

## AQUATIC HABITAT, FORESTRY, WILDLIFE,

AND

## NATURAL AREAS

### INTRODUCTION

Little more than 150 years ago, the Illinois River basin was the haven of one of the most diverse, abundant, and valuable of aquatic fauna found anywhere in the United States. The wealth of natural resources within its basin; its fertile soils, timbered lands, and flowing waters teeming with a myriad of waterfowl, furbearers, fish and mussels, contributed immeasurably to the early development and welfare of the state and nation. Extensive bottomland water areas existed on the lower river below Hennepin in the form of river marshes, long narrow sloughs, ponds, and lakes.

Many changes have occurred within the Illinois River basin which have had a significant impact upon the river and its fish and wildlife population. 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, especially of Chicago and other cities bordering the Illinois River, resulted in vast quantities of industrial wastes and human sewage being produced. Prior to 1900, Chicago dumped its untreated sewage into Lake Michigan, the Chicago River or the Illinois-Michigan Canal. Communities along the Illinois River poured their untreated sewage directly into the river.

By 1890, outbreaks of Cholera and typhoid posed a serious health threat to the citizens of Chicago because of their untreated sewage. To rectify the health crisis, the recently formed Chicago Sanitary District authorized a project which would carry away its health-threatening wastes and create a modern shipping canal between the Illinois River and Lake Michigan by diverting the flow of the Chicago River from Lake Michigan into the Illinois River by way of the Des Plaines River. By 1900, the Chicago Sanitary and Ship Canal was completed and put into operation. Initially the discharge of 3,000 to 9,000 cubic feet per second of water from Lake Michigan and Chicago, laden with untreated sewage, resulted in a brief period of increased fish production within the Illinois River basin. The increased flow raised the water level of the Illinois River and created additional fish habitat. The organic wastes borne by the diverted waters increased the nutrient levels of the water enhancing its productivity.

After 1908, however, fish production of the Illinois River began to decline sharply as its water could no longer assimilate the tremendous volume of Chicago sewage it received. The lethal zone of pollution crept down the river at an average rate of 16 miles per year. By 1911, septic conditions existed in the Chicago Sanitary and Ship Canal and the Illinois

River downstream to Marseilles. As increased quantities of sewage entered the Illinois River, the effect was devastating. Upper stretches of the river became void of oxygen and toxic.

Mayflies, which are indicators of clean water and are an important food of many species of fish, were no longer present in the upper two-thirds of the river after 1950. Fingernail clams, preferred by carp, channel catfish, and freshwater drum, virtually disappeared from the river above Beardstown after 1950. The loss of the river's important fish food organisms was undoubtedly one of the major factors contributing to the declining fish populations.

Since 1982, an improvement in water quality can be attributed largely to the passing of more stringent water pollution laws and their enforcement. Positive changes in the river's sport fish population have also been quite evident. Good walleye, sauger and white bass fishing is now present in the Starved Rock and Marseilles pools of the upper river, where 15 years ago only sickly, bullheads, goldfish and knothed carp with eroded fins and open sores on their bodies could be found. There are still periods of near oxygen depletion in several areas, however, and a legacy remains of polluted river bottom sediments.

At this point it must be stressed that it was not just the pollution of the Illinois River that led to the degradation of the river. Primarily during the 1905-1920 period, some 200,000 acres of the river's rich bottomlands, sloughs and shallow lakes and ponds were ditched, drained and diked. Levees were erected to safely isolate 200,000 acres of flood plain from the river by 1930 -- 50% of the "overflowed land" between LaSalle and Grafton. These levied-off areas, which were vital to the river basin's high fish and wildlife productivity in terms of providing essential spawning, nursery and feeding areas, became productive cropland.

Another event that has altered the aquatic habitat and water quality of the Illinois River, influencing its production of fish, has been the development of navigation. Although a series of low level dams were built across the Illinois River before 1900, it was the construction of the high navigation dams during the 1930's that had the greater impact on the river. The pooling effect of the dams slowed its flow, which increased the rate of sedimentation because its capacity to carry its silt loads was altered. The heavy barge traffic has resulted in wave turbulences that have increased the turbidity of the water and caused erosive scouring of the river bottom and shoreline, directly affecting the ability of some fishes to feed and reproduce.

The practices of the agricultural community over the past 50 years have resulted in many deleterious impacts to the river and its numerous life forms. The destruction of timberlands for conversion to croplands, the cropping of steep sloped lands, and the intensified production of row crops has resulted in an alarming increase in the rate of soil erosion. The deposition of sediments in the river has resulted in its loss of flow capacity, the filling of adjacent bottomland lakes which are essential fish and wildlife production areas, and caused the smothering of valuable bottom-dwelling organisms and plants thus degrading quality habitat areas.

Remaining aquatic habitat suffers from heavy sedimentation estimated at 15.4 million tons of sediment per year deposited in water and on unleveed floodplain. The sum of these impacts on the lower three pools of the Illinois River has been a change in surface acreage of water from 33,936 acres in 1903 to 67,716 acres in 1978, but a reduction in average depth of off-channel water from 4 to 6 feet prior to 1900 to a dismal 2 feet in 1978. It is this continuing loss of depth and increased turbidity from sedimentation as evidenced over the past four decades that most threatens the present aquatic habitat and fisheries resources.

In addition, the increased production of row crops and the practice of monoculture have resulted in a greater use of herbicides, insecticides and fertilizers. Many of the agricultural chemicals used are persistent in nature and extremely toxic to fish and wildlife. When these chemicals are transported to aquatic environments, they are bio-accumulated by some fish, causing their flesh to be unsuitable for consumption.

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 on the Illinois River and its tributary streams 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, dairy and food processing wastes.

In summary, the pollution of basin waters and sediments by human wastes and industrial and agricultural chemicals depleting oxygen levels and bottom vegetative food supplies, the modification of the river to accommodate navigation altering its flow and physical characteristics, urban and agricultural development removing vast acreages of forest and aquatic habitats, and the acceleration of the rates of sedimentation, have destroyed many highly productive bottomland areas of the Illinois River floodplain. The total sum of the many physical, chemical, and biological modifications of the basin waters and land has resulted in the virtual ruination of once valuable and vital natural resources. Concern for this loss prompted the Illinois River Conference of April, 1987.

#### BACKGROUND

The aquatic habitat resulting from natural processes aggravated by man's actions is far removed from the near pristine river existing in 1900. Oxygen depletion has become a problem in the backwater areas of the lower river as wind-generated waves resuspend materials from the now shallow lake bottoms, exerting an oxygen demand and removing dissolved oxygen from the water. The turbidity caused by sediment inflow coupled with wind and towboat generated sediment resuspension has eliminated most aquatic vegetation by reducing the water clarity needed for photo-synthesis and keeping bottom material too stirred ("soft") for plant roots to hold. Peoria Lake, the largest and deepest bottomland lake in the Illinois River valley, has lost 68% of its original volume due to sedimentations, has an average depth of only 2.6 feet, and has an estimated life expectancy of only 15 years. Other bottomland lakes will have a similar fate.

Water quality improvement is credited with restoring sport fisheries to the upper river where carp and goldfish and their hybrids comprised 77% of numbers in electrofishing samples collected 1959-1974. In 1984 carp, goldfish, and hybrids represented only 18% of the numbers in electrofishing samples, and channel catfish, white bass, largemouth bass, smallmouth bass, and walleye, which were not even found in the upper river in 1959 electrofishing, were 13% of the 1984 catch on that stretch. Riverwide, the few smallmouth bass collected in the 1959-1974 period were thought to have been introduced from tributary streams, and only one sauger was collected in over 290 hours of electrofishing, although it had been common prior to 1908.

Although fisheries monitoring will continue, it is apparent that consistent high quality of the overall fishery will not be possible on the Illinois River despite water quality improvements until deeper water areas are once again available to fish during low flow periods.

Today, our rivers and streams need the protection of forests more than ever as their purity is contaminated by substances and practices unknown in an earlier, simpler age. Forested lands adjacent to rivers can help reduce the effects of industrial wastes, thermal pollution, residues from commercial chemicals, and especially of siltation, while still also providing wildlife habitat. It is doubtful that the natural ecology of a river can exist and thrive unless the floodplain adjoining the stream is forested. When this forest is destroyed, more than trees are eliminated--the quality of water is quickly reduced, and the intricate community-relationship between plants and animals is endangered.

Historically, the Illinois River valley provided a diversity, quality and quantity of wildlife habitats of uncommon value. In 1673, Pere Marquette wrote, "We have seen nothing like this river that we enter, as regards its fertility of soil, its prairies and woods; its cattle, elk, deer, wildcats, bustards, swans, ducks, parroquets, and even beaver." In response to luxurious aquatic plantbeds, seasonally exposed mudflats, expanses of bottom-land forests, and the waters of the river and backwater lakes, wildlife flourished.

Today, most of this is gone--having succumbed to a series of events tied to settlement and progress. Aside from the loss of vast acreages of bottomland hardwood forest, little is more dramatic an example of a decaying resource than the disappearance and decline of wildlife in the river system. The once prolific number of waterfowl, furbearers, shorebirds, wading birds and other vertebrate fauna have been chronicled and--finally--grieved. Probably the most familiar and well documented of these has been the fall of waterfowl numbers, particularly the mallard, in the Illinois River valley. From the 1950-59 ten-year average of almost 1,200,000 peak mallard numbers on the river, the number dropped to slightly over 366,000 for the 1980-86 period. This represents a decline of over 70%. In 1984, an all time record low of 259,000 was noted. A shift of mallards to the Mississippi River has been observed, leading to the explanation that it is a function of a reduced habitat factor on the Illinois River. Additionally, the toxic river bottom sediments has reduced the food supply for diving ducks in the Illinois River.

The bays and backwaters of the Des Plaines River near Treats Island (commonly referred to as the Millsdale Waterfowl Hunting Area) have silted in severely over the past 20 years. The seven public waterfowl hunting blinds located at Millsdale used to provide the best waterfowl hunting on the Des Plaines River. Before extensive siltation, this shallow water area provided submergent and emergent aquatic vegetation in an ideal ratio to attract migratory waterfowl. Siltation and sedimentation has changed the dominant vegetation to cattails and lotus with very little open water. Access to the area is extremely limited for waterfowl and waterfowl hunters. Waterfowl use and therefore the quality of waterfowl hunting on this area has declined tremendously. A good recent example of this decline is shown by a total harvest of two wood ducks for all seven blinds on this area on the opening day of the 1986 central zone waterfowl hunting season.

Even though water diversion, drainage, pollution, and dams damaged the Illinois River's environmental system, it has been the insidious and relentless process of silt deposition and sediment re-suspension that have caused the most serious and long lasting problems. Any proposed solution to the river's ecological ailments that ignores or minimizes this factor cannot hope to achieve even a modicum of success. The decline of the river's biological integrity would persist without major funding and programs aimed at keeping excessive sediments from the river and its backwater lakes. This would include the wider application of farming practices with erosion control and water retention benefits (e.g., no-till, minimum till, conservation tillage), the establishment of filter strips and sediment traps, the acquisition of key parcels of land, the reforestation and stabilization of stream banks, and a major shift to cropping systems stressing hay and forage crops. Individually and collectively these would serve to minimize the silt load of the river and its tributaries, thereby reducing both the sediment rate and turbidity.

Natural areas are tracts of land and water that have escaped major disturbances by man and therefore have special value as examples of Illinois' original natural ecosystems and habitats. They often support rare or unusual natural plant communities and animals. In the Illinois River basin these areas include streams, wetlands, bottomlands and uplands. Vegetation ranges from open water (submerged) to forest, prairie, marsh, bog and fen. These natural areas need to be protected from destruction due to conversion to other uses.

More frequent and unnatural flooding, siltation problems, pollution problems, and exotic weeds also threaten Illinois River basin natural areas. Unnaturally high and severe floods along the Illinois River have a negative impact on some natural areas. At Spring Bay Fen, on the east shore of Peoria Lake, flooding is killing rare plants in an area that was rarely flooded in the past, but which floods almost annually now. At other natural areas, emergent aquatic plants have been killed by summer floods. A coordinated program of slowing runoff through land treatment and regulating Lake Michigan diversion waters can help alleviate this problem.

Plants introduced into an area can also threaten natural areas. Purple loosestrife is an aggressive exotic plant invader of wetlands that degrades natural areas and other wildlife habitats. It is a serious pest in the upper Fox River basin and is rapidly spreading throughout the

Illinois River basin. Recent legislation prohibits sale and planting of this pest in Illinois, but control of existing populations is hindered by lack of funds for aerial surveys to locate and monitor populations.

## ACTIVITIES, PROGRAMS, AND STUDIES

### Aquatic Habitat

An ongoing Department of Conservation fisheries monitoring effort initiated in 1975 provides data on changes in populations at 21 sites on the Illinois River from river mile 8.8 to mile 271.5. Fish samples are collected at these sites with electro-fishing gear once each summer for comparison to previous samples. These samples have illustrated that the loss of deeper water habitat can have a dramatic impact on fish populations in low river flow years when fish are subjected to winterkill as in the winter of 1976-77. Catchable-sized sport fish in samples the following summer (1977) were only 30% the numbers found in 1975 samples, but higher river flows in the early 1980's encouraged recovery to 97% by 1984. Smallmouth bass, walleye, and sauger favor the type of habitat found on the upper river where water quality has improved and backwaters have always been few. On the lower stretch, where the numbers of largemouth bass, crappie, sunfish and bullheads are especially dependent on maintenance of the backwater areas favored by these species, monitoring indicates dramatic fluctuations in numbers can occur from year to year dependent on river flow. These fluctuations would not be near as evident if there was sufficient depth in river backwaters to maintain fish even in low flow years.

A Federal Aid in Sport Fish Restoration Act, Dingell-Johnson (DJ) Program, study is being conducted on Lake Peoria by the Illinois State Water Survey. The effort was initiated in July, 1986, and consists of experimental installation of a breakwater constructed of old automobile tires and planting of aquatic vegetation behind this protective barrier. It is hoped that the relatively inexpensive breakwater will reduce wind and towboat generated sediment resuspension and movement, so that the aquatic vegetation planted behind the barrier will become well rooted and grow to start establishment of beds of aquatic vegetation. The aquatic vegetation could further block sediment movement and reduce turbidity, improving fisheries habitat by providing cleaner water, shelter for fish and a high production area for invertebrates fed upon by fish. Baseline fisheries data has been collected in 1986 and 1987, the breakwater put in place in early summer 1987, and plantings of broadleaf arrowhead in 1987 have survived and exhibit good growth. Year one of the study has been completed with two more years left during which removal of the breakwater overwinter (to protect it from ice damage), plantings of different aquatic plant species, expansion of the original plantings, and impacts on local fisheries will be studied. Study completion will be June 30, 1989.

Another DJ federal aid project is an Illinois Natural History Survey study of behavior and movement of adult channel catfish in the Illinois River before, during, and after a 50-day shutdown of commercial navigation due to Peoria and LaGrange lock closures in July, August, and September,

1987. The radiotelemetry study will provide insight into use of the deeper water of the navigation channel and how that use changes with resumption of commercial tow traffic. Since virtually all deeper water areas outside of the navigation channel have been lost to sedimentation, this study could demonstrate if channel catfish have a marked preference for deep water, and, if so, how that preference is impacted by disturbance from tow traffic. More than two dozen catfish have been implanted with radiotransmitters and much movement has been recorded. The Department of Conservation Fisheries Streams Program will also use the navigation cessation period as an opportunity to gather information on any main channel preference by other fish species using a variety of netting gear and electrofishing to collect samples from the deeper water of the main channel during absence of disturbance from tow traffic. These studies will be completed in 1988, with analysis of results and final reports completed in 1989.

DJ funding is being proposed for a creel survey of twenty miles of the upper river to gather information on the extent of the sauger and walleye fishery that has developed below Starved Rock dam in response to improved water quality. The proposed study would relate angler harvest to Department of Conservation monitoring data and responses from angler diaries, to provide insight into effectiveness of the monitoring in tracking development of the sauger-walleye fishery. If approved and funded for 1988, initiation of the study would be completed in 1990.

DJ funding is also being proposed for a study of fish movement and use of deeper water off-channel areas overwinter and an assessment of how critical these areas are to overwinter survival. If approved and funded it would start the fall of 1987 and continue until fall 1990.

The Department of Conservation chairs the Illinois River on-site inspection team of US Army Corps of Engineers, Illinois Division of Water Resources, and Illinois Environmental Protection personnel. The team seeks to find disposal areas for material from navigation channel maintenance dredging that will be least damaging to the environment. Protection of aquatic habitat from filling or pollution from the dredged material is one of the top priorities of this ongoing effort.

### Forestry

Technical assistance to public and private forest landowners is the major forestry program of the Department of Conservation. Preparation of forest management plans and associated field service forestry activities such as wildfire prevention and suppression, insect and disease control, tree planting instruction, designation of surplus trees to be removed in forest improvement practices, forest product utilization and marketing, and on the ground assistance in helping landowners conduct timber sales, have been the traditional means of maintaining, enhancing, and retaining our remaining 4.26 million acres of Illinois forestland. A growing urban forestry assistance program now compliments the rural forestry programs.

The Department of Conservation has and will continue to participate in PL566 funded watershed programs as well as state and locally financed watershed land treatment programs.

There are several cost-share programs now offered which provide financial incentives for forestation and cultural practices to improve and enhance existing forest. The 6 mentioned programs are targeted to control erosion and reduce non-point sources of pollution.

- . FORESTRY DEVELOPMENT ACT (FDA) - A State cost-share program administered by the Department with funds from the Forestry Development Fund. Cost-share is provided for tree planting, site preparation, vegetation control, firebreaks, fencing and timber stand improvement. This program can be utilized by private landowners owning five or more acres in conjunction with the three Federal cost share programs listed below. Statewide, there are 1,156 forest management plans in effect under the act. Acreage amounts to approximately 56,700 acres. Figures for plans and acres within the Illinois River basin are not available, however, an estimate would be 400 plans covering 16,000 acres within the basin.
- . AGRICULTURAL CONSERVATION PROGRAM (ACP) - A Federal cost-share program administered by the Agricultural Stabilization and Conservation Service (ASCS), with technical assistance provided by the Department of Conservation, includes cost sharing for tree planting, site preparation, vegetative control and timber stand improvement. Funding for this program comes from the Federal General Revenue Fund.
- . FORESTRY INCENTIVE PROGRAM (FIP) - A Federal cost-share program administered by the ASCS, with technical assistance provided by the Department of Conservation, which includes cost sharing for tree planting, site preparation, vegetation control and timber stand improvement. Non-industrial landowners with a Department of Conservation approved Forestry Management Plan and a minimum of ten acres may qualify. Funding for this program comes from the Federal General Revenue Fund.
- . CONSERVATION RESERVE PROGRAM (CRP) - A Federal cost-share program administered by the ASCS, with technical assistance provided by the Department of Conservation, which includes cost sharing for tree planting, site preparation, grass, legume plantings, prairie establishment or wildlife plantings. The program is targeted at revegetation of highly erodible lands which are presently in annual agricultural crops. An annual rental payment is also provided for a 10 year period. Funding for this program comes from the Federal General Revenue Fund. Of acres in the Conservation Reserve Program, there are over 4,500 acres statewide that have been committed for tree planting. Exact figures are not available for the Illinois River basin. It is estimated that there will be about 1,200 acres either already planted or designated for planting by the spring of 1988 within the basin.
- . FORESTRY TECHNICAL ASSISTANCE - This program provides the necessary information, guidelines, assistance and training in implementing proper forest management, reforestation, harvesting and marketing techniques, urban planning, and forest protection which includes fire, insect, disease and environmental assessment. Detailed

management plans and guidelines are provided with erosion control and reduction of non-point sources of pollution as a primary concern. Forestry technical assistance is funded from the General Revenue Fund on an annual basis.

- NURSERY PLANT MATERIAL PRODUCTION - This program provides trees, shrubs and prairie plant material for reforestation, afforestation and restoration projects on highly erodible lands. Current annual production is about 3 million seedlings per year. Funding is provided from the General Revenue Fund and the Fish and Wildlife Fund.

### Wildlife

The Department of Conservation owns and manages a number of sites along the Illinois River where management for waterfowl is currently part of routine operating procedures. These include Anderson Lake, Calhoun Point, Des Plaines, Donnelley, Fuller Lake-Helmbold, the Glades, Godar-Diamond, Lake DePue, Marshall County, Pekin Lake, Piasa Landing, Powerton Lake, Red's Landing, Rice Lake/Big Lake, Sanganois, Sparland, Stump Lake and Woodford County. Many of these sites have some water level management capabilities and programs. The others possess refuges, provide feeding areas, or allow duck hunting. Projects aimed at upgrading, expanding, protecting, or increasing the life span of such facilities are currently on file. Completion of these already identified project needs would create a significant number of acres of fairly long-lived, manageable backwater areas reminiscent of those of a hundred years ago.

With financial support from the Department of Conservation and other funding sources, the Natural History Survey has been aerielly monitoring waterfowl populations in the Illinois River valley since 1948. These censuses provide information on the distribution and abundance of various waterfowl species during fall and spring migration with the changing aquatic habitat in the river floodplain.

There are four Department of Conservation projects planned in the Illinois River basin: (1) Banner Marsh levee renovation to reduce flooding and sedimentation, (2) Godar Diamond Island to remove brush reclaiming open water areas from willow, silver maple, and cottonwood invasion, (3) Rip Rap Landing repair of levee and ditch to provide water to wildlife feeding areas and to improve public access, and (4) Stump Lake levee improvements to reduce flooding. The combined cost of these projects is expected to be over \$700,000.

In addition there have been various projects proposed within the Illinois River basin. No funding commitments have yet been made for these projects. The largest project proposed is for Rice Lake. This project would include the re-establishment of a washed out levee and other site improvements to protect Big Lake from flooding seven out of ten years and also reducing sedimentation of the lake. This work would benefit eagles, cormorants, waterfowl, and other wildlife at an estimated cost of \$3.4 million.

Other proposed, but to date unfunded projects, include Fowler Lake levee construction, Crull Refuge levee expansion, Sanganois raising of levee and construction of additional levee, Millsdale Waterfowl Area

dredging to restore aquatic plant beds, Pekin Lake levee rehabilitation, Swan Lake levee construction, and Knapp Island raising of levee. These projects have been proposed to expand and enhance existing bird and waterfowl feeding areas. The estimated total cost of all these projects, excluding Rice Lake, is \$4.6 million.

#### Natural Areas

The Department of Conservation's principal program to identify natural areas is the Illinois Natural Areas Inventory. It is one of the most complete inventories of terrestrial natural areas in the country. Its inventory of stream resources is less complete. Data is available as county reports and computer assisted searches are possible.

The Department, in cooperation with the Illinois Nature Preserves Commission, has a major preservation program in place to protect natural areas. This program includes purchase by the Department or private/local preservation interests, dedication as Illinois Nature Preserves to assure long term preservation, agreements (Natural Heritage Landmarks) with private landowners to protect areas as Natural Heritage Landmarks, and protection from regulated development projects. Considerable time and money is spent on management of natural areas, many of which are developed for public use.

Examples of major natural areas along the Illinois River and its major tributaries include Allerton Park and Carpenter Park Nature Preserve on the Sangamon River, Spring Bay Fen, Miller-Anderson Woods and Starved Rock nature preserves on the Illinois River, Momence Wetlands and Kankakee River Nature Preserve on the Kankakee River, Ryerson Woods and Lockport Prairie nature preserves on the Des Plaines River and a host of wetlands including Volo Bog in the upper Fox River basin. Portions of the Mackinaw and Kankakee rivers themselves are designated natural areas.

The primary protection program is acquisition and dedication as a nature preserve. This program is dependent on "Build Illinois" funds through the Natural Areas Acquisition Program. In 1986 and 1987 seven natural areas within the Illinois River basin were purchased through the Natural Areas Acquisition Program. These sites total over 900 acres. The seven sites are Wolf Road Prairie, Calamus Lake, Vesley-Simpson Prairie (a 150-acre sand prairie), Mananzas Prairie, Meredosia Hill Prairie, 480 acres called Hooper Branch Savanna, and Shick Shack Sand Pond. An additional twelve acquisitions within the basin are planned for 1988 to 1990. To date the Natural Areas Acquisition Program has been funded \$7 million through Build Illinois.

Executive Order #7 (1985) is also an important tool for the protection of natural areas from a variety of development projects. Corps of Engineers permits are also useful. These programs should be maintained as important tools for protecting the public's interest.

In 1985 and 1986, the Department of Conservation surveyed a small portion of the Fox and Des Plaines River basins for purple loosestrife. In 1987, however, insufficient funding prohibited continuation of the survey.

## POSSIBLE COURSES OF ACTION

### Aquatic Habitat

Actions to improve degrading aquatic habitat include items listed below.

1. Continue fisheries monitoring to document impacts of changes in aquatic habitat.
2. Evaluate the success of the tire breakwater experiment at Peoria Lake for possible implementation in other areas to reduce bottom resuspension and encourage re-establishment of aquatic vegetation.
3. Support studies of means to reduce stream bank erosion (such as Court Creek studies) thus reducing sediment input from that source.
4. Initiate studies of the bottom contaminants in the upper Illinois River to ascertain which items are toxic and limiting to needed food resources to improve the fisheries. Once these items are identified, seek methods of detoxifying or neutralizing the sediments.
5. Continue ongoing studies and support proposed studies assessing the relative importance of deep water areas to survival of the fisheries populations. Critical data is needed to show importance of other activities aimed at sediment reductions, pollution abatement, and aquatic vegetation re-establishment.
6. Initiate or support studies to develop inexpensive effective means of re-creating deep water areas within backwater areas and of acquiring and restoring selected drainage and levee districts of levee-protected floodplain or lake areas.

### Forestry

1. Expand the technical assistance program to advise owners of grazed forest land of ways to protect the forest and better forest management techniques. Identify owners of highly erodible cropland and advise them of possible land use changes and tree plantings and encourage establishment of greenways along streams to reduce soil erosion.
2. Provide funding for a strengthened urban forestry program, use this program as a way to convince municipalities to retain forest land and to establish greenways.
3. Recognize the significant long-term role played by forests in providing high quality water by making taxes on this land use minimal and based on that lands' income generating potential. Provide incentive to landowners in regard to taxation of these lands, thereby enabling landowners to continue forest land use rather than change to other less

environmentally valuable land uses. Maintain provisions of the Farmland Assessment Act to provide lower taxes on lands classified as forest.

4. Also needed is a 4 to 5 fold increase in nursery seedling production. Presently production at the State nurseries is about 3 million seedlings per year. A capital and operational budget increase for nurseries and contractual growing additional seedlings would require an additional \$3.5 million for the first year and \$1.5 million per year thereafter.

#### Wildlife

1. Provide technical and economic assistance to the Department of Conservation to assure completion of identified projects which have some degree of funding and support base. These projects would include Banner Marsh levee renovation, Godar Diamond Island brush removal, Rip Rap Landing levee repair, and Stump Lake levee improvements. Additionally, funding should be pursued for the proposed wildlife projects discussed in this paper.

2. Funding should be made available on a cost share, grant, or loan basis to private duck clubs and other such organizations for expansion and improvements of water control structures and equipment. This program would improve and expand their ability to create seasonal off-river lakes to benefit resident and migrant wildlife, primarily ducks, geese, shorebirds and wading birds.

3. The Wildlife Habitat Acquisition Program should be funded at originally planned levels.

4. Continue financial support for the aerial censuses of waterfowl populations during fall and spring migration in the Illinois River valley.

#### Natural Areas

1. Restore Build Illinois funding for the Natural Areas Acquisition Program to originally planned levels in order to prevent natural areas from being lost to land clearing and housing development.

2. Additional aerial survey work is needed to identify and monitor purple loosestrife populations, a serious threat to wetlands in the Illinois River basin. Approximately \$8,000 would be needed to contract an aerial survey for the northern half of the state.

#### General Recommendations

1. Some of the above action suggestions require some buildup of personnel to promote these actions, and to plan and coordinate these programs. Local, regional and State priorities should be defined and funding secured for these priority projects. Federal and State cost share programs should be used as much as possible to make dollars go further. Additionally, local and State programs need to be coordinated to compliment and enhance existing programs and defined priorities.

2. Strengthen local zoning requirements to reduce land use changes in floodplains of the basin. Avoid filling of flood plains and wetlands. Require less intensive land uses on flood plains.

3. Continue the partnership approach of government and private interest groups, such as with the Partners in Conservation effort to promote cooperation between private interests and government toward mutually beneficial fish and wildlife habitat improvements.

4. Aggressively work to arrest the degradation of natural resources caused by erosion and sedimentation. Specific recommendations are included in other sections of this report. Demonstration projects and research should concentrate on protecting and enhancing the condition of natural resources at existing sites thus protecting investments already made.

5. Establish priorities for acquisition programs and determine where the quality natural resources are by completing resource inventories and initiating planning based on the resulting data. Some inventories already begun are: Illinois Fish and Wildlife Information System identifying locations of species, Illinois Streams Information System identifying the resources of stream corridors, and the Illinois Wetlands Inventory identifying the locations of wetlands. Once completed, the data from these inventories can then be used to identify quality natural resources and set priorities for acquisition.

6. Initiate a Statewide Greenways Program to focus resource protection on Illinois' major rivers, such as the Illinois River and its larger tributaries.

## LAKE MICHIGAN DIVERSION

### INTRODUCTION

Water levels on the Great Lakes have been abnormally high for over two years. By the end of January 1987, Lakes Michigan/Huron had set new record monthly highs for 16 consecutive months. Flooding on Chicago's famed Lake Shore Drive has become an all too frequent occurrence. Throughout the Great Lakes, widespread flooding and shoreline erosion, destruction of lakefront homes and coastal property and loss of valuable recreational facilities has again renewed interest in taking whatever measures are available to better control high water levels. On August 1, 1986, the two federal governments asked the International Joint Commission, a bi-national commission formed to resolve disputes over boundary waters between the U.S. and Canada, to undertake a one year study of all existing control measures that could be implemented to provide some relief from high water levels. This includes increasing Illinois' diversion of Lake Michigan water.

Increasing Illinois' diversion of Lake Michigan water is a subject that generates strong opinions by both proponents and opponents. Its role in lake level management is often misunderstood. The purpose of this paper is to briefly review the history of Illinois' diversion, the legal status of the diversion, the primary uses of our Lake Michigan diversion and finally, a discussion of the issues surrounding the potential for increasing the diversion.

### BACKGROUND

Illinois' diversion of Lake Michigan water actually began back when the Illinois and Michigan Canal was opened to traffic in 1848. At that time, annual diversion from Lake Michigan was in the order of 100 cubic feet per second (cfs). In 1854 and 1885, major storms caused massive amounts of untreated sewage to be carried far out into Lake Michigan. This contaminated water found its way into the City of Chicago's water intakes, and caused an outbreak of two waterborne diseases, typhoid and cholera. In the 1885 epidemic, 90,000 people were killed. To correct this dangerous situation, the Sanitary District of Chicago (predecessor of the Metropolitan Sanitary District of Greater Chicago) was created and immediately began a major construction project to change the direction of flow of the Chicago and Calumet Rivers so that water from Lake Michigan and sewage from Chicago flowed into the Illinois River, which drains into the Mississippi River (Figure 1). Flow through the Sanitary and Ship Canal began in 1900 under permits issued by the Secretary of War. The North Shore Channel was completed in 1910, and the last leg, the

Calumet-Sag Channel, was completed in 1922. The design capacity of the system was 10,000 cfs.

A 1910 Corps of Engineers' permit limited diversion through all channels to a combined total of 4,167 cfs. Table 1 is a listing of the monthly and annual mean diversions from Lake Michigan from 1900 through 1970. It is interesting to note that from 1900 through the late 1920s, diversion steadily increased, reaching a maximum (10,000 cfs) in the late 1920s. Diversion then began decreasing (in response to a 1930 U.S. Supreme Court Decree) and took an abrupt decrease after 1938 and has remained at approximately 3,200 cfs ever since. During a 2-1/2 month period in 1956/1957, an increased diversion to 8,500 cfs was authorized by the Supreme Court to be used to alleviate extremely low flow conditions on the Illinois and Mississippi waterway systems due to a prolonged drought.

There is no question that the diversion project played an extremely important role in the continued development of the Chicago metropolitan area. Not only did it help to ensure a safe, dependable source of water supply for the area, but it also created a greatly improved transportation link between the Illinois/Mississippi River system and the Great Lakes.

#### Legal Status

Illinois' diversion of Lake Michigan water has generated sufficient controversy among the Great Lakes states and lower Mississippi River states such that the issue has come before the U.S. Supreme Court on several occasions. The possible health threat to St. Louis when the Sanitary and Ship Canal was first opened in 1900 prompted the first of many U.S. Supreme Court decisions in 1906. Concern over the possible adverse impact on water levels of the Great Lakes from the increasing diversion led the states of Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin to sue Illinois to stop its diversion. Having been convinced earlier that the diversion did not degrade water quality in the Mississippi River, the states of Missouri, Kentucky, Tennessee, Louisiana, Arkansas and Mississippi joined Illinois' defense. In a 1930 Supreme Court decree, Illinois was directed to reduce its diversion to no more than 6,500 cfs, by 1935 to 5,000 cfs and by 1938 to only 1,500 cfs. At that time, water withdrawn for domestic purposes was not subject to any limitation, even though most of it was also diverted. The reduction in diversion into the Sanitary and Ship Canal system coincided with ordered completion of sewage treatment facilities.

In 1958, a suit was again brought before the U.S. Supreme Court by the Great Lakes states asking that Illinois be directed to return its treated sewage effluent to the lake. After an extended period of collecting testimony by the Court's appointed Special Master, the Court approved a new decree in 1967 that limited Illinois' diversion to 3,200 cfs, including domestic pumpage. A 5-year running average was to be used to determine compliance with the 3,200 cfs limitation. In 1980, the Court amended the 1967 Decree to extend the averaging period from 5 to 40 years to allow Illinois to use its diversion more

efficiently.

The 1967 U.S. Supreme Court Decree, as amended in 1980, allows Illinois to determine how the diversion should be apportioned among various competing interests. The General Assembly has directed the Department of Transportation to develop a continuing program for the apportionment of water to be diverted from Lake Michigan among regional organizations, municipalities, etc. for domestic purposes or for direct diversion into the Sanitary and Ship Canal.

#### Illinois' Diversion Today

Illinois' diversion can be broken down into 3 primary categories: domestic water supply, direct diversion and stormwater runoff.

Domestic water supply is by far the largest category, and currently accounts for about 52 percent of our allowable 3,200 cfs diversion. Withdrawals occur along the Illinois shoreline at 15 separate water treatment plants. Chicago's two water treatment plants alone average 1,500 cfs, serving Chicago and its suburban customers. Currently, about 5 million people in northeastern Illinois use Lake Michigan water. By the year 2000, this number will grow by an additional 1.7 million, due to regional growth in the area and the expansion of the Lake Michigan service area westward in DuPage and northwestern Cook Counties. This growth in domestic use of Lake Michigan water can be attributed to the 1980 amended Decree which enables a more efficient allocation of our diversion, to a reduction in the direct diversion of Lake Michigan water into the Chicago Sanitary and Ship Canal system as a result of the improvement in wastewater and stormwater treatment and to the water conservation requirements that must be adopted by all users of Lake Michigan water.

Direct diversion of Lake Michigan water into the Sanitary and Ship Canal system occurs for two primary reasons: 1) to provide for safe navigation, and 2) to improve water quality in the canal system upstream of Lockport. Direct diversion occurs at three separate locations: at the mouth of the North Shore Channel at Wilmette, at the mouth of the Chicago River, and at the mouth of the Calumet River. There are navigation locks and controlling works on both the Chicago River and Calumet River; at Wilmette, there is only a controlling structure to allow lake water to enter the North Shore Channel.

Direct diversion for navigation purposes currently requires approximately 215 cfs, and includes water used in lockages, leakages, and to restore adequate depths in the canal after the threat of a storm event has passed. This component of diversion has been decreased in recent years due to the improvements in management of the canal system made possible by the implementation of the Metropolitan Sanitary District of Greater Chicago's Tunnel and Reservoir Plan.

The diversion of lake water into the canal system for water quality enhancement is called discretionary diversion, and has been

set by state law at 320 cfs through the year 2000. After 2000, it will be reduced to 101 cfs. This component of diversion is used during the warm weather months only to improve water quality in the canal when most needed. Discretionary diversion occurs at all 3 locations.

The last category of Illinois' diversion is stormwater runoff from the 673 square mile watershed that was diverted by the reversal of the Chicago and Calumet Rivers. Under the provisions of the Supreme Court decree, this component of flow must be included in Illinois' allowable 3,200 cfs diversion. Although it is impossible to accurately measure this flow component, it probably is in the range of 680-700 cfs. This flow component is expected to increase as the Chicago metropolitan area becomes more developed, since stormwater runoff is higher from urbanized areas versus less developed areas.

Most of the dry weather flow at Lockport consists of wastewater treatment plant effluent from 3 large plants operated by the Metropolitan Sanitary District. The remainder consists of natural flows of the Chicago River, Little Calumet River and Grand Calumet River and direct diversion for lockages and leakages and, depending on the time of year, discretionary diversion. During significant storm events, stormwater runoff from the diverted watershed is discharged to the Chicago Sanitary and Ship Canal system through combined sewer overflows and storm outfalls. Discharges in excess of 20,000 cfs at Lockport can occur. On rare occasions, backflows to Lake Michigan are allowed to prevent serious flooding in the Chicago metropolitan area.

#### ACTIVITIES, PROGRAMS AND STUDIES

Illinois' diversion of Lake Michigan water has been controversial ever since its inception. More recently, discussions about an increase in Illinois diversion has similarly stirred strong feelings on both sides of the issue. The complexity of the Illinois River ecosystem, the influence of both man-made and natural factors on its flow, productivity and quality make quantitative assessment of the impacts of a particular plan for an increased Lake Michigan diversion very difficult.

In 1976, Congress authorized the Corps of Engineers to conduct a five-year demonstration and study program of increasing Illinois' Lake Michigan diversion from 3,200 cfs up to 10,000 cfs. Although an actual increase in diversion was never implemented, the Corps did complete an information report to the Congress in April 1981 which summarized their study findings. During this evaluation, engineers and scientists from the Illinois State Water Survey and Natural History Survey evaluated the physical, chemical, and biological impacts of the proposed diversion. This included research on the effects of an increased diversion on sediment transport and deposition, bank erosion, water quality, aquatic life, wildlife, flooding and agricultural impacts.

While a detailed review of that report is beyond the scope of

this paper, of particular interest is their finding that since one of the constraints was that increased diversion would not be allowed during periods of heavy rainfall (to avoid the possibility of any increased risk of flooding), an annual increased diversion of up to 10,000 cfs could not be achieved. During a dry year, diversion could be increased to approximately 8,700 cfs on an annual average basis while during a wet year diversion could be increased to only about 5,000 cfs.

The 1981 Corps report found that an increased diversion was not economically justified, considering the impacts on both the Illinois waterway and the Great Lakes system. Concerning environmental impacts on the Illinois waterway, generally they were able to describe both beneficial and adverse effects expected to occur from an increased diversion.

The original operating plan sought to increase diversion to the maximum extent possible (10,000 cfs), subject only to the constraint that when river stages were predicted to approach bankfull conditions that increased diversions would be temporarily discontinued. The Corps acknowledged that their operating plan could be revised to be more sensitive to the various interests along the Illinois waterway. For example, during low flow periods, an increased diversion may be beneficial to most of the various waterway interests. Developing an operating plan keyed to the concerns and needs of the various user groups on the waterway, paying particular attention to those areas subject to flooding, it should be possible to avoid adverse impacts. The Corps is updating their 1981 report and is developing a new operating plan with the goal of providing net benefits to the Illinois waterway system.

The subject of water regulation on the Great Lakes has received much attention over the years on both sides of the border and has been the subject of several long studies by the International Joint Commission. In 1983, the Commission concluded that modification of the existing diversions into and out of the Great Lakes system would not be economically beneficial to achieve better water level regulation on the Great Lakes. However, the record high water levels from 1985 through 1987 caused the federal governments of the United States and Canada to forward a study reference to the International Joint Commission asking them to prepare a report within one year of measures that could be implemented within one year to achieve a lowering of water levels throughout the Great Lakes system. The study reference also asks that they initiate a longer term study to evaluate a full range of options for improving water level regulation of the Great Lakes along with a thorough assessment of environmental, social, and economic impacts. The first report should be completed by early fall of 1987.

Authorization for an increased diversion at Chicago requires either an act of Congress or a modification to Illinois' United States Supreme Court Decree. Because the initiative for an increased diversion has been to provide water level relief on the Great Lakes, it is an international issue, and hence, inappropriate to bring before

the Supreme Court. It has been Illinois' position that any efforts to resolve the high lake level problem should involve all Great Lakes interests, both Canadian and American, and include all existing controlling measures which can impact on Great Lakes water levels. In addition, in response to the potential adverse impacts which have been described in previous studies of an increased diversion at Chicago, Illinois is opposed to an increased diversion until it can be clearly demonstrated that an operating plan can be developed to adequately protect interests on the Illinois waterway. The final section of this issue paper is a reprint of the State of Illinois' position on an increased diversion at Chicago, which was developed by staff in the Governor's office and the natural resource agencies. In keeping with that position, our efforts have focused on providing input and assistance to the continuing studies of the International Joint Commission and the Corps of Engineers to ensure that any operating plan for an increased diversion at Chicago provides maximum protection to our waterway interests.

In response to the high water level problem, several bills have been introduced in Congress which would authorize an increased diversion at Chicago. Recently, Congressman Sensenbrenner of Wisconsin and Congressman Porter from Illinois introduced a bill calling for the establishment of a comprehensive management program for the maintenance of water levels on the Great Lakes at approximately their long term averages. This bill also authorizes the immediate implementation of control measures on the U.S. side, including an increased diversion at Chicago. This bill contains safeguards to protect Illinois waterway interests, such as:

1. Increased diversion at Chicago would be accomplished incrementally, under the direct control and supervision of the Corps.
2. Places a ceiling of 10,000 cfs on increased diversion, and directs that increased diversion be reduced or stopped whenever bankfull conditions at established flood warning stations on the Illinois or Mississippi Rivers are predicted.
3. Directs the Corps to undertake a monitoring program to assess a full range of impacts of any increased diversion.

It is difficult to predict what Congress might do in response to the high water level problem on the Great Lakes. A very dry winter and spring have resulted in a significant drop in water levels on Lake Michigan and the other Great Lakes. One of our most important tasks will be to continue working with the International Joint Commission, the Corps of Engineers and our research agencies to continue collecting information on the potential impacts of an increased diversion and to carefully evaluate any revised operating plans so that should an increased diversion be authorized as part of a recommended plan of action between the federal, state and provincial governments that Illinois interests will be adequately protected.

## STATE OF ILLINOIS POSITION ON LAKE MICHIGAN DIVERSION

This last section is a reprint of the official Illinois position on an increased diversion at Chicago that was developed in May 1987 in response to proposals calling for an increased diversion to provide relief from high Great Lakes water levels.

The problem of rising Great Lakes water levels has become a major issue. The environmental and economic impacts are substantial and clearly evident. Beach erosion due to storm action and high water levels has damaged miles of lakefront recreational areas. Homeowners all along the shoreline are trying to save their property from the encroaching lake. Exacerbating the situation is the fact that the lakes are soon expected to undergo their normal 10 to 15 inch spring increase.

There are clearly no quick fixes to this serious problem. Some people are advocating an increase in the Lake Michigan diversion at Chicago as the least costly method of "doing something" about the problem. However, increased diversion at Chicago, by itself, is not an effective solution. If implemented, this action would, over one year, reduce Lake Michigan by approximately one inch. This is an insignificant amount considering that the Lake is now about three feet above normal. At the same time, an increase in diversion at Chicago could have the following significant adverse impacts on the Illinois River Basin:

- flooding and associated damages to farmland in the Illinois River Valley,
- substantially increased pumping costs and capital costs to maintain levees, placed on drainage and levee districts,
- streambank erosion and sediment transport which is already a major problem in some areas along the River,
- demise of bottomland forests, loss of food for migratory waterfowl and breeding grounds for wildlife populations, reductions in recreational hunting, changes in the fish populations, and
- damages to the substantial amount of conservation and recreation land along the Illinois River owned by the State of Illinois, federal government and private hunt clubs.

These considerable impacts, coupled with the fact that increased Lake Michigan diversion would have a negligible positive impact on the Lake Michigan shoreline, prevent me from supporting increased diversion at this time.

However, while there are no quick fixes, the states and federal governments need to accelerate actions to mitigate future problems due to high lake levels. Several methods are available to help reduce wave action of Great Lakes water levels and thus shoreline damage. Bulkheads, revetments, breakwater walls, off-shore structures, and man-made off-shore islands are all effective but very expensive.

Some studies are currently underway, and others are needed. At Governor Thompson's request the Corps of Engineers was asked to begin studies under the Advanced Measures Program for protection of critical areas along Lake Michigan. Some of these projects are underway. The State of Illinois is providing the non-federal cash contribution for these projects and for several Section 14 Emergency Bank Stabilization Programs of the Corps along the Chicago shoreline in Rogers Park and Edgewater areas. Section 706 of the 1986 Water Resources Development Act (PL 99-662) provides for a Great Lakes Levels Study. This study will examine the impact of weather cycles on Lake levels and relationship of shoreline damage to the regulation of outflows from Lakes Superior and Erie. It will also yield recommendations for new or additional criteria for federal participation in shoreline protection projects along the Great Lakes and connecting channels.

For any solution to be developed, it is critical that efforts to resolve the high-lake level problem be shared by all Great Lakes interests, both Canadian and American, and involve all existing controlling measures which impact inflows and outflows on the Great Lakes. Flows can be further regulated at Long Lac/Ogoki, Niagara River, Welland Canal, and the Black Rock Lock.

Until it can be clearly demonstrated that an operating plan for an increased diversion can be developed which minimizes and mitigates adverse impacts on the Illinois waterway, the state is opposed to an increased diversion at Chicago. The Governor has, however, directed the appropriate State agencies to coordinate and provide assistance to the Corps of Engineers in their continuing study of an increased diversion at Chicago and in the study effort of the International Joint Commission.

## RECREATION

### INTRODUCTION

Illinois' rivers and valleys are becoming increasingly important as recreation resources. River areas display scenic overlooks and geologic formations, harbor rich archaeological sites, and historic river towns. The rivers, backwater lakes, and forested bottomlands provide excellent opportunity for a variety of recreation activities.

Recreation today is seen as a major segment of the economy. Diverse, high quality recreation opportunities are attractive to Illinois' citizens, prospective businesses, and tourists. The "Study of the Economic Significance of Recreation in Illinois," conducted by the Department of Conservation discovered the following facts. Illinois residents spent over \$6.3 billion in 1985 on recreation. The recreation industry in Illinois employs approximately 150,000 people. Recreation expenditures produced tax revenues of almost \$1.8 billion in 1985.

Recreation also enhances the quality of life. The Illinois River basin provides recreation in both quality and quantity, and the people of Illinois recognize it as a significant recreational resource. This report identifies ways to protect and improve this resource.

### BACKGROUND

Recreation in the Illinois River basin includes water-dependent activities such as fishing, waterfowl hunting, boating, and swimming. Recreation also includes activities which are enhanced by proximity to water such as hiking, picnicking, and camping. These types of recreation are provided by local, State, and federal agencies such as park districts, forest preserve districts, the Department of Conservation, and the U.S. Fish and Wildlife Service. In addition, many private concerns provide similar recreation opportunities.

These recreation providers all offer similar recreation opportunities, each also having its recreation specialties. Often these providers produce recreation development plans independent of each other. This can result in an abundance of certain types of recreation, while under supplying other types of recreation. It can result in some areas with high concentrations of recreation sites, or areas with few recreation sites thus creating uneven distribution of recreation opportunities, or one provider having several widely spaced sites creating management difficulties. In short, the lack of cooperation among recreation providers in producing recreation development plans can be problematic and costly. In 1985, local, State, and federal agencies combined cost for providing recreation in Illinois was \$580 million.

A 1985 survey of Illinois residents showed that the most popular recreation activities in the State are bicycling, swimming, softball or baseball, and fishing. In the Illinois River basin, analyses of recreation use data show there is a strong need for more camping, trails, fishing, boating, swimming, and hunting opportunities.

In the Illinois River basin, many recreational sites and facilities are focused on the water -- rivers or lakes -- for recreation. In addition, wildlife habitat and forests are concentrated along the rivers and lakes of the basin. In urban areas, through urban waterfront renewal programs, riverfronts are being improved and made accessible to the public for recreation. Examples of riverfront development are Peoria's riverfront on the Illinois River and development on the Fox River at Elgin, Geneva, St. Charles, and the Rock River at Rockford.

Although there are many recreation providers and many recreation sites in the Illinois River basin, the largest percentage of land adjacent to rivers and lakes is in private ownership, and generally not accessible to the public for recreation. Levees have converted bottomlands to agricultural and urban development. According to the 1969 "Report for Recreational Development of Illinois River Backwater Areas," over forty percent of the bottomlands of the Illinois River were drained or leveed for agriculture. About 20 percent of the bottomlands are publicly owned or used for public recreation. Much of the remaining bottomland area is in urban and industrial use.

The list on the following page of Department of Conservation sites along the Illinois River illustrates the extent that the Illinois River and its tributaries and associated lakes contribute to recreation. This list is not comprehensive for the entire Illinois River Basin, but only the area contiguous to the Illinois River.

These water-related recreation sites are directly affected by the quality of the natural resource in and surrounding them--the rivers, lakes, backwater areas, forests, and geologic formations. Degradation of this resource is occurring at an alarming rate in the Illinois River basin. The natural resource is threatened by channelization, soil erosion, sedimentation, clearing of natural vegetation, and poor water quality. These problems are addressed in other sections of this report. They do, however, directly affect the quality and quantity of recreation available in the Illinois River basin.

It is unclear to what degree these problems are currently affecting recreation use. At some point, resource degradation reduces the quality of recreation and fewer people will use the resource for recreation. No data are available on the impact resource degradation currently has on the quality of water-related recreation use. It is known that, in general, recreation use is increasing in Illinois and this trend is expected to continue.

Illinois Department of Conservation Properties  
in the Illinois River Corridor

<u>Facility</u>	<u>Acreage</u>
Pere Marquette State Park	7,320
Mississippi River Area Sites	
Calhoun Point Waterfowl Management Area	2,313
Stump Lake Waterfowl Management Area	2,950
Glades Access Area	1,454
Godar-Diamond Access Area	2,611
Hadley Landing Access Area	142
Pike County State Fish & Wildlife Area	862
Sanganois State Conservation Area	7,623
Anderson Lake State Conservation Area	2,133
Sand Ridge State Forest	7,180
Jack Wolf State Fish Hatchery	124
Rice Lake State Conservation Area	2,694
Banner Marsh State Fish & Wildlife Area	1,891
Spring Lake State Conservation Area	1,981
Powerton Lake State Fish & Wildlife Area (Leased)	1,429
Woodford County Conservation Area	2,901
Marshall County Conservation Area	3,245
Donnelley State Fish and Wildlife Area	280
Lake DePue State Fish and Wildlife Area	2,136
Matthiessen State Park	1,686
Starved Rock State Park	2,616
Buffalo Rock State Park	43
Illini State Park	510
LaSalle State Fish and Wildlife Area (Leased)	2,058
Heidecke Lake State Fish and Wildlife Area (Leased)	1,475
Gebhard Woods State Park	29
William G. Stratton State Park	6
Illinois & Michigan Canal State Park	2,668
Goose Lake Prairie State Park	2,435
TOTAL ACREAGE	64,795

The table that follows shows the attendance data for a representative sample of Department of Conservation sites on the Illinois River for 1981 to 1986. This table illustrates that most Department of Conservation sites on the Illinois River have experienced stable or increasing attendance in the 1981-1986 period.

1981-1986 Attendance in Thousands

	1981	1982	1983	1984	1985	1986
Banner Marsh	--	12	65	64	75	69
Buffalo Rock State Park	162	128	97	129	132	262
Lake Depue fish & Wildlife Area	--	--	25	43	68	83
Illini State Park	252	339	356	399	324	337
Pere Marquette State Park	1,052	1,087	1,084	1,236	1,290	1,406
Sanganois Conservation Area	19	27	22	23	31	40
Starved Rock State Park	1,255	1,257	1,197	1,157	1,170	1,269
Spring Lake Fish & Wildlife Area	332	306	314	307	256	203
Mississippi Pallasdes State Park	734	468	433	634	688	698
Powerton Lake Fish & Wildlife Area	--	--	--	48	176	138
Matthiessen State Park	135	120	154	191	240	266
Rice Lake	113	145	153	157	140	136
	4,054	3,889	3,900	4,388	4,590	4,907

It should be noted, however, that some sites are experiencing declining attendance possibly due to degradation of the natural resource. It is clear that poor water quality is detrimental to swimming and fishing. Sedimentation is detrimental to boating, waterfowl hunting, and fishing. Erosion problems are detrimental to stream access for all of these water-related recreation activities.

ACTIVITIES, PROGRAMS, AND STUDIES

Recreational programs in the Department of Conservation can be categorized into four major types: management programs, grants to local governments, acquisition programs, and capital development projects. Management programs cover all areas of recreation including fisheries management, wildlife management, natural heritage management, and site management. These programs promote and regulate recreational use, monitor fish and wildlife populations, and improve fish and wildlife habitat on both public and private land.

Grant programs for local recreational development include the Open Space Land Acquisition and Development (OSLAD), the Land and Water Conservation Fund (L&WCF), the Boat Access Area Construction, and the Snowmobile Program grants. These grants are administered through the Department of Conservation and awarded to local governments. Snowmobile grants are available to both local governments and organized snowmobile clubs. All of these grants are 50% matching fund programs, except Boat Access Area grants and snowmobile grants to clubs, which are 100% grants. The boat access grants are for developing and improving boat access facilities on rivers and lakes. Snowmobile grants are for snowmobile trail development and maintenance. The other two grant programs (OSLAD and L&WCF) are broader in scope. Often these grant projects are multi-purpose

combining natural resource and open space preservation with development of recreational facilities. Examples of such projects are an interpretive trail in a natural area, swimming and fishing facilities on a lake, or stream bank stabilization to protect existing recreation facilities.

The third type of recreational program, acquisition programs, currently emphasize the acquisition of wildlife habitat and natural areas, due to the funding available through the Build Illinois Program. Their purpose is to acquire land--wildlife habitat and areas identified in the Illinois Natural Areas Inventory.

Related to the acquisition programs is the capital development program. The capital development program focuses on recreational development and improvements on existing State sites. The Park and Conservation Fund Program is a major capital development effort also funded through the Build Illinois Program. The types of projects included in this program are lodge and cabin improvements and expansion at State parks, new resort facilities at State parks, campground improvements and expansion, general recreation improvements, restoration of historic sites, park road improvements, and improvements at State game farms, tree nurseries, and fish hatcheries.

#### Status of Ongoing Programs

To date, \$11.6 million has been committed to the Open Space Land Acquisition and Development Program statewide. In 1987, \$460,000 was awarded to three municipalities in the Illinois River corridor. This money was used for a lake recreation area in Peru, riverfront development at Hennepin, and a swimming pool at Hardin. In 1986, \$151,000 was awarded through the Boat Access Area Construction Program to three communities in the Illinois River Corridor: Creve Coeur, Grafton, and Spring Valley.

The Build Illinois Wildlife Habitat Acquisition Program has committed \$8.5 million to date for habitat acquisition. Recent acquisitions include 789 acres of Illinois River bottomland at Banner Marsh State Fish and Wildlife Area, 2,952 acres (a former duck club) of Illinois River bottomland forest and backwater lakes at Rice Lake State Conservation Area, 728 acres at Pere Marquette State Park, and 115 acres at Sanganois State Conservation Area. Planned for 1988 is the purchase of 200 acres at Beardstown Marsh, an area of excellent bird habitat. Additional areas totaling about 400 acres have been targeted for purchase at Sanganois State Conservation Area. Two additional sites in the Illinois River basin have been identified as "areas of interest" for acquisition.

Also funded through Build Illinois was \$7 million provided for the Natural Areas Acquisition Program. There are currently twelve areas targeted for purchase within the Illinois River basin.

The capital development program includes the \$100 million Park and Conservation Fund Program to improve State site facilities. This program includes new resort facilities and lodge and cabin improvements at Pere Marquette State Park, which are expected to be completed in the spring of 1988. The total cost of this project is close to \$10 million. Renovation work is also being done on the lodge and cabins at Starved Rock State Park, and White Pines State Park at a total cost of \$5 million. Other projects in the Illinois River basin funded through this program include recreation development at I&M Canal State Park,

waterfowl area expansion at Lake Depue State Fish and Wildlife Area, and road and parking improvements at Donnelley State Fish and Wildlife Area.

The Department of Conservation along with other agencies is also currently involved with two trail projects within the Illinois River Corridor. These projects are the Illinois River Trail and the I&M Canal National Heritage Corridor. The National Park Service has completed a study and review of a proposal to designate the Illinois River and its associated waterways as a National Historic Trail. This would be a waterway trail, rather than a land trail.

The I&M Canal was recently designated by the National Park Service as a National Heritage Corridor. This is the first such corridor in the United States. An I&M National Heritage Corridor Commission was established to oversee management of the Corridor. Other organizations and agencies are involved through cooperative agreements, such as the Department of Transportation and the Cook County Forest Preserve District. In connection with this Corridor, the Metropolitan Sanitary District and others are pursuing a land trail along the canal. Portions of the trail have already been completed.

#### POSSIBLE COURSES OF ACTION

1. Coordinate local and State recreational development activities in order to complement their existing programs and goals. Local, regional, and State priorities for recreation development should be defined. Through coordination, these priorities should complement and enhance each other. Grant programs should increase priority given to applications related to the given local, regional, and State recreation priorities. Grant programs and recreational priorities should be related to other existing programs, such as Corridors of Opportunity, other Build Illinois efforts, and the Illinois River Road.
2. Continue the partnership approach of government and private interest groups, such as the Partners in Conservation effort, to promote cooperation between private interests and government toward mutually beneficial recreation developments. Work together to improve liability laws in Illinois and encourage opening of private land for public recreation.
3. Provide a stronger State presence in river corridor development in order to preserve fish and wildlife habitat and provide recreation access to natural resources now in private ownership. This would include implementation of the Illinois River Trail once designated as a National Historic Trail, and legislation to fund the Illinois River Road established in 1975.
4. Aggressively work to arrest the degradation of natural resources caused by erosion and sedimentation. Specific recommendations are included in other sections of this report. Demonstration projects and research should concentrate on protecting and enhancing the condition of natural resources at existing recreation sites thus protecting investments already made in existing sites.
5. The State should develop recreation opportunities that are not water-dependent at sites where the water resource has degraded to a degree that a quality water-related recreation opportunity is no longer available. The State should concentrate on developing multi-use recreation. Until the degradation

of the Illinois River basin's water resources can be addressed, other types of recreation can then be enjoyed at these multi-use sites.

6. Acquisition programs should concentrate on sites with quality natural resources. There are such opportunities available. Some such sites have already been identified. One example of such an area is a levee protected area. Some previously farmed areas once leveed and protected from floods, then abandoned, have also been protected from the degradation of sedimentation and water pollution. Another example is abandoned hunting clubs.

7. To establish priorities for acquisition programs and determine where the quality natural resources are, resource inventories and planning based on the resulting data should be undertaken. Some inventories have already begun: the Illinois Fish and Wildlife Information System identifying locations of species, the Illinois Streams Information System identifying the resources of stream corridors, and the Illinois Wetlands Inventory identifying the locations of wetlands. These inventories should be completed. The data can then be used to identify quality natural resources and set priorities for acquisition.

8. Visitor services and programs should be increased at existing recreation sites. This would include the addition of interpretive centers and staff, supervised recreation programs, dining facilities, and where appropriate, overnight facilities. Some of these facilities could be developed by the private sector.

9. Increase funding levels of selected current programs. The Wildlife Habitat Acquisition Program and the Natural Areas Acquisition Program should be funded at their originally planned levels.

10. Initiate a Statewide Greenways Program to focus resource protection, recreational development, and tourism promotion on Illinois' major greenways such as the Illinois River corridor.

## COMMERCIAL NAVIGATION

### INTRODUCTION

The State of Illinois offers a distinct geographic and economic advantage to shippers due to its Midwest location at the confluence of the Great Lakes and the inland waterway system. Ocean-going vessels provide direct service to the Port of Chicago from the Atlantic Ocean via the Great Lakes/St. Lawrence Seaway system, and barges operating on the inland waterway system provide service between Illinois and 17 other Midwest and Southern states, including the deep-draft ports of New Orleans and Baton Rouge.

The purpose of this paper is to provide an overview of the importance of barge shipping on the inland waterway system to the Illinois economy, the navigation features of the Illinois Waterway including constraints to barge shipping, and ongoing programs by federal and state agencies and a local community in studying ways to increase the commercial use of the inland waterway navigation system that are cost effective and environmentally sensitive. The paper presents possible courses of action to ensure that commercial navigation is compatible with other uses of the Illinois Waterway.

### BACKGROUND

#### Inland Waterways in Illinois

Illinois has 1,116 miles of inland waterways, which represents about 14% of the nation's total of 7,000 miles of inland waterways with a depth of 9 to 12 feet. The Mississippi River forms the western border of the State for a distance of 581 miles, the Ohio River forms the southern border for 134 miles, and the Illinois Waterway, which includes the Illinois River and waterways in the Chicago area, bisects the State with 365 miles of waterway and provides the water link between the Great Lakes and the inland waterway system. In addition to these more well-known waterways, the Kaskaskia River in southwestern Illinois is navigable for a distance of 36 miles from the Mississippi River.

#### Locks and Dams

The length of the Ohio River from Pittsburgh almost to its confluence with the Mississippi River, the Illinois Waterway and the Mississippi River north of St. Louis are regulated by a series of locks and dams. The dams serve to maintain the depth of the water in the segment of the waterway behind the dam, and the locks form a passage through the dams to allow barges to be raised or lowered from one level to the next.

While the locks and dams are responsible for creating the pools that allow for commercial navigation, the locks can cause

bottlenecks that delay barge operations. Only the Mississippi River, from Locks 27 at Granite City south to the Gulf of Mexico, is not constrained by locks and dams.

### Barges

The typical barge operating on the inland waterway system measures 195 feet in length, 35 feet in width and 12 feet high, and carries a maximum load of 1,500 tons of cargo. On the Illinois River, the size of tows is limited to 15 barges due to the size of the locks.

Barge transportation affords shippers of grain, coal, petroleum products, chemicals and other bulk commodities with a high capacity, low cost system to ship their products. For example, a tow of 15 barges operating on the Illinois River carries a maximum load of 22,500 tons of cargo, the equivalent of 225 railroad hopper cars or 900 truck trailers. An analysis of spot-market rates for the shipment of grain, in 1985, indicated the rate on a shipment of corn by barge from Peoria to New Orleans ranged from a low of 12 cents per bushel to a high of 27 cents per bushel. In comparison, the spot-market rate to ship all types of grain by rail averaged around 26 cents per bushel, and the rate was about \$1.19 per bushel to ship the grain by truck.

### Terminal Facilities

A terminal is a cargo handling facility on a waterway which may include a dock, transfer equipment, storage area, landside access and other related cargo facilities. As of 1982, there were 344 terminals in operation on the waterway system in Illinois. Of this total, 317 terminals mainly handle barge traffic on the inland waterway system while 27 terminals handle overseas and Great Lakes vessels.

### Tons of Barge Shipments

Barge shipments to and from Illinois increased from 70.3 million tons (tons of 2,000 pounds) in 1970 to a peak of 90.7 million tons in 1975, reached a second peak of 89.4 million tons in 1980, but fell to 81.6 million tons in 1983. Since 1970, Illinois has experienced a sharp increase in shipments of grain by barge, while shipments of coal and petroleum products have declined.

Grain shipments increased from 10.0 million tons in 1970, to 19.4 million tons in 1976, and then to 23.3 million tons in 1982, and fell to 21.9 million tons in 1983. Grain shipments by barge from Illinois increased during the decade of the 1970's in response to the rapid growth in U.S. grain exports, in which most of the grain moved by barge from Illinois and other Midwest states to the Gulf ports where it was loaded onto ocean vessels. However, shipments of grain by barge declined sharply following imposition of the embargo on grain sales to the USSR, the growth in exports from other world grain producing countries and rising levels of grain

production in developing countries that had previously been highly dependent upon foreign sources to sustain their populations.

Coal shipments by barge to and from Illinois fell from a peak of 28.1 million tons in 1975 to 21.0 million tons in 1983, and petroleum products fell from a peak of 16.7 million tons in 1974 to 11.5 million tons in 1983. Combined, these two commodities fell by 12.3 million tons from their peak years in the mid-1970's to 1983.

The decline in coal shipments by barge to and from Illinois is primarily attributed to a shift by utilities from the use of high sulfur coal mined in the Illinois basin to low sulfur western coal, which changed the delivery system from barges to railroads. The decline in barge shipments of petroleum products is the result of reduced refining capacity in Illinois and increased shipments of refined products by railroad and truck.

### Features of the Illinois Waterway

The Illinois River has a history of navigation dating back to 1803. The construction of locks and dams began in 1871 and continued until the system, as we know it today, was completed in 1939. The Illinois Waterway consists of 365 miles of channels and has 9 locks and dams. The T. J. O'Brien Lock in Chicago measures 1,000' x 110', the Chicago Controlling Lock is 600' x 84', and the remaining seven locks measure 600' x 110'.

The physical features of the Illinois Waterway vary considerably from upper to lower reaches. The upper reach from Lockport to Starved Rock has a narrow channel and a relatively steep slope. The drop between Lockport and Starved Rock is 2.3 feet per mile. From Starved Rock to the mouth of the Illinois, the channel is wider and much flatter. The drop from Starved Rock to LaGrange is only about 1.6 inches per mile. These physical features impact tow traffic. The upper reaches have smaller tows than the lower channels, although this is not always due only to channel constraints.

The LaGrange and Peoria locks, the two southernmost locks on the Illinois River, have two of the four remaining wicket dams in the United States. These dams are made of large timbers that lay on the bottom of the river when flows are great enough to provide for a 9-foot channel. When the flows get low, the wickets are raised to create a dam. These wickets allow tows to by-pass the locks almost 50 percent of the time. Even though they are costly to maintain, they create significant efficiencies in transportation costs. In 1986, the wickets at Peoria were down 60 percent of the time. This allowed over 2,000 tows to pass by the lock, saving a total of more than 2,700 hours in processing time. The rehabilitation of the two locks will replace some of the wickets with a gate that will allow better control of the pool and allow ice to pass. This will relieve a dangerous condition when wickets must be lowered in the winter. Several times, Corps work boats have been upset and workers forced into the water when ice upstream has broken loose as the wickets were being raised or lowered. The gates will help to avoid this

extremely dangerous situation.

At Marseilles, the lock is about 2 miles downstream from the dam. The canal between the two is only 200 feet wide. This is too narrow to allow the passing of tows, so one must wait while another is in transit on the canal. About 65 percent of all tows encounter delays at Marseilles which average 3 hours. These delays will continue to increase in the future. Any solution to this problem will require not only efficiency studies, but environmental studies as well.

Above Lockport, the Sanitary and Ship Canal serves as the navigation channel. This canal is very narrow and it is congested in many places. Last improved 80 years ago, the canal was not designed for the type of equipment that uses it today.

Dredging on the Illinois is not a major problem. The average dredging is 169,000 cubic yards annually. The major problem area is at the mouth of the Mackinaw River. This area accounts for 25 percent of the average volume. Although small in volume, the location of disposal sites is a sensitive environmental problem that requires resolution.

#### Future Traffic Constraints

Future barge traffic on the Illinois Waterway will be limited by several constraints:

Marseilles Canal - The major constraint is the narrow canal at Marseilles. The existing delays which now average 3 hours per tow will continue to increase. Widening of the canal or the construction of a new canal may be needed to remove this constraint. In either case, an environmental impact statement would have to be prepared.

LaGrange Lock - The LaGrange Lock has the greatest traffic volume. However, since the wickets are down a large percent of the time, average delays are not excessive. There is a possibility though, that if there are some very dry years, this lock could then be a major constraint.

Capacity of the Locks - Past studies by the Army Corps of Engineers have identified major constraints at the locks as early as 1990. This can be extended to the year 2000 by use of non-structural measures. However, in order to handle traffic after that, decisions will have to be made on either restricting traffic or building new locks.

#### ACTIVITIES, PROGRAMS, STUDIES

##### Capacity Studies

Better information needs to be developed on the real capacity of the system. Studies are also required to determine the needs of the

system. What is the future demand and how could it best be met? There are minor modifications which can be done to more efficiently move traffic through the locks. There are also things that the towing industry can do to be more efficient. It is important to analyze these various measures in order to predict when the capacity of the various locks will be reached. With this information, we can then determine when and where problems will develop and make plans to solve them.

An update to the National Waterways Study, to be conducted by the Army Corps of Engineers, will provide updated traffic projections on which to base a determination of future lock capacity constraints. However, the state needs to be conducting independent studies of future traffic on the Illinois and Mississippi Rivers. These traffic projections should include such factors as the state's agricultural production capacity and coal or mineral mining capacities; the distribution of commodities among rail, barge and truck; and the future capacity of the state's rail system.

#### Environmental and Recreation Information

There is a need to obtain better environmental and recreation data. As future traffic makes more demands on the system, we must have a better understanding of the impacts. Commercial navigation is important to Illinois, but so is the natural environment of the river.

Impact studies of barge operations should address sediment resuspension and lateral movement, elevated average sediment concentration and turbidity, waves and drawdown caused by tows, and sediment input to side channels and backwaters. Careful field experiments can determine the impact of one tow and be combined with traffic predictions to assess impacts of increased navigation. Tow passage and fleeting and terminal area effects on mussel beds, fish spawning, and fish wintering habitats need to be determined. Certain areas already have safety problems because of high volumes of commercial and recreational traffic on confined waterways. Recreational activity must be projected and used to assist in siting terminal and fleeting areas. Any state efforts should complement research and monitoring conducted as part of the Army Corps of Engineers' Environmental Management Plan.

#### Ongoing Navigation Programs

This section presents navigation programs being conducted by the U.S. Army Corps of Engineers and the State of Illinois that may lead to increased shipments and to more efficient use of the inland waterway system serving Illinois. Also, an example is presented of local assistance in Dubuque, Iowa to the barge industry which was in need of additional fleeting space on the Mississippi River.

## Army Corps of Engineers

Locks Rehabilitation Program - The ongoing locks rehabilitation program, and its related environmental document, should result in a better understanding of the existing conditions and provide short-term answers to some problems.

Environmental Management Program - This program is looking at a number of barge related issues including habitat rehabilitation and enhancement, a long-term resource monitoring program, a computerized inventory and analysis system, a traffic monitoring program and a program of recreation projects.

Update of the National Waterways Study - An Inland Waterways Review will update the data in the 1982 National Waterways Study to determine if any changes are required in its recommendations.

Study of Locks on the Upper Mississippi River - The Corps of Engineers is assisting the states of Illinois, Iowa, Wisconsin, Missouri, and Minnesota in a study of low cost non-structural measures to increase commercial navigation efficiencies. Although this study is on the Mississippi River, some of the findings may be applicable to the Illinois River.

## Illinois Department of Transportation Programs

The Illinois Department of Transportation (IDOT) has taken an active role in the development of a coordinated intermodal freight transportation system serving the needs of manufacturing companies, farmers, mining operations, commercial enterprises and other users of railroad, truck and waterway shipping. This section of the paper discusses several of IDOT's programs in furthering the development of the inland waterway transportation system serving Illinois shippers.

Directory of Water Terminals - IDOT conducted a survey of existing terminals, and the survey results were published in the Directory of Lake and River Terminals in Illinois. For each of the terminals, the Directory includes such information as the terminal name, location, telephone, owner, contact person, tons of commodities handled, vessel loading/unloading capacity, storage capacity and railroad and/or truck access. The purpose of the Directory is to assist shippers in contacting terminals for the shipment of cargoes to and from Illinois.

Historic Database on Water Transportation - Recently, IDOT published a report entitled Illinois Waterborne Shipping Database. The report contains 63 tables that indicate the commodities and tonnages of waterborne shipments to and from the State of Illinois each year since 1970, and, in addition, includes tables on historic shipments for ports and waterways throughout the United States.

Forecasts of Barge Shipments - IDOT will be developing a series of projections of future shipments on the inland waterway system.

The methodology being used to develop barge forecasts will involve three major steps: 1) Identification of international, national and state production and consumption factors that will affect the need for water transport of coal, grain, fertilizer, petroleum products, sand and gravel and other commodities shipped by the river system; 2) Development of commodity forecasts specific to Illinois for those major commodity groups handled on the inland waterway system; and 3) Development of barge tonnage forecasts to and from the State for major commodities. When completed, the database will assist the State, port districts and the maritime industry in planning for needed port facilities and will provide an immediate source of comprehensive, timely and readily accessible data for investment decision-making and for responding to short-term economic development opportunities.

#### Role of Local Communities

Local communities along the waterway can play an important role in river transportation. The program conducted by a local government agency in Dubuque, Iowa is cited as an example of this type of activity.

The Dubuque Metropolitan Area Transportation Study assisted the barge industry in identifying sites for barge fleetling. Within the Dubuque area, the harbor service operators had been calling for more fleetling space on the Mississippi River, and other interest groups opposed the designation of almost all potential fleetling because aspects of fleetling detracted from their interests. This set the stage for the formation of an intergovernmental Ad-Hoc Fleetling Committee in August, 1985.

Several of the accomplishments of the Ad-Hoc Fleetling Committee which might be applicable to Illinois communities facing similar types of competing needs for riverfront uses, including fleetling, are as follows:

- o Developed a short term contingency plan enabling a response in event of a fleetling space emergency.
- o Promoted public awareness of the economic impact that the transportation industry, and barge fleetling, have on Dubuque and the tri-state area. This included an effort to develop interpretive panels or information kiosks that illustrate the past and present role of waterway commerce in Dubuque's development.
- o Encouraged long-term leases for fleet operators in order to meet the expected long-term growth in the demand for fleetling.

#### Impacts of the Water Resource Development Act of 1986

The U.S. Water Resource Development Act of 1986, PL 99-662, will have several significant long-term impacts on the national inland waterway system.

- o The Act created an Inland Waterway Users' Board composed of 11 shippers and users which will make recommendations regarding construction and rehabilitation priorities and spending levels for features and components of the inland waterways system.
- o The Act authorized the Upper Mississippi River Management Act of 1986. Its purpose is to assure the coordinated development and enhancement of the Upper Mississippi River System, of which the Illinois River is a part. It authorized a total of \$191,415,000 over a ten-year period to plan, construct and evaluate measures for fish and wildlife habitat, implement a long-term resource monitoring program, implement a computerized inventory and analysis system, implement a program of recreational projects, and conduct an assessment of economic benefits generated by recreational activities.
- o It authorized an increase in the fuel tax paid by towboat operators. The current tax of 10 cents per gallon will increase to 20 cents per gallon in steps between 1990 and 1995. These funds will be put into a trust fund to be used for capital improvements on the waterways.

#### CONCLUSION

The Illinois River is important to the State of Illinois and it is important as a national resource as well. There is a vital need to maintain commercial navigation on the river as a major economic resource and to maintain the river as a major environmental resource. This will require considerable effort in doing further studies and in planning. Through the efforts of all concerned, plans can be developed for the future of the Illinois River and to ensure its use as a balanced resource into the 21st century.

#### POSSIBLE COURSES OF ACTION

The navigation channel of the Illinois Waterway is maintained by the Army Corps of Engineers, and the Corps operates and maintains the locks and performs rehabilitation work on the locks as it becomes necessary. The costs of operating and maintaining the navigation system are 100 percent federally funded, and the cost of new locks is 50 percent federally funded and 50 percent funded from the fuel tax on barge operators. Because of this joint federal and private sharing of costs for the commercial navigation system, there is no need for the state or local communities along the waterways to contribute funds for these purposes.

There is the need to carefully study the potential impacts of future increased barge traffic on natural and recreational resources of the waterway. Following are recommended programs for the State and for communities along the waterway to ensure that barge operations are compatible with the environment, recreation uses and local riverfront development needs.

### Environmental and Recreation Studies

While the Corps of Engineers has identified a worthwhile program of studies to assess the impacts of commercial navigation on the environment and on recreational uses of the Mississippi River and the Illinois Waterway, it is critical that the State have ample opportunities to monitor these studies and to review draft reports on study findings and recommendations. To achieve this oversight responsibility, it is recommended that:

- o IDOT be the lead State agency in notifying the Corps of the need for State involvement in ongoing and proposed studies of the impacts of commercial navigation on the environment and recreation uses of the Illinois Waterway.
- o IDOT coordinate its review activities with the Department of Energy and Natural Resources, Department of Conservation and other state agencies as needed.

### Community Programs

Due to the contribution of commercial navigation activities to the economies of the communities along the Illinois Waterway, communities can undertake programs to ensure that future demand for riverfront lands by the barge industry and terminal developers are compatible with community needs and plans for future riverfront uses. Similar to the experience of the Dubuque Ad-Hoc Fleeting Committee, communities along the Illinois Waterway could conduct the following types of programs:

- o Identify riverfront sites suitable for fleeting, terminal development and other uses related to the barge industry including the disposal of dredged materials. Also, identify sensitive areas in which such development should be prohibited.
- o Establish a dialogue with barge terminals and barge operators by such means as ad-hoc committees to discuss the needs and problems of the barge industry and to reconcile problems between the industry and other local interests.
- o Develop public awareness programs to increase the public's understanding of the contribution of the barge industry to the economy of the local area and the State of Illinois.

## DRINKING WATER SUPPLY

### INTRODUCTION

Use of surface water within the Illinois river basin for public water supply purposes is limited. Only the Illinois American Water Company-Peoria Division uses the Illinois River to obtain a part of its raw water supply. With respect to public water supply needs, there are no major on-going water quality problems within the basin. In general, adequate water quality and quantity is available to meet public water supply demands. Those problems which do exist are transient or of a non-point nature (i.e., flooding, reservoir siltation and, to some extent, nitrates). Programs proposed elsewhere in this report will, if implemented, address possible solutions which should favorably impact on the needs of public water supplies within the basin.

### BACKGROUND

There are 11 large and 15 relatively small public water supplies which rely on surface water sources within the Illinois River basin. Only the Illinois American Water Company-Peoria Division has a treatment plant which obtains water from the Illinois River. The Water Company is not totally dependent on the river as a source of supply as wells are used to supply a majority of the water demand. Generally, the river water treatment plant is used to meet the water demands during the warmer months. Water Supplies located on major tributaries of the Illinois River include the following:

Fox River - Elgin uses some water from the Fox River but also has wells. Both the river water and well water is treated at the same central treatment plant. The City of Aurora is planning to install a treatment plant which will use Fox River water along with water from the existing deep wells and shallow wells which are to be developed.

Kankakee River - The Kankakee Water Company uses the Kankakee River as a sole source of supply. The City's of Joliet and Wilmington have plans to construct water treatment plants which will treat Kankakee River water.

Vermilion River - Water treatment plants at Pontiac and Streator owned by the Northern Illinois Water Corp. obtain water from the Vermilion River.

Sangamon River - The City of Decatur has two water treatment plants which use water obtained from an impoundment of the Sangamon River. The Cities of Springfield and Taylorville both have impoundments on tributaries to the Sangamon River which are used for water supply purposes.

Minor Tributaries - The City of Jacksonville uses some surface water from impoundments on Mauvaise Teere Creek; however, most water is obtained from a groundwater collection system and wells located along the Illinois River. The City of Canton has a surface water treatment plant which obtains water from an impoundment on Copperas Creek. The ADGPTV Water Commission has a treatment plant which obtains water from an impoundment on Hodges Creek.

Surface Water is generally not used as a source of supply within the Illinois River Basin as there is sufficient groundwater within the area. Groundwater requires little or minimal treatment before delivery to the distribution system. Surface water, on the other hand, requires rather extensive and somewhat complex treatment in order to provide a safe, potable product. Many of the communities within the basin are quite small and would probably have difficulty in financing the construction and upkeep of a surface water treatment plant. This situation may, however, be changing due to the quality of groundwater available in a number of areas within the Illinois River basin. Frequently, groundwater in this area exceeds the drinking water standard for radium. Communities may find it is cost effective to develop a regional public water supply which uses surface water and serves a large area. The communities may find this type of regional system is much less expensive to construct and operate when compared to installation and operation of individual treatment plants which remove radium.

The public water supplies within the basin which have impoundments on the tributaries are faced with siltation problems. Four communities within the basin which use surface water occasionally experience excursions above the nitrate standard for drinking water. On the other hand, none of the public water supplies which use surface water within the basin are experiencing problems with pesticides nor have there been problems with volatile organic compounds. The siltation problem is being addressed by some of the communities. Bloomington, for example, has installed an additional reservoir in order to keep up with the projected water demands. Decatur has plans for dredging of their lake and are investigating other means to supplement raw water needs. Springfield has initiated a dredging program in the upper reaches of Lake Springfield. As mentioned, there are four communities within the basin which have nitrate levels which exceed the drinking water standards periodically. Public water supply officials provide public notice and work closely with the medical community in advising parents with children under 18 months of age. While the nitrate levels in these communities do not significantly exceed the standard, the parents are advised as to the steps which need to be taken in providing an alternate source of water for their infants.

## ACTIVITIES, PROGRAMS, AND STUDIES

Illinois has had a public water supply program since about the turn of the century. The public water supply program in Illinois is administered by the Illinois EPA under regulations adopted by the Illinois Pollution Control Board. Illinois has also received primary enforcement authority (primacy) for the administration of the Safe Drinking Water Act (SDWA) from the USEPA. The Illinois Pollution Control Board has adopted regulations at least as stringent as those of the SDWA. All public water supplies are evaluated by IEPA on a routine basis to assure conformance with the Board regulations. As deviations from Board regulations are found during the inspection, evaluation and monitoring process, recommendations are made to water supply officials for necessary correction. If needed, enforcement actions are also taken to bring about compliance with the regulations. Raw and finished water samples are routinely submitted from each public water supply as a part of a monitoring program and are analyzed to determine: microbiological quality; inorganic and organic chemical quality; physical quality; and radiological quality. Public notification via the news media is required whenever there is violation of a drinking water standard or a monitoring/reporting requirement. The number of water quality constituents regulated by drinking water standards will be increased from 34 to 81 by 1989 as provided for under the SDWA Amendments of 1986.

The IEPA public water supply program differs from other Agency media programs. The Illinois Environmental Protection Act and the Board regulations are directed toward the actions water supply officials must take in the provision of a safe, potable water. Accordingly, the public water supply program relies heavily on other programs to provide relief from area wide adverse water quality impacts. Although the Illinois Municipal Code provides that public water supply officials can take legal action whenever the source of supply (either ground or surface water) is contaminated, this course of action may be somewhat cumbersome for local officials. Resolution of problems through this process would usually require development or retention of expertise needed to successfully prosecute a case.

## POSSIBLE COURSES OF ACTION

Surface water supplies within the basin are not experiencing major water quality problems. The Illinois American Water Company--Peoria Division operates the only public water supply which uses Illinois River water and even so does not rely entirely on the River as a sole source of supply. Groundwater is used to provide the majority (approximately one half to two thirds, depending on the season) of the water needs while the surface water plant is used to supplement during peak usage periods. Major problems with water quality have not routinely been experienced. However, one such infrequent instance did occur during 1985 when extremely low river flows were coupled with a bloom of microorganisms which resulted in severe taste and odor problems for a time. The surface water treatment plant is provided equipment and facilities which adequately treat and provide a safe, potable water. Safe in that the water meets or exceeds drinking water standards; potable in that the water is not objectionable to sight, taste, or smell. Similarly, quantity

has not been an issue for purposes of supplying water to the Peoria service area. In fact, the water company plans to further expand the availability of water to areas outside the city. A problem being anticipated if Peoria Lake siltation becomes as severe as predicted is hinderence of operation due to excess turbidity brought about by barge traffic. However, this is not a problem at the present time.

Problems with reservoir siltation and periodic excursions above the nitrate standard at several water supplies are more of a non-point source problem and are being addressed in the other areas of study. As these programs are phased in and controls are implemented, benefits to the water supply program will accrue.

The surface water supplies within the basin could be used as reference points to gauge the effectiveness of control programs. As examples: a water supply intake could be used as a water quality monitoring station; reservoirs could be used to gauge the effectiveness of erosion control measures being implemented; and use of reservoirs to pilot techniques for control of algae and other microorganisms as this relates to reduction in nutrient loadings for surface waters.

## WASTEWATER DISPOSAL

### INTRODUCTION

Utilization of the Illinois River for waste disposal is one of the numerous uses found in the system. Concerns about health and negative recreational impacts due to waste discharge are concerns of all users of the Illinois River.

### BACKGROUND

The Illinois River is a major conduit for the transport of treated waste throughout Illinois. It is estimated that 2,109 outfalls are located in the Illinois River Basin today. Illinois has taken great efforts to obtain compliance with effluent limitations by dischargers in the basin. From the municipal facility perspective, the State and Federal government has expended \$2.3 billion 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.

The majority of expended funds have been through the Federal Water Pollution Control Act, Section 201, Construction Grants Program. In addition to these funds, the State established grant funds through the Illinois Anti-Pollution Bond Act of 1970. In a comparable role with these funding programs, Governor Thompson's Build Illinois Program has infused another \$27 plus million into major wastewater programs. The largest discharger in the Illinois River Basin System is the Metropolitan Sanitary District of Greater Chicago (MSDGC). It is estimated that over \$11 billion dollars in local, state and federal funds has gone towards wastewater control in this area since 1970. One project alone, the TARP Tunnel, has significantly modified the impacts of combined sewage and stormwater in the Illinois River Basin System. This is important as the combined sewer overflow from the MSDGC was estimated to be 75% of the total BOD<sub>5</sub> load from this area into the receiving streams. When considering just the main stem of the Illinois River, several other major sewage contributions have also realized increased treatment capabilities. These contributors include: Lockport, Joliet, Morris, Ottawa, LaSalle, Peru, Chillicothe, Peoria, and Beardstown. Review of the entire basin finds the majority of the larger municipalities and an overwhelming majority of the State's population. This information speaks for the need to continue to properly manage waste treatment systems in the basin if we are to be able to focus efforts into nonpoint source pollution control needs in the watershed.

### ACTIVITIES, PROGRAMS, AND STUDIES

The activity of waste disposal is closely regulated through State and Federal Regulations. The procedures for issuance of National Pollution Discharge Elimination System (NPDES) permits are established through a memorandum of agreement with the USEPA; the regulations under 40 CFR 122, 123, 124, and 125; and the Illinois Administrative Code, Title 35, Environmental Protection. Dredge and fill operations are regulated through Corps of Engineers 401/404

review. The sludge program issues permits through Illinois Administrative Code, Title 35, Chapter 1, Section 309.204. Other Illinois Pollution Control Board Rules and Regulations which address other waste/residue disposal also exist. These regulations, in conjunction with ongoing programs to evaluate or establish water quality standards in Illinois, continue to improve and expand upon the effectiveness of waste disposal management throughout the State.

For industrial facilities, the IEPA is committed to utilizing available resources to further implement a pretreatment program that complies with the intent of the Clean Water Act and 40 CFR 403 (General Pretreatment Regulations). The IEPA has required, through intensive reviews and guidance, facility compliance with all the federal requirements. Highlights to this program include; 1) Utilizing Permit, Grant and Compliance mechanisms in the development of a pretreatment program and requirements to meet federal guidelines; 2) Guidance through numerous seminars and written document; 3) Requiring the development and enforcement of local limits to protect the treatment process, water quality and compliance with NPDES limits including a State permit process for sludge disposal.

In addition to the "traditional" programs for management/regulation of waste disposal, the IEPA has ongoing programs in the field of Toxic Substance Control, the USEPA's National Dioxin Study, fish contaminant monitoring, and sludge management and disposal:

Toxic Substance Control -- The major elements of the program include: 1) Development of a multimedia approach for dealing with toxic substances, 2) Development of reliable and accurate methods for measuring the significance of toxic substances in the environment; 3) Identification of appropriate and enforceable standards and controls for toxic substances found to be a problem in Illinois waters.

National Dioxin Study -- The IEPA in conjunction with the USEPA is conducting follow-up sampling for fish in areas where detectable levels of Dioxin have been identified.

Fish Contaminant Monitoring-- The IEPA participates in a cooperative multi-Agency effort to monitor fish flesh sampling and testing for toxic, and assists in the issuance of fish consumption warning throughout the Illinois River Basin and the State.

Sludge Management -- The IEPA regulates the sludge management strategies through the State's permit process. This program will allow the IEPA to actively encourage the recycling of POTW (Publicly Owned Treatment Works) generated sludge. The IEPA will carefully review the sludge treatment and solids handling capacities of POTW's. This will not only insure good handling practice, but will aid with the POTW achieving compliance with the effluent limitations established in their NPDES permits.

## POSSIBLE COURSES OF ACTION

Review of waste disposal conditions in the Illinois River basin finds:

- Effective, enforceable, long-term programs are in place and keeping pace with new concerns and technologies.
- Continued vigilance is needed in the administration of State and Federal regulations. Review of the utilization of Administrative Authority in the control of land pollution at the IEPA, and Administrative Order Authority at the USEPA, indicates that the procedural streamlining and effectiveness of such authority would enhance the IEPA's administrative efforts.
- Development of effective water quality standards must keep pace with new constituents.
- Continued financial support through State infrastructural funding and/or a revolving loan program is needed to help communities defray the costs of compliance with NPDES limits.
- Local initiatives in improvement of operation and management of facilities including refinancing, and "policing" of significant users is needed to reduce excursions from effluent limits.

## HYDROPOWER

### INTRODUCTION

Hydropower was dubbed "an energy source whose time has come again" in a 1980 report by the Comptroller General of the United States to the Congress. Hydropower potential exists at many low dams and it can save the country hundreds of thousands of barrels of oil per day. However, problems and constraints -- economic, environmental, institutional, and operational -- must be carefully investigated to determine the suitability and feasibility of hydropower development at a site. The Federal Energy Regulatory Commission (FERC) estimated the potential capacity at 110,000 megawatts (MW) for sites with power potential over 5 MW each. Hydropower is one of Illinois' largely untapped renewable resources.

The Federal Water Power Act gave the Federal Power Commission, now FERC, responsibility for licensing all non-federal hydroelectric power projects. The regional electrical companies serving the area are required by the Public Utilities Regulatory Act to purchase the power if other buyers cannot be found. In Illinois, potential sale price of the power will be specified by the Illinois Commerce Commission. At present, hydropower is being generated at the Lockport and Marseilles locks and dams on the Illinois River. Other locks and dams for possible hydropower development are at Brandon Road, Dresden Island, Starved Rock, Peoria, and La Grange. There is potential for increasing the capacity at Marseilles Lock and Dam.

### BACKGROUND

Hydropower is one of Illinois' largely untapped renewable resources. With the recent advances in low-head hydropower technology, this resource can provide close to one percent of the power needed in Illinois. However, at the present time, hydropower accounts for only about one-fifth of that potential. Increased cost of fossil fuels and adverse impacts of their use on air and water quality have rejuvenated the interest in hydropower.

The U.S. Department of Energy, DOE, initiated several programs in the 1970s to promote the development of small-scale or low-head hydropower. The Federal Energy Regulatory Commission, FERC, streamlined the regulatory process for such projects. In 1978, the Illinois Institute of Natural Resources (now the Department of Energy and Natural Resources, DENR) initiated studies to assess the potential for small-scale hydropower generation. A study conducted by Wapora, Inc., listed six hydroelectric generating facilities operating in Illinois.

<u>Facility location</u>	<u>River</u>	<u>Net head (feet)</u>	<u>Existing capacity (megawatts)</u>
1. Marseilles	Illinois River	14	2.3
2. Lockport	Chicago Sanitary and Ship Canal	38	17.0
3. Dixon	Rock River	9	4.0
4. Rockton	Rock River	15	1.1
5. Dayton	Fox River	28	4.0
6. Moline	Sylvan Slough	9	<u>3.6</u>
			32.0

Hydropower potential in Illinois is limited because of low hydraulic heads and seasonal variability of streamflow. The hydroelectric generating capacity decreased from 48 MW in the early 1950s to 44 MW in 1960, 43 MW in 1968, and 32 MW in 1978. The Illinois Division of Waterways attributed the decay in hydropower generation to small and uneconomical size of plants, excessive operation and maintenance costs, and relatively cheap and abundant power from steam-electric plants.

In 1979, the U.S. Corps of Engineers completed a preliminary inventory of hydropower resources. This inventory lists 303 sites (including existing generating sites in Illinois) with and without dams that have a potential generating capacity of at least 50 kilowatts (kw). Dam and flow data are available at 57 of the 303 sites. Construction of hydropower generating facilities at sites without dams will be very expensive and will pose significant environmental problems. Combined generating capacity at the 57 sites is estimated to be approximately 176 MW. The sites on the Illinois River and Des Plaines River (from confluence with the Kankakee River to Lockport) are:

<u>Site</u>	<u>Estimated capacity, MW</u>
Lockport Dam, existing	17.0
Brandon Road Dam	9.9
Dresden Island Dam	7.7
Marseilles Dam, existing	2.3
Marseilles Dam, proposed plant	10.2
Starved Rock Dam	15.8
Peoria Dam	8.7
La Grange Dam	12.2

Thus the hydropower generating capacity can be increased from the existing 19.3 MW to 83.8 MW. A megawatt of capacity can meet the electrical needs of 1,000 to 2,000 people. Fifteen of the 21 sites originally identified by Wapora, Inc. in 1982 have already been studied. The studies for the sites with larger capacities indicate that development is economically feasible.

Typically all hydropower plants have a dam to direct water through a power house containing mechanical and electrical generating equipment. The dam increases the net hydraulic head and permits regulation of the flows to moderate the flow variability.

Dams are built across streams and rivers for various purposes, including navigation, water supply, hydropower, and recreation. They affect water quality in terms of dissolved oxygen (DO) levels. There can be both positive and negative effects. Construction of a dam creates backwaters with higher depths and lower flow velocities than exist without the dam. This generally leads to a decrease in DO levels (reaeration is directly related to stream velocity and inversely related to depth) and accumulation of sediments (pollution strains stream DO resources still more) in the pool. Water flowing over the spillway crest or weir causes a significant increase in DO, but releases from the dam through pipes laid near the pool bottom depress DO levels downstream during summers with low flows and high temperatures. The predominant fish and the organisms they feed on have been classified by the prevalent DO levels in a stream. Warm-water game fish need sustained DO levels of 5 mg/l or higher, other game fish such as walleye and northern pike need 6 mg/l or higher, and rough fish such as buffalo fish and drum exist comfortably in the 2-4 mg/l range.

The Illinois Waterway comprises the Illinois River from its confluence with the Mississippi River upstream to its confluence with the Kankakee River, and the Des Plaines River from its confluence with the Kankakee River upstream to Lockport and thence to Lake Michigan. During dry weather, the upper portion consists mainly of treated wastewater effluents diluted with water diverted from Lake Michigan. There are seven locks and dams at Lockport, Brandon Road, Dresden Island, Marseilles, Starved Rock, Peoria, and La Grange. These dams create eight navigation pools extending over the entire waterway of 327 miles length. The Illinois Waterway profile is shown in Figure 1. When flow is passed through penstocks for generating power, there is little aeration of the water passing through the turbines. Laboratory and field tests have been conducted throughout U.S.A. to include in the design and operation of dams such measures as to maintain reasonable levels of DOs upstream and downstream of the locks and dams. However, such measures have not generally been used on the existing dams.

The operation of navigation locks and dams may need some modification during the periods when river flow exceeds the lockage requirements. The literature search did not show any discussion of this aspect. Another concern will be the change in sediment transport because of low-head hydroplants. Relevant information for the Illinois River is not available.

#### ACTIVITIES, PROGRAMS, AND STUDIES

A preliminary inventory of hydropower resources overstated the estimated hydropower capacity because the following factors were ignored: reduction in head due to rising tailwater during high

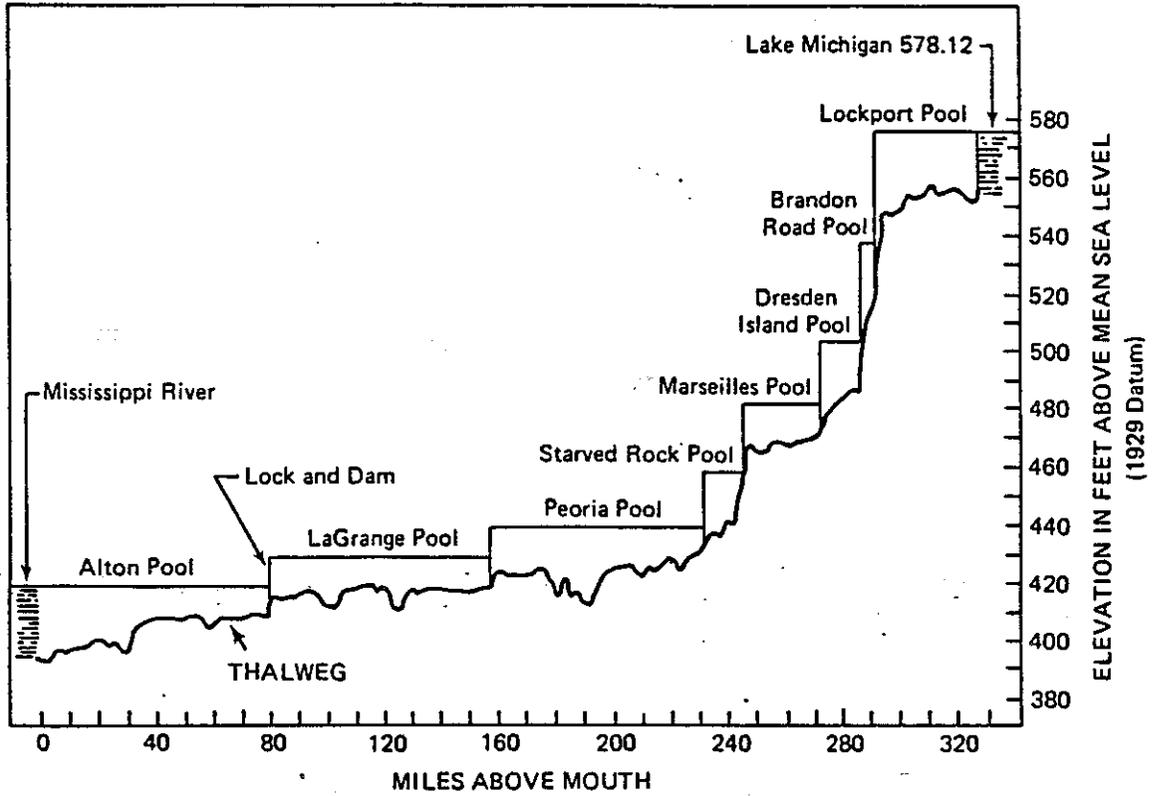


Figure 1. Illinois Waterway Profile

flows; diversions of flow for other uses, and evaporation losses, head losses, and turbine efficiency; shut-down during high flows; and environmental and social constraints. Detailed site-specific studies are expected to cover these deficiencies. The Corps of Engineers prepared a reconnaissance report on the hydropower potential of locks and dams 12, 13, 15, 16, 17, 18, 20, 21, and 22 on the Mississippi River because the national hydropower study indicated that power production at these dams might be economically feasible. Several different-sized plants were economically evaluated for each dam site. At locks and dams 12 and 17, none of the power plants evaluated were economically justified. The remaining locks and dams had some size of power production that is economically justified and could make a contribution to national energy independence.

The Corps of Engineers investigated the feasibility of developing hydropower at the seven locks and dams on the Illinois River during the period from the late 1970s to the early 1980s. Hydropower development was found to be economically justified at the Brandon Road, Dresden Island, Marseilles (a new additional plant), and Starved Rock locks and dams. The power plant at Lockport is already being operated by the Metropolitan Sanitary District of Greater Chicago, MSDGC. Power generation at Peoria and La Grange locks and dams is not economically feasible because of rather low hydraulic heads and wicket-gate operation. The recent Corps reports give the following information:

<u>Lock and dam</u>	<u>Capacity, MW</u>
Brandon Road	9.9
Dresden Island	12.0
Marseilles	10.4
Starved Rock	15.0

Wapora, Inc. conducted a preliminary investigation of small-scale hydropower potential at five sites in Illinois for the Illinois Institute of Natural Resources. The five sites selected were the Oregon Dam on the Rock River at Oregon, the Upper Sterling Dam on the Rock River at Sterling-Rock Falls, the Wilmington Dam on the Kankakee River at Wilmington, the Kankakee Dam on the Kankakee River at Kankakee, and the Elgin Dam on the Fox River at Elgin. Main findings are: flow and head at each site are adequate to generate electrical energy, all the dams are in good condition (with the exception of the Elgin dam), existing power house structures or substructures can be utilized, redevelopment of hydropower at these sites will have few environmental consequences, and development of each site by a private entity seems to be infeasible. It is interesting to note that, with the exception of the Elgin site with the smallest potential capacity, all the sites are in various stages of project planning. The Oregon and Wilmington sites have received preliminary permits; Rock Falls has been exempted from licensing and the powerplant is under construction; and Kankakee has applied for a license. Development efforts are all being made by the municipal officials.

For small-scale hydropower development, the developer has to apply to the Federal Energy Regulatory Commission (FERC) for a preliminary permit that is valid for 3 years and allows the developer time to get power potential, economic feasibility, and other relevant factors investigated and assessed. During this period no one else is issued a preliminary permit for the same site. At the expiration of the permit, the developer can apply for a license or for exemption from licensing if he wants to go ahead with detailed design and construction. These applications so far have been for sites with existing dams, locks and dams, or other control structures. It has been the administration policy to give permits to non-federal and private entities. This preference has kept the Corps of Engineers and other federal agencies from undertaking small-scale or low-head hydropower development even at the dams owned by them.

According to the FERC, nine preliminary permits have been issued (three on the Mississippi River locks and dams 18, 21, and 25; one near Benton on the Big Muddy River; one near Oregon on the Rock River; one near Carlyle (Carlyle Hydro Associates) at Carlyle Lock and Dam; one at Marseilles Lock and Dam on the Illinois River; one near Wilmington on the Kankakee River; and one for Kaskaskia River (Randolph Associates) at the Kaskaskia Lock and Dam). Two applicants have been exempted from licensing: Mr. & Mrs. M. White (Sears Project), and Rock River and City of Rock Falls (Upper Sterling Dam on Rock River). Five applications for licenses are pending (Rockdale Village -- Brandon Road Lock and Dam; Channahon Village -- Dresden Island Lock and Dam; Peru City -- Starved Rock Lock and Dam; Kankakee City -- Kankakee Dam; and LeClaire, Iowa plant on the Illinois side - Lock and Dam 14, Mississippi River).

#### Environmental Concerns

In 1981, Loar and Sale investigated the environmental concerns associated with small-scale hydropower development, particularly the instream flow needs. Establishment of a protected instream flow regime can significantly affect the economic feasibility of small-scale hydropower projects because water needed to provide instream flows is often not available for power production. In addition to this report, four reports have been issued by Oak Ridge National Laboratory on analysis of environmental issues related to small-scale hydropower development, design considerations for passing fish upstream around dams, environmental concerns related to water level fluctuations, and fish mortality resulting from turbine passage.

Techniques for reaeration of hydropower releases are a major concern for regulated rivers such as the Illinois River. Two major categories of hydropower reaeration systems are turbine venting and aeration in the reservoir. Turbine venting covers oxygen diffusers in the turbine flow, air aspiration into the draft tube below the turbine wheel, and mechanical injection with the use of compressors. About a 2 to 4 mg/l increase in dissolved oxygen can be achieved. Reservoir aeration with high-purity oxygen injection was found to be effective. This is capital-intensive but does not reduce turbine

efficiency as does turbine venting. An economic evaluation is necessary to choose one of the other technique.

Tailwater fishing is a popular recreational activity below the small-scale hydroplants such as those proposed on the Illinois River. Their proposed design should, therefore, include consideration of fish screens and fish passage facilities. The design must also not change the sediment flow and deposition patterns to the detriment of water quality and aquatic habitats.

#### CONCLUSIONS

The following conclusions are drawn regarding the suitability and feasibility of further hydropower development at the existing sites in the Illinois River Basin.

1. Detailed hydrologic analyses are always required and operational constraints must be fully determined to make a satisfactory estimate of hydropower potential at any site.
2. Environmental concerns must be identified as well as suitable measures and related costs to reduce the adverse impacts, such as low dissolved oxygen, to a minimum.
3. Thorough economic analyses must always be carried out, with consideration given to both tangible and intangible costs and benefits, to determine the true economic feasibility of hydropower development at a site.
4. For orderly hydropower development, in line with state objectives and goals, cooperation and communication between FERC and the State must continue in the issuing of any permits.

#### POSSIBLE COURSES OF ACTION

The feasibility of hydropower development at some of the existing locks and dams in the Illinois River Basin must continue to be determined through exhaustive hydrologic analyses, knowledge of operational constraints and of environmental impacts that will need mitigation, and economic analyses considering all tangible and intangible costs. The following actions are suggested to achieve the true economic hydropower development in a manner consistent with the goals and objectives of the State.

1. Conduct full hydrologic analyses: All projects should have analyses that include development of daily flow series at the site for 25 years or more, weekly dissolved oxygen and mean temperature values, and monthly values of desired protected or instream flows. The upstream and downstream water stage series should always be developed to calculate the available head.

2. Evaluate the full environmental impacts: Impacts in terms of reduction in dissolved oxygen, reaeration, aquatic habitat, and fish passageways should be investigated in detail. Suitable remedial measures should be identified and their costs determined. Any changes in sediment transport and sedimentation must be investigated and measures to mitigate any adverse impacts be identified.
3. Conduct a thorough economic analyses: These must always be carried out for various values of hydropower capacity that can be developed at the site. Both tangible costs and intangible costs and benefits must be considered to the highest degree possible, to determine the true economic feasibility of a proposed project.