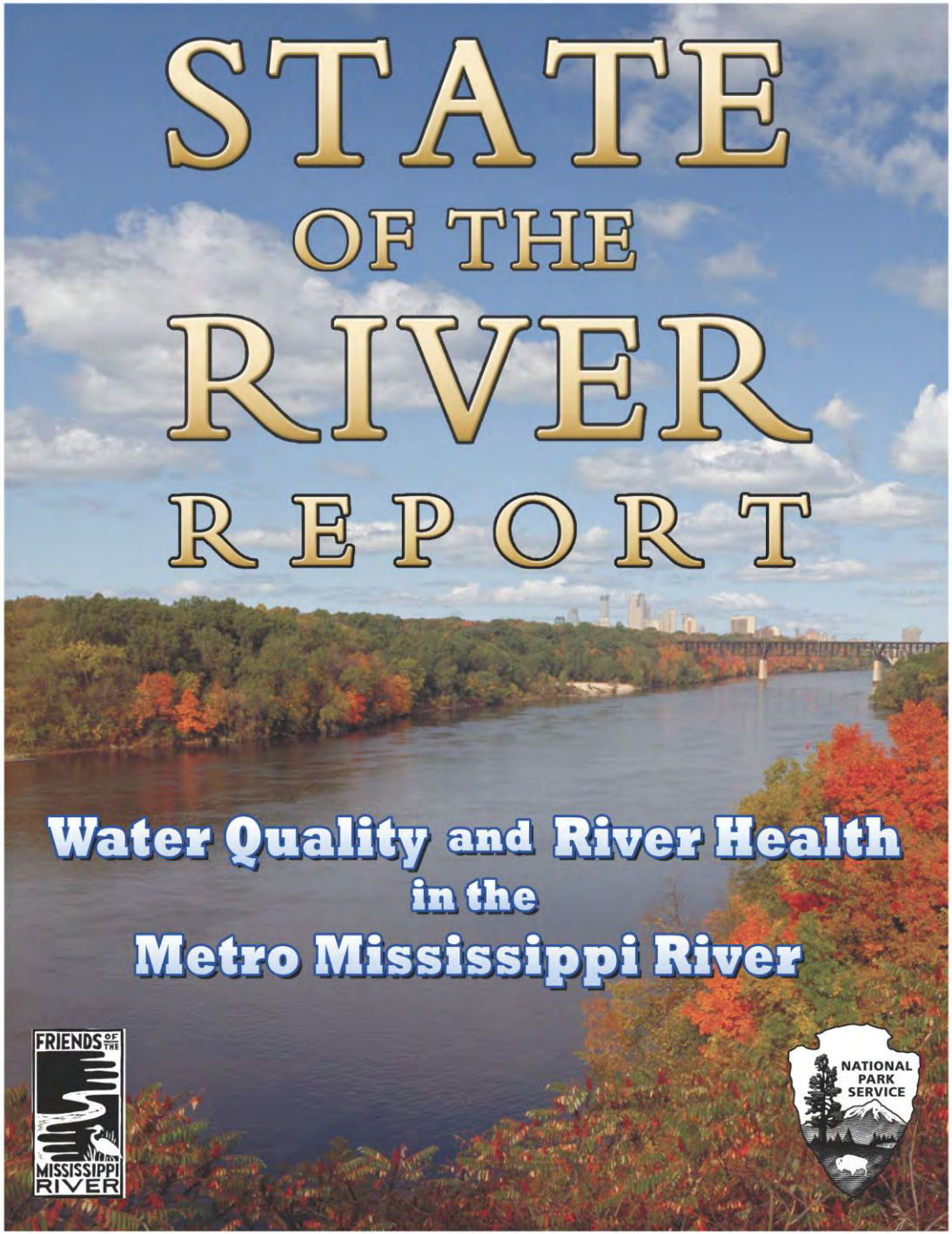

STATE
OF THE
RIVER
REPORT
Water Quality and River Health
in the
Metro Mississippi River
FRIENDS OF THE MISSISSIPPI RIVER
NATIONAL PARK SERVICE

Acknowledgements

THE McKNIGHT FOUNDATION

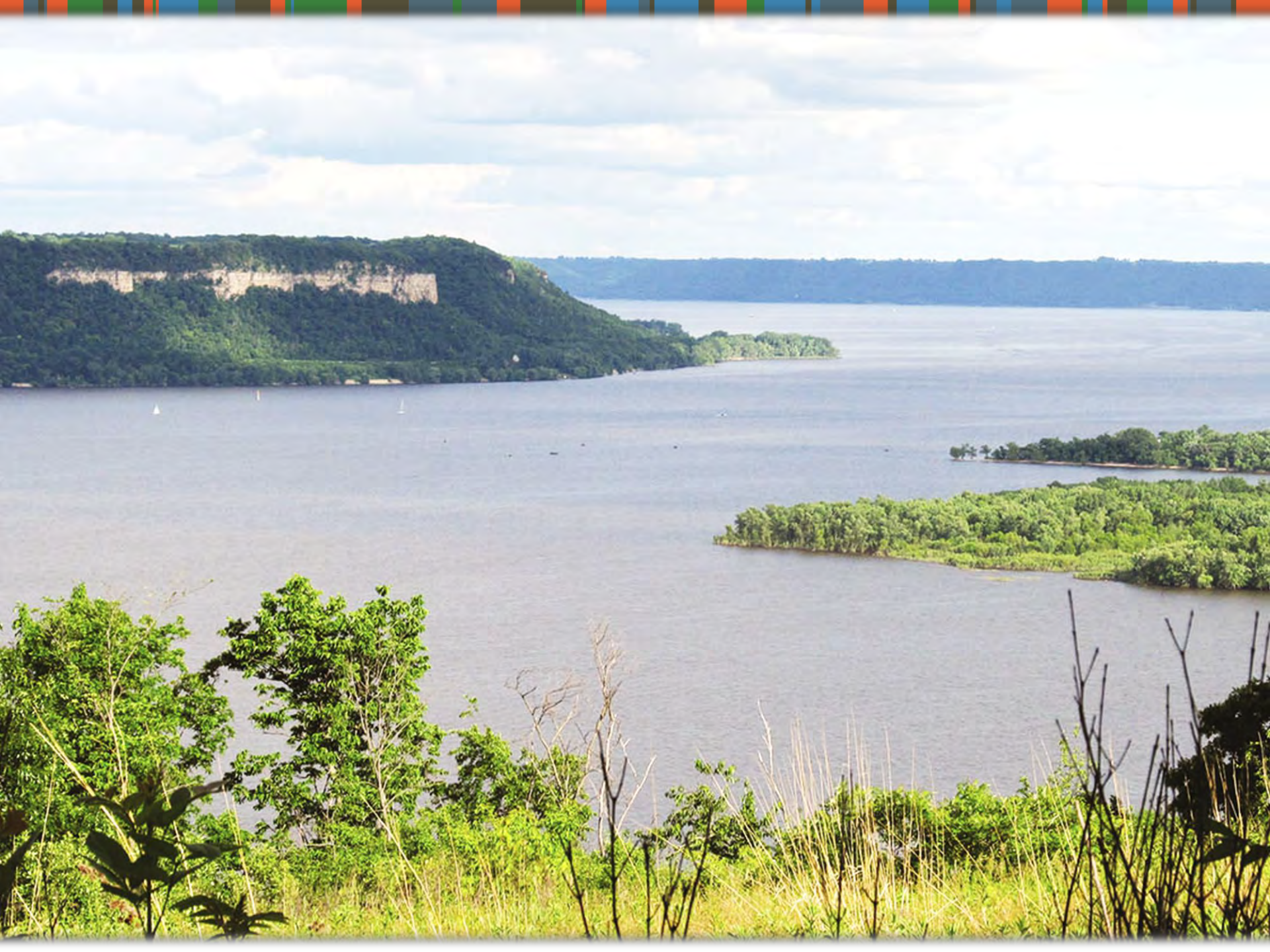
Capitol Region Watershed District

Science Museum of Minnesota

MINNEHAHA CREEK WATERSHED DISTRICT
QUALITY OF WATER, QUALITY OF LIFE

SAINT PAUL
The Most Livable City in America

The Mississippi River watershed



The Mississippi National River and Recreation Area


Can I swim in the river?
Can I eat the fish I catch?
Is pollution getting better?
What about those Asian carp?
Is flow really higher?
Do you guys have some kind of report on this?

Report goals

- Clear and easy to understand
- Increase public awareness
- Build public support around priorities for action
- Audience: Minnesotans who want to know more about the Mississippi River

Science advisors

- John Anfinson - MNRRA
- Mike Davis - MDNR
- Deborah Durkin - MDH
- Dan Engstrom - SCWRS
- Larry Gunderson - MPCA
- Steven Heiskary - MPCA
- **Paul Hoff - MPCA**
- **Kent Johnson - MCES**
- Richard Kiesling - USGS
- **Len Kremer- LMRWD**
- Kathy Lee - USGS
- Patricia McCann - MDH
- **Sue Magdalene - SCWRS**
- Brenda Moraska Lafrancois - NPS
- **Barb Peichel - MPCA**
- Art Persons - MDH
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- **Faye Sleeper - UofM**
- Rory Stierler - MNRRA
- **Joel Stiras - MDNR**
- Judy Sventek - MCES
- **David VanderMeulen - NPS**
- David Wall - MPCA
- Dennis Wasley - MPCA
- Virginia Yingling - MDH

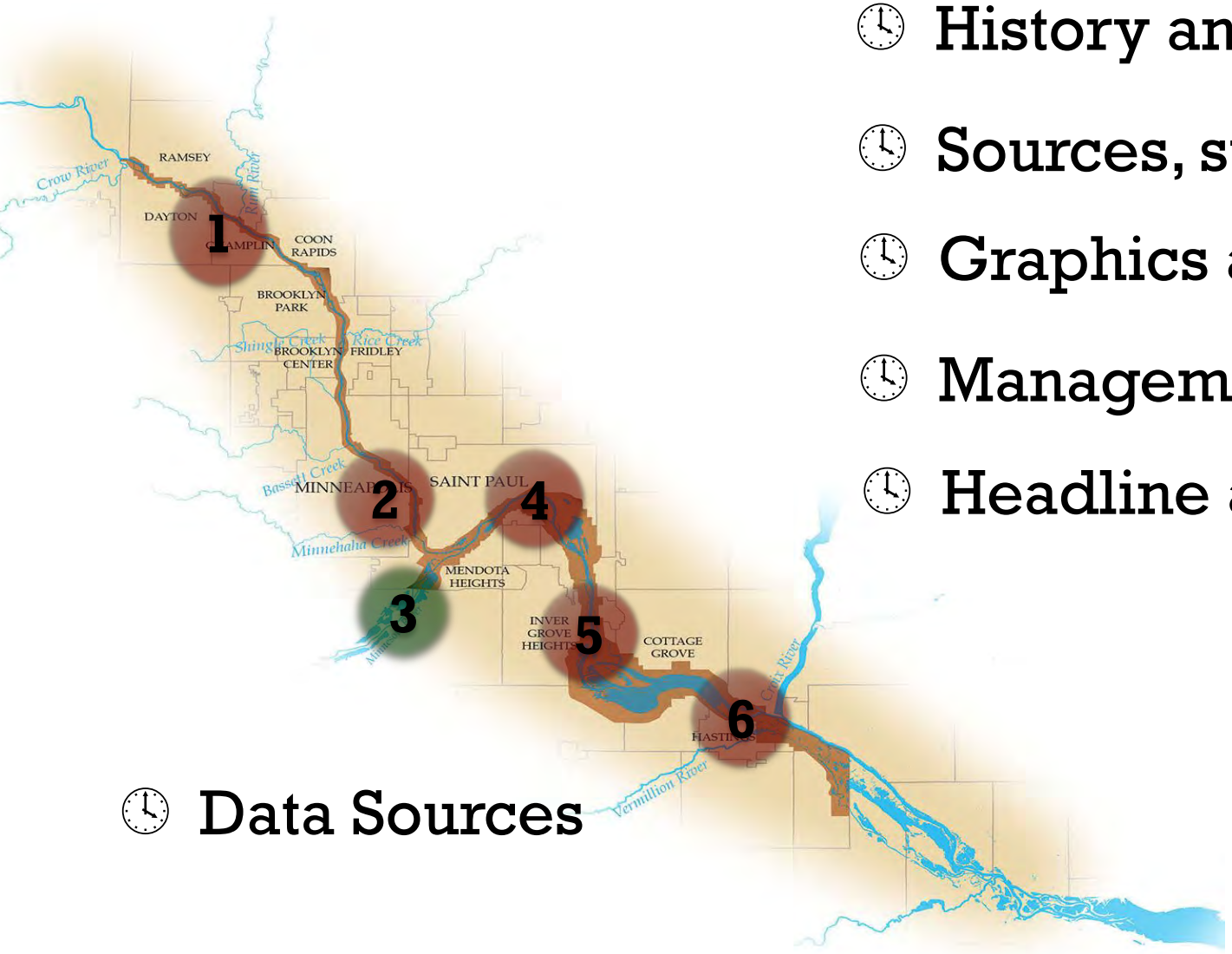
Report development

- Large universe of information
- Advisory and technical teams
  - *Identify potential indicators*
  - *Identify suitable data sources*
  - *Refine indicator options*
- Final cut: **13** indicators

Report indicators

RIVER FLOW	Flow	
SWIMMING & RECREATION	Bacteria	Phosphorus
FISH & FISHING	Fish consumption	
	Fish survey	Asian carp
ECOLOGICAL HEALTH	Sediment	Nitrate
	Mussels	Bald Eagles
OTHER CONTAMINANTS OF CONCERN	Triclosan	PFOS
	Additional Contaminants of Concern	

Indicator Format



- History and background
- Sources, status, trends
- Graphics and maps
- Management solutions
- Headline and summary
- Data Sources

About this presentation

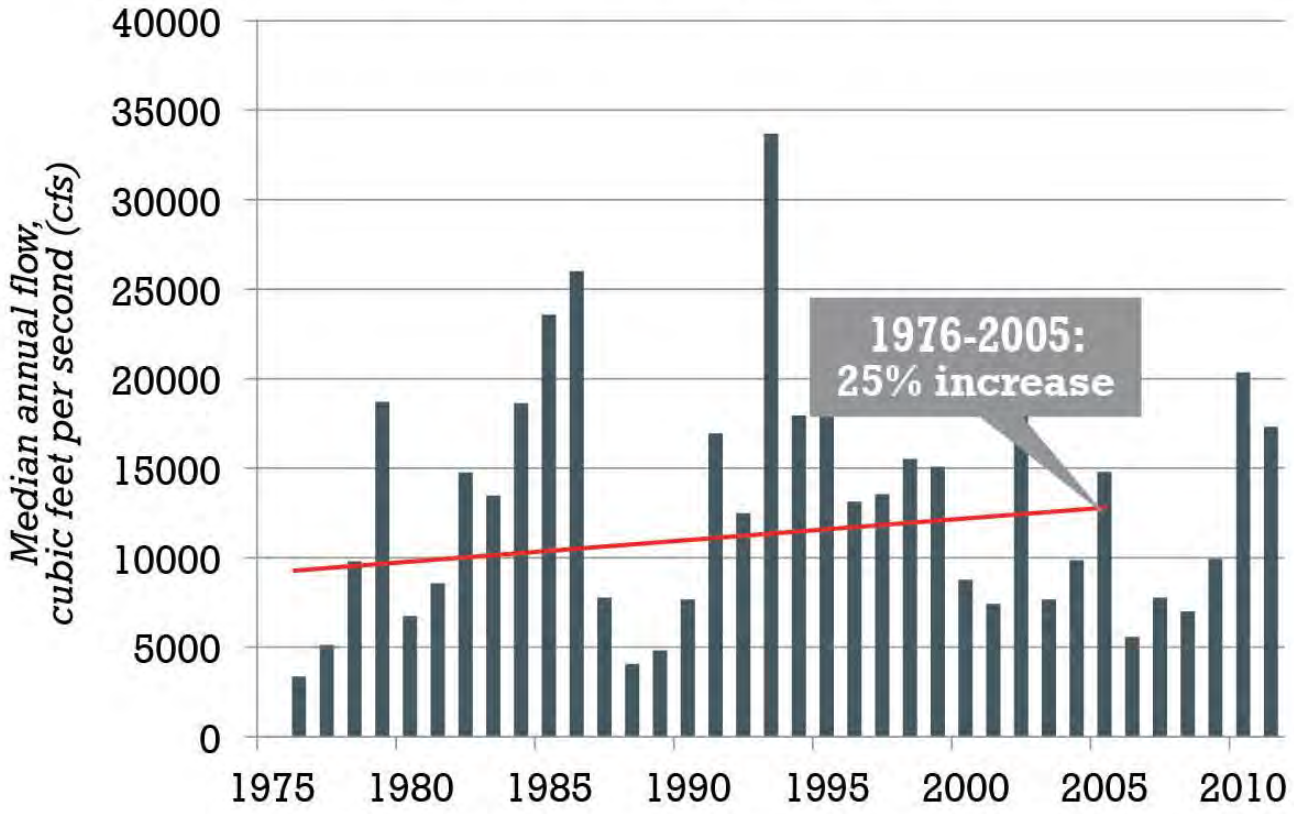
- Presentation of findings
- 13 indicators – 5 in detail
  - Bacteria
  - Asian carp
  - Sediment
  - Nitrate
  - Bald eagles
- Summary and conclusions
- Questions and answers

RIVER FLOW

Flow

History and trends

Figure 3. Annual river flow at Hastings Dam



Data source: Metropolitan Council Environmental Services.

Note: trend analysis available only through 2005.

SWIMMING & RECREATION

Bacteria

Bacteria

Portions of the metro river are impaired with excess bacteria

- Bacteria pollution comes from human and animal sources.
- A clean-up plan is currently under development to address this pollution problem.

Impacts and sources

- Escherichia coli (*E. coli*) bacterium indicates the potential presence of waterborne pathogens.
- Contact with water with high bacteria concentrations can make recreational users sick.
- Sources include:
  - Human waste
  - Livestock
  - Pets
  - Wildlife

History and trends

- *E. Coli* data collected since 2005
- Some stretches showed excess fecal bacteria by 1996
- Modern wastewater treatment systems
  - Reduced raw sewage
  - Improved public health
- Separation of sanitary and storm sewers
  - Began 1985 - now largely complete
  - Kept millions of gallons of sewage per year river

Bacteria

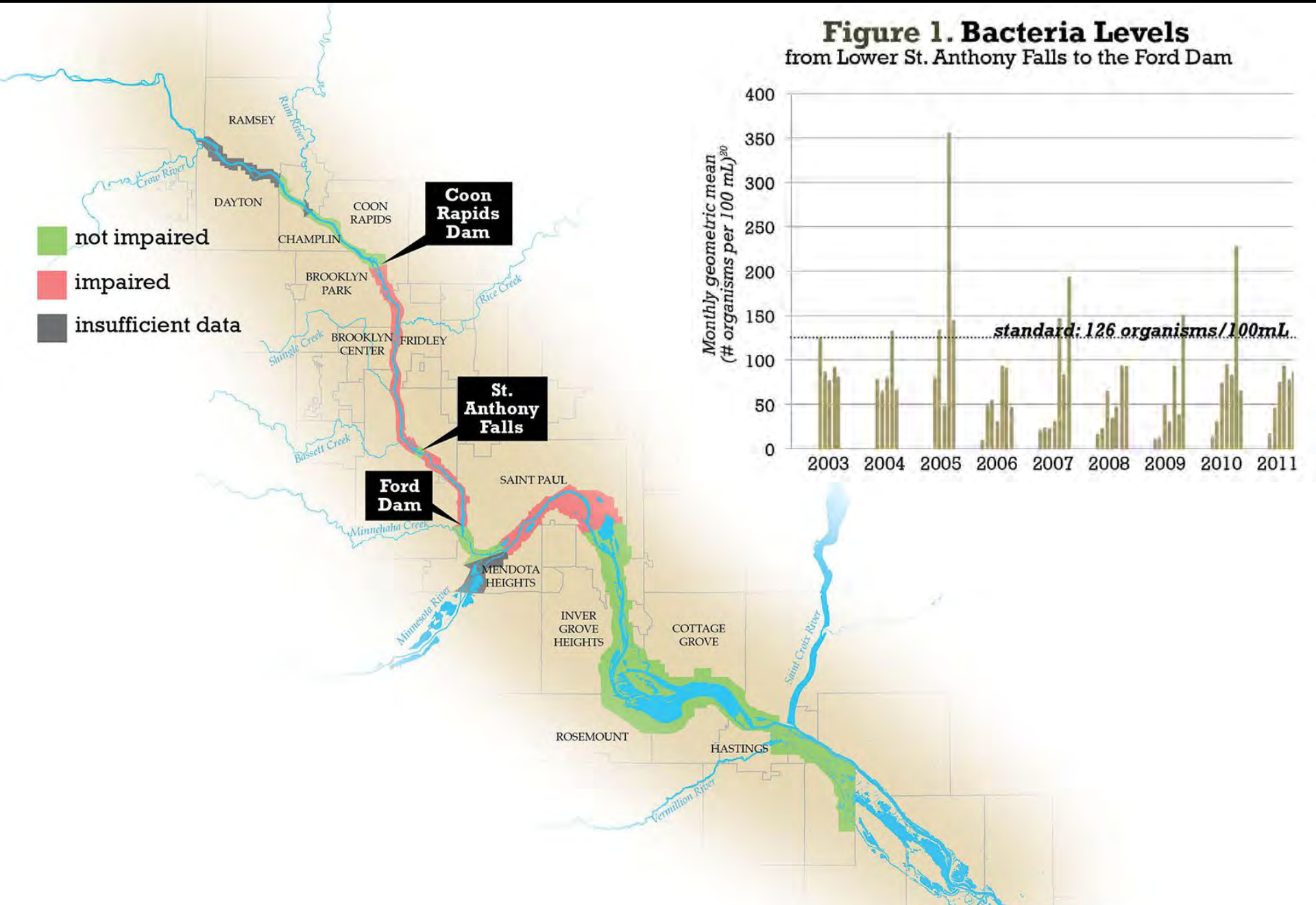


Figure 1. Bacteria Levels

from Lower St. Anthony Falls to the Ford Dam

Solutions

- The MPCA's cleanup plan to address this problem is currently being developed
  - Gather data
  - Identify sources
  - Propose source reductions
- You can help:
  - Pick up pet waste
  - Reduce runoff
  - Septic systems

Bacteria

Can I swim in the river?

Caution is advised in impaired reaches of the river, and you should always wash up afterwards.

Swimming should be avoided throughout the river within 48 hours of rain events.

Bacteria in water is as dangerous for dogs as it is for people. Don't let your dog drink river water.

Asian carp

Asian carp

Asian carp are moving into the metro Mississippi River

- Asian carp are invasive fish
- Pose a serious threat to recreation and ecosystem health

Asian carp

History and trends

- Imported from China to southern U.S. fish farms
- Escaped in the 1970s, established in southern river by the 1980s
- Advancing up the Mississippi River
- Illinois River: extreme infestation

Asian carp

Status

Asian carp caught near Winona in 2012.

Photo: St. Paul Pioneer Press

- Recent catches near Prescott and Winona
  - Bighead
  - Silver
- About 1 dozen caught since 1996
- No established populations yet

Are Asian carp already here?

- eDNA tests in 2011
- Silver carp eDNA found in multiple locations
- No bighead eDNA
- Reliability of eDNA

It's unclear how far upstream Asian carp have reached.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ECOLOGICAL HEALTH

Sediment

Sediment

The river is impaired with excess sediment below the Minnesota River.

- Excess sediment can harm aquatic plants and habitat for fish and other wildlife.
- About 75% of the river's sediment comes from the Minnesota River basin.
- Lake Pepin filling in at 10 times its natural rate.

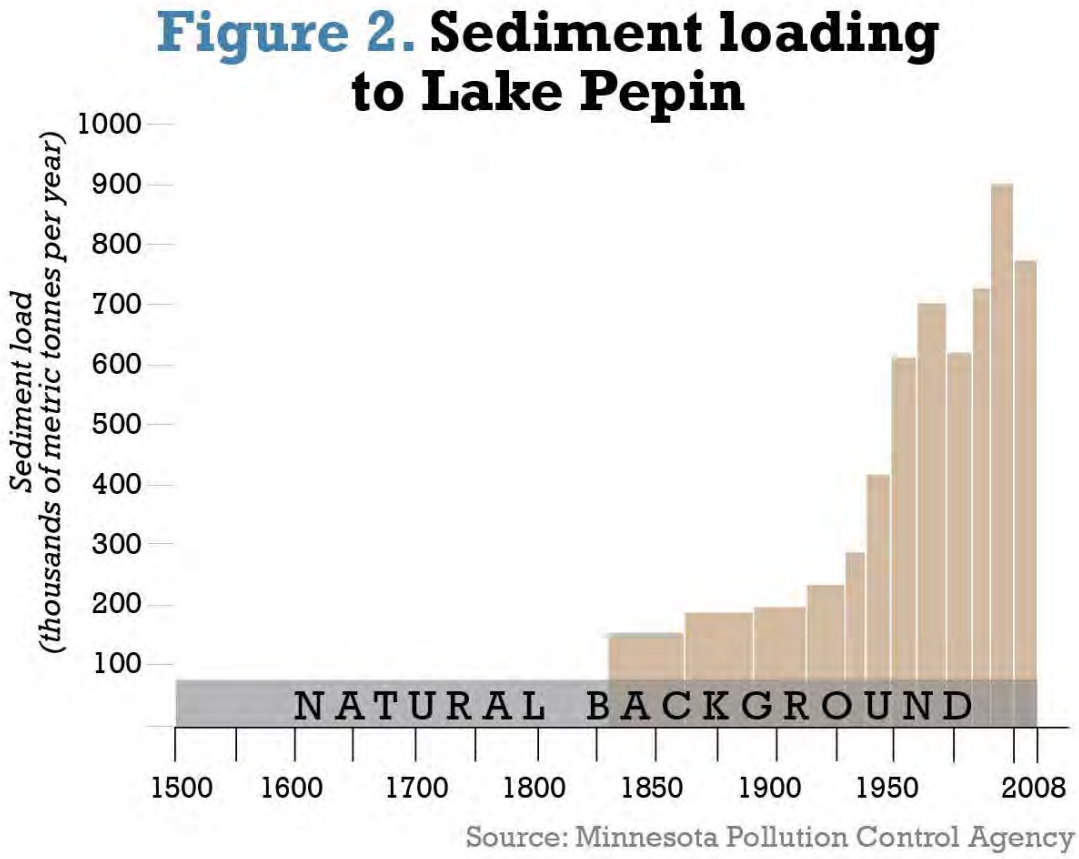
Sediment

Description and impacts

- Tiny particles of soil and organic matter
- Cloudy/turbid water impairs aquatic life
  - Fish & aquatic insects
  - Submersed aquatic vegetation
- Sediment carries other pollutants
- Settles out in Lake Pepin
  - Top portion of the lake will be gone within 100 years

Sediment

History and Trends



- 1930s -1960s: Loads doubled
- Early 1990s: Loads peaked
- Recent loads: ~850,000 metric tons/year
- Current sediment load: 10 times "natural rate"

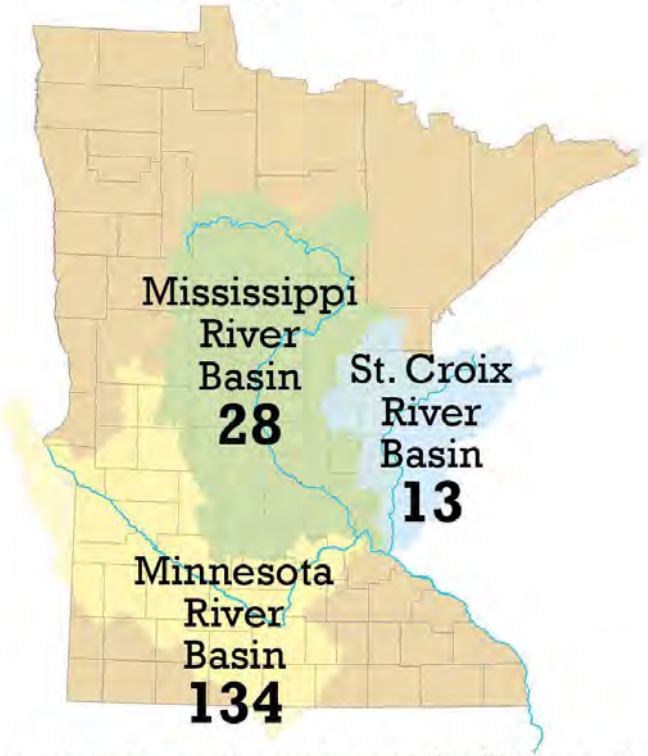
Sediment

Sources

- About 75% from MN River
  - Bluffs, banks, ravines
  - Field runoff
- Additional sources:
  - Mississippi, Cannon Rivers
- Metro area: ~6% of load
- Greatly influenced by increased flows

Figure 1. Total sediment contribution

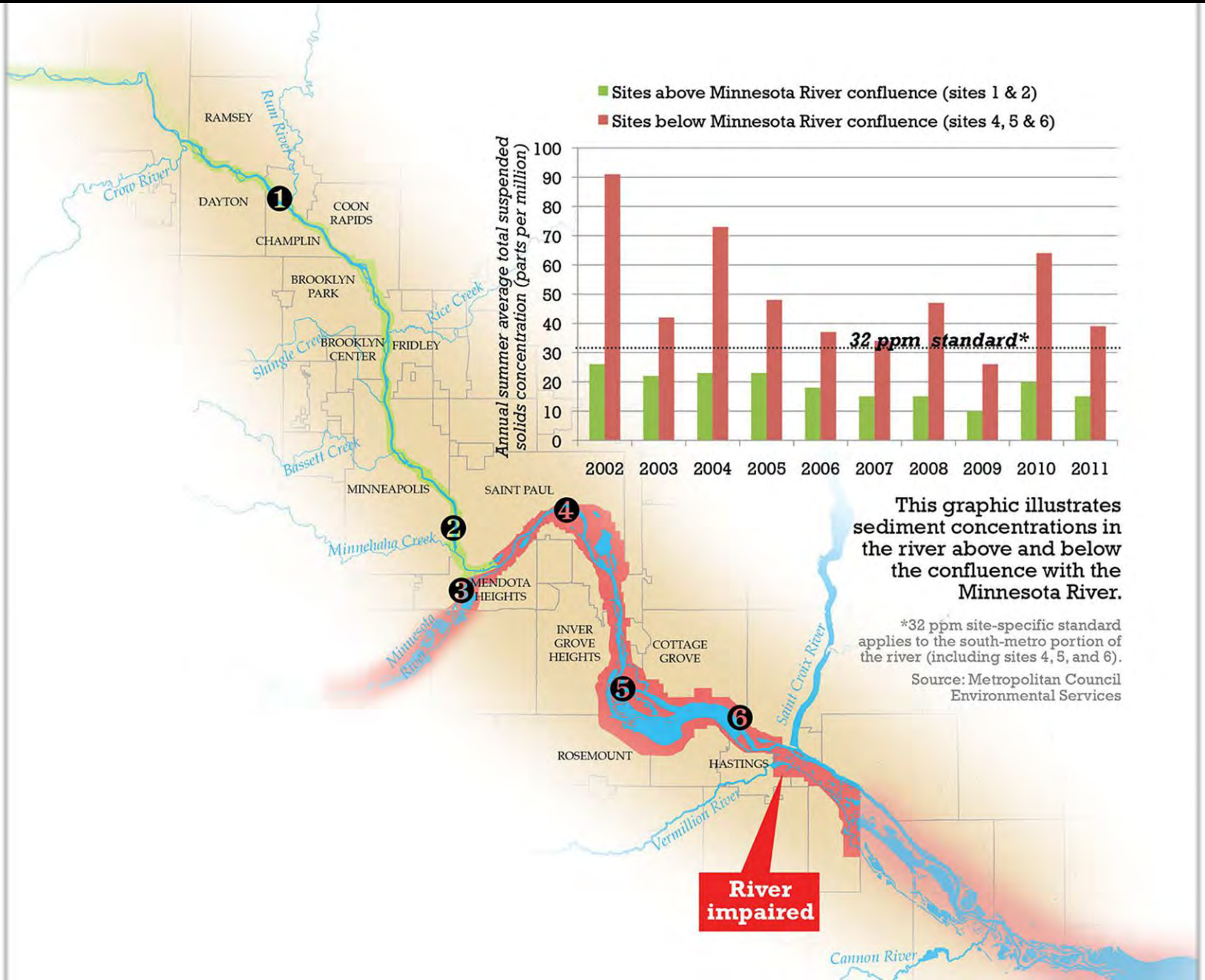
Pounds per acre, per year



On average, sediment loss in the Minnesota River basin is far greater than in the Mississippi or St. Croix River basins.

Sources: Engstrom & Almendinger, 2000, Nater & Kelley, 1998 via Minnesota River Trends – November 2009

Sediment



This graphic illustrates sediment concentrations in the river above and below the confluence with the Minnesota River.

*32 ppm site-specific standard applies to the south-metro portion of the river (including sites 4, 5, and 6).

Source: Metropolitan Council Environmental Services

Sediment

Solutions

- Complete Cleanup Plans
  - Mississippi & Minnesota Rivers
- Agricultural Conservation
- Water retention
- Urban runoff controls
- Mississippi Makeover:
  - Island building
  - Pool "draw downs"

ECOLOGICAL HEALTH

Nitrate

Nitrate

The river currently meets drinking water standards for nitrate

- Excess nitrate poses threats to human health and aquatic life, and is a primary contributor to the Gulf "dead zone."
- Nitrate concentration increased by 47% from 1976-2005.
- The state does not yet have a river nitrate standard to protect aquatic life.

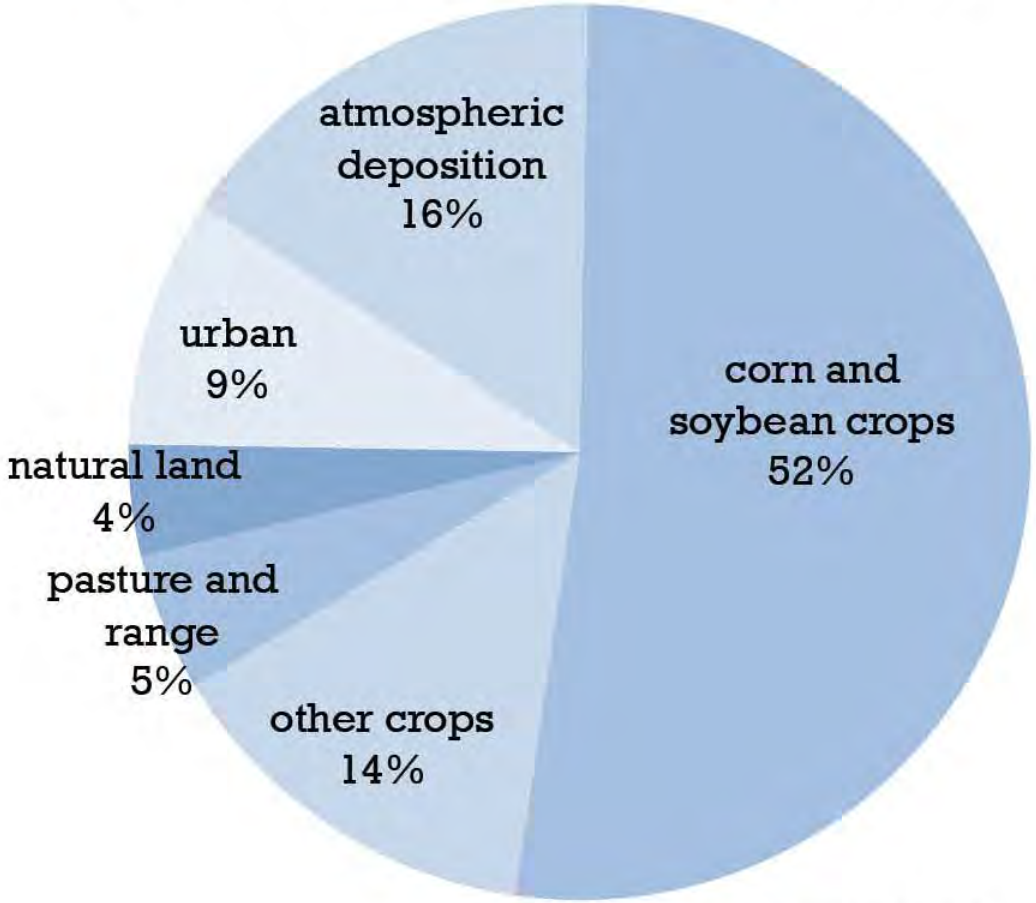
Nitrate

Description and impacts

- Nitrogen is a naturally abundant element
- Nitrate (NO^3) is a common form of nitrogen
- Human health
  - Drinking water standard (10 parts per million, ppm)
  - Blue Baby Syndrome
- Gulf "Dead Zone"
  - Seasonal hypoxic zone in gulf
  - 6,765 square miles in 2011

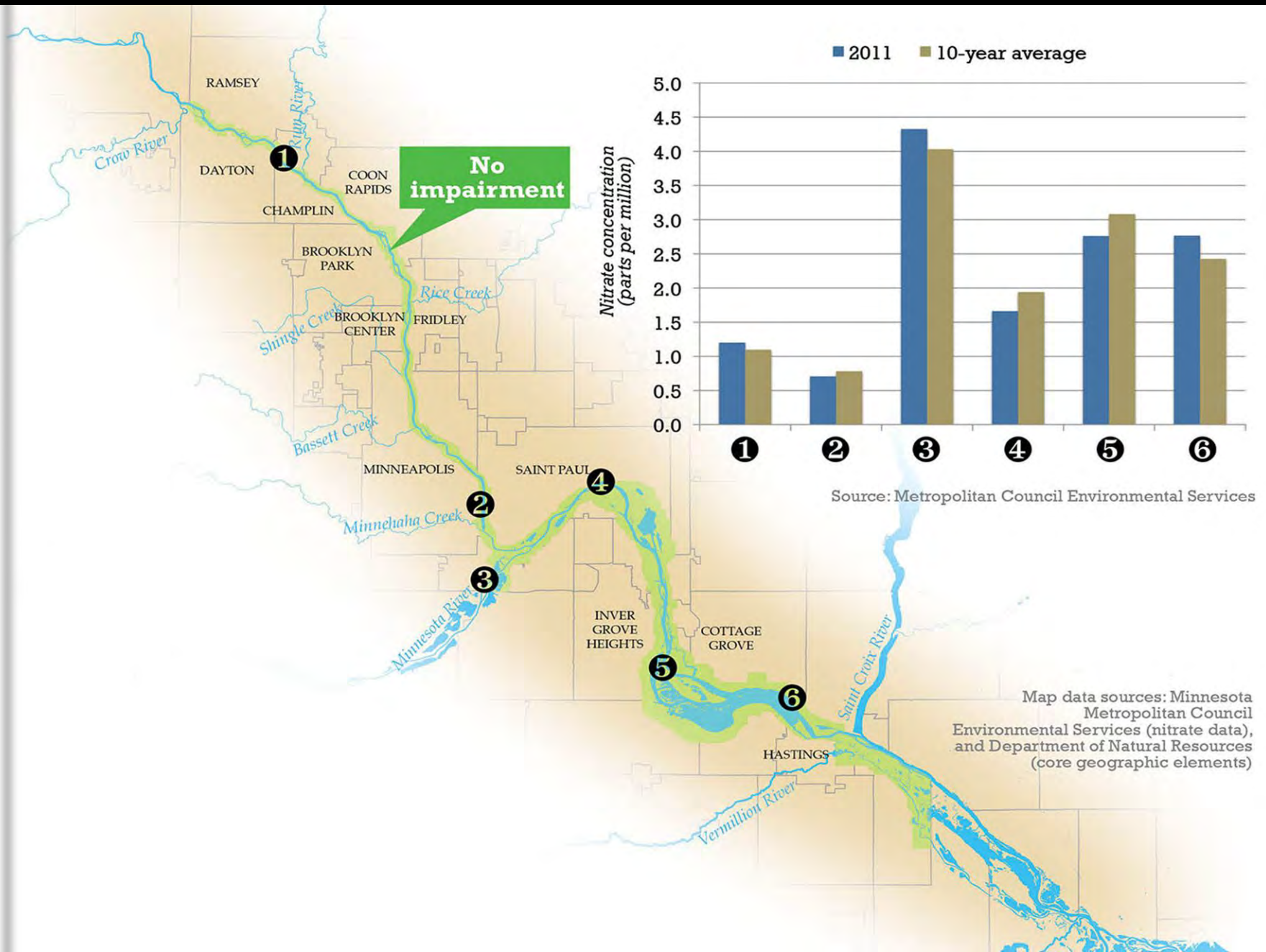
Nitrate

Figure 1. Sources of nitrogen to the Gulf of Mexico, 2006



Source: Alexander, et. al.[66]

Nitrate

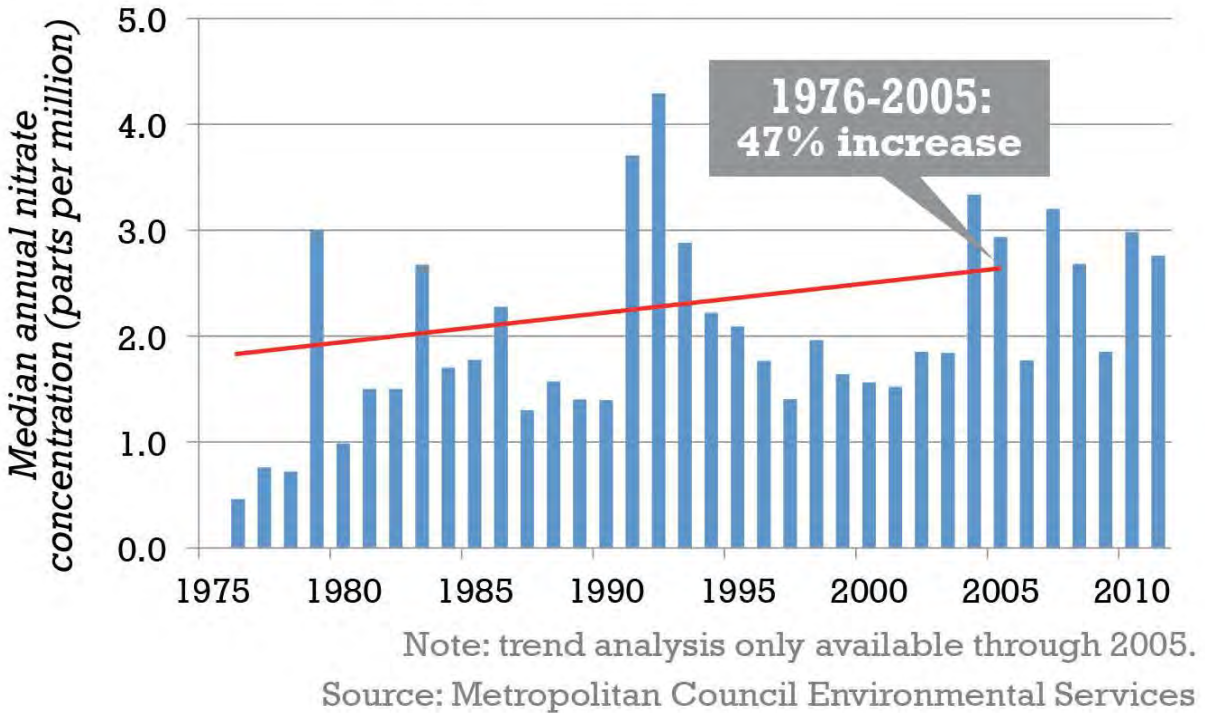


Source: Metropolitan Council Environmental Services

Map data sources: Minnesota Metropolitan Council Environmental Services (nitrate data), and Department of Natural Resources (core geographic elements)

Trends

Figure 3. Nitrate concentrations at the Hastings Dam



Note: trend analysis only available through 2005.

Source: Metropolitan Council Environmental Services

Metro River
1976 – 2005:
47% increase

Clinton, Iowa
1980 – 2008:
76% increase

Nitrate

Solutions

- Establish nitrate standards
  - MN nitrate study
  - River nitrate standard

- Agricultural sources
- Urban runoff
- Air emissions
- Wastewater Treatment Plants

Bald Eagles

Bald Eagles

Background and history

Source: Derek Bakken
(under CC-BY-2.0 license)

- 1963: 417 eagle pairs
- 1940s-1970s: protections
- Today: 10,000 eagle pairs
- Exposed to contaminants via prey
- NPS monitoring eaglets for lead, mercury, DDT, PCBs, PFCs, PFOS

Bald Eagles

Population status

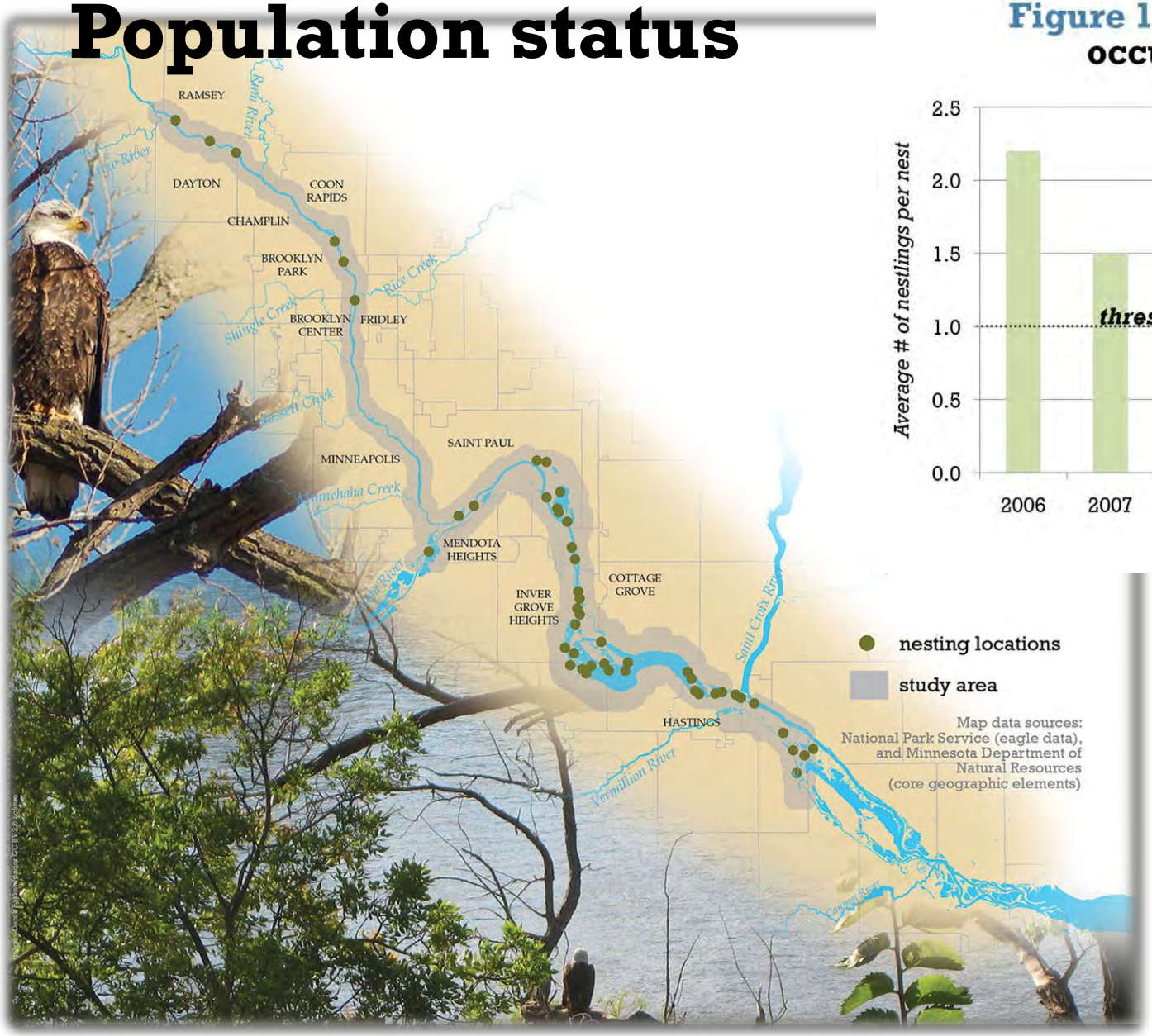
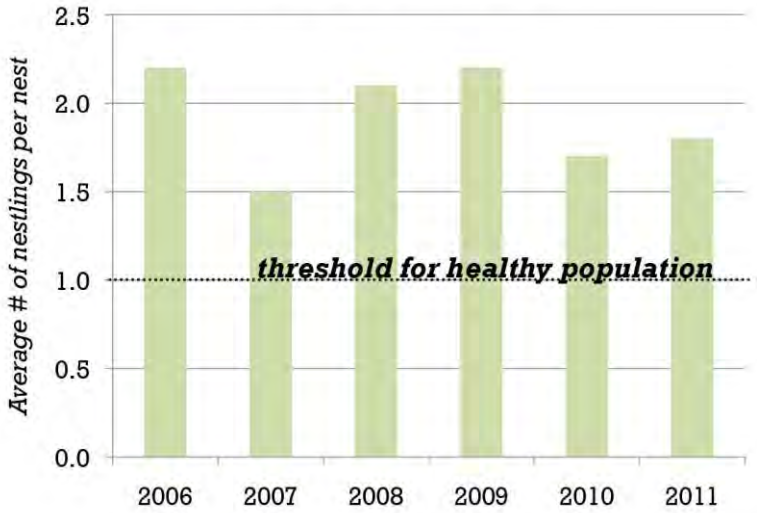


Figure 1. Nestlings per occupied nest



Source: National Park Service, 2012

ECOLOGICAL HEALTH

Bald Eagles

Bald Eagles

Eaglet health status

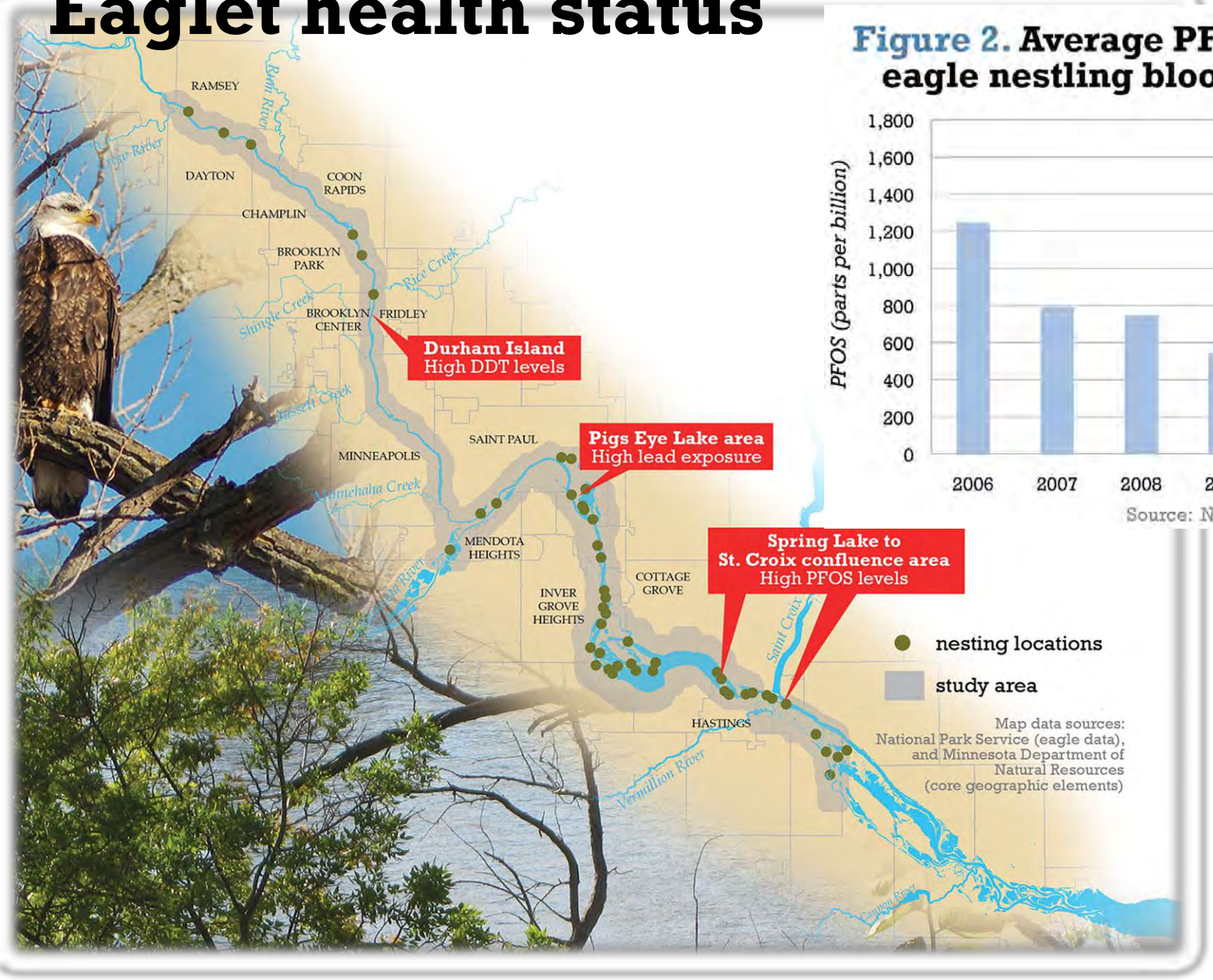


Figure 2. Average PFOS levels in eagle nestling blood samples

Source: National Park Service, 2012

Bald Eagles

Management solutions

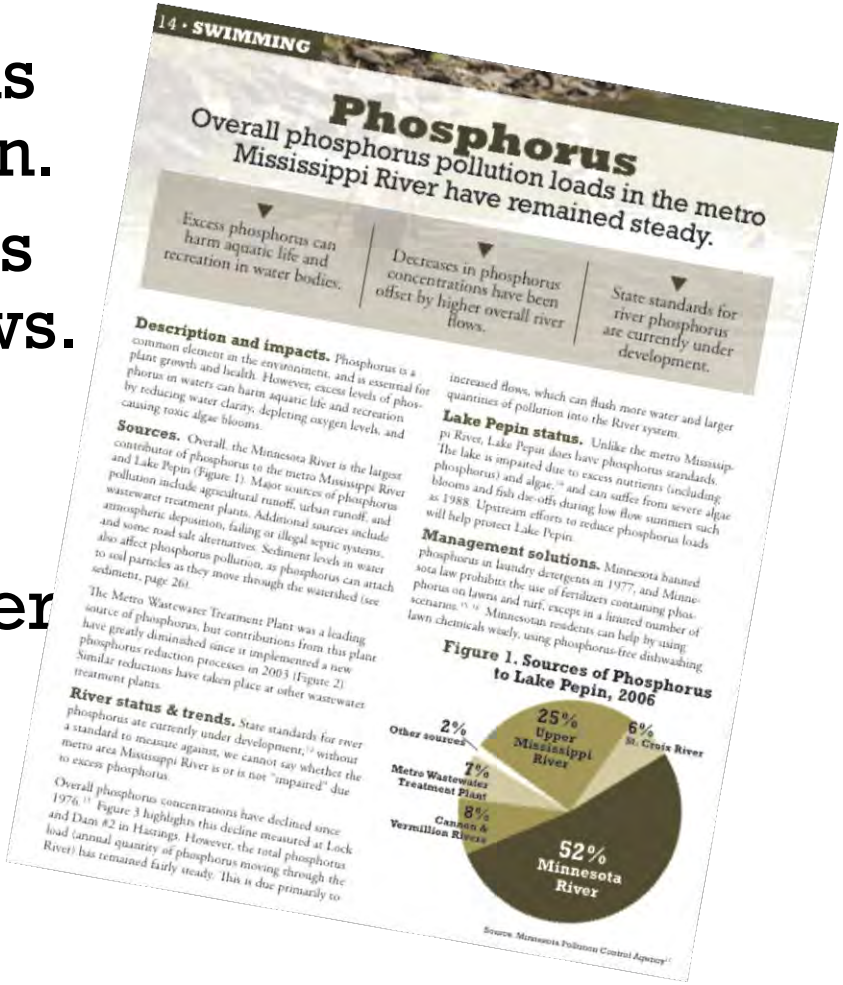
- Monitoring
- Address "hot spots"
- Habitat protection, restoration


GOLD
MEDAL
FLOUR

Phosphorus

The metro area sends too much phosphorus downstream to Lake Pepin.

- Excess phosphorus harms aquatic life and recreation.
- Decreased concentrations offset by higher river flows.
  - *Concentration: down 28%*
  - *Load downstream: stable*
- MN does not yet have river phosphorus standards.



14 · SWIMMING

Phosphorus

Overall phosphorus pollution loads in the metro Mississippi River have remained steady.

Excess phosphorus can harm aquatic life and recreation in water bodies.

Decreases in phosphorus concentrations have been offset by higher overall river flows.

State standards for river phosphorus are currently under development.

Description and impacts. Phosphorus is a common element in the environment, and is essential for plant growth and health. However, excess levels of phosphorus in waters can harm aquatic life and recreation by reducing water clarity, depleting oxygen levels, and causing toxic algae blooms.

Sources. Overall, the Minnesota River is the largest contributor of phosphorus to the metro Mississippi River and Lake Pepin (Figure 1). Major sources of phosphorus pollution include agricultural runoff, urban runoff, and wastewater treatment plants. Additional sources include atmospheric deposition, failing or illegal septic systems, and some road salt alternatives. Sediment levels in water also affect phosphorus pollution, as phosphorus can attach to soil particles as they move through the watershed (see sediment, page 26).

The Metro Wastewater Treatment Plant was a leading source of phosphorus, but contributions from this plant have greatly diminished since it implemented a new phosphorus reduction processes in 2003 (Figure 2). Similar reductions have taken place at other wastewater treatment plants.

River status & trends. State standards for river phosphorus are currently under development,[16] without a standard to measure against, we cannot say whether the metro area Mississippi River is or is not "impaired" due to excess phosphorus.

Overall phosphorus concentrations have declined since 1976.[17] Figure 3 highlights this decline measured at Lock and Dam #2 in Hastings. However, the total phosphorus load (annual quantity of phosphorus moving through the River) has remained fairly steady. This is due primarily to increased flows, which can flush more water and larger quantities of pollution into the River system.

Lake Pepin status. Unlike the metro Mississippi River, Lake Pepin does have phosphorus standards. The lake is impaired due to excess nutrients (including phosphorus) and algae,[18] and can suffer from severe algae blooms and fish die-offs during low flow summers each as 1988. Upstream efforts to reduce phosphorus loads will help protect Lake Pepin.

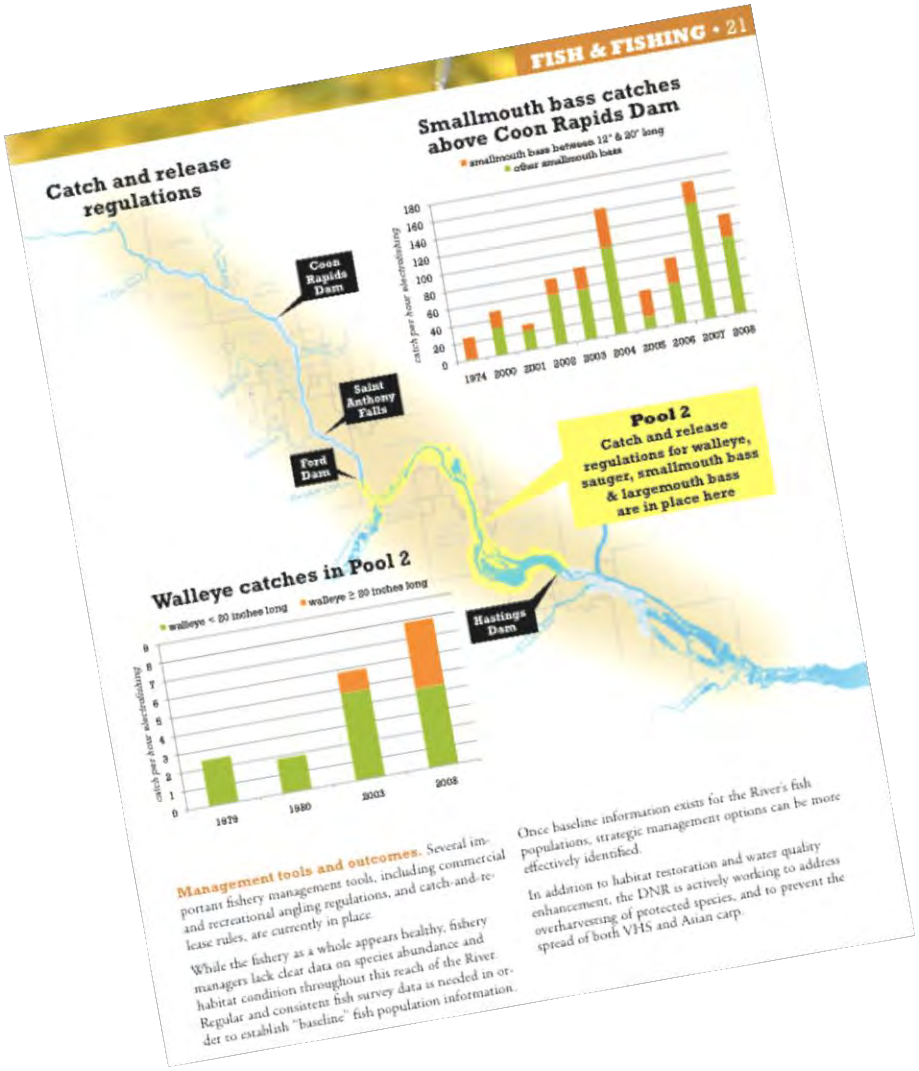
Management solutions. Minnesota banned phosphorus in laundry detergents in 1977, and Minnesota law prohibits the use of fertilizers containing phosphorus on lawns and turf, except in a limited number of scenarios.[19, 20] Minnesotan residents can help by using lawn chemicals wisely, using phosphorus-free dishwashing

Figure 1. Sources of Phosphorus to Lake Pepin, 2006

Source: Minnesota Pollution Control Agency[21]

Fish survey

The metro river is a world class fishery



- Vastly improved fishery
  - Trophy walleye
  - World class smallmouth
- Catch-and-release regulations in place
- Very limited data
  - Additional baseline data recommended

Fish consumption

Fish from the river are safe to eat if you follow state fish consumption advice

- Fish can contain PCBs, mercury, PFOS.
- Always follow site-specific consumption advice
- Consumption guidelines are based on:
  - Species
  - Who you are
  - How often you eat fish
  - Exclude catch-and-release species

18 · FISH & FISHING

Fish consumption

Fish from the River are safe and healthy to eat if you follow the state's fish consumption advice.

Fish in the River may contain mercury, PCBs, and PFOS.

People who frequently eat fish from the river should consult the state's Site Specific Eating Guidelines.

Fish consumption guidelines are based on the fish species, who you are, and how often you eat fish.

Background. Both store-bought and locally caught fish may contain contaminants such as mercury or PCBs that can harm human health. As a result, the State of Minnesota has safe-eating guidelines to help you make informed decisions about the fish you eat.

Statewide Safe Eating Guidelines. The Statewide Safe Eating Guidelines are based on mercury and PCB levels measured in fish throughout Minnesota. While not all waters in Minnesota have been tested for contaminants, the safe-eating guidelines can be used for both tested and untested waters. There are two types of guidelines. Guidelines for mothers and children (more protective) and those for the general population.

Site-specific eating guidelines. In some of Minnesota's lakes and rivers, test results show that fish contain higher or lower than average levels of certain contaminants. In these cases, the resulting meal advice may be more or less restrictive than the Statewide Safe Eating Guidelines.

Contaminants of concern. Fish are rich in iron, protein and omega-3 fatty acids and are a good choice for a healthy diet. However, fish contain small amounts of some toxins. The three toxins of concern in this reach of the River are Mercury, PCBs, and PFOS.

- Mercury: Mercury is a toxic metal that can impact the nervous system, particularly in children and the developing fetus.
- PCBs: PCB exposure is linked to problems in infant development and adult immune function.
- PFOS: Perfluorooctane sulfonate (PFOS) is part of a family of manmade chemicals that accumulate in fish, persist in the environment, and can harm humans and animals.

For more information, see the "Other Contaminants of Concern" section of this report.

Status. There are site-specific eating guidelines in place for the entire River. Some of these guidelines are more restrictive than the Statewide Safe Eating Guidelines.

PCBs in fish, 1970s-2000s

1970s 1980s 1990s 2000s

Pool 1 Pool 2

Source: Wenner and Sandstrom 2010

Mercury in fish, 1970s-2000s

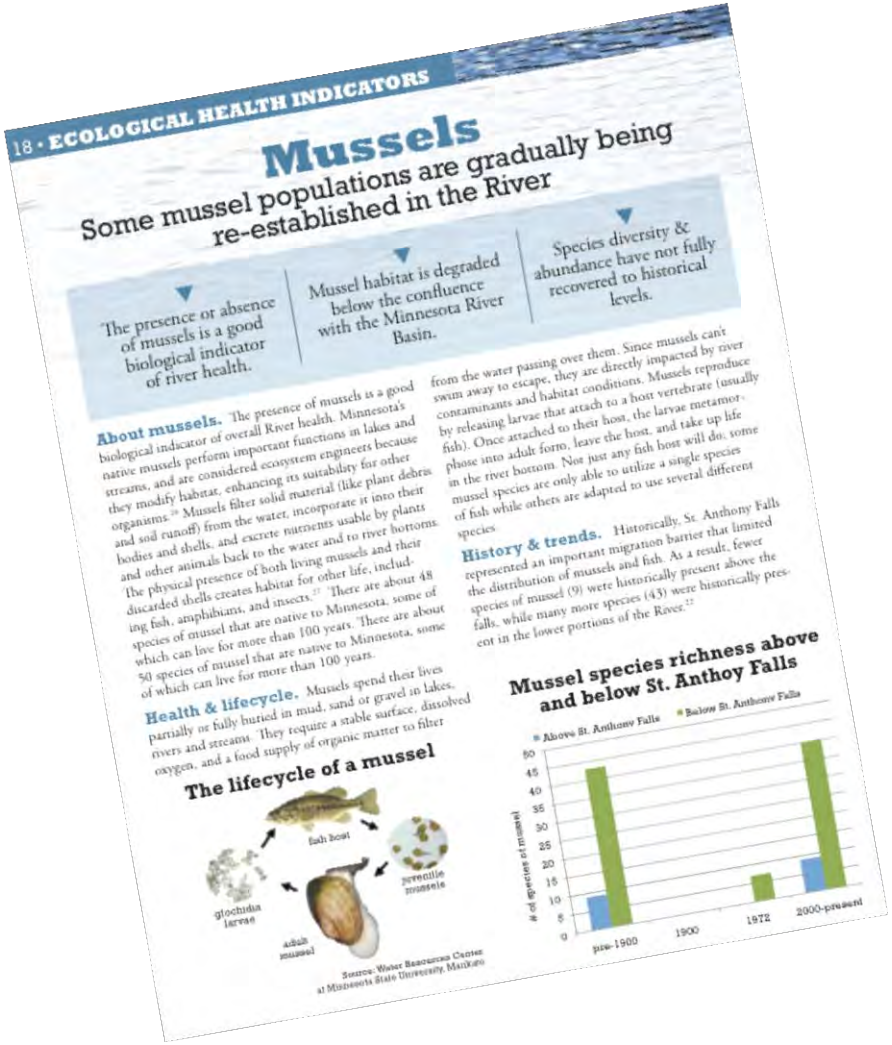
1970s 1980s 1990s 2000s

Pool 1 Pool 2

Source: Wenner and Sandstrom 2010

Mussels

Some mussels populations are gradually being re-established



18 · ECOLOGICAL HEALTH INDICATORS

Mussels

Some mussel populations are gradually being re-established in the River

The presence or absence of mussels is a good biological indicator of river health.

Mussel habitat is degraded below the confluence with the Minnesota River Basin.

Species diversity & abundance have not fully recovered to historical levels.

About mussels. The presence of mussels is a good biological indicator of overall River health. Minnesota's native mussels perform important functions in lakes and streams, and are considered ecosystem engineers because they modify habitat, enhancing its suitability for other organisms.[16] Mussels filter solid material (like plant debris and soil runoff) from the water, incorporate it into their bodies and shells, and excrete nutrients usable by plants and other animals back to the water and to river bottoms. The physical presence of both living mussels and their discarded shells creates habitat for other life, including fish, amphibians, and insects.[17] There are about 48 species of mussel that are native to Minnesota; some of which can live for more than 100 years. There are about 50 species of mussel that are native to Minnesota; some of which can live for more than 100 years.

Health & lifecycle. Mussels spend their lives partially or fully buried in mud, sand or gravel in lakes, rivers and streams. They require a stable surface, dissolved oxygen, and a food supply of organic matter to filter from the water passing over them. Since mussels can't swim away to escape, they are directly impacted by river contaminants and habitat conditions. Mussels reproduce by releasing larvae that attach to a host vertebrate (usually fish). Once attached to their host, the larvae metamorphose into adult forms, leave the host, and take up life in the river bottom. Not just any fish host will do; some mussel species are only able to utilize a single species of fish while others are adapted to use several different species.

History & trends. Historically, St. Anthony Falls represented an important migration barrier that limited the distribution of mussels and fish. As a result, fewer species of mussel (9) were historically present above the falls, while many more species (43) were historically present in the lower portions of the River.[17]

The lifecycle of a mussel

Mussel species richness above and below St. Anthoy Falls

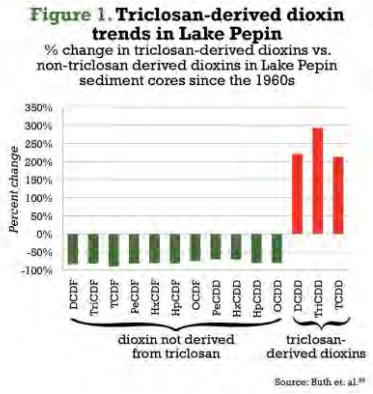
Source: Water Resources Center at Minnesota State University, Mankato

- Mussels are an indicator of river health.
- Mussel habitat is degraded below the MN River confluence.
- Species diversity and abundance have not fully recovered to historic levels.

Additional Contaminants of Concern

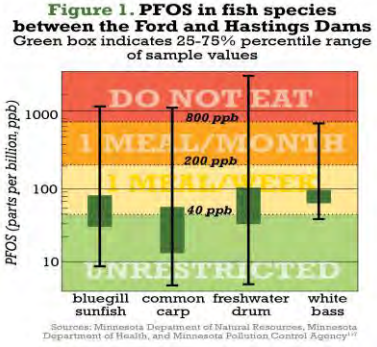
Triclosan

- Common antimicrobial agent
- Human & environmental concerns
- Present in 75% of Americans



PFOS

- Common in household items
- Fish consumption advisory
- Present in east metro groundwater



Additional Contaminants

- PAHs & flame retardants
- Pharmaceuticals & pesticides
- PCBs & mercury

Summary and conclusions

So, how is the Mississippi River?

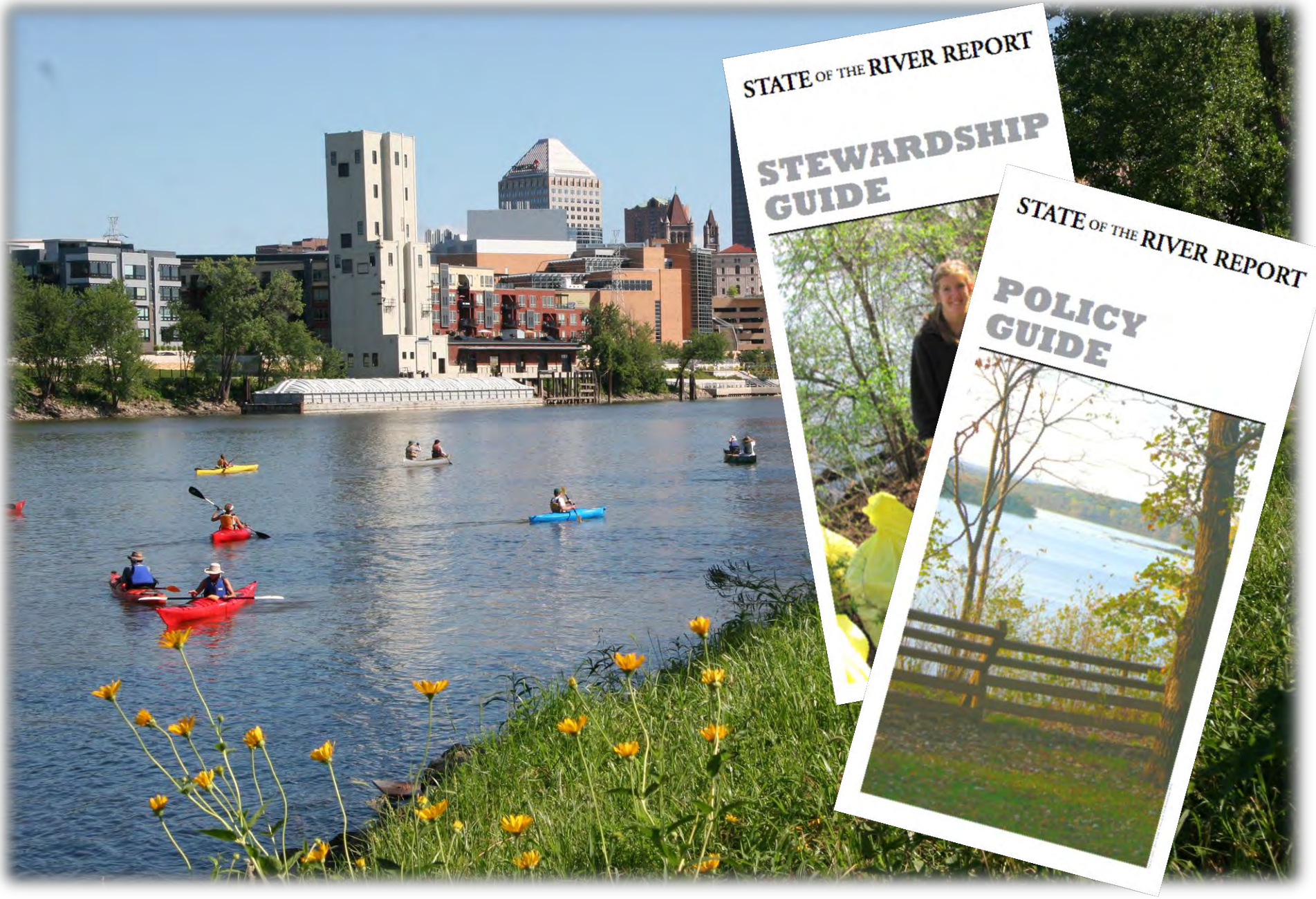
- **Bald eagles**
  - Populations thriving
  - Eaglets in better health
- **Mussels**
  - Returned to the river
  - Areas of good habitat
- **Fish survey**
  - Trophy walleye
  - World class smallmouth bass

Summary and conclusions

- **Sediment impairment**
  - Impaired below MN Confluence
  - Lake Pepin infill
- **Bacteria impairment**
- **Excess phosphorus**
  - Lake Pepin impaired
- **Fish consumption**
  - Site-specific consumption advice
  - PCBs, Hg, PFOS

Summary and conclusions

- **River flow**
  - Increased 25%
- **Nitrate**
  - Increased 47%
  - Gulf "dead zone"
- **Asian carp**
  - Have reached MN
- **Emerging Contaminants**
  - Triclosan, PAHs, PBDEs, etc.
  - Risks not fully understood


STATE OF THE RIVER REPORT
STEWARDSHIP GUIDE
STATE OF THE RIVER REPORT
POLICY GUIDE

For More Information

WWW.STATEOFTHERIVER.COM

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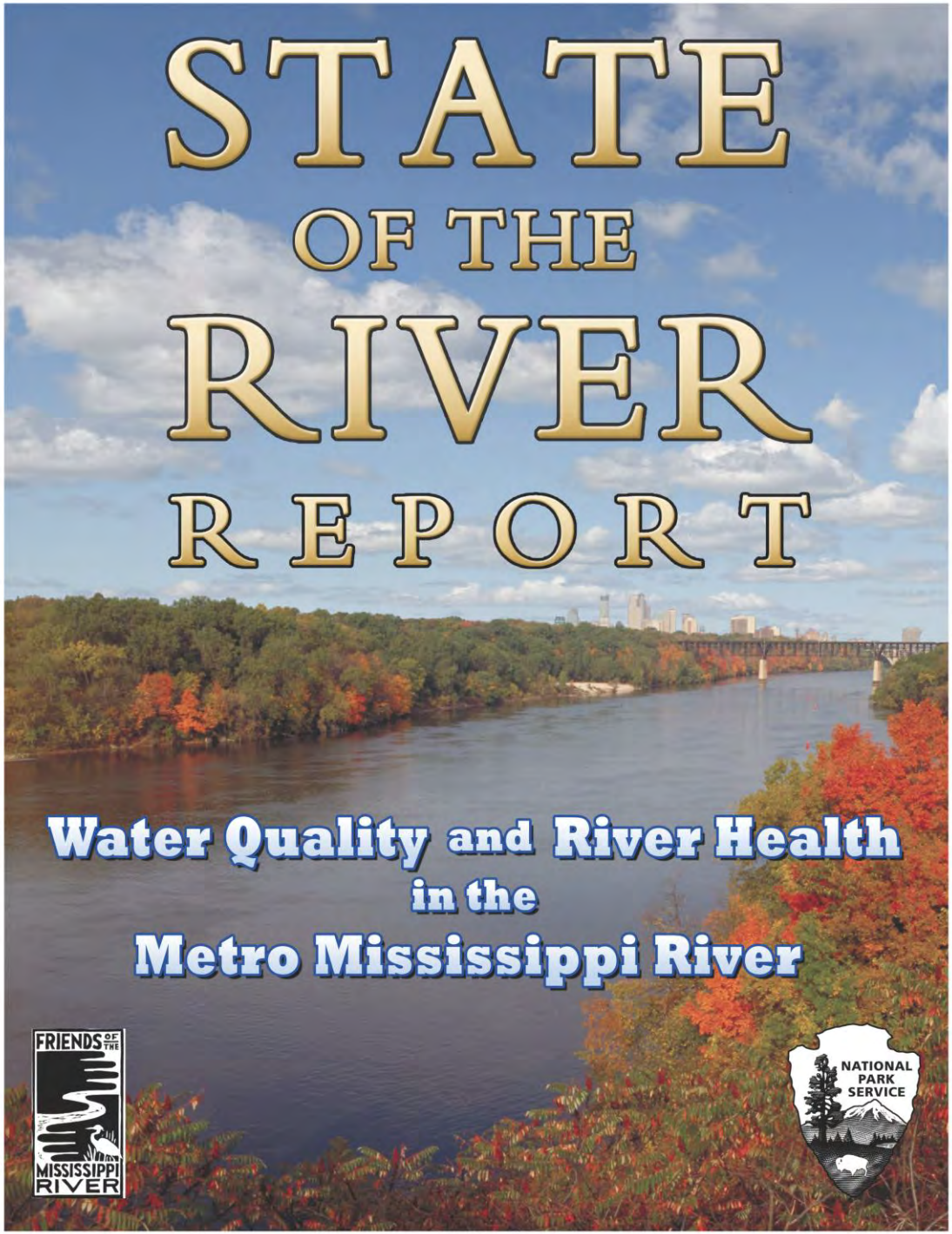
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