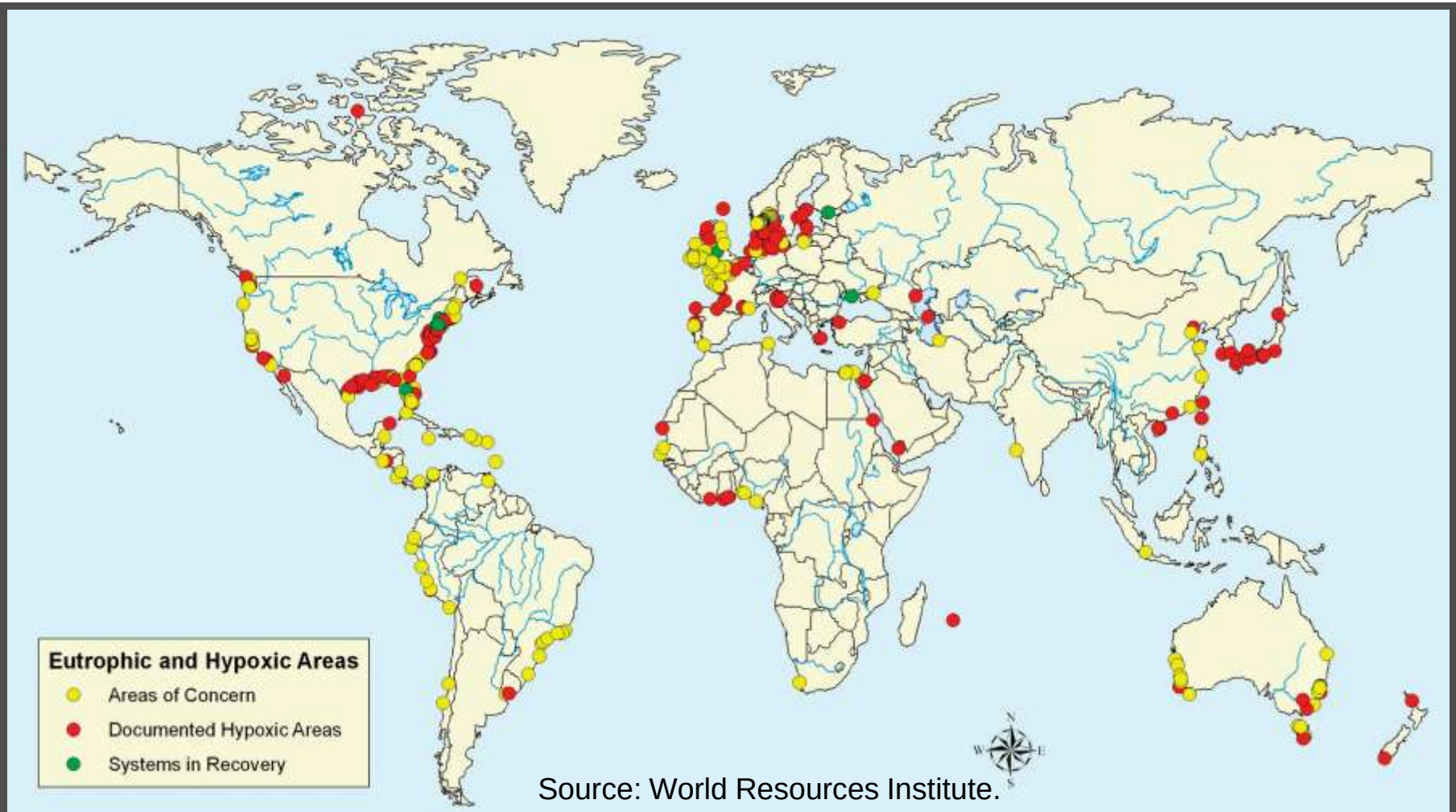
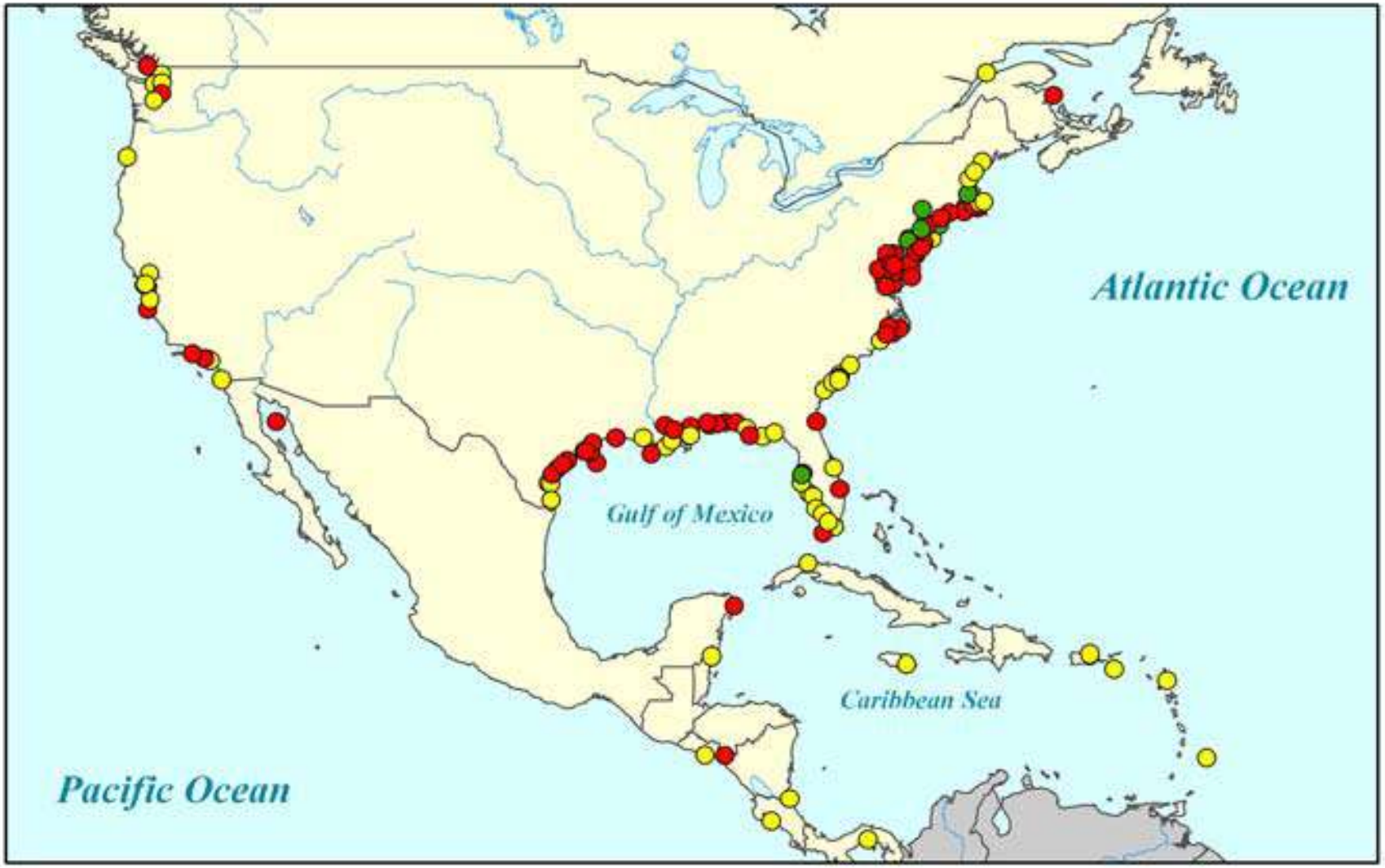
Nutrient Permitting

- Scale of impacts
- Water quality targets and criteria
- Nutrient Removal Technology
- Permitting tools

Hypoxia Areas Have Increased from 10 in 1960 to Over 400 Today



Source: World Resources Institute.



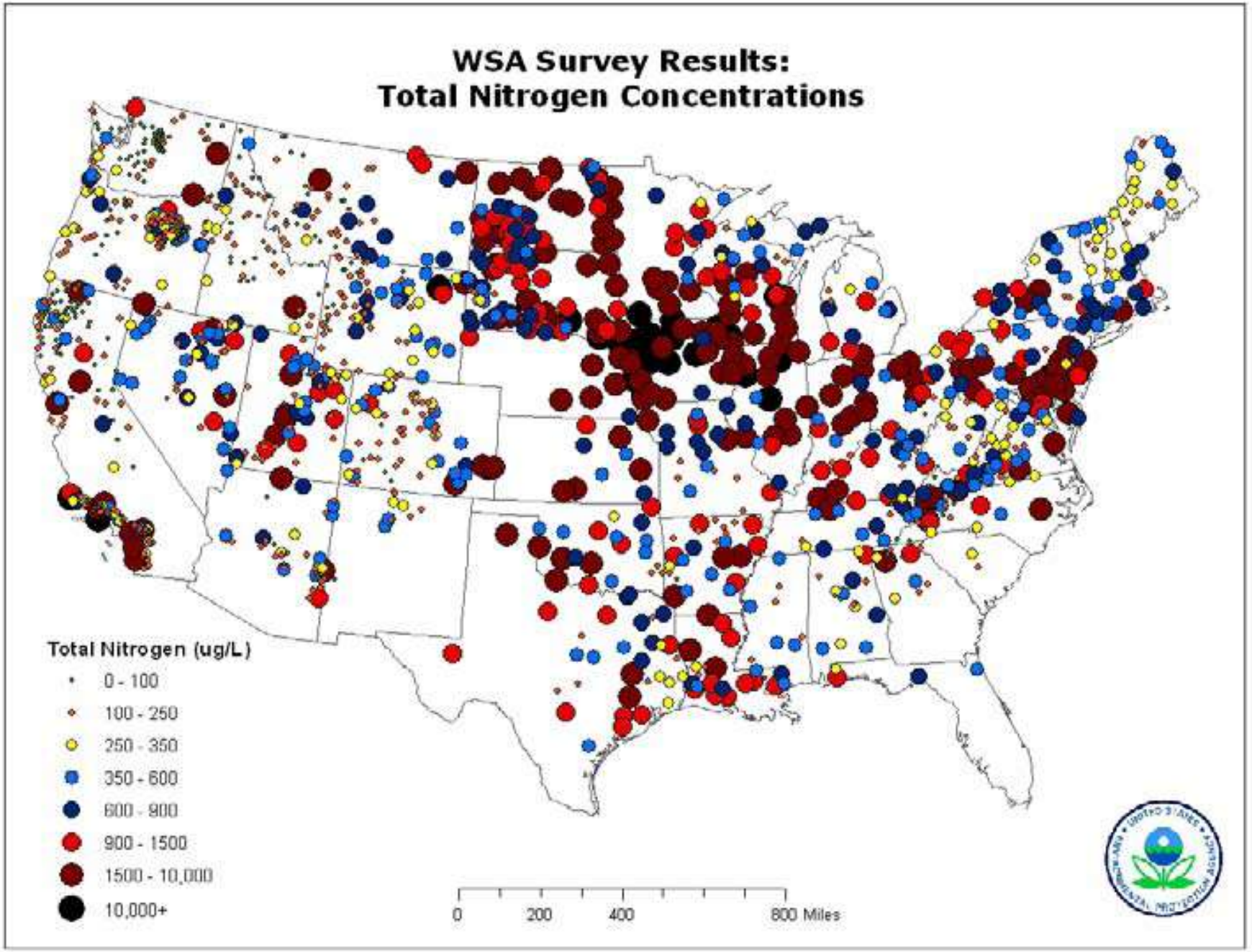
Eutrophic and Hypoxic Areas

- Areas of Concern
- Documented Hypoxic Areas
- Systems in Recovery

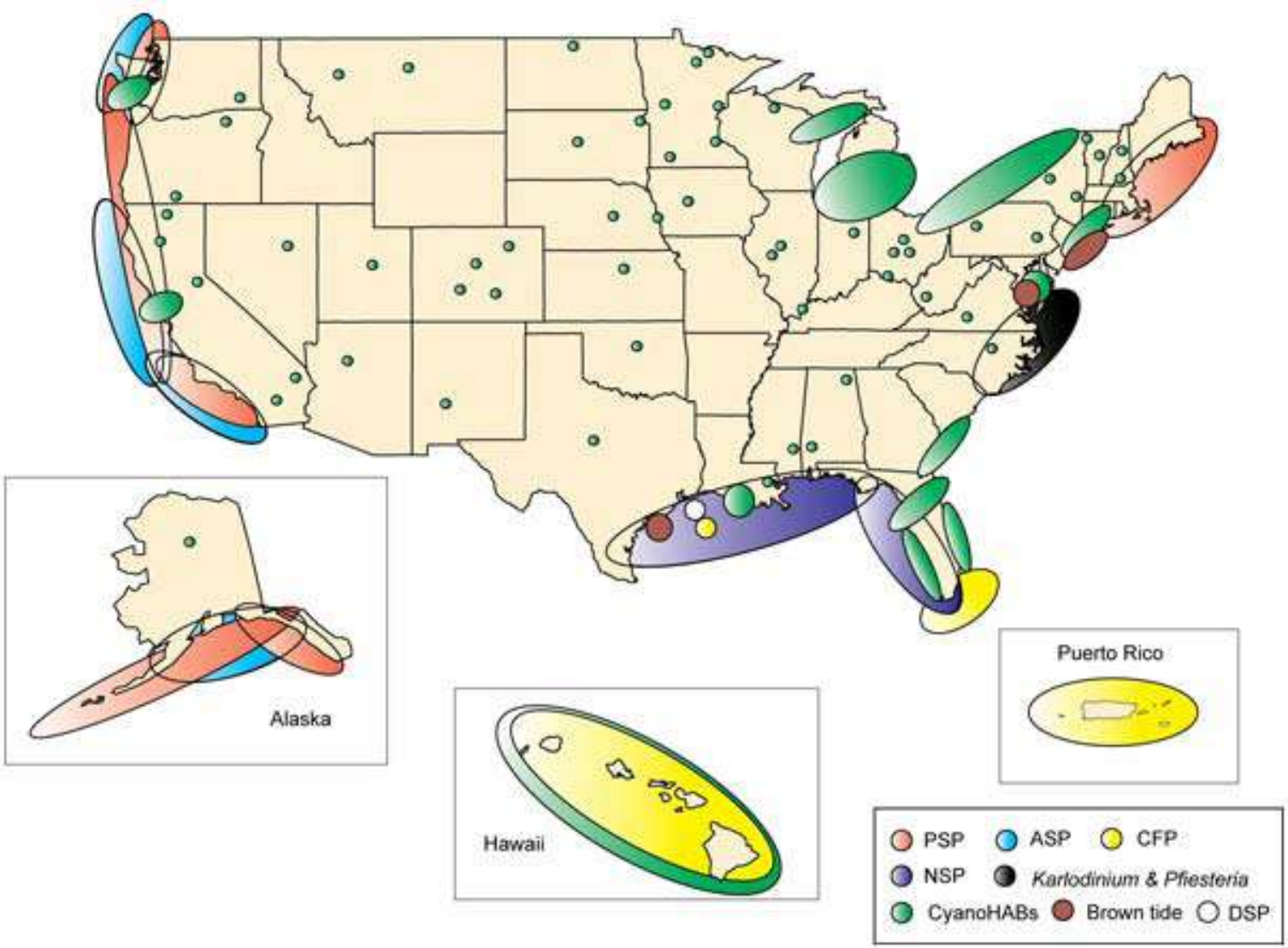
Coastal Eutrophic and Hypoxic Areas of North America and the Caribbean

Data compiled from various sources by R. Diaz, M. Selman and Z. Sugg.

WSA Survey Results:
Total Nitrogen Concentrations

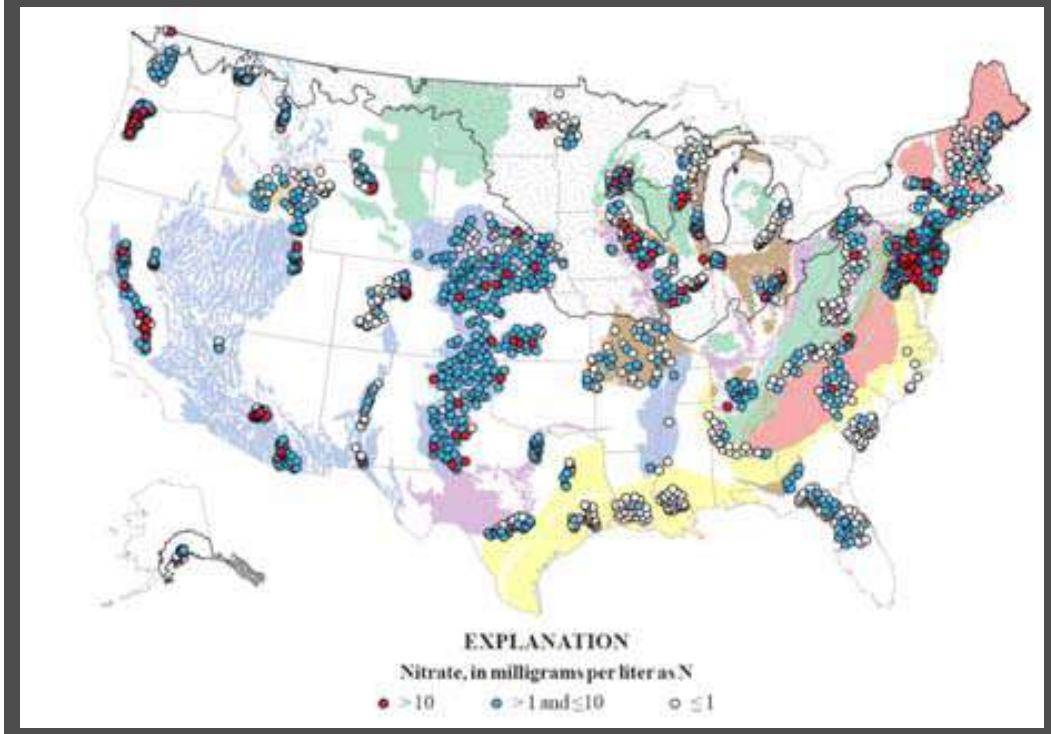


Algal Blooms (WHOI 2007)

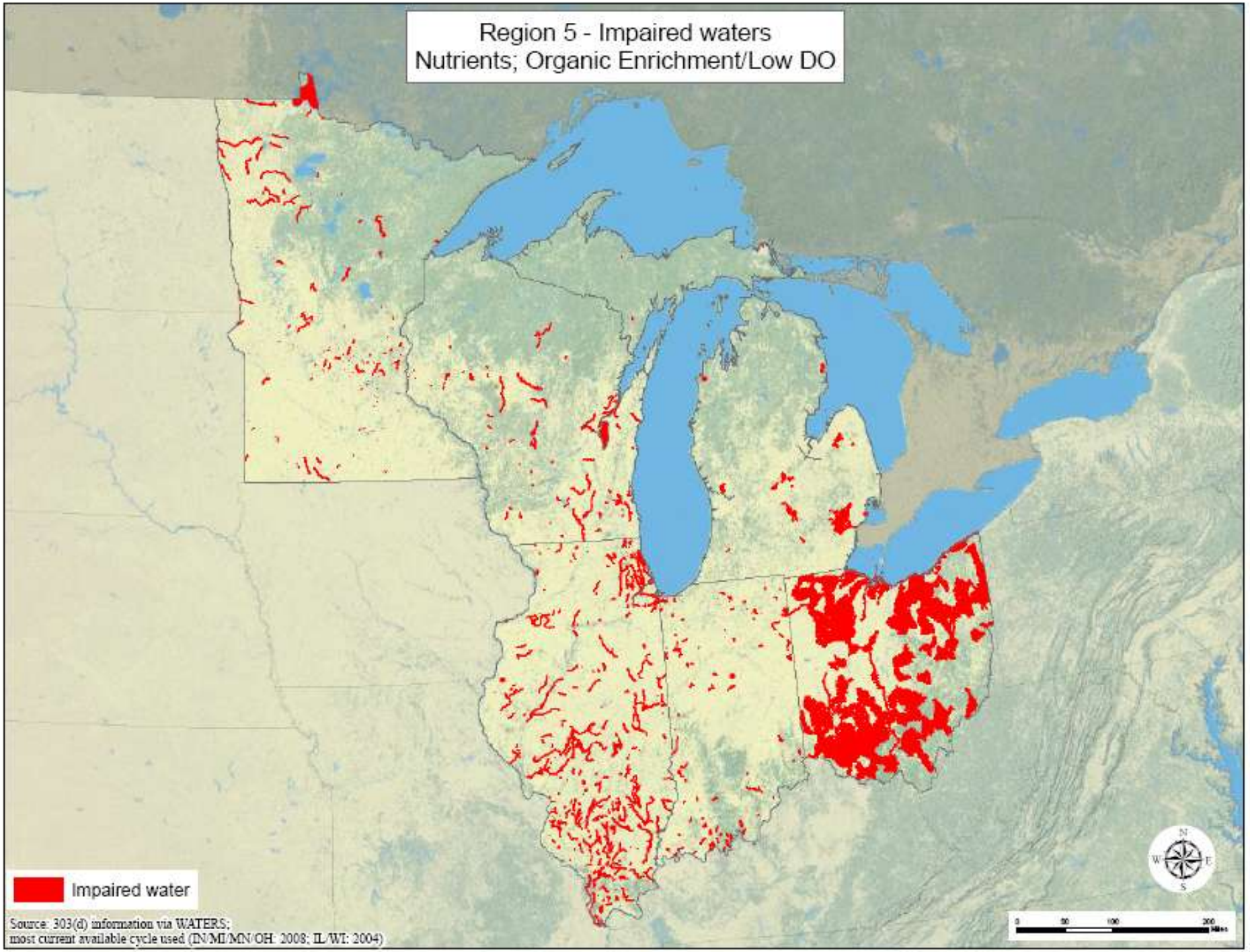


National Drinking Water Impacts

•Public Health Risks – Drinking Water



- •Disinfectant by-products; significant & costly
- •Contaminated drinking water supplies
- •Rate of nitrate violations in community watersystems has doubled over past 7 years
- •Harmful algal blooms
- •Increased treatment costs
  - •Large Systems
  - •Small Systems
  - •Private Wells


Region 5 - Impaired waters
Nutrients; Organic Enrichment/Low DO
Impaired water
Source: 303(d) information via WATERS;
most current available cycle used (IN/MI/MN/OH: 2008; IL/WI: 2004)

National Population Growth

- Increase in nutrient pollution over past 50 years reflects doubling of U.S. population
- Additional 135 million people by 2050
- Nutrient pollution expected to accelerate

Year	U.S. Population
1952	152 million
2008	304 million
2050	439 million

Sources – Key Facts

Municipal Wastewater Treatment

•POTWs are among the most heavily regulated sectors in the U. S.

•Collectively, our nation's municipal wastewater systems treat over 18 million tons of human waste

•Of more than 16,500 municipal treatment system permits, however, only about 4% have numeric limits for nitrogen and 9.9% for phosphorus

Sources – Key Facts

Urban Stormwater

•80% of the U.S. population live on 10% of the land with urban population heavily impacting coastal areas

•Stormwater sources expected to increase dramatically with increased urbanization - 50% of the urban landscape will be redeveloped by 2030 and 30% of needed built environment does not exist

Atmospheric Nitrogen Deposition

•Regulated under the CAA, mobile and stationary account for 55% and 45% of NOx emissions respectively to the atmosphere

Sources – Key Facts

Agricultural Livestock

- Livestock Production in U.S. is a $130 Billion industry
- 96 million cattle, 68 million pigs, and 9.4 billion chickens produce over 1 billion tons of manure annually
- A substantial portion of agricultural livestock production is largely unregulated by the recent CAFO Rule

Agricultural Row Crops

- Row crop agriculture is a $120 billion industry
- Stormwater runoff and irrigation return flows exempt from the Clean Water Act
- Subject to variable controls at the State level

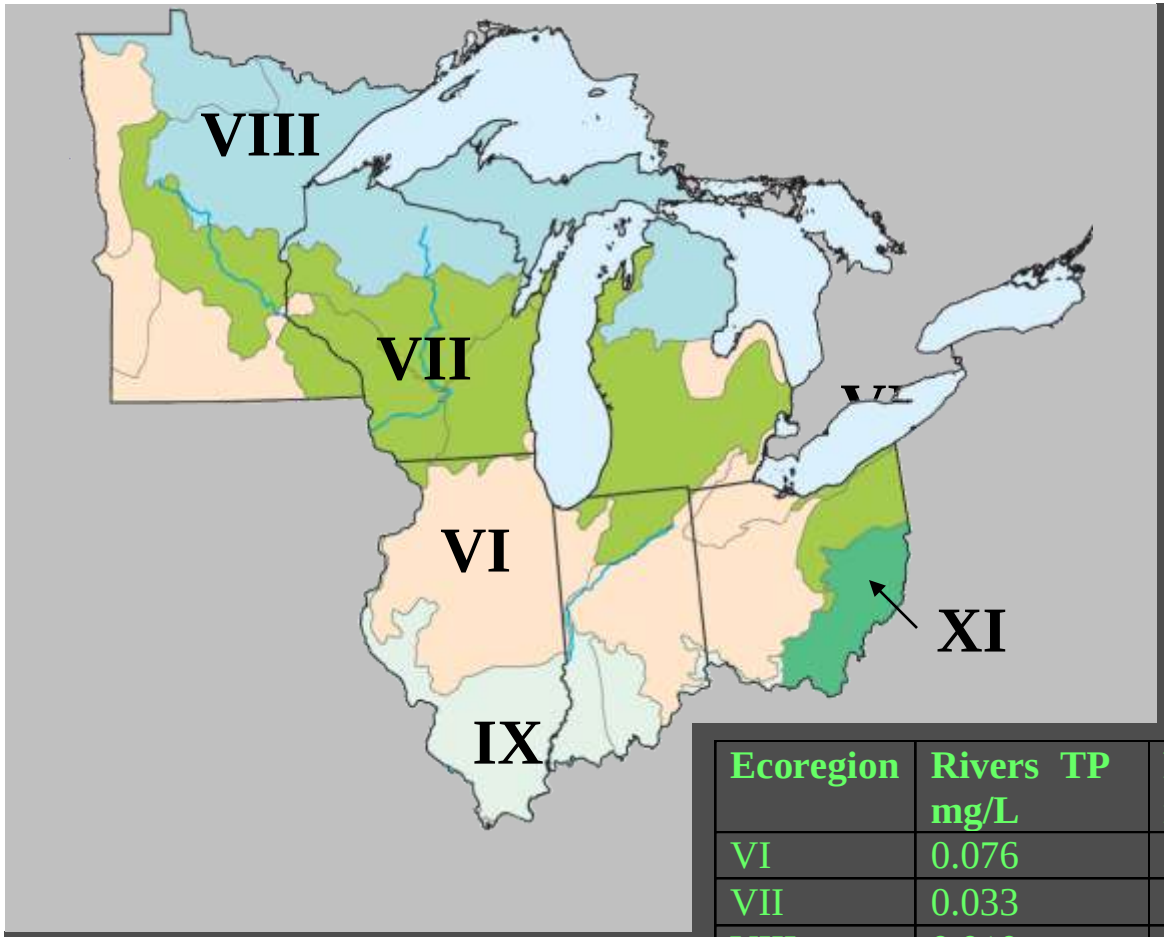
Time-line

- Eutrophication considered pollution problem by ~1950s
- **1972** Great Lakes Water Quality Agreement
  - 1 mg/L phosphorus for major municipal treatment plants discharging in the Great Lakes Basin
- **1986** EPA **“**Gold Book” nutrient recommendation
- States adopt 1mg/L phosphorus domestic sewage effluent standard (e.g. 1992 Wisconsin)
- **1998** EPA proposes nutrient criteria strategy
- **2000 & 2001** EPA recommends 304(a) eco-region criteria
- Nutrients rank among top water impairments
- Environmental advocacy challenges to EPA, FL, WI, MN, Gulf of Mexico, secondary treatment standards, and concerns over State, and Great Lake waters

EPA Water Quality Criteria

- 1986 “Gold Book” set nutrient recommendation for phosphorus not to exceed:
  - .1 mg/L streams
  - .05 mg/L stream entering lake or reservoir
  - .025 mg/L within lake or reservoir
- Effects based - directly related to preventing plant nuisances

EPA Nutrient Criteria Recommendations for Rivers, Streams and Lakes



EPA aggregated national ambient water quality data from 1990-1998, then designated the 25th percentile as the reference conditions.

Ecoregion	Rivers TP mg/L	Rivers TN mg/L	Lakes TP mg/L	Lakes TN mg/L
VI	0.076	2.18	0.038	0.78
VII	0.033	0.54	0.015	0.66
VIII	0.010	0.38	0.008	0.24
IX	0.036	0.69	0.02	0.36
XI	0.010	0.31	0.008	0.46

Proposed State of Wisconsin Phosphorus Rules

- Numeric criteria
- NPDES permit implementation
- Nonpoint source pollution indexes

– **.1 to .075** mg/L for Rivers
– **.04 to .015** mg/L for Lakes

State water quality criteria

- All States have numeric criteria for dissolved oxygen
- All States have narrative criteria that prohibit nuisance conditions generally or prohibit plant nuisances specifically
- IL, MN have numeric nutrient criteria for lakes and impoundments
- WI has proposed criteria for lakes, rivers, and nonpoint runoff indexes

State adoption dates and nutrient criteria plans

Most Region 5 States plan to adopt some set of nutrient criteria over the next several years

Technology

- **Bio P → chemical precipitation → Solid to liquid separation**
- **Phosphorus removal is predictable and reliable**
- **Without filtration, but with good settling about 0.5 to 0.8 mg/L. Note, Madison, WI - 0.2 to 0.3mg/L.**
- **With filtration, total phosphorus concentrations of between 0.11 mg/L and 0.15 mg/L (e.g., Kalispell, MT)**
- **With chemical addition 0.1 to 0.06 mg/L (e.g., Ely, MN., and Clean Water Services, OR.)**
- **Limit of technology for phosphorus may be lower than observations of 0.05, 0.02, 0.01 mg/L (e.g., Concord, MA., Syracuse and Stamford, NY)**

- Sources: EPA R5, R1 and J. Barnard

EPA Nutrient Removal Technology Reports

- **OWM** - *Municipal Nutrient Removal Technologies Reference Document* – January 2008
- Observations of tertiary WWTP at 29 municipalities across the United States and one in Canada (two in Michigan)
- Phosphorus treated 0.6mg/L to 0.01mg/L
- Guide for capital and O+M costs

- **ORD** - *Nutrient Control Design Manual, State of Technology Review Report* – August 2010
- Sustainability is a recurring theme
- World is running out of phosphorus

- **Region 10** - *Advanced Wastewater Treatment to Achieve Low Concentration of Phosphorus* - 2007
- Phosphorus - 0.3mg/L to 0.001mg/L
- Monthly residential fees $18 to $45
- Facilities capable of Nitrogen - 3mg/L
- Advanced nutrient removal enhances disinfection, removal pharmaceuticals and personal care products

Region 1 Nutrient Permitting

- Massachusetts not EPA authorized program
- Lawsuits motivated Region 1 to set limits
- Considered EPA eco-region, Gold Book & literature
- Develops limits for P and N in pre-TMDL waters
- Set WQBEL when TBEL not protective
  - 0.2mg/L for Total Phosphorus
- 7Q10 flows and not to exceed phosphorus 0.1 mg/L
  - Phosphorus
    - Free flowing streams ~ **.**5mg/L to ~ **.**1mg/L
    - Downstream reservoir as low as **.**1mg/L
  - Nitrogen
    - Downstream marine – 8mg/L
- Monthly household charges: $24 to $43
  - 2006 data

Permitting tools

- **CWA 301 (b)(1)(C)** not later than July 1, 1977, point source discharges must be controlled by any more stringent limitation, including those necessary to meet water quality standards
- **40 CFR 122.44(d)** Implements the above.
- **40 CFR 122.44(d)(1)** Requires permits to include limits when "reasonable potential" to violate water standards, including narrative criteria.
- **40 CFR 122.44(d)(1)(ii)** account for existing controls on point & nonpoint sources

Permitting tools

- **40 CFR 122.44(d)(1)(vi)** Where a state has not established a numeric water quality criterion for a pollutant that is present in an effluent at a concentration that has an RP to violate a narrative criterion…the permitting authority must establish effluent limits using [either]:
- (A) must be derived using the State's proposed numeric criterion or an explicit State policy or regulation interpreting its narrative criterion
- (B) must be derived on a case-by-case basis using EPA's water quality criteria supplemented, where necessary, by other relevant information.
- (C) must be established on an indicator parameter if certain conditions are met.

Targets for WQBELs

- State of Indiana draft numeric criteria
- Explicit policy or regulation interpreting narrative criteria (Ohio and Michigan)
- EPA recommended 304(a) criteria
- EPA effects based criteria (Gold Book)
- Other relevant scientific information

Conclusion

- Discharge of nutrients impairing water quality is well understood
- Restoration and protection becomes complicated only when pollutant loads are decoupled from sources
- Solution is not a technological barrier

U.S. EPA Region NPDES Programs

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Nutrient Control Design Manual (August 2010) EPA/600/R-10/100
As of September 21, 2010 awaiting posting to EPA website.

- Municipal Nutrient Removal Technologies Reference Document (2008)
- Emerging Technologies Report on Wastewater Treatment (2008)
http://www.epa.gov/OWM/mtb/publications.htm

EPA Water Quality Trade Policy – 2003
http://www.epa.gov/owow/watershed/trading/finalpolicy2003.html

EPA Water Quality Trading Toolkit – 2007
http://www.epa.gov/WaterQualityTrading/WQTToolkit.html

EPA Managing Wet Weather with Green Infrastructure - Action Strategy 2008
http://swimmablenyc.info/wp-content/uploads/2008/02/epa-green-infrastructure_action_strategy.pdf

CTIC Getting Paid for Stewardship: An Agricultural Community Water Quality Trading Guide - 2006
http://www.conservationinformation.org/images/GPfS_FINAL.pdf