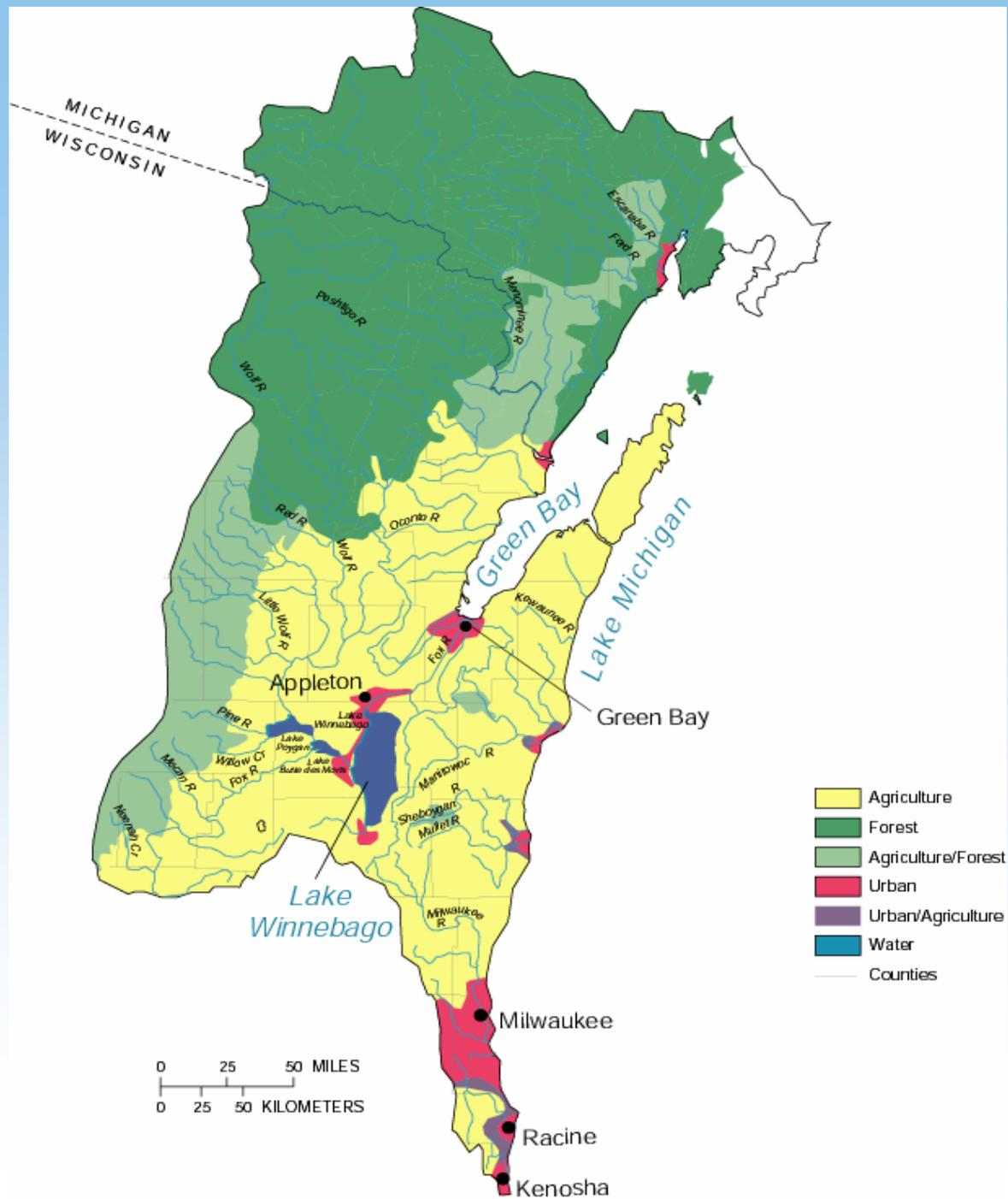


**National Water Quality
Assessment Program
(NAWQA)**

**Western Lake Michigan
Drainages Study Unit**



WMIC Cycle 1

- ✓ **28 Relatively Homogeneous Units (RHUS)**
 - ✓ based on land use, surficial deposit texture and bedrock type
- ✓ **11 Fixed Surface Water Sites**
 - ✓ 8 Indicator and 3 integrator sites
 - ✓ Sampled monthly for water chemistry and annually for biology and sediment chemistry for 3 years

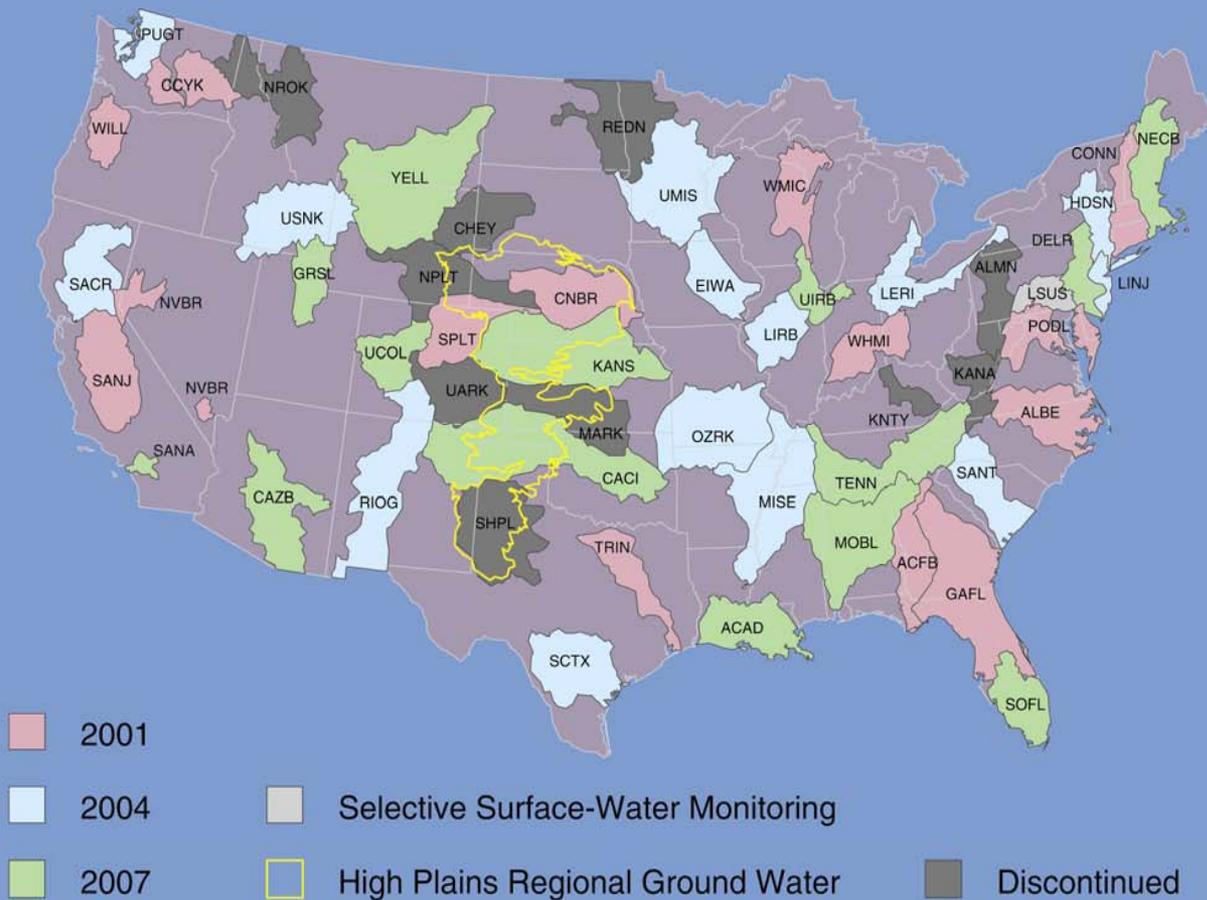
WMIC Cycle 1 (continued)

- ✓ 29 wells in the Cambrian-Ordovician Aquifer
 - ✓ **Most used aquifer in study unit**
 - ✓ **Sampled once for major ions, nutrients, pesticides, VOCs, radon, tritium, and DOC**
- ✓ 58 shallow wells in agricultural land use area
 - ✓ **Compare chemistry between areas with different permeabilities – sand versus clay**
- ✓ Special Studies
 - ✓ **Surface water synoptic studies (high flow/low flow)**
 - ✓ **Ground water flow path and gw/sw interaction studies**
 - ✓ **Biological reference site study**
 - ✓ **Water quality and biology protocol comparison studies**

WMIC Cycle 1 - Results

- ✓ **Naturally occurring chemicals may pose a threat to human and aquatic health**
 - ✓ Dissolved solids in primary bedrock aquifer
 - ✓ Arsenic in bed sediments and in primary aquifer
 - ✓ Radon in drinking water wells
- ✓ **Fertilizers and livestock waste increase nutrient concentrations**
 - ✓ 96% of phosphorus in SW attributable to agricultural practices
 - ✓ High nitrate in 37% of shallow permeable GW wells
- ✓ **Factors that control pesticide occurrence**
 - ✓ 100 times greater concentrations in the SW of agricultural areas
 - ✓ Atrazine found in all SW samples
 - ✓ Highest concentrations in SW after spring runoff (post application)
- ✓ **Urban areas are a source of trace elements and organic compounds**
 - ✓ PCBs in sediment and tissues 10 times higher
 - ✓ 8 trace elements exceeded effects levels in sediment
- ✓ **Environmental setting and land use influence aquatic life**
 - ✓ Aquatic life was most degraded in urban areas
 - ✓ Indexes of biotic integrity indicated degraded water quality at sites with clay surficial deposits
 - ✓ Quality of aquatic life varied in agricultural areas

NAWQA CYCLE II STUDY UNITS



Shift in Emphasis for Cycle 2

- ✓ Increase emphasis on *understanding* water-quality conditions
- ✓ Increase emphasis on *trend* assessment
- ✓ Decrease emphasis on *status* assessment

Although the status, trends, and understanding goals shift in emphasis in Cycle II, none of them go away and the challenge is balance.

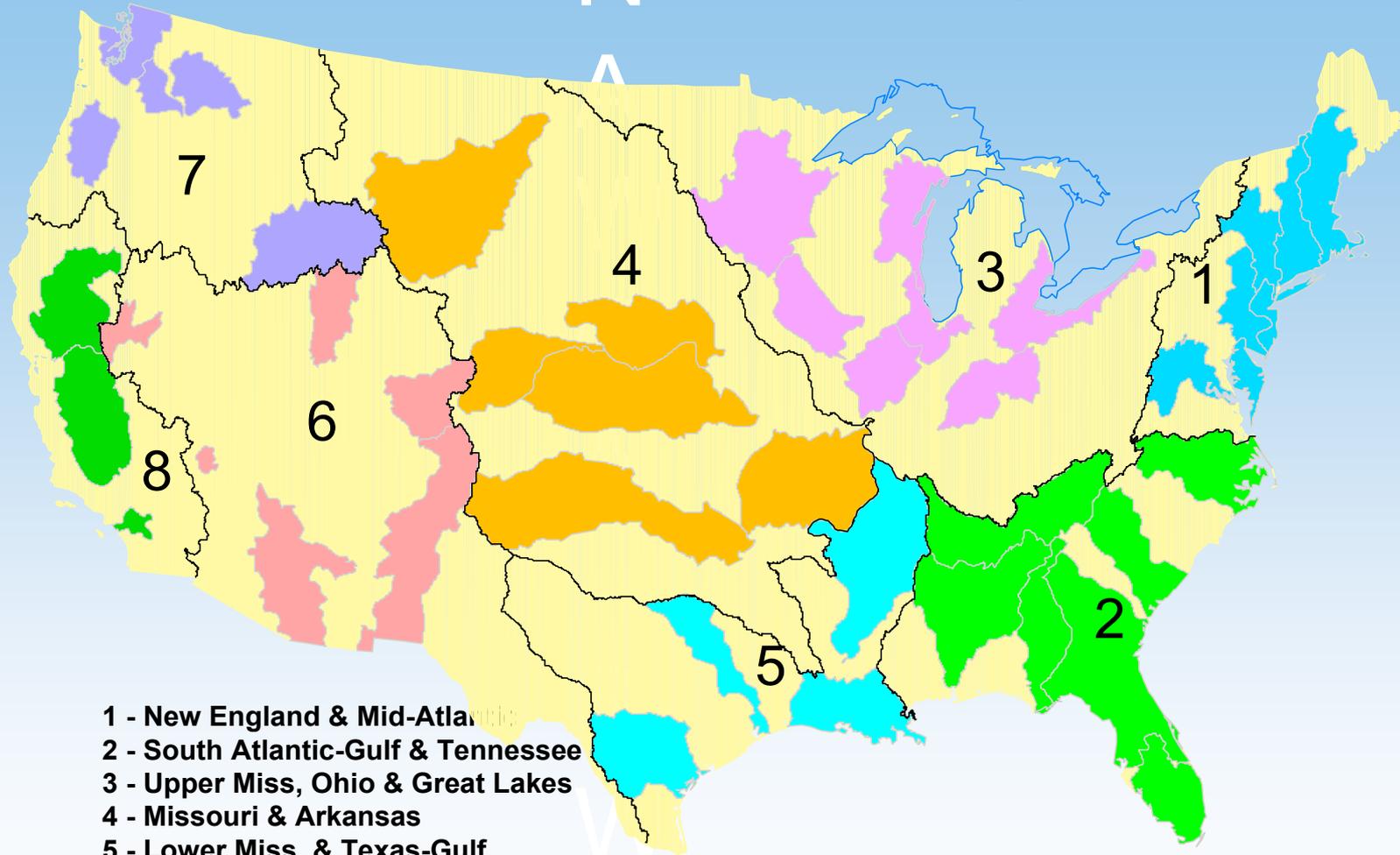
WMIC Cycle 2 plans

- ✓ **Status and trend sampling**
 - ✓ **Ground water, surface water, biology, and lake cores**
- ✓ **Topical Studies**
 - ✓ **Urbanization**
 - ✓ **Mercury**

WMIC Cycle 2 - Status/Trend Sampling

- ✓ **Surface Water**
 - ✓ 4 trend sites for chemistry and ecology
 - ✓ Mercury sampling at 8 sites
 - ✓ Lake sediment coring to take the place of BST sampling
- ✓ **Ground water**
 - ✓ Revisit agricultural land use and Cambrian-Ordovician (C-O) major aquifer studies
 - ✓ Conduct glacial major aquifer study
 - ✓ Drinking water source assessments of C-O aquifers

Proposed NAWQA SW Regions



- 1 - New England & Mid-Atlantic
- 2 - South Atlantic-Gulf & Tennessee
- 3 - Upper Miss, Ohio & Great Lakes
- 4 - Missouri & Arkansas
- 5 - Lower Miss. & Texas-Gulf
- 6 - Rio Grande, Colo. River & Great Basin
- 7 - Pacific Northwest
- 8 - California

Revised -- September 25, 2003

Five national topics selected to address the understanding themes

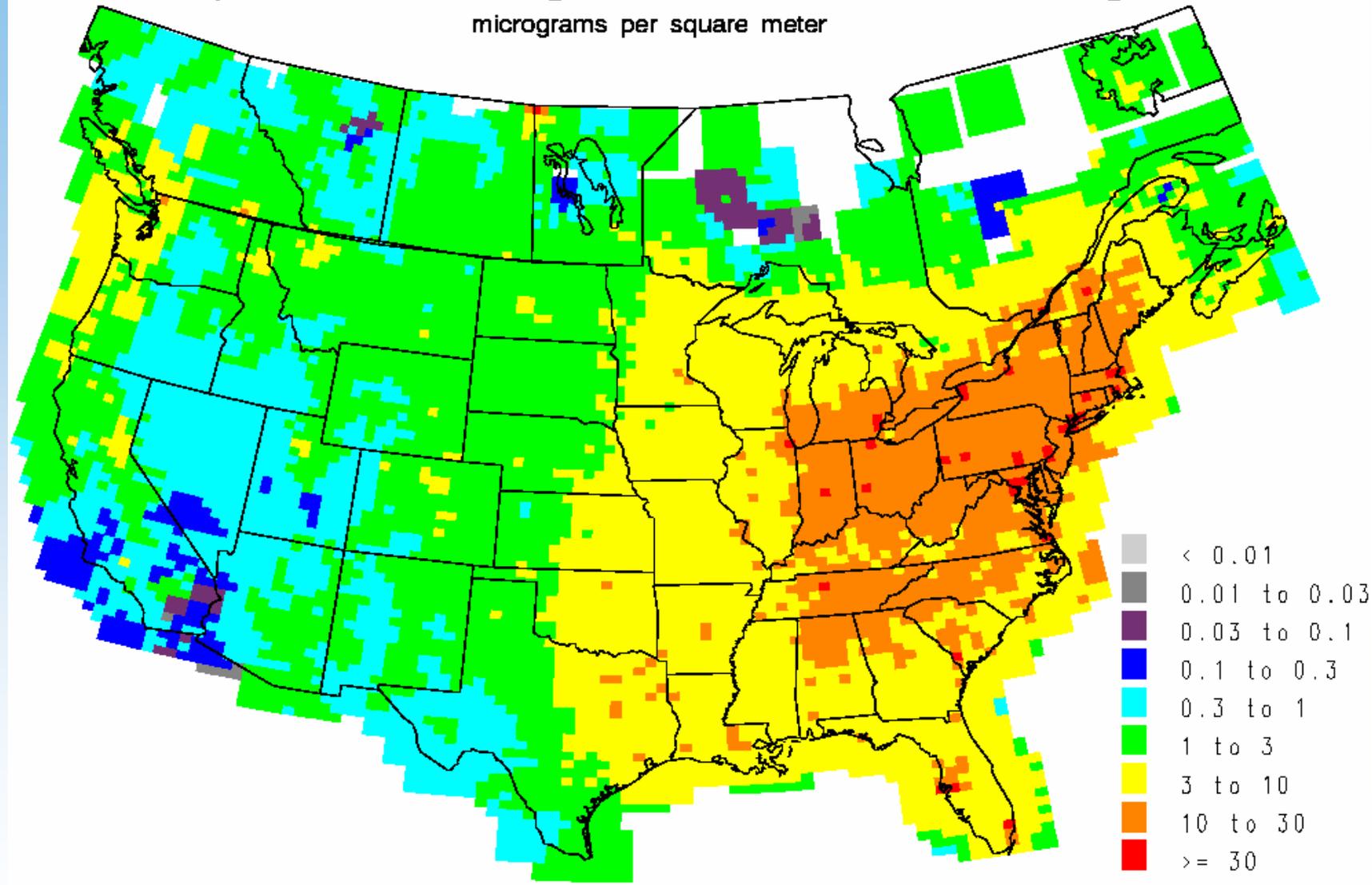
- ✓ Effects of urbanization on stream ecosystems
- ✓ Transport of contaminants to water-supply wells
- ✓ Mercury accumulation in aquatic organisms
- ✓ Sources and transport of agricultural chemicals
- ✓ Effects of nutrient enrichment on agricultural streams

Topical Studies planned for WMIC

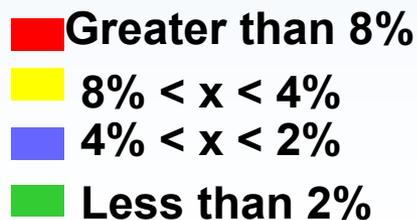
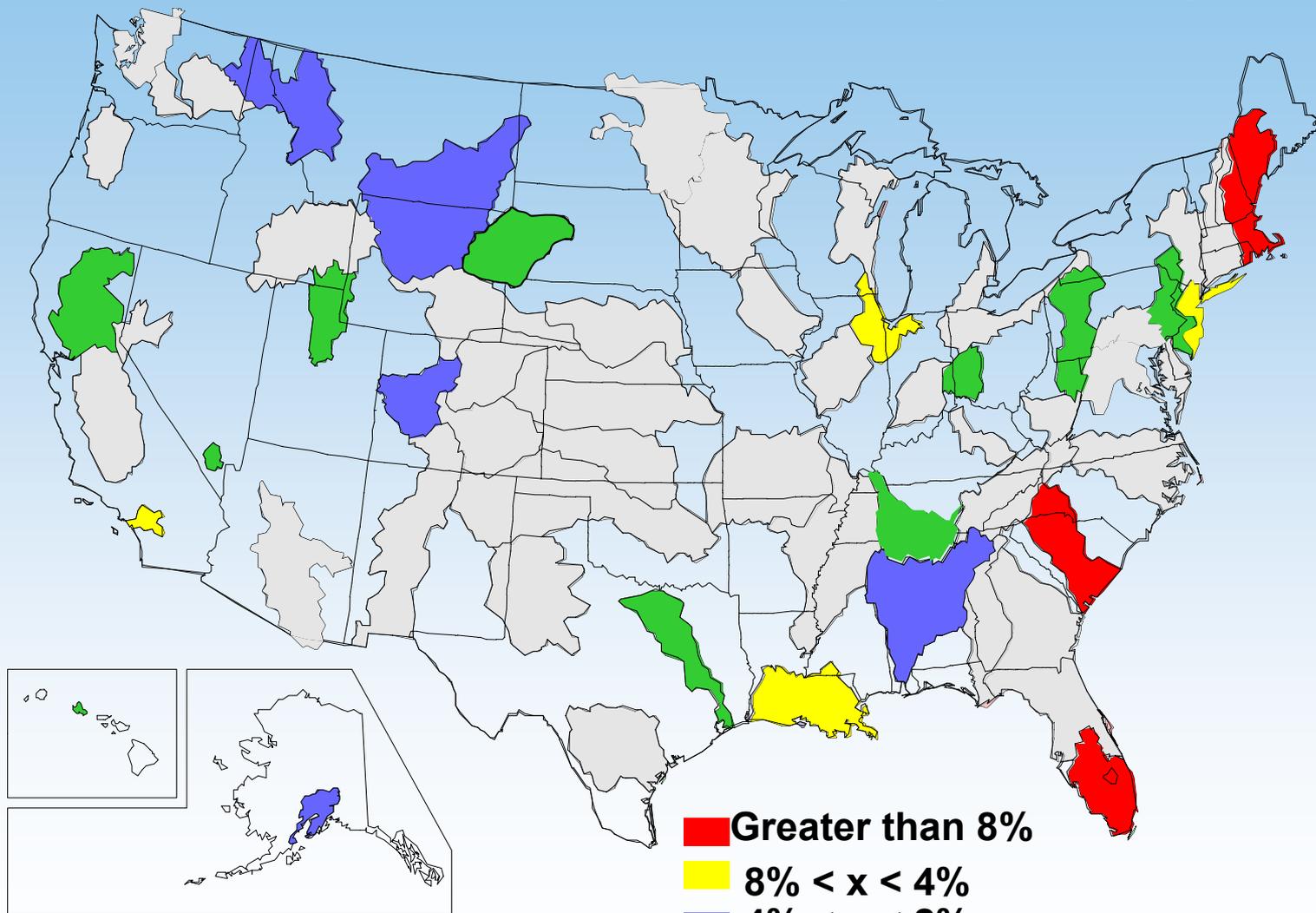
- ✓ 1 – Mercury Accumulation in Stream Ecosystems
 - ✓ **Source strength**
 - ✓ **Methylation efficiency**
 - ✓ **Sediment**
 - ✓ **Total and methyl mercury**
 - ✓ **Microbially-mediated methylation/demethylation**
 - ✓ **Food-web complexity**
 - ✓ **Gamefish (total Hg, stable isotopes)**
 - ✓ **Food chain organisms (total and methyl mercury)**

Wet Deposition – Total Hg from USA, Canada and Background

micrograms per square meter



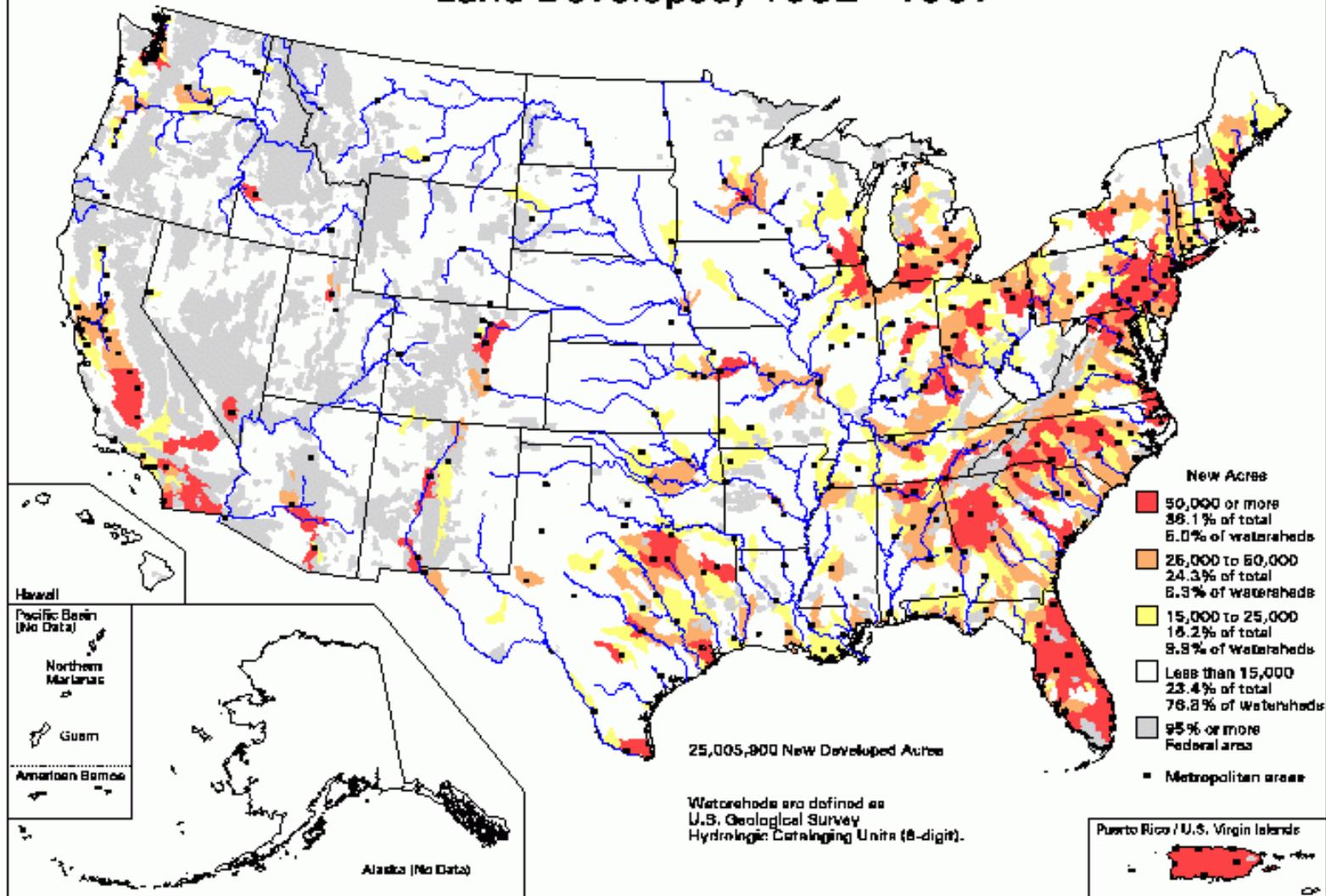
Methylation Efficiency (MeHg/HgT)



Topical Studies planned for WMIC

- ✓ **2 - Effects of Urbanization on Stream Ecosystems**
 - ✓ **Greater Milwaukee and Lower Fox River Valley – 2003 and 2004**
 - ✓ **About 30 sites**
 - ✓ **Nutrients, pesticides**
 - ✓ **Suspended sediment, bed sediment, sediment chemistry, SPMDs**
 - ✓ **Flow, habitat, fish, algae, invertebrates**

Land Developed, 1982 - 1997

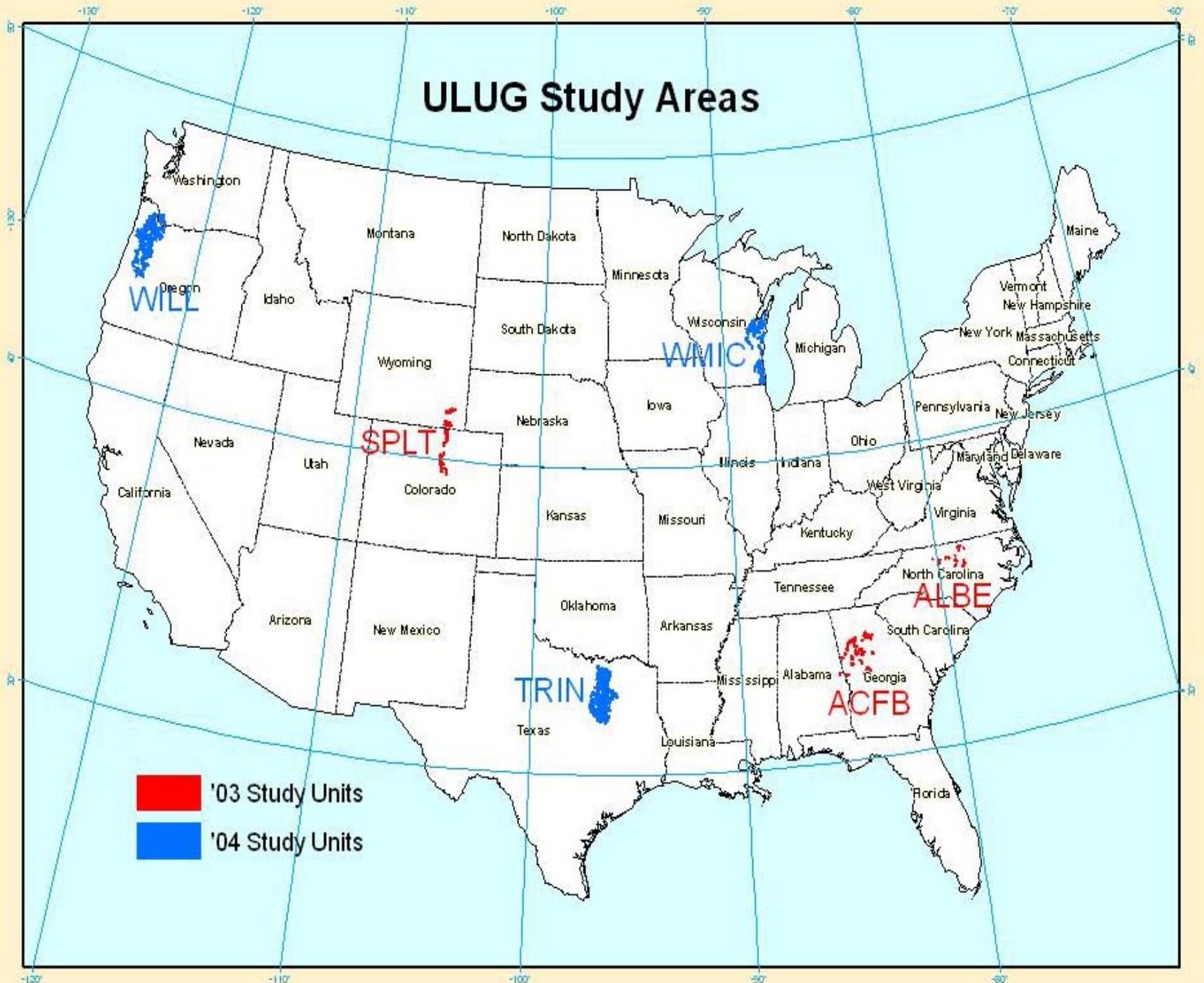


USDA NRCS U.S. Department of Agriculture
 Natural Resources Conservation Service
 Resource Assessment Division
 Washington DC January 2001

Map ID: m5008
 For proper interpretation, see Explanation
 of Analysis for this map at our web site. Search
 for "USDABOTL" to locate our map index.

Data Source: 1987 National Resources Inventory
 Revised December 2000

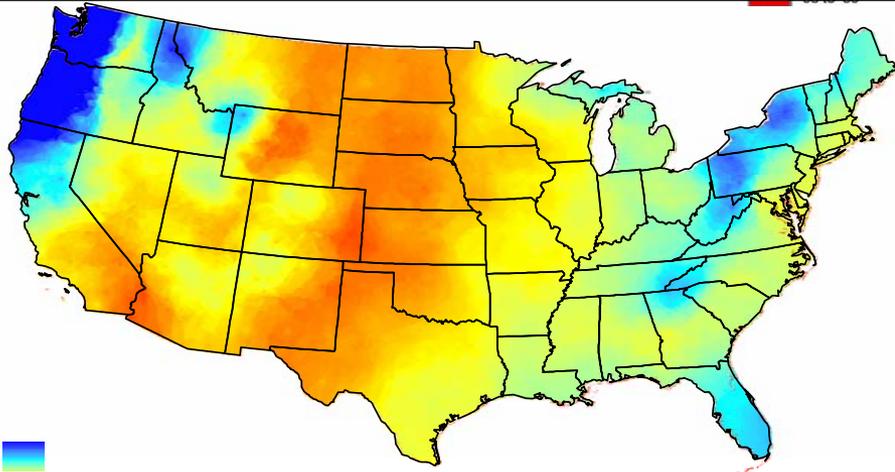
ULUG Study Areas



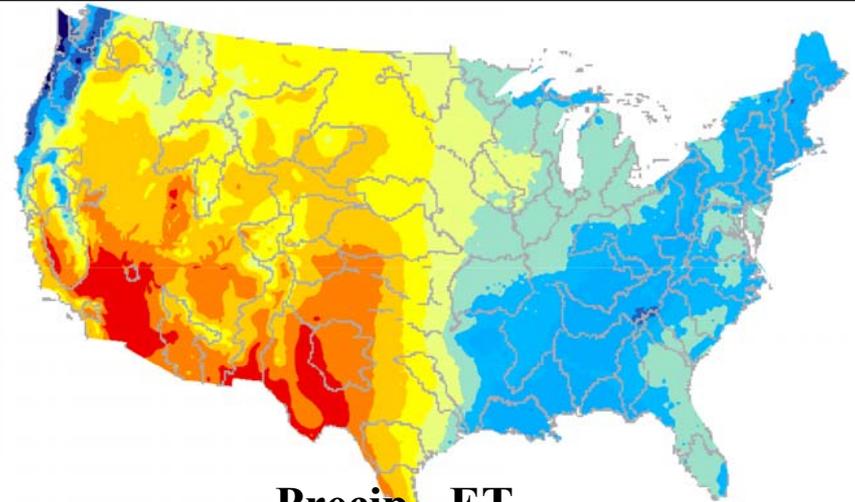
How do the *hydrologic, geomorphic, chemical, and biological* characteristics of stream ecosystems respond to land-use changes associated with urbanization? ...



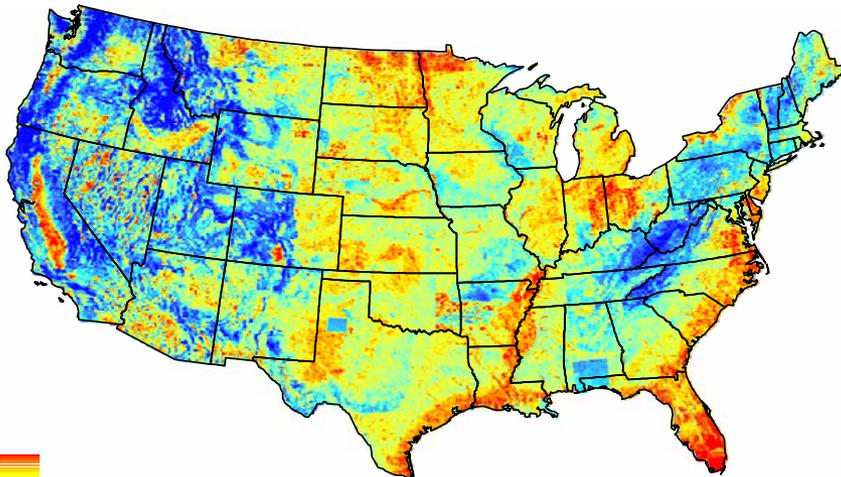
How do these urbanization *responses vary across environmental settings?*



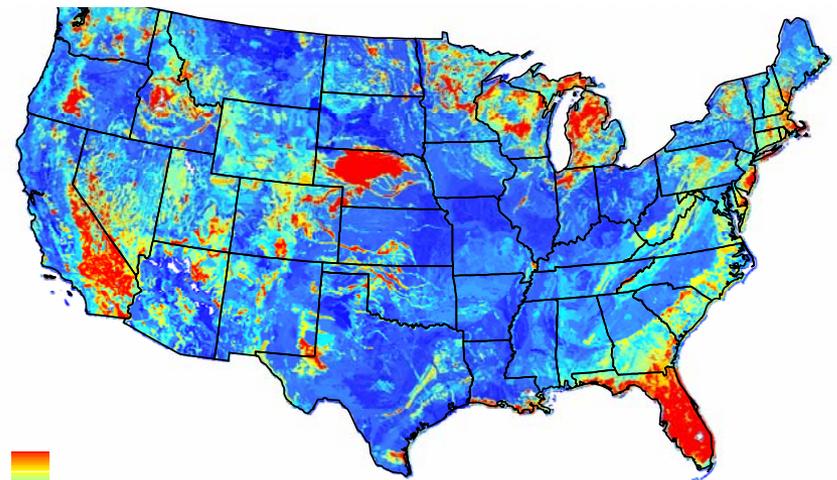
Consecutive wet days



Precip - ET



Slope



Soil permeability

Urbanization issues in the WMIC

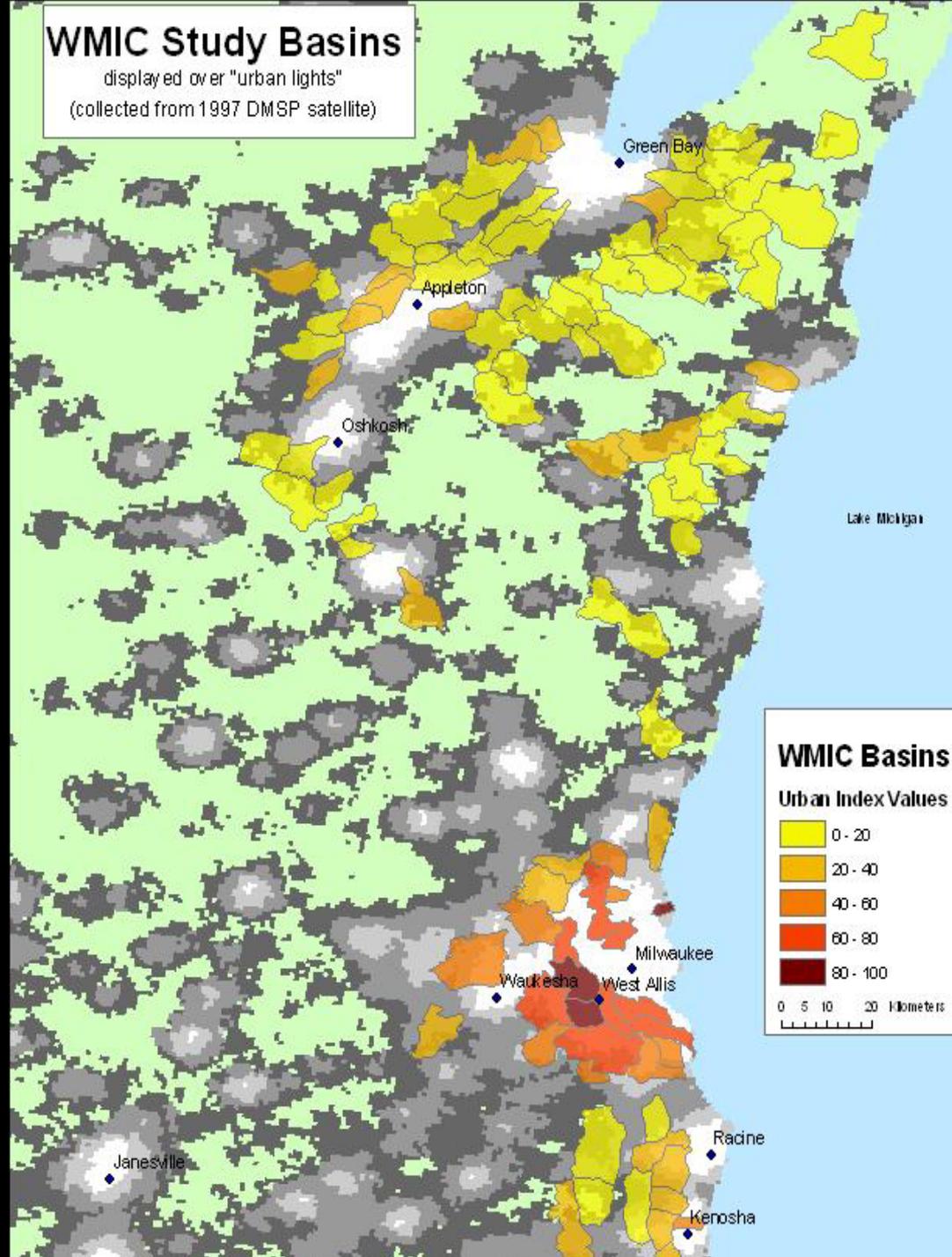
- Accelerated erosion, channel instability, and deposition of potentially contaminated sediments.
- Loss of aquatic habitat and degradation of biological integrity.
- Increases of peak flow, changes in peak durations and flood Volumes, loss of baseflow, reduced groundwater recharge.
- Increases in contaminant concentrations in water, sediment, and biota.

USA Today rated Appleton as having one of the highest urban sprawl indexes in the U.S. for cities less than 250,000 population

The Chicago/Milwaukee/Madison triangle is noted as losing farm land to urban sprawl more than any other location in the U.S.

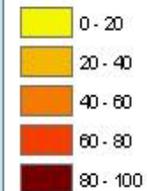
WMIC Study Basins

displayed over "urban lights"
(collected from 1997 DMSP satellite)



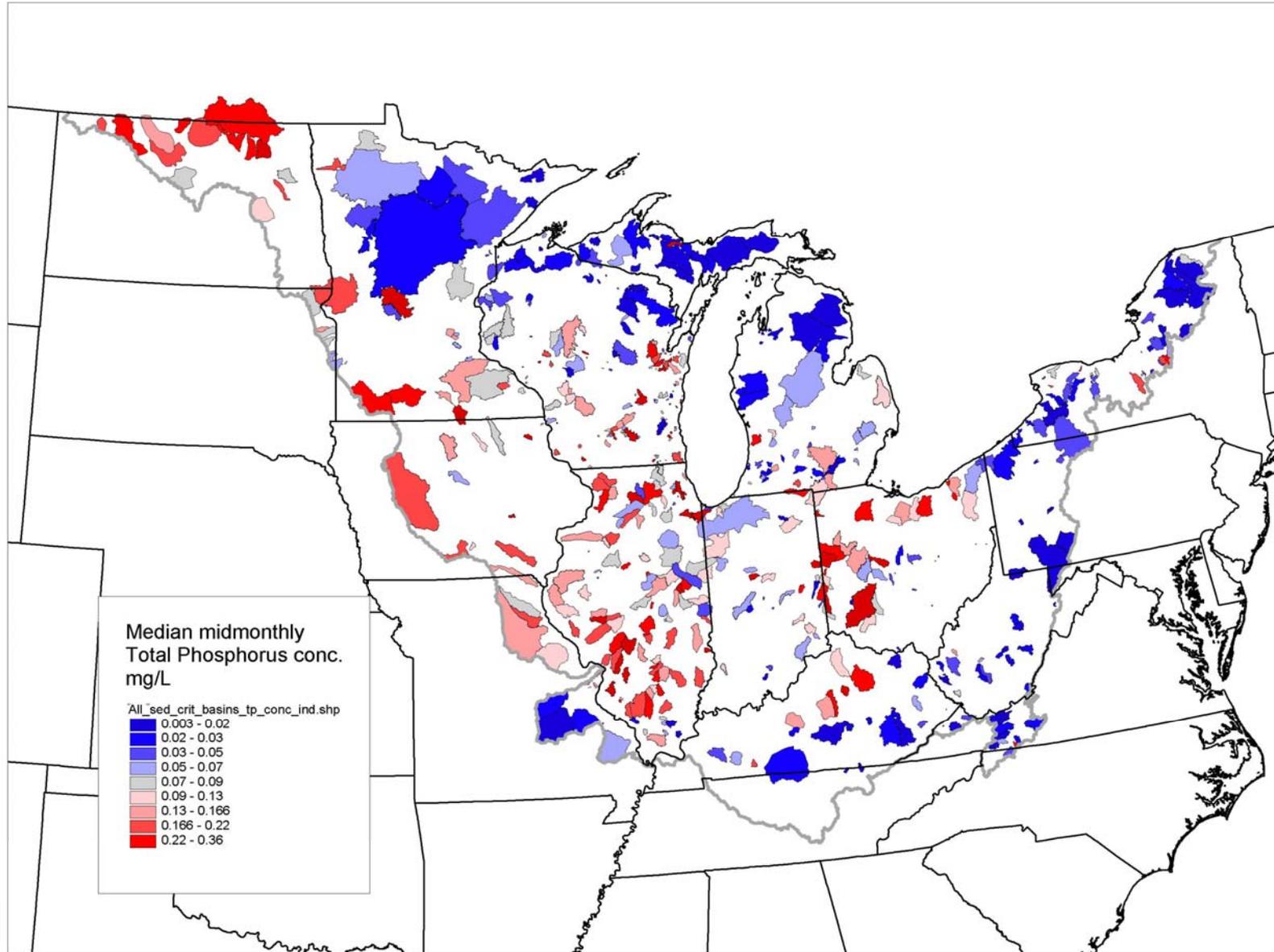
WMIC Basins

Urban Index Values



0 5 10 20 Kilometers

Water quality from over 1600 sites and corresponding basin characteristics are being used to delineate regions with similar potential water quality using Spatial Regression Tree Analysis (SPARTA)

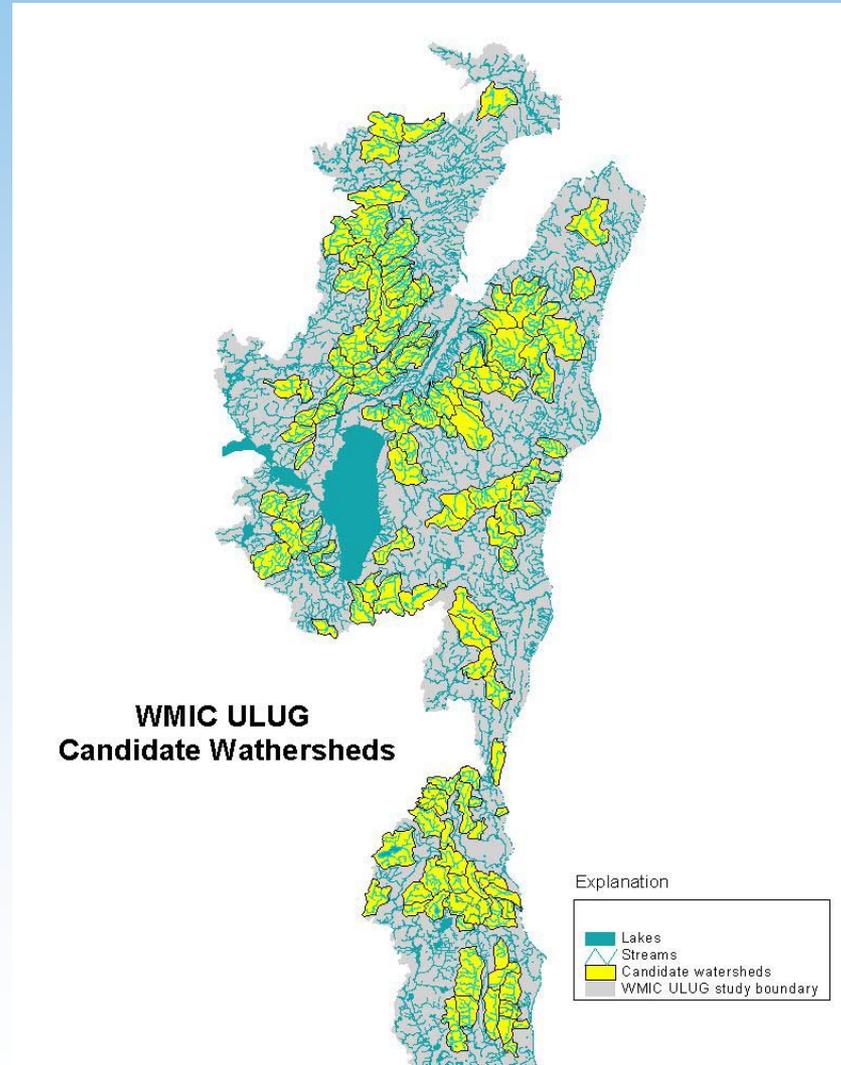


The end

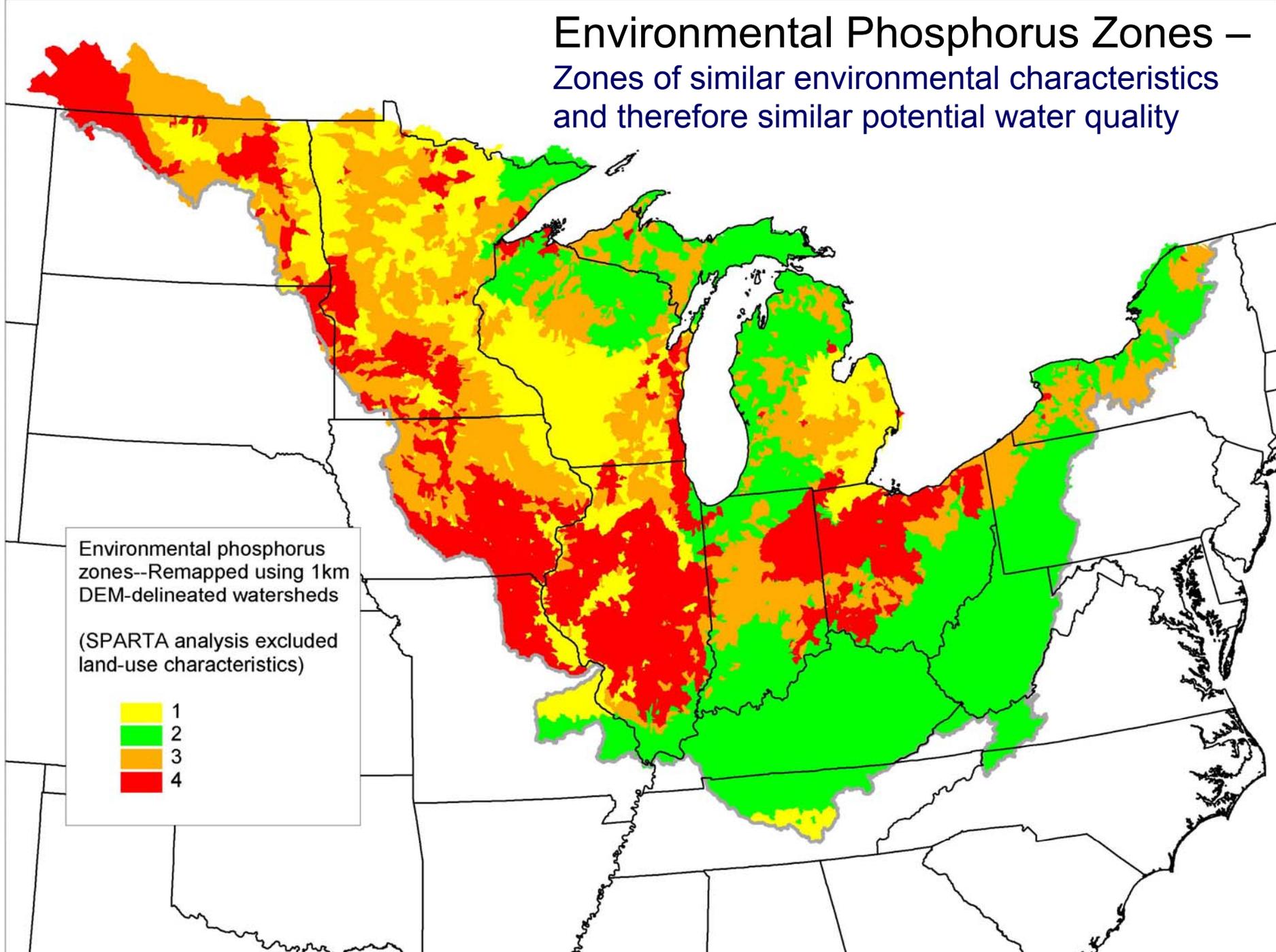
Post end

Resulting Candidate Watersheds

**Automated
Watershed
Delineation:
124
watersheds**



Environmental Phosphorus Zones – Zones of similar environmental characteristics and therefore similar potential water quality

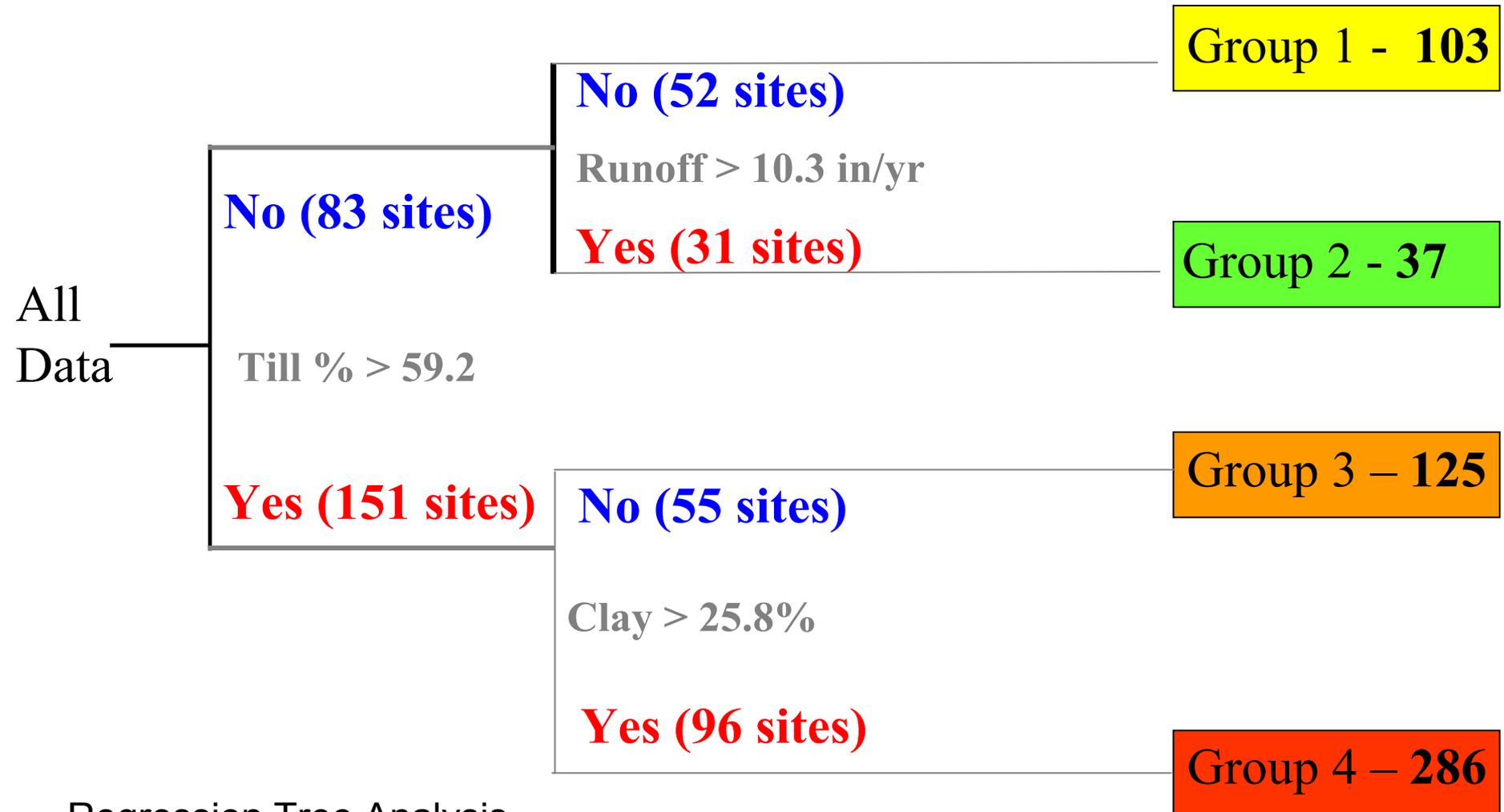


Environmental phosphorus zones--Remapped using 1km DEM-delineated watersheds

(SPARTA analysis excluded land-use characteristics)

- 1
- 2
- 3
- 4

**Group - Mean P
Conc. (µg/L)**



Regression Tree Analysis –
Determine most important environmental
characteristics and break points



Assessing the Chemical and Biological Integrity of Streams

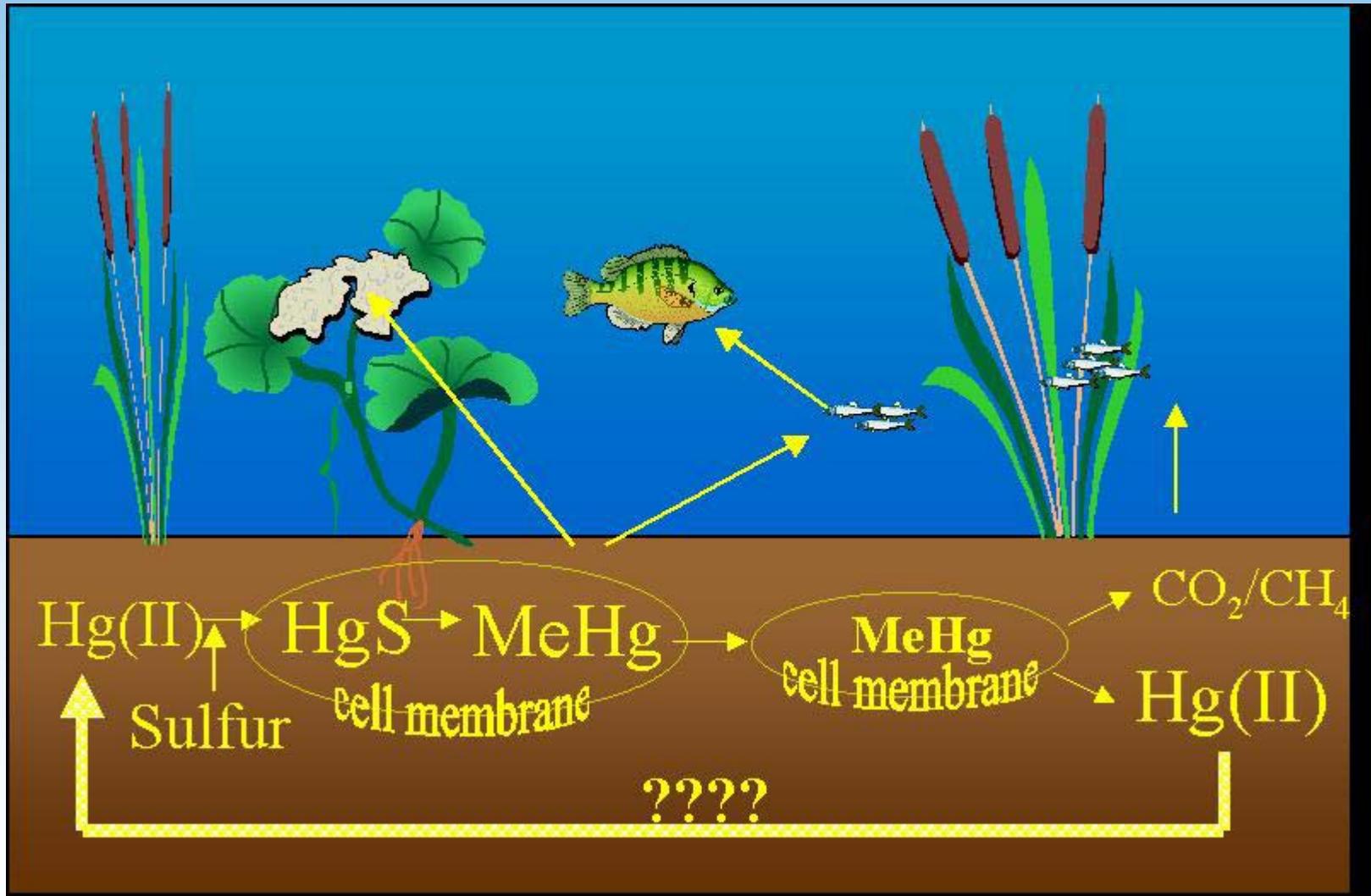
Dale Robertson

David Saad

David Graczyk

Wisconsin District

Mercury Methylation



Cycle 2 (2001 – 2010)

Study Units (42)

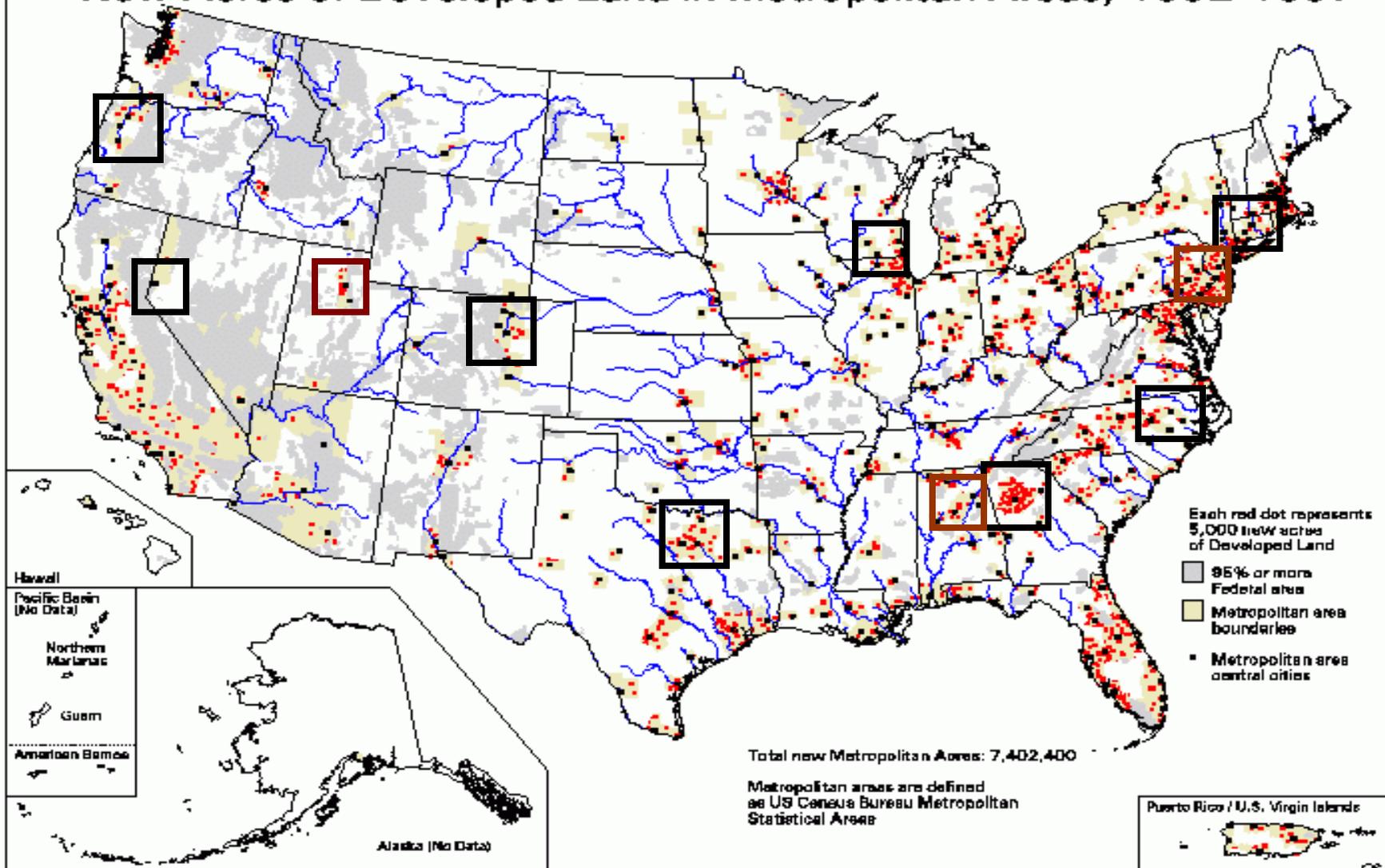
- ✓ **Ensure coverage of most important contaminant source areas (agriculture, urban, natural)**
- ✓ **Ensure adequate coverage of 16 principal aquifers**
- ✓ **Ensure coverage of > 50% of drinking water use**
- ✓ **Ensure coverage of most critical biological resources**

Cycle 1 (1991 – 2000)

Study Units (52)

- ✓ 60-70% of water use and population
- ✓ More than 50% of the land area
- ✓ Even coverage of the Nation in terms of
 - ✓ geographic region
 - ✓ hydrologic and climatic setting
- ✓ Include the programs of other major Federal agencies
- ✓ Represents a wide array of water-quality concerns

New Acres of Developed Land in Metropolitan Areas, 1992-1997



High Funding

Low Funding

20 sites

High baseflow
Low base flow

17 sites

10 sites

High baseflow
Low baseflow
+ 4 to achieve bimonthly

8 sites

Reduced
coverage of
constituents

			HIGH FUNDING		LOW FUNDING	
Water (high and low base, bimonthly)			20	10	17	8
Major Ions	2701	122.21	2	2	2	2
Nutrients	2711	59.50	2	6	2	6
Pesticides	2002.5	330.00	2	6	2	6
DOC	LC 2613	38.00	2	6	2	6
TPC, PIC, POC, TPN	2631	61.20	2	6	2	6
Wastewater cmpds	8033	300.00	2	2	1	1
Pharmaceuticals	9003	350.00	2	2	0	0
Indicator Bacteria	DIST	25.00	2	6	2	6
Fecal coliform	DIST	25.00	2	6	2	6
Suspended Sediment	DIST	30.00	2	6	2	6
Stable Isotopes	NRP	50.00	2	8	2	4
SPMD-extracts (deployed prior to ecology sampling)						
SVOCs and PAHs	8026	231.00	1	1	0	1
Organochlorines	8378	331.00	1	1	0	1
Toxicity (dollars from BRD)	BRD	0.00	1	1	0	1
Bed Sediment (once at low base flow)						
Organics (custom)	LC8375	1,040.00	1	1	0	1
Metals	GD	250.00	1	1	0	1
Suspended Sediment (event sampling at 8 sites only)						
Organics (custom)	LC8375	1,040.00	0	3	0	3
Metals	GD	250.00	0	3	0	3
Ecology (index period varies by study unit)						
RTH Invertebrates	2172	725.76	1	1	1	1
QMH Invertebrates	2176	528.00	1	1	1	1
RTH Algae	PAS	450.00	1	1	1	1
Chlorophyll A / biomass	1632	117.52	1	1	1	1
DTH Algae	PAS	450.00	1	1	1	1
Fish Community			1	1	1	1
Habitat			1	1	1	1
Physical (continuous)						
Stage / Temp	Probe	1,000.00	1	1	1	1
Conductivity	Probe	1,400.00	0	1	0	1



Water Quality Concerns in WI

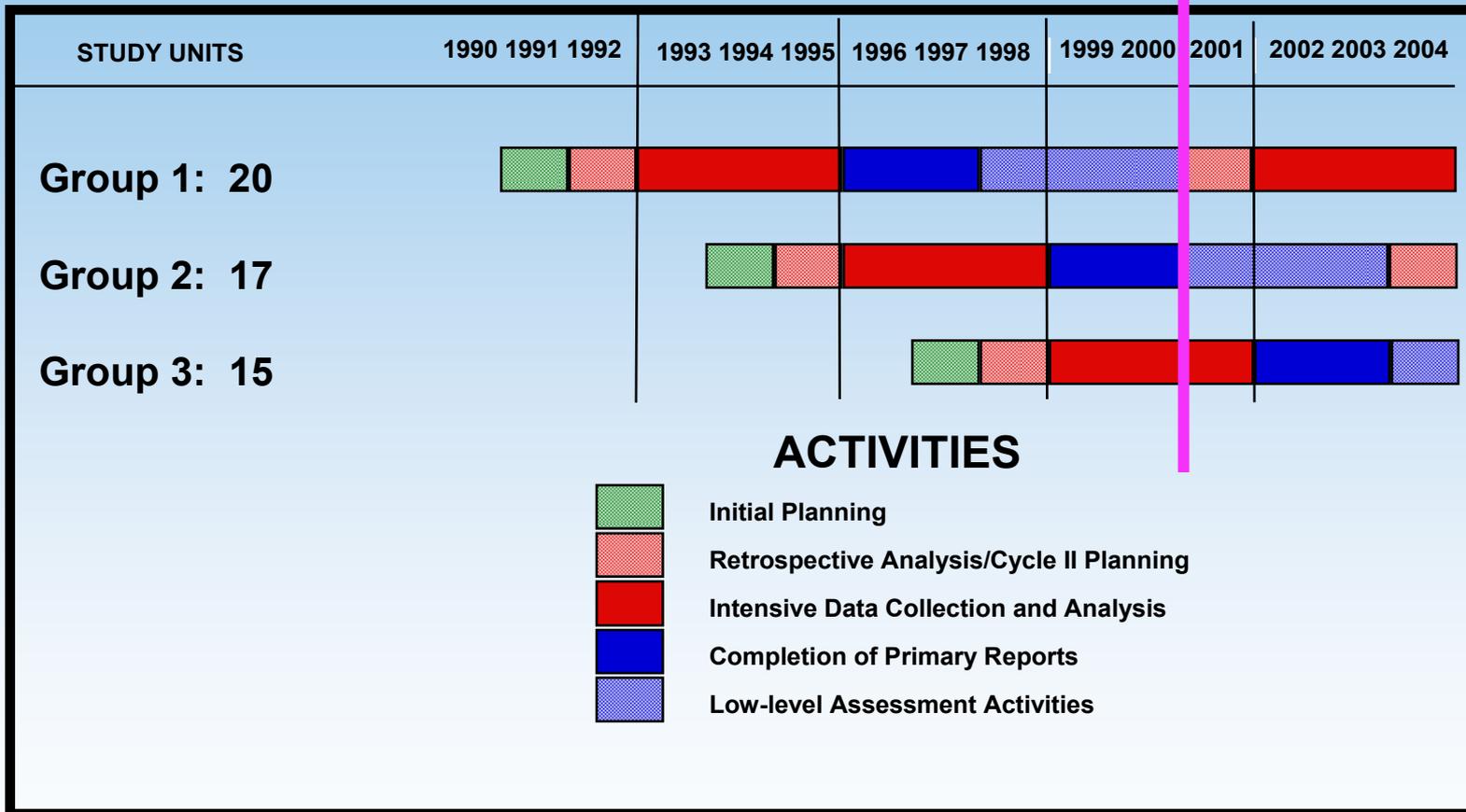
- **Nutrient enrichment/runoff management practices.**
- **Pesticides in ground and surface water**
- **Hg in water and biota (addressed by hg topical)**
- **Urbanization (addressed by urban topical)**

QW Concerns Not Addressed by NAWQA Data Collection

- **Bacteria contamination/closings of beaches.**
- **Bacteria contamination of water supplies**
- **Dioxins—relationship to dwindling lake trout population in lake Michigan**
- **Endocrine disruptors, wastewater compounds, Personal care products, pharmaceuticals**

NAWQA Cycle 1

Cycle II Begins



NAWQA Cycle 2

