0%
In the Illinois River Basin, the principal problems limiting aquatic and associated fish and wildlife habitat are:			
• loss of backwaters and side channels due to sedimentation	90%	2%	2%
• destabilized tributary streams	87%	3%	2%
• changed hydrologic regimes and water fluctuations	80%	10%	2%
• other impacts on the system	53%	14%	0%
In my opinion, study and eventual restoration efforts should focus on:			
• watershed/tributary restoration	80%	3%	0%
• side channel and backwater restoration	75%	5%	1%
• water level management	50%	20%	2%
• floodplain restoration and protection	71%	9%	2%

The comment sheet also provided space for additional participant comments, summarized as follows:

Issues supporting the restoration study efforts included:

- the study and projects are long overdue
- the study needs to be completed before it is too late
- the interested groups need to work together to be more effective and successful

The principal problems affecting aquatic habitat in the Illinois River Basin were described as:

- farmland erosion
- agricultural contaminants in river
- sediment
- lack of aquatic plant growth

Many additional remarks about the study efforts stated that all four of the focus areas are interrelated, and that by addressing these issues solutions to other problems would fall into place naturally.

e. Open House Summary. This series of public open houses covered a wide geographic region throughout the study area. The open houses met the objective of providing residents in the study area the opportunity to meet with study representatives and to comment on the range of study alternatives. Although there were not a large number of attendees, those who did attend offered many comments that assisted the study team as they worked toward selecting a recommended plan. In addition, those in attendance who were not on the study's mailing list were added to the list.

3. Team Meetings to Discuss Goals and Alternatives. Following the Study Initiation Open Houses, team members from the Corps and the Illinois DNR study met several times to develop goals for ecosystem restoration and alternatives to address these goals. Regular stakeholder and inter-agency steering committee meetings were also held. In addition, the study was discussed at the 2001 and 2003 Governor's Conferences on the Illinois River.

4. Site-specific Open Houses. Site-specific open houses were held for Waubonsie Creek in Oswego and Montgomery, Illinois, in July 2002, and for Pekin Lake in Pekin, Illinois, in August 2002. Open houses will be held at additional site-specific locations where study results show projects to be justified and funded.

a. Waubonsie Creek Open Houses. Two site-specific open houses were held for the Waubonsie Creek project in July 2002. The first open house was held on July 1, 2002, at the Illinois Village Hall, Montgomery, Illinois. The second open house was held on July 9, 2002, in the Community Room of the Law Enforcement Center (Police Station), Oswego, Illinois. The open house was publicized in at least two local newspapers and through open house invitations mailed to 243 individuals on the study mailing list, including congressional representatives; Federal, State, county, and city agencies/representatives; businesses; media; and the general public.

Purpose. The purpose of the open houses was for the public to view the proposed project plan and talk one-on-one with the study team during the public review phase. The open house also served as a forum for gathering comments on the recommended plan.

Format. One open house session was held from 5-8 p.m. at each location. Subject matter experts from the Corps of Engineers and the Illinois Department of Natural Resources were available to answer questions on all facets of the proposed project.

Displays. The Corps of Engineers provided photographs and graphics of the project area, a display depicting the Illinois Waterway System, information about the Waubonsie Creek Development Study, and general Corps of Engineers information. The Illinois Department of Natural Resources provided two complementary displays addressing the proposed environmental effect of the project.

Attendance. Approximately 19 visitors attended the open house in Montgomery; approximately 22 attended in Oswego.

Public Comments. Meeting attendees were asked to complete a comment sheet. Twelve comment sheets were returned at the Montgomery open house; 16 were returned at the Oswego open house.

All of the respondents agreed that the open house provided an opportunity to gain a better understanding about the study's goals and purposes, while most agreed that the open house provided an opportunity to gain a better understanding about the study's recommended plan. All agreed that the open house provided an opportunity for everyone to offer comments about the study's recommended plan and that they had a change to talk to a study team member. All felt that the information provided on the displays was valuable in helping them understand the study's recommended plan. In addition, the majority agreed that they understood how the Waubonsie Creek Site Specific Project fit in with the overall purpose of the Illinois River Ecosystem Restoration Study.

None of the attendees disagreed with the plan. There were few actual comments; however, some expressed concern about debris removal and some expressed their desire to See the project progress more quickly.

Summary. Both open houses met the objective of providing residents in the study area an opportunity to meet with study representatives, to hear how the study plan was selected, and to ask questions and offer feedback on the recommended plan.

b. Pekin Lake Open House. An open house was held August 6, 2002 in Pekin, Illinois. The purpose of the open house was to provide information on the study status and on the alternatives being considered for restoring the environment within the Illinois River watershed along the Pekin riverfront and to gather comments on the alternatives. Corps of Engineers, Illinois Department of Natural Resources, and Illinois State Water Survey representatives were present at the open house to discuss the study with the public on a one-to-one basis and to receive the public's comments.

A total of 55 people attended the open house. Of those, 27 percent (15) returned comment sheets.

Overall, comments were very favorable regarding the open house format, displays, and the goals of the study. A strong majority of attendees agreed:

- That the open house provided an opportunity to gain information and a better understanding of the study, that the materials and displays were informative, and that they had a chance to talk to a study team member and offer comments about the study.
- That the goal of the study should be to create and restore aquatic, wetland, and terrestrial habitats and provide ancillary recreation benefits.

The majority of questions asked during the question and answer sessions were directed at how the project would affect boating, fishing, hunting, water quality, and flood heights. Ducks Unlimited provided formal written comment on the project that raised several issues. The issue of most concern regarded the adequacy of a 1,000 gallon per minute groundwater well and pump to provide water to the Northern Unit. Subsequently, the study team reevaluated the well and pump design and made appropriate modifications to address these comments.

Public Views and Comments – August 2004 Open House. In September 2004, a final public meeting will be held in conjunction with the public review of the feasibility report and Environmental Assessment. Public input provided at this meeting and throughout the public review process of the documents will be included in the final report.

Summary. Various publics were identified as target audiences for public involvement and coordination, including elected congressional representatives; Federal, State, county, and city agencies; environmental groups/organizations; farm bureaus; businesses; media; and the unaffiliated general public.

The goals of the coordination process are to inform, educate, and involve the public and solicit feedback through open communication and to include in the plan formulation process all publics interested in and affected by the study recommendation(s).

The public open houses provided the public with opportunities to become informed and educated about the study and involved in the study by providing feedback to the study team. The feedback was gathered, analyzed and used by the study team to shape the plan formulation process and to develop the recommended plan. The study plans that are included in this report have been influenced by the public involvement process.

5. Public Meetings. After the study team developed draft goals and preliminary alternatives, a round of meetings with the public was scheduled. In November 2003, a study newsletter was mailed to a distribution list that had grown to over 1,900 addresses. The newsletter summarized the November and December 2000 and February 2001 open houses; focused on the study's goals and alternatives; and invited the public to attend one of a series of public meetings to be held in December 2003. The Corps and the Illinois DNR points-of-contact for comments or questions were again listed. A news release was issued to media contacts in the study area. Copies of the newsletter and news release are attached in appendix A.

The following table shows the dates and locations of the public meetings.

Date	Location
December 1, 2003	Knights of Columbus Hall Mt. Sterling, Illinois
December 2, 2003	Wildlife Prairie Park Hanna City, Illinois
December 3, 2003	Quality Inn and Suites Bradley, Illinois
December 4, 2003	Hilton Lisle/Naperville Lisle, Illinois

a. Purpose. The purpose of the public meetings was to provide a study update; discuss the draft alternatives being considered at this point in the study; discuss the level of restoration for areas within the Illinois River Basin; and to gather public comments on the draft alternatives.

b. Format. Two sessions were held at each location: an open house from 2-4 p.m. and a public meeting from 6-8 p.m. The afternoon session was informal and allowed ample opportunity for the attendees to visit the displays and talk to Corps and Illinois DNR study team members on a one-to-one basis. The evening session consisted of a formal presentation beginning at 6 p.m., followed by questions and answers and statements.

c. Displays. The Corps provided two displays which included a study map; information on the vision, goals, and alternatives of the program; and complementary photographs.

The Illinois DNR displays consisted of a poster on Natural Grade Control and Stream Channels and two videos entitled *Constructing Riffles and Pools for Stream Rehabilitation* and *Watershed Causes of Channel Erosion.*

Handouts included the November 2003 study newsletter, a copy of the slides used during the formal presentation, and a comment sheet. These handouts, plus the full text of the presentation, were made available on the study's website.

d. Attendance. A total of 153 persons attended the public meetings, as follows.

Location	Attendance	Afternoon/Evening
Mt. Sterling	36	20 afternoon/16 evening
Hanna City	30	16 afternoon/14 evening
Bradley	78	28 afternoon/50 evening
Lisle/Naperville	9	3 afternoon/6 evening

e. Public Comments. Public meeting attendees were asked to fill out a comment sheet after each session. A total of 43 sheets, or 28 percent, were returned. Most of the 43 respondents agreed that the meeting provided an opportunity to gain information and obtain a better understanding of the study. Overall, comments were favorable regarding the open house format and displays, and over 75 percent of the respondents felt that attending the meeting was worth their time.

The following table shows the breakdown of the respondents' primary areas of interest in the study.

Area of Interest	Percent
Environmental	35%
Personal Interest	16%
City/County Government	12%
Regional Planning	12%
Agriculture	7%
State Government	5%
Other Business/Industry	5%
Education	2%
Federal Government (Congressional)	0%
Federal Government (All Other)	0%
Media	0%
Recreation	0%
Waterborne Industry	0%
No Answer	6%

Attendees were asked to agree or disagree with statements concerning the appropriateness of alternative plans. Data is given in the following table.

Study Process Statements	Agree	Neutral	Disagree
I understand the principal ecosystem restoration problems which are being addressed by this study.	91%	5%	4%
The range of alternative plans presented to maintain and restore biodiversity and sustainable populations of native species is appropriate.	77%	12%	11%
The range of alternative plans presented to reduce sediment delivery to the Illinois River is appropriate.	67%	7%	26%
The range of alternative plans presented to restore aquatic habitat diversity of side channels and backwaters is appropriate.	70%	19%	11%
The range of alternative plans presented to improve floodplain, riparian, and aquatic habitats and functions is appropriate.	70%	21%	9%
The range of alternative plans presented to restore and maintain fish passage is appropriate.	56%	35%	9%
The range of alternative plans presented to reduce unnatural water level fluctuations is appropriate.	51%	37%	12%
The range of alternative plans presented to improve water and sediment quality in the Illinois River and its watershed is appropriate.	60%	19%	21%

The public was asked additional questions about the study, and responses are summarized below:

- The majority of respondents agreed that the restoration goals are appropriate to achieve the desired ecosystem restoration needs in the Illinois River Basin.
- Most agreed that the alternative plans presented address the appropriate range of alternatives for ecosystem restoration in the Illinois River Basin.
- The major concerns respondents expressed by respondents were related to sediment delivery and funding issues.

f. Public Meeting Summary. The public meetings met the objective of discussing both the alternatives being considered in the study and the level of restoration for areas within the Illinois River Basin, and gathered the public's comments on the draft alternatives. The dialogue between study team personnel and the public was informative, and feedback received will be used by the study team in selecting a draft recommended plan.

6. Summary of Public Involvement Process. The public was kept informed and involved throughout this process through several avenues—newsletters, public open houses, public meetings, and the study's website. These activities provided the public with numerous opportunities to provide feedback to the study team. This feedback was used by the study team during the plan formulation process; thus, the draft recommended plan has been influenced by the public involvement process. In addition, the study's mailing list grew to almost 2,100 names, primarily as a result of the public involvement activities. Therefore, the goals of the process—(1) opening and maintaining channels of communication with the public in order to give full consideration to public views, and (2) gathering information for use by the study team—were met.

B. NEPA COORDINATION

Section 519 of WRDA 2000 defines the Illinois River Basin as the Illinois River, Illinois, its backwaters, its side channels, and all tributaries, including their watersheds, draining into the Illinois River. Upper reaches of this program area are located outside the Illinois State boundaries, confined to the southeast corner of Wisconsin (headwaters of the Fox and Des Plaines Rivers) and the northwest corner of Indiana (headwaters of the Kankakee and Iroquois Rivers). The original coordination efforts for this program did not include any area outside the boundaries of Illinois. In the event that future projects associated with the program are proposed within the state boundaries of Wisconsin and/or Indiana, individual coordination with appropriate Federal and State agencies would be conducted for compliance with NEPA and other Federal laws and policies applicable to all plans recommended for implementation.

The NEPA scoping process for the EA included coordination letters, public meetings, newsletters, and regularly scheduled meetings with the non-Federal sponsor.

Although a certain amount of risk and uncertainty is inherent for any such undertaking as this, the human environment would not be exposed to any unusual or unique risks or any extreme uncertainties that could lead to significant effects on the human environment. Risk and uncertainty for Goals 1 through 5 can be found in Section 3, of this report, *Plan Formulation*. Given the beneficial nature of this ecosystem restoration program, implementation activities should not result in highly controversial impacts on the quality of the human environment. Overall project uncertainty is reduced by incorporating a comprehensive monitoring plan as well as adaptive management techniques.

All coordination letters from the Rock Island District for this program are found at the end of this section. Coordination was initiated early and continued throughout the plan formulation process. The following agencies received the NEPA coordination letter dated March 24, 2003:

Federal Emergency Management Agency, Region 5
U.S. Environmental Protection Agency, Region 5
U.S. Coast Guard
U.S. Army Corps of Engineers, Detroit District
U.S. Army Corps of Engineers, St. Louis District
U.S. Army Corps of Engineers, Chicago District
U.S. Department of Agriculture, Farm Service Agency
U.S. Department of the Interior, U.S. Geological Survey
U.S. Fish and Wildlife Service, Rock Island Field Office
U.S. Fish and Wildlife Service, Chicago Field Office
Natural Resource Conservation Service
Illinois Department of Natural Resources, Director
Illinois Department of Natural Resources, Scientific Research & Analysis
Illinois Department of Natural Resources, Office of Resource Conservation
Illinois Department of Natural Resources, Office of Resource Conservation,
  Wetland Watershed & EMP Program Administration
Illinois Department of Agriculture, Director
Illinois Department of Agricultural, Association of Illinois Soil and Water Conservation Districts
Illinois Department of Natural Resources, Office of Water Resources
Illinois Environmental Protection Agency, Watershed Management Section

Illinois Department of Transportation
Illinois River Coordinating Council
Izaak Walton League
Izaak Walton League, Heartland Water Resource Board
Illinois Sierra Club
The Nature Conservancy, Illinois River Project Director

The Illinois Department of Agriculture, Division of Natural Resources responded by letter dated April 3, 2003. The department described the importance of the agricultural industry in Illinois. It stated it is essential that all restoration projects be designed and implemented in a manner that is as compatible as possible with the agricultural community. The department also stated that balancing environmental restoration goals while protecting the integrity of agricultural operations should be one of the guiding principles for this program. In addition, the department highly recommended that the Corps closely coordinate with agricultural groups and organizations—such as local soil and water conservation districts, levee and drainage districts, and county Farm Bureaus—on all Illinois River restoration projects. The department urged the Corps to look for opportunities to achieve multiple environmental objectives in planning restoration activities.

The U.S. Fish and Wildlife Service, Rock Island Field Office, responded by letter dated April 22, 2003. To comply with Section 7 of the Endangered Species Act of 1973, the office enclosed a map of the Illinois River Basin and a map of Illinois, with endangered species information included by county. Also included was a more specific description of federally-listed species within Illinois and each species' habitat distribution status.

The Director of the Illinois DNR responded by letter dated April 28, 2003. The DNR recommended that any developments associated with the Plan should be carefully designed to ensure the sensitive resources of Illinois (e.g., wetlands, backwater lakes, threatened and/or endangered species and habitat, natural areas, high quality woodlands, etc) are not inadvertently harmed. The DNR further suggested that future restoration efforts may need to be designed with possible timeframe restrictions (avoidance windows), and expressed the need for pre-construction surveys to avoid impacting sensitive resources (e.g., freshwater mussels, bat roosting areas, etc.).

The U.S. Fish and Wildlife Service, Rock Island Field Office, responded by letter dated August 10, 2005, stating that, contrary to the Coordination Act Report, May 2004 furnished to the District, and after informal consultation with the District, it is mutually agreed that it is not possible to address Section 7 of the Endangered Species Act with a programmatic Biological Assessment. After more information is known concerning the specific restoration projects; individual, site specific and species specific Biological Assessments would be prepared, as necessary.

HAGERTY/dmd/5286

March 24, 2003

Planning, Programs, and
Project Management Division

SEE DISTRIBUTION LIST

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is currently undertaking a Feasibility Study for the Illinois River Ecosystem Restoration project in Illinois. This study will result in the Illinois River Basin Comprehensive Plan with an integrated programmatic environmental document. This study is being conducted under the Corps of Engineers General Investigations (GI) Program in partnership with the Illinois Department of Natural Resources, under the authority of Section 216 of the Flood Control Act of 1970 and the Illinois River Basin Restoration Authority, Section 519 of the Water Resources Development Act of 2000.

The study area encompasses the Illinois River watershed within the State of Illinois. This study will investigate reducing impacts to the fish and wildlife habitat in the Illinois River Basin and providing opportunities in water and related land resources projects and planning services within the Illinois River watershed. Specific attention will be given to identifying opportunities for restoring degraded ecosystem structures and functions, including the ecosystem's hydrology and plant and animal communities, to a less degraded or more naturalized condition.

There are generally two types of efforts occurring: (1) system evaluations focused on assessing the overall watershed needs and general locations for restoration, and (2) site-specific evaluations focused on developing detailed restoration options for possible implementation at specific sites. The focus of this letter is on the system level study for restoration opportunities. All current and future site-specific projects will be coordinated separately.

The basin-wide restoration opportunities fall into four focus areas, as follows:

a. Watershed/Tributary Restoration – Evaluate options to address tributary degradation and instability, looking at stream and wetland restoration, water retention, conservation easements, and riparian buffers.

b. Side Channel and Backwater Restoration – Consider opportunities to restore aquatic habitats in these areas, including off-channel deep water habitat, backwater lakes, side channels, islands, etc.

-2-

c. Water Level Management – Evaluate options to reduce rapid fluctuations and naturalize flows.

d. Floodplain Restoration and Protection – Evaluate floodplain use, potential restoration of floodplain function, and value of/potential for acquisition/use of conservation easements.

The proposed study has not been addressed in previous National Environmental Policy Act (NEPA) documents prepared by the Rock Island District. The Comprehensive Plan, with an integrated programmatic environmental document, will evaluate an array of alternatives and recommend an optimum combination of features for achieving ecosystem restoration benefits. The Comprehensive Plan for this study is scheduled for completion in the summer of 2004.

At this time, we are requesting your comments concerning this study and information regarding any significant existing resources or environmental concerns associated with restoration of the Illinois River Basin, including, but not limited to, riparian, floodplain, and aquatic resources. Specifically, any endangered species, critical aquatic habitat, wetlands, land-use plans, floodplain issues that could be adversely affected by the proposed study, and other issues or problems associated with this study should be reported at this time.

Please provide any comments you may have regarding the proposed study within 30 days of the date of this letter. More information regarding this study can be found on our web site at http://www.mvr.usace.army.mil/ILRiverEco/default.htm. If you have any questions, please call Ms. Karen Hagerty (biologist) of our Economic and Environmental Analysis Branch at 309/794-5286. Written comments may be sent to our address above, ATTN: Planning, Programs, and Project Management Division (Karen Hagerty).

Sincerely,

ORIGINAL SIGNED BY

John P. Carr
Acting Chief, Economic and
Environmental Analysis Branch

MFR: Initial Coordination Letter for the Illinois River Ecosystem Restoration GI/519 Study, Illinois River Basin, IL.

Copies Furnished:

Mr. Jim Mick
Havana Field Headquarters
Illinois Department of Natural Resources
700 South 10th Street
Havana, Illinois 62644

Copies Furnished (Continued):

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ATTN: CEMVS-PM-F (Tamara Atchley)
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PM-A (Bollman)
PM-A (Jackson)
PM-M (Thompson)
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ED-HH (Schwar)
ED-DN
OD-I (Granados)
OC

IL RIVER ECOSYSTEM RESTORATION 90X 13 MAR 03 (DRAFT)

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Illinois Department of Agriculture

Rod R. Blagojevich, Governor

Division of Natural Resources
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April 3, 2003

Ms. Karen Hagerty
Department of the Army
Rock Island District, Corps of Engineers
Planning, Programs, and Project Management Division
Clock Tower Building-P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Ms. Hagerty:

We are in receipt of Mr. John P. Carr's March 24, 2003 correspondence regarding the Feasibility Study that is underway for the Corps of Engineers' Illinois River Ecosystem Restoration Project in Illinois. Mr. Carr has invited all interested parties to provide comments pertaining to the study and information concerning significant natural resources or environmental concerns. Hence, the Illinois Department of Agriculture is conveying the following comments.

The agriculture industry plays a prominent role in the Illinois River Basin. The 26,000-square mile watershed contains more than 10 million acres of some of the most productive farmland in the world, which represents approximately 50% of Illinois' agricultural economy. In addition, through natural resource conservation programs such as Illinois' Conservation 2000 Program, the federal-state Conservation Reserve Enhancement Program, and the USDA Farm Bill Programs, Illinois' agricultural producers are installing conservation practices at an accelerated pace to protect soil and water resources throughout the basin. Undoubtedly, agriculture has a huge stake in the restoration of the Illinois River Basin.

It is our understanding that four components comprise the basin-wide restoration initiative: 1) Watershed/Tributary Restoration, 2) Side Channel and Backwater Restoration, 3) Water Level Management and 4) Floodplain Restoration and Protection. Certainly, these are laudable goals for protecting and enhancing the Illinois River Basin. However, it is essential that all restoration projects be designed and implemented in a manner that is as compatible as possible with the agricultural community. For example, water level management schemes should take into account how the manipulation of water levels will affect agricultural operations in the basin. The same concern applies to the restoration of floodplain function, in terms of potential impacts to agriculture. Balancing environmental restoration goals with protecting the integrity of agricultural operations should be one of the guiding principles adhered to by the Corps of Engineers as they proceed with the Illinois River Restoration Comprehensive Plan and the integrated programmatic environmental document.

Ms. Karen Hagerty
April 3, 2003
Page 2

We highly recommend that the Corps of Engineers closely coordinate with agricultural groups and organizations on all restoration projects for the Illinois River. Examples include local soil and water conservation districts, levee and drainage districts and county Farm Bureaus. These groups and organizations have broad local knowledge that will be valuable to the Corps of Engineers as restoration plans are developed and implemented.

We also urge the Corps to look for opportunities to achieve multiple environmental objectives (e.g., nutrient management, carbon sequestration) in planning restoration activities.

Thank you for the opportunity to comment with regard to the Feasibility Study. The Illinois Department of Agriculture will furnish comments in the future when site-specific projects are disclosed by the Corps of Engineers.

Sincerely,

Mike Beaty, Division Manager
Division of Natural Resources

Copy: Acting Director Tom Jennings, IDA
Tom Doubet, IDA
Cheryl Day, IADD
Chris Stone, AISWCD
Kevin Rund, IFB
Gary Clark, IDNR

United States Department of the Interior

FISH AND WILDLIFE SERVICE
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Rock Island, Illinois 61201
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IN REPLY REFER TO:
FWS/RIFO

April 22, 2003

Mr. Jack Carr
Acting Chief, Economic and
Environmental Analysis Branch
U.S. Army Engineer District
Rock Island
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Mr. Carr:

This responds to a letter dated March 24, 2003, from your office asking for initial coordination comments on the Feasibility Study of the Illinois River Ecosystem Project. As described in the letter, the feasibility study will have two general objectives: (1) system evaluations focused on assessing the overall watershed needs and general locations for restoration, and (2) site-specific evaluations focused on developing detailed restoration options for possible implementation at specific sites. This information request is specifically concerned with the system level study for restoration opportunities.

To comply with Section 7 of the Endangered Species Act of 1973, as amended, we have enclosed a map of the Illinois River basin delineated with all counties which lie within the watershed and a map of the entire State of Illinois, with endangered species information included by county. A more specific description of federally listed species within Illinois and their habitat distribution status are also enclosed.

The Fish and Wildlife Service (Service) looks forward to working with the Corps of Engineers to formulate alternatives which benefit trust species and to help protect the natural resources of the Illinois River system.

This letter provides comments under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.); and the Endangered Species Act of 1973, as amended. If you have any questions please contact Mr. Kraig McPeek of my staff at (309) 793-5800 ext 514.

Sincerely,

Richard C. Nelson
Supervisor

Enclosures

G:\Office Users\Kraig\Illinois Ecosystem study\Initial Coordination Letter to Corps.doc


Counties that fall w/in the IL River watershed
U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR
Lake Michigan
McHenry
Lake
De Kalb
Kane
Du Page
Cook
Lee
Kendall
Will
Henry
Bureau
La Salle
Grundy
Putnam
Kankakee
Stark
Marshall
Livingston
Knox
Woodford
Iroquois
Peoria
Tazewell
McLean
Fulton
Mason
Vermilion
De Witt
Logan
Menard
Champaign
Cass
Macon
Morgan
Sangamon
Scott
Christian
Pike
Shelby
Greene
Macoupin
Montgomery
Jersey
Brown
Schuyler
McDonough
Adams
IL River Basin
IL River Counties
State of IL
Lake Michigan

Current Distribution of Federally-Listed Threatened and Endangered Species in Illinois

US Fish & Wildlife Service - Rock Island, Illinois

DISTRIBUTION OF FEDERALLY-LISTED THREATENED (T), ENDANGERED (E), AND PROPOSED (P) SPECIES IN ILLINOIS

Contact: U.S. Fish and Wildlife Service, 4469 48th Avenue Court, Rock Island, IL 61201 Phone: (309) 793-5800

Revised November 20, 2001

Page 1 of 4

BIRDS	STATUS	HABITAT	CURRENT DISTRIBUTION	POTENTIAL HABITAT	HISTORICAL RECORDS
Peregrine falcon *Falco peregrinus*	Delisted 8/25/99				
Bald eagle *Haliaeetus leucocephalus*	P (Delisting)	Breeding	Adams, Alexander, Bond, Calhoun, Carroll, Fayette, Fulton, Greene, Jo Daviess, Jackson, Mason, Pike, Pope, Randolph, St. Clair, Union, Winnebago, Williamson	Hancock, Jasper	
		Wintering	Adams, Alexander, Brown, Bureau, Calhoun, Carroll, *Cass, Christian, Clinton, De Witt, Fayette, Franklin, *Fulton, Greene, Grundy, Hancock, *Henderson, Jackson, Jasper, Jefferson, *Jersey, Jo Daviess, Johnson, LaSalle, Madison, Marshall, Mason, McHenry, Menard, *Mercer, Monroe, *Morgan, Moultrie, Ogle, Peoria, Pike, Pulaski, *Putnam, Randolph, *Rock Island, Sangamon, *Schuyler, Scott, Shelby, St. Clair, Tazewell, Union, Wabash, White, *Whiteside, Will Winnebago, Williamson, Woodford ***Counties with night roosts**		
Least Tern *Sterna antillarum*	E	Bare alluvial and dredged spoil islands	Alexander, Jackson, Massac, Pope (Mississippi & Ohio Rivers)	Gallatin, Hardin, Pulaski (Ohio River); Wabash, White (Wabash River); Madison (Mississippi River)	
Piping Plover *Charadrius melodus*	E	Lakeshore beaches	EXTIRPATED	Cook, Lake (Lake Michigan shoreline	Cook, Gallatin, Lake, Madison, Pope

FISH	STATUS	HABITAT	CURRENT DISTRIBUTION	POTENTIAL HABITAT	HISTORICAL RECORDS
Pallid Sturgeon *Scaphirynchus albus*	E	Large rivers	Mississippi River downstream of confluence with Missouri River	Ohio River below Dam #53	Calhoun, Hancock, Henderson

DISTRIBUTION OF FEDERALLY-LISTED THREATENED (T), ENDANGERED (E), AND PROPOSED (P) SPECIES IN ILLINOIS
Contact: U.S. Fish and Wildlife Service, 4469 48th Avenue Court, Rock Island, IL 61201 Phone: (309) 793-5800

Revised August 4, 2000

MAMMALS	STATUS	HABITAT	CURRENT DISTRIBUTION	POTENTIAL HABITAT	HISTORICAL RECORDS
Gray bat *Myotis grisescens*	E	Caves and mines, rivers & reservoirs adjacent to forests	Alexander, Hardin, Jackson, Johnson, Madison, Pike, Pope, Pulaski	Search for bats prior to any cave impacting project, particularly in southern and southwestern Illinois	Adams, Jersey
Indiana bat *Myotis sodalis*	E	Caves, mines (hibernacula); small stream corridors with well developed riparian woods; upland forests (foraging)	Adams, *Alexander, Bond, Ford, *Hardin, Henderson, *Jackson, *Jersey, Johnson, *LaSalle, Madison, Macoupin, McDonough, *Monroe, Perry, Pike, *Pope, Pulaski, *Saline, Schuyler, Scott, *Union, Vermillion ***Counties with hibernacula** **Critical Habitat: Blackball Mine, LaSalle County**	**Statewide** - search for bats prior to any cave impacting project, particularly in southern and southwestern Illinois	Cook, Christian, Jo Daviess, Madison, Morgan, Will

INVERTEBRATES	STATUS	HABITAT	CURRENT DISTRIBUTION	POTENTIAL HABITAT	HISTORICAL RECORDS
Karner blue butterfly *Lycaeides melissa samuelis*	E	Pine barrens and oak savannas on sandy soils and containing wild lupines (*Lupinus perennis*), the only known food plant of the larvae	EXTIRPATED	Carroll, Iroquois, Jo Daviess, Kankakee, Lake, Lee, Ogle, Winnebago	
Hines emerald dragonfly *Somatochlora hineana*	E	Spring fed wetlands, wet meadows and marshes	Cook, Will, DuPage, (Des Plaines River drainage)		
Illinois cave amphipod *Gammarus acherondytes*	E	Cave streams in Illinois sinkhole plain	Monroe, St. Clair		
Iowa pleistocene snail *Discus macclintocki*	E	North-facing algific talus slopes of the driftless area	Jo Daviess		

REPTILES	STATUS	HABITAT	CURRENT DISTRIBUTION	POTENTIAL HABITAT	HISTORICAL RECORDS
Eastern massasauga rattlesnake *Sistrurus c. catenatus*	CAN	shrub wetlands	Clinton, Cook, Fayette, Knox, Lake, Piatt, Will		Adam, Champaign, Clark, Coles, Crawford, Cumberland, DeKalb, De Witt, DuPage, Edgar, Hancock, Logan, Madison, McLean, Mercer, Peoria, Stark, Tazewell, Warren

DISTRIBUTION OF FEDERALLY-LISTED THREATENED (T), ENDANGERED (E), AND PROPOSED (P) SPECIES IN ILLINOIS
Contact: U.S. Fish and Wildlife Service, 4469 48th Avenue Court, Rock Island, IL 61201 Phone: (309) 793-5800

Revised August 4, 2000

MUSSELS	STATUS	HABITAT	CURRENT DISTRIBUTION	POTENTIAL HABITAT	HISTORICAL RECORDS
Higgins= eye pearlymussel *Lampsilis higginsi*	E	Mississippi River; Rock River to Steel Dam	Jo Daviess, Mercer, Henderson, Rock Island **Essential Habitat: Sylvan Slough at Rock Island**	Adams, Carroll, Hancock, Pike, Whiteside (Mississippi River upstream of Dam 22)	
Fanshell mussel *Cyprogenia stegaria (=C. irrorata)*	E	Wabash River	White	Gallatin)	
Fat pocketbook pearlymussel *Potamilis capax*	E	Mississippi, Wabash, Little Wabash, Ohio Rivers	*Hancock, *Pike (Mississippi River); Gallatin, Lawrence, Wabash, White (Wabash & Little Wabash Rivers); Pope, Massac (Ohio River) ***Transplanted populations**		
Pink Mucket pearlymussel *Lampsilis orbiculata (=Plethobasis obrupta)*	E	Ohio River	Massac	Alexander, Gallatin, Hardin, Pope, Pulaski	
Orange-footed pearlymussel *Plethobasis cooperianus (=P. striatus)*	E	Ohio River below confluence with Cumberland River)	Pulaski	Alexander, Massac, Pope	Clark, Crawford, Lawrence, Wabash (Wabash River)
Tubercled-blossom pearlymussel *Epioblasmas torulosa torulosa*	E	Rivers	EXTIRPATED		
White warty-back pearlymussel *Plethobasis cicatricosus*	E	Rivers	EXTIRPATED	Clark, Gallatin, White (Wabash River)	Clark, Crawford, Lawrence, Vermillion, Wabash (Wabash River)
Clubshell *Pleurobema clava*	E	Rivers	Vermillion (N. Fork Vermillion River)		Wabash & Lower Ohio Rivers
Rough pigtoe *Pleurobema plenum*	E	Rivers	EXTIRPATED		Wabash & Lower Ohio Rivers
Ring pink *Obovaria retusa*	E	Rivers	EXTIRPATED		

DISTRIBUTION OF FEDERALLY-LISTED THREATENED (T), ENDANGERED (E), AND PROPOSED (P) SPECIES IN ILLINOIS

Contact: U.S. Fish and Wildlife Service, 4469 48th Avenue Court, Rock Island, IL 61201 Phone: (309) 793-5800

Revised August 4, 2000

PLANTS	STATUS	HABITAT	CURRENT DISTRIBUTION	POTENTIAL HABITAT	HISTORICAL RECORDS
Prairie bush clover *Lespedeza leptostachya*	T	Dry to mesic prairies with gravelly soil	Cook, DuPage, Lee, Ogle, McHenry, *Winnebago * introduced	Search for this species whenever prairie remnants are encountered	
Small whorled pogonia *Isotria medeoloides*	T	Dry woodlands	Randolph		St. Clair, Tazewell, Williamson
Eastern prairie fringed orchid *Platanthera leucophaea*	T	Mesic to wet prairies	Cook, DuPage, Grundy, Henry, Iroquois, Kane, Lake, McHenry	Search for this species whenever prairie remnants are encountered	
Mead=s milkweed *Asclepias meadii*	T	Virgin prairies	*Ford, Saline, *Will * introduced	Search for this species whenever prairie remnants are encountered	
Lakeside daisy *Hymenopsis herbacea*	T	Dry rocky prairies	*Tazewell, *Will * introduced		Logan, Menard
Decurrent false aster *Boltonia decurrens*	T	Distrubed alluvial soils	Bureau, Fulton, Jersey, Madison, Marshall, Mason, Morgan, Peoria, Pike, Putnam, Schuyler, Scott, Tazewell, Woodford (Illinois River floodplain; St. Clair (Mississippi River floodplain)	Brown, Calhoun, Cass, Greene, Grundy, LaSalle, Pike (Illinois River floodplain); Alexander, Jackson, Monroe, Randolph, St. Clair (Mississippi River floodplain)	
Leafy prairie clover *Dalea foliosa*	E	Prairie remnants on thin soil over limestone	Will (Des Plains River floodplain)		
Dune thistle *Cirsium pitcheri*	T	Lakeshore dunes	Lake (introduced)		Cook
Running buffalo clover *Trifolium stoloniferum*	E	Distrubed bottomland meadows	EXTIRPATED		Cook, Fulton, Hancock, Henderson, Peoria
Price=s potato bean *Apios priceana*	T	Wet floodplain forests, shrubby swamps	EXTIRPATED		Cook

Illinois
Department of
Natural Resources

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http://dnr.state.il.us

Rod R. Blagojevich, Governor

April 28, 2003

Mr. John P. Carr
Acting Chief, Economic and Environmental Analysis Branch
Rock Island District, Corps of Engineers
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Mr. Carr:

Reference is made to your letter of March 24, 2003 concerning the proposed Feasibility Study for the Illinois River Ecosystem Restoration project in Illinois. The Feasibility Study will result in an Illinois River Basin Comprehensive Plan with an integrated programmatic environmental document. Your letter requests comments regarding the Feasibility Study, as well as information concerning any significant resources or environmental concerns associated with the Illinois River basin.

The Illinois River basin contains myriad sensitive resources including wetlands and backwater lakes, endangered/threatened species habitat, natural areas, and high quality woodlands, to list but a few. Any developments associated with the Comprehensive Plan will need to be carefully designed to ensure these resources are not inadvertently harmed. We foresee the need to design some elements of the plan to avoid encroachment into natural areas or listed species habitat, possible time restrictions on construction activities to avoid spawning, breeding, and nesting periods, and pre-construction surveys for such things as freshwater mussel populations, bat roost trees, and other resources of special concern.

The details of impact avoidance and minimization will, of necessity, have to be determined after more is known about the various plan elements. However, because of IDNR's partnership in the plan, all of its elements will be subject to a comprehensive environmental review under various Illinois statutes protecting endangered/threatened species, natural areas, nature preserves, wetlands, and cultural resources. These analyses, in addition to reviews of any required Corps of Engineers and/or IDNR, Office of Water Resources permits, will be coordinated through the Department's Division of Resource Review and Coordination.

We look forward to working closely with the Rock Island District in development of the Comprehensive Plan. Please contact Robert Schanzle of my staff at 217-785-4863 if we can provide specific resource information or be of any other assistance at this time.

Sincerely,

Joel Brunsvold
Director

JB:RWS:rs

cc: IDNR/OREP (Tom Flattery, Steve Davis, Robert Schanzle)
IDNR/ORC (Brian Anderson, Debbie Bruce, Jim Mick)
IDNR/OWR (Loren Wobig)
USFWS (Richard Nelson)
Division File

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United States Department of the Interior

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IN REPLY REFER TO:
FWS/RIFO

August 10, 2005

Colonel Duane P. Gapinski
District Engineer
U.S. Army Corps of Engineers
Rock Island District
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Gapinski:

The letter regards the Illinois River Basin Restoration Study (Study), and the Fish and Wildlife Coordination Act Report (Report) prepared for the study dated May 2004. In our Report, we recommended that feasibility planning include preparation of a programmatic Biological Assessment (BA) pursuant to Section 7 of the Endangered Species Act. During further informal consultation with your staff, we have come to the mutual conclusion that it is not possible to establish program boundaries or the scope of effects sufficiently to support a programmatic approach for the Study.

Many of the objectives for the Study and the Navigation and Ecosystem Sustainability Program overlap, and most of the mainstem and floodplain activities proposed as part of the Study are identical to those described in the 2004 programmatic BA and Biological Opinion prepared by our respective offices for the Upper Mississippi River – Illinois Waterway System Navigation Feasibility Study. As projects proposed under the Study are initiated, informal consultation will allow us to determine whether Section 7 compliance may be expedited in the second tier of the programmatic process established in the Navigation Study, or if compliance will require site-specific consultation. Other actions undertaken outside of the Navigation Study planning area, such as watershed work, will require individual consultation and Section 7 compliance on a project-by project basis.

This letter provides comments under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.); and the Endangered Species Act of 1973, as amended. We look forward to assisting your office in

Colonel Duane P. Gapinski 2

further planning and implementation of this important program. Questions regarding this letter may be directed to Mr. Bob Clevenstine at the above telephone number, extension 205.

Sincerely,

Richard C. Nelson
Field Supervisor

cc: R3 (Lewis, Szymanski)
Refuges (Steinbach, Mabery)
Illinois DNR (Schanzle)

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8. RECOMMENDATIONS

It is recommended that the Illinois River Basin Restoration Program, authorized in Section 519 of WRDA 2000, be continued and expanded to more fully address the restoration needs of this nationally significant resource.

Alternative 6 was selected as the preferred alternative. Alternative 6, if fully implemented over the next 50 years, would:

- provide a measurable increase in system ecological integrity
- reduce systemic sediment delivery by 20 percent
- restore 12,000 acres of backwaters
- restore 35 side channels
- protect 15 islands
- restore 75,000 acres of main stem floodplain
- restore 75,000 acres of tributary floodplain and riparian areas
- restore 1,000 stream miles of aquatic habitat
- provide fish passage along the Fox, DuPage, Des Plaines, Kankakee, Spoon, and Aux Sable Rivers
- produce an 11 percent reduction in the 5-year peak flows in tributaries
- increase tributary base flows by 20 percent
- reduce water level fluctuations along the main stem during the growing season by 65 percent
- provide system level improvements in water quality.

In total, this plan would provide benefits to approximately 225,000 acres and 33,000 miles.

Corps of Engineers cost-shared restoration efforts would begin with $153,850,000 ($100,000,000 Federal funds) in restoration funds through 2011 (Tier I) with the potential to expand to $384,615,000 ($250,000,000 Federal funds) in restoration efforts through 2015 (Tier II). The funding and activities would begin significant restoration consistent with eventual implementation of Alternative 6 (Recommended Plan). These initial phases are proposed to demonstrate the benefits of the various practices and project components prior to seeking additional funding.

Tier I efforts would be cost shared 65 percent Federal ($100 million) and 35 percent non-Federal ($53.85 million). This funding level would provide approximately $127.0 million for planning, design, construction, and adaptive management of restoration projects; $24.1 million for the technologies and innovative approaches component; and $2.75 million for system management. The estimated annual Operation and Maintenance cost, once all features are in place, is $125,000. If funding is available, a report to Congress will be submitted in the 2011 timeframe, documenting the project successes and the results from approximately the first $153.85 million ($100 million Federal) in restoration efforts.

The current authorization provides ongoing authority to evaluate and implement Critical Restoration Projects. It is recommended that the Illinois River Basin Restoration Program, authorized in Section 519 of WRDA 2000, be modified to more fully address restoration needs of this nationally significant resource. These recommendations were developed in cooperation with the State of Illinois Department of Natural Resources, other Federal and State agencies, local governments, and various non-governmental organizations.

Recommended Amendments to Section 519 of the Water Resources Development Act (WRDA) Of 2000, Public Law 106-541:

- That the per project Federal cost limit for Critical Restoration Project be increased from $5 million to $20 million. Increasing the per project cost limit would allow implementation of a wider range of critical restoration projects more directly matching the scale identified in the Comprehensive Planning efforts. Without modification, many larger projects could not be implemented as effectively or at all.

- That the current authorization for Critical Restoration Projects be expanded to more fully address component (b)(3)(B) calling for the development and implementation of a program for the planning, conservation, evaluation and construction of measures for fish and wildlife habitat conservation and rehabilitation, and stabilization and enhancement of land and water resources in the Basin. Replace the specific criteria for Critical Restoration Projects found in Section 519, with a requirement that restoration projects be identified following an implementation framework and inter-agency coordination. Individual critical restoration projects may involve restoration activities at several non-contiguous locations within a pool or sub-watershed.

- That authorization for implementation of a Technologies and Innovative Approaches Component be provided as a complement to the Critical Restoration Project activities. Activities would include initiatives called for in Section 519 (b).(3).(A) development and implementation of dredging and beneficial use technologies; (C) long term resource monitoring; and (D) and a computerized inventory and analysis system.

- That authorization be provided allowing the development of cooperative agreements and fund transfers between the Corps of Engineers and the State of Illinois: scientific surveys at the University of Illinois; and units of local government: counties, municipalities, and Soil and Water Conservation Districts to facilitate more efficient partnerships.

- That authorization be provided that the Chief of Engineers may enter into cooperative agreements with the Natural Resources Conservation Service for services to be performed by contract, grant or agreement, or by any other instrument or resource available to and consistent with the authorities of the Natural Resources Conservation Service.

- That the authorization be expanded to allow non-profit organizations to serve as sponsors and sign Project Cooperation Agreements for restoration projects implemented under the Illinois River Basin Restoration program. Notwithstanding Section 221 of the Flood Control Act of 1970 (42 U.S.C. §1962d-5b), for any Illinois River Basin Restoration project carried out under Section 519 (c) of the Water Resources Development Act of 2000, a non-Federal interest and sponsor may include a non-profit organization, with the consent of the of the affected local government.

- That the Secretary of the Army, in consultation with the State of Illinois, submit a report to Congress every 6 years describing the accomplishments of the programs and any needed adjustment. Submittal of this report is to be timed to allow consideration as part of a comprehensive Water Resources Development Act.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They reflect neither the program and budgeting priorities inherent in the formulation of the national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before transmittal to Congress as proposals for authorization and implementation funding.

________________________	____
(Date)	DUANE P. GAPINSKI Colonel, U.S. Army District Engineer

ILLINOIS RIVER BASIN RESTORATION
COMPREHENSIVE PLAN
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

DRAFT

FINDING OF NO SIGNIFICANT IMPACT

I have reviewed the information in this Comprehensive Plan with Integrated Environmental Assessment, along with data obtained from Federal and State agencies having jurisdiction by law or special expertise, and from the interested public. I find that the recommended alternative for systemic ecosystem restoration of the Illinois River Basin would not significantly affect the quality of the human environment. It is anticipated that implementation of the recommended alternative (Alternative 6) would cause the current trend of ecological degradation in the Illinois River Basin to reverse and, in time, result in overall improvement in biodiversity and ecological integrity. Therefore, it is my determination that an Environmental Impact Statement is not required. This determination will be reevaluated if warranted by later developments.

Factors that were considered in making the determination that an Environmental Impact Statement is not required are as follows:

A. All future projects would require separate, site-specific National Environmental Policy Act documents that would follow all procedures and processes required by law.

B. Implementation of the recommended alternative for this Comprehensive Plan should result in a reduction in sediment delivery to the Illinois River Basin as a whole.

C. Implementation of the recommended alternative for this Comprehensive Plan should result in an increase in the quantity and quality of backwaters and side channels in the Illinois River Basin.

D. Implementation of the recommended alternative for this Comprehensive Plan should result in improvements in the quality of floodplain and riparian habitats and improvements in the quality of in-stream (aquatic) habitat.

E. Implementation of the recommended alternative for this Comprehensive Plan should improve access to diverse habitat such as backwaters and tributary habitat in the Illinois River Basin to restore and/or maintain healthy populations of native fish species.

F. Implementation of the recommended alternative for this Comprehensive Plan should naturalize hydrologic regimes on the main stem of the Illinois River and its tributaries, reduce tributary peak flows, and increase tributary baseflows, thereby improving aquatic and riparian habitat.

G. Implementation of the recommended alternative for this Comprehensive Plan should improve water and sediment quality in the Illinois River Basin.

H. Implementation of the recommended alternative for this Comprehensive Plan should provide a level of restoration that would provide a measurable increase in ecological integrity/ecosystem health at the system level in the most cost effective manner.

I. Early and ongoing coordination with the appropriate State and Federal agencies has been maintained during the plan formulation process to address any potential concerns that may arise from implementation of this program

J. Public comments received either during the public meetings or the public review process for the Comprehensive Plan with Integrated Environmental Assessment have been considered prior to signing this Finding of No Significant Impact.

K. The Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers, the State of Illinois Department of Natural Resources, the State Historic Preservation Officer, and the Advisory Council on Historic Preservation executed a Programmatic Agreement (PA) entitled: *Programmatic Agreement Among the Chicago, Rock Island, and St. Louis Districts of the U.S. Army Corps of Engineers, the State of Illinois Department of Natural Resources, the Illinois State Historic Preservation Officer, and the Advisory Council on Historic Preservation, Regarding Implementation of the Illinois River Ecosystem Restoration.* The Programmatic Agreement meets the requirements of Section 106 of the National Historic Preservation act of 1966, as amended, and its implementing regulations 36 CFR Part 800, "Protection of Historic Properties," and is appropriate to address potential concerns to any significant historic properties within the State of Illinois.

(Date)

DUANE P. GAPINSKI
Colonel, U.S. Army
District Engineer