Nutrients – Future Requirements, Management Options

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Presentation Outline

- Why nutrients are a concern in surface waters
- Sources of nutrients
- Regulatory approaches to nutrient reduction
- Management options with different approaches

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Clean Water Act

- The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.

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Nitrogen and Phosphorus in the Environment

- Basic component of cell structure
- One or both nutrients may limit growth of primary producers
- When excess N and P are present, algae/aquatic macrophytes will grow in excess (eutrophication)
- Diurnal DO swings: supersaturation and low DO
- Algae/die, settle to bottom/bacterial decay causes hypoxia
- Altered DO affects the aquatic community
- Nutrient levels build up in closed systems (lakes, impoundments) and recycle
- Nutrients discharged to open systems (rivers) may have impacts at downstream locations
- Drinking water impacts – nitrate levels above drinking water standards

USEPA Case for Nutrient Controls

(courtesy Jeff Lape/Deputy Director OST)

Evidence – Examples

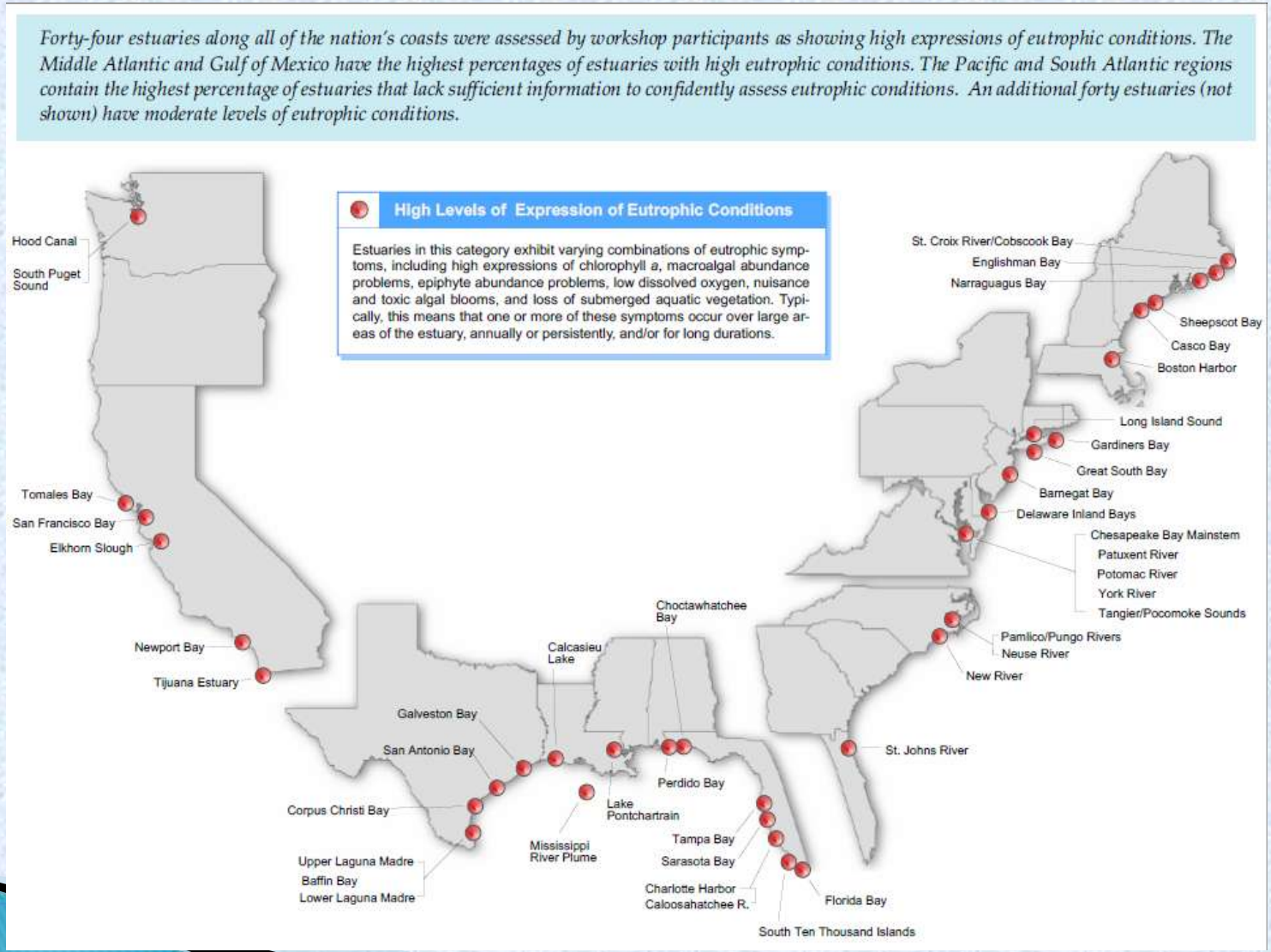
- **14,000 N and P Impairment Listings in 49 States**
- **168 Hypoxic Zones in U.S. Waters**
- **National Drinking Water Impacts and Costs including Drinking Water Nitrate Violations**

Documentation

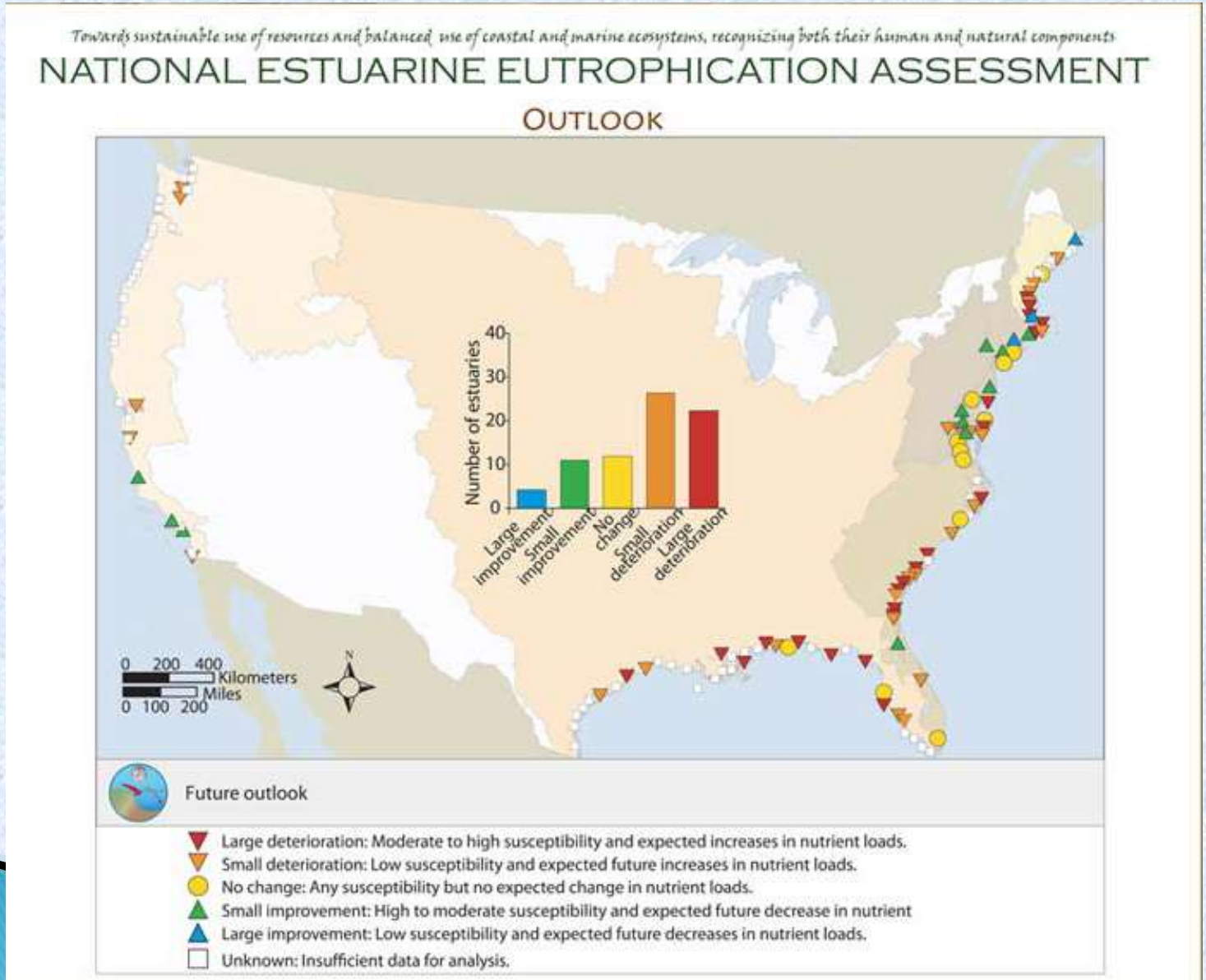
- Nutrients in the Nation's Streams and Groundwater:1992-2004
- National Coastal Condition Report (EPA 2008)
- Wadeable Stream Assessment (EPA 2006)
- Mississippi River Water Quality (NRC 2008)
- Effects of Nutrient Enrichment (NOAA 2007)
- Reactive Nitrogen in the U.S. (EPA SAB 2009)
- National Lakes Assessment (EPA 2010)
- *An Urgent Call to Action: Report of the State-EPA NITG (2009)*
- *Numerous other reports and studies*

Estuaries with Eutrophic Conditions

Forty-four estuaries along all of the nation's coasts were assessed by workshop participants as showing high expressions of eutrophic conditions. The Middle Atlantic and Gulf of Mexico have the highest percentages of estuaries with high eutrophic conditions. The Pacific and South Atlantic regions contain the highest percentage of estuaries that lack sufficient information to confidently assess eutrophic conditions. An additional forty estuaries (not shown) have moderate levels of eutrophic conditions.



Eutrophication Trends



Sources of Nutrients

- POTWs
- Municipal/ Industrial Storm Water
- Row crop agriculture
- Animal Feeding Operations
- Onsite septic systems
- Atmospheric

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Emerging Nutrient Regulations

- Nutrients – Phosphorus and Nitrogen
  - Water Quality criteria
  - Technology based standards (POTWs)
  - Loading reduction to correct specific impact/impairment (TMDLs)
- POTW and industrial nutrient removal to low levels is:
  - Technologically achievable
  - Expensive
- Nonpoint reduction will require changes in agricultural practices and means of measurement

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Nutrient Control Mechanisms

- Historic – Respond to observed impact
  - Site specific removal requirements
  - Best management practices
  - Great Lakes watershed point source limitations/ detergent bans
  - TMDLs to address site-specific impairments

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Nutrient Criteria Regulatory Background

- In 2000, EPA required states to develop nutrient water quality standards criteria for lakes, reservoirs, streams and rivers
  - published guidance to states on development of criteria
- In the event that states do not adopt criteria, EPA may adopt criteria for the state
- States are at various stages of adopting nutrient criteria for different receiving waters

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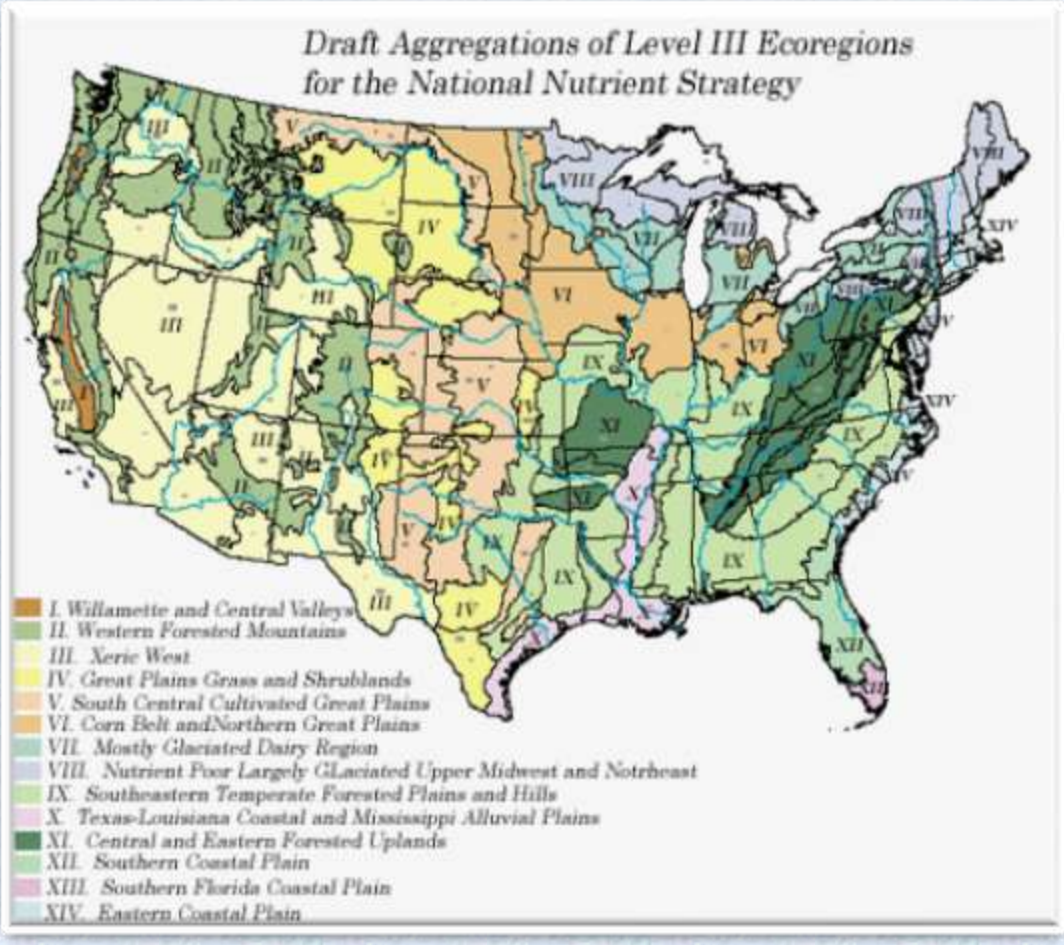
USEPA Proposed Criteria

- Nutrient concentration criteria
  - EPA is requiring nutrient criteria to be developed by the states as a result of court cases
  - Ecoregion approach vs state specific approach (25th percentile)
  - Indiana Ecoregions:
    - VI – Corn Belt Northern Great Plains
    - VII – Glaciated Dairy
    - IX – Southeastern temperate woods/hills



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Progress Toward State Development of Numeric Nutrient Criteria

including lawsuits, petitions, and alternative accountability frameworks

Nutrient Issues for Indiana: Major Watersheds

- Great Lakes:
  - Lake Michigan
  - Lake Erie
  - Great Lakes Water Quality Agreements
- Illinois River basin
  - Mississippi watershed
- Wabash – Ohio River basin
  - ORSANCO / Mississippi watershed

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Nutrient Concentration Criteria

- Difficulty in establishing cause – effect relationships between N & P concentrations and observed biotic indices for streams and rivers
- Slow state response – third party intervention
  - USEPA has proposed criteria for Florida waters
  - Notice of intent to sue USEPA re Wisconsin criteria
  - Notice of intent to sue USEPA re Kansas criteria
- Many water bodies will exceed criteria
  - 303(d) listing
  - TMDLs
  - Potential effluent limits no greater than water quality criteria

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Nutrient Criteria: States Progress

- Wisconsin
  - Adopted P standards for all surface waters
  - Nitrogen standards –
- Illinois
  - P standards for lakes
  - No agreement on criteria for N & P based on cause & effect
- Ohio – looking at establishing nutrient criteria for waters with DO issues/high chlorophyll *a* concentrations/biological impacts
- Michigan – On hold
- Minnesota – Lake standards for P

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Wisconsin Phosphorus Criteria

- 100 ug/l for rivers; 46 listed in rule
- 75 ug/l for streams
- Stratified reservoirs – 30 ug/l
- Non-stratified reservoir- 40 ug/l
- "Two-story fishery lakes (cold water fishery in bottom) – 15 ug/l
- Lake Michigan – 7 ug/l
- Lake Superior – 5 ug/l

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Water Quality Criteria Comparison

	Total P, mg/L	Total N, mg/L
WI Stream Criteria	0.075 – 0.100	Not developed
FL Stream Criteria	0.040 – 0.35	0.62 – 1.67
IN Ecoregion VI	0.0625 – 0.072	1.91 – 3.63
IN Ecoregion VII	0.031	1.15
IN Ecoregion IX	0.030 – 0.083	0.08 – 1.669
White River (Madison Co)	0.18	3.2
Wabash River (Vermillion Co)	0.22	4.6
St. Joseph River (Elkhart Co)	0.049	2.7
Elkhart River (Elkhart Co)	0.076	2.5
Maumee River (Allen Co)	0.19	4.3

River values averaged from STORET for locations having larger data sets

Secondary Treatment Standards

- Secondary treatment is required by the Clean Water Act and defined in the 40 CFR Part 133
- NRDC has petitioned USEPA to include nutrient removal in the definition of secondary treatment – limit of technology?
  - 0.3 mg/L P
  - 3.0 mg/L N
- Petition under review – decision expected mid-2011

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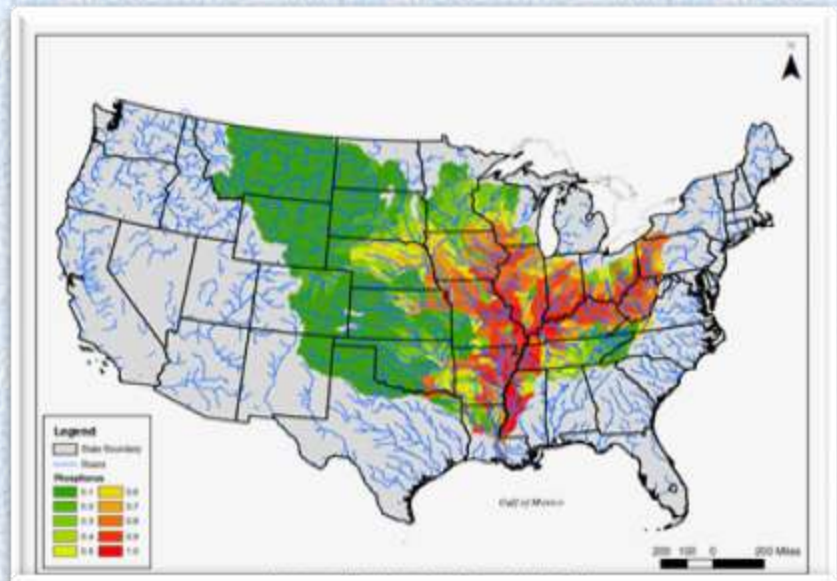
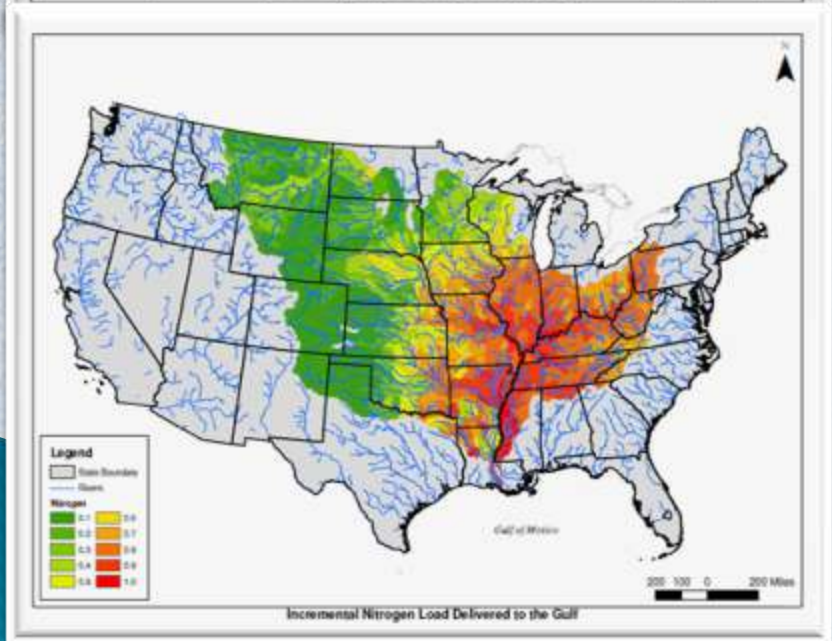
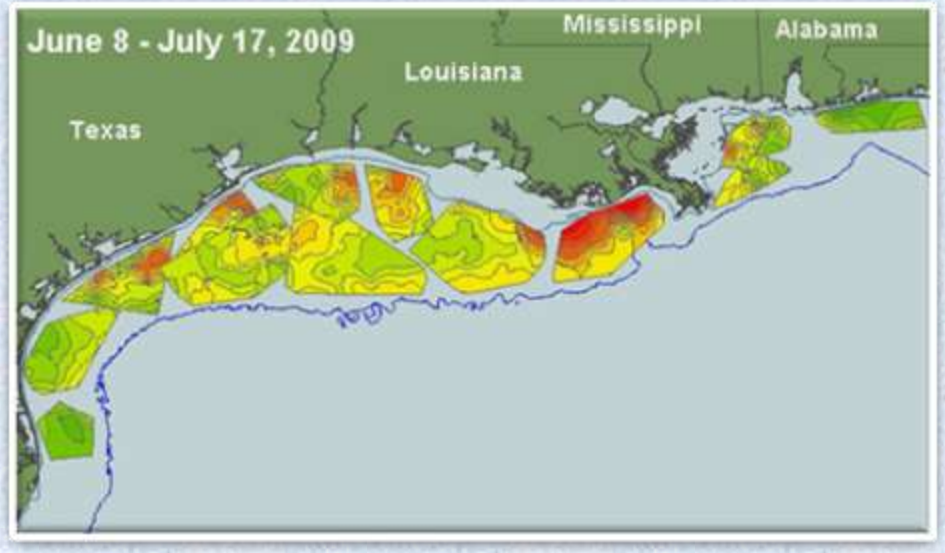
Watershed Nutrient Loading



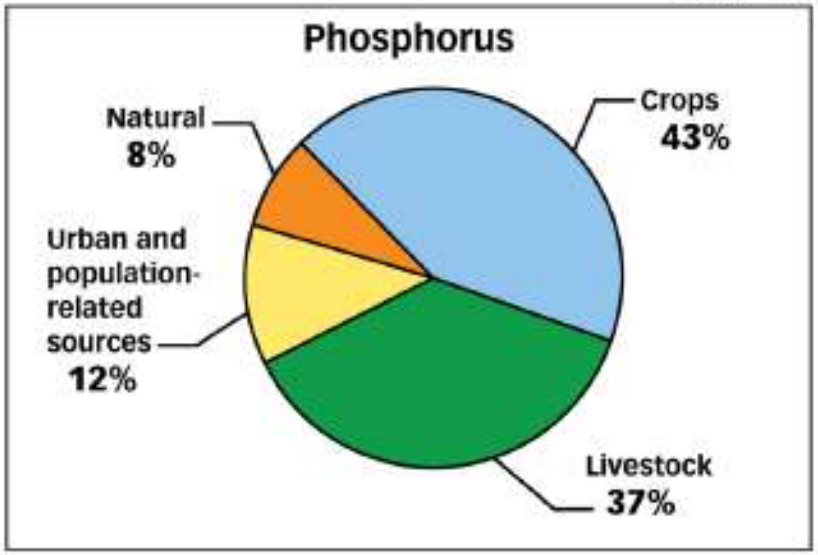


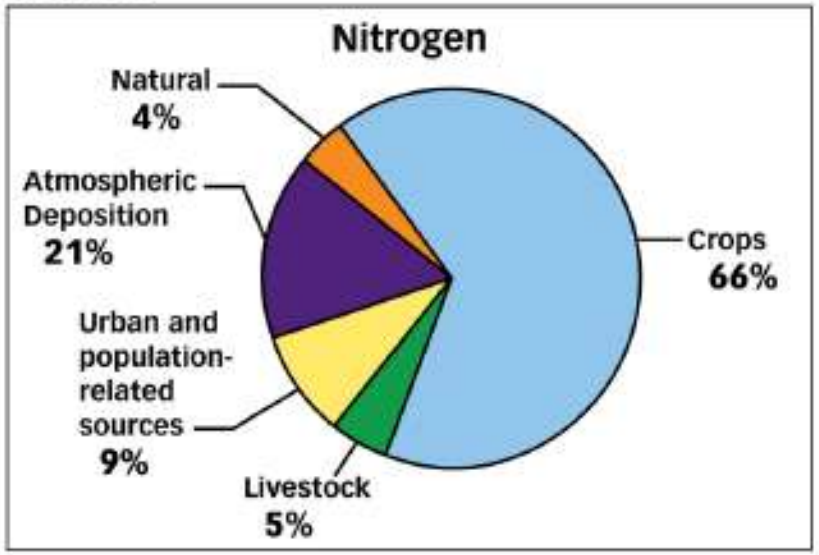
Incremental Nitrogen Load Delivered to the Gulf



Relative Nutrient Source Contributions

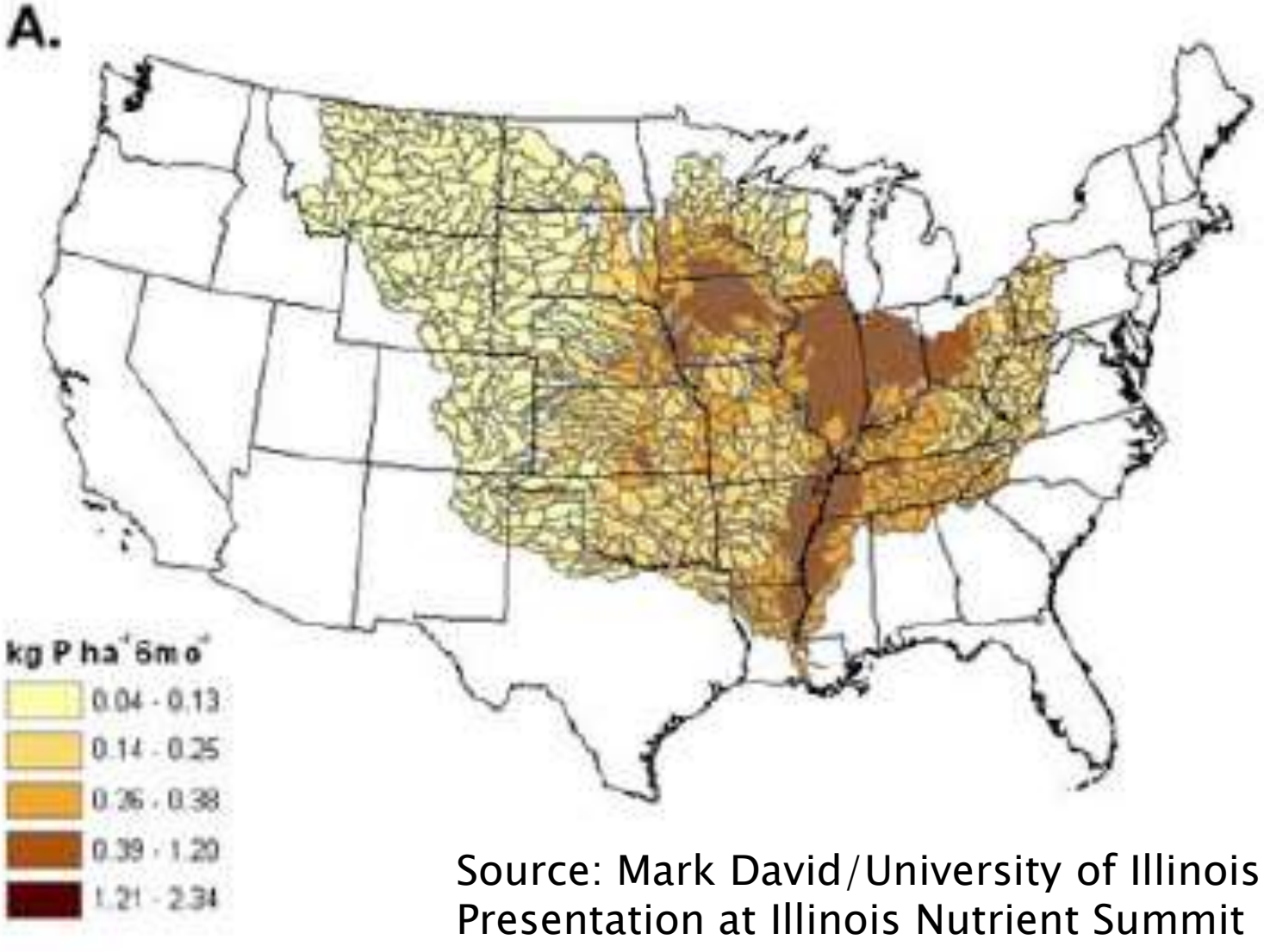
Gulf of Mexico





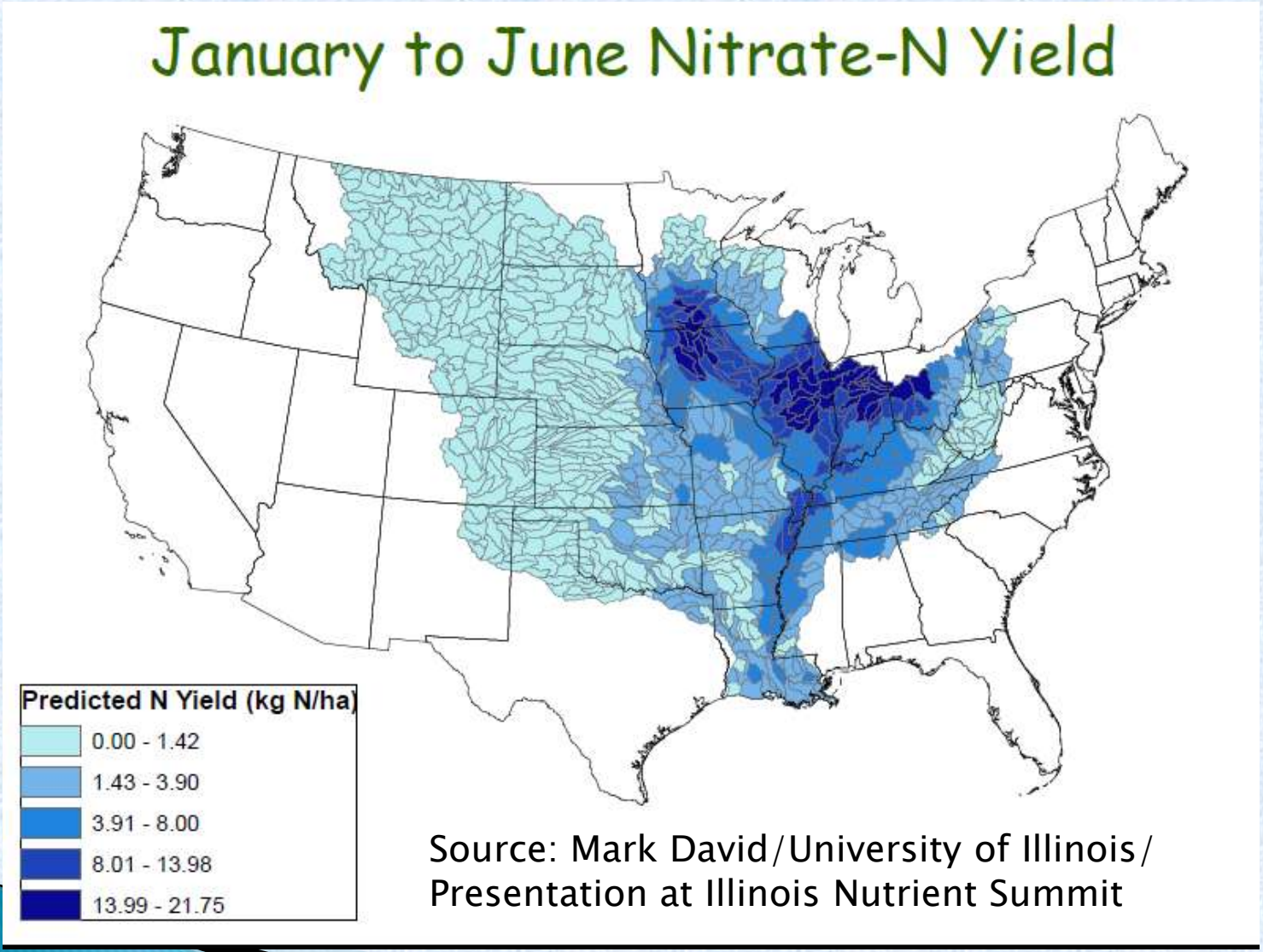
Source: Presentation by Ephraim King/Director OST. Illinois Nutrient Summit

Phosphorus Yields – Mississippi Watershed



Source: Mark David/University of Illinois/
Presentation at Illinois Nutrient Summit

Nitrate Yield – Mississippi Watershed



Source: Mark David/University of Illinois/
Presentation at Illinois Nutrient Summit

Watershed Issues/Watershed Approaches

- Petition to achieve nutrient reductions throughout Mississippi River basin
  - Meeting in Mississippi later this month
- Majority nonpoint
- Nutrient trading –
  - Within watershed
  - Across watersheds
  - Point source – point source
  - Point source – nonpoint source

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Summary – Management Approaches

- Water Quality Standards
  - Cause and effect analysis for streams is weak for Midwest steams
  - Point source reductions through WLA and permit
  - TMDLs identify sources and needed reductions
  - How to achieve reductions from nonpoint sources
- Technology Standards
  - Biological nutrient removal
  - Limits of technology
- Watershed approach
  - Reductions achieved cost-beneficially to achieve use objectives

Issues to Consider as Stream Water Quality Criteria are Developed

- Consider the objectives – what uses will be protected?
  - Habitat
  - Stream morphology
  - Local uses/ Downstream uses
- Low N and P concentrations may be proposed
  - 303(d) listing
  - Effluent limits = water quality criteria
  - Urban storm water will an issue
  - Trading may not be an option
- Regulated sources are a small part of the overall loading
- Urban storm water will need to be addressed
- Non-point sources – management and regulatory options for reductions
- Flexibility for overall management/adaptive management

References

- USEPA (2000) *Ambient Water Quality Criteria Recommendations Rivers and Streams in Nutrient Ecoregion VII EPA 822-B-00-018*
- USEPA (2000) *Ambient Water Quality Criteria Recommendations Rivers and Streams in Nutrient Ecoregion VI EPA 822-B-00-017*
- USEPA (2000) *Ambient Water Quality Criteria Recommendations Rivers and Streams in Nutrient Ecoregion IX EPA 822-B-00-019*
- *NOAA (1999) National Estuarine Eutrophication Assessment*

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Questions?

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