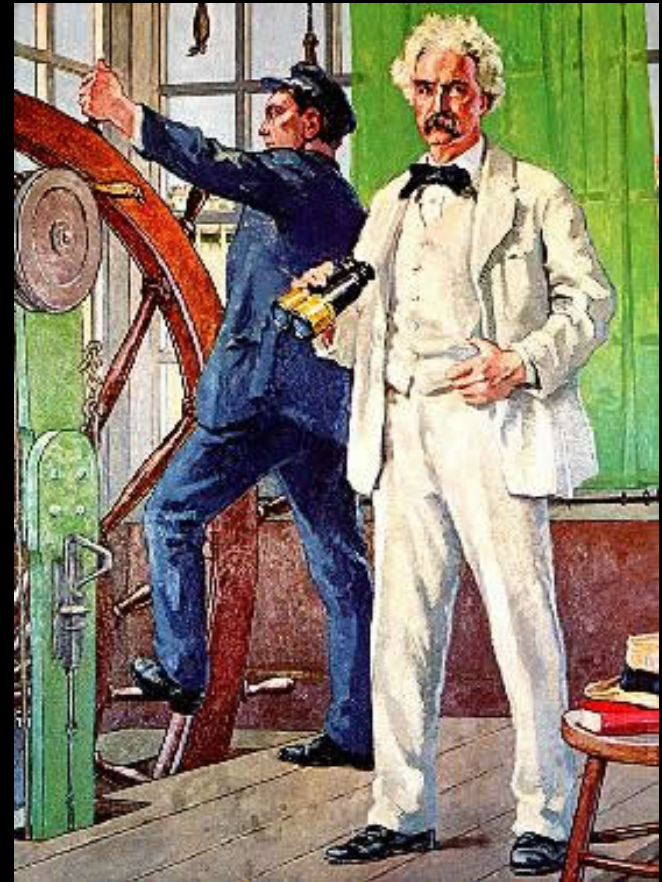


The Mississippi is well worth reading about. It is not a commonplace river, but on the contrary is in all ways remarkable. Considering the Missouri its main branch, it is the longest river in the world...It seems safe to say that it is also the crookedest river in the world...





# Renewable Natural Resources Foundation

Charting a New Course for the  
Mississippi River Watershed

## *Longstanding Impediments to Effective Management [of Water Resources]*

AGU

Washington, DC

December 3, 2019



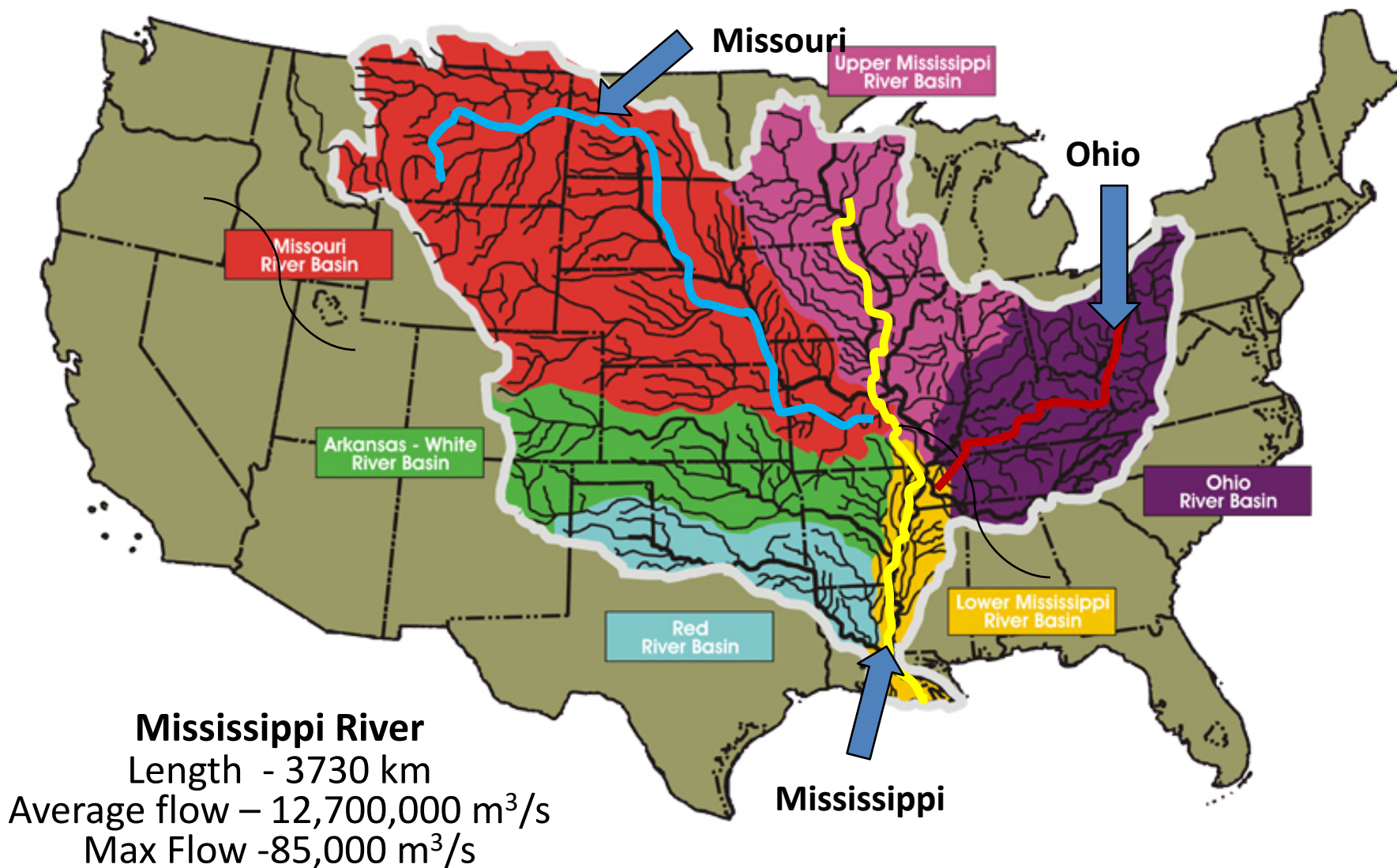
**Gerald E. Galloway, Jr., PE, PhD**  
Center for Disaster Resilience  
Glenn L. Martin Institute Professor of Engineering  
University of Maryland





# The Mississippi Basin Drains 41% of the Contiguous United States

**Mississippi River Basin**  
3.1 million km<sup>2</sup>  
32% of total US farm acreage







# The United States and the Mississippi Basin Face Significant Water Resources Challenges





# BLUF

---

- **The nation will face many difficult water resources challenges in the decades ahead and it is operating without a plan to manage and sustain these resources**
- **Federal and State Governments need to clearly define the role they believe they should play in dealing with water issues**

# Water Challenges

- Drought and Water Demand
- Degraded Water Quality
  - Not fishable, swimmable, drinkable; non-point source pollution
- Increases in Flood Damages
  - \$8B annually and growing
- Ports, Harbors and Waterways in Transition
  - Non competitive harbors; aging inland waterways
- Protection of the Environment
- Restoration of Environmental Damages
  - Everglades, Coastal Louisiana, Chesapeake Bay; California Bay Delta

# Water Challenges

- Understanding the Water-Energy Nexus
- Use and Protection of Groundwater
  - Lack of investigation; source protection
- Execution of Watershed-Based Planning
- Dealing with Interstate Conflicts
  - Missouri Basin; ACF; Colorado
- Crumbling and Out of Date Infrastructure
  - ASCE “D” Grades; >\$2 Trillion deficit
- Lack of Assessment and Monitoring
  - Continuing drop in investment and operations



# IMPEDIMENTS

Change

Unresolved Past

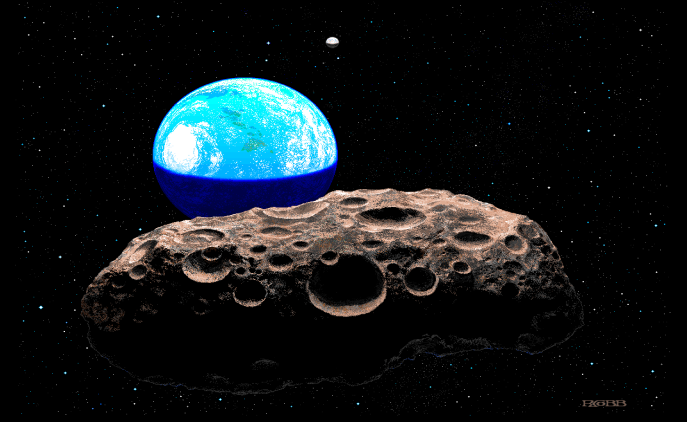
Lack of Vision

Poor Management

Lack of Attention

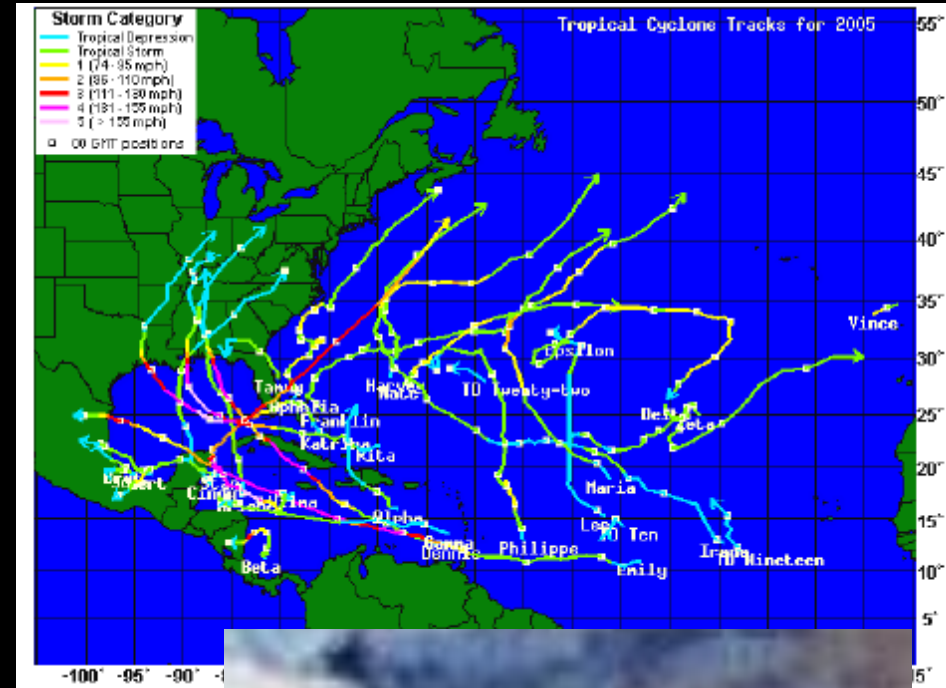
# 21st Century Change

- **Population Explosion**
- **Pressures for Development**
- **Scarce Resources**
- **Aging Infrastructure**
- **Technological Surge**
- **Volatile, Uncertain, Complex, Ambiguous  
National and World Situations**
- **Climate Change**



# Stipulation: Climate Change

- Increased Temperatures
  - Glacial Melt - Sea Level Rise
  - Increased Hurricane Intensity - SST
  - Increased Flooding
  - Increased Drought
- AND THE COMBINATIONS  
OF ALL THE ABOVE





## IMPEDIMENTS

Unresolved Past

# Governments Failing to Listen and to Act

---

- Water and its governance have been extensively studied by Blue Ribbon groups
- Most recommendations of these groups are ignored
- Where recommendations are implemented, they are often later reversed on change of political parties
- Recommendations are consistent over time

## **Hoover Commission - 1949**

The interagency committees have failed to solve any important aspects of the problem..because the dominant members, the Corps and the Bureau have been unwilling to permit interagency committees to settle their differences. The result has been neglect of virtually all major areas of interagency conflict.

## **Eisenhower - 1952**

....we need partnership to the limits of everyone's ability

## **Hoover Commission - 1955**

Federal development of water resources is carried on today under a complex of conflicting policies which have been evolving to meet changing conditions, needs and pressures for well over a century of direct Federal activity, and which cause competition, duplication, and waste



## **National Water Commission – 1973**

- Laws and legal institutions should be reexamined in the light of contemporary water problems. Many water laws, both statutory and judge-made, have their origin in the 19th century and were fashioned to meet social needs of that era.....In particular, there is need to modernize laws dealing with ground water
- development, management, and protection of water resources should be controlled by that level of government nearest the problem and most capable of effectively representing the vital interests involved .
- flood plain management[should be] the Nation's primary future strategy

## **Second National Water Assessment -1978**

- There is little in the existing structure or procedures which clearly defines the nature and extent of the federal interest in the nation's waters.

## **Western Governors' Association, 1989**

- The primary recommendation of this paper is that the President appoint a White House level group, chaired by a high-level White House official, with membership drawn from departments and independent agencies with jurisdiction over water programs, to serve as an interagency forum to improve coordination of federal water programs with each other and with state water policy.
- A principal characteristic of federal water policy is that policies are made in an ad hoc, decentralized manner. No agency of the executive branch or committee of Congress is responsible for keeping an eye on the "big picture." Thus, federal water policy lacks a unifying vision or even a set of guiding principles

# Sharing the Challenge - 1994

## ● Need Floodplain Management Act

- » Define Fed, State, Local Responsibilities
- » Establish Co-equal National Objectives
  - Flood Damage Reduction
  - Preservation and Enhancement of the Environment
- » Take Balanced Approach –Structural and Non-structural
- » Plan Comprehensively
  - Avoid Use of the Floodplain
  - Provide Adequate Protection to Those at Risk

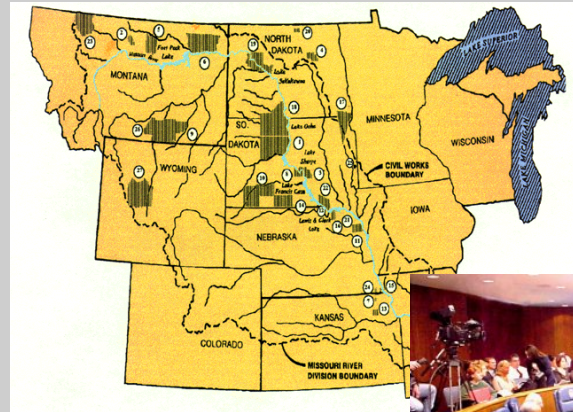
## IMPEDIMENTS

Lack of Vision

# ★ *National Policy*

Unless you consider the jumble of conflicting laws, regulations and procedures that deal with the water as policy or vision, the United States is operating without any policy or vision.

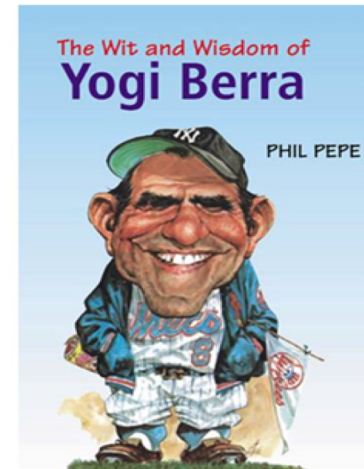
- Establishes Relationships
- Develops Agreed-upon Direction
- Sets Priorities





# The Nation Has No Vision for Its Water Future: It is Rudderless

- There is no roadmap of how to deal with growing challenges - no comprehensive policies or plans
- The federal interest is not defined; States vary in interest in and ability to deal with water
- Decisions are made and programs are operated primarily on the basis of ad hoc short- term political interests and near-term fiscal issues
- Congress has surrendered its guiding hand to the Administration and Internal “ad-hocism”
- Hard choices are not being made and problems are being ignored and are growing
- Water allocations and laws are vestiges of the 19<sup>th</sup> Century



**Think Ahead !**

“If you don't know  
where you are going,  
... you will wind up  
somewhere else”

**VISION!**

# Challenges – Vision of the Future



**World Class System?**

# Water Resources Project Development Criteria

- 1965 Water Resources Planning Act –P&S
- 1973 – WRC Principles and Standards
  - Economic, regional, social, environmental
- 1983 – White House Principles and Guidelines
  - Economic only





photo: U.S. Fish and Wildlife Service

## Modernize Federal Water Policy

### Modernize the Army Corps of Engineers Update the Principles and Guidelines

The Federal objective of water and related land resources project planning is **to contribute to national economic development** consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.

New  
Corps  
Regs

# Water Resources Project Development Criteria

- 2007 – WRDA - Revision Direction
  - Sustainable economics
  - Public Safety
  - Avoiding unwise use of floodplain
  - Protecting and restoring natural environment
  - Regional/watershed based

No substantive contact with  
Congress or states



# Water Resources Project Development

- 2009 - 2012 – Review and Update of P&G
- 2012 – Congress (App Managers Report) restricts Corps use of new PR&G
- 2014 - CEQ released final Interagency Guidelines and Blog post on how PR&G can help communities

Poor Management

# **We Are Not Effectively or Efficiently Managing Our Water Resources**

---

- Lack White House and Congressional leadership
- Don't know where we stand –no assessment since 1970s
- Lack coordination of national and federal water effort
- The nation is operating on an ad-hoc, minimally collaborative manner focusing on stovepipes for today
- Federal, state, tribal and local responsibilities not adequately defined; states frequently feel ignored in federal process
- Nation faces same water problems over and over without action –patch and move on



# The Silo Effect

Today, the diverse water resources challenges throughout the United States are often studied, planned and managed in individual silos, independently of other water areas and projects. Generally, this has resulted in local and narrowly focused project objectives with little consideration of the broader watersheds that surround the project.

Congressman James Oberstar

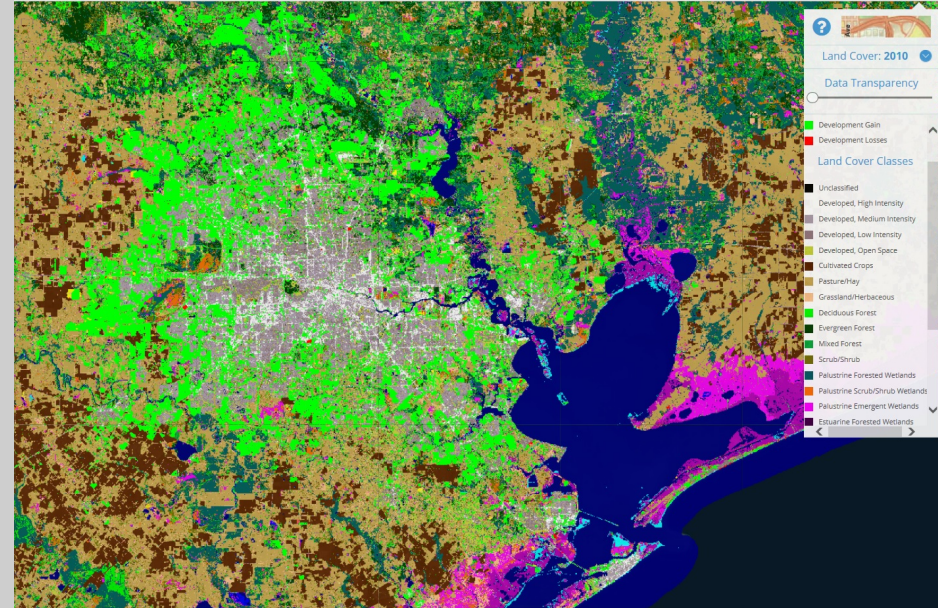
Aug 27, 2009



# The Result of Poor Management

- Ad-hoc Projects
- Rebuilding in Risk Zones
- Jumble of Standards
- Minimal Comprehensive Planning (IWRM)
- Little Attention to the Environment

**No Direction!**



# Federal Flood Standards

Project Design Standard

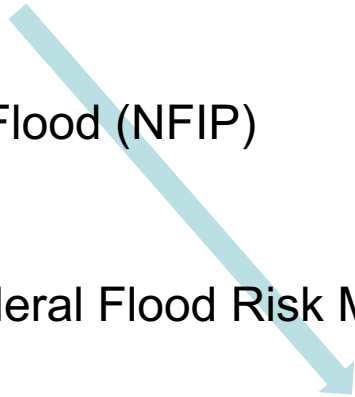
100-year Flood (NFIP)

Executive  
Order (EO)  
13690

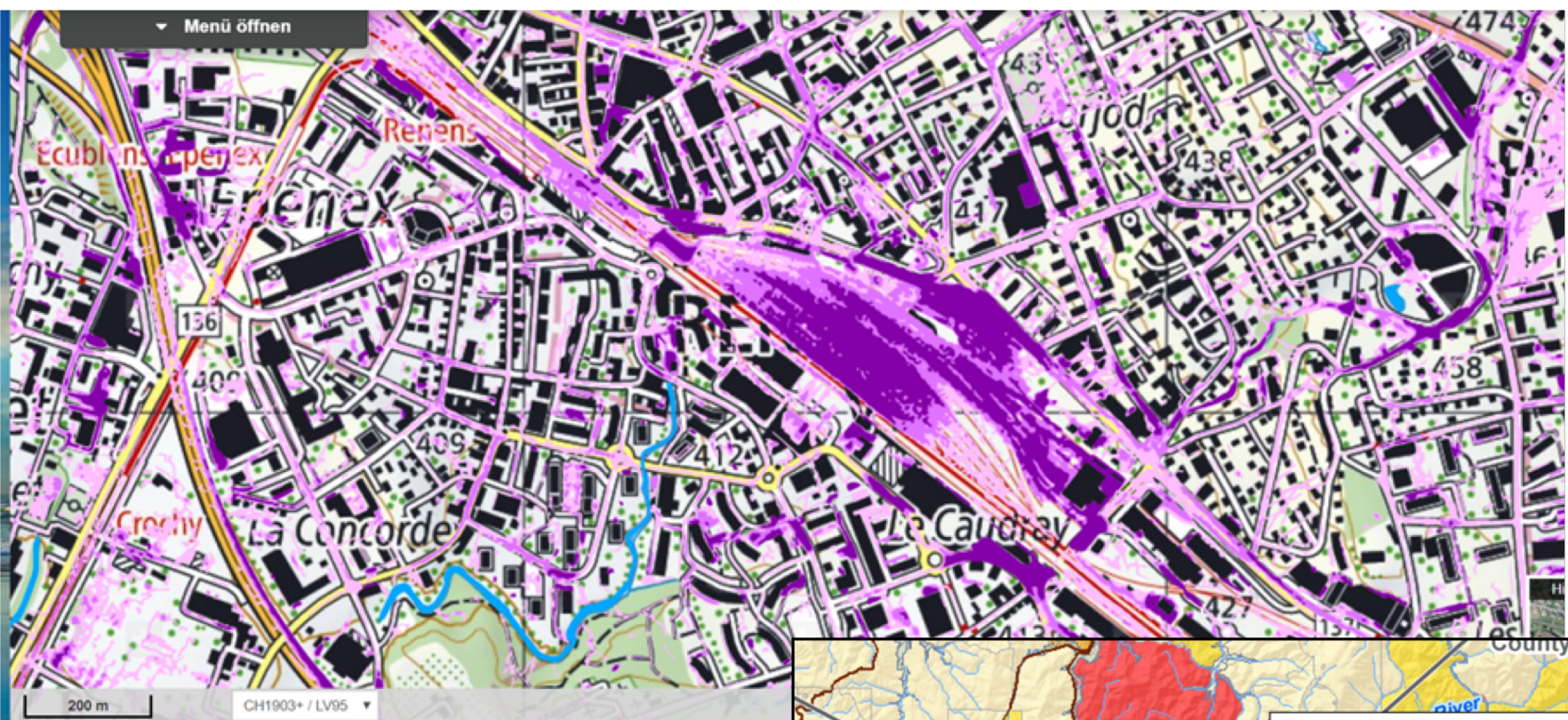
Revoked by  
Section 6 of  
EO 13807,

Federal Flood Risk Management Standard (Federal Actions)

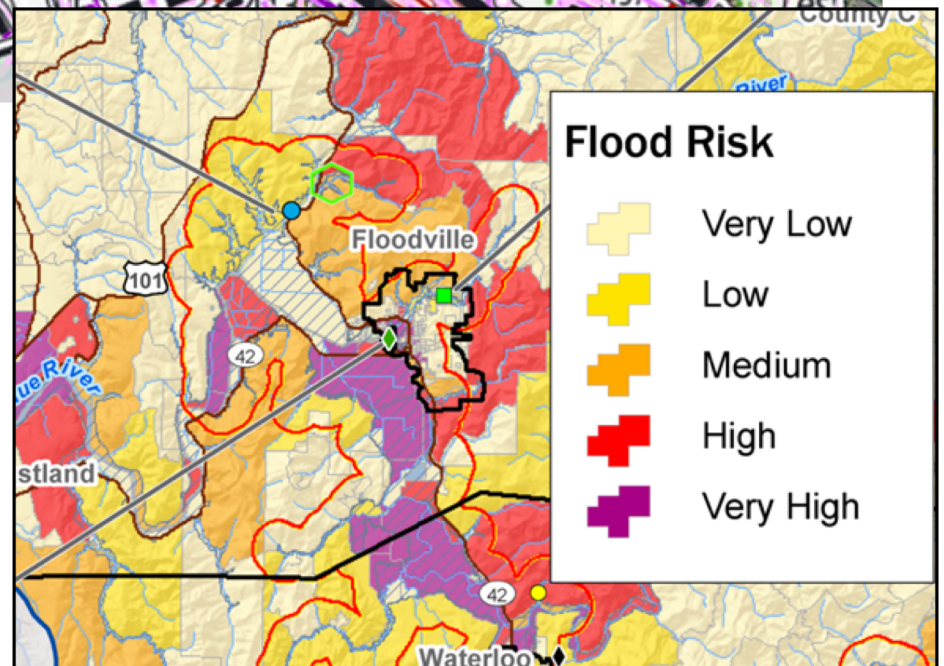
Neverland







**Surface Drainage Hazard Map  
Switzerland**



**FEMA Flood  
Risk Map**

## IMPEDIMENTS

Lack of Attention

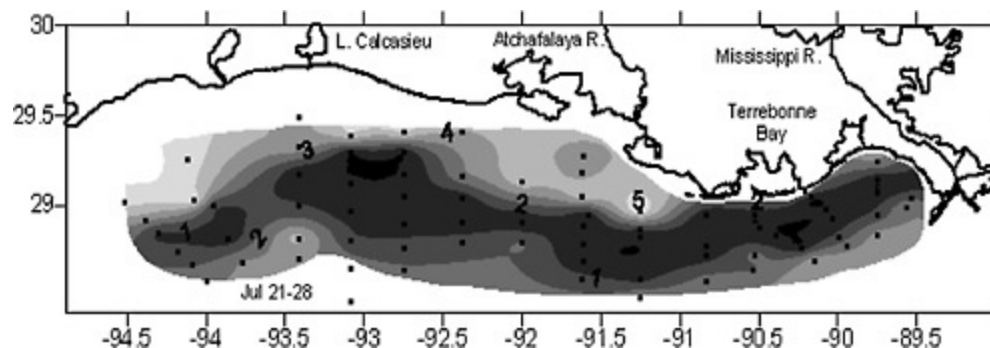
# Except In Crisis, Water Is Not on the Radar Screen of Federal or State Decision Makers

---

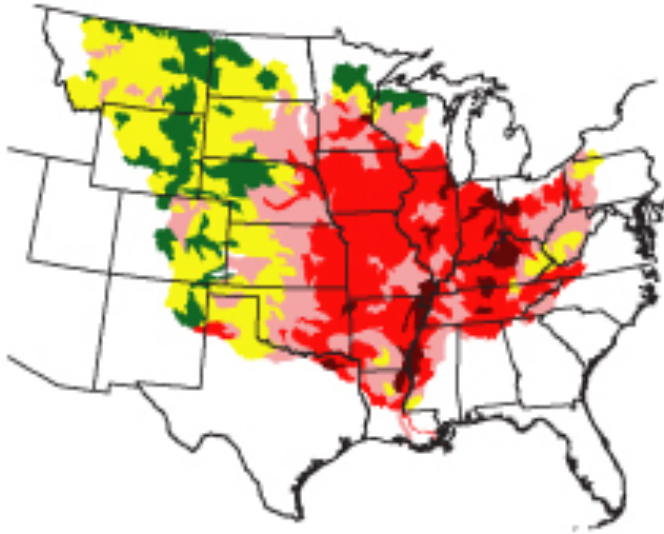
- Minor Disasters (NOLA , Sandy are eaches)
- Drought planning
- Rock pinnacles
- System operations
- Pollution (non-point, hypoxia, municipal)
- Dam and levee safety



# Hypoxia



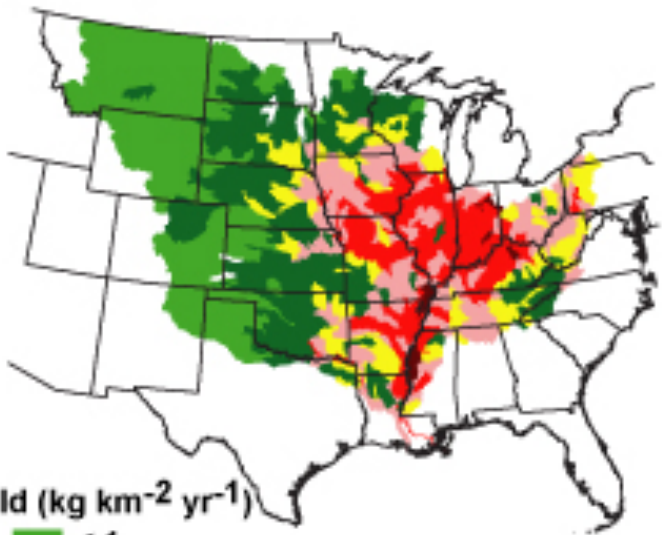
Phosphorus yield delivered to local waters



*National Academy*  
Identify Contributors  
Establish Goals  
Allocate Targets  
Implement

**10 Years!**

Phosphorus yield delivered to the Gulf of Mexico



Yield ( $\text{kg km}^{-2} \text{ yr}^{-1}$ )





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LOADING...



## Midwestern Farm Runoff Creates Headache For Louisiana Shrimpers

By TRAVIS LUX | NEW ORLEANS PUBLIC RADIO • OCT 17, 2019

Share ([http://facebook.com/sharer.php?](http://facebook.com/sharer.php?u=http%3A%2F%2Fwww.tinyurl.com%2Fy474p96e&text=Midwestern%20Farm%20Runoff%20Creates%20Headache%20For%20Louisiana%20Shrimpers)

[u=http%3A%2F%2Fwww.tinyurl.com%2Fy474p96e&text=Midwestern%20Farm%20Runoff%20Creates%20Headache%20For%20Louisiana%20Shrimpers](http://facebook.com/sharer.php?u=http%3A%2F%2Fwww.tinyurl.com%2Fy474p96e&text=Midwestern%20Farm%20Runoff%20Creates%20Headache%20For%20Louisiana%20Shrimpers)

Tweet ([http://twitter.com/intent/tweet?](http://twitter.com/intent/tweet?url=http%3A%2F%2Fwww.tinyurl.com%2Fy474p96e&text=Midwestern%20Farm%20Runoff%20Creates%20Headache%20For%20Louisiana%20Shrimpers)

[url=http%3A%2F%2Fwww.tinyurl.com%2Fy474p96e&text=Midwestern%20Farm%20Runoff%20Creates%20Headache%20For%20Louisiana%20Shrimpers](http://twitter.com/intent/tweet?url=http%3A%2F%2Fwww.tinyurl.com%2Fy474p96e&text=Midwestern%20Farm%20Runoff%20Creates%20Headache%20For%20Louisiana%20Shrimpers)

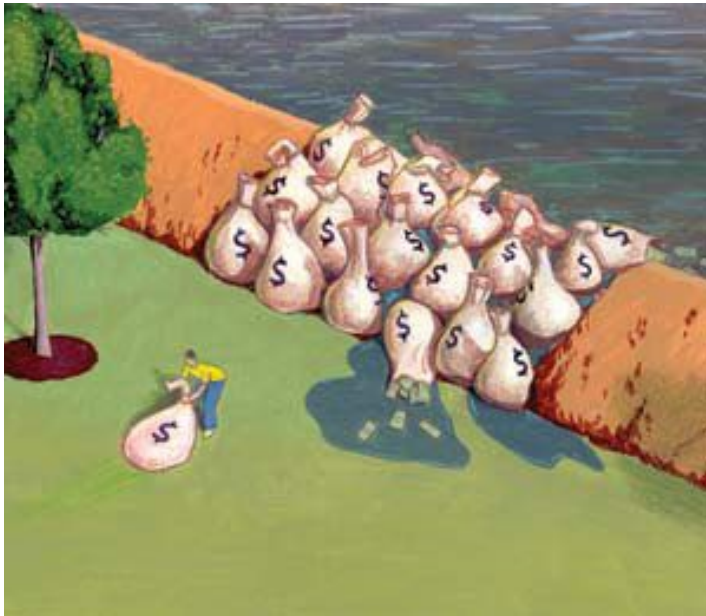
Email ([mailto:?](mailto:?subject=Midwestern%20Farm%20Runoff%20Creates%20Headache%20For%20Louisiana%20Shrimpers&body=http%3A%2F%2Fwww.tinyurl.com%2Fy474p96e)

[subject=Midwestern%20Farm%20Runoff%20Creates%20Headache%20For%20Louisiana%20Shrimpers&body=http%3A%2F%2Fwww.tinyurl.com%2Fy474p96e](mailto:?subject=Midwestern%20Farm%20Runoff%20Creates%20Headache%20For%20Louisiana%20Shrimpers&body=http%3A%2F%2Fwww.tinyurl.com%2Fy474p96e)

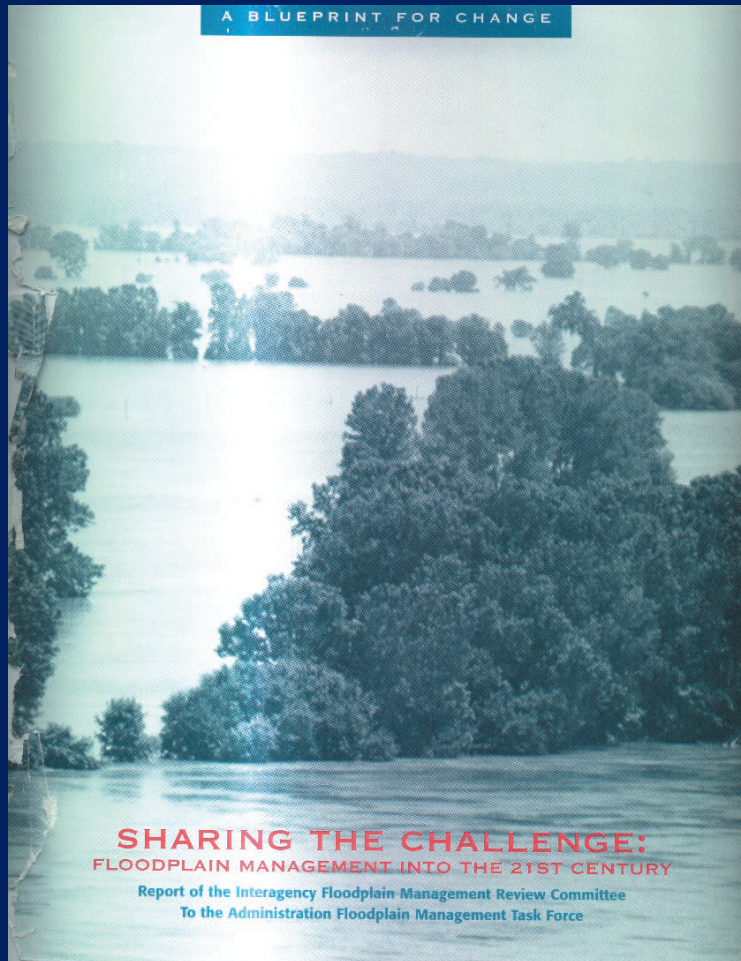


([https://news.stlpublicradio.org/sites/kwmu/files/styles/x\\_large/public/201910/DeadZone\\_Olander\\_3.jpeg](https://news.stlpublicradio.org/sites/kwmu/files/styles/x_large/public/201910/DeadZone_Olander_3.jpeg))

2017  
**INFRASTRUCTURE**  
**REPORT CARD**  
**ASCE**



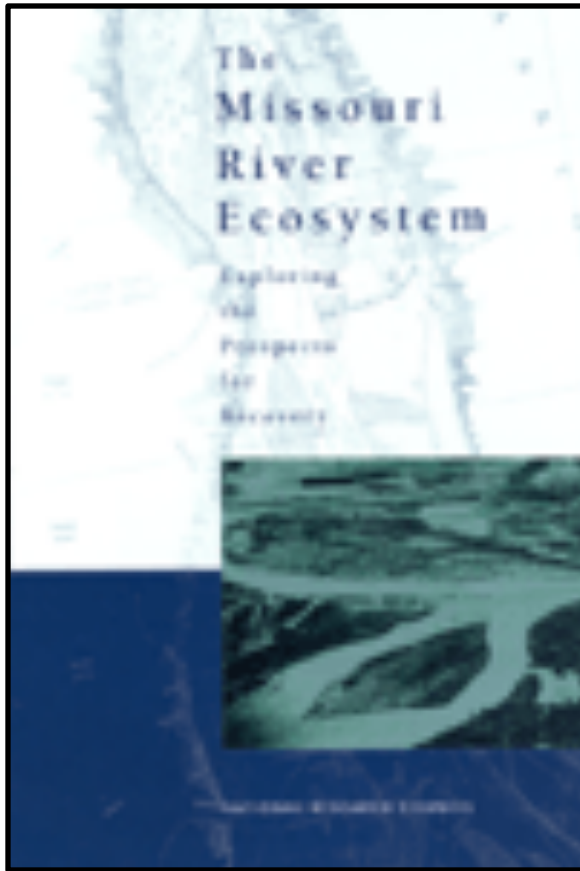
CATEGORY	2013	2017
Aviation	D	D
Bridges	C+	C+
<b>Dams</b>	<b>D</b>	<b>D</b>
<b>Drinking Water</b>	<b>D</b>	<b>D</b>
Energy	D+	D+
Hazardous Waste	D	D+
Inland Waterways	D-	D
<b>Levees</b>	<b>D-</b>	<b>D</b>
Ports	C	C+
Public Parks	C-	D+
Rail	C+	B
Roads	D	D
Schools	D	D+
Solid Waste	B-	C+
Transit	D	D-
<b>Wastewater</b>	<b>D</b>	<b>D+</b>
GPA	D+	D+
Cost to Improve**	\$3.6T	\$4.59T



[The President should]  
Propose enactment of a  
Floodplain Management Act  
which establishes a national  
model for floodplain  
management, clearly  
delineates federal, state, tribal,  
and local responsibilities,  
provides fiscal support for  
state and local floodplain  
management activities, and  
recognizes states as the  
nation's principal floodplain  
managers;

*1994 White House Floodplain  
Management review committee*





# **National Research Council Study 2002**

## **The Missouri River Ecosystem**

Current management of the Missouri River system represents an accretion of federal laws, congressional language, appropriations instructions, and organizational interpretations. They confuse and compound the management

Congress should provide a federal Missouri River Protection and Recovery Act and the fiscal resources needed

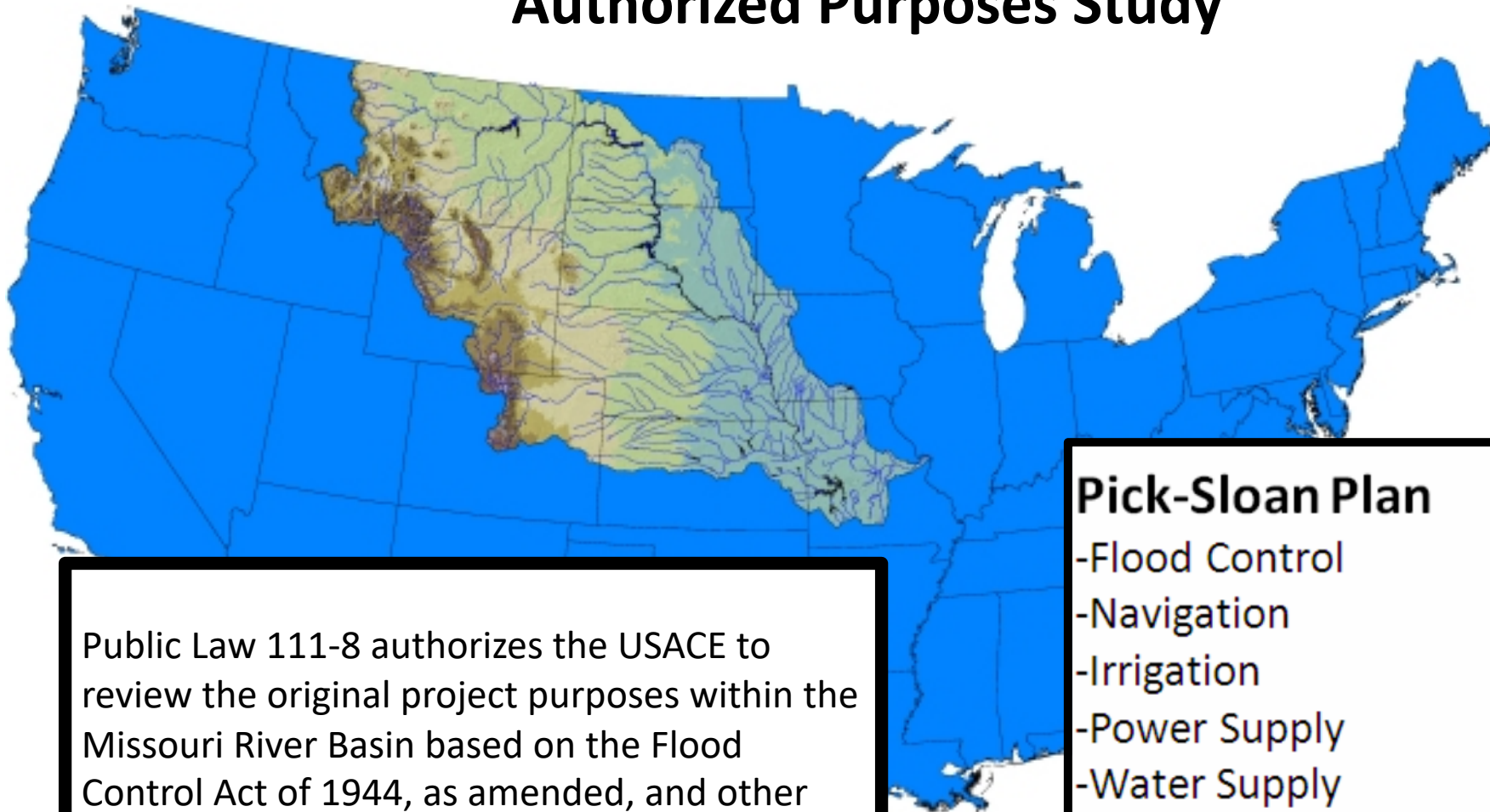
# Conclusions

---

- **The Missouri River ecosystem is in trouble and needs attention.**
- **The ecosystem changes are not just scientific measurements, but represent valuable losses to society**



# Authorized Purposes Study



Public Law 111-8 authorizes the USACE to review the original project purposes within the Missouri River Basin based on the Flood Control Act of 1944, as amended, and other subsequent relevant legislation and judicial rulings to determine if changes to the authorized project purposes and existing federal water resource infrastructure may be warranted

## Pick-Sloan Plan

- Flood Control
- Navigation
- Irrigation
- Power Supply
- Water Supply
- Water Quality
- Recreation
- Fish and Wildlife



**How Are We Addressing  
These Challenges?**

# ★ *Challenges*

## *Dealing with the Congress and Administrations*

- **Congress and Administration Need to Resolve Conflicts and Inconsistencies in De Facto Water Policy**
- **Administration Should Establish a Body to Coordinate Federal Activity**
- **P&G Should BE Revised**
- **BCA Should not Be Sole Decision Criterion**
- **Congress Should Fund Ex-Post Project Evaluation**
- **Corps Should Track Public Participation**

**“216”**

# American Water Resources Association's National Water Resources Policy Dialogue

Washington, D.C.  
September 17-18, 2002



Third National Water Resources  
Policy Dialogue - January 2007  
Arlington, VA



## AMERICAN WATER RESOURCES ASSOCIATION

### Second National Water Resources Policy Dialogue

Tucson, Arizona

February 14-15, 2005





Stewardship of the Nation's water resources is being neglected and the manner in which we deal with water issues is dysfunctional.

AWRA  
February 2007

## Third National Water Policy Dialogue

Directed by  
Kerry P. O'Dell  
Executive Vice President

Improving the American water supply is a national priority. The results of the 2007 National Water Policy Dialogue are a critical first step in addressing the Nation's water resource issues. The Dialogue, which was held in the President's Conference Room, was the first of its kind. It brought together the Congress, the Executive Branch, the States, the Tribes, and the public to discuss the Nation's water issues and to develop a national water policy. The Dialogue was a landmark event in the history of water policy in the United States. It was a first step in addressing the Nation's water resource issues. The Dialogue was a landmark event in the history of water policy in the United States. It was a first step in addressing the Nation's water resource issues.

The participants in the 2007 Dialogue developed a national water policy that will guide the Nation's water resource management. The Dialogue was a landmark event in the history of water policy in the United States. It was a first step in addressing the Nation's water resource issues. The Dialogue was a landmark event in the history of water policy in the United States. It was a first step in addressing the Nation's water resource issues.

**AMERICAN WATER RESOURCE ASSOCIATION**  
4 West Federal Street • P.O. Box 1825 • Middleburg, VA 22113-1825  
PHONE: (540) 687-3230 • FAX: (540) 687-3236 • [www.awra.org](http://www.awra.org)



Our Nation's approach to dealing with water is ad hoc. Numerous studies by the National Academies, other nonpartisan organizations, and both the Administration and the Congress speak to **“management by earmark.”** We address problems as they appear or as they merit political support rather than addressing long term needs.

AWRA

February 2007

# Third National Water Policy Dialogue

Our Nation's approach to dealing with water is ad hoc. Numerous studies by the National Academies, other nonpartisan organizations, and both the Administration and the Congress speak to **“management by earmark.”** We address problems as they appear or as they merit political support rather than addressing long term needs.

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4 West Federal Street • P.O. Box 1825 • Middleburg, VA 20118-1825  
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# Dialogue Recommendations

- **Establish Broad Principles for Water Management – a National – Not a Federal - Vision**
- **Translate Vision Into Water Policies**
- **Encourage Policies that Promote Watershed Planning and Change Policies that Do Not.**
- **Use Nation's Vast Scientific Knowledge About Water - Fully Consider In Making Decisions**



# America's Watershed: A 200-year vision

## *An Intergenerational Commitment*

### Our people ...

- Enjoy a quality of life unmatched in the world.
- Lead secure lives along any river or tributary in the basin.
- Enjoy fresh air and the surrounding fauna, flora, and forests while hunting, fishing, and recreating along any river or tributary in the basin.
- Travel easily, safely, and affordably to various destinations in the watershed.
- Drink from and use the abundant waters of any river, stream, or aquifer in the basin.
- Choose from an abundance of affordable basic goods and essential supplies that are grown, manufactured, and transported along the river to local and world markets.

❖ National security & comprehensive flood damage reduction.

❖ Environmental sustainability & recreation.

❖ Infrastructure & energy.

❖ Water supply & water quality.

❖ Movement of goods; agriculture & manufacturing.

*Leveraging engineering, science, technology and public policy*



## The Mississippi River Watershed: Ever...America's Heritage™

“Efforts to sustain the Mississippi River system will require a unified vision and intergenerational commitment to realize that vision.”

Detrimental environmental impacts that affect the future sustainability of the Mississippi River should be recognized, emphasized, and addressed in the context of a progressive, interdependent watershed system. Leadership and action within this watershed perspective is urgently required.

We, the undersigned representatives of the Midwest Natural Resources Group, provide this united message as a call to action to urgently address the sustainability of natural resources within the Mississippi River watershed. We believe that the MNRG is in an excellent position to facilitate the development of an integrated vision for natural resources sustainability, support partnerships to achieve integrated goals, and promote a holistic approach to the long-term stewardship of the Mississippi River watershed.

Br Michael J. Walsh, Commander, Mississippi Valley Division  
U.S. Army Corps of Engineers

Max M. Eldridge, Regional Executive North Central Area  
U.S. Geological Survey

Terrence Virden, Regional Director  
Bureau of Indian Affairs

Juan Palma, State Director  
Bureau of Land Management, Eastern States

Br John Peabody, Commander, Ohio River and Great Lakes Division  
U.S. Army Corps of Engineers

Shari Muller, Acting Regional Administrator Region 1  
Environmental Protection Agency

Jan Allen, Manager, Great Lakes Airport Division  
Federal Aviation Administration

Joseph M. Oleson, Acting Regional Administrator  
Department of Homeland Security Federal Emergency Management Agency

Joseph A. Lundy, Director of Field Services - South  
Federal Highway Administration

Tom Mellus, Region 3 Director  
U.S. Fish and Wildlife Service

Karl Christensen, Forest Regional Forester  
U.S. Forest Service

Laura L. Ferguson, EPA PPT  
Regional Office, Great Lakes Environmental Research Laboratory  
National Oceanic and Atmospheric Administration

Eric Quillen, Regional Director  
National Park Service

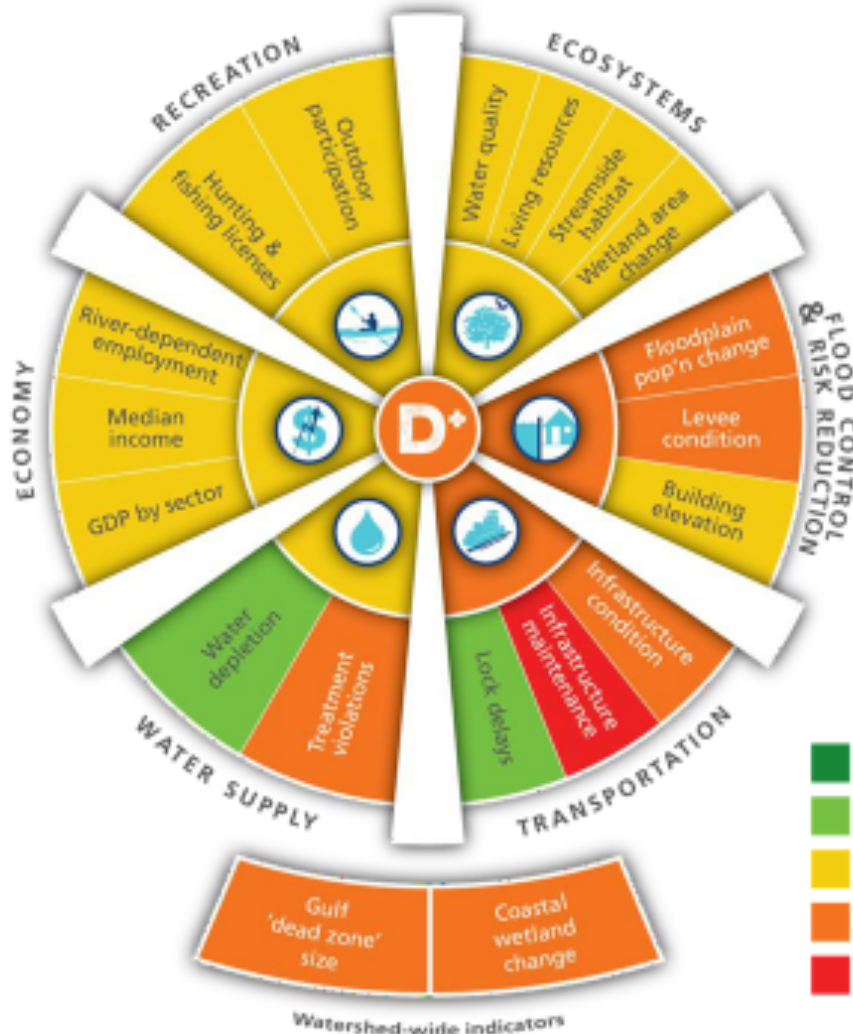
Tom Krup, Wisconsin and Great Lakes Environmental  
Natural Resources Conservation Service



PT USCG  
vention Division



# Report Card Results



- 6 goals measured
- 17 basin scale measurements
- 2 watershed scale measurements
- Results for watershed
- Results for basins



US Army Corps  
of Engineers®



BUILDING STRONG  
COLLABORATIVE  
RELATIONSHIPS FOR  
A SUSTAINABLE  
WATER RESOURCES  
FUTURE

# National Report:

## Responding to National Water Resources Challenges

- Revitalize and/or reshape means at all levels of government to improve water resources management...
- Foster continued dialogue about a sustainable national water resources future direction and develop supporting strategies to elevate water resources and related infrastructure as a critical national priority





# What's Needed

---

- Administration and Congressional Recognition of Need for Leadership and Coordination and Action to Manage and Chart Path Forward
  - Establish a federal coordinating activity in EOP with minimal staff (WRC?) to ensure horizontal and vertical integration
  - Integrate federal agency actions on water on a national basis; develop watershed approach (lead systems integrator)
  - Conduct national assessment (308?)
- Collaborative development of national (not federal) vision/plan/framework; address tough issues
  - Integrate states into action (EU Water Framework)
  - Develop realistic action plan with priorities
- **Development of realistic long-term investment strategy**

# Last Words

---

- **The nation will face many difficult water resources challenges in the decades ahead and it is operating without a plan to manage and sustain these resources**
- **The Federal and State Governments need to clearly define the role they believe they should play in dealing with water issues and collaborate on moving ahead**

HE  
394  
.M4M5

UC-NRLF  
\$B 241 793

GIVE US AN  
UNOBSTRUCTED  
MISSISSIPPI.

YB 66101

A  
MEMORIAL TO CONGRESS

TO SECURE

AN ADEQUATE APPROPRIATION

FOR A PROMPT AND THOROUGH

IMPROVEMENT OF THE MISSISSIPPI RIVER

WITH AN APPENDIX BY

SYLVESTER WATERHOUSE,

*Of Washington University.*

*Miss. River improvement convention.*

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1877.





# PRESIDENT'S STATE, LOCAL, AND TRIBAL LEADERS TASK FORCE ON CLIMATE PREPAREDNESS AND RESILIENCE

## Recommendations to the President



November 2014

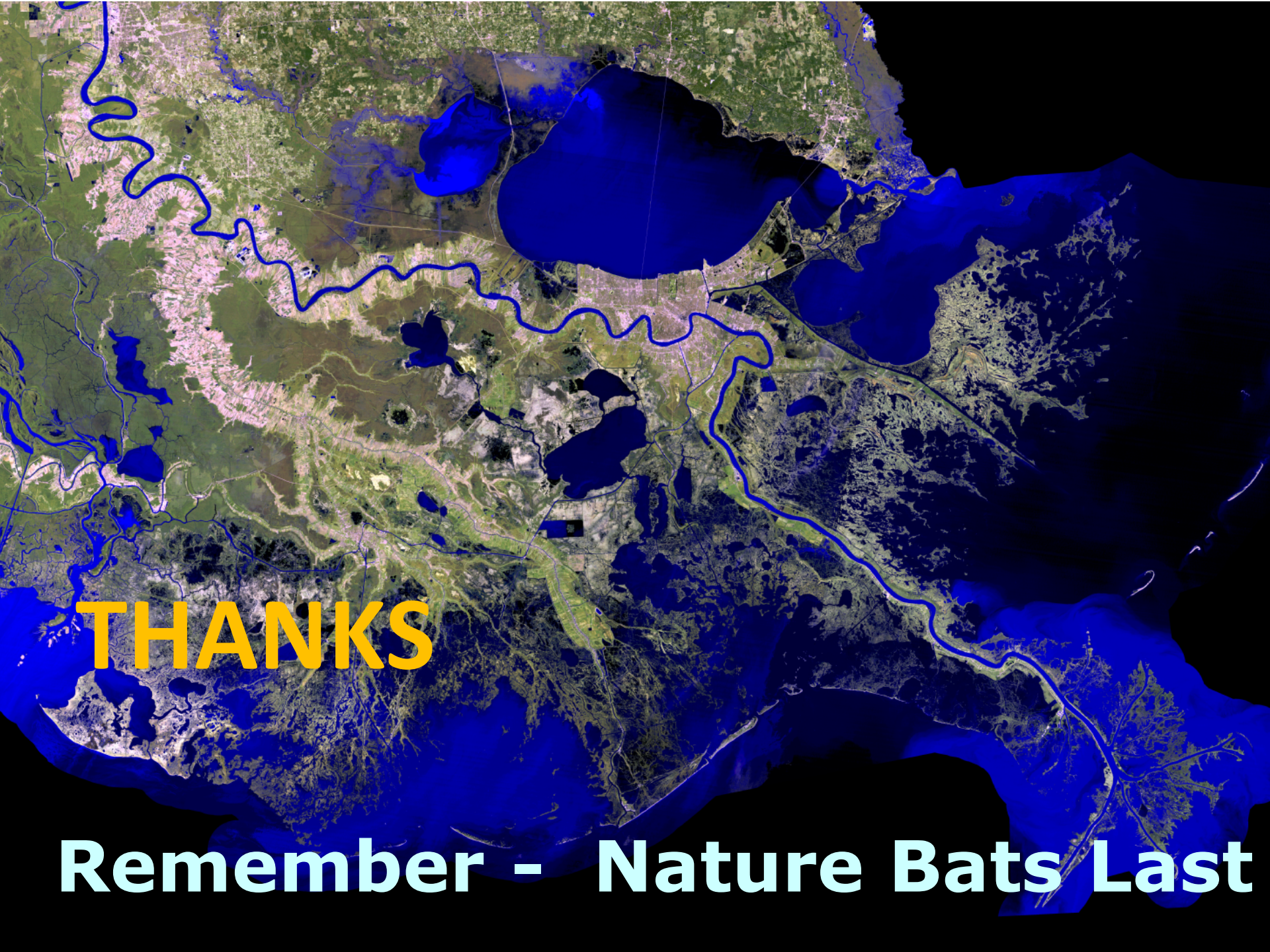
"Alice laughed: "There's no use trying," she said; "one can't believe impossible things."

"I daresay you haven't had much practice," said the Queen. "When I was younger, I always did it for half an hour a day. *Why, sometimes I've believed as many as six impossible things before breakfast*

*Alice in Wonderland.*



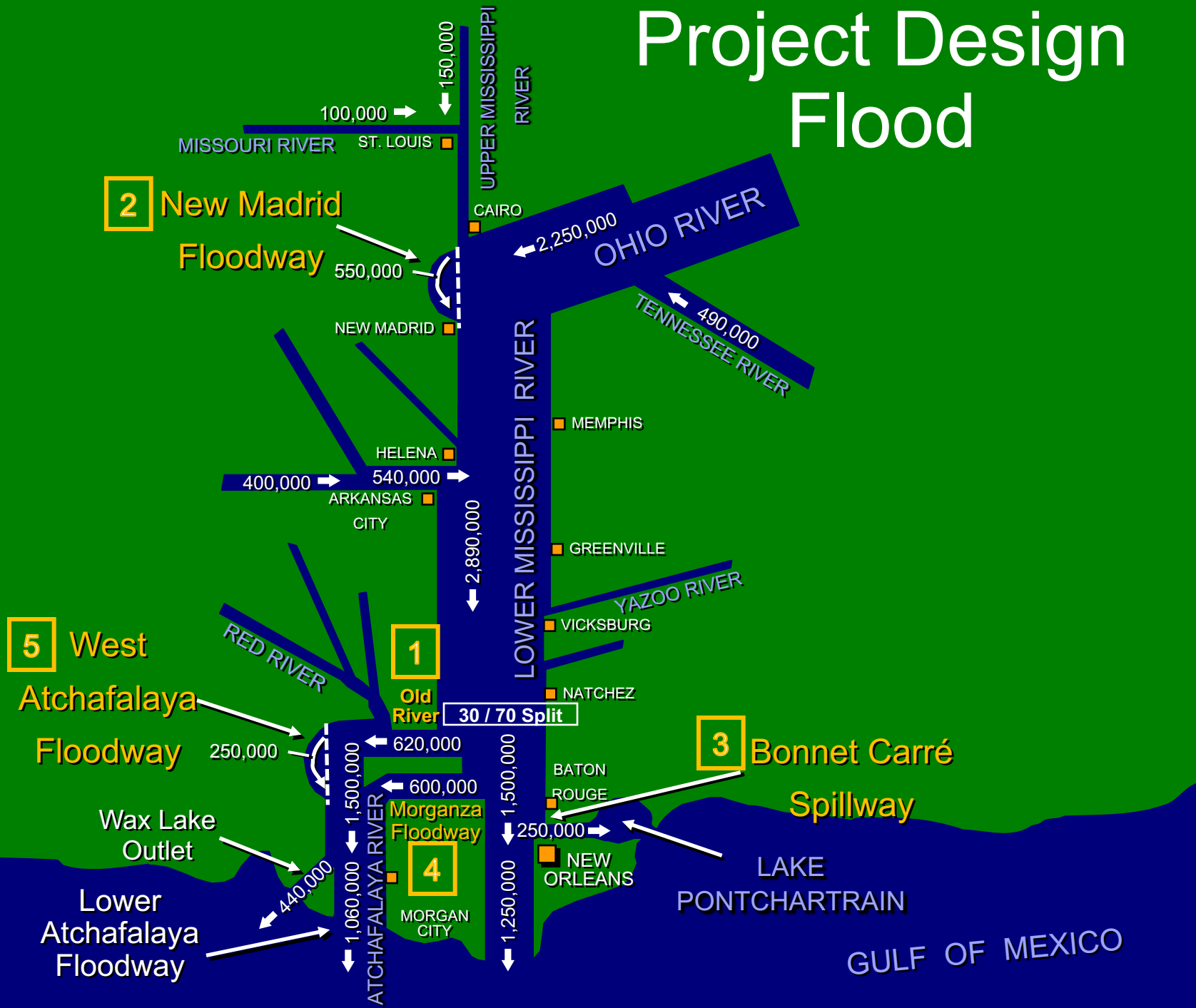




**THANKS**

**Remember - Nature Bats Last**

# Project Design Flood





# ROOM FOR THE RIVER – The Netherlands

An aerial photograph showing a river restoration project in the Netherlands. The river is a dark, winding line on the left. To its right is a large, green, rectangular field, possibly a sports field, surrounded by trees. Further right is a residential area with houses and roads. The riverbank between the river and the field is a mix of green grass and brown, eroded soil, indicating ongoing work or recent completion. The sky is not visible, and the overall scene is a mix of natural and urban environments.

RvR began as idea in 1986, gained momentum in 1990s, US projects as inspiration

Netherlands Embassy

27.08.2001



# Yu the Great, 2025 BC



*What Would They Say?*









# MRERP

## Missouri River Ecosystem Restoration Plan and Environmental Impact Statement



One River ■ One Vision



# MISSOURI RIVER RECOVERY PROGRAM



**Missouri  
River  
Recovery  
Implementation  
Committee**

Promoting Economic Justice for Family Scale Farming

The Cornucopia Institute



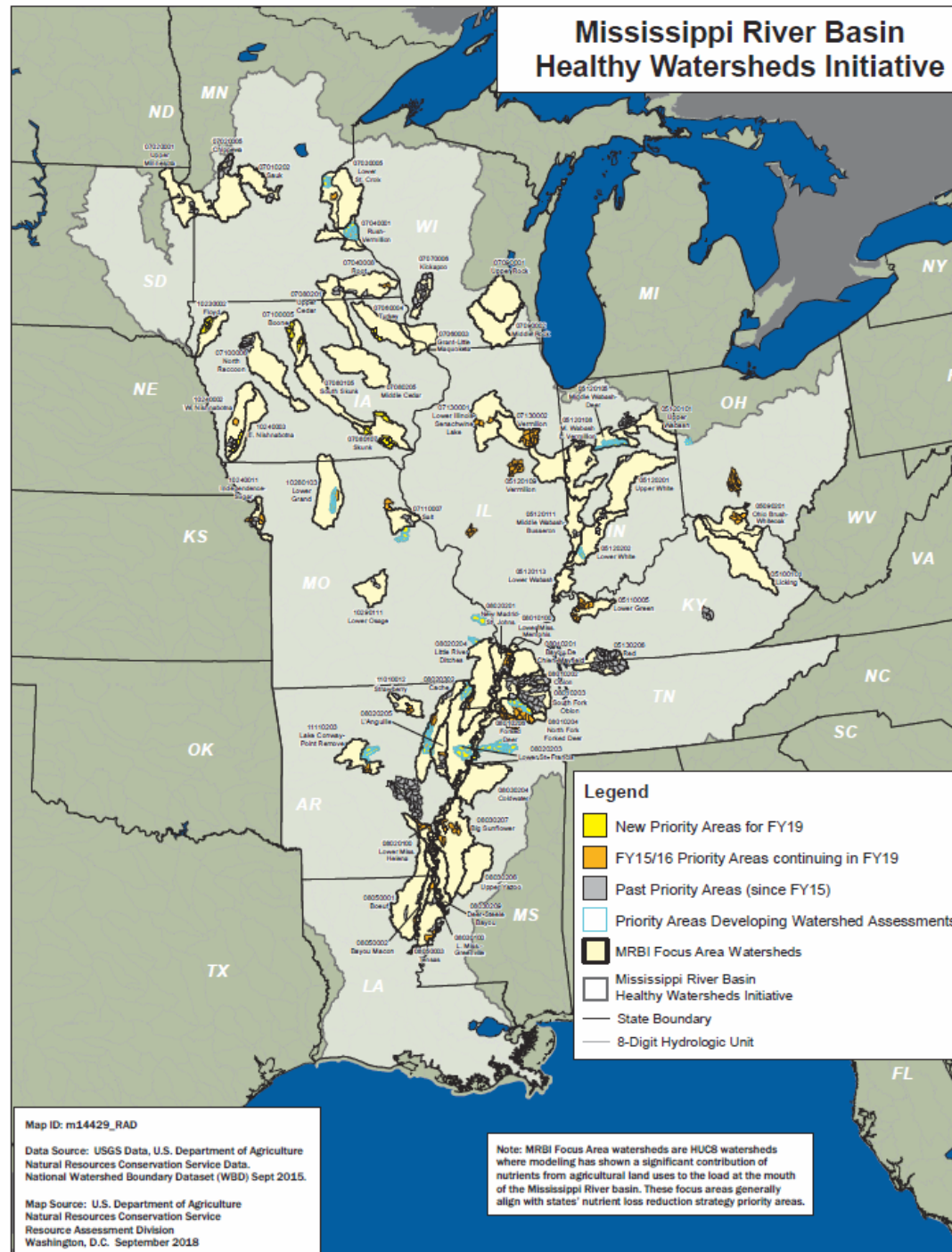
# MISSISSIPPI RIVER CITIES & TOWNS INITIATIVE

*An Association of United States Mayors*





# Mississippi River Basin Healthy Watersheds Initiative





OHIO RIVER BASIN  
ALLIANCE

Past, Present, and Future



## Upper Mississippi River Basin Association

### **Pick-Sloan Plan**

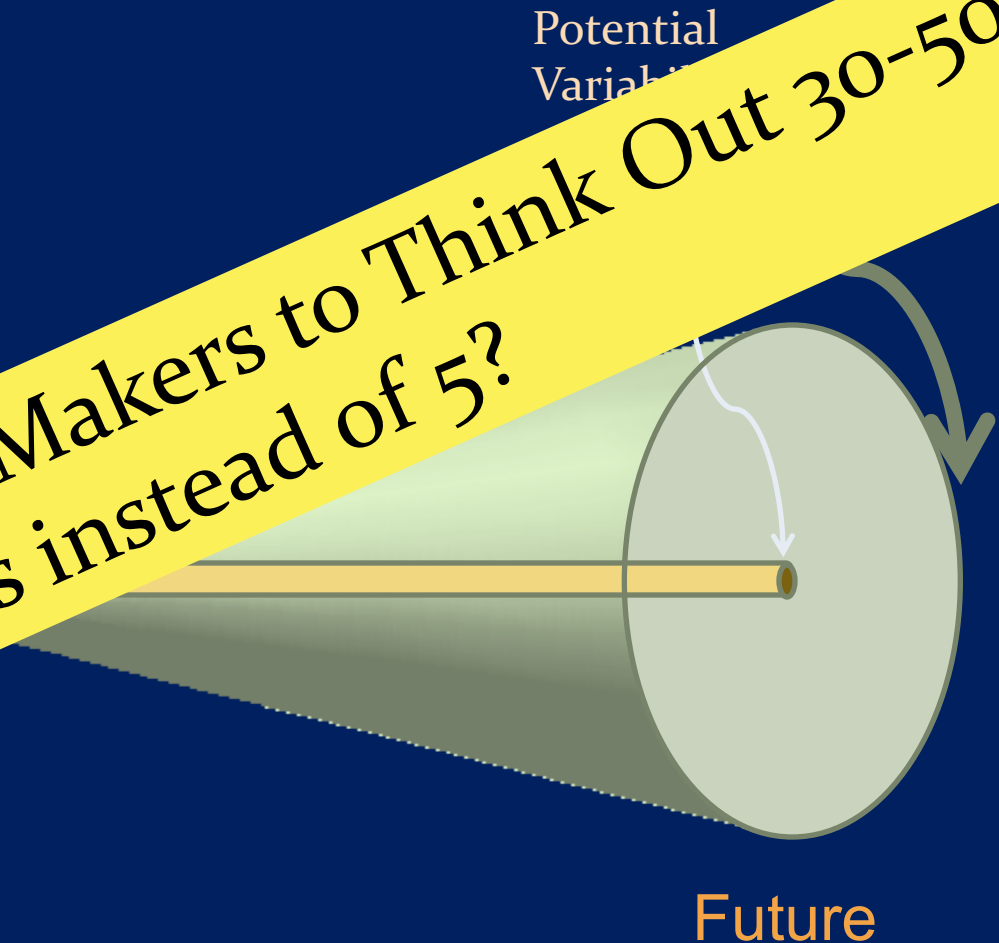
- Flood Control
- Navigation
- Irrigation
- Power Supply
- Water Supply
- Water Quality
- Recreation
- Fish and Wildlife

# Short-term Planning

- Traditional Planning
  - Short term
  - Cylindrical
  - Stationary
  - Economic Focus

Getting Decision Makers to Think Out 30-50 Years instead of 5?

- Conical
- Non-stationary
- Sustainable

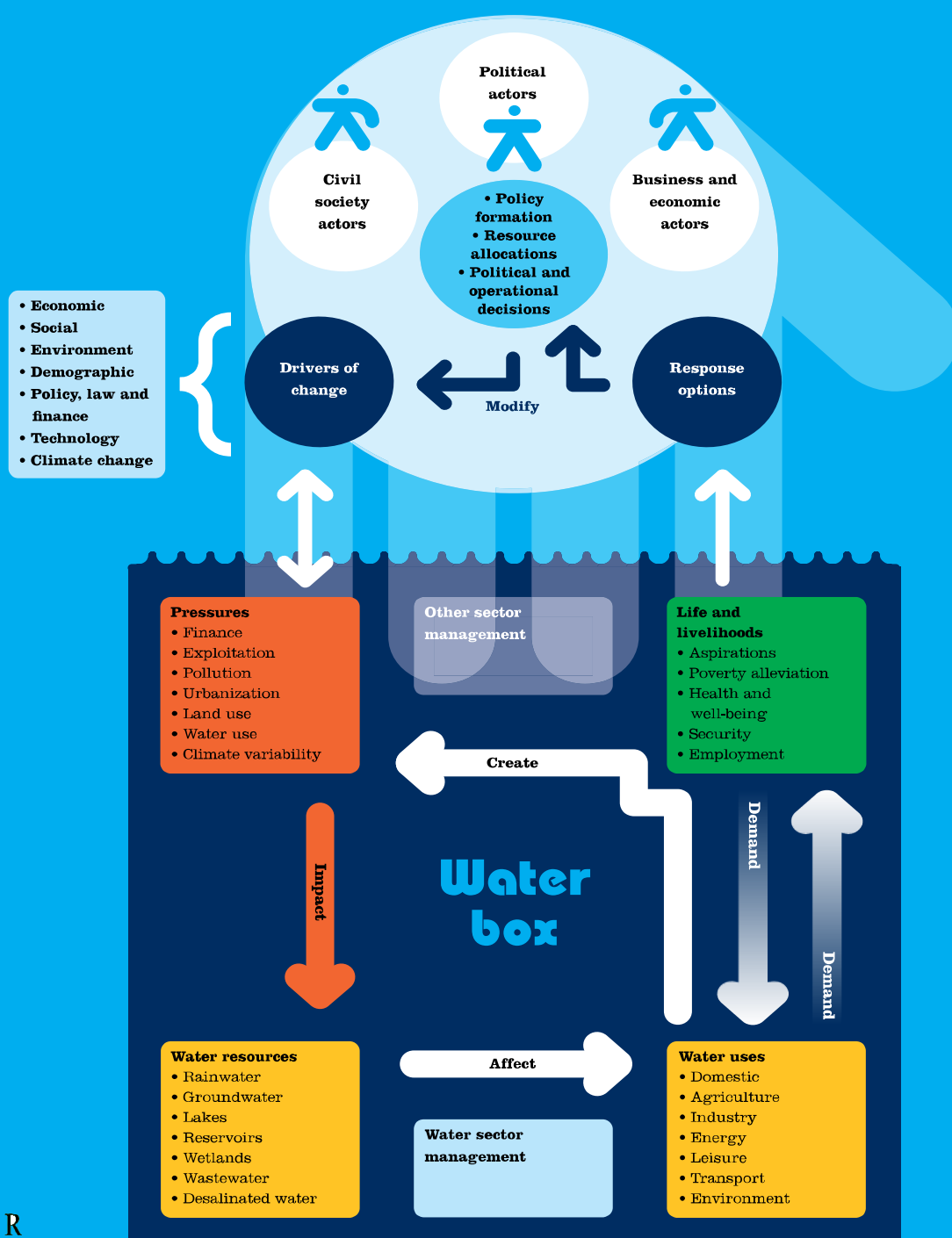


Adapted from Marc Waage , Denver Water and Malcom Pirnie

# Opening the “Water Box”

Decision-making affecting water

UN Third World Water Development Report





## Pressures

- Finance
- Exploitation
- Pollution
- Urbanization
- Land use
- Water use
- Climate variability

Impact

## Water resources

- Rainwater
- Groundwater
- Lakes
- Reservoirs
- Wetlands
- Wastewater
- Desalinated water

Other sector  
management

Create

Water  
box

Affect

Water sector  
management

## Life and livelihoods

- Aspirations
- Poverty alleviation
- Health & well-being
- Security
- Employment

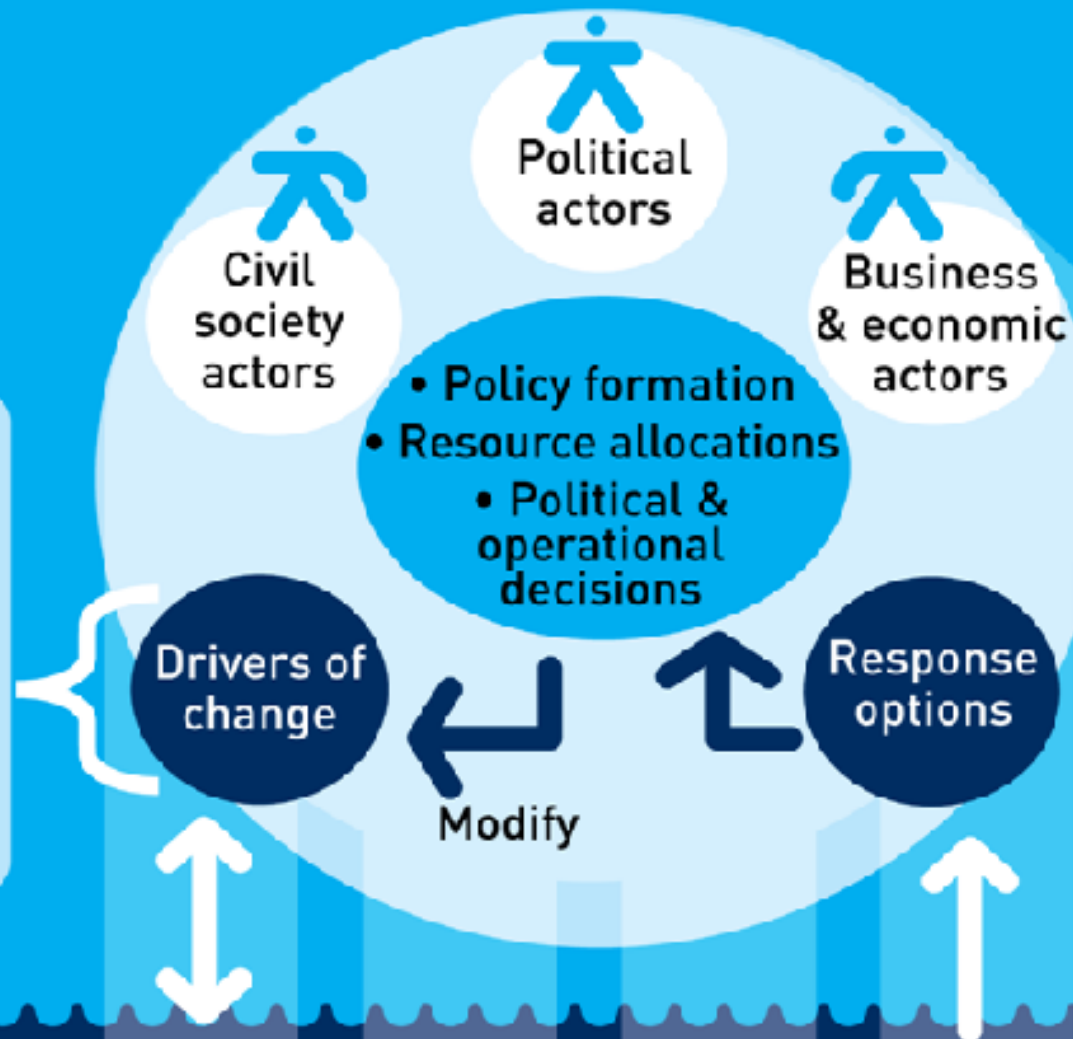
Demand

Demand

## Water uses

- Domestic
- Agriculture
- Industry
- Energy
- Leisure
- Transport
- Environment

- Economic
- Social
- Environment
- Demographic
- Policy, law & finance
- Technology
- Climate change



Pressures

Life and Livelihoods

# The Mississippi Basin



# The Distribution Map of Flood Diversion Area

**Population: 582,000**  
**Area: 921 km<sup>2</sup>**  
**Storage 5.5 B m<sup>3</sup>**

**Jingjiang**

**Honghu**

**Wuhan**

**Population: 1,295,000**  
**Area: 2797 km<sup>2</sup>**  
**Storage 18.1 B m<sup>3</sup>**

- ① Wanshi Extended Flood Diversion Area
- ② Jingjiang Flood Diversion Area
- ③ Huxi Preparation Flood Storage Area
- ④ Renmin Dayuan Flood Storage Area
- ⑤ Honghu Flood Diversion and Storage Area
- ⑥ Jiangnan Luchengyuan Flood Diversion and Storage Area

-  Flood Diversion and Storage Area
-  Water Body
-  Safety Area
-  Boundary of County

Department of Geographic Information Science  
Nanjing University  
Oct. 26, 2008

0 5 10 20 30 40 Km



The Water Framework Directive establishes a legal framework to protect and restore clean water across Europe and ensure its long-term and sustainable use.

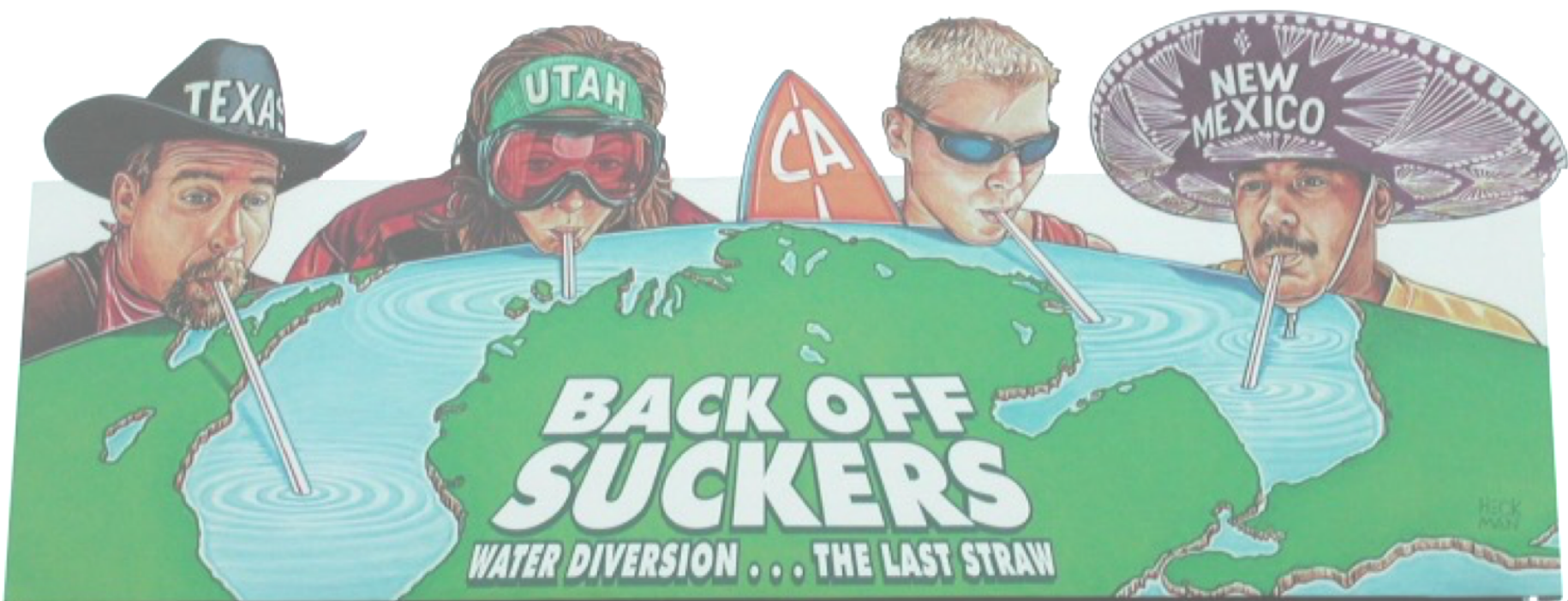
The directive establishes an innovative approach for water management based on river basins, the natural geographical and hydrological units, and sets specific deadlines for Member States to achieve ambitious environmental objectives for aquatic ecosystems. The directive addresses inland surface waters, transitional waters, coastal waters and groundwater.

Directive 2000/60/EC of the European Parliament  
and of the Council of 23 October 2000 , *Establishing a  
Framework for Community Action in the Field of Water  
Policy*





- **Directive on the quality of water intended for human consumption**
- **Framework for community action in the field of marine environmental policy**
- **Framework for community action in the field of marine environmental policy**
- **Directive on the assessment and management of flood risks**



INFINITY