

1999
GOVERNOR'S CONFERENCE
ON THE MANAGEMENT OF THE
ILLINOIS RIVER SYSTEM

The Illinois River:
Responsible Management for the
New Millennium



Proceedings

Seventh Biennial Conference
October 5-7, 1999
Holiday Inn City Centre
Peoria, Illinois

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Illinois Water Resources Center

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Illinois Department of Commerce and Community Affairs

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University of Illinois

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U.S. Army Corps of Engineers

Rock Island District

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U.S. Department of Agriculture

Natural Resources Conservation Service

U.S. Fish & Wildlife Service

U.S. Geological Survey

Executive Proclamation



WHEREAS, the Illinois River System is an integral part of our state's geography, history, economy and ecology; and

WHEREAS, our state should embrace an integrated approach to large river management and work according to a coordinated, efficient and continuous management for our river; and

WHEREAS, the implementation of the Illinois River Partnership and Coordinating Council, the Conservation Reserve Enhancement Program, and Conservation 2000 are important milestones in efforts to protect the resources of the Illinois River; and

WHEREAS, the 1999 Conference on the Management of the Illinois River System is October 5-7 at the Holiday Inn City Center in Peoria; and

WHEREAS, the theme of the Conference is "The Illinois River: Responsible Management for the New Millennium"; and

WHEREAS, citizens may take this day to recognize the economic, recreational, social and environmental benefits of conserving to properly utilize the resources of the Illinois River Basin;

Therefore, I, George H. Ryan, Governor of the State of Illinois, proclaim October 1999 as ILLINOIS RIVER SYSTEM MANAGEMENT MONTH.

In Witness Whereof, I have hereunto set my hand and caused the Great Seal of the State of Illinois to be affixed.

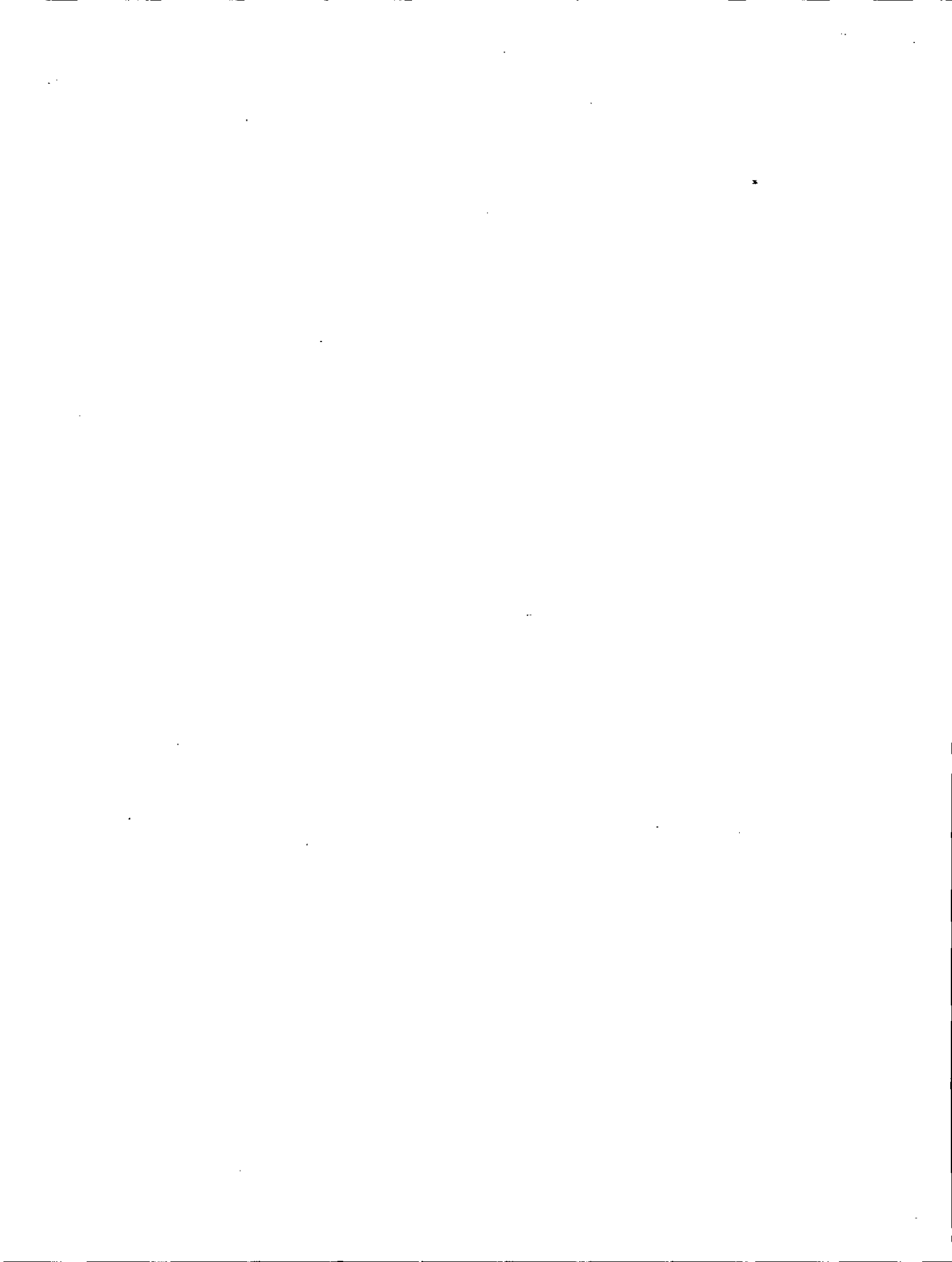
*Done at the Capitol in the City of Springfield,
this FIRST day of OCTOBER, in the
Year of Our Lord one thousand nine hundred
and NINETY-NINE, and of the State of
Illinois the one hundred and EIGHTY-FIRST*



Deese Witt
SECRETARY OF STATE

George H. Ryan
GOVERNOR

Proceedings



OPENING ADDRESS

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Good Morning and Welcome! At this time I would like to convene this Opening Session of the 1999 Governor's Conference on the Management of the Illinois River System. I am Bob Frazee, Natural Resources Educator with University of Illinois Extension and am serving as Co-Chair for this conference. This morning as I mingled with people in the hallways, it was exciting to be a part of the interest and enthusiasm that is being generated by holding this seventh biennial conference on the Illinois River System. I am very pleased to report, that as of a few minutes ago, we now have over 300 individuals registered for this conference. This is our largest conference ever – a true indication of the growing interest that is concerned about protecting our Illinois River System for the future! In looking over the registration list, we have a very diverse group of participants in terms of their backgrounds and the groups and agencies they represent. This is tremendous! With this diversity in mind, I would like to encourage each of you throughout the conference to actively seek out individuals with *different* opinions and viewpoints on river management. Share your thoughts and concerns with each other, open your minds to new perspectives, and explore the opportunity for compromise. A tremendous opportunity for networking will occur this evening during our barbecue and social on the Peoria Riverfront.

Fourteen years ago, as the first conference on the Management of the Illinois River System was being organized, we encountered a number of obstacles. At that time, a number of organizations and agencies would not even meet together in the same room because of differing viewpoints on river management. Many of the organizations and agencies had a single focus, only looking at the Illinois River with a narrow view such as specific water pollutants, eroded topsoil, or number of fish species present. A final major obstacle was the lack of state and federal funding dedicated to improving the Illinois River System.

A significant number of very positive changes have occurred since we began planning for the first Illinois River Conference held in 1987. Today, work on the Illinois River is marked by interagency cooperation and bi-partisanship, resulting in a great deal of synergistic benefits. Watershed management is espoused by everyone as we now realize that everything associated with the Illinois River – the soil, water, air, plants, and animals – is inter-connected. Today, in response to environmental concerns, our state and federal partners have stepped forward with aggressive programs, such as the Illinois River Conservation Reserve Enhancement Program, the U.S. Army Corps of Engineers Environmental Management Program, and Illinois Conservation 2000, to improve the Illinois River Watershed.

I am very pleased to report that as we embark on this new millennium, interest and enthusiasm for protecting and enhancing the Illinois River System is snow-balling and is currently at an all-time high. I strongly believe that the past six Governor's Conferences on the Illinois River System have played a significant role in this effort by creating awareness to important river issues; building strong coalitions between agencies and organizations at the local, state and federal level; reporting on measurable accomplishments; and identifying future goals and river initiatives.

Appropriately enough then, is the theme for this year's conference, "The Illinois River: Responsible Management for the New Millennium." During the next two days, our conference speakers will be focusing on the seven issues that will influence the river and its watershed as we move into the 21st century.

The Governor of Illinois, Mr. George Ryan, recognizes the tremendous importance of the Illinois River System to our state and further realizes that it also provides Illinois with a key environmental challenge. Consequently, the 1999 Conference on the Management of the Illinois River System has been designated a Governor's Conference. A special Governor's proclamation has been issued to emphasize our state's commitment to conscientiously manage this important natural resource for the benefit of future generations. This Proclamation reads as follows:

WHEREAS, the Illinois River System is an integral part of our state's geography, history, economy, and ecology; and

WHEREAS, our state should embrace an integrated approach to large river management and work according to a coordinated, efficient, and continuous management for our river; and

WHEREAS, the implementation of the Illinois River Partnership and Coordinating Council, the Conservation Reserve Enhancement Program, and Conservation 2000 are important milestones in efforts to protect the resources of the Illinois River; and

WHEREAS, the 1999 Conference on the Management of the Illinois River System is October 5-7 at the Holiday Inn City Centre in Peoria; and

WHEREAS, the theme of the Conference is "The Illinois River: Responsible Management for the New Millennium"; and

WHEREAS, citizens may take this day to recognize the economic, recreational, social and environmental benefits of conserving to properly utilize the resources of the Illinois River Basin;

Therefore, I, George H. Ryan, Governor of the State of Illinois, proclaim October 1999 as **ILLINOIS RIVER SYSTEM MANAGEMENT MONTH.**

Signed, Governor George H. Ryan; Dated, October 1, 1999

This Proclamation will be on display in the foyer throughout the conference and will also be printed in the Conference Proceedings. Unfortunately, Governor George Ryan is unable to attend this Illinois River conference, as he is out-of-state on official business.

Two years ago, following the 1997 Illinois River Conference, a statewide planning committee was formed to begin making plans for the conference convening here today. These committee members, who are listed on the blue insert in your Registration Folder, can be identified by the blue committee ribbon on their name tags. They have done an outstanding job of developing the program and making the necessary arrangements. Would the planning committee members please stand and be recognized.

I am also pleased to announce that we have over 70 co-sponsoring agencies and organizations that have assisted in promoting this conference and are committed to protecting and preserving the Illinois River System. They are listed on page 32 of the Abstracts and Speaker Information Booklet. We welcome each of you and thank you for helping to make this conference a success!

This year, we are especially indebted to a number of agencies and organizations for providing significant financial contributions to enhance the quality of this conference. These Conference Underwriters are designated with an asterisk on page 32 of the Speaker & Abstract Booklet. These contributions have enabled our Conference Planning Committee to waive the registration fees for our

speakers and moderators – a gesture that I'm sure is greatly appreciated. Following our conference, each registered participant will receive a copy of the Conference Proceedings through the mail in approximately 3 months.

At this time, I would like to recognize the efforts of several individuals who have made significant contributions to the organization of this conference.

First, it is my pleasure to recognize my co-chair for this conference, Steve Havera. Steve is an Animal Ecologist with the Illinois Natural History Survey and serves as Director of the Forbes Biological Station and the Frank C. Bellrose Waterfowl Research Center at Havana. Steve will be chairing the conference sessions tomorrow. Steve, thank you for the excellent leadership you have provided to this conference.

The Heartland Water Resources Council of Central Illinois has been serving as the local administrative entity for handling the many arrangements necessary to make this a successful conference. Mike Platt is their Executive Director and Wendy Russell is the Office Manager. Please join me in thanking Mike and Wendy for their efforts in organizing this conference. While you are at this conference, if you should have questions or need local information, please look for a conference participant with a special Heartland Water Resources name tag and they will be happy to assist you.

I am pleased to recognize Jon Hubbert, with the Natural Resources Conservation Service and Kim St. John with the Prairie Rivers RC&D who were responsible for organizing the Conference Conservation Tour. This tour, that was held yesterday, provided participants the opportunity to view the abundant natural resources of the river ecosystem and learn about the rich cultural heritage of the Illinois River Valley. Thank you, Jon and Kim, for an outstanding tour.

Another individual I would like to recognize is David Soong, with the Illinois State Water Survey, who has chaired our Exhibits Committee. This year, through David's leadership, we have our Exhibit Hall filled to capacity with 45 educational exhibits. Thank you, David for your help in organizing the exhibits.

I would like to encourage all conference participants to take time and meet with the Exhibitors to learn about the many diverse projects that are occurring throughout the Illinois River System. The exhibitors are listed on Page 31 of the Speaker & Abstract Booklet. Would all of the exhibitors please stand and be recognized.

A new feature to this year's conference was the addition of a Pre-Conference Panel Presentation on Nutrients, Nutrient Cycling, and Hypoxia in the Mississippi River Basin. The U.S. Geological Survey, under the leadership of Paul Terrio, organized and conducted this very lively and informative panel last night. Thank you, Paul.

Throughout our two-day conference, please refer to the Abstract and Speaker Information Booklet for the agenda and for more complete information regarding the speaker's topic and personal background. On behalf of the planning committee, I hope that you will find this conference to be exciting, informative, stimulating, and enjoyable.

At this time, it is my pleasure to introduce to you Mr. Bud Grieves, Mayor for the City of Peoria. Mayor Grieves will officially welcome you to the friendly City of Peoria, situated midway on the Illinois River between Chicago and Grafton.

It is now my pleasure to introduce the Moderator for our Opening Session, David Leitch. David is State Representative for the 93rd Representative District and is very active in legislative matters involved with the Illinois River Watershed. David will introduce the Keynote Speakers for our Opening Session.

**REMARKS ON THE MANAGEMENT OF THE ILLINOIS RIVER SYSTEM BY THE
DIRECTOR OF THE ILLINOIS DEPARTMENT OF NATURAL RESOURCES**

Brent Manning

Director, Illinois Department of Natural Resources

Greetings from Governor Ryan and thank you all for being here.

The Illinois River continues to be a priority for the Department of Natural Resources.

The Illinois River watershed touches 90 percent of the state's population..... includes nearly half the agricultural land in our state.... and carries more than half the corn produced in Illinois to market every year.

Soil erosion and sedimentation continue to be one of the river's biggest threats.

The Department administers the state side of the Conservation Reserve Enhancement Program in partnership with the USDA FSA and the NRCS.... the Illinois Department of Agriculture.... the Illinois Environmental Protection Agency.... and the local soil and water conservation districts in 29 counties in the eligible area.

CREP is a cornerstone of the strategy for the Illinois River restoration.

The current memorandum of understanding allows for 100,000 acres.... and ultimately 232,000 acres.... of the most environmentally sensitive crop land to be restored to native vegetation.

These restoration efforts are occurring in the subwatersheds adjacent to the middle Illinois and Peoria Lakes sections of the Illinois River and the adjacent watersheds of the Vermillion... Mackinaw... Spoon, Lower Fox... Lower Sangamon.... and Kankakee Rivers.

Just last month the Department negotiated with the USDA to amend the CREP agreement to include the Lamoine River watershed.

That's good news because the Lamoine River is the second highest contributor of sediment to the Illinois River.... second only to the Spoon.

It also will be welcome news to landowners in Adams, Brown Hancock, McDonough and Schuyler Counties who now are eligible to participate in the program.

Since one of the main goals of the Illinois CREP Program is to reduce soil erosion and sedimentation by 20 percent.... including the Lamoine Basin will significantly help achieve that goal.... and help achieve it at a more rapid pace.

Adding the Lamoine did not increase the original cost of the program and will help the state

reach its 100,000-acre check point and allow for the expansion of the program to the 232,000 acres.

The state and the USDA are focusing dollars directly to the private landowners who are willing and ready to help the state achieve its restoration goals.

CREP has the potential for restoring almost 20,000 acres in the Lamoine and providing a corridor of habitat that covers 80 percent of the stream miles in the Lamoine watershed.

Currently, there are 20,000 acres enrolled in the federal component of the CREP Program and 13,500 acres in the state options. And... we already have 60 landowners involving 4,500 acres signed up from the Lamoine since that announcement occurred.

The Conservation 2000 program also has been very important to the Illinois River watershed. There are 13 ecosystem partnerships in the watershed dedicating to improving it.

During the past four years nearly \$4 million has been spent on almost 150 ecosystem grants in this area involving everything from landowner education to land acquisition.

Exciting things continue to happen with pilot programs. The Interagency Pilot Watershed Program is a good example.

This effort by IDNR, IEPA, IDOA, NRCS and FSA is intended to coordinate the delivery and assessment of watershed restoration programs statewide.

One of the four pilot work areas is Court Creek near Galesburg in the Spoon River Basin.

We are working with a citizen-led watershed committee to develop a comprehensive watershed restoration plan.

Court Creek is unique because it is in the CREP area, is subject to intense monitoring efforts, and is adjacent to Haw Creek, so we have a good comparison for the work the team is doing.

As one of the pilots, Court Creek will help guide how we deliver watershed restoration programs in the next decade.

Don Roseboom of the Illinois State Water Survey is helping us develop and implement innovative stream restoration techniques.

He's developed the willow post techniques that are commonly used and we are implementing the Newbury Weirs at site M. Those are just a few examples.

These kinds of innovations are critical to the Illinois River watershed as it is estimated that streambank and channel erosion account for more than half of the sediment delivered to the Illinois River.

And, as you know, and will hear about later during this conference, we are working with Caterpillar on important dredge technology.

We are working in partnership with the U.S. Army Corps of Engineers on a number of restoration projects.

Who would have thought just a few years ago how much we would have accomplished. We have much more to do, but we are working together and we are getting the job done.

The time is right to move ahead even further.

Wouldn't it be wonderful if we could expand on the successes of CREP to other federal and state programs!

Wouldn't it be great if we could somehow provide a more simplified mechanism for landowners in the Illinois River Valley to obtain a sort of one-stop shopping for all state and federal programs!

If we all worked together, combining the resources of the federal and state agencies we would achieve our goal quicker and we would provide greater service to the landowner.

The possibilities are endless. And, I believe, if we all work together, we will find a way to enhance our efforts to date that will make it easier for landowners to participate.... and will result in reduced sedimentation and improved water quality for the Illinois River watershed.

**REMARKS ON THE MANAGEMENT OF THE ILLINOIS RIVER SYSTEM BY THE
DIRECTOR OF THE ILLINOIS DEPARTMENT OF AGRICULTURE**

Joe Hampton

Director, Illinois Department of Agriculture

Good morning.

I want to thank each of you and your organizations for coming here today to discuss ways to better utilize and preserve the Illinois River.

Let there be no mistake – the Illinois River is absolutely vital to both the economy and the ecology of the state of Illinois and is a priority for the Department of Agriculture.

Illinois' leading industries are agriculture and food production. Our prominence in these industries would not be possible without the availability of barge transport along the river.

Just a few months ago, I was meeting with a group of pork producers from the Phillipines who were touring Illinois businesses. During our conversation, one of the men in the group asked me to talk about government supports for agriculture. I started talking about Loan Deficiency Payments and other programs.

That wasn't the government support he wanted to talk about.

He asked me how close the nearest paved road was to my farm.

Of course, there's a paved road leading right up to the house.

This farmer from the Phillipines told me he has to travel for miles to get to a decent road, much less a navigable waterway.

He opened my eyes to the fact that our infrastructure gives Illinois farmers a significant competitive advantage over producers in other countries.

We must do all we can to protect, preserve and enhance that infrastructure.

Each year, more than 42 million tons of goods are shipped up and down the Illinois River. This includes nearly 18 million tons of corn and soybeans being shipped to the gulf of Mexico, more than 3 million tons of coal and 11 million tons of petroleum and chemicals.

Because of the Illinois River, we can ship our products quickly and efficiently.

You can ship a ton of corn 514 miles on just a gallon of fuel on a barge. You'll get that same ton of corn 202 miles by rail and only 59 miles by truck.

So....It's easy to see how easy access to the river system puts us at a competitive advantage over even our neighboring states.

But with that enterprise comes responsibility.

Illinois farmers have stepped up to the plate. The Illinois Department of Agriculture has committed nearly \$7 million since 1996 to implement soil and water conservation practices in the 53 counties of the Illinois River watershed.

That money, however, only reflects part of the cost. Farmers in those 53 counties have put up 4-and-a-half-million-dollars of their own money for those conservation efforts.

Through the state's Conservation 2000 effort alone, 18-hundred individual conservation projects have been completed in the Illinois River watershed, benefitting more than 102-thousand acres.

Because of those efforts, more than 560-thousand tons of soil are kept out of the waterways each year.

This year, the 51 Soil and Water Conservation Districts in the Illinois River watershed will receive \$3-point-4-million to provide technical assistance to reduce soil erosion and sedimentation and protect water quality.

More directly, 117 streambank stabilization projects have been constructed through the Streambank Stabilization and Restoration Program – protecting more than 14 miles of streambanks.

Through our sustainable agriculture grant program, we continue to look for new ways to protect water quality through alternative crops, nitrogen rate studies, residue management and other practices. This program not only offers grants to conduct research, but also funds education programs to share new ideas on profitable and environmentally beneficial agriculture.

Granted, the primary concern of most of us in agriculture in this room is moving grain along the Illinois River.

We do want to see dredging and expanded locks to ease the flow of barge traffic.

We do want to see an end to the logjam of barges trying to make their way to the Mississippi River.

These interests, however, are not exclusive of the environmental concerns that are also going to be discussed at this conference.

Farmers have a great interest in keeping the Illinois River healthy.

First, rural communities all along the Illinois River rely on the river for their water supply. Farmers and rural residents want clean water for themselves and for their families, communities and the rest of society.

Farmers are embracing conservation efforts in order to prevent erosion, reduce field runoff, protect water quality, and at the same time provide improved wildlife habitat and expanded recreational opportunities.

Conservation efforts will continue to protect some of the richest soils in the world, will ensure a quality water supply for generations to come and will reduce the need for dredging along the river.

And...improvements to the river will keep barge traffic moving and will require less cost, less fuel consumption and less time waiting to move a tow through the locks - a matter of being able to compete in the work marketplace.

All too often, business and the ecology are pitted against each other. Preservation of the Illinois River offers an opportunity for both sides to work together for a common goal.

A healthy Illinois River makes good business sense and it makes good environmental sense.

So let's not let a golden opportunity pass us by.

"The wealth of Illinois is in her soil, and her strength lies in its intelligent development,"
Andrew Sloan Draper.

RESPONSIBLE MANAGEMENT: WHAT DOES IT MEAN?

Richard B. Pierce

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INTRODUCTION

Greetings. I am Richard Pierce, Director of Ducks Unlimited's Great Lakes and Atlantic Region Office. I appreciate the opportunity to be part of this important conference on the future of resource management on the Illinois River. Today I would like to talk to you about Responsible Management of this great resource, and to share with you some things that Ducks Unlimited is doing to help waterfowl, wildlife and water quality in the Illinois River watershed.

Fish and wildlife agencies and non-governmental organizations like Ducks Unlimited have always strived to be responsible managers of our habitats and ecosystems. Often, as we look back at previous management practices and policies, we may think our predecessors were sometimes shortsighted. However, these men and women were dedicated professionals, doing the best with the limited information they had.

However, it is important to realize that actions we might otherwise view as early mistakes were important lessons from which we learned how ecosystems respond to human interventions. With the accumulation of new and better information through both science and trial and error, our concept of being responsible managers has changed.

Because of this evolving standard, we will always grapple with what is responsible management and be critical of past actions. Still we cannot sit idly by. Our challenge is to ensure that our management decisions are guided by the best information available today with a prospective eye on the potential environmental and societal changes of the next century.

ELEMENTS OF RESPONSIBLE MANAGEMENT

What are the elements of responsible management? In our definition, responsible management:

- 1) Maintains, restores and enhances ecological integrity;
- 2) is economically sustainable; and
- 3) is socially acceptable.

I will explore each of these points as they pertain to responsible management associated with the Illinois River.

Ecological Integrity

The Illinois River is a highly altered system. Humans have made significant changes over the

past 150 years to the river corridor, adjacent floodplain and even high into the watersheds feeding the river. Maintaining, restoring and enhancing the river's ecological integrity will be no easy feat, and will require intensive inputs of time, money, resources and management. The idea of letting nature take its course is not a feasible option. We have long passed that point in the history of human alteration of the Illinois River.

Thankfully, new efforts to restore ecological integrity through responsible management can build upon the existing foundation of state, federal and private habitat areas - the historic anchors for fish and wildlife populations along the river. Here, we would be wise to heed Aldo Leopold's admonishment that the first step in intelligent tinkering is keeping all the cogs and wheels.

Protecting existing ecological values and functions of past conservation investments should have priority consideration. While not perfect, the system of private and public fish and wildlife conservation areas that we have inherited are a consequence of the responsible management of our predecessors.

At the same time, new innovative techniques for restoring ecological integrity need to be tested and evaluated on a strategic, incremental basis at new locations. Such techniques also must prove to be economically sustainable and socially acceptable if they are to be expanded to a larger watershed context.

Economic Considerations

Responsible management must have an economic consideration, especially in our days of tight and competitive government budgets.

Alterations of the landscape involve trade-offs, both ecological and economic. Benefits of ecological restoration efforts need to exceed costs, and where possible, involve constituencies who value such restoration and are willing to financially support short and long term projects. Fortunately, the economic benefits of ecological restoration projects are becoming more widely recognized both by society and among select user groups.

For instance, waterfowl hunting in Illinois generates in excess of \$75 million per year in economic activity. License fees, special excise taxes and private donations paid by sportsmen and women during the last 60 years have resulted in the establishment of a conservation infrastructure of public lands along the Illinois River that is easily valued in excess of \$1 billion. Waterfowl hunters and other similar user groups will continue to provide a significant source of funding for restoring and maintaining habitat for wildlife in the futures as long as they see benefits being derived from their conservation investment.

Similarly, financial support for conservation improvements on private land also is increasing at an accelerated pace. This is particularly true in the case of federal agricultural programs and policies. Last year the US Department of Agriculture spent approximately \$2 billion on lands enrolled in the Conservation Reserve Program (CRP) and Wetlands Reserve Program (WRP). To put this into perspective, if conservation were viewed as a commodity crop, CRP would rank third behind corn and soybeans, and WRP would fall just behind soybeans and rice in terms of USDA outlays.

These and other economic trends suggest that both the public at large and individual private citizens are willing to make larger investments in ecological restoration in the Illinois River watershed and to financially support such investments through responsible management. At the same time, global markets for agriculture and other industry dictate that lands devoted to these purposes must become more efficient. The consequence of these trends is that land use will change over time in a direction that provides greater overall economic stability.

Along the Illinois River, this likely will mean fewer lands used for primary production and more lands dedicated to conservation purposes. Lands that remain in agriculture or other types of production will be managed more intensively for those uses. By the same token, user groups and the public who financially support lands devoted to conservation are expected to demand greater ecological benefits to accrue from their investments as well.

Social Acceptance

In addition to enhancing ecological integrity and providing greater economic stability, management actions must be socially acceptable.

Projects to restore ecological integrity must be balanced with local needs to maintain navigational and recreational uses of the Illinois River. By the same token, more effort is needed to find ways which traditional uses of the state's lands and waters can be more compatible with ecological objectives.

Also, social acceptance does not necessarily mean giving the most vocal local interests get what they want. Land use and management decisions within the Illinois River have consequences far beyond our state boundaries. For example, problems with hypoxia in the Gulf of Mexico have brought critical attention to water quality issues and agricultural practices in the Illinois River watershed. The commercial fishermen in Louisiana and the corn farmer in Illinois both have a vested stake in the outcome of our efforts to manage the Illinois River ecosystem responsibly.

Another example of the Illinois River's role in both national and international affairs is its function as a migratory corridor for waterfowl and other birds. The Illinois River serves as the *principal migration route for ducks in the Mississippi Flyway*.

The river corridor also provides both breeding and migration habitat for numerous neotropical songbirds such as warblers and other important birds, and the area has been recognized as a western hemisphere shorebird reserve.

Social acceptance means that partnership efforts, such as those carried out under the North American Waterfowl Management Plan, need to be expanded as we focus on the Illinois River. These collaborative efforts help to leverage funds and target investments in areas that provide the greatest ecological benefit for a wide range of species and people.

In addition, partnerships also provide a process for helping to build consensus among otherwise divergent societal interests. Such partnership ventures need to be encouraged and expanded, especially with non-traditional conservation partners and organizations.

DUCKS UNLIMITED'S ROLE

Ducks Unlimited is excited about the potential of working with the various partners on the river, and brings a strong commitment to the Illinois River because of its contribution and importance to North American waterfowl and wetland wildlife in general. The opening of DU's Great Lakes/Atlantic Regional Office in Ann Arbor, MI last year was a result of DU's growing commitment to habitat protection, restoration and wildlife conservation in the Great Lakes region.

During the first half of this century, the Illinois River valley was one of the most important staging areas for ducks in North America, drawing sportsmen from around the world. A thriving industry of duck clubs, guiding, decoy carving and call making was associated with this waterfowl hunting tradition. Illinois is one of DU's top states in terms of dollars raised and volunteer commitment because of this long standing waterfowl tradition.

In the mid-1950s, the Illinois River began losing much of its prominence as a sportsmen's paradise. A dramatic shift in migratory patterns of diving ducks occurred at this time as pollution, sedimentation and other factors greatly reduced production of fingernail clams and wild celery in the river and its backwater lakes.

The Illinois River also has lost more than two-thirds of its migrating dabbling ducks during the last 40 years primarily due to habitat loss and degradation.

Still, approximately 25 percent of all ducks in the Mississippi Flyway migrate through the Illinois River valley. For this reason, the river has been established as a critical focus area under the North American Waterfowl Management Plan with a goal of increasing the current 32,000 acres of wetland habitat by 40 percent. And these are the reasons Ducks Unlimited is now bringing its resources to Illinois like never before.

With the opening of the new Illinois Field Office, Ducks Unlimited will bring significant technical, professional, and financial resources to ensure the responsible management of the Illinois River well into the next century. DU's niche will be in helping to build funding partnerships for projects that restore ecological integrity, and in promoting management practices that are economically sustainable and socially acceptable. Bottom line is that we want to help put more habitat back on the river, improve the water quality, and increase the quality of life for those that use the river.

SUMMARY

In summary, several important points can be made about responsible management decision affecting the Illinois River ecosystem:

1. Responsible management is a dynamic standard that evolves with our scientific understanding and practical experiences applied to the landscape.
2. In highly altered and human dominated ecosystems such as we have here, the option of letting nature take its course is not an ecologically responsible alternative because the system is not capable of self-recovery.

3. In most cases, intensive management is needed to restore lost or degraded ecological functions and values on the remaining sites available for this purpose.
4. Efforts to restore ecological integrity will be economically sustainable as long as individuals, user groups and political special interests responsible for funding responsible management activities derive corresponding benefits.
5. Existing conservation investments should be maintained and supported for both ecological and economic reasons.
6. Consideration must be given to local, regional, national, and international perspectives when developing socially acceptable management responses to resource problems.
7. Responsible management is guided by historical functions and values, but is intended to meet future ecological and human needs in order to achieve success.

I want to applaud the diverse group of interests represented here at this conference. It is paramount that we all work together to ensure responsible management of the Illinois River, our local and international treasure. I commit to you Ducks Unlimited's resources to ensure that it happens. Thank you.

**FEATURED SPEAKER ON THE MANAGEMENT OF THE
ILLINOIS RIVER SYSTEM**

Corinne Wood

Lieutenant Governor of Illinois

Thank you, Representative. Good afternoon, everyone.

It's a pleasure to be here today, as Lieutenant Governor and as Chair of the Illinois River Coordinating Council, to talk about one of our most important natural resources: the Illinois River.

I am involved in a lot of state programs and initiatives. And I've seen a lot of successes along the way. But I have to tell you, the Illinois River conservation effort is one of the most promising I've seen. It is promising not simply because of responsive government action, though that clearly plays an important role, and I want to thank Representative Sloan, Representative Leitch and other area lawmakers for their assistance.

It is *also* promising because individuals and communities throughout the watershed are getting involved and working together at a grassroots level to make a difference. Citizens, businesses, farmers, academia, scientists, public officials, and the recreation and tourism industry are all *heavily* involved in protecting water quality -- and maximizing benefits from our water resources.

I know of no one more involved than Mike Platt and the folks at Heartland Water Resources. They are a great asset to area watershed protection efforts, and I thank them for their work. I also want to thank them for putting together this conference -- and to thank all the sponsors who made this gathering so complete.

The last administration, in particular my predecessor, Bob Kustra, was very committed to preserving water quality throughout the 55-county Illinois River Watershed. The fact that Governor Ryan has continued to lend the support of the Governor's Office to this conference -- and has asked me to serve as *chair of the Illinois River Coordinating Council* -- sends a clear message that *this* administration is *just* as committed to protecting the watershed.

The groundwork for conservation was set a few years back -- with development of the Integrated Management Plan for the Illinois River Watershed -- and with creation of the Illinois River Coordinating Council. The council is making tremendous progress implementing the river management plan. In fact, two-thirds of the 34 recommendations are in the process of being *implemented*.

And we are exploring the best ways to implement the remaining third.

Today, I want to update you on the work of the council. First, though, I'd like to take a few minutes to introduce myself to those of you I am meeting today for the first time.

The first years of my life were spent in a house on my grandparents' farm, near Barrington, in the northeast corner of the Illinois River watershed. I say "farm." It was actually only 80 acres or

so. The spreads in Lake County are obviously much smaller than they are in the Peoria region. And many are practically surrounded by sprawling new communities. But as a kid, that little farm was my whole world. Though we soon moved into town, I remembered those days on the farm fondly. And as a teenager, I took a job at what might be considered an urban farm: our local greenhouse. There were no chickens or other livestock -- but plenty of sticky soil -- and more flowers than I'd ever before seen in one place. The money I earned at that greenhouse was my ticket to college.

I enrolled at the University of Illinois at Champaign, where I met Paul Wood, the man who for two decades has been my husband. Paul stems from Springfield. So, with my ties to northern Illinois, Champaign and the Capitol City, I have spent time in various parts of the Illinois River watershed. Presently, we live in Lake Forest, several miles northeast of my grandparents' farm. Life has a way of coming full circle. So, I believe, can nature.

A quarter century ago, many of our waterways were extremely polluted. Fish were dying in record numbers. And numerous waterways were unfit even for recreational purposes.

While there has been considerable recovery, we are by no means in the clear yet. In fact, as our population continues to grow, particularly in northeastern Illinois, we are likely to see unprecedented stress placed upon our limited water resources.

But we *have* made *tremendous* progress.

- The Federal Clean Water Act tightened restrictions on water pollution.
- Factories stopped depositing raw waste into the rivers.
- Cities developed better sewage treatment facilities.
- And farmers adopted conservation practices that helped keep soil, pesticides and fertilizer on fields and out of waterways.

In June, I had the pleasure of hosting a forum on the Fox River, which winds from Lake County on the north to Ottawa on the south. Like other waterways, it was nearly lost in the 1960s and early '70s. In recent years, it has rebounded, with clear water, healthier fish populations, and visitors coming from all directions to enjoy the scenic river. So it was a surprise to some when the American Rivers environmental watchdog organization recently declared the Fox one of the nation's 10 most endangered waterways. To understand the declaration, you have to look at the demographics:

- Eleven percent of Illinois' population is situated in the watershed.
- The population in the area has grown by one-third in the last 20 years.
- And it is expected to increase by one-third again in the *next* 20 years, with another 600,000 people moving into the area.

The increasing concentration of area residents and businesses puts tremendous stress on the Fox River watershed. The river will have to provide more drinking water for residents and receive more wastewater from sewage treatment plants.

It will be exposed to much higher concentrations of fertilizer from suburban lawns. And it will carry more stormwater runoff from streets, yards and parking lots. More people will want to fish

the river and use it for boating, skiing, swimming and other recreational activities. And more businesses, factories and homes will rise up along its banks.

If the water quality of the Fox River is degraded, that will have a negative impact on waterways downstream, including the Illinois and Mississippi Rivers.

And the Fox River is only one of several waterways in the Illinois River watershed. Only one of many tributaries likely to be impacted by continued urban sprawl.

A tremendous challenge awaits all of us who live in the Illinois River watershed and who care about our water resources. Governor Ryan and I are committed to working with you to meet that challenge head on. We took a number of actions in the spring legislative session that I believe will help.

First, we extended the Conservation 2000 Program, which was set to expire this year. Conservation 2000 is an ongoing, multi-agency initiative administered by the departments of Natural Resources and Agriculture -- and by the Illinois Environmental Protection Agency. Over the last several years, the program has proven very effective in meeting several goals:

- It has promoted sustainable farming practices, such as conservation tillage, to reduce runoff and other forms of sedimentation that pollute waterways.
- It has boosted funds for a wide variety of services offered through local soil and water conservation districts.
- It has provided dollars for development and preservation of wildlife habitat.
- It has enhanced Illinois' natural recreational resources.
- It has provided funds for outreach and research.
- It has resulted in satellite mapping used by volunteer organizations throughout the state.
- And it has allowed for regular ecosystem monitoring and assessments.

Those goals are as important today as ever. Extension of the Conservation 2000 Program to fiscal year 2009 ensures we will *continue* to make progress -- in those areas and others -- in the years ahead.

Second, we passed a fiscal year 2000 budget allocating \$15 million for the Conservation Reserve Enhancement Program, known as CREP. The program provides incentive payments and technical assistance to farm owners who plant grasses and trees and restore wetlands. The state's four-year \$48 million commitment to CREP enables us to leverage more than \$200 million in federal funds for these voluntary, long-term conservation measures. Those funds will help reduce soil erosion on more than 232,000 acres in the Illinois River watershed.

At the recommendation of the Illinois River Coordinating Council, we also sought and obtained federal approval to add the LaMoine River Watershed, in west central Illinois, to our CREP program. The LaMoine is second only to the Spoon River in the amount of sediment dumped annually into the Illinois River.

Previously, CREP participation was available only for highly erodible land adjacent to the middle Illinois and Peoria Lake sections of the Illinois River -- and the watersheds of tributaries such as the Lower Fox, Vermilion, Kankakee, Mackinaw, Spoon and lower Sangamon Rivers.

Third, we worked with lawmakers to pass the Open Lands Trust Act. It's the most ambitious open space initiative in Illinois history. The Open Lands Trust will provide \$160 million over the next four years to help state and local governments purchase, preserve and protect recreation areas and open spaces.

From time to time, we all need someplace to go where we can have a little quiet time. Where we can get some exercise. Where we can enjoy wildlife and natural beauty not found in our cityscapes – and reconnect with ourselves and our families. Open spaces fulfill that need and make our communities more attractive and enjoyable. We want to see communities include open spaces in their development plans. And we want to make inclusion of those spaces affordable. Through the Open Lands Trust Act, we're doing that.

Fourth, we ended *two years* of stalemate, passing legislation that sets up stringent guidelines for the creation and operation of large-scale livestock facilities. These farms now must meet an eight-point list of siting criteria under the watch of local and state officials before construction can begin. Those criteria include odor control, disruption of local traffic, the treatment and disposal of wastes, and the prevention of potential water and ground contamination. We don't want to stifle agricultural production, but we *do* insist that producers use environmentally responsible practices.

Fifth, we want the state to serve as an economic partner in helping landowners clean up brownfields – and turn wastelands into promised lands. We are working to achieve this goal by offering Environmental Remediation Tax Credits – which give businesses investing large amounts in cleanup costs a substantial tax credit. And we are pursuing funding for the Brownfields Redevelopment Grant Program, which reimburses communities for much of the cost of restoring brownfields for redevelopment.

Brownfields cleanup will also receive a boost from Illinois FIRST, our historic new infrastructure improvement program. In addition, Illinois FIRST will provide financial assistance to communities struggling to maintain adequate water and sewage systems – so they can renovate existing systems or create new ones.

Our challenges are great. But we are responding with all available resources. And we are making a real difference throughout the Illinois River watershed.

Finally, today, I'd like to update you on actions of the Illinois River Coordinating Council.

The council recognizes that many recommendations included in our plan for improving the watershed will require input from the scientific community.

So earlier this year, we created a Science Advisory Committee to provide input to the council, help us identify potential resources that can assist in our efforts, and ensure our actions are based on the most current sound science. In addition to presenting the council with recommendations of the committee, its members are working with other council bodies on specific watershed protection measures.

Which brings me to the other major news regarding the council. At our meeting last month, I proposed the council develop four working groups.

The Federal Issues Working Group will examine issues related to the upcoming farm bill deliberation as well as federal legislation and existing programs.

The State Issues Working Group will look at state programs and services as well as any proposed legislation that might impact the watershed -- or legislation that needs to be proposed to accomplish the Integrated Management Plan's goals.

The Strategic Planning Working Group will assess our accomplishments to date, determine what still needs to be done, and develop a plan for achieving it.

And the Community Action Working Group will explore ways to enhance the most important resource in our conservation efforts: grassroots involvement of citizens throughout the watershed.

Members of the Science Advisory Committee -- as well as interested citizens -- will serve on all these committees. We want good ideas to surface. And we want to head off as many potential threats to the watershed as we can *now, before* more damage is done. Neither government nor the Illinois River Coordinating Council can achieve all the goals of the Integrated Management Plan single-handedly.

It takes the commitment of those who live by and benefit most from the Illinois River and its tributaries. It takes good people like you, who care about our environment, and who want to leave the earth in even *better* shape than they found it. Those of us on the coordinating council want to involve as many of you as possible in addressing the watershed's needs. And we want the actions of the council to compliment steps you are taking at the community level as well as possible. So, please, let's keep the dialogue going -- at conferences like this one, and in our daily lives. We've made great strides. We have a lot to accomplish yet -- and we will.

THE ECOLOGY AND CULTURE OF WATER

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INTRODUCTION

Two free resources that drive all biotic and abiotic processes, sustaining all life on earth, are water and light energy. All places and living things can be defined by the way they handle these two resources, the processes of which are grounded in complex interactions with local biological and mineral resources. The entire surficial environment of the earth—geology, soil, topography, flora, fauna—is mediated by water. All living things develop in an aqueous medium in their own genetically defined ways.

As a society, we are becoming increasingly aware that the earth's resources are not limitless. It is less understood, however, that the ability for the earth's natural ecosystems to mitigate the changes we impose, and still be able to continue functioning sustainably, is also limited. Jean Prior (1991) discusses this concept clearly: "People may modify the land to suit their purposes, but it is wise to remember that the land must be used in accordance with its capacities as established by geologic history and expressed in landscape shapes and underlying deposits, including groundwater and mineral resources."

Although vitally important to all life systems, water remains one of the most misunderstood and mismanaged resources on earth. When we are unaware of, ignore, or are wasteful in our relationship to the interaction of water with other natural resources, water can become a waste product and potentially a powerful source of destruction.

Our culture, however, has become functionally detached from how the natural world around us works, unaware of its realities, and unmindful of its capacities. We have lost touch with the importance of a sustainable cultural relationship with land and water, and largely forsaken the human relationship with the natural environment. Our technologies permit us to extract resources from distant places, and import them at great expense, allowing us to defer accountability for unsustainable behavior insofar as our limited resources are concerned. This curious capacity to deflect or defer accountability for our own relationships with land and water appears to be born of a belief that there are no real rules in nature.

Short of inexorable geologic change, the extent to which we mismanage natural systems, either intentionally or through a failure to comprehend the rules and inherent capacities of our surrounding natural systems, is the extent to which these systems become more dysfunctional. Mismanagement of water is a primary factor in this increasing level of ecosystem dysfunction. The range of adverse impacts associated with an inattentiveness to the relationships of water in built and natural environments is profound.

Many "natural disasters," such as floods, landslides, erosion, and other changes, such as loss of biodiversity, aquifer depletion, and climatic change can be traced to our failure to understand the

ecology of water.

Understanding the human relationship to the interaction of water with the geology, soils, topography, flora, and fauna unique to a place is a first step by which a culture can learn to live sustainably. The purpose of this paper is to examine current problems associated with the human relationship to land and water and to suggest that there are creative and economically crucial solutions. It will focus on the ecology of water within the physical context of the Chicago region and the Midwest, and while the basic principles evaluated here are adaptable to other geographic contexts, the specific applications of solutions will vary.

NATURE'S HYDROLOGY

Throughout the glaciated regions of the upper Midwest, most natural wetlands and aquatic systems, including the lakes, streams, and rivers were formed either from direct precipitation or from groundwater discharge. In our biome, aquifer recharge occurred prevailingly in upland landscapes, and few natural wetlands were formed from surface runoff water.

Historically, water infiltrated the deep-rooted vegetation of prairies and woodlands, setting up a flownet relationship below the surface that is dependent on topography and the characteristics of the underlying till stratigraphy. According to Richardson, Wilding, and Daniels (1992), there are four kinds of water movement dominant in soil development in the glaciated Midwest: 1) recharge, or water movement to the water table; 2) flowthrough, or lateral groundwater movement; 3) discharge, or movement from the water table either to or near the soil surface; and 4) stagnation, or slow water movement creating water table mounds.

The glacial geology of the upper Midwest is characterized by limestone or dolomitic bedrock, overlain by gravels, sands, silts, and clays derived from such bedrock. When water moves through these substrates, carbonates can dissolve in the slow-moving groundwater, and the discharge will tend to be rich in bicarbonates. Bicarbonate-rich water that discharges through upward movement due to evapotranspiration potentials will precipitate carbonates near the soil surface, whereas water that discharges near the water table, such as in seeps and fens, will remain both bicarbonate-rich and isothermic. Either method of groundwater discharge provides a surface habitat that is virtually stable in its physicochemical and hydrologic properties.

Although water in local wetlands varied enormously with regard to the mixture of groundwater discharge and direct precipitation, most of our more than 700 native wetland plant species are adapted to the stable habitats created by the blend of groundwater discharge and precipitation. Most of these species are denizens of either alkaline or circumneutral conditions.

According to Swink and Wilhelm (1994), there are five basic types of wetlands in the region of southern Lake Michigan. These wetlands can be classified generally as aquatic, marsh, fen, bog, and swamp. Unfortunately, few of these wetland habitats remain intact today, and few people are aware of their natural attributes, either their inherent biodiversity or their ineffable beauty. To help the reader appreciate the diversity of our local wetland habitats and the varied roles of water distribution in their formation and sustenance, the major community types are described below. (Note that surface runoff water, other than clean spring snow melt, is not a significant factor in healthy wetland systems.)

Aquatic plant communities are occasional throughout the region. They formed in potholes and

in lacustrine plains where there was little or no surface discharge. Aquatic communities are sustained by waters from a surrounding watershed greater than that provided by rain over their surfaces. Generally, these excess waters filter down through vegetated ambient ground into the underlying soil until they reach impervious material, and exit by way of springs, rills, or seeps. Along our major streams, aquatic plant communities developed in alluvial sloughs and ponds derived from surface melt or tributary streams. Depending upon the groundwater contribution, aquatic waters ranged from hard to soft, or else they consisted of still-flowing alluvial waters.

Marsh plant communities generally occur along the transition between aquatic communities and drier communities, or in large flats that are regularly inundated by shallow surface waters for much of the growing season. Marshes are best developed locally in the lake plain, in lacustrine flats, and along the lower reaches of the Des Plaines and Kankakee river drainages. The sedge meadow, a community with affinities to fens and wet prairies, develops in large, shallow, lacustrine flats, and is dominated by sedge hummocks. The kinds of surface waters suitable for marshes are those received directly from rain, or as a combination of rain and the essentially clean overflow from streams fed prevalingly by base flow or snow melt.

Fens are wetland communities that occur in areas where the glacial formations are such that bicarbonate-rich ground water discharges at a constant rate and temperature along the slopes of kames, eskers, moraines, river bluffs, or even dunes, or in flats associated with these formations, provided the material through which the waters traveled is rich in carbonates. Depending on the circumstances, fens can occur where marl is at or near the surface or where peats are constantly bathed in minerotrophic ground water. Such areas can be wooded or open. Marly fens are generally found on open prairie slopes, and commonly produce constantly flowing rills discharging over the surface. Related to these hillside fens are the wooded seeps that occur sporadically on steep bluffs. As fens become peatier, there is a tendency for cation exchange to damp off, causing circumneutral or even acidic conditions, which can occur in the flat, black-soil prairies and in certain morainic depressions.

As the cation exchange capacity damps off further, bog conditions can begin to develop. Commonly, the peatland floats on a minerotrophic head of water. The deeper roots are thus exposed to calcareous or circumneutral conditions, and the shallower roots are imbedded in the upper sphagnum mat, probably in a more acidic environment. In large basins or in areas where the influence of minerotrophic waters is insignificant, acid bogs can develop. Related to the acid bog, often in sand flats or basins, are floating sedge mats that rise and fall with the water table.

Swamps are wetlands characterized by trees growing in large flats or basins that are poorly drained; most of the water leaves through evapotranspiration. They can occur in the backwaters of large, slow-moving rivers, such as the Kankakee, or in wet sandy flats in the Kankakee Sand Section south of the Valparaiso Moraine. They can also occur on moraines in wet depressions. North of the Valparaiso Moraine, in the lake plain, they are best developed in the large flats behind the high dunes, where lies one of the richest and most complicated forested systems in our region. It is characterized by a complex hydrology and is interspersed by gentle rises, shallow depressions, and hummocks, and consists of an inseparable mixture of wooded fen, bog, and mesic forest.

It is important to understand that the clear line of demarcation (edge) we often search for and identify between upland and wetland habitats in contemporary landscapes is of far less importance in the natural landscape, where the wetland/upland distinction is highly undifferentiated. Such concepts as wetland edge are more artifacts of a regulatory mandate than observable manifestations of the natural landscape.

REGIONAL HYDROLOGY

In natural areas, the primary recharge occurs in upland to mesic habitats, and discharge can occur anywhere along the spectrum from higher to lower gradients, depending on the relationship of geology, soils, surface and groundwater gradients, and other factors. Imagine the ecological attributes of a landscape mediated by a combination of flora, fauna, soils, and geology, such that groundwater was the dominant form of hydrology, as once occurred throughout most of Illinois and the upper Midwest.

At the time of European settlement, the Illinois River, draining more than one half of the land within the state of Illinois, was virtually still-flowing, with little perceivable discharge into the Mississippi River. According to Barrows (1910), the average fall between Hennepin and Pekin, a distance of 55.8 miles, is 0.82 inches per mile. "The Illinois is a river of relatively insignificant volume. Its natural low-water discharge is but a small fraction of that of the upper Mississippi and Ohio rivers. The nearly level channel and the small volume result in a very sluggish river, which has been described as a stream that more nearly resembles the Great Lakes than an ordinary river, and again as one that partakes more of the nature of an estuary than of a river."

Consider these accounts of the now beleaguered Illinois River, once one of the most beautiful and biologically fecund rivers in North America.

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

The Illinois river . . . presents to the eye a smooth and sluggish current, bordered on each side by an exuberant growth of aquatic plants, which, in some places, reach nearly across the channel. We soon found the water tepid and unpalatable, and oftentimes filled with decomposed vegetation . . . There is perhaps no stream in America whose current offers so little resistance in the ascent . . . Both banks are bordered by a dense forest of cottonwood, sycamore, and other species common to the best western bottom-lands. Of the fertility of the soil, no person of the least observation can for a moment doubt . . . (Schoolcraft 1821).

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. There are many small lakes and rivers. That on which we sailed is wide, deep and still, for 65 leagues. In the spring and during part of the summer there is only one portage of half a league (Thwaites 1900, from Jacques Marquette, around 1674).

It is also significant that this portion of the continent, referred to by Transeau (1935) as the "Prairie Peninsula," lies within a physiographic region where the ratio of rainfall to potential evaporation ranges from 0.6:1 to 1:1. In contrast, in regions where the ratios are greater than 1:1,

the tendency is for mesophytic forest to develop. Therefore, when Barrows did his study in 1910, of the approximately 37 inches of rainfall that fell annually across northeast and central Illinois, very little was discharged as surface runoff into the Illinois River. Instead, water either percolated into the aquifers, discharged slowly and evenly to seepage areas and fens or evapotranspired. Simple arithmetic tells us that a balanced system receiving a given amount of precipitation per year cannot continue indefinitely to evapotranspire the same amount and lose an additional amount to runoff without a considerable increase in dryness.

Weaver and Noll (1935) documented the absorption capabilities of prairie ecosystems and their unique relationship of water, vegetation, and soils, during their grassland studies. According to their findings, "The porosity of . . . moist grassland soil into which the water sinks is impressive. It accounts for the fact that on fully vegetated lands practically no erosion occurs except, possibly during storms of unusual violence, and even then erosion is seldom serious." In a study involving interceptometers in Nebraska, they noted that eleven rainfall events over a year resulted in the loss of about 1% of the total rainfall from a prairie dominated by *Andropogon scoparius* (little bluestem grass) and with a slope of five degrees. A wheat field under the same conditions lost more than seven times that percentage of water volume, and a fallow field lost more than nine times that of the prairie, or 10.2% of the rain that fell.

Such observations are further supported by an ongoing study at Iowa State University (Bharati 1996), where, based on eight sampling measurements, a five-year-old planting of *Panicum virgatum* (switch grass) exhibited the capacity to infiltrate, on average, more than 7.5 inches of rainfall per hour; an adjacent rowcrop on the same soil infiltrated 2 inches per hour.

WATER IN THE CONTEMPORARY LANDSCAPE

If we wish to influence water infiltration positively, improve water quality, reduce flooding and restore wetland and aquatic habitats, the intricate surface and groundwater relationships of our natural hydrology must be understood and incorporated into planning and land use. It is essential that practitioners responsible for all forms of land use—architects, landscape architects, engineers, planners, developers, contractors, agricultural producers, and government regulators—consider the natural hydrologic patterns not only of the site, but also of the surrounding area or watershed.

Stormwater management is a consideration in nearly every development project, but traditionally, water is viewed either as a burden or as a purely utilitarian commodity. Professionals are trained to collect and convey surface waters quickly and efficiently from the site to areas remote from their purview, presumably to be dealt with by somebody else. They analyze, design, and construct storm drainage and detention/retention systems that attempt to confine site and regional impacts of surface water-generated storm flows. It is rare, however, for these evaluations to consider the natural hydrologic character of the area, or the hydrologic context in which the site and surrounding natural systems formed over geologic time: time measured not by decades or lifetimes, but by thousands of years of system development.

Every tract of land, no matter how large or small, is affected by and interacts with water. We are often frustrated by the fact that precipitation falls everywhere, not just in wetlands or in places designated by engineers and ecologists. Precipitation in the Chicago area amounts to about 37 inches, or about one million gallons of non-compressible fluid per acre per year. When it falls, two things can happen. It can infiltrate the soil and become an asset to local life, or it can run off and become a liability to life downstream.

Site development generally results in an increase of impervious surfaces associated with the construction of buildings, roadways, and walks. Even landscape systems, particularly those areas dominated by a typical turf grass lawn, can generate significant volumes of dirty surface water runoff. Nearly all of the intercepted water is collected and shunted away from the site. Most development sites contain an extensive, costly storm sewer network that quickly conveys a large portion of every precipitation event, discharging its flow into the mandatory detention basin, where its focused energy is released into the nearest stream corridor, or possibly a larger storm sewer system.

Discharged water carries with it sediments, greases, and oils from roadways and parking lots, and excess fertilizers and pesticides from conventional lawn care. Other areas have no detention at all, allowing runoff to flow uncontrolled and untreated into area sewers or drainage ways. In all cases, most of it is passed downstream to somebody else.

Much of the water falling on the ambient landscape is no longer able to infiltrate into the ground, where it once provided a constant source of groundwater seepage to sustain a stable stream hydrology, even during periods of prolonged drought. Instead of a stable watershed and associated groundwater hydrology, many systems are now dominated by erratic surface water hydrology. Waterways experience rapid fluctuations in streamflow velocity and volume, generated almost completely in response to surface water discharges. The force of these combined stormwater flows is focused on a landscape, with its inherent soils, fauna, and flora, formed with a completely different type of hydrology. The erosive power of this shift in hydrology is impressive.

Drainage ditches are gouged into the landscape where no surface drainage existed before. The collective runoff acts to carve out existing streams and rivers, resulting in deeply incised stream banks, subject to constant erosion and sedimentation at rates not seen since the glaciers receded. The loss of infiltration and groundwater recharge in the surrounding watershed, coupled with the depression of normal water levels in the stream system, combine to lower the regional water table, and starve the stream during periods of drought. On the opposite extreme, intense periods of rainfall, once mediated by a landscape highly capable of absorbing and using the water as a resource, now regularly result in flash floods in areas that were not historically subject to flooding. The economic, environmental, and cultural impacts of flooding are significant, and often catastrophic.

The instability of streamflow, coupled with degraded water quality, make it difficult for aquatic life to adjust. Desirable species of fish, birds, and other aquatic organisms must struggle for survival in a stream system that may experience virtual or complete desiccation during dry periods that exhibit increased water temperature and altered water chemistry, including low dissolved oxygen. Habitat availability becomes critically limiting to many species.

Whole sections of stream bank become overgrown with dense stands of trees and shrubs, effectively shading out the deep-rooted perennial forbs and grasses that are necessary to stabilize the soil layer. With the loss of a deep-rooted cover to secure the soil, the bare ground becomes increasingly exposed to erosive forces, resulting in accelerated streambank erosion. A new industry, streambank bio-engineering, has emerged to deal with this phenomenon. Unfortunately, many well-designed and potentially useful solutions are likely doomed to long-term failure unless we find intelligent ways of dealing also with the root cause: mismanaged water.

We have forgotten that floodplains, as we know them today, are not a natural phenomenon, but an engineering term created to describe a zone of flood-prone land that can change just as rapidly

as the next upstream development. With each passing generation the culture becomes more distant from reality. Its words take on new meanings in accordance to the real experience of the young.

"River." What image does the word evoke? We picture a long channel, with steep muddy banks, that surges with brown roiling water after the rains, and during the "droughts," a scarcely wet ditch with shallow pools of gulping carp, discarded appliances, and abandoned grocery carts.

THE PLIGHT OF WETLANDS

Our society's failure to comprehend and synthesize natural hydrologic processes into all forms of land use is epitomized by our management of wetlands. It is a common misconception that wetland systems throughout our region rely on surface water hydrology for sustenance, or that they are *stormwater driven*. Most modern wetland literature asserts that the basic value of wetlands is related to their ability to provide flood storage and to serve as a cleansing mechanism for filtering stormwater pollutants.

Yet, these two factors are most directly responsible for the degradation or outright destruction of our remnant wetland habitats and the poor performance of most wetland mitigation projects. Imagine requiring our kidneys and livers constantly to store and filter a random suite of toxicants. This problem occurs only because we have failed to take advantage of water where it falls, turning it instead into a destabilizing force to be dealt with elsewhere.

We are aware of no scientific evidence to suggest that naturally occurring remnant or recreated wetland habitats located throughout this region benefit from direct surface water discharge and inundation. To the contrary, there is overwhelming scientific evidence that illustrates that surface water inundation of wetland habitats will result directly in their degradation. Research indicates that changes in water quality, water quantity, and physicochemistry can significantly impact the function and sustainability of wetland systems.

The USEPA publication *Natural Wetlands and Urban Stormwater: Potential Impacts and Management* (1993), summarizes research findings describing stormwater impacts to wetland habitats. According to this document, changes in vegetative community structure, productivity, water quality, and hydrology are inseparable. Changes in vegetative community structure appear to be correlated with the time of year, water depth changes, and frequency and duration of inundation experienced in the wetland from excess stormwater discharge (Azous 1991; Cooke 1991; Stockdale 1991; USEPA 1985). Changes in water quality (chemistry and sediment loading) have the potential to affect the vegetative community structure and productivity, thereby reducing the availability of plant species preferred by fish, mammals, birds and amphibians for food and shelter (Lloyd-Evans 1989; Mitsch and Gosselink 1986; Weller 1987).

Wetland plant species are generally specific in their requirements for germination, and many are sensitive to flooding. Horner (1988) found that emergent zones of palustrine wetlands receiving urban runoff in the Pacific Northwest were dominated by the opportunistic non-native, *Phalaris arundinacea* (reed canary grass), whereas unimpacted wetland plant communities were composed of a more diverse group of native species. Ehrenfeld and Schneider (1990) discuss the relationship between stormwater discharge and changes in plant community composition. They found a reduction in indigenous wetland species and an increase in the colonization of exotic species due to changes in hydrology, water quality, or both. Van der Valk (1991) noted that wetland species may have limited ability to migrate in the face of persistently raised water levels;

many species can spread only through vegetative methods under such conditions. The result may be lowered plant diversity in the wetland-to-upland gradient. This is evident in many remnant wetland systems, where the lower gradient zones subjected to longer periods of surface water inundation have exhibited more substantial degradation than the edges of the wetland.

Studies have been conducted to evaluate hydro-period impacts on individual species. Stockdale (1991) found that *Typha* spp. (cattails) survive well under fluctuating conditions, and that *Phalaris arundinacea* (reed canary grass) has a wide tolerance to water level fluctuations, though it does not survive long periods of inundation during the growing season. In contrast, *Carex* spp. (sedges) are highly specific with regard to hydrologic preferences. According to Frederickson (1982), modifying natural wetlands with impoundments may result in radically different hydrologic regimes that are not ecologically sound. The introduction of stormwater runoff or water control objectives, causing hydrological disturbances in impounded wetlands, could result in the development of stressful habitat conditions.

Changes in the pH of water associated with management practices or the introduction of stormwater also can have an effect on the biota in impounded systems. Most organisms are adapted to function within particular pH ranges, and abrupt or substantial variations in pH can have adverse effects on aquatic life, usually in the form of reduced productivity and increased mortality (Newton 1989). Urban stormwater can vary significantly in pH, so the variable nature of stormwater inflow could result in abrupt changes in pH in an impoundment. Since only a few species can adapt to conditions of changing salinity, pH, temperature, and dissolved oxygen, low species richness could result (Devoe and Baughman 1986). Given the predisposition of most native species to either ombrotrophic or minerotrophic conditions (Swink and Wilhelm 1994), wetlands dominated by waters with fluctuating physicochemistry and volumes are depauperate in species richness.

Another point to be considered is that the environment least capable of handling excess water is a wetland habitat that is already saturated. This is often the case in detention and wetland mitigation projects that involve the excavation and creation of emergent and shallow water marshland habitats that rely primarily on surface water hydrology for sustenance. Except perhaps for marshes filled pre-jurisdictionally or illegally, the creation of such habitats is not an appropriate form of mitigation. A wide range of factors must be evaluated to determine the appropriate restoration or water management strategy for any specific project or site. The solution must be one that renders the hydrologic condition more stable, and reduces runoff waters to a level that fosters ecosystem stability.

These findings, which are supported by many other studies, help to shape an understanding of the types of impacts and wetland degradation that are occurring in varying degrees to nearly all the remnant or created wetland systems throughout our region, particularly those that are most directly exposed to rural or urban stormwater runoff. Changes in surrounding land use and vegetative cover have altered the natural hydrology of our wetlands from habitats formed and sustained almost completely by groundwater discharge and direct precipitation, to wetland systems almost totally dominated by surface water hydrology.

As a result of these changes, increased runoff exposes surrounding wetland systems to periodic, repeated inundation. With accelerated erosion, surface water flows carry sediments that are then deposited within the wetland, altering the chemistry, nutrient cycling, root zone, germination conditions, and other critical growth factors. The combination of excess ponded water and sedimentation result in the obliteration of the more conservative native wetland species, those

plants with strict physiological parameters that constitute complex systems. The high diversity of species that favor isothermic, groundwater-fed alkaline conditions and a very specific hydrological regime yield to a few weeds such as *Phalaris arundinacea* (reed canary grass), *Typha* spp. (cattails), *Phragmites australis* (common reed), *Lythrum salicaria* (purple loosestrife), and a handful of other species.

This default weed flora is tolerant of direct surface water inundation, rapid fluctuations in water levels, poor water quality, and sedimentation. The tremendous biodiversity, system stability, and biological function of our region's natural wetland habitats are lost.

THE "OUTDOOR RUG" PHENOMENON

A trademark of nearly every cultural landscape across the country is the turf grass lawn. The aesthetic dictated by the lawn implies a landscape that requires regular watering, yet can never be wet, that must at once be short, yet lives on fertilizer. The landscape is essentially designed to divest itself of water and resources, the two input components it needs most. This is the legacy of a cultural attempt to create a water-loving landscape that cannot abide water.

To achieve this design, the topsoil is typically removed, the underlying clay is compacted and a thin layer of topsoil and sod is rolled out over it. Such sod commonly consists of Kentucky blue grass, *Poa pratensis*, which is not native to Kentucky or even the Americas. In the typical context, the root system is but a few inches deep, and the whole layer represents little more than a drug-dependent "rug" with an exaggerated floor pad. Because water cannot penetrate the clay floor and the shallow root system will die if it sits in water, the "floor" is tilted at no less than a 2% slope, often a requirement in local ordinances. More expensive or elaborate designs will include bumps or berms placed artistically throughout the landscape, and storm drains situated cleverly so that water drains quickly from the site, discharging into detention basins at all deliberate speed.

Current fashion makes it important to maintain the height of the Kentucky blue grass as low as is physiologically possible and still have something that looks like a green rug. This requires virtually constant mowing, lest grass blades here or there get taller than others. Mowing, of itself, might be relatively harmless if it did not use fossil fuel in unremediated internal combustion engines. For every gallon of gas burned, about 15 pounds of various oxides (mostly carbon dioxide, and other worse things), which the ecosystem of the earth has not seen since the Paleozoic (200 million years ago), are produced and given over to our atmosphere.

Since it is culturally important to grow Kentucky blue grass short, it must be fertilized regularly, which makes it grow fast, so that it must be mowed often. Inasmuch as no other living things are allowed in the lawn, the full aesthetic requires the application of as much broad-leaf herbicide and pesticide as the landscape maintenance budget will permit. When it rains, water quickly saturates the rug, inducing runoff that begins its course down the slope, carrying with it herbicides, extra fertilizer, and anything else added to the lawn.

To control the flow into local streams, engineers and designers of such landscapes have fashioned huge holes in the ground placed tactically to receive such waters and any toxicants, pollutants, or unused nutrients. There the water sits, its volume and any dissolved or suspended components to be metered into the nearest stream. Water from such landscapes throughout the watershed accumulates in massive storm surges, filling the rivers with filthy water, eventually passing it along the Mississippi River to the Gulf of Mexico.

This regular movement of huge volumes of dirty water into the estuarine regions of the Mississippi River delta is contributing to a catastrophic decline in the productivity of the spawning grounds of the Gulf of Mexico. Meanwhile, having sent our rainwater downstream, we no longer have the water to recharge our landscapes. Since water continues to evaporate and transpire, our landscapes are soon dry and sear, often within hours of the last rain. The solution, inevitably, has been to install expensive irrigation networks to mine water from deep within the ground, a supply that is the largess of a landscape far away that still infiltrates and stores water in net amounts.

This contrived "living" rug phenomenon has led to a curious infrastructural aesthetic: few other living things are acceptable on the rug. Only certain shrubs, planted in artistic groupings of 5s and 7s, and even-sized, lollipop-shaped trees planted in rows are allowed. Expensive plantings include huge clumps of mulch placed in small rings at the bases of the trees and shrubs. Trees growing in clay holes on bumps commonly do not live long, partly because the holes have either too much or too little water in them. In order to forestall the mortality of ill-fated trees planted out of place, a new industry has developed to provide underdrainage for the clay holes. The relevant point here is that such trees and shrubs are not really alive in the sense that they are members of a community and participate in the annual replication and stability of that community.

Other than mowing, fertilizing, and pesticing, the only human involvement in such a landscape consists of workers who replace dead trees. Such landscapes are largely devoid of other living things as well, save, perhaps, gaggles of sedentary urban geese that have lost the capacity to migrate, . . . but not the capacity for other bodily functions.

Considering the sterility and lifelessness of our contemporary landscapes, one could get the impression that our culture regards the outdoors as little more than living rooms to be designed only with attention to the vagaries and vicissitudes of the design aesthetic of its day. The people of the culture no longer can see that there really is such a thing as an outdoors, or that it matters. Nevertheless, water remains a real thing, a noncompressible item that flows downhill. The more of it there is, the greater the volume; the greater the volume, the greater the potential flow energy. The greater the energy, the more resources it can carry with it. Water is one of the few resources that winds up on the top of the hill free, as a result of evaporation and condensation, rain, dew, or snow. Other resources, such as nutrients and soil, are less easily restored to the top of the hill. For them, the energy required is not sunlight energy, which mediates water restoration, but some other energy source, and, on the scale of the human lifetime, usually one that involves money and labor.

Water flowing downhill and carrying resources with it leaves the top of the hill bereft of resources, and render the bottom of the hill surfeited with them. The same force that brings water free to the top of the hill enforces evaporation potentials such that, in the Chicago area, about one million gallons of water are evaporated from each acre per year, which is approximately the amount that falls annually. The first principle of our contemporary culture seems to be: *get as much water out of sight as fast as possible*. Depending on local ordinances, the rate of disposal can vary, but all of it must leave. Just how the downstream neighbors handle it is *their* problem.

It is not sufficient, once the liabilities associated with the contemporary aesthetic are understood, simply to stop all the mowing, watering, fertilizing, and pesticing, and "let nature take its course." This contemporary landscape has nowhere near the stability or biodiversity to coalesce into a self-sustaining, self-replicating ecosystem. If current human involvement were simply to disappear, the landscape would not "succeed" into some pre-Columbian Eden. Rather, if the Kentucky blue grass went unmowed, a few other weeds like bull thistle and dandelion would flourish along with the grass for a few years, eventually giving way to weedy shrubs and trees,

such as buckthorn, box elder, Amur honeysuckle, and black locust. Over time, the few ground cover weeds would be shaded out, soil would erode, and the roots of the trees and shrubs would become exposed and begin to topple. There would be few butterflies, birds, or anything else, other than perhaps some roving gangs of starlings feeding on box elder bugs. All the while, water, soil, and other resources will run downhill, polluting the rivers.

It should be noted that the authors are not opposed to the use of turf grass lawns. There are many useful applications for turf grass. We are opposed, however, to the *contemporary mores* that demand we default the entire outdoor landscape to turf grass, particularly when other landscape treatments are available that are far more ecologically and economically sensible.

What would be so wrong, so unattractive, so heretical to look out upon, indeed, walk within, a landscape inhabited by a profusion of native grasses and sedges, replete with comely perennials and colorful butterflies, infused with flowering shrubs, and dominated here and there by groves of trees — trees with futures? Would it be so radical to propose that trees be free to grow branches in whatever manner the habitat permits, and to grow broad, expansive root systems with a diversely populated rhizosphere rich in water and mycorrhizal fungi? Would we be so unable to countenance clean streams and rivers that flourish with fish and mussels and abound with birds?

THE AGRICULTURAL DILEMMA

Water in nearby agricultural lands is disposed of just as foolishly. Prairie lands, with their deep roots and water holding root systems, once stored net amounts of fixed carbon each year in the creation of deep black soils. Very little water ran off the surface of the land. Most of the water either transpired through the living tissues of hundreds of different species of plants or seeped at a constant rate into the groundwater, only to discharge finally in fens and springs far from where it fell. The richness and fertility of Midwestern soils owes its properties to the hydrology of the grasslands, where subterranean reduction exceeded oxidation.

Weaver and Noll (1935) described the erosive effects of tillage on prairie soils.

... on bared or sparsely vegetated slopes both run-off and erosion may occur after relatively light showers. It soon becomes clear that the most important factor tending to decrease erosion in non-tilled lands is the maintenance of a plant cover.

The quantities of water lost during torrential rains even from small areas are impressive and naturally lead to calculations of the amounts running off from whole hillsides, the total amount of soil removed, the effects of this run-off in forming gullies and ditches, and of the sediment finally silting up the fertile lowlands. The water is lost to ground storage; the deepening of gullies and ditches lowers the water table, which results in a constant tendency of the water in the upper layers to sink to lower levels. The habitat is gradually changed. The hard, compact, poor absorbing surface left after severe erosion is always impressive. That the water holding capacity is reduced is not difficult to understand . . . erosion can be held largely accountable for disastrous floods, on the one hand, and drought on the other.

This is hardly a new phenomenon. Amos Sawyer (1874) noted that:

During the last twenty years our climate [in Illinois] has been slowly but surely changing from wet to dry. . . . But the most important agent [of this change]--one that is yet to produce greater mischief--seems to have escaped [our] attention: it is the aqueous. The chemical and mechanical effects of this agency are constantly at work, and the result is plainly visible in the deepening of the channel of all our small streams. [It] is hard at work night and day, summer and winter, overcoming every obstacle placed by nature or man to impede its progress. The work marked out for it to do is no less than the complete drainage of the ponds and lakes of our prairies: and so surely as the world stands, so surely will the task be accomplished. . . . Every little streamlet has its miniature Niagara Falls: but, unlike their giant relation, they are making visible progress every year, and are consequently (strange as the language may seem) more instructive. The 'hard-pan,' which only yields after repeated blows from the sturdy laborer's pick, and grinds off its steel at the rate of two inches per day, crumbles and gives way under the combined agency of frost and water: the largest trees in the forest yield to the conquering element. . . . Every little streamlet is bringing its bed down to a level with its parent stream, and the merry rippling of their little cascades greets the ear on every side, and tells you in language not to be misunderstood that they will in time accomplish the work allotted them to perform--the thorough drainage of the land through which they pass.

Illinois's topsoil, once fertile beyond imagination, now chokes the last of life from the Illinois River. Demissie and Bhowmik (1987) note that the average depth of Lake Peoria in 1903 was 8.0 feet, but by 1985 it was no more than 2.6 feet deep. The huge fishery along the Illinois, which, in 1908, at its peak yielded 24 million pounds of fish, by 1964 yielded only 1.5 million pounds (Emge et al. 1974). The mussel-fishing industry, once huge, no longer exists. The reasons for this decline are many and complex, and Illinois biologists have been writing about the effects of man on the Illinois River for many years (Bellrose et al. 1979; Mills, Starrett and Bellrose 1966; Starrett 1972). For the first half of this century, the Peoria lake filled at a rate of about 0.05 foot per year, which was too fast to sustain a diversity of life forms. From 1965 to 1975 it was filling at a rate of 0.1 foot per year, and from 1975 to 1985 the Lake Peoria section of the Illinois River was gagging on 0.12 foot per year.

The Heartland Water Resources Council estimates that by the year 2040, Lake Peoria will have vanished as a water body, leaving little more than a narrow and muddy navigation channel. Mike Platt, executive director of the council, sees a grim future, the lake having "turned into willow thickets and mudflats by 2016, swarming with mosquitoes, with only a narrow, muddy barge channel open for boating. Marinas will have become ghost towns. Waterfowl will have fled and fish will have declined. Property values will have plummeted. What will properties along the river be worth when (people) look out over willow thickets and mudflats?" (Peoria Journal Star, August 7, 1996).

Soil erosion and hydrologic alterations to the landscape associated with conventional tillage practices trigger other detrimental side effects. A recent SCS study (1990) concluded that, of the original average 18 inches of topsoil across the state of Iowa at the time of settlement, 10 have been lost to wind and water erosion, and that, of the remaining 8, half the tilth (related to soil organic carbon) is gone. When soil loses tilth, it loses its organic matter, and therefore its ability to absorb water. The corollary to lost water absorption is increased erosion, and therefore

exaggerated divestment of erodible resources, which then accumulate in somebody else's back yard in amounts too great to be useful, if not actually destructive. The long-term consequences on both the local and broader economy are frightening.

As the water in the soil is drained away, the reduction/oxidation relationships change dramatically. Whereas once the prairies held their water, and carbon was fixed beneath the surface in net amounts, annual row crop tillage now causes carbon to be oxidized more rapidly than it is fixed, a situation exacerbated by the constant drain of water through the tile systems and into the ditches. Consequently, during each growing season, carbon dioxide that was fixed millenia ago is now released into the atmosphere in amounts greater than it is taken up, potentially contributing to the problem known as global warming. This net release of soil organic carbon (SOC) is not a minor concern. Recent studies on the amounts of carbon stored in the Conservation Reserve Program (CRP), in which deep-rooted native grasses are planted in some of the less productive or more erodible soils, have shown that nearly ten years of SOC storage can be oxidized within a single growing season after tilling. These amounts can be impressive, since land in CRP, over a broad geographic area, can gain an average of 0.5 tons of organic carbon/acre/year (Gebhart et al. 1994).

Water is even overlooked as a factor in the interpretation of natural areas. In a polemic on the management of remnant natural woodlands in Illinois, Wilhelm (1991) points to the hydrologic changes occurring deep within the shade of Midwestern woodland areas. Much of the change can be attributed to the cessation of annual fire, which was practiced by the native people for millennia before European settlement.

Already . . . where shade has become the most extreme and herbaceous ground-layer the thinnest, the forest floor is open to sheet erosion. It is evident that the increasingly species-poor community of the [woods] no longer can hold water or soil. Recent and dramatic increases in the number, depth, and width of erosional ditches, though not yet quantified, are obvious to those who have been watching. It is yet to be determined just how much water is running off the slopes, but indirect evidence suggests that it is a significant percentage of the annual precipitation. . . . Because summer and fall vegetation on the forest floor of the [woods] is sparse, much annual precipitation sheet-flows toward ever deeper erosional ditches and carries with it soil, native plant seeds, and diaspores. Tree buttresses are wholly exposed and some have been undercut by loss of soil. Many small maples are undercut and propped on their roots, 5 cm or so of soil having washed away since their germination 10-15 years ago. . . . Although woody mesophytes are the prevailing species at this time, simple arithmetic tells us that no balanced system receiving a given amount of rain per year can continue indefinitely to evapotranspire the same amount and lose an additional amount to runoff. Indeed, as the water table lowers these mesophytes will be less and less able to draw upon the deep ground water accumulated in the presettlement [period]. Droughts and episodic rainfall events inevitably will begin to take their toll on a system that has become overstocked with phreatophytes [water-loving plants] and no longer has sufficient means for holding precipitation. The cumulative negative effects of such natural system collapses are now felt throughout the streams and rivers of the prairie province, ultimately to degrade and diminish estuaries of the Mississippi River delta region, spawning ground for many fishes of the Gulf of Mexico.

Hydrological impacts associated with shortsighted land management practices are not limited to the Midwest. Note the following citation:

The trees are large and noble in aspect and stand widely apart except in the highest parts of the plateau where the spruces predominate. Instead of dense thickets where we are shut in by impenetrable foliage, we can look far beyond and see the tree trunks vanishing away like an infinite colonnade. The ground is unobstructed and inviting. There is a constant succession of parks and glades—dreamy avenues of grass and flowers winding between sylvan walls, or spreading out in broad open meadows. From June until September there is a display of wildflowers which is quite beyond description. The valley sides and platforms above are resplendent with dense masses of scarlet, white, purple, and yellow. It is noteworthy that while the trees exhibit but few species the humbler plants present a very great number both of species and genera. . .

Dutton (1887) wrote this in his physical geology report on the Grand Canyon district in Arizona. Since then, overgrazing and fire suppression have so depleted the Colorado River watershed of its capacity to absorb water that the dramatic topography is able to conduct massive amounts of precipitation rapidly to this once beautiful canyon. The immense flow energies and scouring capacity of the water have rendered the canyon little more than a deep and wondrous landscape, bereft of the verdure described by Dutton. The uplands, once blessed with the deep root systems of bunch grasses and many flowers, are now heavily eroded and largely defaulted to compacted soils, shallow-rooted Asian brome grasses, and sage-brushes.

Consider the plight of the western valleys and bays. Currently, stands of pine, juniper, or oak, undisciplined by regular controlled burns, according to the custom of the native peoples, become ever more dense, and their leaves accumulate for years beneath them, unable to decompose as fast as they fall in the dry climate. The leaves shade away the ground cover vegetation, and therefore reduce the slopes' capacity to hold water. Finally, when the winds are high and the humidities are low, the inevitable uncontrolled fire starts, with catastrophic results. The heat produced is tremendous—many trees are killed, the ground is laid bare, and life and property are lost. When the rains come, waters flow freely over the erosive, exposed soils, and fill the streams with brown, scouring, roiling waters that immediately debauch into the bays, befouling them as well. Soaked slopes without a stabilizing root architecture slip away, carrying everything upon them, including houses and roads.

Imagine the coastal ranges and the Sierras of the western states, currently so bedeviled by catastrophic wildfires, mud slides, and water shortages, again replete with healthy pines, flower-rich slopes and chaparrals, and streams again filled with base flow waters. Today, people fear the fires and resent the mud slides, complain of water shortages, and decry the pollution of the bays, as if there were nothing that could be done about it. Attentiveness to the fire practices of the native people, the natural hydrology, and the local ecology could be incorporated generally into all manner of landscape designs to render a land rich in flowers, safe from uncontrolled fires, unsusceptible to mud slides, and nurturing to the major rivers and bays. As the awareness and correlative ethics of the people grew, so also would the health and safety of the land.

THE NATURE OF LANDSCAPE EVOLUTION

Impacts to historic biological systems, as a result of processes associated with European

settlement, have occurred with a magnitude and rapidity without precedent in the history of the continent's biota. In plant communities, for example, there is a striking difference between areas inhabited by a full component of locally native species and those inhabited predominantly by weeds. The conservative systems contain native biodiversity that is suited to the processes, and they will exhibit long-term stability.

Weed communities, by comparison, are adapted either to catastrophic disturbance or the kinds of activities associated with traditional cultural landscapes. These weed communities contain neither the biodiversity nor the aggregate adaptive ability to coalesce into self-replicating, sustainable systems.

In our contemporary, fragmented landscapes, the conservative elements of our native systems, supplanted in place, have neither refuge, effective migration routes, nor the time to adapt or move. Rather, their populations are decimated time and time again until their local extirpation or ultimate extinction occurs. The destiny of many systems dominated by weeds is further destabilization, during which resources such as water, soil, and nutrients are often lost at rates faster than they are replaced (Swink and Wilhelm 1994).

RESTORING A CULTURAL RELATIONSHIP WITH THE LAND AND WATER

What do we mean when we say we want to restore the landscape, or restore the health of the earth? What is it that needs to be restored? How do we know when the land is healthy? Such questions can be hard to answer for a people who have become so distant and removed from the idea that their relationship with the earth is integral both to the long-term perpetuation of their culture and the renewability of the earth's living surface.

One way of approaching the answers to these questions in human societies, for example, is to regard a culture healthy so long as it continues to renew itself with each new generation of individuals and families. The health of a culture is dependent upon the behavior of the individuals within it.

Each individual is born with a unique combination of genes that the culture has never experienced before, and is born into a time and circumstance that has never been before or will be again. Individuals are reared in the ways of their people by the family within the culture, and draw strength and experience from the knowledge and wisdom of their elders.

With an eye toward tomorrow, these elders have tested the knowledge and wisdom of their forebears, made scarcely detectable modifications in response to their own experience with their people and their land, and passed it along to young ones. In this way, the health of the culture is assured, as the people, utterly respectful of the experience of the past, respond to the subtle vicissitudes of an ever changing earth, so that their culture might perpetuate itself and replicate the full potential of human experience with each passing year.

Take the metaphor of the Turtle Mother, as propagated by many of the native peoples of eastern North America. The elder tells the story, a care-worn hand touching the shoulder of the young one. "The earth is on the back of the turtle. So goes the turtle, goes to earth." The young one can see that if he befouls the waters wherein the turtle lives, so also he befouls his own world. If the turtle dies, so also the people die. The circle of life is broken, and the earth falls off the back of the turtle.

So it is with the ecosystems of the earth with which human cultures interact. The warp and weft of life and human culture on any remnant acre of the earth is unique to the earth. No other complex of genetic expressions has such an experience of the singular geological, historical, and climatic definition of a place as do the organisms that have long residency in it. With each passing season there is a propagation of young with genes that are at once nearly identical to those of their parents, yet manifesting combinations of genes that have never been before. With the inborn "experience" of long-time residency in their habitat, the next generation is at the same time equipped to accommodate subtle shifts in climate and the gradual changes brought on by mountains and seas rising and falling.

This coevolution of life forms with the geological and meteorological transformations of the earth occurs at a time scale that is inextricably linked with the regular cycles of the earth around the sun, and the time periods necessary for individuals of populations both to transmit the experience of the place to subsequent generations and yet to allow small genetic changes to satisfy subtly new conditions.

Rates of change in human cultures and ecosystems are buffered against catastrophic collapse by an internal diversity that works to protect the whole against the development of exaggerated, untested individual behaviors or genetic malformations. Without such protections, rapid, system-wide changes can cripple the system's ability to renew itself and conserve its local knowledge of the place.

The health of an ecosystem or a culture degrades in accordance with the degree to which it destabilizes or simplifies itself, and there comes a time when there is not enough diversity within the system, with either enough memory of the past or enough potential for the future, to continue. The evolution of a system so compromised ceases.

Establishing a sustainable relationship with the living earth requires the reintroduction of a *capacity* for change. Water out of place is a primary agent in both cultural and ecological instability; therefore, our relationship with water is related to our ability to sustain a culture and the culture's ability to sustain the living fabric of the earth.

THE CHALLENGE TO OURSELVES

We believe that sustainability is an overarching principle for all land use. To support the hydrologic cycle, ecosystem stability, and other critical natural processes, it is necessary to consider local, regional, or even global issues on land use of all sizes. In contrast to a sustainable approach, much of our contemporary infrastructure and conventional planning methodologies are products of a contrived visual aesthetic with little understanding, relationship, or grounding in the unique realities of place.

Such methodologies represent a cultural indifference to the function of natural systems, or even the energy required to maintain this infrastructure, much less any long-term consequences. This is especially true with respect to the dynamics of water. Site planning and development, as a whole, must evaluate local natural systems and integrate their essential aspects into problem solving techniques, such that design is based on historical patterns of terrain, water, and climate.

A primary obstacle facing sustainable planning and design is that no one profession has the depth of training and skills necessary to do it alone. Sustainability requires a multi-disciplinary

approach. Traditional academic degrees and professional training lead us to believe we have earned the competence to solve very specific types of problems. As David Orr (1995) points out: "The ideal of a broadly informed, renaissance mind has given way to the far smaller idea of the academic specialist."

To overcome this impediment, the challenge to planning and design professionals is to synthesize a broad spectrum of expertise. The leaders of future sustainable development must be able to facilitate a dialogue between environmental scientists, landscape architects, engineers, builders, planners, architects, local, state and national decision makers, and a public that expects quality of life to be supported by its environment. It is encouraging to see that the seeds of sustainable planning, design, and development are emerging from a variety of disciplines.

If we are to shift toward sustainability successfully, we must first address several basic shortcomings that are pervasive in the planning and design professions, including landscape architecture. Design professionals must learn to recognize the drawbacks associated with continued reliance on the standard default, an unwieldy combination of visual aesthetics.

"If it comes down to a decision between good design and the environment, I'll always opt for good design." Thus proclaimed a design practitioner in one of the professional design journals several years ago. This is a curious, disturbing statement, but unfortunately, it is a sentiment too commonly expressed among contemporary design professionals. How do the criteria for "good design" differ from those for "the environment"?

What is the controlling factor in aircraft design--performance and safety, or just aesthetics? Is not the performance of the land on which we live and depend just as important as the performance of a transportation vehicle? A safe, high-performance airplane is inherently attractive. So also would be a building and landscape well integrated into the *place*.

Sustainable design is more than artwork, and more than a painting or a piece of sculpture. It is the achievement of artistic goals within the parameters set by the chain of an unfolding past and future. Every form of development on the land, no matter how small, requires an understanding of the relationship between land use and its impact on water and other resources. The implications of *this understanding must be disciplined by a cultural ethic that mandates a response that accommodates ecological and cultural stability.*

Fellow humans have voices, and are subject to whims and temporal urges. They have faces and money. Too often it is easy to be seduced into believing that the exigencies of the day are paramount. Few people see the faces of plants and animals. Plants and animals have no money. Yet, attentiveness to the exigencies of their survival is profoundly informative in regard to the requisite relationship we must develop with the living earth.

Building a sustainable relationship with the living earth requires that our actions be grounded in environmental realities. In a culture-driven society, this requires an ethic. Since the beginning of the Holocene, and perhaps for much of the Quaternary, an important component in the shaping of the landscape has been mankind. Human beings are governed not only by random interactions within the ecosystem, but by choice. Fundamental interactions such as predation, competition, and foraging are complicated by the fact that humans can *decide* how to act, often with no immediate ecological parameter coming to bear on this decision, other than a human ethic.

According to Leopold (1966),

All ethics so far evolved rest upon a single premise: that the individual is a member of a community of individual parts. His instincts prompt him to compete for his place in the community, but his ethics prompt him also to cooperate. The land ethic simply enlarges the boundaries of the community to include soils, water, plants and animals, or collectively: the land. We can be ethical only in relation to something we can see, feel, understand, love and otherwise have faith in. A land ethic, then reflects the existence of an ecological conscience, and this in turn reflects a conviction of individual responsibility for the health of the land.

The design of environments where humans and other organisms interact, where actions create reactions, where the future is built on an understanding and appreciation of the past, requires that good design and the environment be synonymous. Regardless of scale, the design of sustainable environments means facilitating human purposes in concert with natural processes.

Once we understand the realities of place, there are infinite opportunities for creative expression; true design freedom is possible only within these limits. Since every place is unique, every design will require new creativity, innovation, and technology. A new aesthetic, encompassing every aspect of infrastructure, will emerge as we become more successful at designing whole systems. This requires a design process based on the interconnection of natural systems, and an increased understanding of the relationship between an individual site, the surrounding region, and beyond. The products of such design will be both visually interesting and sustainable if they integrate basic physical and behavioral factors into the solution (Patchett and Wilhelm 1995).

As our awareness of the reality of sustainability expands, the attributes of environmentally grounded design will be simply and clearly expressed, without hindrance to a formal and purely aesthetic design paradigm. As Orr (1995) contends, "When human artifacts and systems are well designed, they are in harmony with the ecological patterns in which they are embedded. When poorly designed, they undermine those larger patterns, creating pollution, higher costs, and social stress."

In our opinion, if sustainability is to be achieved, it will require a collaboration of philosophy, science, ethics, and creativity. Water management is a key touchstone of sustainability. There is no other resource or form of energy, with the ability both to sustain or destroy, more powerful than water.

SUMMARY

We were dismayed, although not surprised, to hear the conclusions of a recent report presented to the president of the United States by a so-called "flood expert," proclaiming that floods are a natural phenomenon, and that nothing can be done about them; that we can only plan ahead to save lives. To the contrary, floods, as we know them today, are not a "natural" phenomenon. In presettlement landscapes in the Midwest, the only substantial form of flooding generally occurred during the spring snow melt, when grounds were still frozen and incapable of absorbing the meltwater. It tended to create expansive, placid, still-flowing pools, quite a different form of hydrology from the snow melt dynamic in today's urban, suburban, and rural landscape, the volumes and characteristics much altered by numerous hydrologic and hydraulic modifications in

the land.

Until our people can comprehend that the devastating floods of 1993 in the Mississippi River valley were not caused by an unusual and excessive amount of rainfall, but rather, by an unusual and excessive amount of rain falling on a landscape sorely needing water, but stripped of its capacity to absorb it, both droughts and floods will continue to become more frequent and catastrophic.

A principal cause of many of our water problems is directly related to the self-deception built into land use policies of all kinds. Many policies consist of agendas that are characterized by unrelated values and narrowly focused priorities. For example, local stormwater management ordinances routinely focus on water quantity issues, because many voters live in flood-prone areas. Such ordinances reflect little understanding of water quality or the implications of how water is dispersed throughout the landscape, because few voters are aware of the ecology of water so long as it is not in their basement or inundating their roads.

Decisions made in such contexts may appear to be economically sound because they are supported in part by a series of federal, state, and local programs, but the long-term economic and ecological consequences of such actions are rarely recognized. A redirection in these programs that integrates sustainable economic and environmental objectives will give decision makers better choices and solutions.

Another barrier to sound policy is a lack of knowledge within the citizenry and their elected representatives regarding their environment and sustainable economic alternatives (DuPage County Environmental Commission 1993). No one factor will guide future sustainable land use and site development more than education. Making informed decisions is paramount to preserving the quality and quantity of the earth's resources.

A primary goal of sustainable design in building and site development should be, wherever possible, to retain water where it falls, treating the water as a resource, not discharging it as a waste product. This will require new design innovations throughout the urban and rural environment in the form of buildings that detain and use water, redesigned site drainage systems that replicate surrounding natural hydrological patterns, and the integration of landscape systems with agricultural crops that have specific water holding capabilities and are uniquely adapted to the region. Many of these ideas, in various forms, have already or are currently being introduced in a wide range of areas around the globe.

Since precipitation is universal, our relationship with water must be developed everywhere. Every form of land use, whether urban, suburban, rural, or otherwise, must be based upon a clear understanding of the relationships of water within the physical characteristics unique to each place. Whatever the context of human inhabitancy or nature's hydrology, the manner in which water is incorporated into the design, development, and management of the land should be such that water does not act as a depleter of resources. It is our proposition that a sustained economy and culture are most assured if priority is given to developing new paradigms that incorporate water into our lives in ways that sustain life and nurture our precious resources.

Today, we divest ourselves of natural resources and sterilize our imaginations in regard to creating economic growth, jobs, and prosperity. Envision, instead, a new economy, defined by the extent to which we reinvest in natural resources, as industrial, urban, residential, and agricultural North America is redesigned and rebuilt sustainably. Children who now are born into a world

feeling that there is no hope for a sustained future can be enlisted into a cultural recovery program based on reality and a sense of tomorrow. Whatever their particular bent or special gift, their youthful energies, and natural openness toward tomorrow can be deployed within a new cultural ethic, one that engenders hope and a sense of self-worth -- a world in which elders pass along *wisdom*, as well as knowledge.

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James Patchett is founder and President of Conservation Design Forum, Inc. a multi-disciplinary consulting firm dedicated to the principles of sustainable land planning, design, development, and long-term systems management. The firm also specializes in natural features inventories and assessments, ecological restoration and reclamation design, watershed and regional systems planning, and post-construction site stewardship, management, and research. Jim received an undergraduate degree in landscape architecture, and master's degrees in both landscape architecture and civil engineering (water resources). In over 20 years of practice, he has worked for academic institutions, a public conservation agency, and for both large and small private design and environmental consulting firms. Jim combines his training as a landscape architect and hydrologist in the development of natural resource-based site planning and design techniques involving the integration of native landscapes, the preservation and enhancement of natural systems, and the design of innovative stormwater management strategies. Prior to forming Conservation Design Forum in 1994, Jim served as Environmental Services Manager in the Chicago office of Johnson, Johnson & Roy, Inc., and is currently Chair of the American Society of Landscape Architect's Water Conservation Open Committee and is heading a national task force responsible for the preparation of new ASTM "Sustainable Site Planning and Development" guidelines.

Dr. Gerould Wilhelm, Vice President, Conservation Design Forum, Inc., is a noted botanist and ecologist, and co-author of the definitive text, *Plants of the Chicago Region*, one of only two such works in the world rated as "excellent" by Robert Frodin, author of *A Geographic Guide to the Floras of the World*. He is responsible for the development of the Floristic Quality Assessment method of evaluating the natural quality of plant communities. The methodology has now been adapted for use in Illinois, Iowa, Michigan, Missouri, Ohio, parts of Wisconsin and Indiana, and southern Ontario. Jerry is a nationally recognized leader in the ecological restoration movement, and has served as the Midwest Board representative in the Society for Ecological Restoration. Prior to joining Conservation Design Forum in January, 1996, Jerry was employed for 22 years as a research taxonomist with the Morton Arboretum in Lisle, Illinois.

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URBAN INITIATIVES ON THE ILLINOIS RIVER: A CHICAGO EXPERIENCE OF THE CHALLENGES AND SOLUTIONS

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I consider myself an urban ecologist. What does that mean? Aren't "urban" and "ecology" fundamentally contradictory? No. What it means is that I accept the concept of cities and love what they provide, though I believe that that can be much more environmentally friendly. I believe that the duality of urban ecology is something most people can understand and accept and that most people are not simply "environmentalists," or "city people," or "farmers," or "polluters." Usually, people are more than one thing. It is the ability to blend disciplines, perspectives, values, and strategies that characterizes urban ecology, and urban river initiatives today, particularly on the Chicago River waterway. It is within this arena that Friends of the Chicago River does its work.

What I would like to do today is lay out for you the urban challenges and urban solutions undertaken by Friends of the Chicago River. To paraphrase Stephen Covey, the author of the 7 Habits of Highly Effective People, all things are invented twice – once when they are planned and once when they are executed. Likewise, Friends' work is a constant shifting between these two stages. So, what I will share with you today is a blend of ideas, philosophy, plans, on-the-ground projects and experience.

Addressing urban river issues requires addressing four themes that describe the parameters within which our work must be accomplished. These themes set the stage for our work and describe the limits and constraints that we face, as well as the opportunities. What I will do today is describe these parameters and how Friends responds to them. These four parameters are (1) physical constraints, (2) social and cultural barriers, (3) chronic, systemic, intractable problems, and (4) questions of vision for what urban waterways can and should become. Let me elaborate on these.

PHYSICAL CONSTRAINTS

1. Our river is largely inaccessible, hidden behind fences and driven over in a flash. It has been channelized and in many locations sits about 15 feet below grade, making physical access down steep banks difficult and also limiting visual access. Often you can't even see the river.
2. Our river channel itself is hugely modified—deepened and straightened with steep banks uncharacteristic of natural northeastern Illinois. Some would say these banks will never be restored to their pre-settlement condition. They are probably right. In-stream habitat has largely been removed, except for debris that is there now.

3. The water in our now straight prairie river moves slowly and is subject to occasional high nutrient loads. Natural aeration is limited, so even though our water has improved dramatically local fish populations are constrained by low dissolved oxygen.

SOCIAL AND CULTURAL BARRIERS TO CHANGE

Unless we address social and cultural barriers, I believe we have little chance of long term, sustainable success. These are some of the prominent ones:

1. People have no basic knowledge of their connection to their river or water supply which, I believe, dampens incentive to be good stewards of the River.
2. The reputation of the river dominates the reality and limits concern for and stewardship of the River. Many people still think of our once-natural river as dead and worthless. It is even dyed on St. Patrick's day, memorializing the time when our river was near dead and so foul that dying it was an improvement. I have been out to the River on St. Pat's Day and spoken to the kids hanging out by the River. In general they have two responses when asked what they think about the green dye. First, they want to know how bad it is. Second they say, "they wouldn't do it if the river wasn't dead, would they? Nothing lives in there, right?" In my mind the dying of the river perpetuates the reputation. A 1994 study by the Army Corps of Engineers showed that what people want most for the river is clean water.¹ One can infer from this finding that a) they still think the river is pretty bad, or b) that the significant improvements to water quality in recent years have either not been ample enough, or c) that the improvements have not registered in the public conscience. I am inclined to think it is the latter. Perceptions die hard.
3. Economic goals guide many river initiatives. To many the river is an economic resource first and foremost. Attaching economic priority to River activity shapes the types of river initiatives that will or will not work.
4. The people and communities along the river are remarkably diverse. Some of Chicago's most ethnically, racially, and economically diverse communities are along the river. I believe if we are to make a difference in our river over the long run we need to involve the full spectrum of Chicago communities in its revival. The question is how to do this when many of these communities have other pressing issues such as education and employment.

CHRONIC, SYSTEMIC AND INTRACTABLE PROBLEMS

Certain conditions facing our urban river are a given, at least for the foreseeable future. Despite our best efforts they are fixed, or they re-occur, or perhaps we don't even know how to address them. They are part of the bigger picture within which we work. Among these are:

1. Economics of river edge property. River edge real estate in Chicago has become increasingly valuable. As a result, it is unlikely that we can get typical riparian setbacks and buffer areas (100 feet or so). Landowners want to be able to develop as close to the river edge as possible. So, even if the city and environmental agencies establish as a goal

¹"Resident Use and Perception of the Chicago and Calumet Rivers," by David Wallin, U.S. Army Corps of Engineers, 1994. Page 36.

the improvement of natural habitat in and along the river, we have to find ways to do this in a more or less confined space.

2. Sediment. We have it and much is contaminated. But, for the time being we have no where to put it and nobody stepping forth with a real need to dredge.
3. Hydrology that is hugely unnatural. Most of our watershed could be more aptly described as a sewershed. Our flows are "flashy." In some cases up to 70% of the stream flow is treated effluent. The North Branch Watershed Project, a collaborative effort lead by Friends and the Lake County Storm Water Management Commission and funded by the IEPA documented more than 900 outfalls in our upper watershed.
4. A political structure that is not set up for linking river communities and other stakeholders in joint decision making and collaborative projects. As you know, rivers don't acknowledge political boundaries.
5. Finally, there is never enough money and never enough time. Sometimes it seems to me that our river is an endless list of projects. To be involved in the Chicago River is a long term commitment. I believe we need to be thinking 25 or 30 years down the road and setting long term goals and developing long term visions.

QUESTIONS OF VISION

1. What our river can and should become is not always clear. Most environmental efforts use pre-settlement conditions as their target. Our River, an uncommon prairie stream discharging into a Great Lake was lost before it was studied, before "ecology" was practiced, so we have little guidance as to where to set out target. Moreover, even if we knew clearly what the pre-settlement Chicago River was like we could hardly achieve it in our big city/ suburban landscape within our lifetimes. What river should we then aim for?

So these are the parameters that define the world of Friends' work. What programs has Friends undertaken to respond to and work within these parameters? Here's how:

PHYSICAL CONSTRAINTS

1. Create access. One of Friends goals since our founding in 1979 has been public access to the River. We have fostered access through guidelines for downtown development, and through advocacy for city ordinances requiring that river edge developments receive special review. Included in these guidelines are provisions, for example, to lower the height of the revetments along the river and regrade river banks, so that people can get to the water. (Recently, in response to this position the city built a new river park and lowered the wall on the edge of the river bank by several feet.) Clearing brush from the river edge together with our volunteers and community partners also helps to provide visual access. Another project, the Gompers Park Wetlands, was constructed next to the river but higher than the river, at grade. In this sense, rather than building down to meet the river's level we are, in a sense, bringing the river up to overcome its physical location so low below grade.
2. Enhance habitat. Our urban rivers can be vastly habitat enhanced. Water quality has improved, and it is time to catch up to these improvements with habitat. In an old barge turning basin where not a barge has been seen in years, there are wetlands plant returning where the basin has filled with sediment. Wading birds and amphibians are there. At this

location, we are constructing a marsh habitat together with the US Fish and Wildlife Service and residents of the local community.

3. Accept modest levels of restoration for the incremental change that they provide. On our steep banks we have been working with local communities to establish native plants and create trails. The activities, while having only modest environmental value, bond people to the river as an important feature of the city and their lives. And while some may call them simply landscaping I see them as more than that – I see them as a form of social change. They help reach audiences that might not immediately be engaged by environmental priorities. They lead to other benefits. I have seen one bank planting project lead to broader community understanding of the River, landscaping with native plants, and citizens getting involved in advocacy for river issues, all of which are good for the river. A native plant garden on a degraded river bank provides a vehicle for other watershed improvements.
4. Creative Engineering. We have some creative engineers at our Metropolitan Water Reclamation District. They designed river aeration stations that put oxygen back in the water. They used a creative approach that also saved money. In our urban area where physical constraints are cannot easily be changed, engineering provides great promise.

SOCIAL AND CULTURAL ISSUES

1. Educate people about their river. To tackle education and awareness Friends initiated the Chicago River Schools Network (CRSN) in 1994. By linking the programs of numerous government agencies and civic groups, the CRSN recruits, trains, and assists teachers so that they can meet their state goals while using the river in their curriculum. We now have more than 140 teachers in the Network. I believe watershed protection will get a lot easier when everyone knows where their water comes from and goes. Its a simple big picture goal.
2. Engage people as stewards. Our more practical goal for the CRSN is to effect change in the river by helping the teachers and their students engage in action projects - water quality monitoring, cleanups, advocacy and changes in their own behavior at home that can improve the River. In doing so we also hope to foster changes in individual behavior.
3. Change perceptions. We deal with the infamy of the river and its awful reputation by taking people to see the river. A developer that sees a great blue heron has a new understanding of what it means to plant river edge vegetation. People who canoe on the river find that is wonderful despite its past and present problems. Our river has cleaned up to a point where they see it as a hidden gem in the city. In addition, they gain an appreciation and understanding for sewage treatment projects like our Deep Tunnel and the need for public funding. Every year we take thousands of people on river trips, including about 800 that we take canoeing.
4. Engage diverse communities by embracing a range of goals. Our canoe trips are lead by guides trained through our U-CAN (Urban Canoe Adventures) program. This program is an example of the way we engage communities that might not be able to enjoy the river or participate in its revival. Guides are recruited from city schools and clubs. They receive training in paddling, water safety, first aid, public speaking, river history, and ecology. Then, after completing the training, they run trips. After eight trips guides receive a modest stipend. By providing what amounts to job training and a summer job, Friends is able to involve young adults from rich, poor, and ethnic communities inn the river. Similarly, at a public housing development on the river where we are doing restoration work, we also made it a priority to launch a programs that would create jobs. This was done through a partnership with the City of Chicago called Chicago Greencorps, which employs people who were formerly out of work

to do river restoration, greening, and access creation. By including jobs creation in its goals, in response to community need, and by forming partnerships with other agencies skilled in this area, Friends has been able to expand its river constituency.

5. The fact that our river is so heavily valued as an economic resource has created certain realities and opportunities for our organization. By embracing and advocating downtown redevelopment and economic revival, Friends has developed a reputation as a group that supports business and that business supports. This has helped us build a strong organization which is necessary if we are to stay in the river improvement game for the long haul. In the last year we have begun two river restoration projects with large corporations that own property on our North Branch. If our approach to business and economics were different, or even non-existent, we would probably not be able to launch projects such as these. I believe our approach fills one necessary niche in the larger environmental movement.

CHRONIC, SYSTEMIC AND INTRACTABLE PROBLEMS

I wish had new insight on problems like contaminated sediment and altered hydrology, but I don't. I guess that's why they are intractable. Nonetheless, I believe we can come closer to solutions by applying a few principles that have worked to address other issues. These principles are:

1. Demonstrate the experience of partnership and success. One systemic problem is government structure that is just not conducive to the joint planning, resource sharing and collaboration that is needed for watershed protection. Our approach to this has been to demonstrate collaboration and give people the experience of partnership. Our belief is that if they do it once, if successful, they will do it again, even on a larger scale. This has been our experience with the Prairie Wolf Slough Wetlands. From this collaborative project involving a handful of partners grew the North Branch Watershed Project, a model project for the state funded by the Illinois EPA. More than 24 municipalities and agencies are now participating in this effort to address non-point source pollution, flooding, and other problems of urban waterways.
2. Be flexible and "Go for the Light." The problem of resources (never enough time or money) is addressed by our "go for the light" philosophy. Every where you turn on our river is another potential project. Friends works on the ones that have citizen leadership, government partners, funding, and that stand a good chance of getting done. During the real estate boom of 80's we spent a lot of time on economic redevelopment downtown. When the real estate markets declined but flooding became more important in the late 80's and nineties we turned our attention to the North Branch of our river where these were significant problems. Our willingness to work on a variety of issues with a variety of partners has also helped us address the vicissitudes of funding that so often plague non-profit organizations.
3. Involve citizens and do on the ground projects. Friends believes that citizen involvement is crucial to the success of projects and necessary if we are to translate watershed principles into public understanding. Having citizen participation adds media presence, enhances that feel good part of your projects and work, develops heroes who will be long term stewards, and provides a voice for funding support. We believe that on-the-ground projects are the most successful tool for maintaining and developing partnerships.
4. Use creative design. To address real estate values that inhibit our access to land that could be used for habitat enhancement, last year we invited designers from around the country to see how we would install green, habitat enhancing river edges on narrow strips of river bank. This

year, with help from the Army Corps of Engineers, several demonstration projects will be installed by the City of Chicago.

RANGE OF VISION

Finally, to address the question of vision, Friends:

1. Develops and tests ideas. One tool we have used since our earliest days in the late 70's is the design charette, a convening of people with maps and pens to study and design alternatives for the River. Last year we held design charette to help generate ideas about what to do with our river banks in the city. These banks have been lined with concrete, steel and wood pilings that are now crumbling. When these banks are rebuilt, can they be rebuilt in a more natural fashion? Friends brought design professionals from many disciplines into Chicago to answer that question and they have created a series of test designs and guidelines for the restoration of river banks on deep draft waterways. Some of these designs will soon be implemented as test projects by the city of Chicago with fund support from the Army Corps of Engineers.
2. Start dialogue on vision questions. The vision for our river's water quality is one that needs to be clarified. Visions are provided by the Clean Water Act, and are implied by regional and local plans. Nonetheless there seems to be a disconnect between regulatory prescriptions for our river and the existing visions. Much of our waterway system is designated as "secondary contact" under our state regulations. Nonetheless, near my house I see many people fishing the river throughout the year, often for consumption. People are talking of swimming in the river. The City of Chicago's new River Plan calls for a river that supports canoeing, kayaking, and fishing. This implies a river that smells good, looks good, and supports wildlife and the occasional flipped kayak. Now that our water quality has improved discussion of how we get to the next step needs to be held. Through conferences, meetings, lunches and in elevators and with our friends, members and elected officials Friends is raising the question - should designation of our river and the standards associated with that designation be changed? Gentle advocacy on this issue, to start the dialogue, for the time being, seems to me an appropriate tool for getting at this difficult question of vision.

In conclusion, addressing the problems of urban rivers - whether they are related to vision, or are intractable and chronic, or social and cultural - requires, at this point in time, the ability to tolerate and work with ambiguity. We do not yet have answers. We must be willing to try new strategies. It also requires patience. It will be many years before we seem some problems resolved or even simply addressed. Until we can insert a stewardship ethic and a new relationship to water into our daily lives, we will not be able to fully address many problems. But we can soften damage, do some healing, restore some natural quality, and improve peoples' lives if we are determined, willing to accept a balanced approach that respects differences, and define our work and successes broadly. Finally, addressing urban river issues requires a vision for the future - one that I suggest we set high, so that future generations will enjoy, love, and benefit from our river heritage. We are just at the beginning of the long work of addressing and resolving the challenges of urban waterways.

**UPPER MISSISSIPPI RIVER-ILLINOIS WATERWAY SYSTEM NAVIGATION
STUDY: FEASIBILITY STUDY**

Gary L. Loss

U.S. Army Corps of Engineers
Clock Tower Building, P.O. Box 2004, Rock Island, Illinois 61204-2004

The \$55 million feasibility is examining the needs for increased navigation capacity for the next 50 years on the Upper Mississippi River and the Illinois Waterway. Significant efforts have been expended in gathering impacts on the environment, on a site specific and systemic basis, and also, in examining the economic justification for small and large scale measures. Innovative engineering and construction techniques have been developed that could be incorporated into the recommended improvement measures. The feasibility study was initiated in 1993 by the Corps of Engineers and will result in a final recommendation to be released in December 2000. Extensive coordination with numerous agencies, environmental groups, industry and the public has been underway throughout the study.

ECONOMIC IMPORTANCE OF LEVEE AND DRAINAGE DISTRICTS

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ABSTRACT

Levee and Drainage Districts are political subdivisions of their respective States. Similar to municipalities, districts have the right to assess property, the right of eminent domain, and are governed by local elected representatives. The purpose of district organization by landowners is to work together to meet certain local needs. Needs include construction and maintenance of interior drainage, pump station and/or natural drainage outlet maintenance, and local flood protection. Property owners inside the district pay land assessments to cover the cost of improvements. Drainage Districts share many public-private responsibilities. Responsibilities include maintenance of the levee systems along our navigation system. Many of the locks and dams along the Upper Mississippi and Illinois Rivers tie into existing drainage district levee systems. Without the districts, navigation pool elevations could not be maintained. Drainage Districts often operate and maintain interior sedimentation basins, reducing sediment into both the drainage system and the river system. In many situations, the entire district acts like a large detention basin. Pumping rates are typically less than one inch over the watershed in 24 hours, greatly reducing runoff rates. Economic benefits include agricultural flood damage reduction and protection of critical infrastructure—roads, railways, water, and wastewater treatment facilities. Environmental benefits include reduction in sedimentation, reductions in runoff rates, and maintenance of water elevations in interior wetland and wildlife conservation areas. The economic benefits of a local government working with state and federal government initiatives far exceed state and federal buy-outs. Levee and Drainage Districts can greatly enhance the regional economic health. Levee and Drainage Districts provide an economic development tool to help promote improvements to all three major river basins needs: Navigation, Flood Control, and the Environment.

PRESENTATION

Objectives

I would like to spend the next few minutes discussing Drainage Districts, some historical background, how they function, and why they are important. I will specifically be addressing districts in Illinois along the Mississippi and Illinois Rivers, districts with levees and pumping stations.

Specific objectives include:

- Improve understanding of why and how districts were formed.
- Issues of public health concerning waterborne diseases.
- How districts can reduce sedimentation and runoff.

- How districts protect our critical infrastructure.
- How districts play an important role in economic development.

History and Formation

Drainage and levee protection is nothing new in this country. In 1743, under King Louis XV, an ordinance was passed requiring landowners in Louisiana, along the Mississippi, to participate in levee maintenance. If landowners did not provide proper maintenance, they would forfeit their property. When the State of Illinois was established, the Illinois constitution in 1818 authorized "internal improvements" including drainage.

The Swamp Act was passed by the U. S. Congress in 1850 as a response to health concerns – chills, fever, and ague (malaria) plagued the Midwest. The Swamp Act encouraged drainage for public health. However, large-scale drainage did not become cost effective for another 25 years, until improvements in steel plows and drainage tile developed. In 1878, an Illinois constitution amendment clarified organization of Drainage Districts. Over the next 40 years, 1880-1920, virtually all the Drainage Districts we have today were organized and constructed.

What is a Drainage District?

Districts are a political subdivision of the state. They are an organization of landowners for the purpose to construct and maintain infrastructure, to improve drainage and provide flood protection. Districts are also involved in settling basins and upland reservoirs to reduce erosion and collect sediments and have the right of eminent domain.

How Do They Fund Improvements?

- Assessments are spread within the district boundaries and are similar to taxes. Assessments are typically levied per acre, although a few are by property owners.
- Require cost/benefit analysis and are court approved, including court hearings.

District officials have numerous statutory obligations and responsibilities. Levees were originally built privately. However, with improvements to the navigation system in the 30s, public/private responsibilities were established. Districts were required to maintain the landside of the levees. Responsibilities include:

- Maintaining ground cover;
- removal of burrowing animals;
- repair erosion – non-mainstem river; and
- maintaining drainage structures.

In addition to levees, many districts have floodwalls and closures. Railroads utilize the flat topology of districts as well as many state and federal highways. R.R. closures are inspected annually. Closures require annual inspections to verify workings and check for settlement. As a result of the Locks & Dams built in the 1930s, many gravity drained districts required pumping or increased pumping. District officials check conditions on pump stations, check for settlement and keep the facilities clean. In the Upper Mississippi Valley, they also provide all fuel, operation and maintenance expenses. Local land assessments pay the operation and maintenance expense.

When districts were organized at the turn of the century, plans of reclamation were filed through the courts. Ditches and drainage must be maintained in accordance with the court approved plans. Responsibilities include maintaining channel capacity and sedimentation removal, along with erosion and bank repair.

Land Use

Riverside drainage districts make-up approximately 3% of the state. Approximately 550,000 acres along the Mississippi and 215,000 acres along the Illinois River are inside levee and drainage districts.

Land cover, state-wide, is primarily agriculture, with over 80% in cropland or pasture. Remaining land use includes: 12% forested, 4% wetlands and 3% urban. (1994 DNR land cover information.)

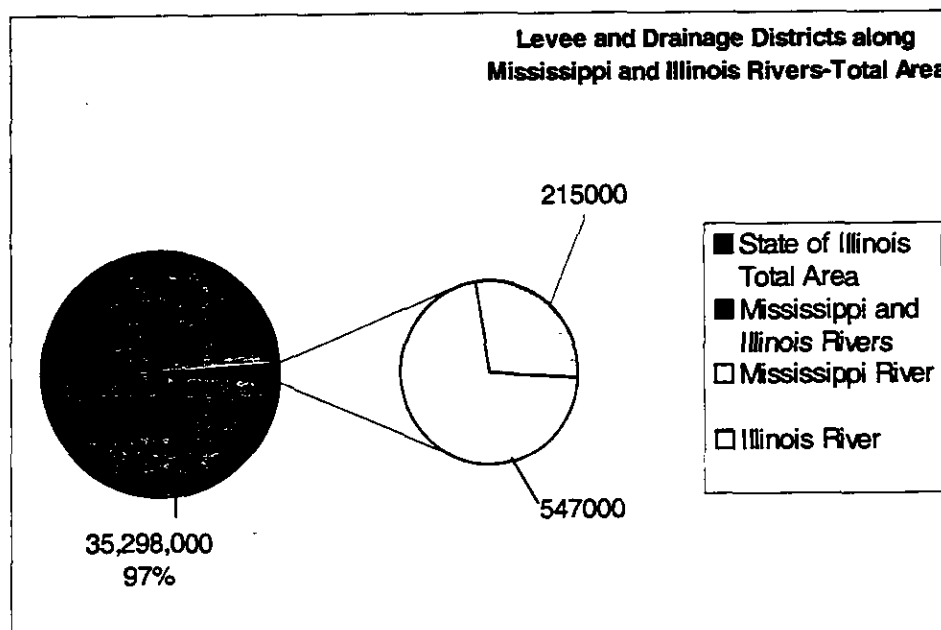


Exhibit 1. Illinois land inside riverside drainage districts.

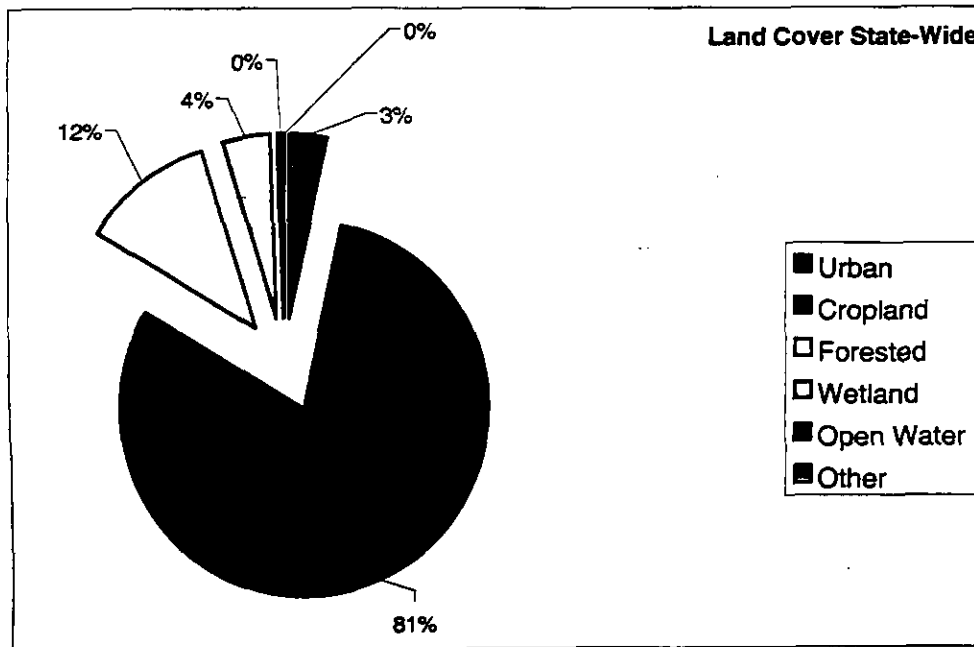


Exhibit 2. Land cover -- state-wide.

Along the Mississippi River, land inside drainage districts are more diversified than the state averages: 77% is cropland, 3% forested, 12% wetland, 1% open water and 7% urban. Along the Illinois River, less than state averages exist, with 89% in cropland, 4% forested, 3% wetland, 2% open water and 2% urban.

Land Value

How does land value differ in drainage districts vs upland areas and why are districts so attractive for farming? Recent land values in the Adams County area are as follows:

Exhibit 3: Land value.

Source: Balke Agri-Service, 10/99.

Bottomland

Prime Farmground	\$3,500/acre
Good Farmground	\$2,000-2,500/acre
Timberland/Wetlands	\$1,000-1,400/acre

Upland

Prime Farmground	\$1,500-3,200/acre
Good Farmground	\$1,500-2,500/acre
Timberland/Wetlands	\$800 - 1,200/acre

After the great flood of 1993, the Integrated Floodplain Manager Review Committee (The Galloway Report) evaluated the feasibility of relocating farming operations. What they found is what any local could have told them: Farming in the floodplain makes economic and environmental sense.

1. Corn-fields in well drained floodplain uniformly average 15% higher than state average in Missouri
2. High yield upland areas are presently in full production – any additional production in upland areas would be in areas averaging 14-26% lower than average well drained flood plain yield.
3. Additional wetlands do little on flood volumes in events over a 2 to 5 year event, and basically no benefits on events over a 25 year frequency.

In studies by Hirschi in 1999, expected net returns were highest for crops of corn and soybeans. Returns use 2.44/bushel for corn and \$5.86/bushel for soybeans. Prices are converted to real dollars using the Producer Price Index. Expected net revenue was analyzed for different levels of flood protection.

Exhibit 4: Expected net returns, Hirschi.

Protection Level	Crop Insurance Yield Coverage	Expected Net Returns	Late April Corn	Early May Corn	Early May Soybeans	Late May Soybeans	CRP/ WRP
200	0%	\$194.24	27.75%	22.25%	31.5%	18.5%	0%
100	0%	\$191.57	27.75%	22.25%	31.5%	18.5%	0%
50	0%	\$186.04	27.75%	22.25%	31.5%	18.5%	0%
25	50%	\$176.42	27.75%	22.25%	31.5%	18.5%	0%
10	65%	\$152.52	27.75%	22.25%	31.5%	18.5%	0%
5	50%	\$94.13	27.75%	22.25%	31.5%	18.5%	0%
2	N/A ¹	\$67.34	0%	0%	0%	0%	100%

Alternative uses were also evaluated by Hirschi: Timber, (bottomland forest), with cost of planting as subsidized by several programs were analyzed. Green Ash @ 30 year maturity provide an expected annualized net return in the range of \$30-65/acre/year. Hay and pasture were also less than corn at \$93.65 and \$20.11 per acre respectively.

Exhibit 5: Alternative land uses, Hirschi (1997).

Activity Type	Market Value per acre	Comments
Timber Sales*	\$50-\$111	High value species: Oak and Walnut Returns expected once every 50 years
Annual Deer hunting lease**	\$2-\$17	Higher value for white-tailed deer
Annual Goose hunting lease*	\$13-\$203	Higher returns for crops/water area combinations
*Terry Fisk, Farm manager, Freeman Coal Co. Canton, IL		
**Jim Raspis, Illinois Department of Natural Resources, Springfield, IL		

Environmental Partnerships

A lot has already been mentioned today on the importance of partnerships – many drainage districts represent over a 100 year experience in building partnerships.

- Landowners elect to govern themselves with the creation of districts
- Partnership with the Corps in the Upper Valley developed contractually in the 1930s
- Many other agencies partner with the districts.

For example, just this year Indian Grave District partnered with IDNR and Quincy Park District to create a 260 acre habitat area in Adams County, Illinois. Unfortunately, Drainage Districts sometimes get a bad rap. Farmers feel they are friends to the environment. The districts often provide:

- Sediment reduction, Greenways and habitats, and
- Erosion protection partnerships with NRCS and the Corps of Engineers as well as local conservation groups.

Some examples include the sedimentation basins in the Sny Island Levee & Drainage District – over 2,500 acres are set aside for sedimentation and beneficial reuse of the sediments for conversion back to farming. These are sediments not getting into our rivers. The entire district, in the Sny's case, are 110,000 acres that acts like a large detention basin. Less than 0.4 inches in 24 hours can be discharged out of the district due to sizing of the pumping station. Without the district, a large rain, during a wet period, would discharge directly into the river.

Critical Infrastructure

Districts protect critical infrastructure including, highways, bridges, railroads and water and wastewater treatment plants.

Data From the Corps of Engineers Floodplain Management Assessment indicates, over 600 critical facilities were impacted during the 1993 flood. Many impacted facilities were either in districts or access to the facilities was through districts.

Exhibit 6: Critical facilities, Corps of Engineers Floodplain Management Assessment.

Critical Facilities Impacted by the 1993 Flood (Midwest States)	
Critical Facility	Total
Municipal & Industrial NPDES	27
Superfund Sites	2
Landfills	2
Hazardous Waste Facilities	61
PetroChemical and Major Pipeline	105
Water Treatment Plants	13
Major Water Supply Intakes	24
Water Well Fields	69
Sewage Treatment Plants	4
Power Plants	16
Hospitals	2
Group Homes	0
Schools	142
Federal and State Bridges	112
Prisons	4
Airports	21
Fire & Police Departments	25
Military Installations	3
Communications Facilities	0
Post Offices	0
TOTALS	632

In Illinois, districts contain 13 ports on the Illinois and 18 on the Mississippi. Infrastructure includes 139 miles of U.S. Highways and Interstate; 277 miles of state highways; and 770 miles of railroads. Environmental areas include: 4,000 acres – fish and wildlife; 4100 acres of state parks; and 7,300 acres of state conservation areas.

Unfortunately, levels of flood protection in Illinois is typically only a 50 year flood frequency. In Europe, agricultural land is typically protected to more than a 500 year frequency and urban areas considerably higher. Economic impact in the Quincy area, due to losing the bridge between Illinois and Missouri, showed nearly 1.8 million per week, just in retail sales.

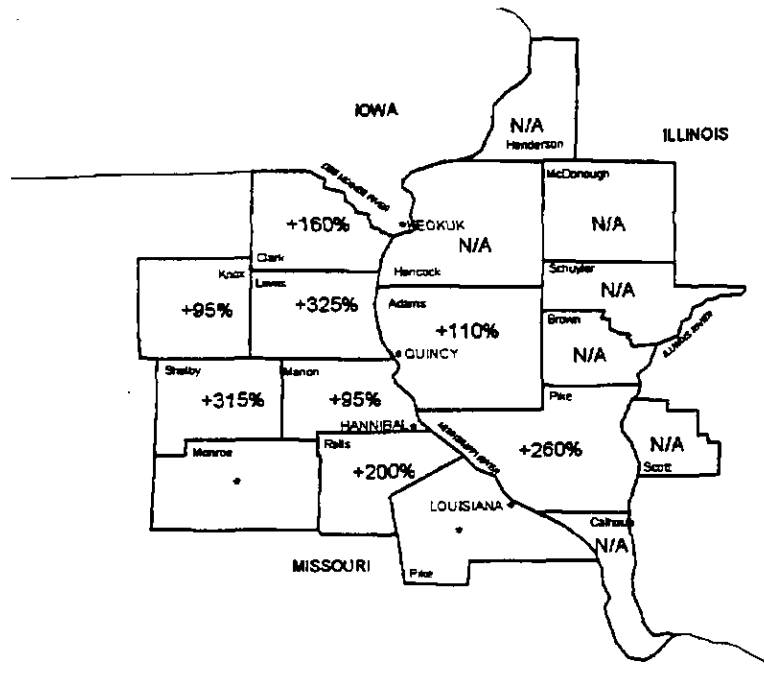
Exhibit 7: Bridge closings affecting Illinois residents, 1993.

Date Closed	Date Reopened	Bridge Closed	Highways Affected	Vehicles Daily
July 1	September 25	Quincy IL (Memorial)	U.S. 24	7,400
July 2	August 8	Louisiana MO	U.S. 54	3,750
July 2	September 22	Hannibal MO	U.S. 36	7,400
July 4	October 6	Alton, IL	U.S. 67	20,500
July 5	July 19	Keokuk, IA	U.S. 136	8,600
July 10	N/A	Ft. Madison, IA	IL Route 96	3,350
July 16	September 25	Quincy IL (Bayview)	U.S. 24	6,900
July 18	November 7	Hardin, IL	IL Routes 16/100	3,400
July 18	October 11	Chester IL	IL Routes 3/150	5,200

Sources: IIRA; Illinois Department of Transportation, "1991 Average Daily Total Traffic Map," State Primary System Map of Illinois.

We are seeing a major trend in commuting from the rural, smaller communities to urban areas for jobs. In the Quincy area, counties have seen between 100% to 300% change in commuters over the last 30 years. i. e., transportation is extremely important.

Exhibit 8: Percent change in commuters from Missouri to Adams County, Illinois and from Illinois to Marion County, Missouri, 1960-1990.



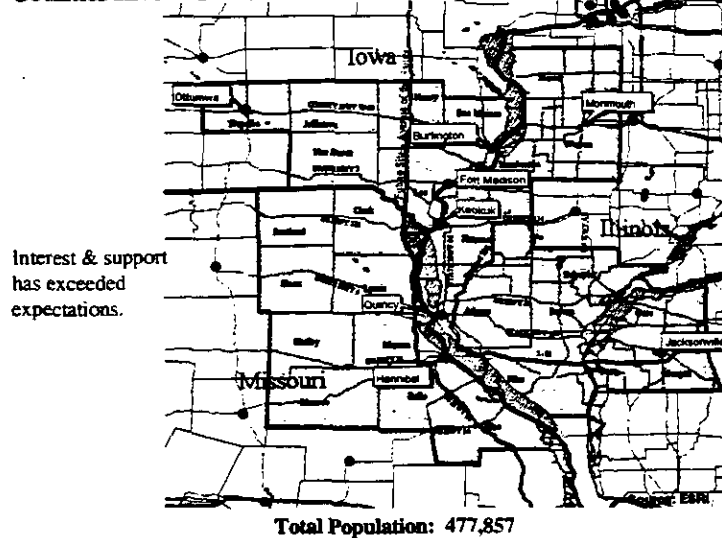
Economic Development

Finally, let's discuss how districts can help in economic development. An example is the Port Authority study for Western Illinois, resulting in state legislation in Illinois, Missouri and Iowa in the creation of a tri-state Port Commission. Plans involve identifying potential sites for intermodal facilities. Intermodal sites are areas connecting the 9 foot navigation channel to one or more railroads, and 4-lane highways.

Counties involved in the legislation include 11 in Illinois, 9 in Northeast Missouri, and 6 in southeast Iowa. They will also be looking into the feasibility of Foreign Trade Zones. Drainage Districts will play an important part to safe river access and development.

Exhibit 9: Mid-America Intermodal Authority, Port District Study – Klingner.

Counties Involved in States' Act for Mid-America Port Commission



Summary

In summary. Agriculture drives Illinois economy and Illinois Drainage Districts are a critical part to this economic engine.

In conclusion:

- Levee & Drainage Districts are important to the regional economy.
- Our current transportation network is dependent on L & D district's infrastructure.
- Levee & Drainage Districts can provide an economic development partnership in other non-agricultural uses.

ECONOMIC IMPACT OF AGRICULTURAL COMMODITIES ON THE UPPER ILLINOIS RIVER

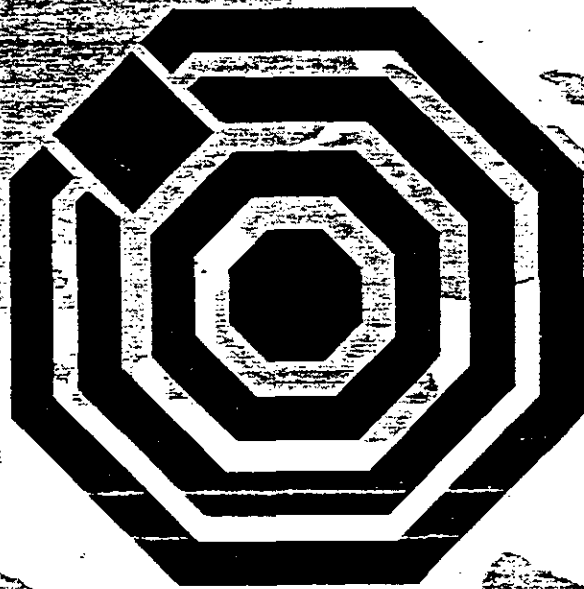
Thomas E. Jennings

Illinois Department of Agriculture
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E-mail: tjenning@agr.state.il.us

The Chicago Board of Trade has formulated and devised a proposal to change the corn and soybean delivery mechanism from the existing warehouse receipt system to shipping certificates at specific locations along the Upper Illinois River. The proposed Illinois Waterway Delivery System will simplify the grain delivery process and the delivery terms will reflect changes in the cash market and the natural flow of grain in the marketplace. Investment in maintenance of the Illinois River System is imperative to the success of the Illinois Waterway Delivery System and will compliment the functionality of the grain merchandising and marketing process.

The Illinois Water Delivery System offers enhanced price transparency which will efficiently operate in the current and projected natural flow of grain. In order for this system to be successful, the Upper Illinois River must be operationally dependable for the long term and be able to support delivery capacity in a flow market. The inherent flexibility of shipping certificates will potentially enhance the normal flow of grain to barge loading stations and represents a dramatic improvement in the existing system.

Chicago Board of Trade



The New Corn and Soybean Delivery System Beginning in 2000

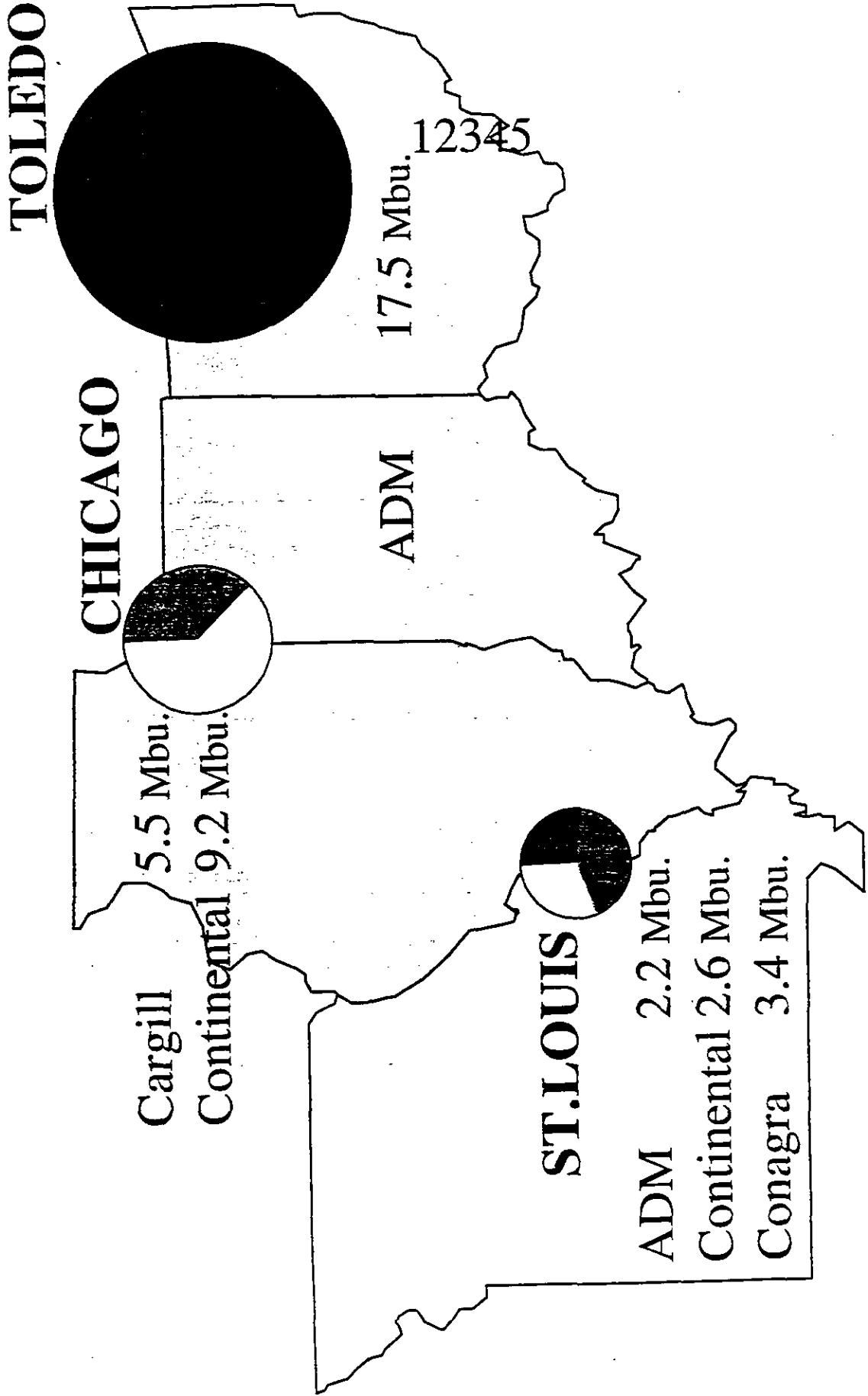
TASK FORCE DELIVERY CRITERIA

- Provide convergence of cash and futures
- Offer price transparency
- Be simple and easily understood
- Prices a marginal unit rather than pricing or tracking an average price
- Operates in the current and projected natural flow of grain
- Is operationally dependable and financially sound

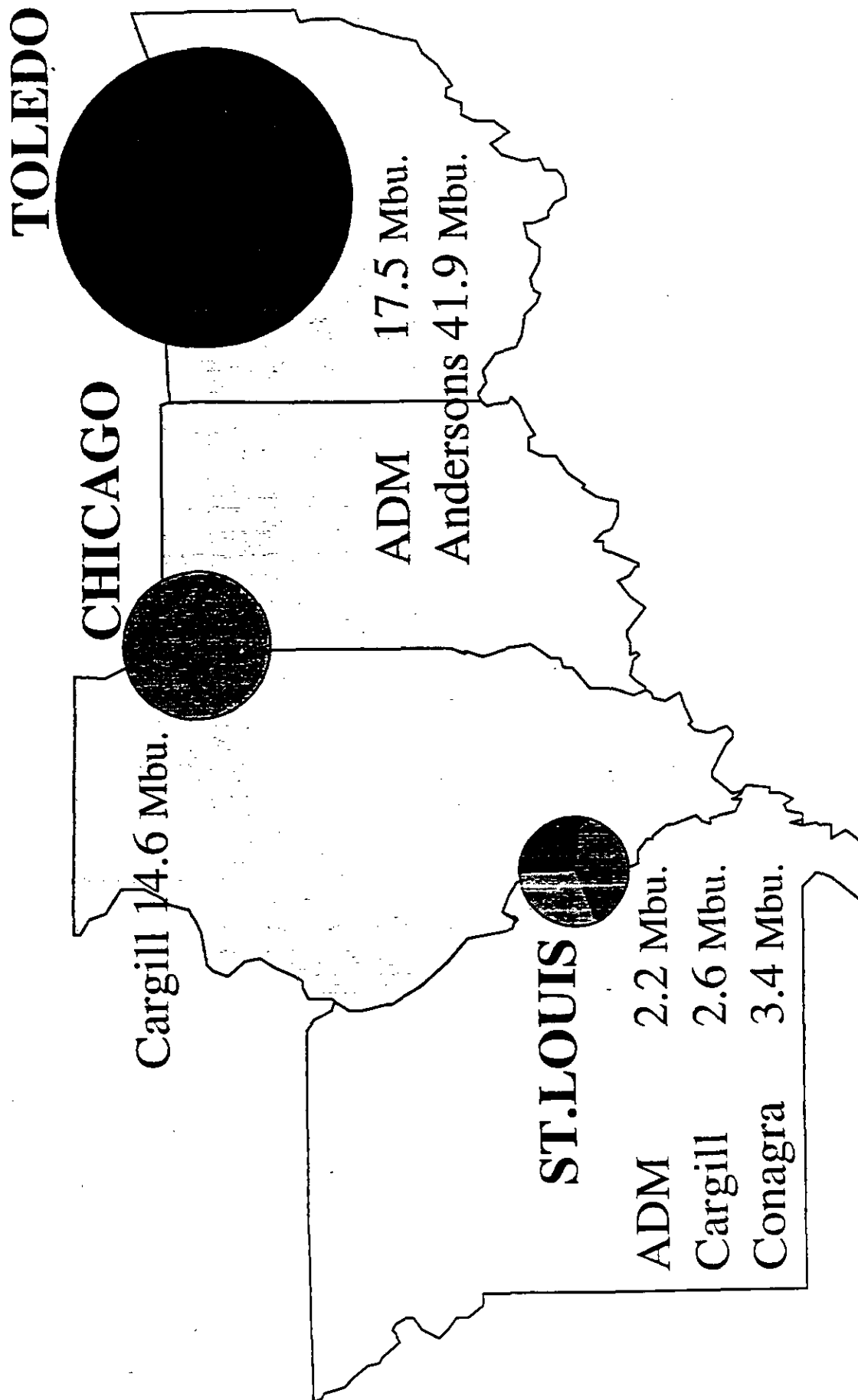
CONVERGENCE OF CASH AND FUTURES

- Single Central Unified Delivery
- Location in the major flow of grain
- Load-out Preference for Taker's
Barges
- Move the LTD to mid-month

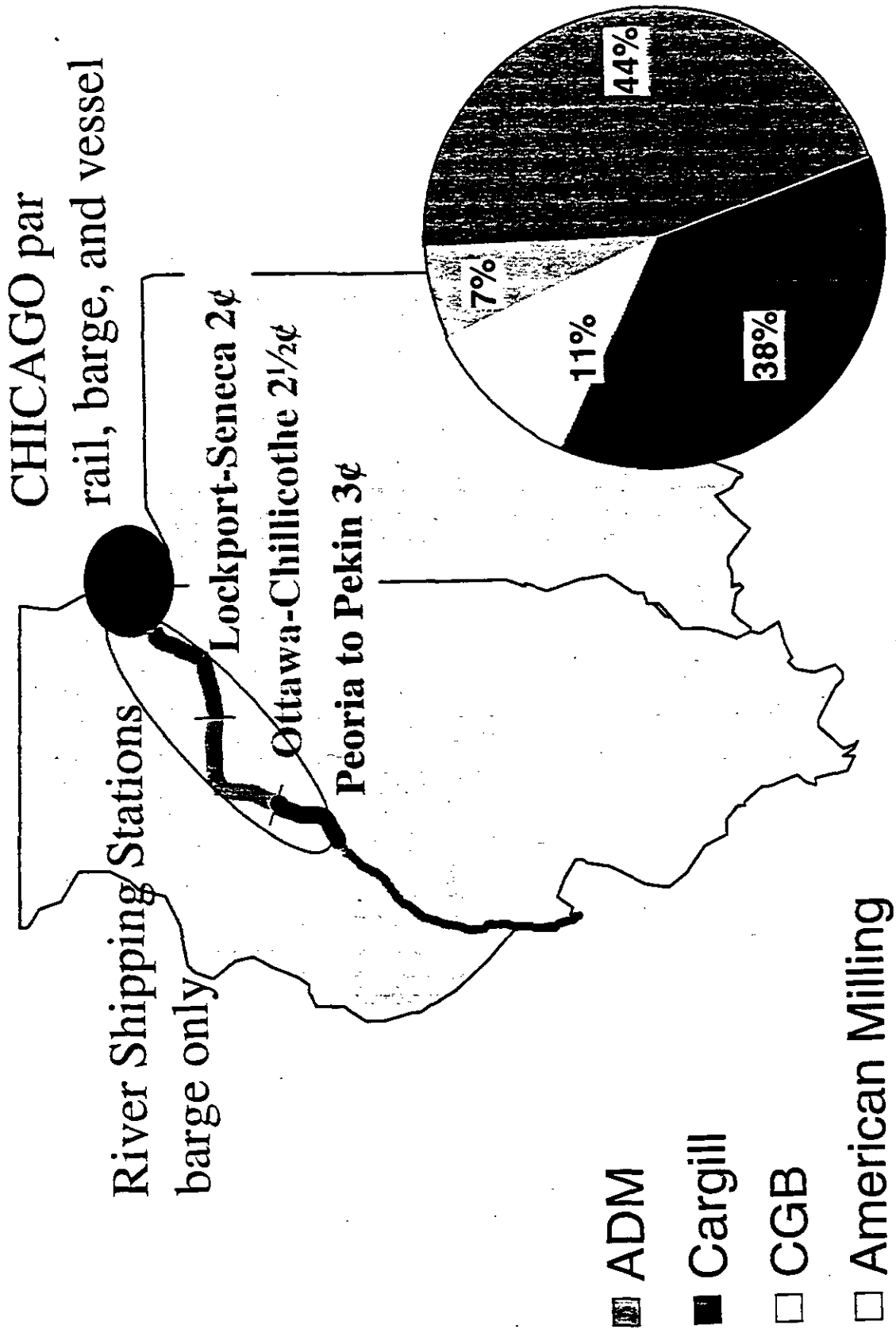
1998 DELIVERY LOCATIONS



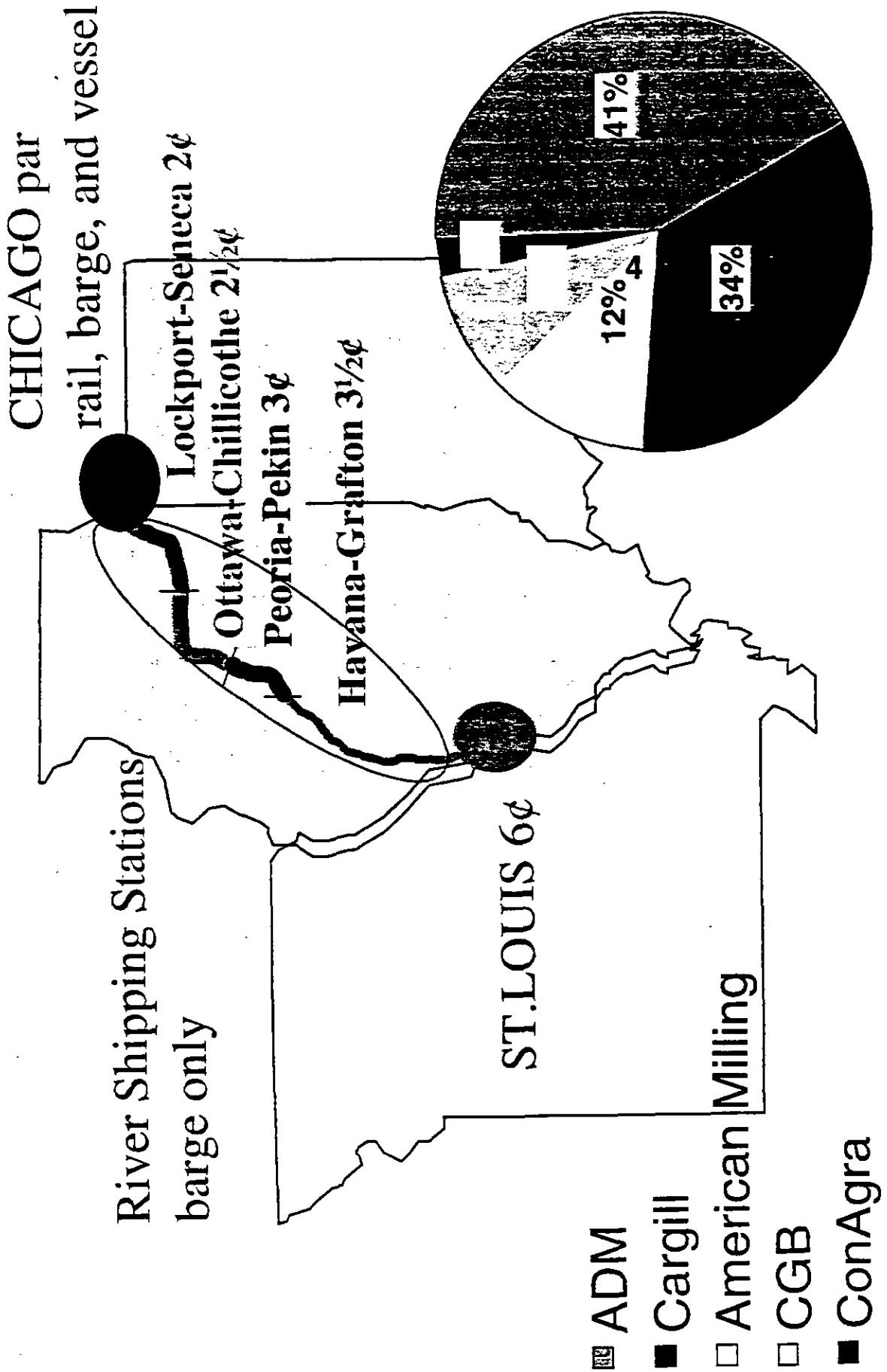
1999 DELIVERY LOCATIONS



2000 CORN LOCATIONS

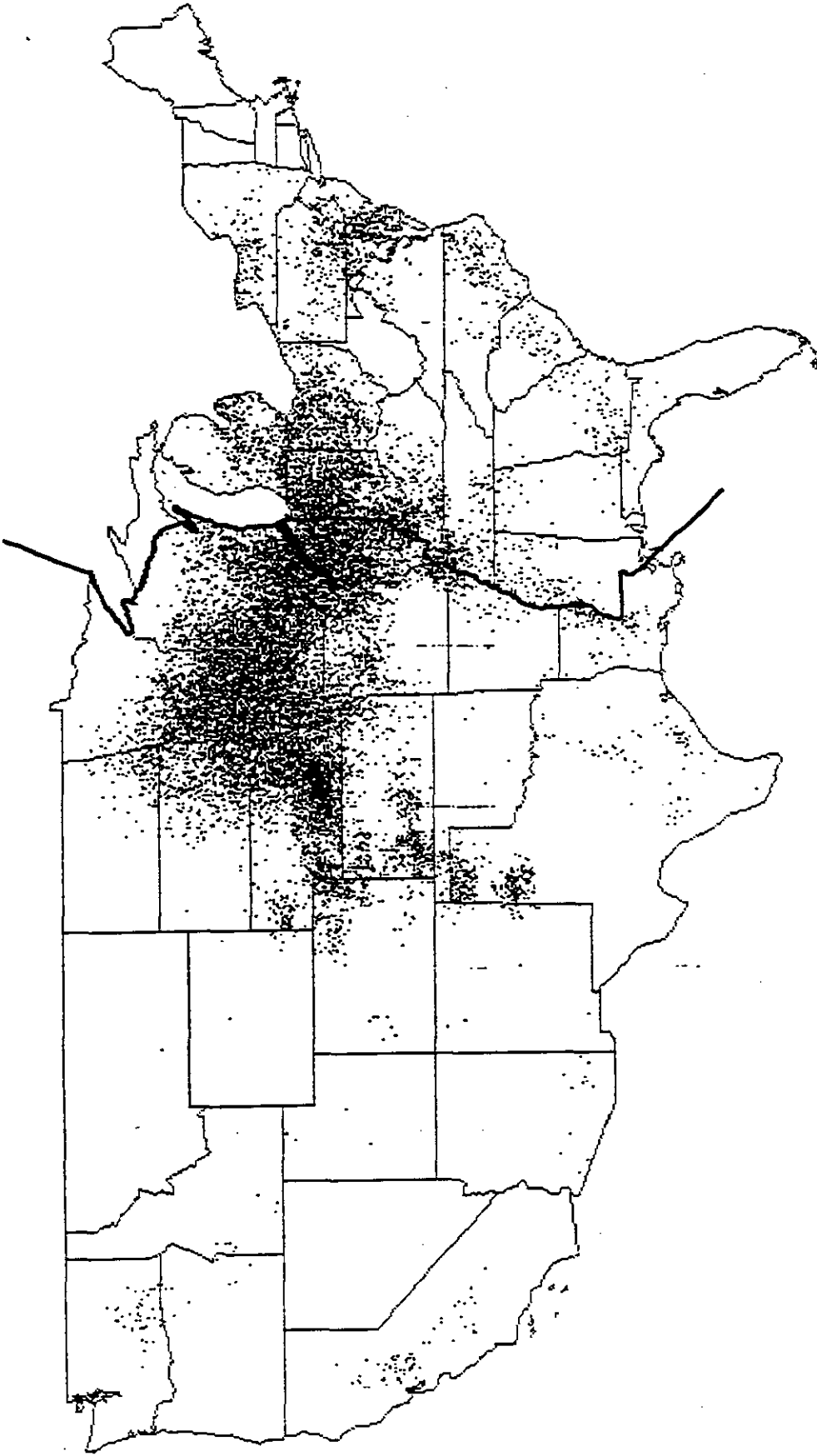


2000 SOYBEAN LOCATIONS



CORN PRODUCTION

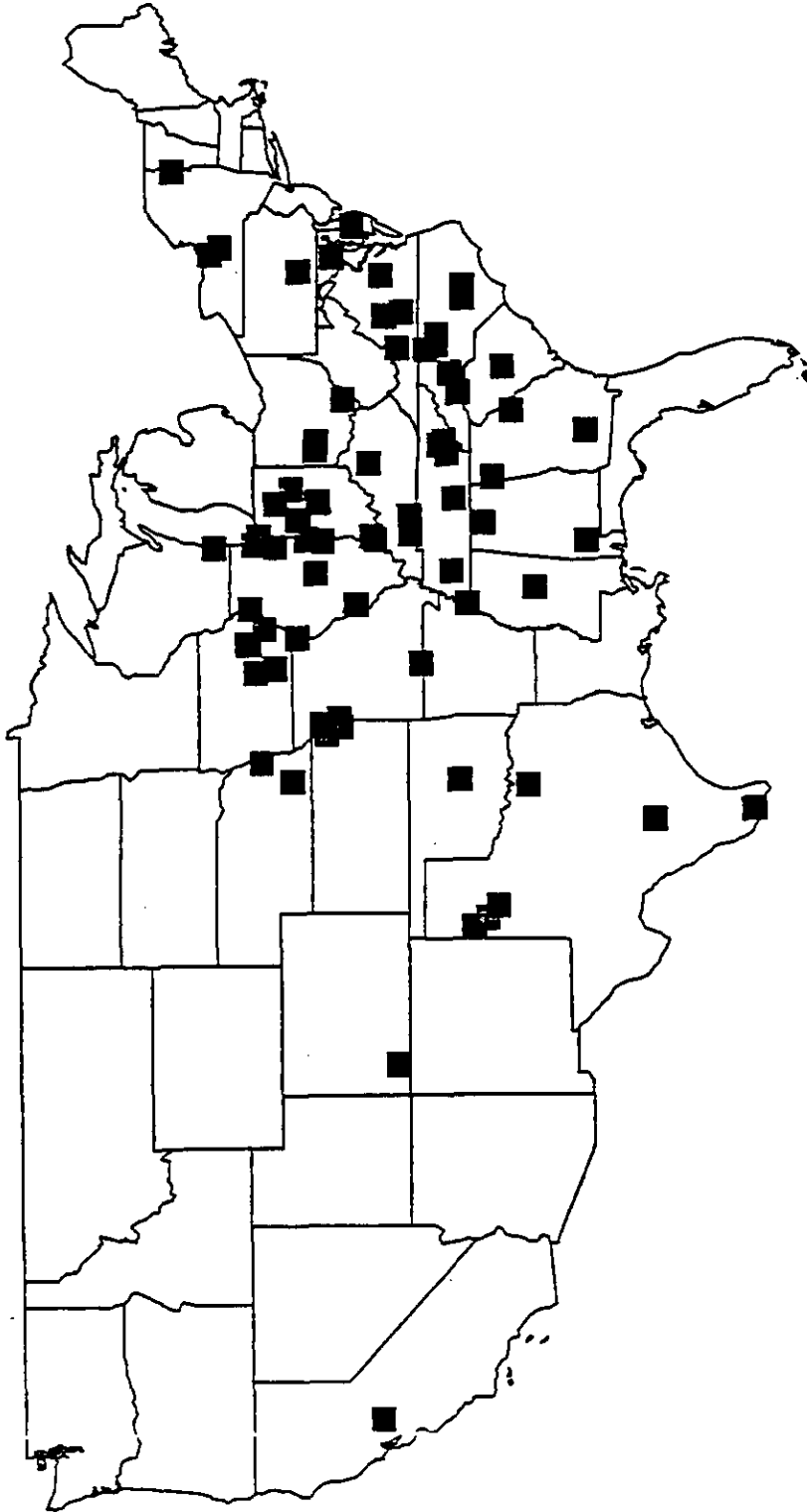
WESTERN U.S. & ILLINOIS w/ 78.3% EASTERN U.S. w/ 21.7%



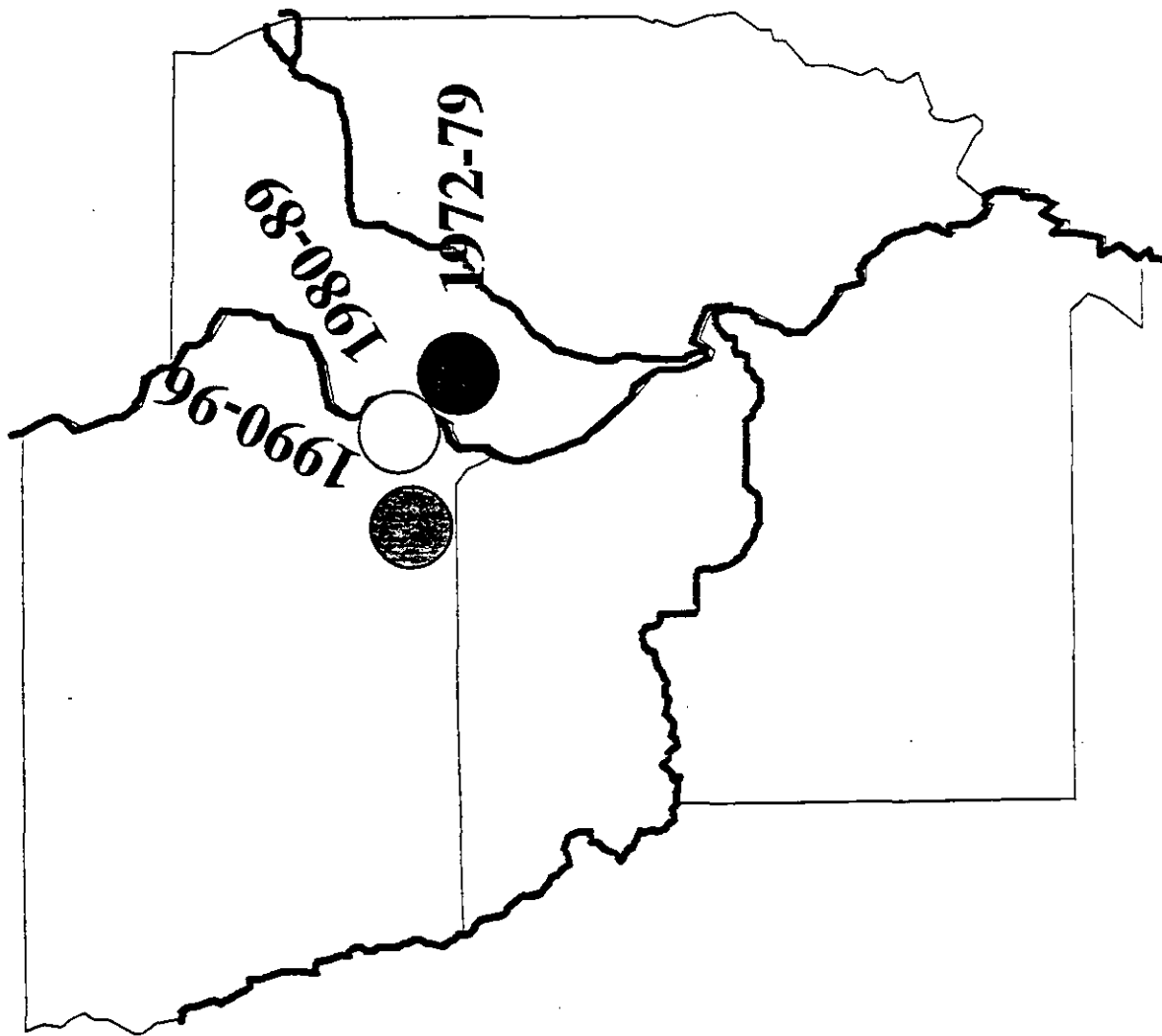
9,293 BILLION BU. IN 1996
1 DOT = 500,000 BUSHELS

SOURCE: USDA/NASS

CORN PROCESSING PLANT LOCATIONS

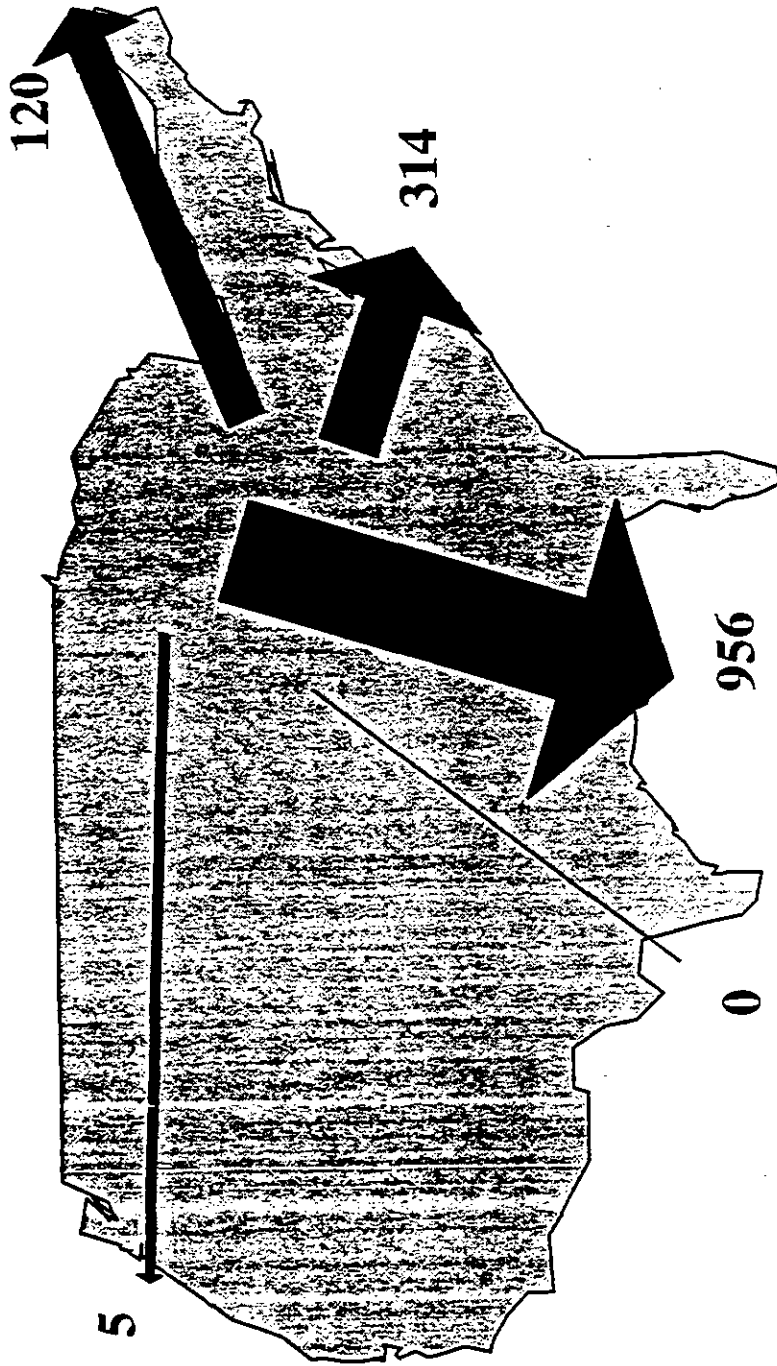


GEOGRAPHICAL CENTER OF CORN PRODUCTION



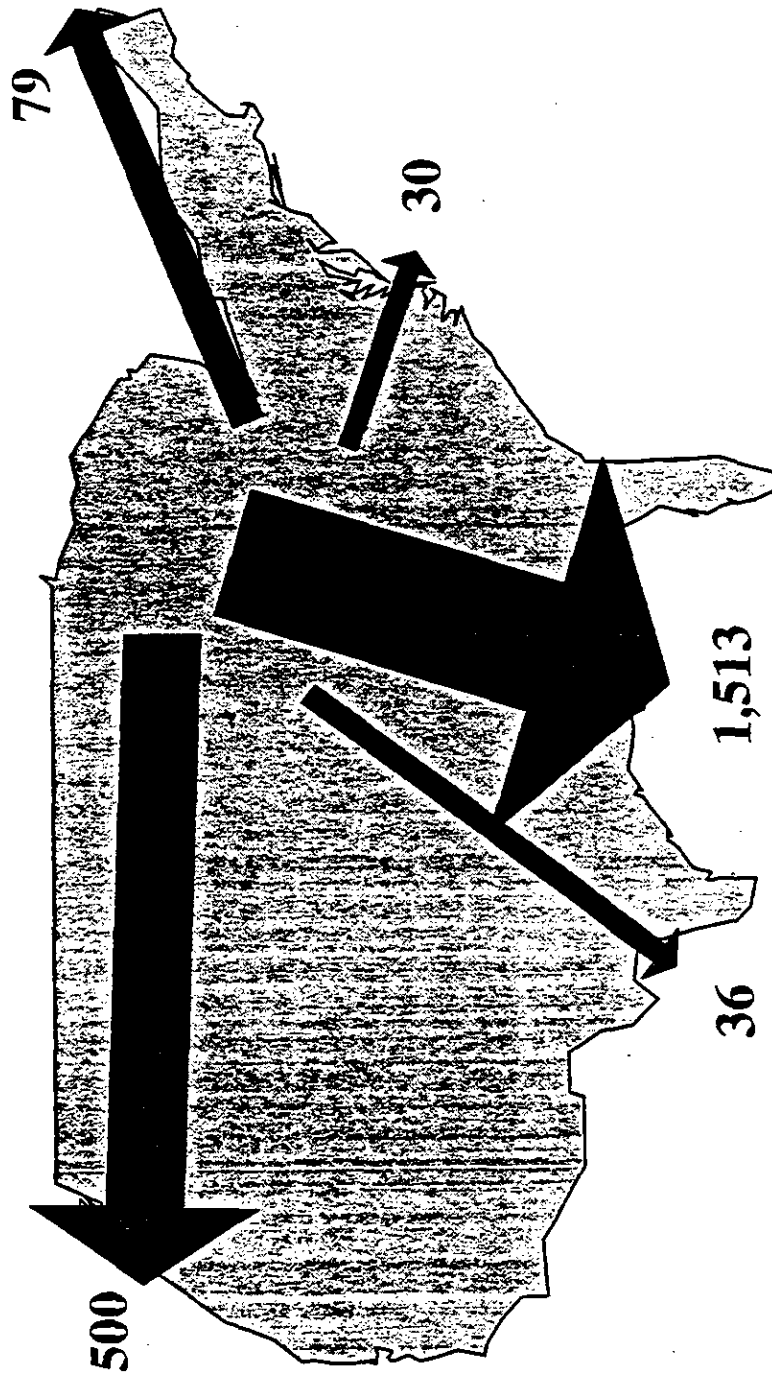
CORN EXPORTS 75-76

(m.bu.)



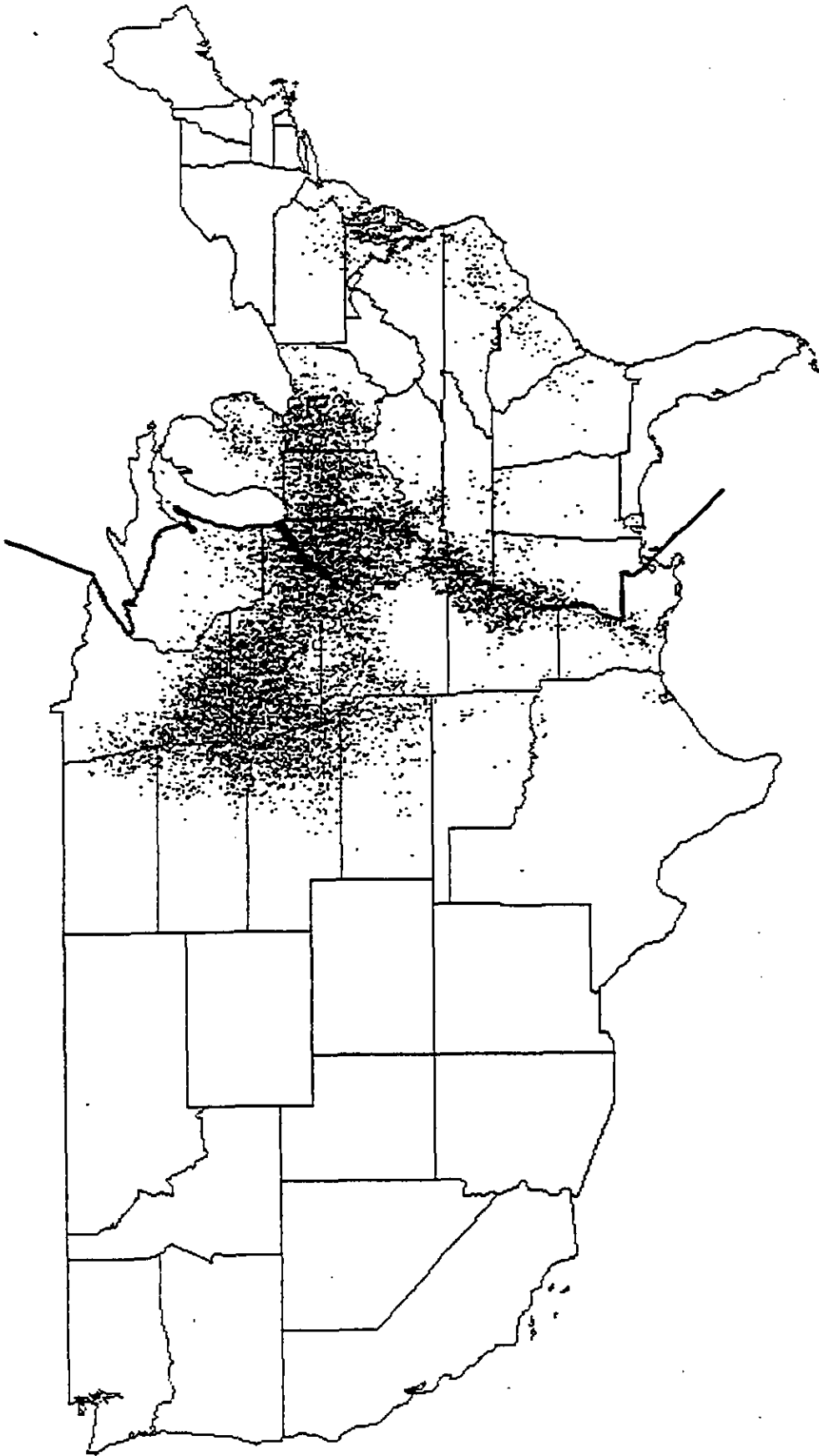
CORN EXPORTS 95-96

(m.bu.)



SOYBEAN PRODUCTION

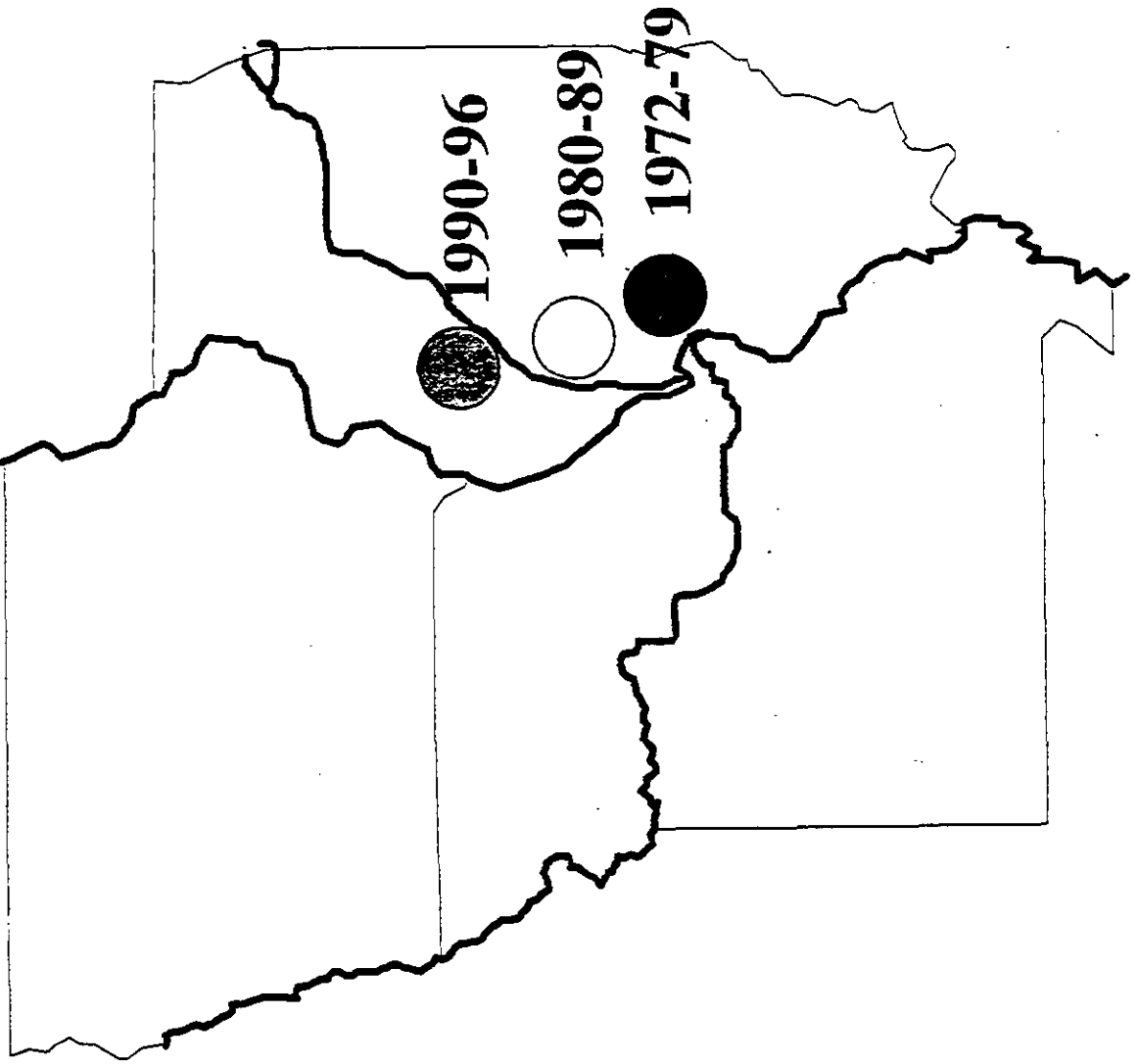
WESTERN U.S. & ILLINOIS w/ 71.7% EASTERN U.S. w/ 28.3%



2.382 BILLION BU. IN 1996
1 DOT = 200,000 BUSHELS

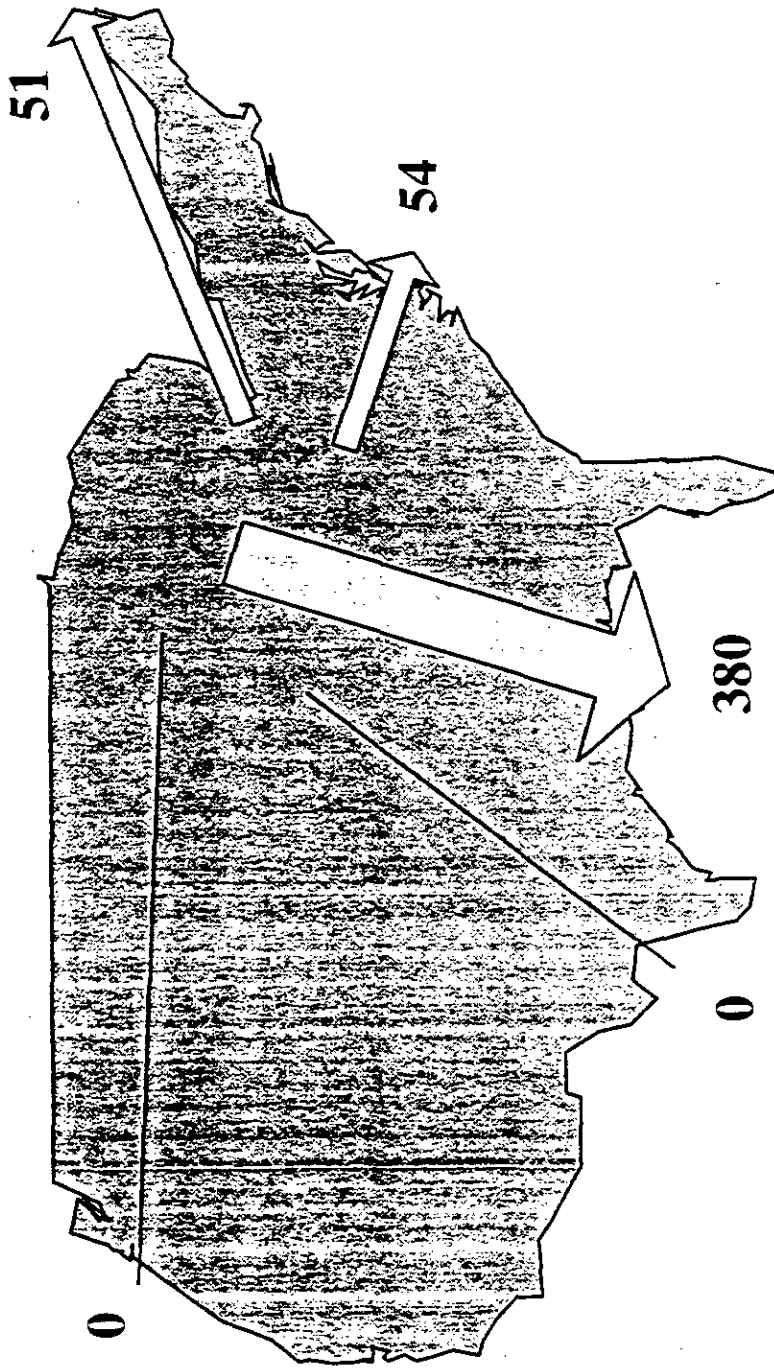
SOURCE: USDA/NASS

GEOGRAPHICAL CENTER OF SOYBEAN PRODUCTION



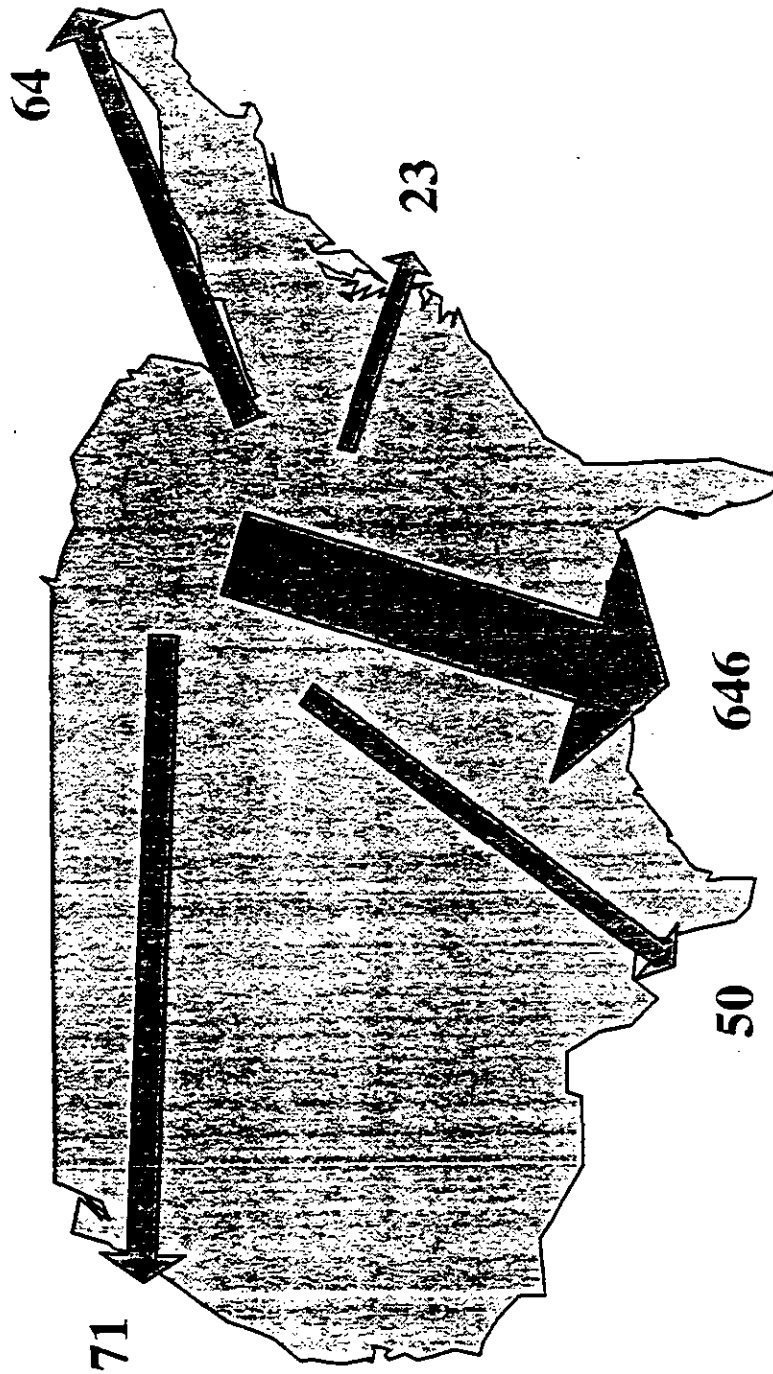
SOYBEAN EXPORTS 75-76

(m.bu.)

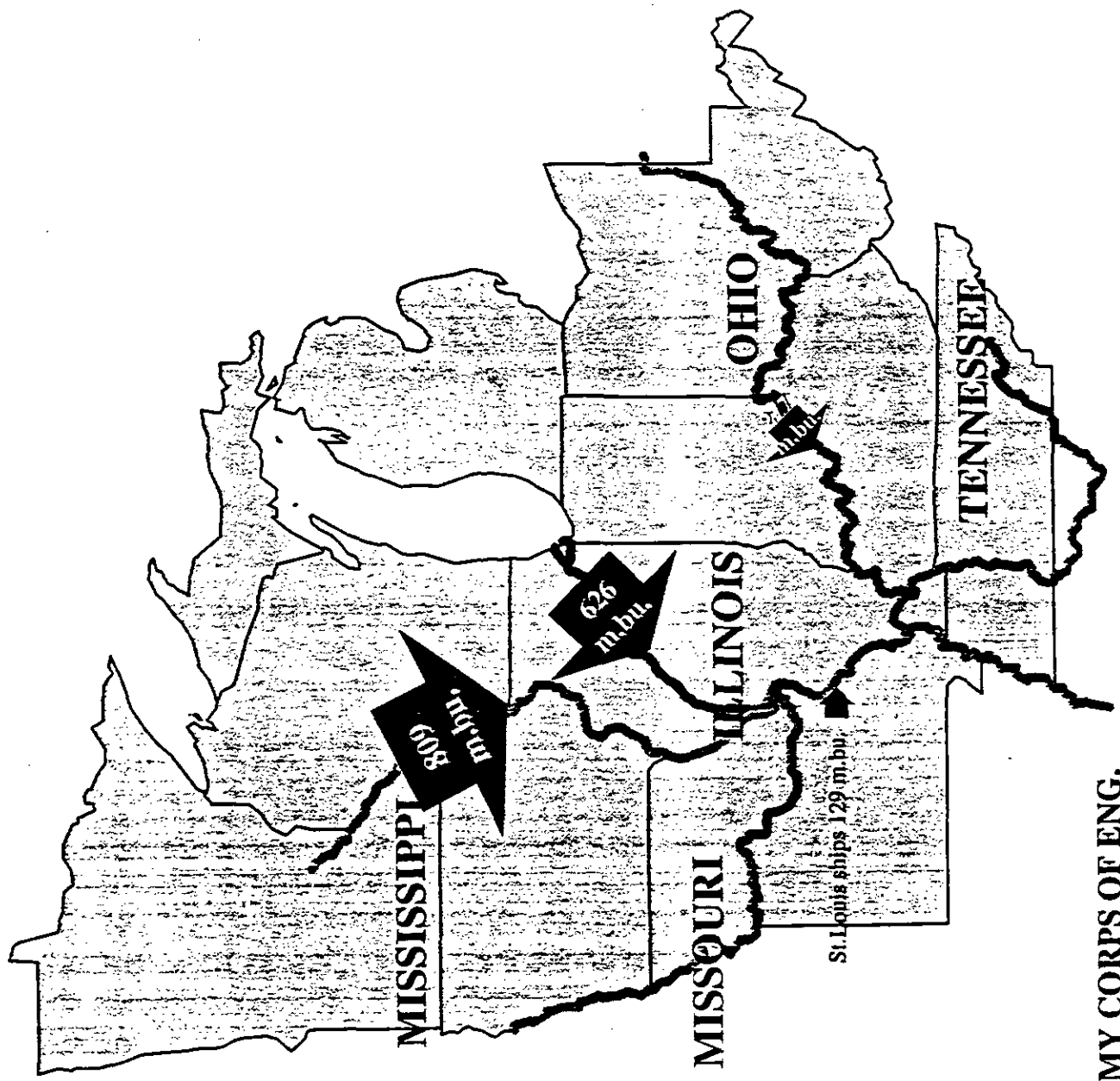


SOYBEAN EXPORTS 95-96

(m.bu.)



GRAIN SHIPMENTS ON MAJOR MIDWEST WATERWAYS in 1995

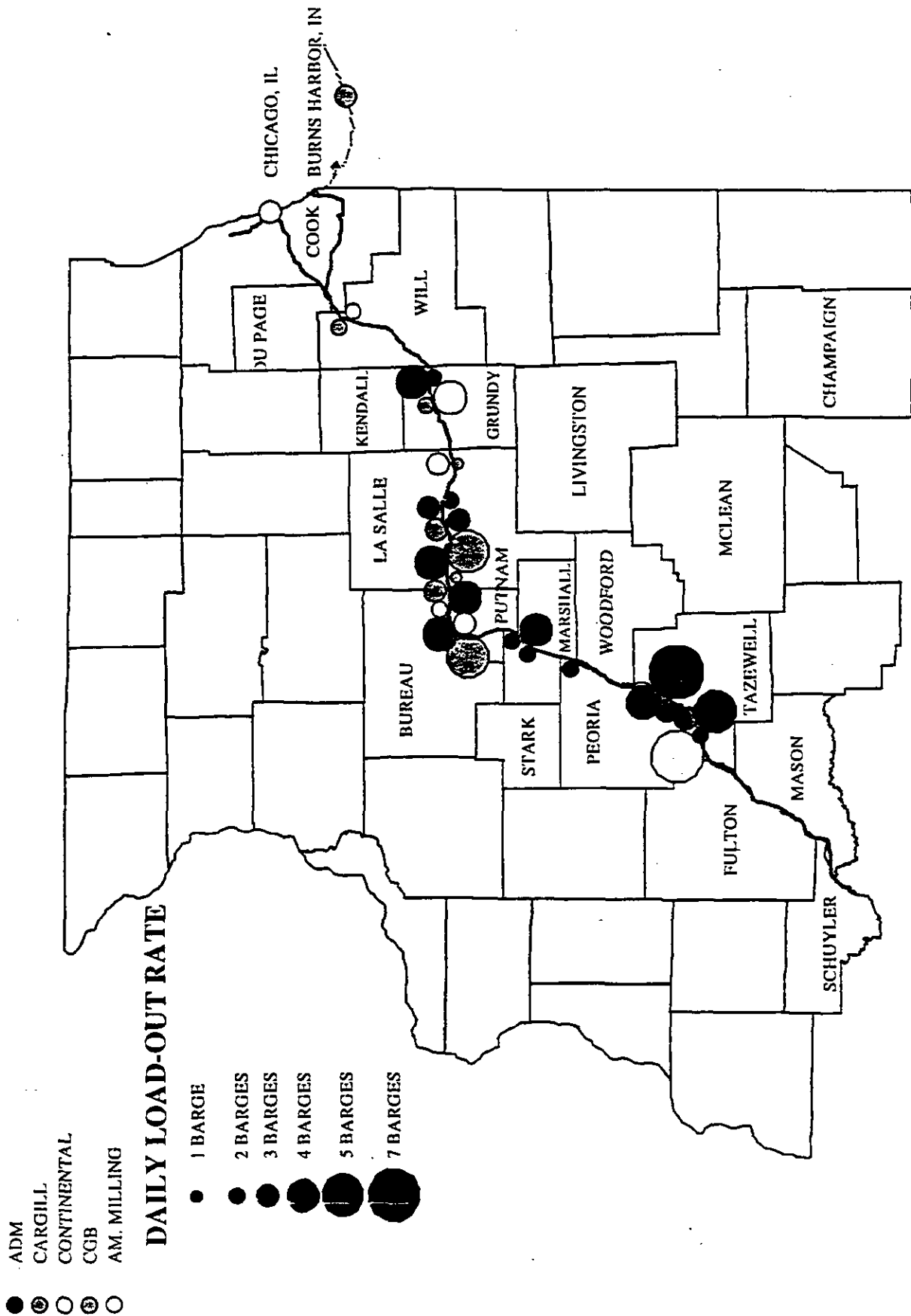


SOURCE: U.S. ARMY CORPS OF ENG.

Delivery Capacity in a Flow Market

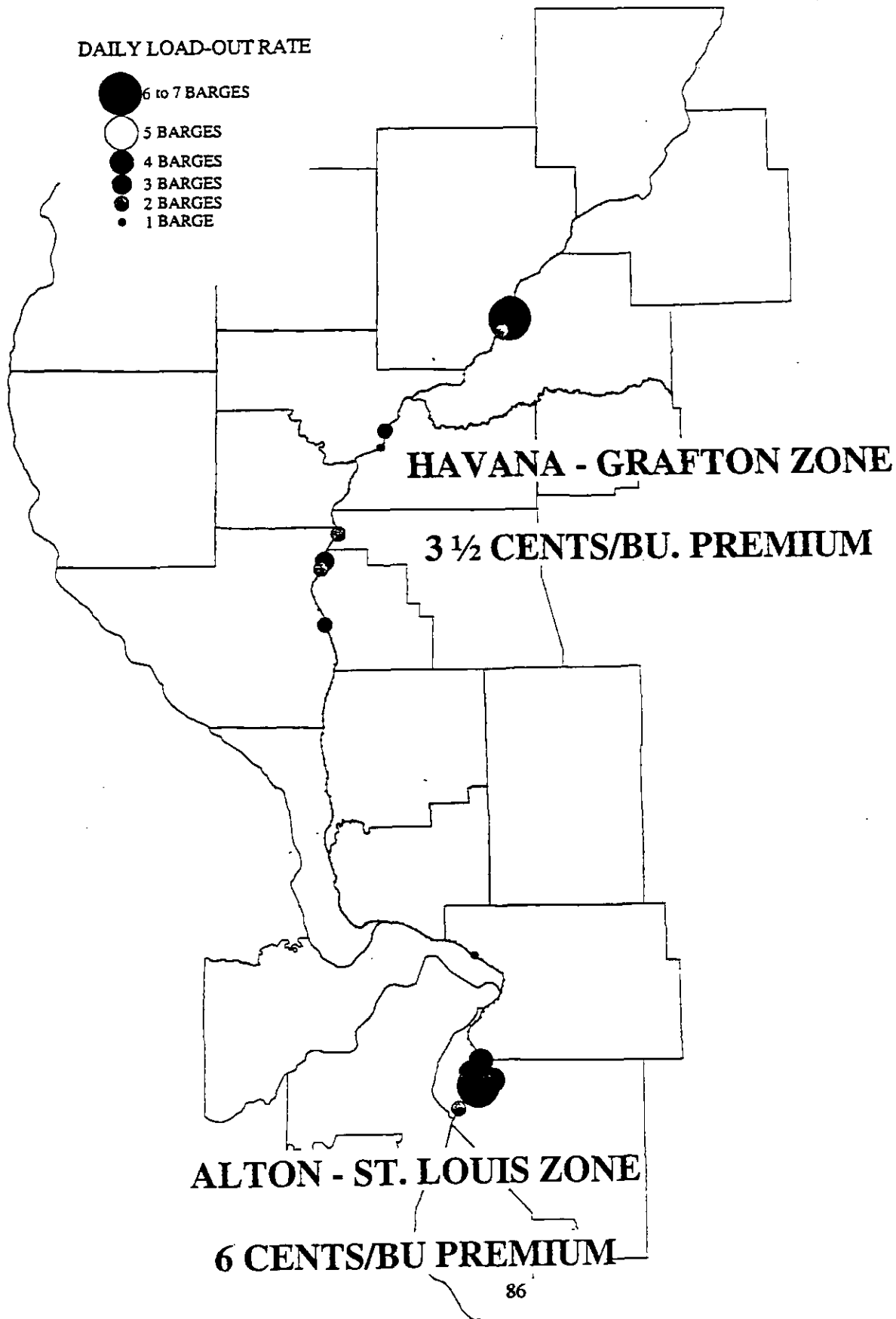
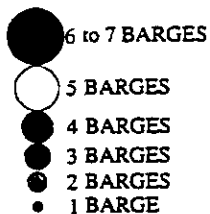
- The IWDS is also adjacent to a major flow of soybeans and corn to IL processors.
- Given flexibility of shipping certificates, cost of tapping into this flow should be small.
- This implies that effective delivery capacity of IWDS is substantially larger than normal flow to barge loading stations.
- This also serves to reduce the potential for price manipulation by large longs.

ILLINOIS WATERWAY DELIVERY SYSTEM



ADDITIONAL SOYBEAN DELIVERY TERRITORY

DAILY LOAD-OUT RATE



OTHER INITIATIVES

- Last Trading Day moved one week earlier
 - LTD is the business day preceding the 15th calendar day of the delivery month
- Reduced load-out charge
 - Premium of 4 cents per bushel paid by taker on invoice in lieu of 6 cents per bushel currently paid by taker on load-out
- Reduced storage charge
 - Premium of \$.0012 per bushel per day for Chicago and \$.0010 per bushel per day for River locations

RIVER CONTINGENCIES

- Contingency for Illinois River closures
 - USACE announced closure of more than two weeks
 - Closure affects a majority of shipping stations
 - Taker receives loaded barge in St.Louis with freight paid to the Gulf
 - Taker reimburses maker an amount equal to 18 cents per bushel (premium plus contingency)

ILLINOIS RIVER CLOSURES

- Unlike the Upper Mississippi or Great Lakes, the Illinois River never officially closes, however, severe weather conditions may lead to Coast Guard navigational restrictions.
- Extended closures (rehabilitations) are scheduled one year in advance with public input.
- Short closures (repairs & maintenance) are scheduled 30 days in advance with public notice.
- Unscheduled closures (emergencies, equipment failure, accidents) are typically short in duration.
- Barge traffic clears the channels of ice during the winter.
- Locks are routinely cleared by the Army Corps of Engineers.
- Lock de-icing procedures on average, take 1 hour, 41 minutes, every 2 ½ days during the winter.
- Total closure time at all locks combined per winter is three days.
- Closures due to flooding are minimal, notwithstanding record levels of rainfall.

OPERATIONALLY AND FINANCIALLY SOUND

- Maximum capacity limited
 - 30-day load-out capacity
 - 25% of net worth outstanding
- \$5 million net worth requirement
- Shipping certificates with full value secured by bond or letter of credit

Fewer Barriers to Entry

- Construction of a river barge loading facility inexpensive, especially relative to construction of terminal market storage elevator.
- As a result, there are no significant barriers to entry of new delivery facilities.
- In the very unlikely case that existing levels of concentration allow operators of IWDS facilities to earn abnormal profits, entry of new facilities will ensure competitive pricing.

- Barge freight market far more transparent than vessel or rail
- CIF market highly transparent cash market
- Barge market less concentrated than vessel or rail

Conclusion

- New CBOT contracts represent a dramatic improvement on the existing system.
- Potential for manipulation sharply reduced.
- Hedging performance will be excellent.
- Changes to proposal could upset the delicate balance that is the contracts' virtue to the overall detriment of contract performance.

THE MISSISSIPPI BEAUTIFICATION AND RESTORATION PROJECT

Chad Pregracke

East Moline, Illinois
(309) 436-9848

Chad Pregracke is a 24-year old native of East Moline, Illinois, was raised and has worked along the Mississippi River all his life. His personal commitment to river cleanup began in 1997 after working in the clamming industry along the Mississippi and Illinois Rivers. While working, Chad noticed the immense amount of trash littering the banks of the rivers. After making numerous calls to state officials without any success, Chad realized that he was going to have to do something about this problem on his own. He began contacting private companies such as Alcoa Aluminum and requesting financial assistance to operate his cleanup program. He was successful in receiving \$8,400 from Alcoa which jumpstarted his work. He has since received assistance in removing over 225 tons of trash from the Mississippi River, from river cities placing dumpsters along the banks to towing companies assisting with the removal of large items such as the top of a school bus.

As of September 13, 1999, Chad has removed the following:

1,598 Pounds of Trash	2,197 Tires	572 Steel Barrels
150 55-Gallon Plastic Barrels	194 Propane Tanks	126 Refrigerators
275 5-Gallon Buckets	16 Freezers	75 Coolers
24 Washing machines	27 Water Heaters	82 Gas Tanks
51 TVs	13 Stoves	33 Sinks
6 Tubs	13 Toilets	98 Chairs
4 Motorcycles	12 Bicycles	4 Campers
7 Boats	27 Bed Springs	1 Ford Van
1 Hot Tub		

These are only some of the items removed. The trash is documented, sorted, and recycled.

Chad began receiving national attention when he appeared on the front page of the Sunday edition of the Quad City Times. This prompted attention from the Associated Press, CNN, and was reported by Peter Jennings. In 1999, Chad was invited to have lunch with Vice President Al Gore to discuss his work and he has received national awards in conservation and restoration of our natural resources.

In the summer 1999, Chad began "Community River Relief and Celebration" which consists of a community river cleanup in the morning, followed by a festival of food vendors, live bands, and exhibits of environmental and natural resources organizations and agencies. The festivals have already been held in Burlington and Davenport, Iowa, and Peoria, Illinois. Chad is planning to continue the festivals in future summers in other river cities. He also has plans to begin "Adopt A River Mile" to help communities continue work which he or the festivals have begun.

THE ILLINOIS CONSERVATION RESERVE ENHANCEMENT PROGRAM

Debbie S. Bruce

Illinois Department of Natural Resources
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(217) 785-8287
E-mail: dbruce@dnrmail.state.il.us

Conservation Reserve Enhancement Programs (CREPs) offer states a unique way to create a state-federal partnership to address specific environmental problems. Illinois has designed a successful CREP for the Illinois River. The Illinois River is one of the state's most significant natural resources, as well as functioning as a major navigation corridor connecting Lake Michigan to the Mississippi River. It is one of only three functioning large river-floodplain ecosystems remaining in the nation. The river is threatened by siltation and sedimentation and loss of habitat due to the landscape changes in the watershed which have eliminated the majority of the natural wetlands. Illinois' CREP is working with agricultural landowners to restore wetlands and native vegetation along the main stem of the river and its major tributaries. The state offers landowners incentives above the federal portion of the program to provide for longer term environmental benefits by offering contract extensions and permanent easements. Landowners have embraced the Illinois program and the river restoration efforts. The general Illinois CREP design will be described and examples of the flexibility of the Illinois CREP in addressing restoration, enhancement, and protection for the river will be given.

**THE KANKAKEE RIVER BASIN PARTNERSHIP:
CONSERVING THE KANKAKEE RIVER BASIN FOR THE FUTURE**

R. A. Schultz and J.E. Mick

Kankakee River Basin Partnership
199 S. East Avenue, #2, Kankakee, Illinois 60901

ABSTRACT

The presentation will provide a brief history of the Kankakee River Basin and a discussion of its current problems. Information will be provided regarding the outstanding diversity of the area in terms of its flora and fauna and its natural habitats. The threat to this unique ecosystem presented by sedimentation from various sources both within Illinois and Indiana will be explained. The projects already begun and funded through the Conservation 2000 program in the Kankakee Basin will be described and linked to the Kankakee Basin Stewardship Plan's goals and objectives. Specific attention will be given to the "State Line Project" which is being developed in cooperation with the IDNR, U.S. Corps of Engineers, and Basin Partnership. Once approved and authorized, this project is expected to involve sand bed removal, wetland restoration, and reestablishment of mussel beds in an area of the Kankakee River adjacent to the Indiana - Illinois state line in a remnant of the once huge "Grand Kankakee Marsh." This project will test new technology for sediment removal and other restoration techniques. The presentation will include slides of various features of the Kankakee basin.

INTRODUCTION

From its origin near South Bend, Indiana, the Kankakee River once flowed for 240 miles through numerous bends and oxbows forming the "Grand Kankakee Marsh" a wetland area of some 400,000 acres at the Illinois-Indiana border. After joining its major tributary, the Iroquois River, near Kankakee, the river continues to Wilmington where it has its confluence with the Des Plaines River and forms the headwaters of the Illinois. Today, the "Grand Marsh" exists only as a remnant in the still meandering Illinois segment of the Kankakee known as the Momence wetlands. Channelization and drainage for agriculture transformed the Indiana segment into an 84 mile long drainage ditch intended to reduce flooding and efficiently de-water farmland. Fortunately, the Illinois portion of the Kankakee still supports a diversity of habitats and unique and endangered flora and fauna. However, sedimentation resulting from channelization and other land use practices in both Illinois and Indiana have had a continuing degrading effect on the Kankakee's ecosystems.

The Kankakee River Basin Partnership has developed a stewardship plan to help in evaluating proposed projects within the basin intended to help preserve and protect the basin's ecology. Many of these projects will be accomplished through the use of funds received from IDNR's Conservation 2000 program.

ENVIRONMENTAL QUALITY AND PROBLEMS

As stated in the introduction, there is a significant difference between the condition and ecological value of the Kankakee River basin as it presently exists in the states of Indiana and Illinois. The once meandering Kankakee River and its vast wetlands (nearly 400,000 acres) in Indiana are now farmland and an efficient drainage ditch. However, much of the Kankakee in Illinois has retained its natural state. According to the Illinois EPA's 1996 statewide watershed assessments, the Kankakee/Iroquois River basin is an "exceptional water system" with "good" overall resource quality. This assessment resulted from the Agency's evaluation of a total of 970 stream miles along the Kankakee River and its tributaries. A "good" rating was given to 893 miles (92%) with only 77 stream miles (8%) rated as "fair." This makes the Kankakee/Iroquois basin the highest rated watershed in Illinois.

The assessment lists suspended solids, siltation, and nutrients attributed to agriculture, urban runoff, and contaminated sediments (sediment and/or phosphorous attached to sediments) as the primary causes of water quality degradation in the basin.

The ecological value of the Kankakee and the increasing risk to its preservation have long been an impetus for action by environmental, recreational, and sportsmen's groups within the basin. There have been numerous studies by state agencies over the years which have documented the existence of rare habitats, unique ecosystems, rare and endangered species as well as the presence of at least localized sedimentation problems which impact the basin's water quality and biodiversity. As is often the case, many of those interested in preserving and enhancing the Kankakee's ecology are frustrated by the lack of action by state and federal authorities to address the issues identified as threats to the environmental health of the region. These things take time.

It now appears that real action on several fronts will take place in the not too distant future to begin to resolve the threats to the Kankakee basin and its ecological resources. This statement can be made because the attention of the necessary political, technical, and environmental authorities at the local, state, and federal levels is now focused on the Kankakee Basin and its problems. This came about as a result of several things. In addition to all of the previous studies of the Kankakee, one of the most recent called attention to the increasing sedimentation problems in the basin. The Alliance to Restore the Kankakee (ARK) was formed and raised the 50% local matching funds (about \$250,000) to allow a three phase, multi-year study by the U.S. Geological Survey (USGS) to analyze sedimentation in the river basin. This 1992-1996 study was significant in that it evaluated areas on the Kankakee and Iroquois in both Illinois and Indiana. Previous studies in the basin were limited to evaluating conditions in either one state or the other. In addition, this study was able to combine and correlate new data with historical data from earlier studies performed in the 60's, 70's, and 80's. The USGS study showed that the sedimentation problems were continuing and in certain areas increasing their negative impacts on the basin's ecological health. This study as well as the increased activism of local stakeholders got the attention of state and federal legislators. The Army Corps of Engineers (COE) was authorized to perform a "Reconnaissance Study" of the Kankakee basin to determine the need for further scrutiny in the form of a "Feasibility Study." At this time, the "Recon Study" has been completed and the "Feasibility Study" is underway and will be completed by an engineering firm under contract with the COE. Under federal law, no major environmental restoration projects can be undertaken until a COE "Feasibility Study" has been completed and recommendations made. Therefore, the commencement of the COE Feasibility Study is a major step towards identifying and resolving the Kankakee

basin's problems.

KANKAKEE RIVER BASIN PARTNERSHIP

A major factor in the progress now being made towards enhancing and restoring the resources of the Kankakee basin is the formation of the Kankakee River Basin Partnership. This group was formed about four years ago as an offshoot of ARK to take advantage of the financial resources available through the IDNR Conservation 2000 Program. The stated goals of the Partnership are to restore, protect, and enhance the high quality, naturally diverse, and productive ecosystems of the Kankakee River Basin. The Partnership is made up of local people who represent a wide range of stakeholders within the Basin including agriculture, conservation, business, industry, labor, recreation and government interests. The monthly meetings of the group are well attended and at these sessions the 23 voting members conduct business and direct the activities of the organization in accordance with its by-laws. There is always time allotted early in the meeting agenda for input from the general public or any interested parties who wish to present issues for consideration.

One of the most important functions of the Partnership is to solicit, accept and review proposals from stakeholders for various programs and projects to be funded through the C-2000 Program. A subcommittee of the Partnership is charged with the task of evaluating these proposals for compliance with the C-2000 Program eligibility criteria and conformance with the goals established in the Kankakee River Basin Stewardship Plan. In 1998, the Partnership developed a basin-wide stewardship plan for management and restoration of the area's natural resources. The plan was composed by combining the EQUIP plans developed by the NRCS Districts in Will, Kankakee, and Iroquois counties with additional features added to reflect the issues and concerns raised by various stakeholders. The Stewardship Plan was adopted in the spring of 1999 after a series of public meetings that allowed input regarding problems and possible solutions from the concerned public. Since its adoption, more than 70 local groups, businesses, and governmental entities have endorsed the Stewardship Plan.

The Stewardship Plan represents a common approach to solving the problems of the Kankakee River Basin and to ensure the protection, preservation, and enhancement of the region's high quality natural resources by private landowners as well as local, state, and federal governmental interests. The main goals of the Plan are:

- Stabilize the water resources;
- stabilize the land resources;
- improve water quality;
- preserve the high quality natural resource values;
- restore or enhance native species and degraded habitats;
- promote natural resources educational opportunities; and
- protect prime farmlands.

The Partnership is pledged to achieve these goals in a manner that respects the positions of the various stakeholders while providing a better quality of life for all of the basin's inhabitants.

C-2000 SUCCESSES

In 1998, IDNR granted the Partnership nearly \$1 million in C-2000 funds to complete several projects in the basin. The authorized projects ranged in cost from nearly \$190,000 for conservation easements and management plans to create riparian buffers along tributary streams in Iroquois county, to \$8,500 for repair of gullies and erosion control at a site owned by the Bourbonnais Twp. Park District in Kankakee County. Another major project at a cost of \$40,000 involves selective removal of logjams at 12-15 locations along Langham Creek in Iroquois County. These flow obstructions result in severe erosion of the banks and bottom of the creek which even in its current state, is known to be an important nursery stream for sport fish.

C-2000 funds in the amount of \$160,000 were awarded for completion of an erosion site map of the Kankakee River from LaPort, IN to the I-55 bridge in Illinois near Wilmington. These sites will be identified on maps and their exact locations fixed by Global Positioning Technology. In addition, existing hydrological, hydraulic, and channel geometry data will be compiled. This data will be a very valuable tool for the COE feasibility study's problem assessment and recommendation process. Perhaps the most ambitious project funded in 1998 was a land acquisition proposal brought to the Partnership by the Kankakee River Conservancy District (a unit of the Kankakee County government). This proposal, funded at \$595,360, will purchase lands from willing sellers in the "Momence Wetlands" which will be managed by the Conservancy District in conformance with the Stewardship Plan. This area is a remnant of the huge Grand Kankakee Marsh which once encompassed 400,000 acres.

The Partnership's C-2000 success continued in 1999 with nearly \$90,000 awarded to complete agricultural BMP projects such as grassed waterways and terraces to control runoff from sites in Will County. Funding was also provided to restore wetland areas along tributary streams and to stabilize 1,000 feet of eroding shoreline on the Kankakee River near Wilmington, Illinois.

OTHER SUCCESSES

The Partnership had a significant part in inducing the Illinois legislature and then governor Edgar to release a special \$1.5 million appropriation to the IDNR to use to fund land acquisitions in the critical Momence wetlands and other riparian areas of the Kankakee and Iroquois Rivers.

Another particularly exciting development involves a special, fast tracked Corps of Engineers project to be performed at the Illinois/Indiana state line. Called the "State Line Kankakee River Aquatic Ecosystem Restoration," this project is being managed by the Chicago COE office and will be subject to the COE's Section 206 Program requirements. Under these rules, its implementation can proceed on a schedule independent of the basin wide feasibility study. Actual construction could begin within two years.

The proposed project features would restore aquatic habitat (fisheries, mussels, wetlands) by removing sediment, creating wetland habitat, creating a controlled sediment removal area (sediment trap) and potentially creating new or enhancing existing spawning areas by restoring floodplain function. The surrounding levee structure will be removed in a portion of the property to permit the river to naturally flood the property again. A constructed wetland (restored stream meander) with an access channel to the river would introduce fish habitat and potential spawning features to

an area currently used as an agricultural field. The restored stream channel (constructed wetland) will be designed to incorporate substrate suitable for establishing a mussel population. Excavated materials, brush and trees removed as part of the project will be put to beneficial use in berm construction and habitat development as much as possible.

New technology is to be utilized for sediment removal which has been shown to be highly efficient in solids removal while having significantly less disruptive impacts on the removal area's ecosystem and with virtually no resuspension of sediments which could impact downstream locations. It is hoped that the State Line project will illustrate successful methodologies and cost efficient techniques that can then be utilized in other restoration projects.

BUILDING FUTURE SUCCESS

The Partnership hopes to continue its success in winning C-2000 funding for additional projects in future years. The Partnership will continue to seek input from its member stakeholders and solicit proposals from appropriate sources within the Kankakee basin. These proposed projects will be evaluated for their compliance with the C-2000 Program requirements and the goals and objectives of the Stewardship Plan. We are encouraged by the apparent willingness of the Illinois legislature to continue to fund the C-2000 Program for additional years. However, it would be unrealistic to expect that this source of funding will be adequate and available long enough to address all of the needs identified in the basin. Clearly, other financial resources will need to be tapped in order to achieve the goals set forth in the Stewardship Plan.

This realization and the more immediate short term need to find sources of operating funds resulted in the creation of the Partnership's Alternative Funding Committee. The Partnership has relied on the charity of its active membership for completing the routine administrative tasks such as reproduction, mailings, faxes, etc. that are required to successfully pursue its activities. It would be much more efficient and certainly less stressful if an adequate operating fund could be established to finance these tasks. The committee has begun contacting charitable organizations and foundations involved with sponsoring environmental programs and activities. It is hoped that a "benefactor" can be found to provide operating funds for the day to day, year to year workings of the Partnership.

Past efforts to develop and implement conservation projects in the Kankakee basin have been unsuccessful for the most part. The failure to solicit meaningful input from all parties who have a stake in the area and to fully inform the general public about the issues certainly was a major reason for the demise of these well intentioned efforts. The members of the Partnership realize that the real strength of the organization lies in its diversity. The broad representation presented by its membership allows for realistic discussion of the pros and cons of all proposals and issues that come before the partnership for action. Rather than having limited insight into how certain programs and issues will impact the stakeholders within the basin, the monthly Partnership meetings allow all points of view to be expressed. This results in spirited discussion and yes, even conflict, but it is this activity by concerned and committed stakeholders that creates improved plans of action. It would be futile to attempt to implement preservation and reclamation projects such as those being undertaken in the Kankakee Basin without broad based support of those whose interests may be significantly affected.

The Kankakee River Basin Partnership has learned from the mistakes of the past and is positioned to move ahead with the vision presented in its Stewardship Plan to preserve, enhance, and protect the ecological assets of the highest quality watershed in the State of Illinois.

THE MACKINAW RIVER PARTNERSHIP

Terry Giannoni

Mackinaw River Watershed Council
RR 2, Box 151, Lexington, Illinois 61753

Thanks to all of you for coming today. I would like to visit with you this morning about something that I'm pretty proud of.

As Bill mentioned my name is Terry Giannoni. I am a landowner/farmer on the banks of the Mackinaw River about 3 miles southwest of Lexington, Illinois in McLean County. Our production agriculture operation is corn/soybean rotation. My background is not in the sciences but I did grow up on the banks of a river. The Chicago River, north branch. I have a BA in Economics, a Masters in Insurance, and have spent the last 1/4 century in the urban business insurance industry, not a natural background for me to be here this morning. My goals for our production agriculture operation is to produce ever growing quantities of food and fiber for ever expanding world population but do so at a realistic impact to our environment. That's why I am Vice President of the Mackinaw River Watershed Council, a grass roots conservation organization and that's why I'm here this morning.

Briefly the Mackinaw River begins as a drainage ditch each of Sibley, Illinois in Ford County. From there it begins it's 130 mile journey to just south of Pekin, Illinois where it enters the Illinois River. On its way it passes through 6 counties draining 1136 square miles. The river and its feeder creeks and streams comprise a watershed of 744,000 acres which is primary production agriculture on some of the most fertile soils in the world but it is dotted with small towns, new subdivisions, crossed by 3 interstate highways and has all the pressures of modern progress.

During 1993 THE NATURE CONSERVANCY discovered the watershed as a once in a century opportunity to protect a great resource. They partnered with the Illinois Environmental Protection Agency to look for ways to protect this great resource. They found it was a "stream of state" meaning nearly all the watershed was owned by private landowners. They organized the Mackinaw River Partnership as a grass roots organization designed to find common ground on river management, pool resources, create new ideas, and gather energy to preserve, protect, and restore the river for the benefit of all.

This process of "finding common ground" was much more involved than any of us early volunteers imagined. It took painstakingly long just to create our mission statement. "To preserve and enhance the natural resources of the Mackinaw River through education, good management practices, and voluntary cooperation while respecting property owner rights." A simple enough statement that took more than 3 full days to create.

With our mission set, we set about creating a plan to do it. With the help of more than 100 volunteers, the watershed plan was created. It is specific and detailed and has plans for our river but can be adapted to local conditions elsewhere. It has specific goals for best management practices for agriculture, streambank stabilization, runoff control structures, research and

education and a time frame to do it in. We have a few copies out at our booth you are welcome to or you could get an address there to request a copy.

Some of our 15 year goals:

- 22,500 acres of wetlands, detention and retention ponds;
- 15,000 acres of forest and prairie land;
- 15,000 acres of woodland management;
- 90 miles of streambank stabilization;
- 700 miles of filter strips; and
- a long list of agricultural best management practices.

With all this in hand we began the legal process of finally existing. The Mackinaw River Watershed Council was chartered in August of 1998 as a 501{c}3 organization and got on seeking members and doing demonstration projects.

So where are we? We have 15 demonstration projects built and on the ground. We have 9 more projects and various stages of completion and 21 additional projects that are on the drawing boards and being looked at. We also have two really unique projects:

First is a wastewater treatment wetland for a small community in Woodford County. Design work is currently being done for an innovative solution for wastewater treatment wetland as an alternative to a very expensive wastewater treatment plant.

Second is funded by the Kellogg foundation. It's a 5-year water quality study on the Mackinaw. The purpose of the study is to determine to impact of filter strips, waterways, and related agricultural best management practices have on water quality. Information learned will help us target our cost share dollars towards the practices that actually have the greatest effect on water quality.

This was a brief overview of our 6-year project. We may have some time for questions later or please visit our booth in the vendors' area. Thanks for your attention.

WATERSHED MANAGEMENT: ILLINOIS RIVER ECOSYSTEM RESTORATION STUDIES

Teresa A. Kirkeeng-Kincaid and Bradley E. Thompson

U.S. Army Corps of Engineers, Rock Island District
Clock Tower Building, P.O. Box 2004, Rock Island, Illinois 61204

ABSTRACT

The Illinois River is a major tributary river of the Upper Mississippi River System. The system is designated a nationally significant ecosystem by the Water Resources Development Act of 1986 which mandated that the rivers be managed to balance competing interests in this natural resources. A wide variety and number of migratory birds, as many as 285 species of birds, are likely to be found in this area use the Illinois River valley. Degradation of the ecosystem comes from many sources that include hydrological processes, flooding, strip mining practices, runoff, sediment transport and deposition, and diminished nutrient cycles. Two Corps of Engineers' Studies: the Peoria Riverfront Development study and the Illinois River Ecosystem Restoration study will evaluate components of the State of Illinois' Integrated Management Plan and address aspects of the degradation of the Illinois River Ecosystem. Environmental restoration activities could include limited stream restoration, wetland creation, wildlife restoration, land surface restoration, recommendations for maintaining viable populations of native species, and other engineering solutions to environmental problems in the watershed. A holistic review of ecosystem management practices will be conducted in a partnership with state and Federal agencies to restore fish and wildlife habitat and in the development of a system-wide management plan. Particular emphasis will be placed on restoration of wetlands, neotropical migrants, Federal and state significant species, and protection of floodplains and floodways for fish and wildlife enhancement. The Peoria study will begin in calendar year 1999 and the Illinois River Ecosystem Restoration study will begin in the year 2000.

DISCUSSION

The Corps of Engineers currently has three priority mission areas: Navigation, Flood Damage Reduction, and Ecosystem Restoration. These priority missions were developed by the Administration to guide Corps involvement in water resource activities. While Navigation and Flood Damage Reduction are often thought of as the historic role of the Corps of Engineers, I would like to address my comments to Ecosystem Restoration. This is the newest of the priority mission areas and has great potential to influence the future of our water resources and to address many needs being discussed at this conference.

More specifically, I will be addressing two study efforts the Corps of Engineers is partnering with the Illinois Department of Natural Resources on: the Peoria Riverfront Development study and the Illinois River Ecosystem Restoration study. Both of these efforts are in the initial phases.

Corps of Engineers Ecosystem Restoration projects are implemented using an Ecosystem Approach, they seek to identify engineering solutions to water and related land resource problems, and relate to Corps missions and expertise in water resources management. An

ecosystem approaches looks at an ecological community together with its physical environment, as an integrated unit. This perspective serves to strengthen and emphasize the need to address restoration from a broad watershed perspective. Engineering solutions to water and related land resources problems could include such items as stream restoration, wetland creation, water level management, sediment retaining structures, island creation, and dredging of side channels and backwaters.

A great deal of groundwork has been done on the Illinois River to identify resource problems and potential solutions. Both of these studies will be able to build on the efforts of the State of Illinois' to develop an Integrated Management Plan for the Illinois River Watershed. Some of the problem areas and solutions identified by that effort which will be evaluated further include:

- Preservation of Critical Habitats for wildlife abundance, distribution, and diversity;
- restoration of degraded streams;
- reduction of deviations from the natural hydrograph;
- improvement in water quality;
- reduction in peak flood flows; and
- reduction in sediment delivery

The Corps of Engineers project implementation process includes the following steps:

- Problem Perception –The non-federal sponsor identifies a problem.
- Request for Federal Assistance – Corps involvement begins with a request, typically a letter, from the non-federal sponsor for assistance.
- Study Problem and Report Preparation – If applicable to Federal authorities a study can be initiated. These studies are conducted in two phases.
 - Reconnaissance – involves limited study effort. The goals are to assesses Federal and Non-Federal interest, scope the Feasibility Study, and ends in the signing of the Feasibility Cost Sharing Agreement. Both the Peoria and Illinois River studies are in this phase.
 - Feasibility – more detailed study effort to determine feasibility for a project, develops specific alternatives and makes recommendations for eventual implementation.
- Report Review and Approval – Reports are processed through Corps of Engineers to OMB.
- Congressional Authorization – Projects are then authorized by Congress in Water Resource Development Acts and funds appropriated.
- Project Implementation – Construction or management modifications are implemented.

There are a number of ways an Ecosystem Restoration study can be authorized and conducted in partnership with the Corps of Engineers. Study and project authorities are provided to the Corps of Engineers as part of various Water Resources Development Acts (WRDA). These authorities allow the Corps of Engineers to participate with non-federal project sponsors (states, cities, local governments, non-governmental organizations) in investigating projects. These authorities include:

- Project Specific Authorization – a project can be authorized by specific language in WRDA. The Peoria Riverfront study was authorized in this way.

- Environmental Management Program (EMP) – authorized in 1986 is an ongoing program, which seeks to restore and enhance the environment of the Upper Mississippi River system, including the Illinois River.
- Continuing Authorities (Section 1135, 204, 206) – These three sections allow the Corps to participate in ecosystem restoration with somewhat different cost sharing requirements based on the area being investigated. Section 1135 of WRDA 1986 provides for restoration based on a 75 Federal/25 Non-Federal split of costs if the construction or operation of a Corps of Engineers project contributed to the degradation. The same 75/25 cost share is also available with Section 204 of the 1992 Water Resources Development Act, which allows the Corps to restore, protect, and create aquatic and wetlands habitats in connection with dredging of authorized projects. Finally Section 206 of WRDA 1996 provides authority to carry out aquatic ecosystem restoration and protection project. These do not need to be related to an existing Corps project and have a 65/35 cost share.

The Corps of Engineers is increasingly using a Watershed Approach, which seeks to examine and recommend courses of action to address multiple water resource issues within a study area defined as all or part of a watershed. This type of approach will be used for both Illinois River studies. However, adequately addressing studies from this broad approach requires partnerships with other agencies and organizations if we are to find and implement successful solutions. As a result, watershed study recommendations are not likely to be limited to just the Corps of Engineers.

I will now briefly address the two Illinois River studies. Both of these studies are currently in the Reconnaissance phase and will be cost shared with the Illinois Department of Natural Resources.

First, the Peoria Riverfront Development study is focused on the Peoria Lakes region of the Illinois River. This study is essentially ready to start Feasibility, but the final touches are being made to the Feasibility Cost Sharing Agreement. As part of this study, opportunities will be explored to address sediment deposition and restore environmental conditions, especially those that relate to the downtown Peoria Riverfront Development Project, a public and private cooperative effort to revitalize the downtown area of the city. More specifically potential projects include:

- Island Creation – construction of islands using material dredged from the lake. This type of feature would likely be in combination with developing side channels around the islands.
- Reduction of Sediment Inputs – as part of the project opportunities to address sediment delivery to the lakes, through such efforts at tributary stream restoration, sediment traps, or upland treatments will be investigated.
- Habitat Diversity – as the Peoria Lakes have continually lost water depth due to sedimentation much of the habitat diversity within the lakes has been lost. Any restoration project recommended will seek to diversify habitats to support native fish and wildlife species. This is likely to take the form of adding additional deep water habitat and providing numerous habitats on and around constructed islands.

The second study, the Illinois River Ecosystem Restoration Study includes a much larger geographic area, the entire Illinois River Watershed. Efforts are currently underway to scope the feasibility study efforts. This study will seek to address the degradation of the Illinois River Basin that comes from many sources and includes sediment transport and deposition, changed

hydrologic regimes and water fluctuations, and alterations to tributary streams and the floodplain. The study will look for opportunities to partner with other State and Federal agencies to look for potential restoration projects including such activities as sediment control, protection and creation of wetlands and critical habitats, stream restoration, and improved water level and floodplain management. This study will utilize an ecosystem and watershed approach to address four resource areas as requested by the Illinois Department of Natural Resources the non-federal sponsor:

1. Side Channel and Backwater Areas – Many of these areas have been greatly diminished in area due to sedimentation over that past 100 years.
2. Floodplain Function – Roughly 50 percent of the Illinois River floodplain has been leveed.
3. Water Level Management – Numerous alterations have been made to the Illinois River including the construction of the Chicago Sanitary and Ship Canal, diversion of Lake Michigan water, Chicago Metropolitan Reclamation District (MWRD) operation, urbanization of the upper watershed, construction of mainstem dams and levees, and large scale land use changes.
4. Tributary Stream Basins – many of the tributaries of the Illinois have been destabilized through channelization, land use changes, and removal of riparian buffers.

At the present time I am not able to provide a great deal of insight into the eventual outcome of these studies. Currently the Peoria Riverfront Development study is scheduled as a two to three year study effort. We are working with the State of Illinois to finalize the signing of the Cost Sharing Agreement. Once that agreement is signed work will begin on the feasibility study. If this occurs in the very near future we will be working to complete the study so that any recommendations can be authorized for implementation by the Water Resources Development Act of 2002.

The scope and time frame for the Illinois River Ecosystem Restoration study is still being defined. However, some items that have been discussed include the potential to utilize existing continuing authorities for project implementation. Another option is to seek multiple interim authorizations in future WRDAs throughout a somewhat longer study time frame.

The Corps of Engineers looks forward to working in partnership with the State of Illinois and others to complete these important efforts, and I look forward to having more specifics as well as some initial successes to report at the next Illinois River Conference in 2001.

WATERSHED RESOURCES: A VIEW FROM CORPS HEADQUARTERS

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INTRODUCTION

This morning I would like to discuss our initiatives in Corps of Engineers Headquarters, especially those involving watershed resources. I believe that much of what we are doing is relevant to management of the Illinois River system.

The Corps of Engineers maintains and regulates the navigable waters of the United States. Today, the Corps maintains over 12,000 miles of waterways. These waterways carry about 1/6 of the Nation's inter-city freight, at a cost per ton-mile about 1/2 that of rail or 1/10 that of trucks. The Corps also dredges 300 commercial harbors, through which pass 2 billion tons of cargo a year, and over 600 smaller harbors. With more than 15 million American jobs dependent on our import and export trade, these ports are vital to our economic security. The ports and waterways also play a role in national defense.

The Corps also carries out its major flood control mission with systems of dams and levees. The Corps of Engineers' 383 dams and 8,500 miles of levees prevent \$16 billion in flood damages on an average annual basis. The Corps also has an active Flood Plain Management program providing important services to communities and to the public. While most of the past Corps of Engineers flood protection projects are structural, we are committed to giving full consideration to non-structural measures as well.

The Corps' ecosystem restoration mission has evolved over the past decade, and is now an essential part of our program. Our Ecosystem Restoration mission provides an opportunity not only to restore valuable environmental resources, but also to carry out projects that more effectively balance economic and environmental needs.

In addition to its primary missions, the Corps of Engineers may address water resource problems through certain other authorities. These include: shore and coastal projects to provide flood protection for coastal communities and water supply, recreation, hydropower and fish and wildlife resources are included as project purposes in our multiple purpose dams and reservoirs. The Corps can often construct small projects more quickly through its continuing authorities program. These smaller projects do not require specific Congressional authorization.

ECOSYSTEM RESTORATION INITIATIVES

I would like to touch upon some of the Corps of Engineers projects that reflect our Ecosystem Restoration mission.

We are currently investigating measures to restore the Everglades to a more natural historic condition, while balancing future requirements for other uses such as municipal, industrial, and agricultural water supply. We are working in partnership with Department of Interior, EPA and other Federal agencies, state and regional agencies, and public interest groups to develop a plan that will balance future needs while restoring this unique resource.

Poplar Island is an island in Chesapeake Bay that is being restored through an effective partnership of environmental and economic interests. The ecosystem restoration project is being constructed in the footprint of an eroding island in the Bay. It will serve as a placement site for 38 million cubic yards (CY) of dredged material from the Baltimore Harbor navigation project over the next 24 years. Ultimately, the project will provide important wetland (555 acres) and upland habitat (555 acres). The project was planned and designed by a partnership that included the Corps of Engineers, EPA, Fish and Wildlife Service, National Marine Fisheries Service, and several agencies of the State of Maryland, including the Maryland Port Administration and the Maryland Environmental Service.

Sonoma Baylands is a 348-acre hayfield on the shore of San Pablo Bay near San Francisco that we are restoring to a tidal salt marsh habitat. About 2 million CY of dredged material were used to restore the ground elevation to the historic tidal marsh elevation. Construction started in 1994 and the \$8 million project was completed in 1998. The California State Coastal Conservancy sponsored the project and now maintains the site. The Corps continues to assist with monitoring and remediation, as needed, of the project's ecological features.

The Napa County Flood Control and Water Conservation District, and the Corps are partners in an effort to provide 100-year flood protection, restore a "living" river, and address watershed needs. The emphasis on preserving environmental qualities of the river has resulted in a project very different from a traditional channelization solution. The \$182 million project includes:

- Lowering old dikes;
- providing terraces for flood flows and 108 acres of new wetland habitat;
- utilizing a dry oxbow to bypass high flows;
- maintaining existing stream geometry by removing some bridges and replacing others;
- adding new levees and floodwalls;
- stabilizing river banks;
- adding grade control structures to reduce erosion;
- emphasizing aesthetics; and
- including recreation trails.

We just signed a Project Cooperation Agreement and initiated construction.

WATERSHED PLANNING

Watershed Planning provides an opportunity to address all water resources purposes in a holistic perspective. Perhaps unique among Federal agencies, the Corps of Engineers has been organized along major watershed boundaries. And while much of the recent attention to watersheds has been focused on the environmental aspects of watersheds, it is important that we consider the full range of watershed resources in our investigations.

One example of a recent Corps of Engineers watershed resource study is in the Willamette River Basin. In partnership with the Oregon Department of Water Resources, we are investigating project modifications at 13 reservoirs for future needs, including navigation, water supply and recreation. Over 60 entities helped fund this study. Population growth, increasing development, expanding irrigation and listings under the Endangered Species Act are place new demands on the reservoirs that could effect project operations. The study will determine how and to what the extent the reservoirs may help to meet future water demands in the valley and if changes in project authorizations are necessary. The study will be complete in 2001.

CIVIL WORKS INITIATIVES

I would also like to address some efforts, which relate what we are doing at Headquarters to the Illinois Watershed. These include process improvements, efforts to improve plans and projects, utilization of common sense planning, and partnerships.

We are currently making several improvements to our processes. We are redefining the roles of our Headquarters, Divisions and Districts. The bottom line will be greater empowerment to our field offices where the work is done. We are streamlining the process for preparing and reviewing Corps studies and reports, to reduce the time and cost to reach a decision on project feasibility. We are also streamlining our planning guidance to make our process clear and understandable, to our project delivery teams, our partners and the public.

We are committed to continually improving our plans and our projects. We must view problems in a systems context, and the comprehensive watershed approach is an excellent example of this. We must explore the full range of alternatives -- structural and non-structural -- in solving watershed resource problems. We must consider innovative solutions. While the term may be overused, we need to think "outside the box" when necessary. We should apply all of our programs and authorities in solving watershed problems. We should use technical assistance programs such as Planning Assistance to States, Flood Plain Management Services, and our continuing authorities when they provide a fast track response to a problem.

Our process needs to be driven by common sense. For example, it doesn't make sense for everyone to agree on the best solutions to problems, while our procedures cannot reflect the value of those solutions. Our process needs to balance economic development and the environment in solving problems. We should not have to choose between one or the other. Our projects solve local problems, but they should also be the right answer from a global perspective. Our process must be cost-effective, but it must also be comprehensive. We need to take some time in investigating each project to look at the larger system in which our problem fits. But we should do that efficiently and effectively.

We are committed to strong partnerships. Wherever possible, we should apply our Corps of Engineers capabilities in providing assistance. We are teaming with local, state and regional governments to help solve problems. The Illinois River initiative is an excellent example of what our involvement should be. All Corps of Engineers projects are cost-shared. This contributes to the strength of our partnerships, but it sometimes slows the process. We will continue to work with our partners to make this system work effectively. We are committed to working with our other

Federal agencies to addressing your problems more effectively. We have numerous success stories and lots of opportunities for Federal TEAMWORK. As far as I am concerned, that is the only path to follow.

I am excited by the Illinois River System Partnership. You have an excellent Corps of Engineers team to work with – from the project delivery team to the Rock Island District and the Mississippi Valley Division. Corps Headquarters is also committed to be a strong part of that Team.

HYPOXIA: ILLINOIS ASSESSMENT WITH A BRIEF PERSPECTIVE ON THE NATIONAL ASSESSMENT

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INTRODUCTION

Recent assessments of hypoxia in the northern Gulf of Mexico (Rabalais et al., 1999; Goolsby et al., 1999; CAST, 1999) have identified the Midwest as the major source of excess nitrogen that is alleged to cause hypoxia. [Hypoxia is defined as a concentration of dissolved oxygen less than 2 milligrams per liter (mg/l) in water.] This presentation focuses on reconstructing the general trends of nitrogen and dissolved oxygen concentrations in the Illinois and Mississippi Rivers in the 20th Century. These data can be used to test key assumptions in the assessments of Gulf hypoxia.

The Illinois River has been the focus of intensive study for over a century. It is well documented that water quality and ecosystem health in the Illinois River deteriorated rapidly in the early 20th Century. An excellent history of the Illinois River is provided by Talkington (1991). Illinois is a young state in that there was little modern development prior to the mid-19th Century. It was a state dominated by tall-grass prairies, forests, and wetlands. Many parts of central and northern Illinois were poorly-drained, malarial marshes (Ackerknecht, 1945; Wooten and Jones, 1955).

Talkington (1991) describes how from the mid-19th to mid-20th Centuries the landscape and the rivers were greatly transformed by agricultural and rural development, urban growth, and engineering works. In northeast Illinois sprang up one of the world's greatest cities - Chicago - with a metropolitan population of over 7 million. The rate of improvement in wastewater treatment was for many decades outstripped by even higher rates of industrial and population growth. Many rivers became septic - even the hearty carp could not survive. Biological populations were decimated and hundreds of people died each year from diseases such as typhoid and cholera. Water quality and ecosystems have also been greatly influenced by variations in precipitation (floods and droughts), temperature, by the construction of locks and dams, levees, navigation channels, canals, diversions, and by dredging, drainage, and changing land-use practices.

Gradually, starting in the 1920s, waste management systems were implemented. With the subsequent enactment of pollution control laws and regulations, plus implementation of voluntary programs, remarkable improvements in water quality and aquatic ecosystems have occurred over the past few decades. The partial clean-up has been almost as dramatic as the deterioration at the start of the century.

In order to identify specific causes of changes in water quality, all these and other factors need to be considered. During the last half century, much attention has been given to the increase in nitrate concentration in many waters throughout the nation. While acknowledging that excessive

use of inorganic nitrogen fertilizer can result in high nitrate concentrations in surface waters, this presentation draws attention to other factors that also must be considered in evaluating the causes of changes in nitrogen concentrations in the Illinois and Mississippi Rivers.

NITROGEN CYCLE

The total nitrogen content of water is the sum of dissolved and particulate organic nitrogen, and inorganic ammonia, nitrite and nitrate. These different chemical forms of nitrogen can be transformed from one to another. Over time and under suitable conditions, all forms of both dissolved and particulate nitrogen can become biologically available. As many life forms are nitrogen limited, an increase in nitrogen availability often leads to an increase in biological productivity, i.e., an increase in the supply of nitrogen increases the amount of carbon dioxide that is converted to biomass. Excess nitrogen, and/or other nutrients, can lead to eutrophication - an excess of biomass which can deplete the dissolved oxygen in lakes, rivers, and marine waters by decomposing biomass back to carbon dioxide.

The nitrogen, carbon, and oxygen cycles are closely linked. Changes in the nitrogen cycle profoundly influence the carbon and oxygen cycles. Conversely, changes in the carbon and oxygen cycles profoundly influence the nitrogen cycle. Rabalais et al. (1999) and CAST (1999) examine many of the linkages among the carbon, nitrogen, and oxygen cycles in the northern Gulf of Mexico, but fail to examine these linkages in the Mississippi River Basin.

Like many chemical elements, nitrogen is often studied in terms of biogeochemical cycles. Biogeochemical cycles are continuous and have no beginning and no end, but for illustrative purposes we start and end in the atmosphere in describing the nitrogen cycle in very simple terms. Nitrogen in the atmosphere is fixed by various forms of vegetation, including algae, alfalfa, and soybeans. This nitrogen is used by plants and animals and the rich soils of central Illinois contain over 10,000 kg of natural organic nitrogen per hectare in the top meter or so. Organic nitrogen is present in living and decaying life forms. Especially in decaying life forms, organic nitrogen and associated bacteria can be particularly noxious and pose many risks to human health. Nitrogen in the plants and soils, and nitrogen fertilizer, can be transformed into inorganic forms of nitrogen such as ammonia, nitrites, and nitrate. Each molecule of nitrate contains three atoms of oxygen and one atom of nitrogen - NO_3 . The production of nitrate from organic nitrogen and ammonia requires much free oxygen and is a necessary step in the cleansing of organic-rich systems. If there is not enough free oxygen in water to meet biochemical demands, organic nitrogen and ammonia cannot be converted to nitrate. The production of nitrate is a necessary step in transforming organic nitrogen and ammonia into nitrogen gases which can be returned to the atmosphere to complete the nitrogen cycle.

In addition to being a vital factor in explaining trends in the various forms of nitrogen, the concentration of dissolved oxygen in surface waters is perhaps the best single indicator of the health of aquatic ecosystems. To use the words of the Illinois Environmental Protection Agency: "*Dissolved oxygen is the most significant element to aquatic life and an indicator of quality.*" (Sefton et al., 1980).

DATA SOURCES AND QUALITY

It is important to note there are no continuous records of water quality for the Illinois and Mississippi Rivers over the last century. If there were, ours would be an easy job; in fact, many scientists before us would simply have gone to the archives and pulled out the nitrogen trends.

What we have done is reconstruct hundred-year trends of nitrogen concentrations in the Illinois and Mississippi Rivers by assembling highly-fragmented data sets of varying quality. The monitoring sites have changed over time, a variety of measurement, storage, and analytical methods have been used, varying forms of nitrogen have been measured, and the measurements have been taken at varying points in time. Turning the fragmentary data into historical trends has been like putting together a jigsaw puzzle when many pieces are missing and there is no color picture for guidance. Despite many inhomogeneities and data gaps, we are confident that the overall trends are reasonably accurate. Confidence in the trends is enhanced by demonstrating their consistency with some known variations in nitrogen sources (e.g., population and industrial growth and changing farming practices) and with changes in dissolved oxygen concentrations.

The many data sources are identified in the last section - Data Sources and References. Many of the data reside in the libraries of the Illinois State Water and Natural History Surveys. That these data are being used a hundred years after they were collected testifies to the scientific thoroughness and powers of observation and reporting of scientific giants such as A. W. Palmer, S. A. Forbes, and C.A. Kofoid.

For the Lower Mississippi River, we have much less data than for the Middle Mississippi River and the Illinois River. For St. Francisville, LA, Goolsby et al. (1999) and Turner and Rabalais (1991) provide nitrate concentrations for 1905-1906, 1933-1935, and for 1954 onwards. Goolsby et al. (1999) also provide data on average organic nitrogen and ammonia concentrations for St. Francisville for 1980-1996. No data on organic nitrogen and ammonia concentrations at St. Francisville are presented for the first three-quarters of the century. To reconstruct the concentration of total nitrogen, we apply the same nitrate plus nitrite : organic nitrogen plus ammonia ratio reported for the Middle Mississippi River to the nitrate plus nitrite values reported for St. Francisville. Given the fact that the Lower Mississippi River is today richer in organic nitrogen and ammonia than the Middle Mississippi River, this ratio method is likely to be conservative in estimating total nitrogen concentration at St. Francisville. Goolsby et al. (1999) assume that "*there are no instream losses of nitrogen between the outflow point of each large basin and the Gulf of Mexico*", thus providing a framework for linking variations in nitrogen in the Middle and Lower Mississippi Rivers.

WATER-QUALITY TRENDS

Figure 1 shows the reconstructed trends of various forms of nitrogen in the Middle Illinois River (Peoria to Havana). The top curve shows total nitrogen. Similar trends in the Middle Mississippi River (St. Louis to Cairo) and the Lower Mississippi River (St. Francisville, LA) are provided in Figures 2 and 3 respectively. Figures 4 and 5 show the trends in the concentration of dissolved oxygen in summer in the Upper Illinois and Middle Mississippi Rivers.

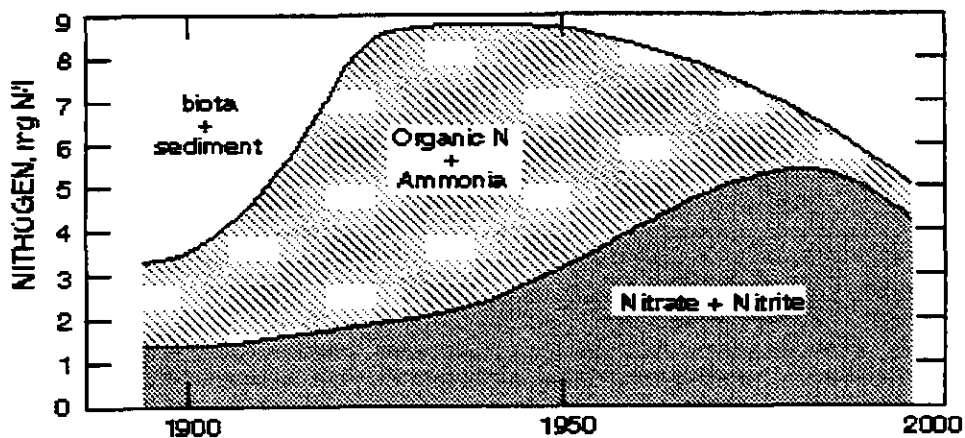


Figure 1. Concentration of nitrogen in the Middle Illinois River (Peoria to Havana)

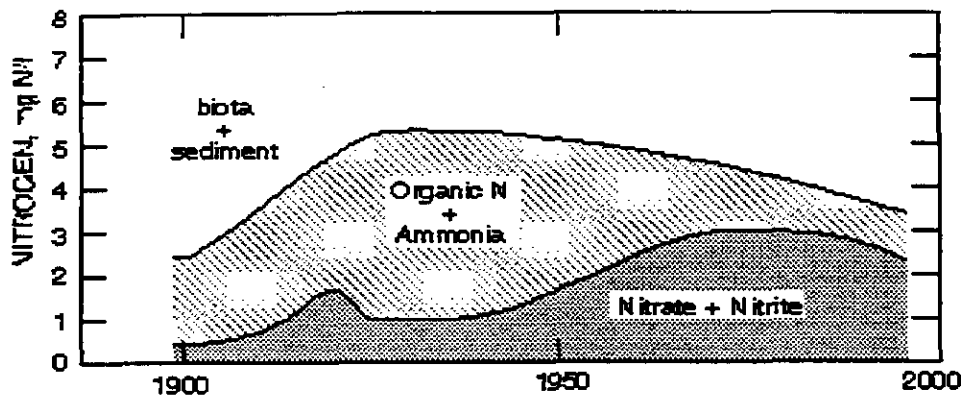


Figure 2. Concentration of nitrogen in the Middle Mississippi River (St. Louis to Cairo)

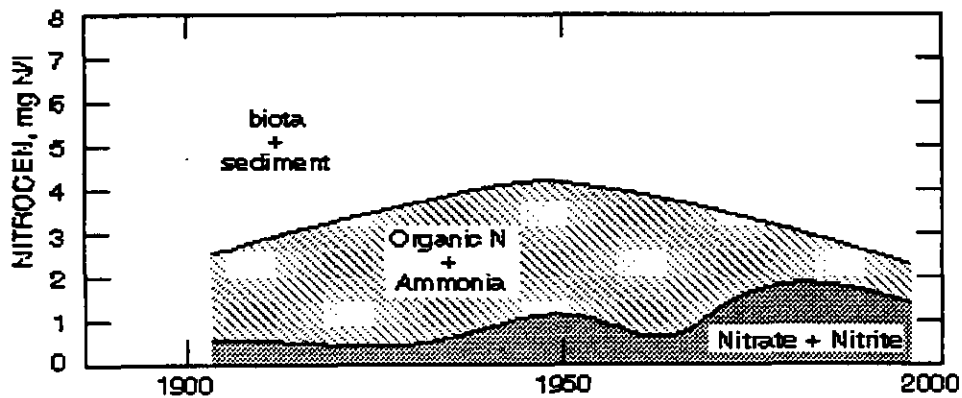


Figure 3. Concentration of nitrogen in the Lower Mississippi River (St. Francisville, LA)

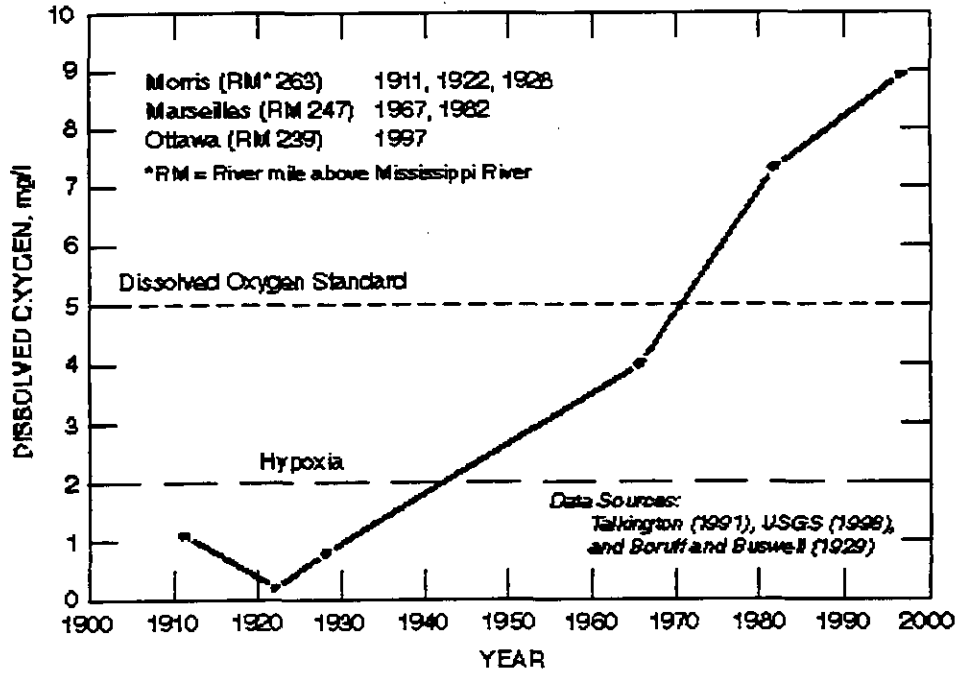


Figure 4. Summer values of dissolved oxygen in the Upper Illinois River

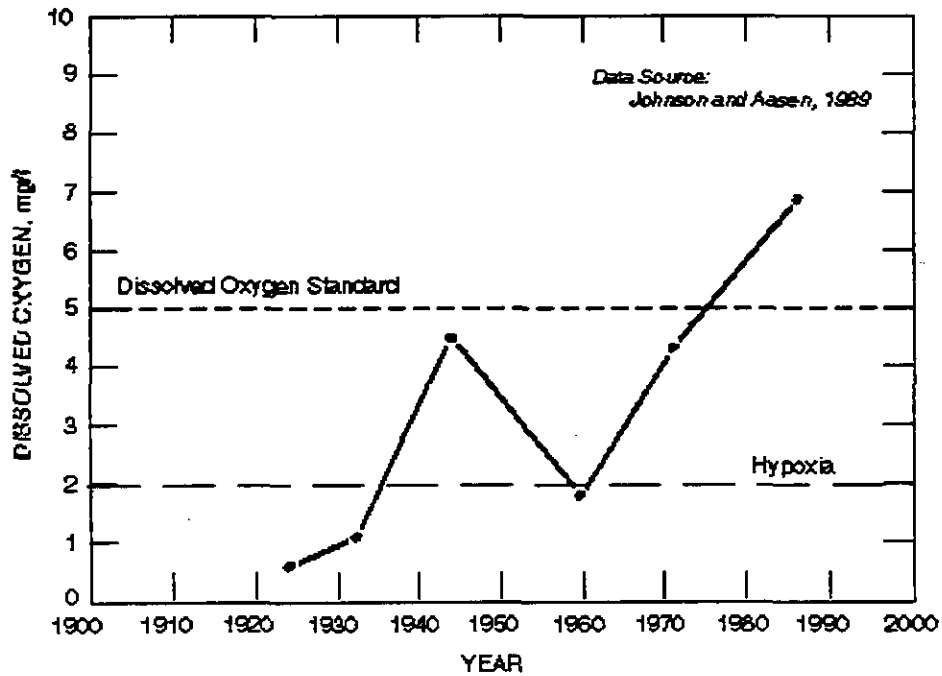


Figure 5. August mean values of dissolved oxygen in the Upper Mississippi River at Newport, MN

The following are the main features of the trends:

1. The concentration of total nitrogen increased rapidly in the early decades of the century and subsequently decreased.
2. Nitrites and nitrate constituted about 40-45 percent of total nitrogen in the Illinois River and 20-25 percent in the Mississippi River at the start of the century. Organic nitrogen and ammonia constituted about 55-60 percent of total nitrogen in the Illinois River and 75-80 percent in the Mississippi River.
3. In recent years, nitrites plus nitrate have constituted about 80 percent of total nitrogen in the Illinois River and 60-70 percent in the Mississippi River. Organic nitrogen and ammonia constitute about 20 percent of total nitrogen in the Illinois River and about 30-40 percent in the Mississippi River.
4. The concentration of dissolved oxygen in sections of the Illinois and Mississippi Rivers decreased rapidly during the first two decades of the century, remained at low levels until mid-century, and subsequently increased. In 1928, the Illinois River was hypoxic as far downstream as Rome (river mile 178). Even as far downstream as Kampsville (river mile 32), average June-August concentration of dissolved oxygen in 1928 was 2.4 mg/l (Boruff and Buswell, 1929). Hypoxia was even worse in the bottoms of the rivers. The river bottoms of nearly the entire lengths of the Illinois and Upper Mississippi Rivers became hypoxic (Richardson, 1928; Ellis, 1931; Scarpino, 1985).

INTERPRETATION

Changes in concentrations of nitrogen and dissolved oxygen must be interpreted in the context of dynamic and interactive chemical, physical, and biological systems. Understanding systems dynamics requires consideration of the inputs, transformations, transport, storage, and release of chemicals. Changes in the inputs of nitrogen to the rivers can account for many changes in nitrogen concentrations in rivers. However, nitrogen and dissolved oxygen concentrations are also influenced by many other factors such as suspended sediments, bottom-load sediments, water quantity, biological productivity, biochemical oxygen demand, and nitrogen fixation and denitrification. The forms of nitrogen in the rivers are also influenced by direct inputs, together with other factors such as temperature, precipitation, microbial activity, other nutrients, chemical and biological transformations, and the availability of dissolved oxygen. The complexity of the nitrogen cycle can result, for example, in observed increases in nitrate concentrations when total nitrogen inputs are constant or declining. Consequently, full interpretation of reported changes in nitrogen concentrations in rivers is beyond the scope of this presentation. In fact, this is the first time that these nitrogen trends have been presented and full interpretation and refinement of the trends is a subject of future research. We concentrate in this presentation on identifying some of the major factors that must be considered in such research.

At the start of the century, the amounts and chemical forms of nitrogen are probably due mainly to natural processes. Three dams already existed on the Illinois River, the Illinois and Michigan Canal had been built, and waste from urban centers was increasing. Nevertheless,

Bellrose (1979) concluded that: *"During the late 1890's, the waters of the Illinois River still ran comparatively clear."*

Palmer (1903) documented the large amount of organic matter in the Upper Illinois River from human and animal waste, especially from Chicago and Peoria, but recognized that in the Lower Illinois River the organic matter *"consists of vegetable matters."* He also reported that *"The enormous quantities of nitrates found in the water at Averyville and Kampsville during March and April, the freshet season, are in the main derived from the leaching of surface soils by the run off and the discharge of tile drains."* Clearly, very little of the large amounts of nitrates in the Illinois River a century ago can be attributed to the application of inorganic nitrogen fertilizer or atmospheric deposition, which began on a large scale only after World War II.

Kofoed (1903) reported luxuriant vegetation on many stretches of the Illinois River and its backwater-lakes. He estimated that perhaps 300,000 tons of phytoplankton were exported from the Illinois River to the Mississippi River each year, in addition to vast amounts of plant debris. Considering only the plankton, and assuming a carbon to nitrogen ration of 6:1, this represented an export of about 40,000 tons per year of nitrogen. Additional large quantities of nitrogen must have been stored in the luxurious nitrogen-rich vegetation of the river and transported downstream as debris. Although a large part of the nitrogen in the Illinois River at low flow appeared to be from urban and industrial sources, the vast majority of nitrogen in winter and spring - high flow and high concentration - was from other sources, mainly non-point source runoff (Palmer, 1903).

The first quarter of the 20th Century saw a rapid deterioration in water quality and ecosystem health and productivity. Talkington (1991) noted that: *"By 1922, the Illinois River carried waste equivalent to the volume that would be produced by 6.2 million people. By 1962, the waste had been reduced to 28 percent of the 1922 level. By 1971 volumes were cut to 13 percent. Another 32 percent reduction by 1982 brought the total waste load down to 9 percent of the original 1922 level - equivalent to the volume that would be produced by about half a million people."*

Diversion of water from Lake Michigan diluted the waste to some degree. During the first 4 decades of the century, an average of over 7,000 cubic feet per second (cfs) were diverted. This was reduced to 1,500 cfs in 1938 and raised to 3,200 cfs. in 1961 (Bellrose et al., 1979). The reduced diversion of Lake Michigan can be expected to have resulted in higher concentrations of pollutants.

Large amounts of nitrogen were also removed from the newly cultivated and drained fields. Jenny (1941) reported that about 40 percent of the large quantities of organic nitrogen in virgin soils is removed during the first 40 years of cultivation. This amounts to the removal of billions of tons of nitrogen throughout the country (Viets and Hagman, 1971).

One reason for the high concentration of organic nitrogen and ammonia in the rivers was undoubtedly the lack of sufficient dissolved oxygen to meet the high biochemical demand, including the oxidation of organic nitrogen and ammonia to nitrate. Data presented by Palmer (1903) show that in the late 1890s and early 1900s, the oxygen consumed in the Mississippi River from Quincy to Chain-of-Rocks exceeded oxygen consumed along the Illinois River, even at Morris on the Upper Illinois. [Oxygen consumed is the amount of oxygen required to oxidize the organic matters present in water. However, as many organic matters are not affected by the oxidizing agent, the quantity of oxygen consumed does not bear a direct and definite ratio to the total quantity of

organic matter contained.] Hypoxia - the depletion of dissolved oxygen - was probably caused by the high biochemical demand for dissolved oxygen.

Another reason for the persistence of high concentration of dissolved nitrogen in the Illinois River through mid-century was the loss of aquatic vegetation and other forms of aquatic life. In the early 20th Century, Kofoid (1903) described the nitrogen dissolved in the water as the "unutilized" residue not taken up by the vegetation. Bellrose et al. (1979) noted that: "*Aquatic and marsh vegetation declined almost to the point of extinction during the middle years of the study period (1938-1976).*" This decline of vegetation represented the loss of a major reservoir for nitrogen. Instead of being utilized by the vegetation and converted to particle form, large amounts of nitrogen must have remained dissolved in the water and contributed to high concentrations of dissolved nitrogen in the Illinois River.

During the first half of this century, when agriculture was principally animal-powered (U. S. Department of Agriculture, 1947), large numbers of farm animals contributed to the high nitrogen concentrations in the rivers. For example, during the period 1920-1940 there were about 60 million horses, sheep, and mules in the USA. With the transition to machine-supplied horsepower, the number dropped to less than 20 million. In 1980-1996, animal manure was estimated to contribute about 15-20 percent of the nitrogen flux down the Mississippi River (Goolsby et al., 1999; Doering et al., 1999).

Despite increases in the inputs of nitrogen fertilizer and atmospheric deposition of nitrogen, and heavier rainfall over recent decades (Goolsby et al., 1999), there has been a decrease in the concentration of total nitrogen in the Illinois and Mississippi Rivers. A combination of factors responsible for this decrease probably include the following: implementation of wastewater treatment programs; decreased mineralization of soil nitrogen; the evolution of more mature and efficient farming systems; the implementation of regulatory and voluntary pollution prevention and land conservation programs; and a change from animal-powered to machine-powered agriculture.

Nitrogen also constitutes a fraction of the sediment transported by the Mississippi River to the Gulf each year. Data on the USGS home page indicate that the transport of sediment to the Gulf has decreased by about 70 percent over the last three centuries. Most of this decrease occurred after the construction of locks and dams in the late 1930s. If all the nitrogen associated with sediment were included in the calculations, the decrease in nitrogen transported by the Mississippi River to the Gulf of Mexico over the last 50-60 years would be even greater than shown in Figures 1-3.

The rivers have changed from being disease-ridden and organic rich to being less polluted and more inorganic. The increased concentrations of dissolved oxygen have allowed much of the reduced concentrations of organic nitrogen and ammonia to be transformed into inorganic nitrate, which can then be converted to nitrogen gases and released to the atmosphere.

ASSESSMENTS OF HYPOXIA IN THE NORTHERN GULF OF MEXICO

The federal government, under the interagency Committee on Environment and Natural Resources (CENR) of the White House Office of Science and Technology Policy, the Council for Agricultural Science and Technology (CAST), and the Environmental Institute of the University of

Alabama have recently produced science assessments of the causes and effects of hypoxia in the northern Gulf of Mexico (Goolsby et al., 1999; Rabalais et al., 1999; CAST, 1999; Carey et al., 1999). Rabalais et al. (1999) and CAST (1999) conclude, on the basis of assumptions, selected data, and models by Goolsby et al. (1999), that the transport of nitrogen from the Mississippi River Basin has increased about 3-fold in the last 30 years. CAST (1999) concludes that *"Nitrogen export from the Mississippi River Basin has increased 2- to 7-fold over the last century."* CAST (1999) recognizes that *"the Mississippi River's discharge has increased only slightly since the 1900's, while N flux has increased more."* These assumed increases in the transport of nitrogen from the Mississippi River Basin are then used by Rabalais et al. (1999) to calculate an assumed increase in primary productivity in the northern Gulf of Mexico. The assumed increase in primary productivity is then assumed by Rabalais et al. (1999) and CAST (1999) to result in a depletion of dissolved oxygen and a worsening hypoxic situation.

CONCLUSIONS

Much unique and valuable data resides in the Illinois Scientific Surveys. The mining of these data and their interpretation in the context of linked biogeochemical cycles has demonstrated that the Illinois and Mississippi Rivers are cleansing themselves. Increases in nitrate concentrations in recent decades must be considered in the context of large decreases in the concentration of organic nitrogen and ammonia.

The data presented here demonstrate that the concentrations of nitrogen in the Illinois and Mississippi Rivers have decreased over the last 50 years and are today about the same as they were a century ago. These data invalidate the above key assumptions used by Rabalais et al. (1999) and CAST (1999) in the Gulf of Mexico hypoxia assessments. If the concentration of total nitrogen in the Lower Mississippi River had increased 2- to 7- fold over the last century, it would now be 5.0 to 17.0 mg N/l. The average concentration of total nitrogen at St. Francisville for 1980-1996 was, in fact, 2.26 mg N/l (Goolsby et al., 1999).

Water-quality and ecosystem changes in the Gulf of Mexico should be evaluated using the trends in total nitrogen shown in Figures 1-3, rather than being based on erroneous assumptions. At the same time, a careful evaluation of the homogeneity of historical records needs to be undertaken.

Sound policies must be based on sound science.

ACKNOWLEDGMENTS

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ILLINOIS' PERSPECTIVE ON TOTAL MAXIMUM DAILY LOADS (TMDLS)

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ABSTRACT

Section 303(d) of the Clean Water Act (CWA) requires states to: (1) identify waters which will not attain applicable water quality standards with technology-based controls alone (e.g., those that are water quality limited); (2) establish a priority ranking for such waters, taking into account the severity of pollution and the uses to be made of such waters; and (3) target watersheds for the development of Total Maximum Daily Loads (TMDLs) that would be initiated before the next biennial reporting period. As a result, the Illinois 1998 303(d) list consists of a total of 741 waterbody segments (539 stream segments; 201 inland lake segments; and 1 segment for Illinois' portion of Lake Michigan) which have been ranked within 336 watersheds. New federal regulations for the 303(d) program are currently in the offing. Highlights from these new, as yet proposed, requirements and their implications on the waterways in Illinois and the approach the state will take on the development of TMDLs will be presented.

INTRODUCTION

The Clean Water Act (CWA) recently celebrated its 25th anniversary, but until very recently even those who track the daily activities in the field of water pollution control could tell you little of the requirements or meaning of Total Maximum Daily Loads. Section 303 of the CWA contains provisions for developing and revising water quality standards and for a continuing planning process that lets USEPA approve state effluent limits, area-wide management plans, inventories of wastewater treatment works and other actions the states may need to comply with the water quality standards set out in other parts of the CWA. These provisions have been actively worked on for decades – but not so for Section 303(d), the TMDL program. With the publication of proposed new regulations (40 CFR 122, 123, 124, 130 and 131) on August 23, 1999, past actions by affected dischargers, environmental interest groups, the states and USEPA may merely be prolog for the “new world” of TMDLs about to unfold. These past actions have included, through September 1999:

- 17 federal court orders for USEPA to develop TMDLs if specific states fail to do so (1986-1999);
- 12 cases in which litigation was filed to compel USEPA to develop TMDLs in specified states; and
- 5 notices of intent to sue, to compel USEPA to develop TMDLs.

If litigation -- and recent litigation at that -- is any measure of the importance of TMDLs, then these numbers speak of the increasing value of completed and approved TMDLs. Litigation at this rate also begs the questions: what are TMDLs, what are the implications on existing and proposed wastewater dischargers, and what effect will TMDLs have on nonpoint sources such as row crop and livestock production and construction generated runoff? In order to understand these issues and the impact of the new TMDL regulations -- assuming they are adopted as proposed -- the Section 305(b) water quality monitoring and evaluation process and its applicability to 303(d) must first be considered.

TMDLS AND 305(b)

Under the current regulations, TMDLs are the determination of the greatest amount of loading that a water can receive without violating the water quality standards. They are, in a mathematical sense,

$$\text{TMDL} = \text{WLA} + \text{LA} + \text{MOS}$$

where WLA is the wasteload allocation, or point source component, LA is the load allocation, or nonpoint source component, and MOS is the margin of safety, which must account for the limits of technical understanding and expertise in designing the TMDL. The goal of TMDLs, to achieve compliance with the water quality standards through an implementation plan designed to address all known loadings to the waterway, can be complicated by several factors:

- Changes to the water quality standards (e.g., a reduction in a currently used standard, or the establishment of an entirely new criterion);
- New problems uncovered (e.g., new data on fish tissue indicating contamination where none had been known to exist before);
- New priorities (e.g., expansion of the monitoring program into unsurveyed streams and lakes)
- Growth and development (e.g., water quality decline may occur, even if regulated point sources are known and controlled according to existing regulations); and
- Changes in environmental conditions (e.g., flow alteration due to the modification or construction of a dam).

It should be noted that implementation plans, under the current TMDL construct, have been argued to be more a requirement of Section 303(e), the continuing planning process, and not 303(d). This is one of the many points of controversy surrounding the TMDL program, and one of the issues that has become the subject of the recent proposed TMDL regulations.

In order for a stream or lake to be placed on the 303(d) List, that waterbody segment must be identified as failing to meet its designated use, the prescribed use(s) to which that water may be held. Those uses may include aquatic life support, fishing, swimming, drinking water and others. Water quality and other parameters are sampled/measured and evaluated each year for waterways

in Illinois. The sampling is conducted within an overall monitoring program that can be subdivided into several sampling efforts, established for specific data needs. Some of the monitoring programs now underway are the Ambient Water Quality Monitoring Network (AWQMN), the Pesticide Monitoring Subnetwork, the Industrial Solvent Subnetwork, the Intensive Basin Surveys, Lake Michigan Monitoring and Fish Contaminant Monitoring. All told, 4000 monitoring stations around the state are used to collect data on chemical, physical and biological parameters.

While all monitoring networks have specific goals, locations and time frames for sampling, one common use of the data collected is the biennial publication of the 305(b) Water Quality Report. The 305(b) Report, in short, contains data and summaries on all monitoring statewide and the identification of all assessed streams that do not meet designated uses. To arrive at this point, the collected data are reduced through further refinement and evaluation steps in which the water chemistry, sediment chemistry, fisheries and macroinvertebrate data are classified using a relative scoring system. Over the years, the following lake acreage and stream miles have been assessed:

Table 1
Illinois Stream Miles and Lake Acreage Assessments

305(b) reporting cycle	Data collection period	Lake acres assessed	Stream miles assessed
1986	1984-1985	25,302	3400
1994	1992-1993	N/A	14,159
1996	1994-1995	188,243	28,454
1998	1996	188,288	28,448

The 1998 data represents 83.6% of the total lake acreage and 32.7% of the total stream miles in the state. Of those waterbodies assessed, overall lake use attained full or partial support on 89.2% of the acres assessed, and streams attained full or partial status on 99.1% of stream miles assessed.

The 305(b) Report also provides an indication of water quality trends for a given waterway. Those with declining trends are identified as "threatened" and are placed on the 303(d) List. All waters that were previously identified on an earlier 303(d) List are carried over to a new List, unless a TMDL has been completed. Waters for which a sport fish consumption advisory has been issued are also included on the 303(d) List. Finally, USEPA recently required that streams identified as impaired due to nonpoint sources of pollution be included. This last factor resulted in a major expansion of the Illinois 1998 303(d) List.

The role of a proper, comprehensive lake and stream water quality monitoring program, as it affects the 303(d) List, cannot be understated. Lacking that data, the causes and sources of water impairment cannot be evaluated and fundamental levels of use attainment could not be determined. The 303(d) List, then, is the subset of waters assessed under the 303(b) stream and lake monitoring and evaluation process that do not meet those use designations and are therefore identified as impaired.

Figure 1 indicates the percentage of stream miles impaired by various factors as determined under the 305(b) process.

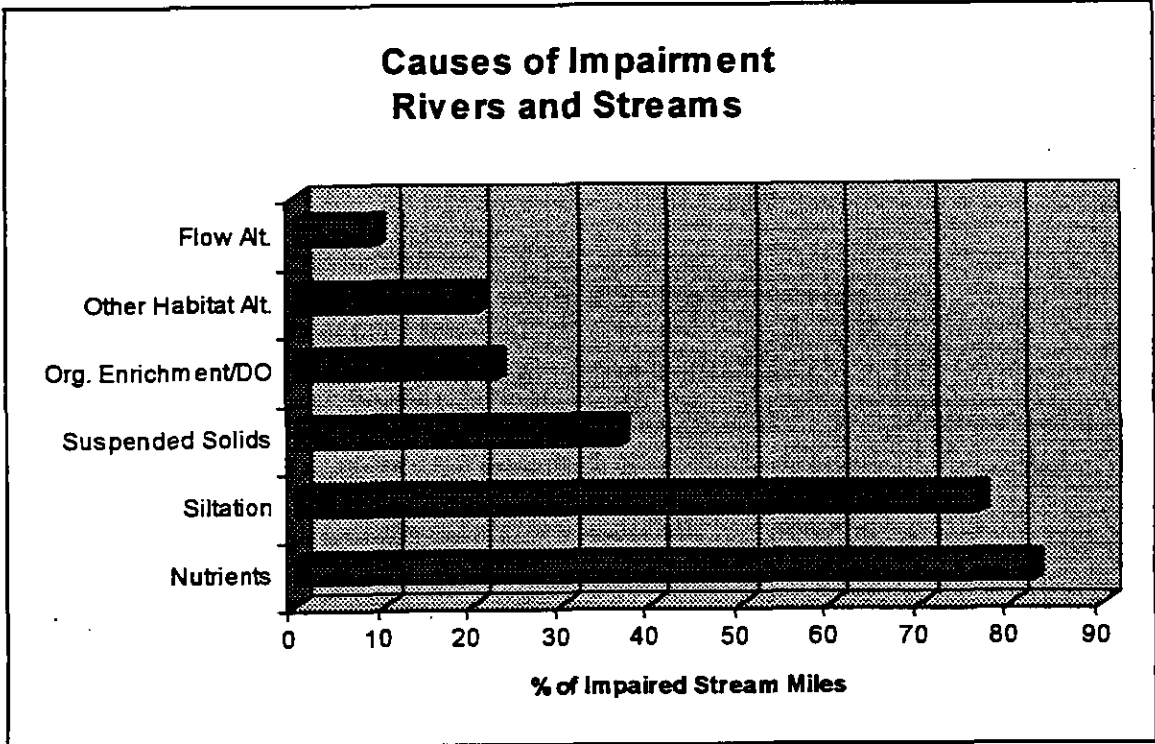


Figure 1.

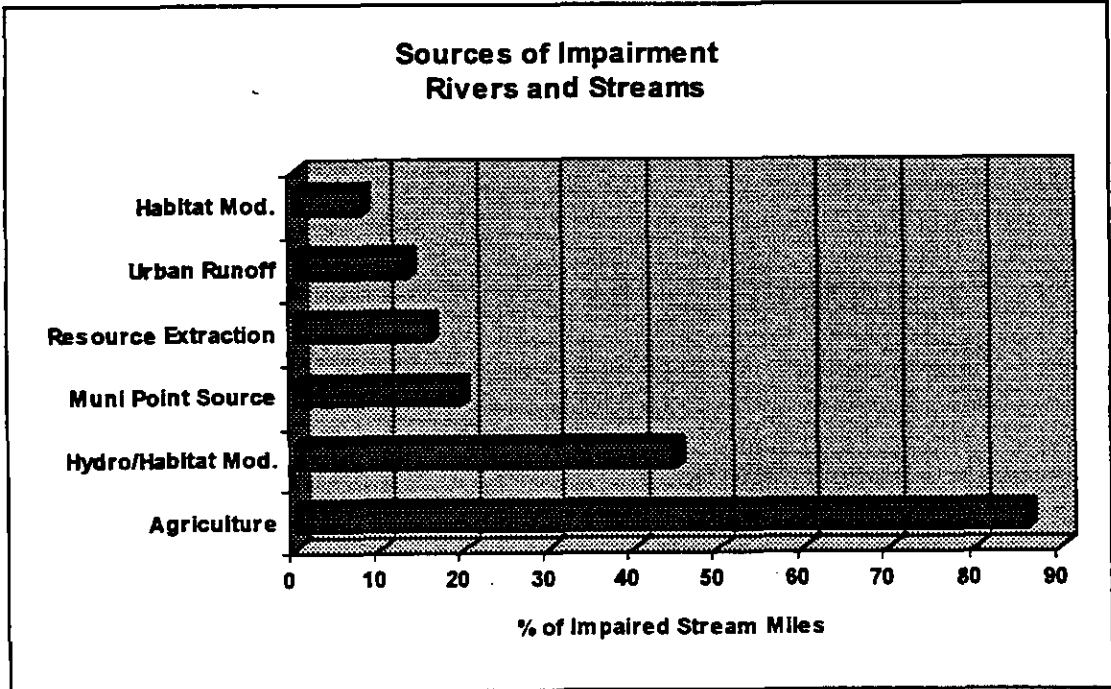


Figure 2.

Sources of impairment are identified in Figure 2, and include agriculture, hydrologic/habitat modification and municipal point sources as the three highest ranked sources. Causes and sources of impairment are required data in the 303(d) List, and both are derived from the data collected and evaluated for the 305(b) Report.

According to the USEPA TMDL requirements, impaired stream on the 303(d) List must be ranked as a means of determining the order in which TMDLs will be developed. States are allowed flexibility in establishing this ranking procedure. Illinois used the following method for the 1998 303(d) List. Segments with sport fish advisories were included, while other segments were added based on a scoring system in which the severity of pollution and the use and resource value were assigned separate numeric scores. Pollution severity was assigned a weighting factor based on the support use classification (i.e. nonsupport segments received a factor of 4). These factors were then multiplied by the stream miles or lake acreage affected. Uses and resource value were scored on the basis of the following point system:

- Illinois River and lakes greater than 4000 acres = 10 points
- Public water supply lakes and waters = 10 points
- Mississippi River and lakes between 2-4000 acres = 9 points
- Water used for swimming = 5 points
- Major tributaries and lakes less than 1000 acres = 4 points

The total score, and the basis for ranking those segments, is the sum of the scores for the severity of pollution and the use and value of the resource.

THE 1998 303(d) LIST

The most recent submittal of the 303(d) list was approved by USEPA on August 19, 1999 and includes 741 waterbody segments -- 538 stream segments, 201 inland lake segments and Illinois' portion of Lake Michigan. Although the importance of the List to dischargers, potential dischargers and users of Illinois surface waters has yet to be fully determined, the waters on the Illinois 303(d) List make up only 5% of all waters in the state. A representation of the listed waters is shown in Figure 3.

As approved, the 1998 303(d) List contains a schedule for the development of TMDLs that will be done over the next two years. That two year schedule contains 25 stream and lake segments within seven watersheds throughout the state (see Table 2).

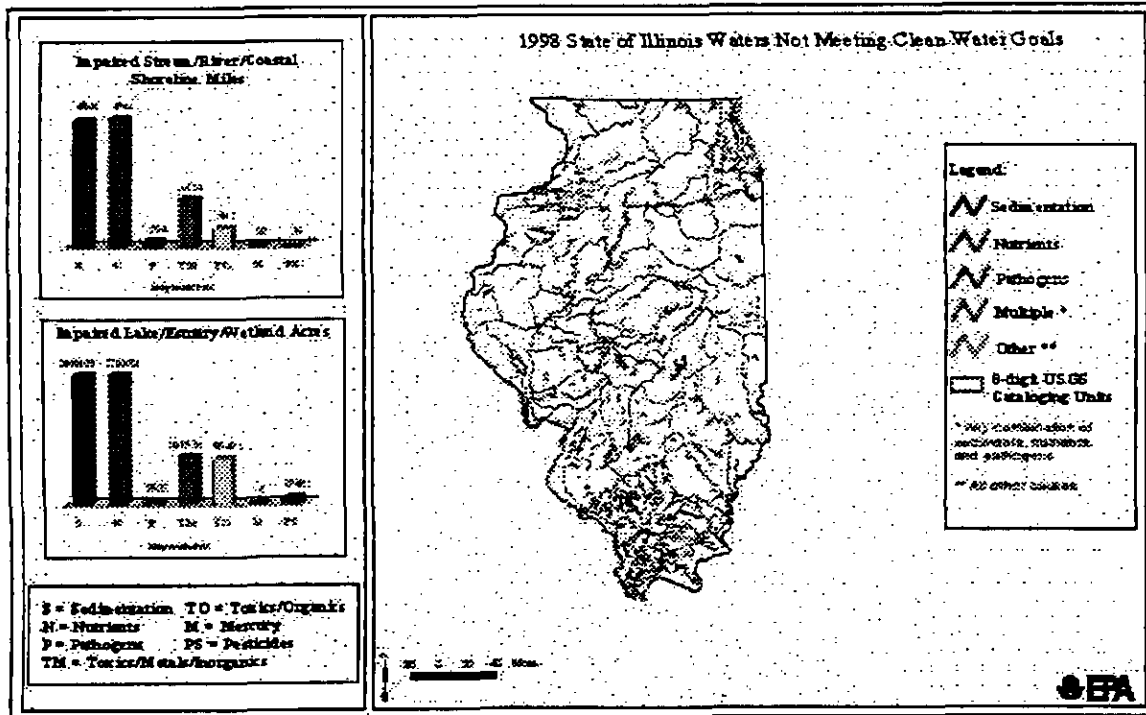


Figure 3. 303(d) Waters in Illinois.

Table 2
Waterbodies on the 1998 303(d) List -- 2 Year Schedule

Waterbody	Size (miles/acres)	Rank
Busse Woods	590	4
Meachum Creek	2.89	4
Salt Creek (2 segments)	22.75 and 14.96	4
Spring Brook	3.29	4
Westbury	7.20	4
East Branch, DuPage River (5 segments)	3.18, 4.66, 8.92, 6.44 and 3.90	7
Hidden Lake	10.0	7
Lacey Creek	3.77	7
St. Joseph Creek	4.31	7
East Fork, Kaskaskia River	21.1	19
Kinmundy Reservoir	20.0	19
Cache River (4 segments)	7.25, 9.89, 2.97 and 0.12	23
Rayse Creek (2 segments)	13.05 and 16.69	24
Andy Creek	10.54	32
Big Muddy River	6.93	32
Kaskaskia River	6.42	56

Additional stream segments may be on the 1998 303(d) List identified with the same waterbody name; for purposes of this table, the identifications have been simplified and actual locations (watershed identification codes) have not been included. Since 1998 listings are based on 1996 data, updated data is evaluated to determine trends and to establish whether these segments should remain on the updated List. That process is now underway and it is likely that several segments, including those on the 1998 Two Year Schedule, may be considered for de-listing.

The streams on the 1998 two year schedule were selected based on their relative rank and the complexity of the identified causes and sources of impairment. As a result, these segments do not contain sources of a historic nature (i.e., sources associated with past activities or discharges that resulted in sediment contamination or other chemical, biological or physical modification not related to current land use practices), interstate waters or waters affected by air borne containments, all of which individually or collectively could inhibit TMDL development simply due to a lack of practical and available technical solutions or legal problems that may be encountered due to vagaries in the TMDL regulations.

TMDL DEVELOPMENT IN ILLINOIS

Now that the 1998 303(d) List has been approved, work on the development of TMDLs in Illinois has begun. In May 1999 the Illinois EPA issued a request for proposals for the 25 waterbody segments on the 1998 Two Year Schedule. Eight bids were received from interested contractors. At this time (October 1999), the award of a contract(s) is imminent.

The contractor(s) will be required to develop TMDLs and implementation plans for the waterbodies using water quality, fisheries, macroinvertebrate and other data collected by the Illinois EPA, and land use and other necessary data to generate a computer model of the basins in questions. Those models will be designed to facilitate decisions on how best to reduce loadings to the stream or lake from point and nonpoint sources.

Over the course of the 18 month contract, three rounds of public meetings will be held. The initial meeting, to be held shortly after the contractor(s) are selected, will afford the public an opportunity to hear more about TMDLs, the causes and sources of impairment for the segments on the 1998 Two Year List, and the projected plans by the Illinois EPA and our contractor(s) for the coming months. Two additional meetings will be held in or near the affected basins and will be specific to those waterbody segments, one meeting will occur about midway through the contract and one will be near the end. The later stage meetings will allow the public to be briefed and ask questions of the Illinois EPA and the contractor(s) about the ongoing and nearly completed work to establish TMDLs and implementation plans for those basins.

REVISIONS TO THE FEDERAL TMDL REGULATIONS

The draft regulations published on August 23, 1999 propose several key revisions to the manner in which the TMDL program will operate. Revisions are also proposed that link TMDLs to related parts of the water program under the Clean Water Act, those dealing with NPDES permits, antidegradation provisions and water quality standards. One of the most significant areas of contention under the existing TMDL regulations, the incorporation of nonpoint sources, has been firmly and specifically included under the proposed regulations.

Here are a few of the more significant points of the proposal made by USEPA:

- Nonpoint source management under these regulations relies on the ability of the TMDL to provide "reasonable assurance" that the plan to address the pollutant will be "implemented expeditiously" and have adequate funding to insure a satisfactory result. Options to provide this insurance include plans that rely on state regulations, local ordinances, or performance bonds, contracts, cost share agreements or memoranda of understanding. Regulatory alternatives are possible but not strictly mandated under this proposal.
- The degree to which the state that generates the data can decide which data should have greater value than other data (i.e., monitored versus evaluated data) has not been clearly resolved in the draft regulations. This appears to leave open to question whether data can and should be extrapolated, and by what degree.
- The proposal applies drinking water standards (maximum contaminant levels, or MCLs) at

water supplies, in situations when the parameter in question cannot be applied to the waterbody. MCLs were developed to protect human health as a result of ingestion of treated drinking water – not as ambient, aquatic life protection standards. Applying MCLs in this manner appears to circumvent to procedures states use in adopting water quality standards for specific waters and their respective uses.

- Antidegradation policy affords protection of the designated uses and also applies to waters which currently exceed the standards and those that are considered highly valued. Since these waters meet or exceed the standards by definition, then application of TMDLs to them appears to be an inconsistent policy. Those water that show a declining trend, whether subject to antidegradation or not, are currently evaluated for TMDLs.
- NPDES permits allow dischargers to operate within those effluent limit specified under the water quality standards. Since listing a segment under 303(d) prohibits the addition of pollutants until a TMDL has been completed, renewal, modification and issuance of new NPDES permit may become problematic. USEPA proposes to address the NPDES issue by allowing “offsets” (i.e., effluent trading, in which a discharger may negotiate a reduction in the pollutant load with a third party). The legalities, practicalities as well as the manner and degree to which monitoring and permitting may need to be established under the offset may all need further evaluation.
- In a move that will undoubtedly require an increase in the workload by the states administering the NPDES program, USEPA is reserving the option of “advancing” permits needing renewal that result in discharges to impaired waters. Currently those permits are allowed to remain as originally issued pending resolution of the problematic issues. Under this proposal, USEPA would require the states to move the renewal process forward, potentially requiring reductions in the established effluent limits for some dischargers.
- *Certain waters under this proposal will be given “high” priority, meaning that these waterbodies will be put on a fast track for TMDL development – possibly as fast as five years from the adoption of these regulations – based on the presence of threatened and endangered species, the use of those waters as drinking water supplies or the use of the waters by “sensitive aquatic species”. Historic, cultural and economic uses of the waterbody can also mean the designation of high priority status.*

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POTENTIAL USE OF INNOVATIVE DREDGE TECHNOLOGY AND BENEFICIAL USE OF SEDIMENT FOR RIVER RESTORATION

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During the past century sediment has filled over 70 percent of the volume of the Illinois River backwaters and side channels. Areas that were once six to eight feet deep are now 18 inches or less at normal pool. Sedimentation's dramatic adverse impact on recreational and environmental resources has been well documented (see references below). The sediment has essentially replaced a diverse benthic habitat with a flat, featureless layer of fine grained sediment under shallow water. Additionally, since 1900 higher average water levels resulting from the altered hydrologic regime have made it impossible for many native floodplain flora and fauna to remain in their historic locations. Within a generation most of the 60,000 acres of backwaters will be converted to willow covered mudflats if depth is not restored and sediment input reduced.

The filling of the of the backwaters is dramatically illustrated by the Department of Natural Resources flyer "Illinois River Backwaters Between Chillicothe and Lacon," included as Figure 1. In this seven mile stretch it is readily apparent that the islands which separated Babbs Slough from the main channel in 1970 were one long, wide peninsula by 1994. Areas such as the upper end of Sawyer Slough have essentially been converted to land and other areas such as the island in Wightman Lake near river mile 189 have widened and in some instances are now connected to the shore. At normal pool Babb's Slough now averages about eight inches in depth. This area was once several feet deep and famous for waterfowl hunting. Today hunters have difficulty getting their boats into the slough.

This paper focuses on an overview of concepts for removing sediment from the backwaters and side channels. Other speakers will discuss programs for reducing sediment inputs. The shallowness of the backwaters lends a sense of urgency to finding a way to remove vast quantities of sediment. The impending conversion of these areas from marginal aquatic habitat to terrestrial floodplain will further stress regional populations of invertebrates, fish, mussels, waterfowl and other organisms. Sediment in shallow water also contributes to turbidity and other water quality problems. It is easily stirred up by fish, waterfowl, waves and boats. Aerial photographs show sediment plumes up to a mile long behind recreational boats and several miles long behind barge tows (Figure 2).

The near-term sediment removal concept concentrates on restoring habitat diversity to some areas in the backwaters and on the floodplain. In short it calls for providing varied water depth in selected areas to provide areas for fish to overwinter outside the main channel while nearby shallows remain suitable for shorebirds. Excavated sediment can be used to build islands and elevated floodplain areas which approximate the elevations and hopefully the soil moisture conditions that existed prior to 1900. This will allow the return of many floodplain hardwoods and other species which cannot tolerate the current flood regime. The concept calls for converting shallow, marginal aquatic habitat into higher quality aquatic as well terrestrial habitat.

Illinois River Backwaters Between Chillicothe and Lacon

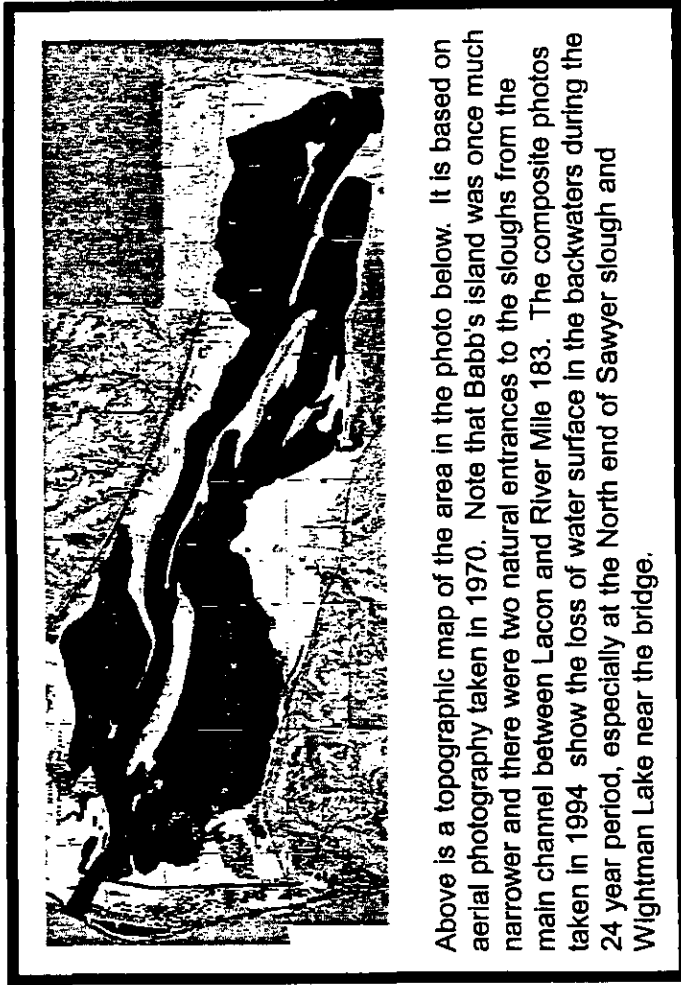
This map is a composite of aerial color, infrared photographs taken by the U.S. Geological Survey in 1994. The photos are available on the Web site of the Upper Midwest Environmental Sciences Center in LaCrosse WI. (<http://www.umesc.usgs.gov/>). Map compiled by the Waste Management and Research Center of the Illinois DNR.

The 60,000 acres of Illinois River backwaters have lost over 70% of their capacity since 1900. Backwaters that were six to eight feet deep now average less than 18 inches due to accumulated sediment.

The lakes and sloughs pictured here have lost much of their value to fish, waterfowl, and other plants and animals. Even shallow draft recreational boats frequently are unable to navigate these areas. The public has a huge investment in these backwaters, many are currently state and federal refuges. Unless depth is restored, these waters will totally fill with sediment and be converted to willow-covered mudflats.

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Figure 1.



Above is a topographic map of the area in the photo below. It is based on aerial photography taken in 1970. Note that Babb's island was once much narrower and there were two natural entrances to the sloughs from the main channel between Lacon and River Mile 183. The composite photos taken in 1994 show the loss of water surface in the backwaters during the 24 year period, especially at the North end of Sawyer slough and Wightman Lake near the bridge.



Route 17

The alternative is to lose virtually all of the aquatic habitat outside the main channel.

Most of the accelerated sedimentation in Illinois River has occurred since the Lake Michigan diversion began in 1900. Other dramatic changes over the century also impacted the river hydrology including the navigation channel and dams, altered farm practices, stream channelization, and urban runoff. Since the problem developed over a century, it is reasonable to expect a restoration effort to take as long as twenty years. This would provide time to remove, dewater, and find uses for sediment and allow funding to be appropriated over many years. A large scale restoration could involve removing hundreds of millions of cubic yards of sediment. In the Peoria area the sediment generally consists of fine grained silt and clay particles with little sand. The sediment averages about 50 percent moisture content and is similar to cookie dough in consistency. Figure 3 is a photo of a fresh sediment core.

TECHNOLOGY

River dredging to maintain Mississippi and Illinois navigation channels was historically associated with *environmental problems*, because the dredged material was frequently placed in backwaters and side channels. Conventional hydraulic dredges agitate the sediment, mix it with water and discharge a slurry consisting mainly of water carrying five to fifteen percent sediment. Today the slurry is usually pumped to a diked or bermed placement site where it settles and gradually dewater. Because it is mostly water it must be placed in a diked area and dried before



Figure 2. Fine grained sediment is easily resuspended, especially in shallow water. In this picture a suspended sediment plume several miles long is visible behind a barge tow in Upper Peoria Lake. Plumes of varying lengths are also generated by fish and recreational craft.

it can be moved or put to most beneficial uses. An advantage of the hydraulic dredge is that it can efficiently move the slurry for miles through relatively inexpensive pipelines. Disadvantages include the need to manage large volumes of water, resuspension of contaminants and sediment particles, and the total disruption of the structure and consistency of the in-place sediment. An alternate technique that reduces the amount of water added to the sediment, maintains its consistency, reduces resuspension would be desirable.

A number of high solids slurry pumps and similar devices exist which manufacturers claim can pump material with 30 to 50 percent moisture content under suitable conditions (Figure 4). A high solids pump could place material in a barge or on-shore holding area. Its advantage lies in the greater amount of sediment contained in the slurry which decreases the required amount of storage and bermed dewatering area. Such pumps could also be used to discharge sediment directly from the river or from barges onto fields or containment areas.

Clam shell buckets on floating cranes are commonly used to dredge channels and boat slips. They mix little water with sediment and can be used to directly build low islands such as those built in 1994 in Upper Peoria Lake. Their primary limitation on a major restoration project is the length of the boom. Material must be double handled if it is placed farther than the crane can reach.

DRE Technologies, Inc. of Nashville developed a new type of dredge which combines a small clam shell bucket with a displacement pump. Their dredge takes bites of sediment without

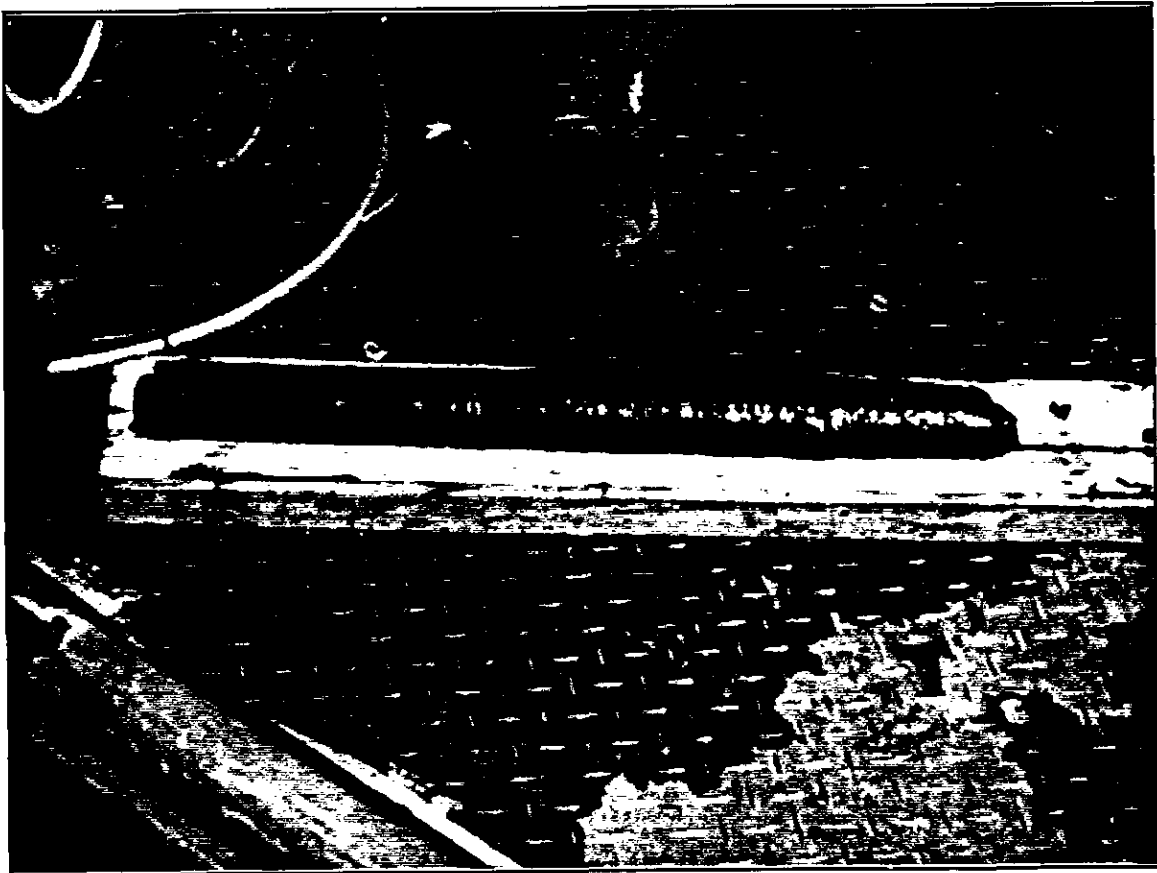


Figure 3. Sediment cores up to nine feet in length show that the sediment is soft but relatively firm. As seen above a fresh core keeps its shape and loses little water. If the sediment can maintain its in place consistency during excavation, it will be much easier to build islands or dewater on shore for other uses.

adding water, drops it into a small hopper, and a displacement pump sends it through a pipe at essentially *in situ* moisture content. The discharge is much thicker than that of a hydraulic dredge (Figure 5).

Bucket wheel excavators on tracks have been used for many years in the mining industry and for handling bulk materials. Engineers familiar with the design of these machines believe that they can be modified to operate in shallow areas of Peoria Lake and other backwaters. They would scoop sediment off the bottom and place it on a conveyor belt. Traction would be provided by wide, low ground pressure tracks. Figure 6 is an excavator on conventional tracks.

Caterpillar Inc and at least one other company is investigating the use of a large diameter excavating wheel mounted on a floating platform to remove sediment with very little resuspension or added water. The concept is a high volume device that would bring sediment off the bottom at essentially its natural consistency. A conveyor could be used to move the sediment to a placement site.

Floating conveyor belts are used in several mining operations. Figure 7 shows a 2100 foot floating conveyor operating in California. Several engineers have concluded that conveyors could move Illinois River sediment for miles if necessary, provided it is not mixed with excessive amounts water during excavation.

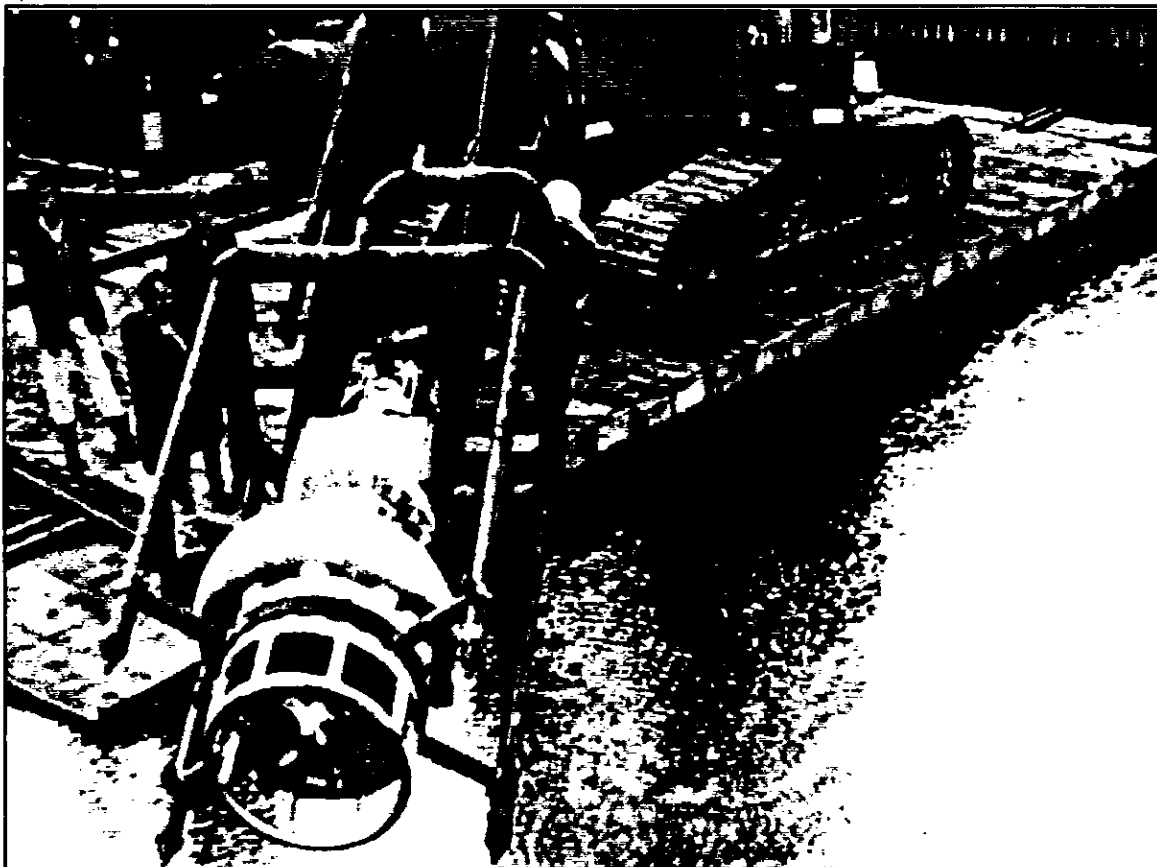


Figure 4. A number of companies make pumps which are capable of handling material with a high solids content. The pumps are available in various sizes and can be mounted on conventional excavator arms or cranes.

BENEFICIAL USE OF SEDIMENT

A comprehensive river restoration project could generate millions of cubic yards of dredged material. DNR is looking into potential uses which will depend on the chemical constituents and the cost of moving sediment. Some potential uses include: constructing islands and other habitat, landscaping soil, strip mine and brownfield reclamation, construction fill and flowable fill for construction. The Corps of Engineers Waterways Experiment Station is investigating some of these uses.

DNR collected 900 pounds of sediment from the river bottom in April, 1999. It was dried and used to grow five species of plants in pots at an Illinois Natural History Survey greenhouse. Preliminary results indicate no noticeable difference in germination, wet weight and dry weight of plants grown in sediment and Champaign County top soil. Peoria Lake sediment has been successfully used by IDOT contractors to vegetate a new highway intersection. A University of Illinois soil lab is evaluating soil formed by sediment placed in fields many years ago. The texture, mineralogy, organic matter content and nutrients contained in sediment are similar to that found in high quality topsoil. River sediment is initially quite hard, but after weathering develops soil structure and much improved tilth.

Building new islands in the river or enlarging existing ones is a likely use of some sediment. The islands would most likely be long and narrow to minimize the impact on flood heights and



Figure 5. The DRY DREdge (TM) by DRE, Inc. uses a small clamshell bucket and a displacement pump to remove and transport sediment at essentially its *in situ* moisture content. The discharge above is about the consistency of toothpaste. The current working model has a low capacity compared to conventional machines.

could be built high enough to provide habitat for a number of floodplain hardwood trees and other native species that are unable to adapt to the current altered hydrologic conditions. They would also reduce wind and wave action and provide safe nesting and resting areas for numerous bird species. The large number of waterfowl using the two artificial islands in Upper Peoria Lake provide evidence that this concept will prove useful to wildlife.

The Corps of Engineers built two small islands in Upper Peoria Lake as part of the Environmental Management Program (Figure 8). In 1994 a clamshell dredge was used to place sediment into two narrow islands in the lake about a mile long. The primary limitation on their size was the distance the crane's boom could reach. The first island consisted of the soft material of the upper sediment layer and was expected to wash away. The larger island used more consolidated sediment and sand from the original bottom. Both islands are still in place and the larger one is covered with trees. Neither island has any rip rap or other shoreline protection. The islands are viewed by many as prototypes for the design of future islands.

Large new islands up to several hundred feet wide could be developed using a number of techniques. A conventional or high solids dredge could pump sediment into an island shaped containment area built with a clamshell or other device. It would take a relatively long time for these sediment to dewater and consolidate.

Another option would use a conventional floating crane and clamshell in combination with a conveyor to overcome the short reach limitation of the clamshell (Figure 9). The conveyor could

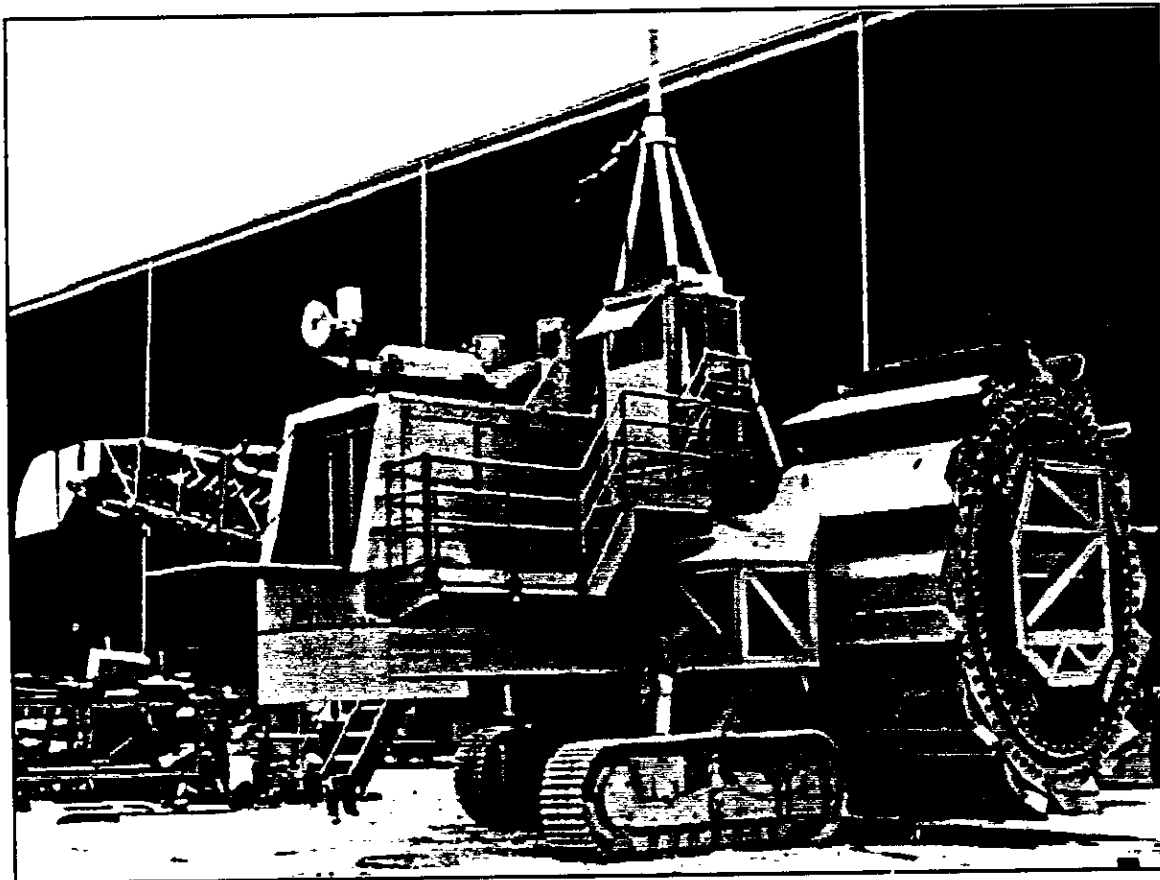


Figure 6. Conventional tracked wheel excavators are used in mining and materials handling situations. The machine could be adapted with wider tacks and other features to operate in shallow water in Upper Peoria Lake. The excavator discharges to a conveyor belt.

effectively extend the reach of the crane for miles if desired. This would allow sediment with relatively low moisture content and some of its initial consistency to be conveyed intact to an island under construction. It would decrease the amount of time needed for the material to consolidate. The island's height above normal pool could be increased by adding lifts as the sediment dries. If one of the excavator concepts proves feasible, such construction could become even more efficient. The conveyor could also transport sediment for land placement.

If it is necessary to protect new islands from the erosive force of waves, a number of methods could be employed including rip rap and geotextile tubes. These tubes can be 30 feet in circumference and hundreds of feet in length. When pumped full of sediment they are quite firm and can perform like an erosion proof berm. In coastal areas such tubes are used to develop wetlands and protect beaches and diked areas (Figure 10). The Fox Waterway Agency in Northern Illinois placed a geotextile tube as a breakwater several years ago that is still performing well. They are currently in the process of constructing an island using about 6,000 linear feet of tubes. The tubes may also prove useful to break up wave and wind fetch in wildlife areas such as Lake Senachwine.

Huge amounts of sediment could be pumped or conveyed to areas on shore and stockpiled until used for landscaping soil, fill or other purposes. It is possible that it may be built into large mounds and planted with trees or grasses until needed. Large mounds built in southern Illinois by Native Americans consist of sediment and provide examples of the potential durability of such stockpiles.



Figure 7. This 2100 foot floating conveyor belt is operated by CalMat, Inc. at Irvine Lake in California. Conveyors could be used to move excavated Illinois river sediment at *in situ* moisture content. Like pipelines, conveyors could move sediment over several miles to a shore facility or to build islands. They are more expensive than pipelines.

The Peoria Lakes and other backwaters could be deepened by using of the technologies discussed above. For the most part the techniques have existed for some time, but have not been commonly used in combination or for environmental habitat restoration. It is likely that several techniques will be used in any restoration project given the varying conditions in the river valley. Judicious dredging could preserve the areas as aquatic habitat until erosion control methods have time to reduce the sediment inputs and society decides the long term future of the river corridor.

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Figure 8. The two long, narrow islands in the foreground were constructed by the Corps of Engineers in 1994 as part of the Environmental Management Program. They are still in good shape after withstanding five years of waves and weathering without riprap or other protection. The islands are used extensively by numerous species, especially birds. They also break up wind fetch and reduce the adverse effect of waves.

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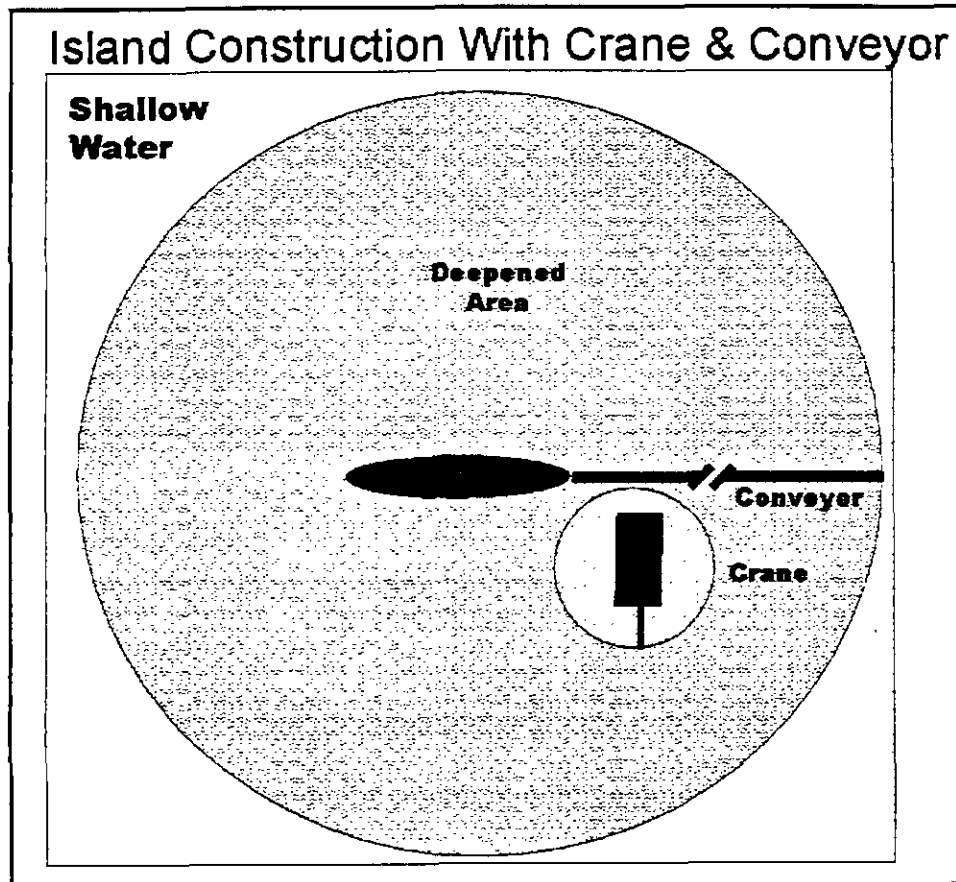


Figure 9. A conventional clam shell bucket on a floating crane built the islands in Figure 8. Its main limitation was that material could not be excavated over an area larger than the crane could reach and still deposit material on the island. By using a conveyor belt in combination with a crane, sediment could be moved long distances from the excavation point and used to build islands, be placed on shore or in barges. Floating conveyors could extend several miles.

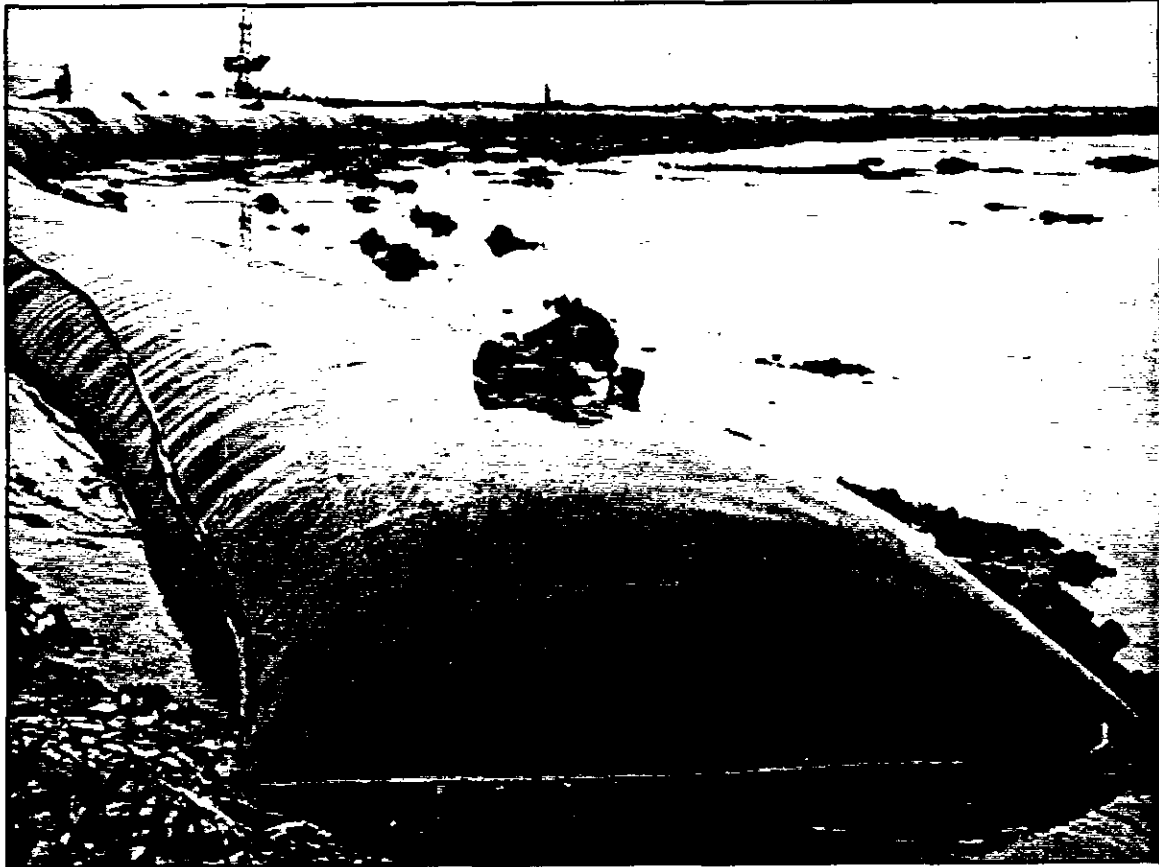


Figure 10. Geotextile tubes filled with sand and sediment are becoming increasingly popular in water resource applications. They can be used in place of riprap to protect shorelines and are capable of supporting vegetation. Tubes could be used in shallow water to break up waves. They could serve numerous functions in an Illinois River Restoration Project including protecting islands from the erosive force of waves generated wind and vessels.

**WHY SUSPENDED SOLIDS WILL NOT SETTLE AND SEDIMENTS
WILL NOT CONSOLIDATE IN BACKWATER LAKES:
A DISCUSSION OF POSSIBLE ANSWERS**

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At one time, the clear, backwater lakes along the Illinois River were prolific nurseries for a wide variety of commercial and sport fish, and resting and feeding grounds for world-renowned populations of migratory waterfowl. Today, these once verdant lakes are turbid and filling with unconsolidated sediment. Because of these physical conditions, the lakes lack the habitat structure required by native plants and animals. The high turbidity limits light penetration and prevents aquatic plants from propagating. The unconsolidated sediments do not provide the stable structure needed by macro-invertebrates, an important food source for fish and fowl alike. Besides the continuous inflow of suspended sediment, the turbidity and unconsolidated sediments are due to several factors, including carp and the modern chemistry of the Illinois River. Answers to the questions "why suspended solids will not settle and sediments will not consolidate in backwater lakes?" are critical to the restoration of backwater lakes.

The Wetlands Initiative has investigated these problems at a backwater lake located near Henry, Illinois, and sponsored a symposium of experts to explore the questions. One of the resulting hypotheses is that the sediment particles are not consolidating because of chemical and microbial interactions, perhaps due to excess nitrates in the water. The altered microbial community appears to be producing organic polymers that link the sediments together in small flocs that are about the specific gravity of water, and do not settle out of the water column. A corollary to this theory is that the excess nitrate in the water may be due to the disturbance of the bottom sediments by foraging carp. Mixing, and therefore oxygenating, the sediments prevent the development of the anoxic conditions that would lead to a reduction of nitrate.

Enhancing the de-nitrification capability of backwater lakes and other aquatic systems throughout the basin could reduce the nitrogen loads carried by the streams and rivers into the backwater lakes. This can be achieved by restoring riparian wetlands and by stabilizing the anaerobic zone in wetlands, swales and backwater lakes. The presentation will review current research on consolidation of sediments in backwater lakes and proposals to reduce nitrates in the Illinois River by restoring wetlands.

IMPACTS OF LEVEES ON FLOOD STAGES AND THE BENEFITS OF MANAGED FLOOD STORAGE

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ABSTRACT

The issue of levees and their impacts on flood heights along the Illinois River has been studied by engineers since the early 1900's. The results of these past studies are reviewed and compared to the most recent analysis of this issue which is based on a study by the Illinois State Water Survey. The State Water Survey used the UNET unsteady flow computer based model to predict profiles for the 25-, 50-, and 100-year flood events. The model was also used to evaluate changes to flood stages along the Illinois River when various combinations of levee districts are converted to provide for managed flood storage. The relative benefits of providing managed flood storage in relation to acres of farmland protected and wetlands created is evaluated.

INTRODUCTION

The first levee and drainage districts were organized to reclaim and develop the Illinois River floodplain as early as 1880 and by 1920, when the State started to regulate floodplain development, there were already 46 existing levee districts in the basin. The section of the river downstream from Peoria has since the turn of the century, experienced frequent flooding and levee overtopping. Part of the increase in flooding in this reach of the river was attributed to the construction of the 36 levee and drainage districts that exist along lower reaches of the Illinois River below Peoria. See Figure 1. Along the lower reaches of the Illinois River, over 180,000 acres of floodplain bottom lands were developed for primarily agricultural uses. Numerous studies have been undertaken since the early 1900s to address the impacts of increased flooding due to levee construction and to determine the economic value of converting some of the more marginal districts into public fishing and hunting grounds as well as temporary flood storage.

DIGEST OF PREVIOUS STUDIES

The Rivers and Lakes Commission of the State of Illinois in 1915 published a "Report on Illinois River and Its Bottom Lands," which directed much of its analysis to evaluating drainage and levee districts and their adverse effects on river flood heights and upon the one-time great fishing industry of the Illinois River.

In the summarized conclusion and findings of this report the authors stated:

"In a state of nature the river in flood occupied its entire valley from hills to hills. For many miles in the lower river this flood plain averaged 3 miles in width and in great floods

from 7 to 9 feet in depth.

In the lower one-third of the river, farm land levees have reduced the width of the flood plain by almost 80 per cent and have reduced the cross section of the flowing stream in a great flood to about 25 per cent of the available cross section of the 1904 flood.

Although a large part of the flood flow has always passed by way of the channel, the velocity being comparatively slow upon the land, it is our conclusion that the farm land levees are a menace to themselves, in that they have so restricted the flood water channel and are lacking in height, generally speaking, to such an extent that they are likely to be overtopped in a great flood. As the protection afforded to different districts is quite variable, it is evident that the lowest levees will suffer first and will tend to protect higher levees. If all the districts are to be protected, however, a greater available flood cross section must be provided which may be accomplished in several ways, or the flood rates must be reduced through storage."

The authors of this report further concluded that:

"there is no question but that the exclusion of the flood water from the bottom lands through the construction of levees has a tendency to increase the flood run-off rates of a stream. We have investigated this matter quite carefully as applied to the Illinois River particularly in the measured flood of 1904, assuming it to pass through the present levee system. It is estimated, however, that the net effect of all levee districts so far constructed would probably increase the maximum flow rate only about 5 per cent and when the bottoms are fully leveed about 10 percent. This rather unexpected result is accounted for by the fact that in an excessive flood, such as the flood of 1904, the valley is practically filled with water several days before the apex of the flood and the maximum flood rate occurs at time when the gage is nearly stationary for several days both before and after the apex. A smaller stream or a flashy stream would doubtless make a better utilization of the storage in its valley."

This report was the first to analyze the value of converting some levees to flood storage.

"Apex Storage. A much greater effect can be produced in mitigating floods if certain large reservoirs could be held empty and the flood waters only admitted when the flood is approaching maximum rates and the water passing into the reservoirs could be accommodated.

"We have investigated this proposition and find that in the lower river at Kampsville for instance, the heights are most largely governed by the Mississippi River. In this vicinity storage on the Illinois River could accomplish nothing material. The present levee districts are not adapted to flooding, but if we should assume that all future levee districts, which would be substantially equal in storage volume to the districts at present constructed, should be so built and so operated that they could be flooded without great damage except the loss or crop when flooded, then we estimate that there would be about 850,000 acre-feet of storage above the LaGrange Dam, which if used to the best advantage, would reduce the flood flow rate about 25 per cent at Beardstown, making a difference in the height of water of about 3.4 feet. A similar estimate at Peoria indicates that through storage it would be theoretically possible to reduce a great flood about 2 1/2 feet."

The 1915 report projected future flood heights under a number of different assumptions:

"It will be observed that in the lower eighty miles of river this water surface follows quite closely the actually observed flood in 1913. It is estimated that the maximum from the original flood would occur in the vicinity of Valley City, at which place the water would be about 4 feet higher than in 1904. This difference remains substantially the same up as far as Beardstown, above which place the difference gradually becomes less, and it is estimated that at Peoria the retarding effect of the leveed districts downstream has been nearly lost. This figure further shows for example with the completion of all proposed levee improvements the 1904 flood event would result in a five foot higher flood stage at Meredosia yet all effects would nearly dissipate at Peoria."

The report concluded that a flood that was 35% greater than the 1904 flood would represent a fifty year flood event and it would seem reasonable to increase the height of all levees where necessary to pass a flood of this magnitude without danger to the levee system. It was their opinion in this report that it would be good policy to build all levees up to a height of 3 feet above the projected fifty year event. With apex storage provided in the construction of new levees which if used to the best advantage could reduce gage heights at Beardstown by 3.4 feet.

In 1929, the State Geological Survey published a report covering drainage issues in Illinois. This report considered problems that were holding back the reclamation of the large areas of extremely fertile lands in the river bottoms throughout the state. This report concluded:

"the reclamation of the bottom lands of the State is a matter which should concern every citizen who has the welfare of the State at heart and wishes to see all its natural resources developed to the fullest extent. This is a resource which, with proper farming is inexhaustible, and which would add some \$50,000,000 annually to the wealth of the State.

But the report further states that:

"In the past, districts have been scattered at random along the streams, each one working independently and with no thought or care as to the effect its plans might have on the lands above or below. Where levees have been built, they have as a rule been placed too close to the banks of the stream, to the detriment of the lands on the opposite side; and where levees have built on both sides, sufficient floodways have not been left, with disastrous results to the levees themselves or to the lands above. The damaging overflows along the Illinois and Mississippi rivers in 1922, 1926, and 1927 can be traced directly to this lack of foresight on the part of the districts. It is now realized that the overflowed land cannot be satisfactorily reclaimed in this way.

"Until the 1922 flood, the districts along the Illinois River were in excellent condition, both physically and financially. The floods of 1922, 1926, and 1927 have caused very heavy damage, and the damage claims amounting to nearly \$2,000,000 have been filed. The flood of 1922 was no greater than the flood of 1904 as far as total volume of discharge at the peak of the flood is concerned, but the crest of the flood was much higher, as indicated above. This situation in the Illinois valley has come about through the lack of some central control over the locations of the levees. In most instances the districts have placed their levees within 100 feet of the banks of the river, and at places the flood plain is restricted to

about 1,200 feet in width.

“A flood equal in magnitude to that of 1922 is likely to recur on an average of once in ten years. It is out of the question to correct the situation by moving the levees farther from the stream, the cost would be prohibitive. All that the levee districts can do is top raise their levees three or four feet above the flood crest of 1926. Because of the increased height of levees and the increased hydrostatic pressure during high water, the danger of the levees breaking will be greater than in the past, and the districts will have to maintain their levees better and watch them more closely during flood periods.

“As a number of the districts are in bad shape financially, and the landowners more or less discouraged, the State could buy the land in some of them at a very reasonable price and use the areas as hunting and fishing preserves ordinarily and as reservoirs for storing the surplus flood waters when necessary.”

House Document No. 182-72-1, submitted to Congress on December 16, 1931 was a report on the Illinois River by the Chief of Engineers which covered navigation, flood control, power development and irrigation. This report analyzed all previous great floods of record since 1844 and discussed remedial measures, the principal of which was to provide levee setbacks in eleven drainage and levee Districts. The Corps of Engineers recommended that Federal participation be limited to projects to be done below Beardstown.

In making reference to the 1922 flood, the District engineer stated that: “had it not been for the breaking of levees almost daily, thereby making available for storage purposes near the crest of the flood at a total of 28 drainage and levee districts, the water would have gone higher and the damage would have been still greater.” A comparable situation existed during the flood of October 1926 when levees enclosing 27 districts broke.

As one means of reducing flood heights, the report discussed the possibility of utilizing seven selected drainage districts as flood control reservoirs, the areas to remain empty during times of normal flow and thus be available for storing excess waters during periods of great floods. The seven districts reported upon were found to have available storage capacities totaling 731,000 acre feet.

In 1937, the Division of Waterways undertook a study to again evaluate the relative merits of drainage and levee districts throughout Illinois. This study was done in recognition that the construction of levee systems as a means of protection from the flood waters of the rivers has presented to the State a problem affecting the flood control of rivers. This study looked at 131 Districts in the Illinois, Mississippi, Ohio and Wabash river basins. This study suggested “that only those districts, that have no adverse effects on flood heights of the river and can operate successfully from the profits of their own production, shall be eligible to receive aid from the State.” A large portion of this study looked at using levee “set-backs” in the area of Beardstown from mile 80 to 89 which is a length of River that contains two bottlenecks. With setbacks to the South Beardstown, Big Prairie and Coal Creek Drainage and Levee Districts, a flood crest reduction of 0.98 to 1.6 feet was estimated if 2,564 acres of floodway could also be cleared with a total project cost of \$1,206,400.

House document No. 692-77-2 submitted to Congress on March 30, 1942 is another report by the Chief of Engineers covering a study of Drainage and Levee Districts along the Illinois River.

This report was written to determine whether certain districts might economically be used for the dual purpose of controlling floods and to provide wildlife conservation areas. After an analysis, this report concluded that the conversion to a dual purpose would have been uneconomical without the inclusion of the benefits of hunting and fishing. The Corps did recommend that the Big Prairie Drainage and Levee District be acquired at public expense and if lowered by notching, a maximum flood of 135,000 cubic feet per second at Beardstown would be lowered approximately 0.6 feet, and the effect felt as far up as Havana.

In May 1946, the Illinois Department of Conservation and the Illinois Natural History Survey made a joint study and report upon the wildlife and flood control possibilities inherent in 17 selected drainage and levee districts located along the Illinois River. These seventeen districts were analyzed from the standpoint of their respective values for flood storage, for agriculture, and for recreation and wildlife and also from the standpoint of the amount of money each district had received from public treasuries.

In October 1947, the Fish and Wildlife Service submitted a report to the Corps of Engineers covering fish and wildlife interests in the Illinois River valley insofar as they would be adversely affected by the Corps 1945 plan for basin wide flood control using reservoirs on tributary streams. In order to compensate for the reduction in flood storage capacity which would result from the elimination of flood and navigation control reservoirs on tributary streams, the U. S. Fish and Wildlife Service recommended that the Corps of Engineers consider the acquisition of five Levee and Drainage districts for use as flood control reservoirs. In each case, conservation pools were recommended so that the areas could be used as public hunting and fishing grounds except in times of great floods. The five districts were Hennepin, East Liverpool, Thompson Lake, South Beardstown and Keach.

In 1950 the Department of Conservation funded an engineering study to demonstrate the possibility of converting certain drainage and levee districts with limited flood control value from their present marginal agricultural use into public hunting and fishing grounds. This report looked at 13 levee and drainage districts and analyzed the cost of conversion to flood storage and conservation and the maximum water storage capacity of the reconverted areas plus abatement of flood conditions to be expected at various critical points along the river following conversion of the levees. This study noted that while the subject of combining flood control with recreational use has been discussed for years, this study was the first analysis to estimate the true cost of such redevelopments. This study also provided an historical overview of past studies and flood events and concluded that "taking all facts into consideration, the levees may be held responsible for having raised the high water mark at Beardstown by more than ten feet, based upon consideration of identical floods of 115,000 c.f.s. each in 1904 and 1943. This report also calculated the annual benefits of one acre-foot of storage in 12 Illinois River levee districts. The most benefit per acre-foot was attributed to the Hennepin District followed by Spring Lake, Banner Special, East Liverpool, Thompson Lake, Big Lake, Coal Creek, South Beardstown, Crane Creek, Big Swan, Hartwell, and Keach. This report went on to calculate in detail the total benefits of a levee acquisition program and rated the following levees in suggested order of importance: Hennepin, Spring Lake-Clear Lake, Banner special, East Liverpool, Thompson Lake, Big Prairie, Hartwell, and Keach.

The Division of Waterways also studied the removal of the Big Prairie levee in a 1952 report.

STATE WATER SURVEY STUDIES

In 1995, the Office of Water Resources initiated a three year study with the Illinois State Water Survey for the completion of a state of the art analysis of the hydrology and hydraulics of the Illinois River system and its leveed floodplain. Three reports were published under this contracted study by the State Water Survey.

The first report covered an updated analysis of the flood frequency relations for the Illinois River and its tributaries. The resulting analysis developed discharge frequency relations for the Illinois River gaging stations at Marseilles, Kingston Mines, and Meredosia, and the gaging stations on the five major tributaries (Mackinaw, Spoon, Sangamon, La Moine, and Macoupin). Stage frequency relations were also developed for the Illinois River gages at Peoria Lock and Dam, Kingston Mines, Havana, Beardstown, and La Grange Lock and Dam. This information was then used to develop the 2-, 10-, 25-, 50- and 100-year discharge and stage hydrographs required for the boundary conditions in the unsteady flow UNET model simulations. From this report it was noted that the annual maximum water elevations at six stations in the Alton Pool of the Illinois River are largely governed by the relative severity of the Mississippi backwaters and the concurrent magnitude of flood peak and volume at Meredosia. During the 1941-1993 period, the highest water elevations were recorded in 1993 at Grafton, Hardin, Pearl, and Florence, but at Florence the flow value rank was 2 and at Meredosia the flow value rank was 4 (the flood at Meredosia was only a 4- or 5-year flood). The highest water elevations were recorded at Valley City and Meredosia in 1943 when the measured flood flow at Meredosia was the highest observed. Flood water surface profiles in the Alton pool depend on the joint probability of high Mississippi backwaters and high flood flows at Meredosia.

The second Water Survey report covered the results of computer simulated flow modeling study. An unsteady flow modeling examination was based on the application of the UNET hydrodynamic model originally developed by the Corps of Engineers. The application of this model was to compute water surface profiles for the 10-, 25-, 50-, and 100-year floods using the hydrographs developed in the first Survey report. The lower Illinois River UNET model consisted of a total of 412 cross sections along the Illinois River as well as the lower reach of the Sangamon River up to Oakford. The model was calibrated to the May 1979 and March 1985 floods. These floods were ranked fourth and second in severity at Meredosia. The model was further tested by simulating the December 1982, June 1974, April 1973 and July 1993 flood events. Annual peak flow analysis showed that the 1993 flood had a recurrence interval of 3 to 5 years which indicated that the 1993 flood was not due to major flood flows in the Illinois itself but because there was prolonged flooding on the Mississippi that caused backwater effects upstream on the Illinois River all the way to Havana.

Once the model was calibrated, the State Water Survey was able evaluate the reduction in peak flood stages due to conversion of various levees for use as managed flood storage areas. The flood storage was provided by providing a 2 to 6 foot deep opening up to 4,000 feet in length in various combinations of levees to determine the optimum location and effectiveness of providing flood storage. See Figure 2. Levees below Hillview were not considered for the managed flood storage option because stages were governed by backwater effects of the Mississippi. Model simulations showed potential flood managed storage benefits for levee modifications in the McGee Creek, Scott County, Spring Lake, Thompsom Lake, Lacey, and Crane Creek Levee and Drainage Districts. See Figure 3. The effectiveness of combining various combinations of modified levees were evaluated with the model and the result showed that the conversion of the Lacey-McGee Creek

levees will provide 100 year flood protection for an additional 36.9 percent of the downstream levee districts while modifications to the Spring Lake and Scott County districts will also provide comparable protection for an additional 33.8 percent of the downstream districts. See Figure 4.

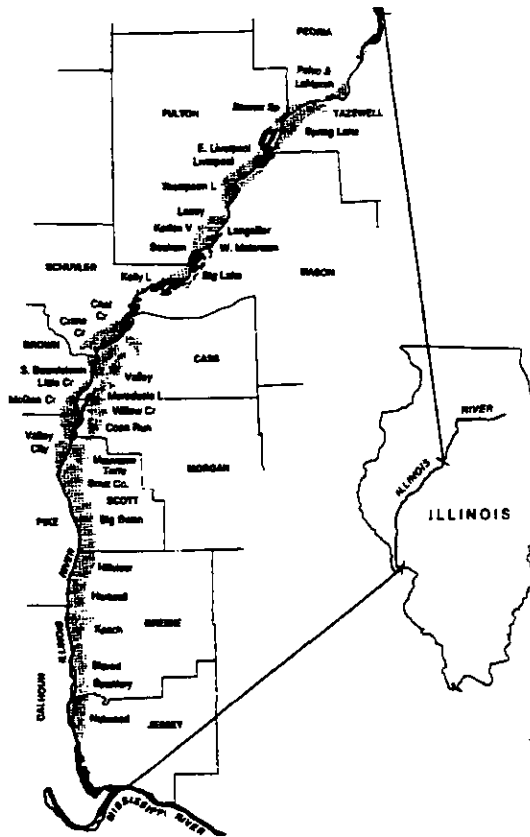


Figure 1. Levee Districts along the Lower Illinois River. (From SWS)

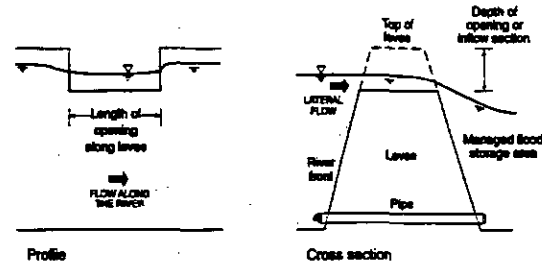


Figure 2. Managed flood storage. (From SWS)

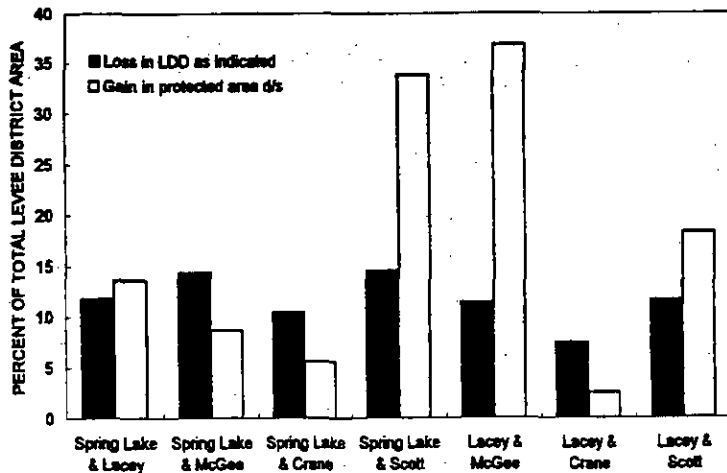


Figure 3. Area gained and lost from managed flood storage. (From SWS)

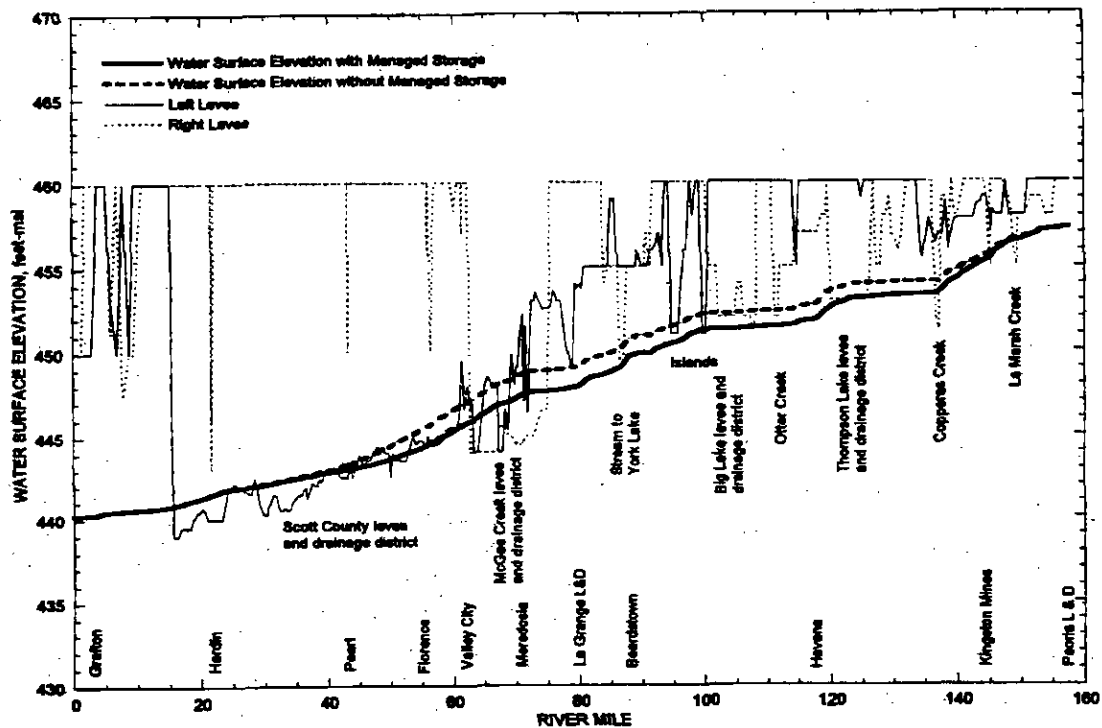


Figure 4. Water Surface profiles (100 year) with and without managed flood storage at Lacey and McGee Levee and Drainage Districts. (From SWS UNET model study)

FUTURE USES OF THE MODEL

With the development of unsteady UNET flow model, the State of Illinois has a scientifically based analysis tool for evaluating future conditions and potential changes along the floodplain of the Illinois River system. Issues such as levee raise impacts, flood fighting guidelines, and changes in channel cross sections due to sedimentation can be evaluated with the UNET model.

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WATERSHED MANAGEMENT: THE BIG PICTURE

Major General Phillip R. Anderson

Commander, U.S. Army Corps of Engineers, Mississippi Valley Division

INTRODUCTION

As a University of Illinois graduate, it's good to be back in Illinois.

And it's good to be back in Peoria where the Illinois River is the front door versus the back door to this city.

When invited to speak at this conference, I asked to see the agenda. I saw that I could fly in and speak at the end. However, I chose not to because of the quality, caliber and commitment . . . This conference has proven to be a valuable investment of my time.

I've been asked to address watershed management -- the big picture. Clearly, not just a Corps responsibility. If we're going to be successful, we all need to understand the watershed and how it works.

Truly understanding the watershed requires a "boots on the ground" approach. On Tuesday, I did that in and around Peoria Lakes, by jon boat and vehicle. I saw first hand the challenges of lake sedimentation, sediment loads, bank erosion, and stream channel erosion. And I saw first hand the opportunities for beneficial use of dredge material, habitat restoration, artificial islands, streambed grade controls, bank erosion controls, and delta wetland construction.

It was invaluable to me to see the situation on the ground, first hand, and I want to publicly thank John Marlin and all involved for organizing the tour.

WATERSHED APPROACH

Now, as I hope all of you know, watershed studies are initiatives which seek to examine and recommend courses of action to address multiple water resource issues within all or part of a watershed.

The investigations and recommendations address the multiple purposes and multiple objectives of the river, to include *environmental* and economic objectives, as well as many other water resources management issues.

Many of the issues discussed during this conference point to the importance of understanding and addressing water resource problems from a watershed perspective. From excessive sedimentation of Illinois River backwaters and gulf hypoxia to navigation and flood plain management, the types of problems that need to be solved are not easily addressed on a site by site

basis or through uncoordinated independent actions. Using the holistic view of watershed management will help us tackle these problems.

So, recognizing that I stand between you and adjournment of this conference, I'd like to present a short overview of what watershed management is and the Corps' role in watershed planning.

WATERSHED PLANNING

The intent of a watershed study in general is to achieve a comprehensive view of water and related land resources problems and opportunities. A watershed study works to define the measures potentially available to solve such problems and identifies implementation responsibilities.

A watershed study is characterized by its resource orientation, its ecosystem perspective, and its comprehensive approach. Watershed planning is a systematic approach to evaluating the alternative uses of the water and land resources of an area. This is done in an effort to identify conflicts and trade-offs among the competing uses of these resources so that informed decisions can be made when changes in the use of these resources are discussed.

WATERSHED PERSPECTIVE

Historically, there has been a tendency to focus on just a specific navigation lock, levee district, or even restoration site. The Corps is moving towards an increased assessment of the relationship between any individual action or combination of actions and its impact on the watershed.

I would encourage all of you to continue the dialog with Col. Mudd and the staff of the Rock Island District to determine how these authorities, individually and collectively, can be used to meet your watershed planning and improvement needs.

ECOSYSTEM RESTORATION

In the 90s, the Corps of Engineers placed a heightened emphasis on the restoration of ecological resources as a primary mission area and budgeting priority. Restoration now joins navigation and flood damage reduction as the three major mission areas.

Watershed management is a natural fit with ecosystem restoration. Ecosystem restoration approaches an ecological community together with its physical environment, as an integrated unit. This perspective serves to strengthen and further point out the need to address restoration from a broad watershed perspective.

NATIONWIDE EXAMPLES

Two examples of large-scale watershed restoration studies include the Corps' efforts in partnership with numerous other agencies, organizations, and individuals in Florida and Texas.

In Florida: Kissimee River Restoration - focuses on addressing degradation to the Everglades and water resources in Central and South Florida. The effort has taken a watershed approach to identifying restoration needs.

A major focus of this effort is to restore a more natural flow of water to the Everglades. The project could ultimately involve removing more than 240 miles of levees and canals, constructing wetlands and new reservoirs, and elevating some 20 miles of U.S. Route 41.

Partnership efforts have involved 17 federal and state agencies.

In Texas: Upper Trinity River Restoration - Involves an 8,100-square-mile watershed and includes the Dallas-Fort Worth metro area. The project focuses on jointly evaluating the potential for ecosystem restoration and flood damage reduction.

Partnerships represent an impressive part of this study, as well. The North Central Texas Council of Governments is coordinating the involvement of the 9 cities, 3 counties, and various agencies participating in the study process.

And Dr. Jim Johnson mentioned some other ecosystem restoration projects in his presentation.

INVOLVEMENT IN WATERSHEDS

Watershed management is a concept that is not new to the Corps.

Water experts have long recognized the greater effectiveness and efficiencies to be gained by adapting regional or river basin perspectives in identifying needs and solutions. To effectively meet new water resources infrastructure demands we need to develop frameworks and approaches for integrated water resource development and management. A specific means of accomplishing this is through producing comprehensive studies of watershed needs.

Historically, the Corps conducted framework studies and assessments to evaluate broad needs for the conservation, development, and utilization of water and land resources. The Level B regional or river basin studies we produced in the 1960s laid the groundwork for much of the water resources development and infrastructure today.

However, somewhere along the way we lost many of the incentives supporting a watershed focus, decreased our research on water management, and generally lessened our ability to address water problems from a big picture approach. We as a Nation failed to listen to the River Basin Commissions that once led the way.

We currently have no overall federal integrator or coordinator, something the Water Resource Council aspired to achieve in the 1970s.

The Mississippi Valley Division conducted numerous watershed or basin studies during the 1970s and 1980s. The Atchafalaya Basin floodway System study in 1982 and the Pearl River Basin study in 1984 are examples of comprehensive basin-watershed studies. Among the lessons learned from these studies is the fact the more complex the water resources issues are, the greater the requirement for an excellent working relationship with the customer, whether it be a local sponsor or state and local entities and that we need to guard against studies for study sake.

CURRENT INITIATIVES

Examples of present watershed/basin efforts underway by MVD include the Upper Mississippi River System-Environmental Management Program, the Demonstration Erosion Control Program in the Yazoo River Basin, Mississippi, and certainly, the Illinois River Ecosystem Restoration Study that we have learned about earlier in this conference.

The EMP program encompasses the main-stem Mississippi River and certain major tributaries upriver from its confluence with the Ohio River. Key components of the EMP are the Habitat Rehabilitation and Enhancement Projects and the Long Term Resource Monitoring Program. The Habitat Rehabilitation and Enhancement Projects have protected 28,000 acres of floodplain wetlands and aquatic habitats previously lost or degraded. The Long Term Resource Monitoring Program carries out monitoring and applied research directed at advancing overall understanding of river system ecology.

The Demonstration Erosion Control Project in the Yazoo Basin is an intensive program designed to demonstrate the effectiveness of a watershed or systems approach to reduce erosion, sediment, and flooding. Problems within the basin were found to be so intrinsically related, such that measures to retard erosion within a watershed will reduce sedimentation and flooding and enhance fish and wildlife communities.

The DEC was authorized by Congress in 1984 and has included work over the past 15 years in 16 watersheds in the Yazoo Basin. Grade control structures, bank stabilization, debris basins, and land treatment are among the Improvements being constructed. Congressional adds for the DEC have included language that the Committee expects the Administration to continue to request funds for this important project.

ILLINOIS RIVER ECOSYSTEM STUDY

While still in the development phase will utilize a watershed approach to address the very river this conference is being held to discuss.

The types of issues that have led to the Illinois River's degradation can only be successfully addressed through a holistic and collective effort.

Today, the Corps has a workforce representing a broad spectrum of professional disciplines that can address the complex water, and other natural resource issues, facing the Illinois River and our nation. The Corps is increasingly incorporating watershed and ecosystem perspectives in its planning.

I am personally committed to working in partnership with local, federal, and state agencies, as well as the public, to seek innovative approaches, to preserve and restore our important natural resources such as the Illinois River.

THE FUTURE OF WATERSHED MANAGEMENT

With regard to the future of watershed management, the Corps believes the time is right to reframe our focus for water resources problems and needs assessment from a narrow site level to a watershed or river basin scale.

We need to find ways to fund such approaches and to forge cooperative alliances and institutional mechanisms to enable such planning to be successful.

Section 729 of WRDA 86 is a mechanism for continuing our watershed planning efforts in the future. Section 729 efforts have not been funded in previous budget years. However, our FY 2001 budget recommends the initiation of two studies: Rio Grande Basin and Delaware River Basin.

The Mississippi Valley Division has recommended watershed studies for the Red River, White River and the Des Moines River basins, but these have not been included in the budget, to date.

WRDA 2000

The WRDA 2000 legislative initiative provides for continuing Section 729 as an annual \$5 million program. In addition, several other WRDA 2000 initiatives seek to expand our watershed authorities.

Challenge XXI

Challenge XXI is another program that holds promise for our future focus on watershed-based solutions to our water resource problems. The program was included in WRDA 99 with authorized funding of \$200 million over a 5-year period. The Administration strongly supports the Challenge XXI program which uses a watershed approach to problem solving.

For the future we must look for expanded watershed authorities and for new means of funding watershed approaches to water resource problems. We must forge the cooperative alliances which will enable us to do so.

PARTNERSHIP

The participation and partnership of numerous agencies and groups is critical. At the federal level alone 34 agencies, 10 cabinet departments, 11 independent federal agencies, 4 agencies of the Executive Office of the President, and even the Federal courts have some responsibility for water resources development.

Successful watershed projects require the combined efforts of groups such as: the U.S. Department of Agriculture, the Fish and Wildlife Service, the Coast Guard, the Department of

Transportation, the Environmental Protection Agency, the U.S. Geological Survey, multiple state agencies, regional and local governments, local business, and non-profit groups.

By involving a number of agencies and organizations, as well as members of the public and private sectors, additional funds and resources can be brought to the table to aid implementation.

Partnerships also allow numerous agencies and organizations to bring in their individual insights and work at solving the problem more effectively.

CONCLUSION

To summarize my observations from this conference, the basin problem here is sediment. The solutions are upland and riverine sediment controls. The tools to ensure we find proper solutions are upland sediment control and sediment erosion studies.

In order to do this, the Corps needs help with Section 729 funding, but we must also proceed with solid cost-sharing initiatives now. Our goal is not to just produce studies, but to produce positive results.

It's been an honor and a privilege to share lunch with you today, and I hope my remarks have provided you with a better understanding of the Mississippi River Valley's Watershed Management Program.

Managing water resources throughout the country, but specifically on the Illinois and Mississippi rivers, is essential to the prosperity and future of our country.

The Corps of Engineers takes this responsibility very seriously, as do I. Working together, we can solve the watershed issues of today and protect resources for future generations tomorrow.

CLOSING ADDRESS

Stephen P. Havera

Illinois Natural History Survey, Forbes Biological Station
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I would like to thank all of you for attending the seventh Governor's Conference on the Management of the Illinois River System. Your interest in the welfare of the river, as demonstrated by your participation in the conference, is essential if we are going to embark into a new century with a biologically and economically sound river system. The twentieth century witnessed many changes to the Illinois River system ranging from the significant diversion of Lake Michigan water into the waterway in 1900 to the sedimentation and unnaturally fluctuating water levels with which we are dealing today. What the twenty-first century will bring to the Illinois River system can be greatly influenced by us. We have a century of knowledge to build upon. We need to draw upon the knowledge, integrate new methodology, techniques, and information as they emerge, and incorporate these aspects into our desire to extend the longevity, biological productivity and economical aspects of the Illinois River system.

We must work together toward these goals, and here too, we already have vehicles to do so, such as the Lt. Governor's Integrated Management Plan for the Illinois River Watershed and the Conservation Reserve Enhancement Program. The coordinating council established to implement the integrated management plan is there to listen to your input. Use them to express your ideas. The Illinois River system directly or indirectly affects almost everyone in our state. The river is one of our most important natural resources and it is up to all of us to do our part to ensure its continued livelihood.

I want to thank you for your participation in this conference; I want to thank our more than 70 co-sponsors for their support and financial contributions; I offer very special thanks to Co-Chair Bob Frazee, Mike Platt and Wendy Russell of the Heartland Water Resources Council, and the multiagency steering committee, all of whom devoted numerous hours toward the success of this conference. We are grateful for the addresses sharing comments and insights offered by our featured speakers -- Lt. Governor Corrine Wood, Major General Phillip Anderson, and Chad Pregracke -- by the state agency directors and their representatives, and by all of our many presenters. Now it is time for us to carry the information acquired here to our respective destinations and apply that toward our responsibilities in sustaining the Illinois River system in the new millennium. Our 1999 conference stands adjourned.

Appendices

Photographs



1999 participants attend a pre-conference panel presentation and discussion, "Nutrients, Nutrient Cycling, and Hypoxia in the Mississippi River Basin," which was held the evening before the Call to Order.



Conference Co-Chair Bob Frazee calls the 1999 Governor's Conference on the Management of the Illinois River System to order.



Peoria Mayor Bud Grieves welcomes participants.



Pictured from the left are Bob Frazee, Lt. Governor Corinne Wood, Illinois State Representative Ricca Stone, and Conference Co-Chair Steve Havera holding the Governor's Proclamation that reaffirms the State's commitment to improving the Illinois River.



Richard Pierce from Ducks Unlimited, Inc., speaks on "Responsible Management: What Does It Mean?"



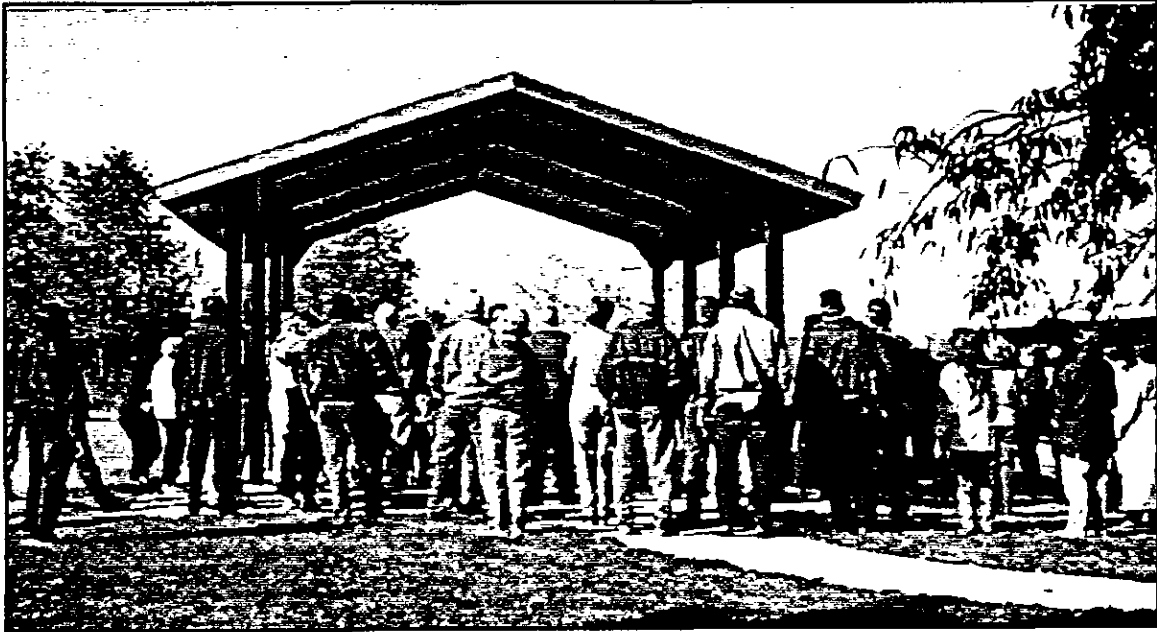
Major General Phillip R. Anderson of the U.S. Army Corps of Engineers addresses the Thursday luncheon on "Watershed Management: The Big Picture."



Featured speaker Chad Pregracke talks about his efforts to clean up the Mississippi River at the Wednesday evening barbecue at the new Gateway Building on the Peoria riverfront.



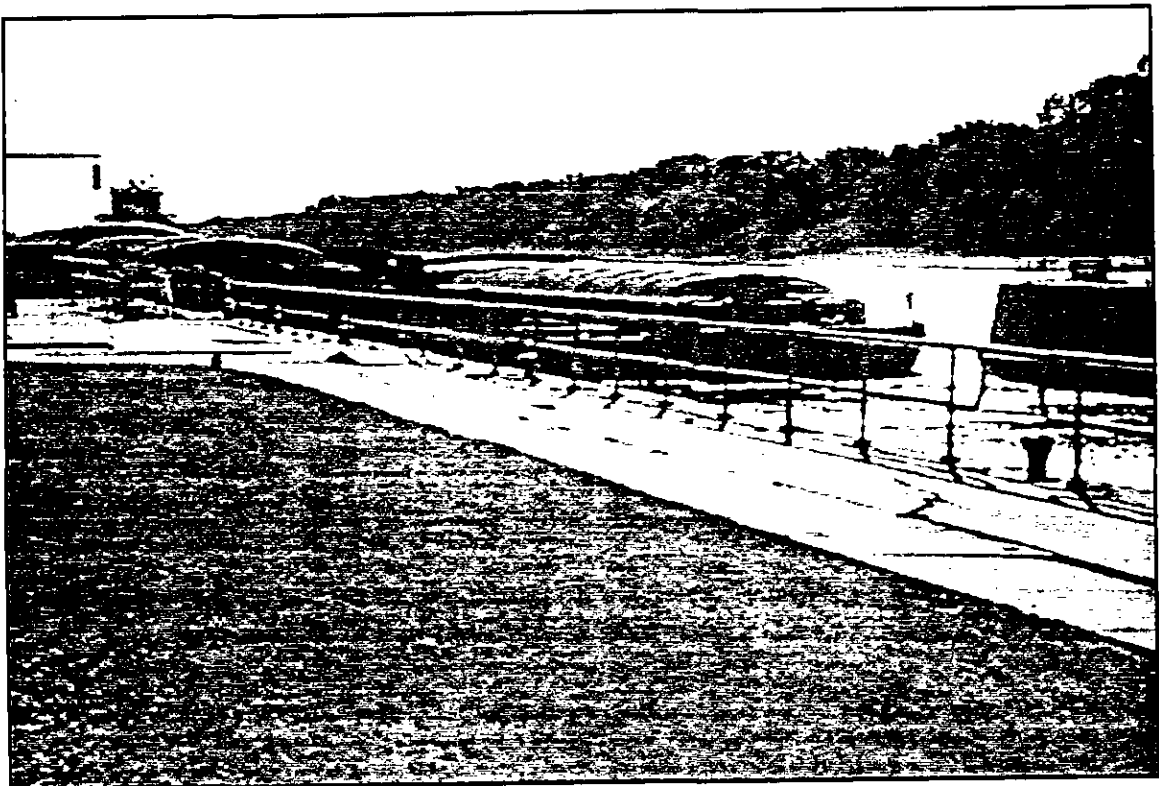
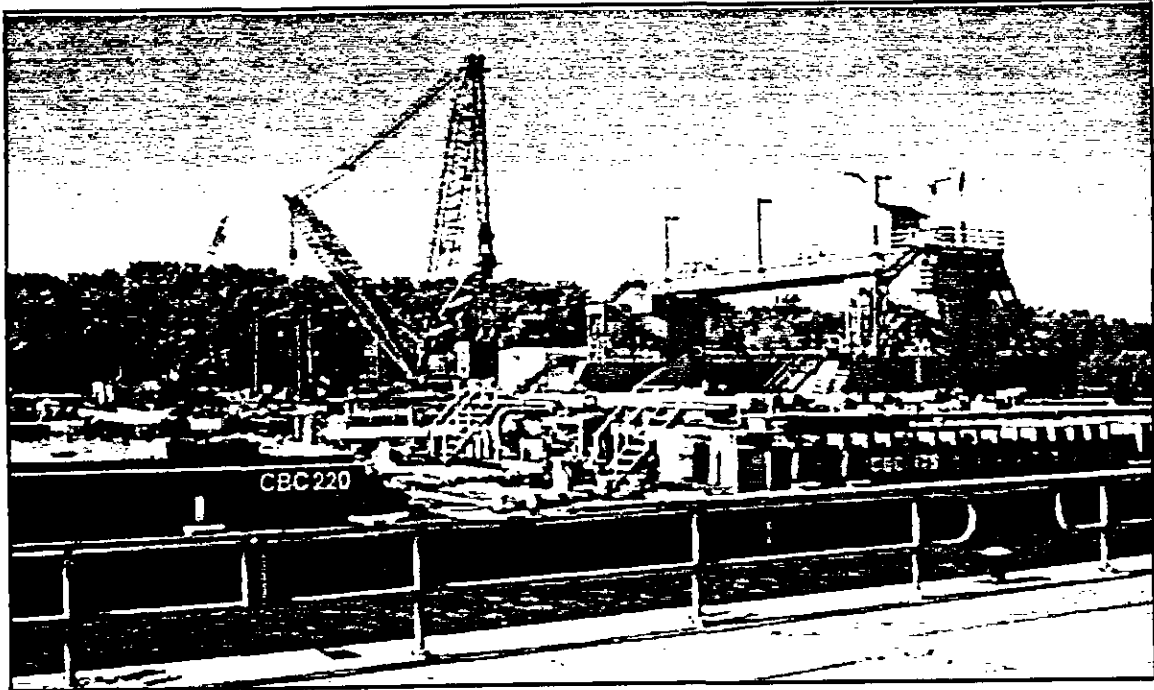
Participants visit the exhibit area where a record number of displays and information booths helped to make the 1999 conference the most successful ever.



The Conservation Tour gave participants a chance to visit several backwater lakes where ducks and fish are returning. Here the group stops at Banner Marsh.



The Conservation Tour stops at a park in Havana, Illinois.



One of the stops for the tour was the Peoria Lock and Dam shown here and above.

Exhibit Participants

American Fisheries Society - Illinois Chapter
Friends of the Chicago River
Green Strategies
Groundwater Protection - Integrating Surface and Ground Watershed Planning
Heart of Illinois Sierra Club
Heartland Water Resources Council
Illinois-American Water Company
Illinois Commerce and Community Affairs
Illinois Department of Agriculture
Illinois Department of Agriculture - Bureau of Land and Water Resources
Illinois Department of Natural Resources
Illinois Eco Watch Network
Illinois EPA
Illinois Farm Bureau
Illinois-Indiana Sea Grant College Program
Illinois Middle School Groundwater Project - Southern Illinois University
Illinois Natural History Survey
Illinois River Carriers' Association
Illinois River Project
Illinois River Soil Conservation (Peoria County SWCD Task Force)
Illinois State Water Survey
Illinois State Water Survey - Watershed Science Section
Illinois Water Resources Center
McCann Environmental
Prairie Rivers Resource Conservation and Development
Sierra Club - Midwest Region
Soil and Water Conservation Society
The Mackinaw River Project/The Nature Conservancy
Tri-County Riverfront Action Forum, Inc.
Tri-County Regional Planning Commission
U.S. Army Corps of Engineers - Rock Island District
U.S. Army Corps of Engineers (CELMS-PD-F)
USDA - Natural Resources Conservation Service
U.S. Geological Survey
University Illinois Extension

Participants

Adams, Becky, East Peoria High School

Adams, Ross, U.S. Fish & Wildlife Service

Allison, Mel, IDNR - Water Resources

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Arnold, Jeff, Illinois Natural History Survey

Austen, Doug, IDNR - Watershed Management Section

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Baldwin, Lou

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Blodgett, Doug, The Nature Conservancy

Blye, Chuck, Heartland Water Resources Council

Bogner, Bill, Illinois State Water Survey

Bonfert, Gretchen, Green Strategies/Illinois River Coordinating Council

Borah, Deva, Illinois State Water Survey

Bowe, Gabe, East Peoria High School

Brong, Mary, Wildlife Prairie Park

Brown, Mark, IL Dept. of Natural Resources

Bruce, Debbie, IL Dept. of Natural Resources

Bruyn, Rodger, Bureau Co. Farm Bureau

Burkholder, Mary, Dept. of Commerce & Community Affairs - Deputy Director

Campion, Dennis, University of Illinois Extension

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Cavanaugh-Grant, Deborah, University of Illinois

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Cerven, Steve, Yetter Manufacturing

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Cipriano, Renee, Senior Advisor on the Env. and Natural Resources, Gov.'s Office

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Cline, Michael

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Cook, Jack, Forest Preserve District of Kane County

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Cripps, Michelle, Illinois Natural History Survey

Cruse, Larry, IL Dept. of Natural Resources

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Czapar, George, University of Illinois

Dairs, Tom, Henry Riverfront Development Comm.

Dalton, Bob, IDNR - Division of Water Resources

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Davis, Bud, Caterpillar Inc.

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Erickson, Nancy, Illinois Farm Bureau

Erickson, MaryAlice, IL River Coordinating Council

Ernenputsch, Todd, U.S. Army Corps of Engineers

Ettinger, Albert, Environmental Law & Policy Center

Farnsworth, Rick, University of Illinois

Fehr, Doug, Peoria County Farm Bureau

Ferencak, Joe, IDNR - Fisheries

Flakne, David, Novartis Corp. Protection

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Freeman, Mark, East Peoria High School

Gale, Chris, East Peoria High School

Gee, Jim, City of Washington

Giannoni, Terry, Mackinaw River Watershed Council

Gilles, Ted, Peoria County SWCD

Girard, Tanner, Illinois Pollution Control Board

Goetsch, Warren, IL Dept. of Agriculture

Goodman, Mike, The Nature Conservancy

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Klingner, Mike,

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Moore, Robert, Prairie Rivers Network

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