# Water Availability & Watershed Management Customer Workshop

Water Quality
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National Nonpoint Source Expert &
Regional Agricultural Advisor

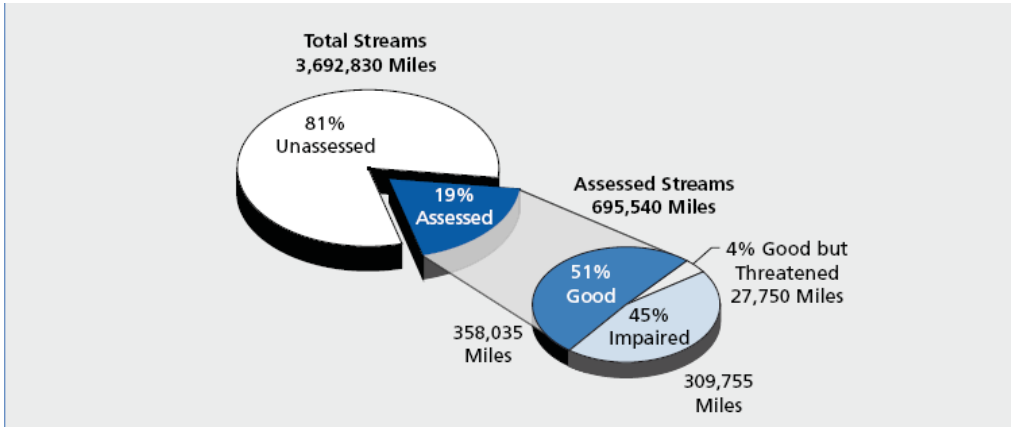
# Pollutants of Concern

Nutrients (TP, TN)

Pathogens

Sediment (suspended, deposited)

# Agricultural NPS is a Leading Source of Water Quality Impairment



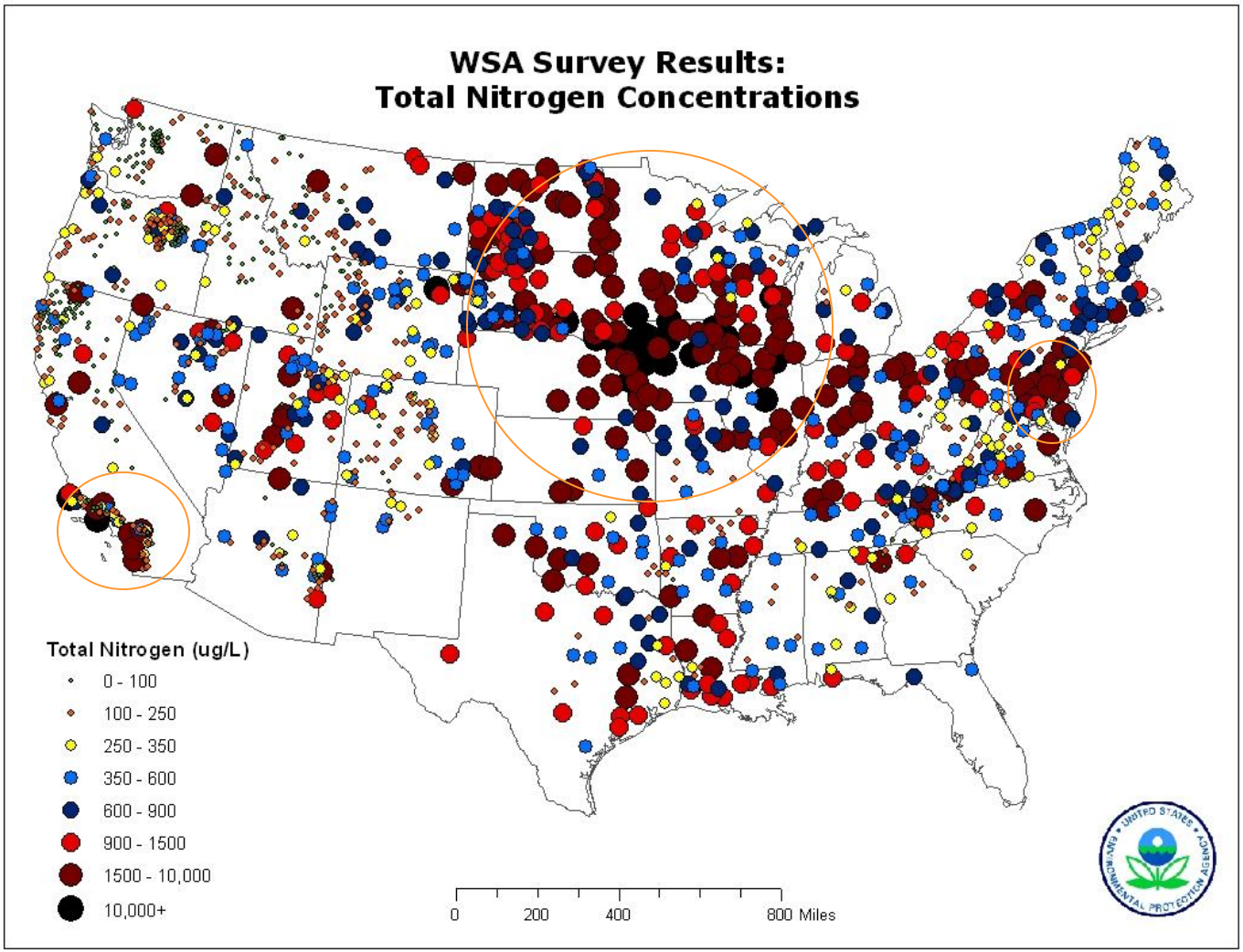

- Number one source for rivers and streams: 94,182 miles (33% of impaired miles)
- Number three source for lakes, ponds, and reservoirs: 1,670,513 acres (20% of impaired acres)
- Number nine source for estuaries: 792 square miles (8% of impaired area)

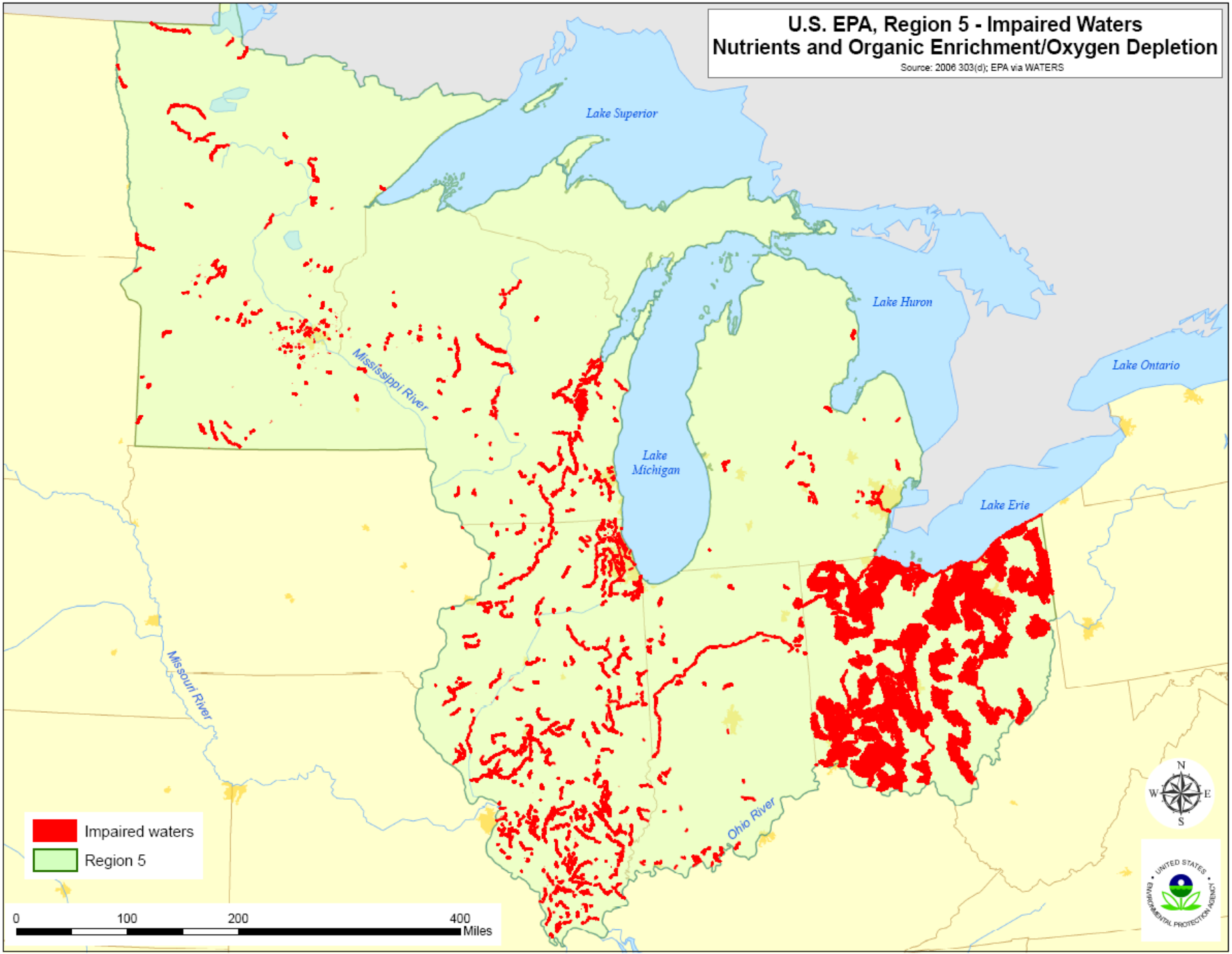
Source: CWA 305(b) National Water Quality Inventory: Report to Congress, 2002 Reporting Cycle

# Sources - Key Facts

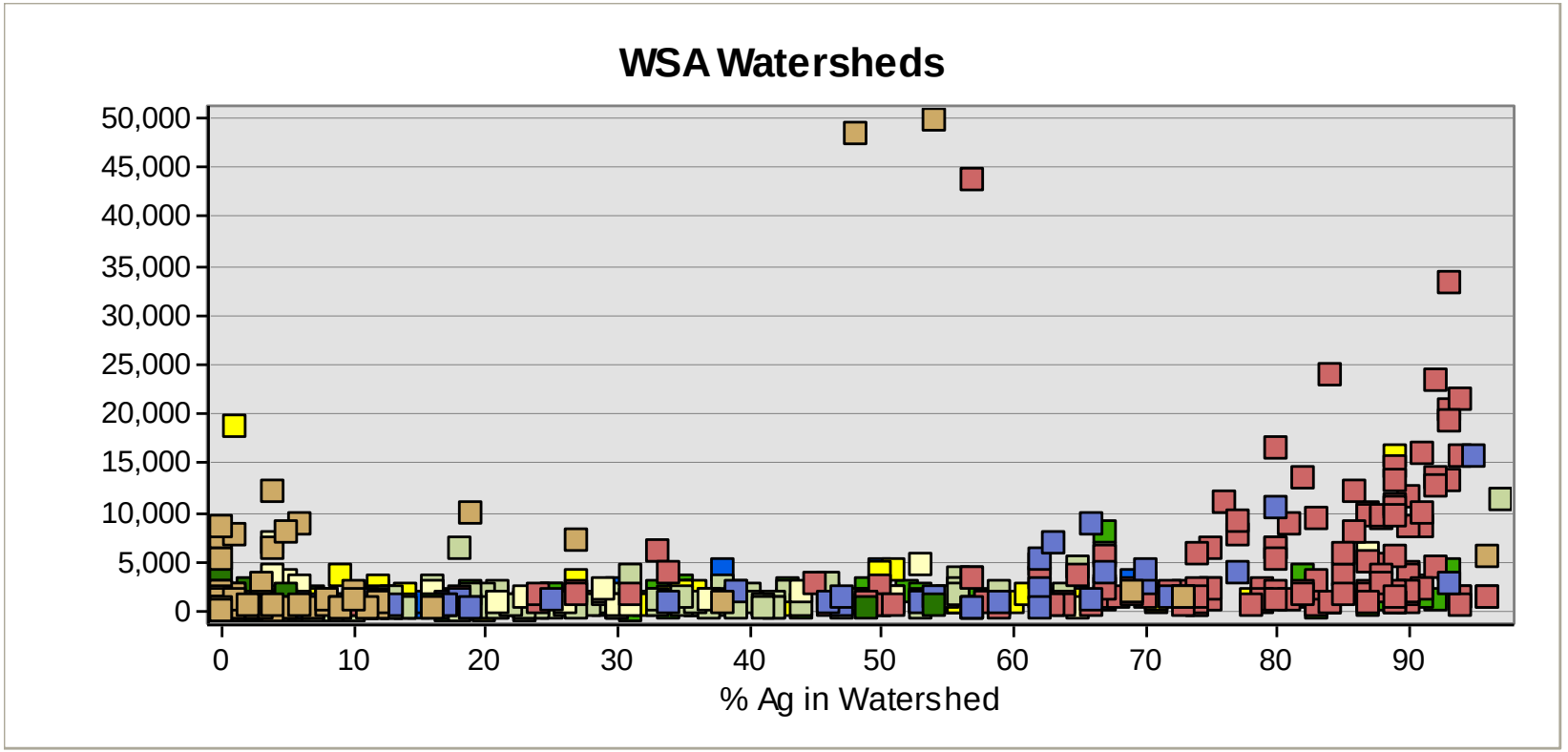
- **Agricultural Livestock**
  - Livestock Production in U.S. is a $130 Billion Industry
    - 96 million cattle, 68 million pigs, and 9.4 billion chickens produce over *1 billion tons* of manure annually
  - A Substantial Portion of Agricultural Livestock Production is Largely Unregulated by the Recent 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

# Concentrations of Nitrogen Nationally

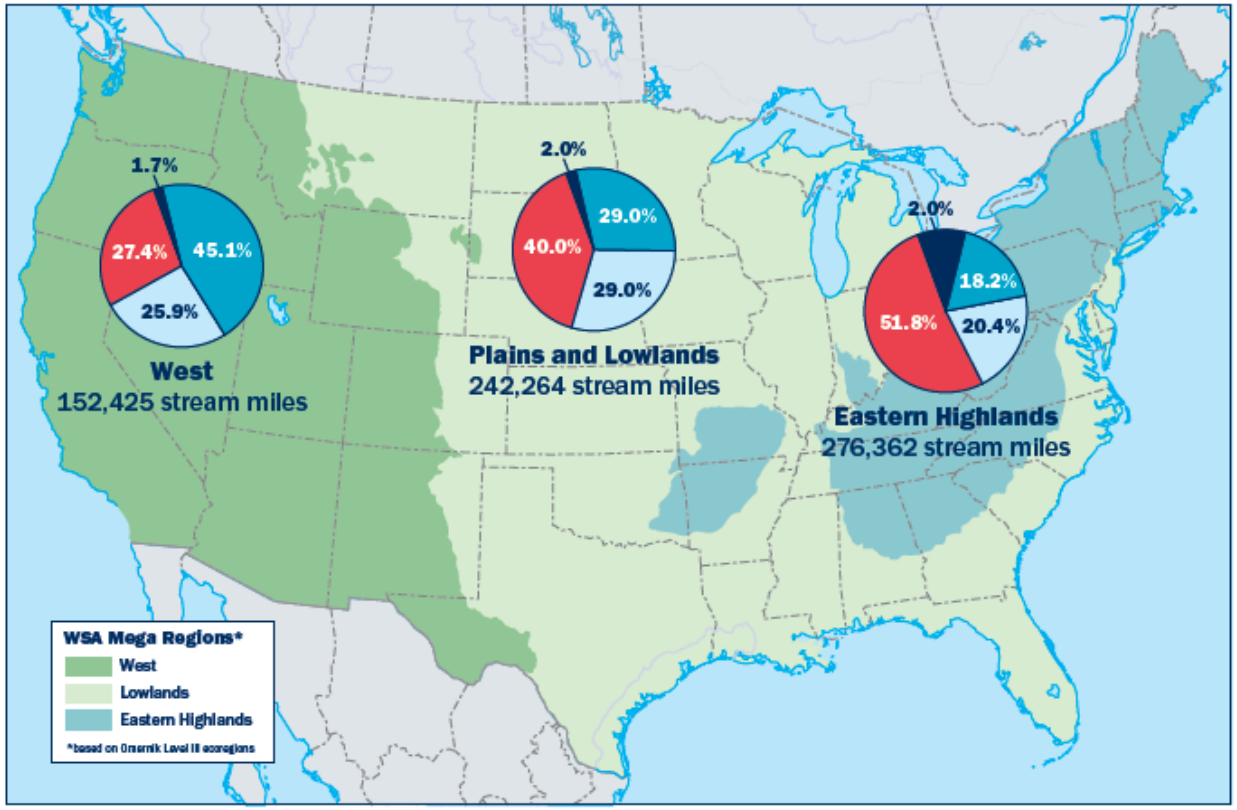


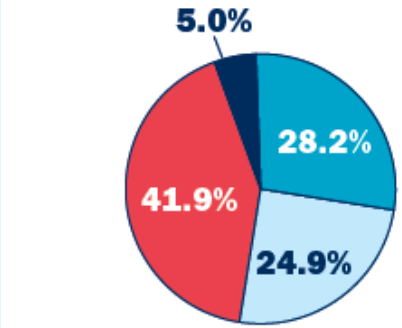

U.S. EPA, Region 5 - Impaired Waters
Nutrients and Organic Enrichment/Oxygen Depletion
Source: 2006 303(d); EPA via WATERS
Lake Superior
Lake Huron
Lake Ontario
Lake Michigan
Lake Erie
Mississippi River
Missouri River
Ohio River
Impaired waters
Region 5
0
100
200
400
Miles
N
W
E
S
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

# Nitrogen Concentrations Increase with Percent Agriculture in Watershed



# Poor Stream Biology is Twice as Likely in Streams with High Levels of Nitrogen, Phosphorus or Sediments

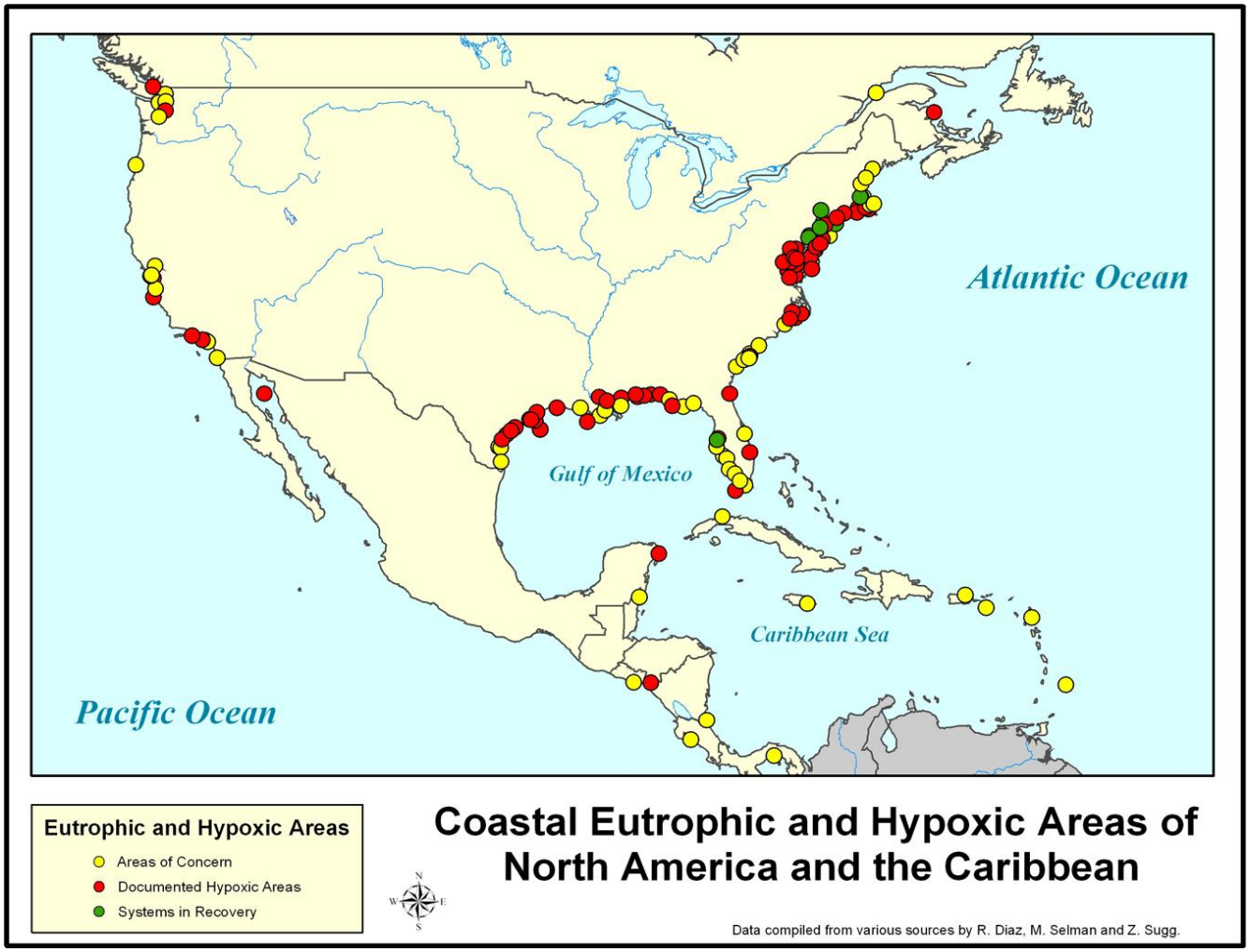


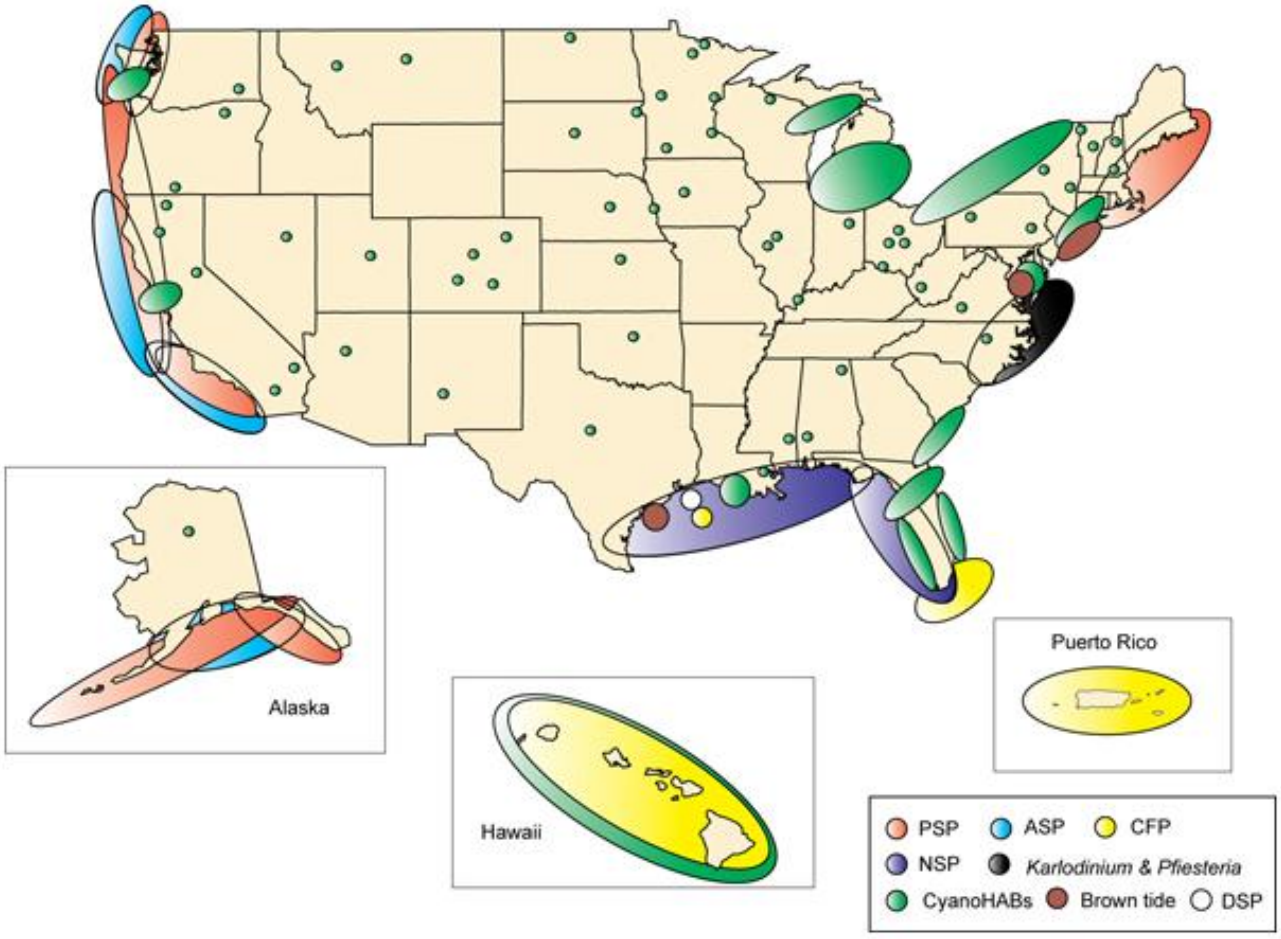

Good
Fair
Poor
Not Assessed

From the December, 2006 Wadeable Streams Assessment

# Hypoxic Zone Locations

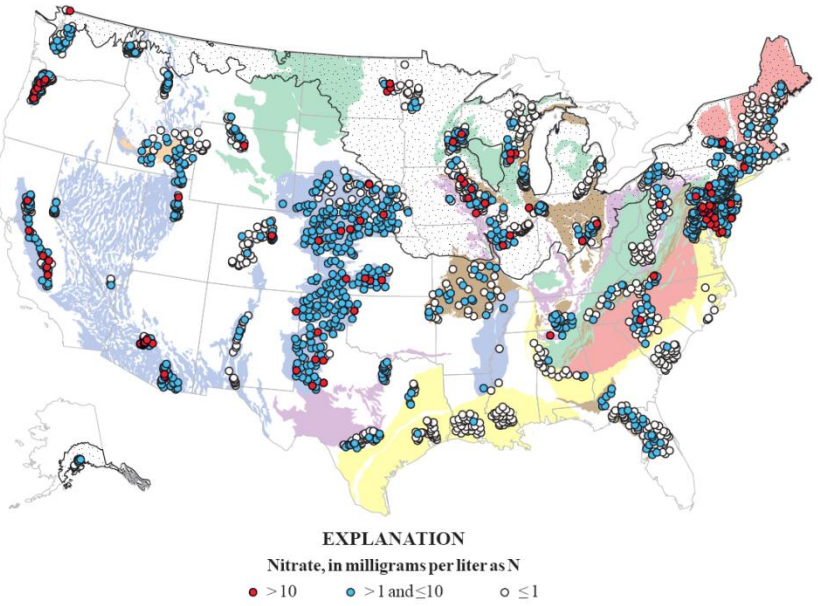


# Algal Bloom Occurrences in the United States (WHOI 2007).



# National Drinking Water Impacts

- **Public Health Risks – Drinking Water**




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

# Nutrients

BMPs/Management Measures Systems

(source, transport,  treatment)

{Technology Based/WQ Based}

Manure Management/Utilization

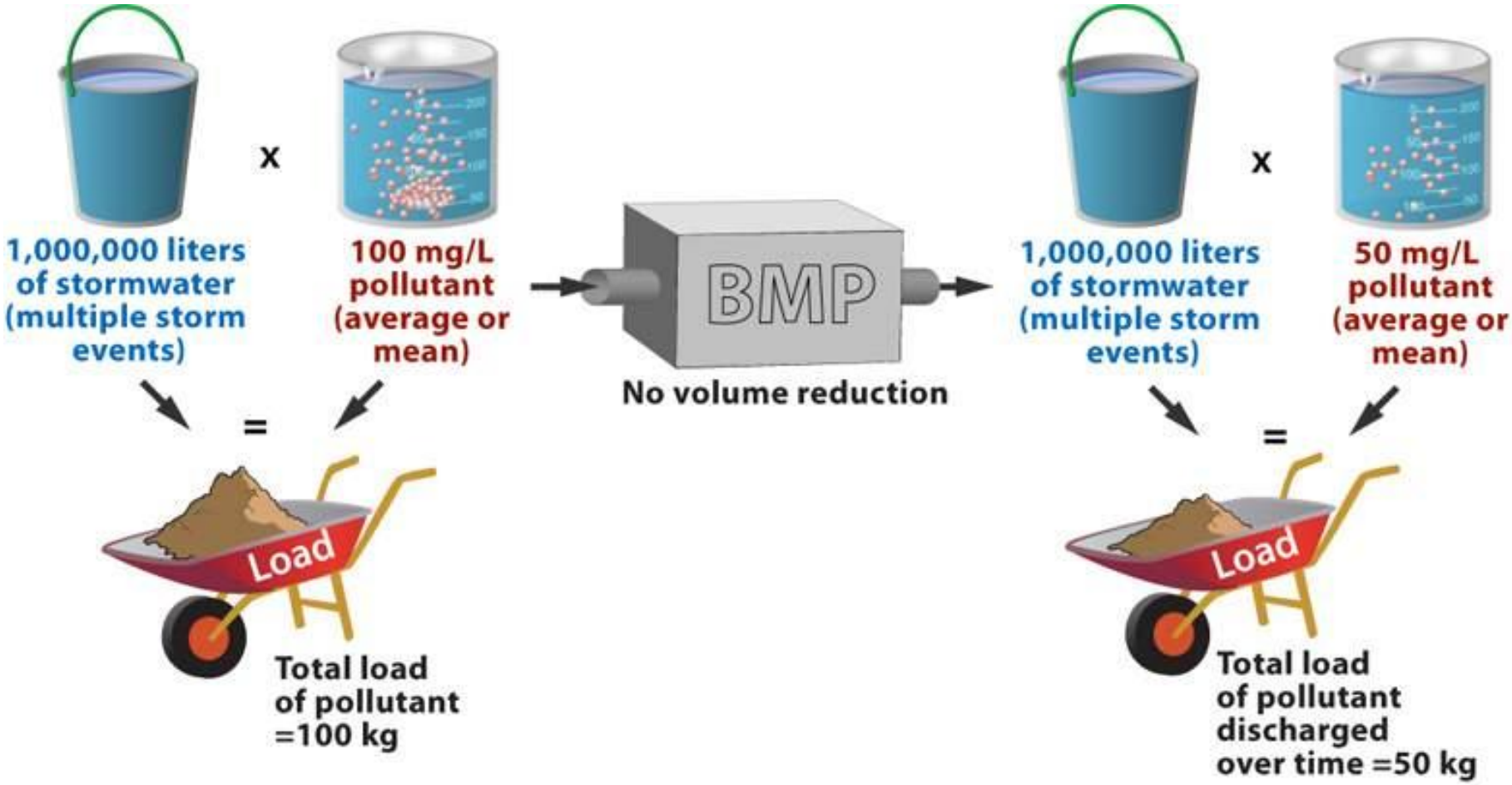
Dose (load)-response models

Impact analysis (concentration/load)

# Volume Reduction

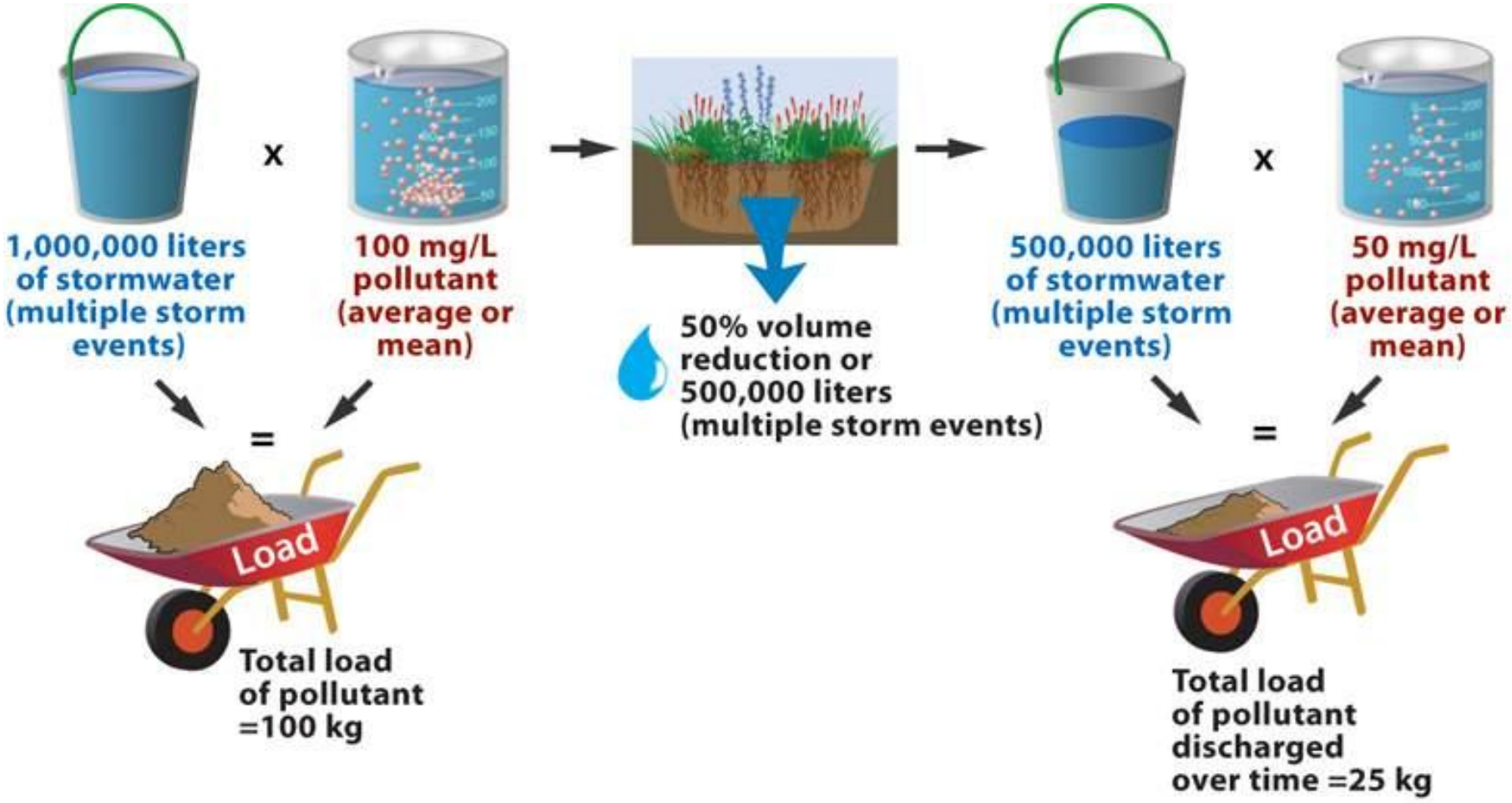
- Volume (and velocity) reduction is important for its impact on the physical and biological aspects of streams
- Volume reduction also plays an important part in pollutant reduction…

# Total Load Reduction




In this example, the BMP removes 50 kg or 50% of the "total load" of this pollutant.
It does not reduce the volume of stormwater discharged.

# Impact of Volume Reduction on Total Load




In this example, the BMP removes 75 kg or 75% of the "total load" of this pollutant. The "true" performance of this BMP is only apparent when we factor in the impact of volume reduction and calculate the total load of the pollutant.

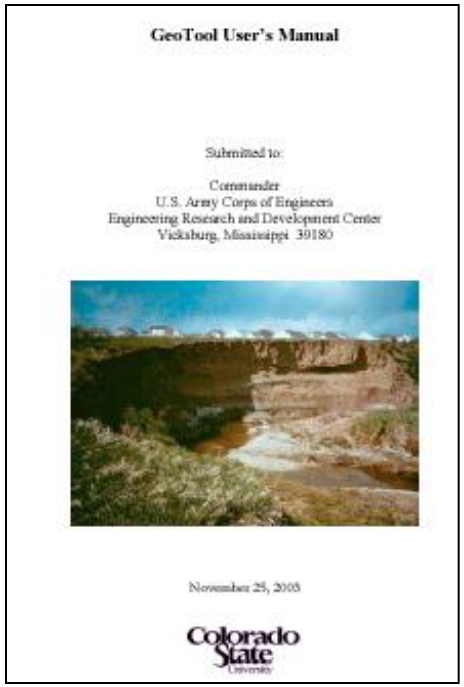
# Common effectiveness categories

- Biotic effectiveness
- Geomorphic effectiveness
- Hydraulic effectiveness
- Cost effectiveness
- Engineering effectiveness

# Biotic effectiveness

- Relative changes in a generally-accepted measure of aquatic health in the receiving water body.
  - IBI score
  - population of targeted species
- How to evaluate future projected future populations?

# Geomorphic effectiveness

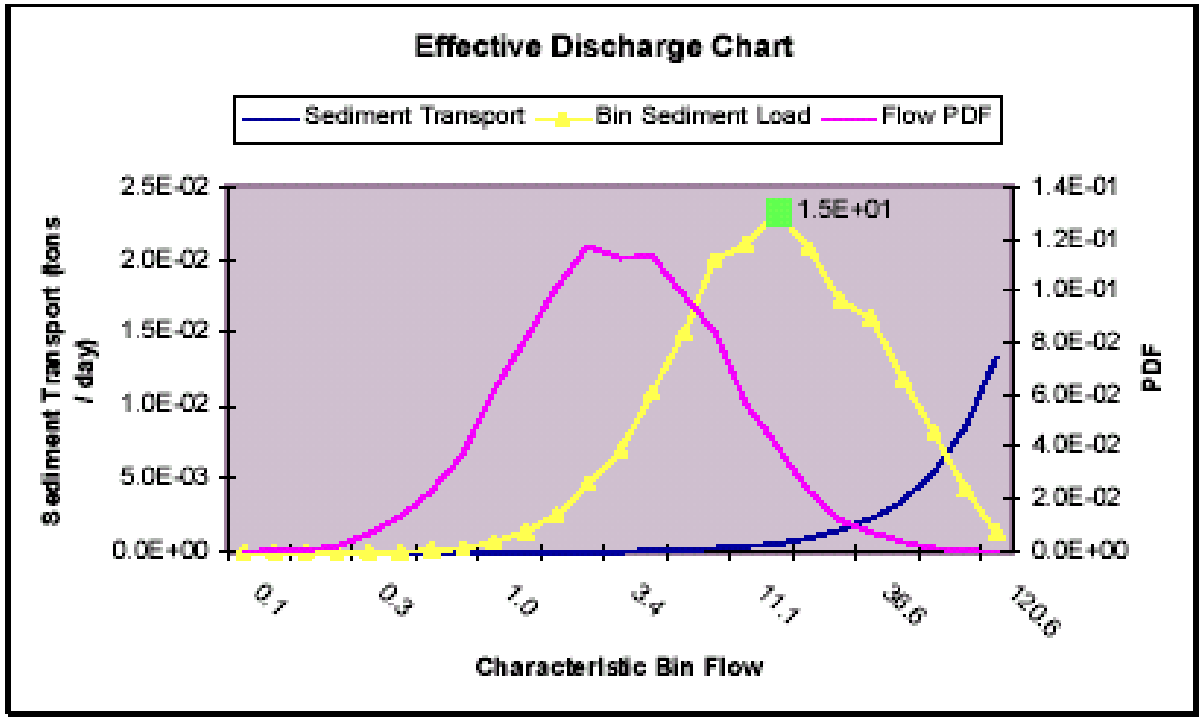

GeoTool User's Manual

Submitted to:

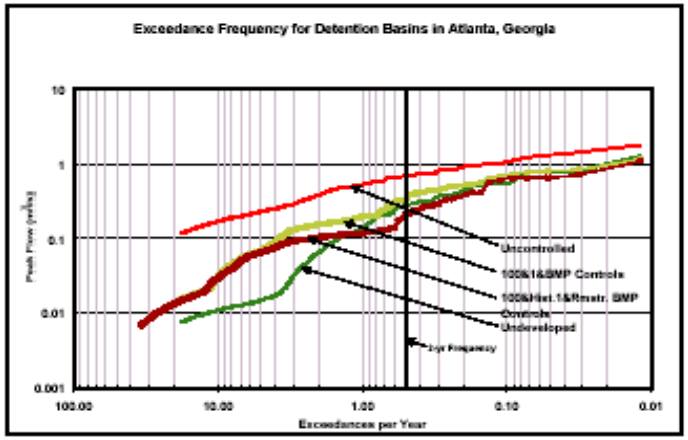
Commander
U.S. Army Corps of Engineers
Engineering Research and Development Center
Vicksburg, Mississippi 39180

November 25, 2003

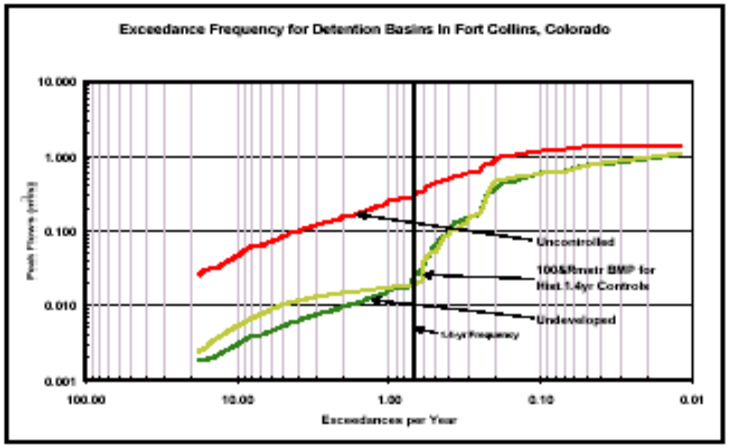
Colorado State University



# Hydrologic effectiveness




**How closely does the post-BMP in-stream flow mimic the pre-development flow?**




Effects of design practice for flood control and BMPs on the flow frequency curve. Nehrke, S.M. et al,. 2003

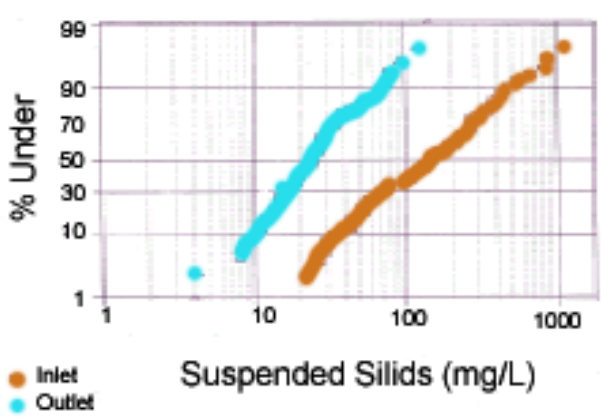
# Cost Effectiveness

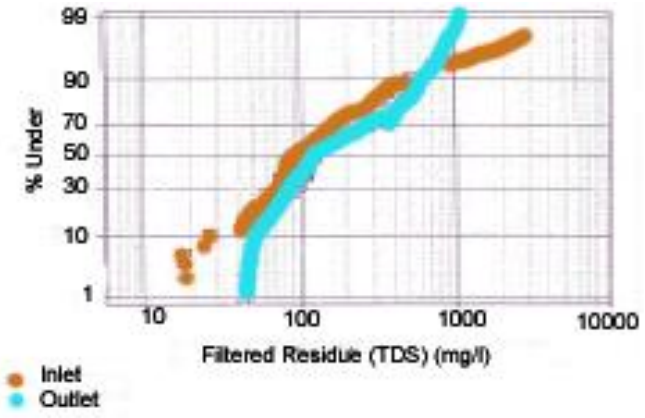
- Unit cost
  - $/kg stressor kept from the receiving water
  - Whole-life cost, Net Present Value,
    - Normalized for time and location?
- How to “discount” future capture mass?
- How to evaluate benefits?
  - Monetized
  - Other

# Engineering effectiveness

- Most common connotation
- Ability of a BMP to reduce a stressor reaching the receiving water during a designated period.
- Measured as a load (mass/time) or concentration

# Effluent probability method




- Incorporates climatic variability and site specificity regarding inlet concentration
- Data intensive

Modified from Urban Stormwater BMP Performance Monitoring –
A Guidance Manual for Meeting the National Stormwater BMP Database Requirements

# Drainage Management Functions

| Function | Basis for Performance Standard |
|---|---|
| Groundwater Recharge | Annual recharge rate |
| Water Quality (capture/release) | Capture volume, draw down time |
| Water Quality (flow-through) | Capture volume, design hydrograph |
| Channel protection | Shear stress management |
| Flood Control | Design storm, peak attenuation |

# Flashiness Index

- Frequency and rapidity of short term changes in streamflow
- Increased flashiness has been linked to lower biological scores
- Focus on matching flashiness to more natural flow regimes

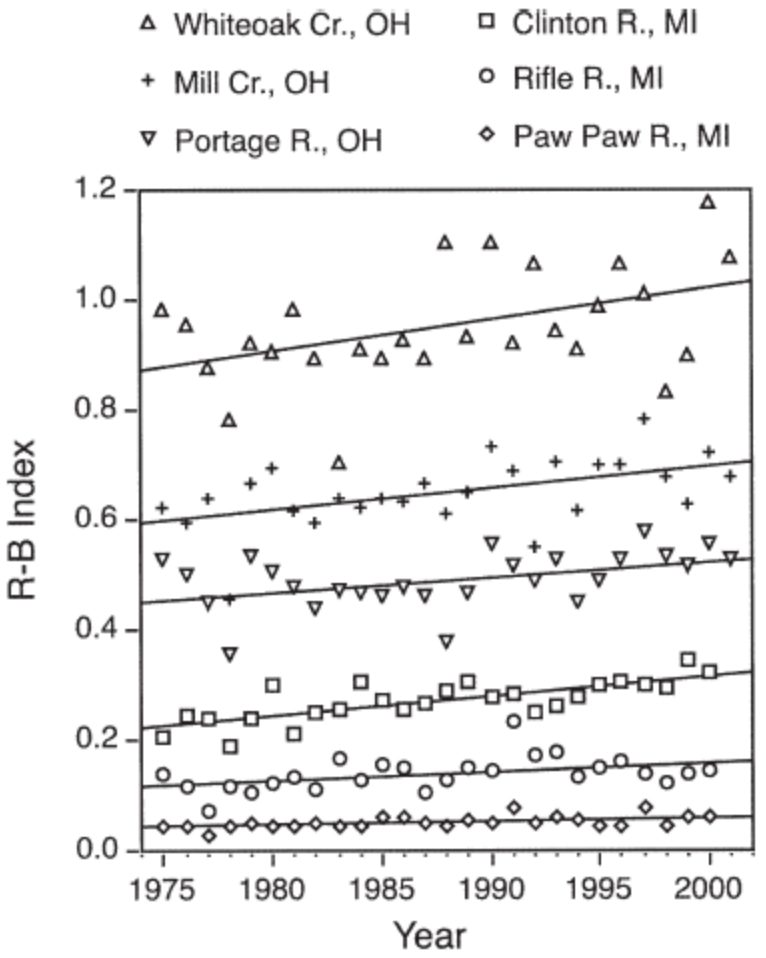



Figure 8. Time Trends in R-B Index Values for Six Streams in Ohio and Michigan for 1975 Through 2001. All streams have increasing trends that are significant at the 95 percent level ($p < 0.05$).

**Source: Baker et al., 2004**

# SWAT-DRAINMOD:

Representation of denitrification

Easy user interface

Goal-spatial representation

# Watershed Level Analysis

Cumulative Impacts

Landscape Assessments

Ecosystem Services Parcel Contributions

# When selecting BMPs, know your watershed

- Water Quality Standards/Designated Uses
- Existing impacts (impairments and perceptions)
- Social setting (landowner acceptance)
- Existing Cropping Systems
  - Stewardship
  - Technology Based Approach
- Drainage and flooding issues
- Future conditions

# Products

Distribution plans

Follow-up Monitoring and Evaluation