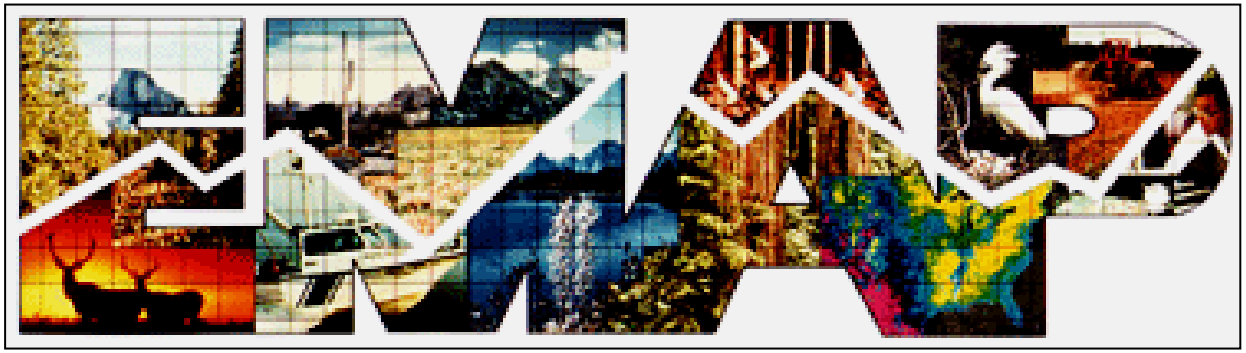
Presented at

Great Rivers Reference Condition Workshop

January 10-11, Cincinnati, OH

Sponsored by

The U.S. Environmental Protection Agency and The Council of State Governments



Environmental Monitoring and Assessment of Great River Ecosystems (EMAP-GRE)

Improving the science and practice of assessing Great River Ecosystems

US EPA Office of Research & Development

National Health & Environmental Effects Laboratory

Mid-Continent Ecology Division Duluth, MN

http://www.epa.gov/emap/greatriver

RESEARCH & DEVELOPMENT

Building a scientific foundation for sound environmental decisions

Why EMAP Great River Ecosystems?

- **Legislative mandates**
  - **Clean Water Act & Government Performance and Results Act. Arguably, these are minor drivers of river management compared to navigation, flood control, hydropower, recreation, habitat restoration, and endangered species.**
- **EMAP adds value**
  - **Contributes to diverse assessment needs through research and demonstrations of scaleable sampling designs that produce statistically-robust data.**
  - **EMAP designs and ecological indicators yield baseline statements of condition and characterizations of reference conditions.**
  - **The ability to measure condition is fundamental to adaptive management.**

Goals

Develop, demonstrate, and transfer methods to make consistent, unbiased, cost-effective condition assessments for the Ohio, Missouri, and Upper Mississippi Rivers.

What are the current water quality and biological conditions?

Are conditions changing?

Are conditions associated with management or restoration activities?

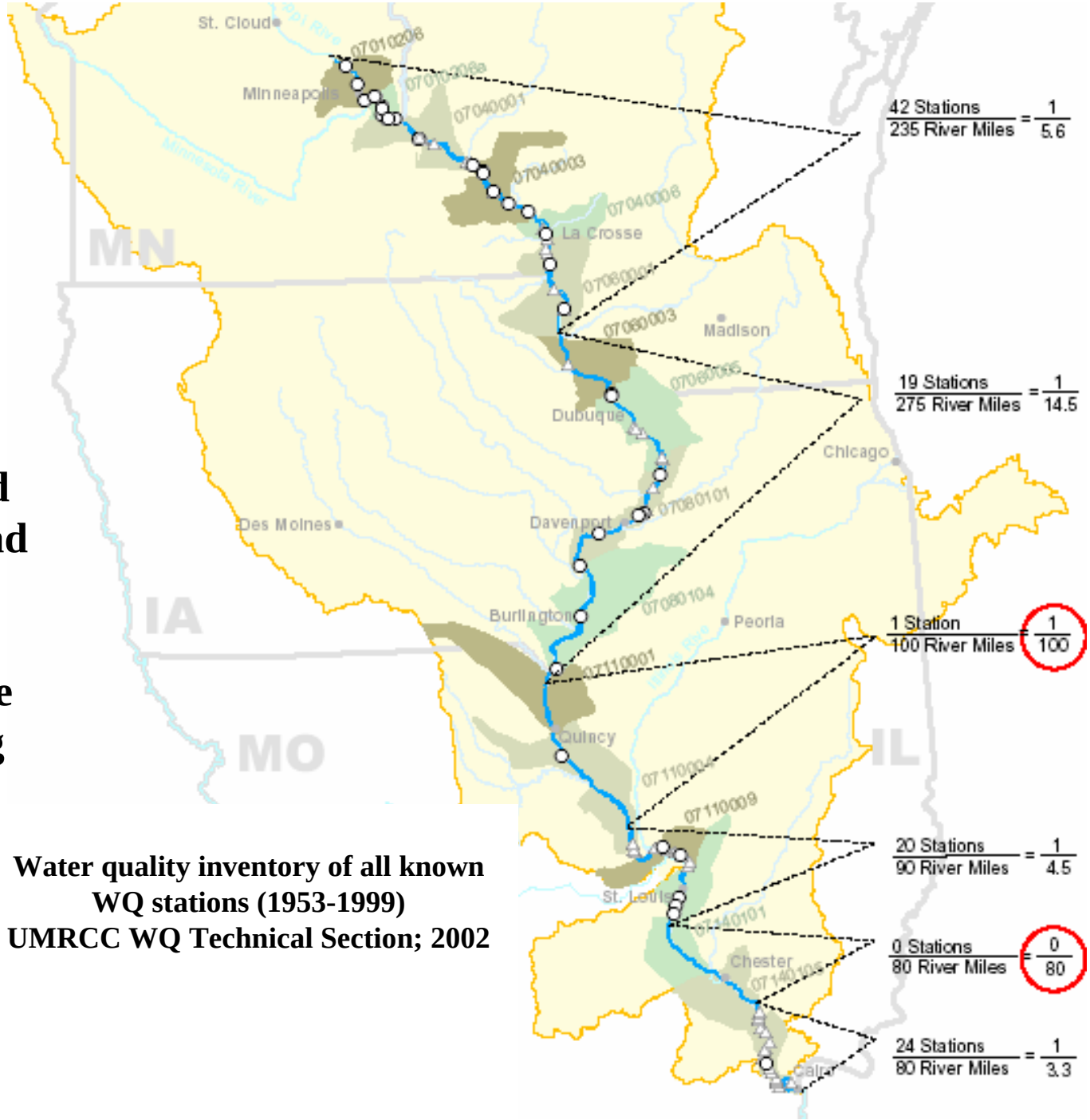
Guiding Principles

CWA reports for large interstate rivers are inconsistent and based on inadequate and inappropriate data.

Biology integrates environmental stresses.

But, don't we know a lot about these rivers already?

No, *ad hoc*, targeted, and selected-pool approaches have yielded spatially, temporally, and methodologically scattered WQ monitoring data that are inadequate for assessing river systems.



Water quality inventory of all known WQ stations (1953-1999)
UMRCC WQ Technical Section; 2002

EMAP Approach

Designs

Status (Trends)

Variance Estimation

Panel Rotation

Variable Density Approaches

Spatial Balance

Frame Development

Population Identification

Indicators

Bioassessment Framework

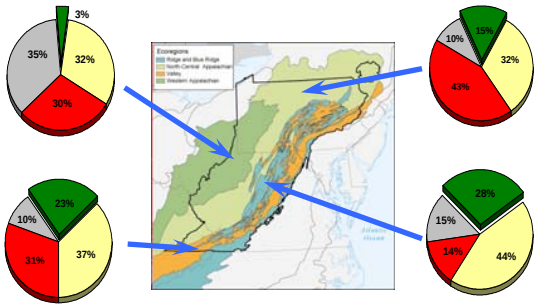
Reference Condition

Regionalization

Calibration

Construction

Assessments



Analysis

Data

Field Sampling

Training

Partnerships

EMAP Question

What % (±error) of [resource] in [unit] is in [condition] as indicated by [indicator] ?

Water quality assessments

What % (±) of the Ohio River main-stem in KY is impaired by nitrate?
What % (±) of the Mississippi River main-stem in MN is impaired by turbidity?

Management & restoration

What % (±) of the Mississippi River backwaters in IL is good duck habitat?
What % (±) of the Missouri River rip-rapped shorelines in MO has fish assemblages dominated by native species?

Bioassessments

What % (±) of the Missouri R in NE has benthos taxa dominated by tolerant taxa?
What % (±) of the Mississippi River main-channel in WI is clear enough to support the growth of SAV?

EMAP (& other programs):

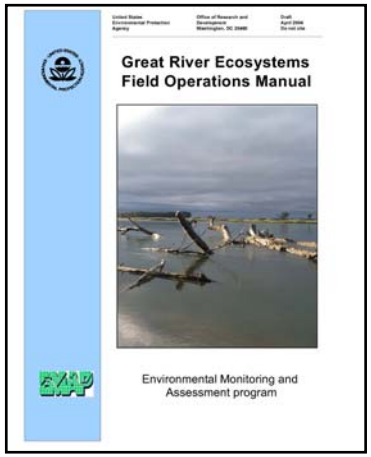
Questions are explicit.
Results are spatially nested.
Assessments over time yield trends.

EMAP-GRE Partners

Upper Missouri River	Lower Missouri River	Upper Mississippi River	Ohio River	Analyses
USGS North Dakota & Montana District Offices; North Dakota Dept Health EPA Region 8	USGS Missouri, Iowa, Kansas, Nebraska District Offices; Missouri Dept of Conversation; Nebraska Game & Fish Commission EPA Region 7	USGS UMESC Wisconsin DNR Minnesota DNR Minnesota PCA Iowa DNR Illinois Natural History Survey Missouri Dept Conservation EPA Regions 5 & 7	EPA NERL EPA Region 3 EPA Region 4 EPA Region 5 ORSANO	University of Louisville Stroud Water Center Southwest Missouri State University USGS UMESC EPA NERL EPA MED EPA MED, WED, & contract staff University of Minnesota

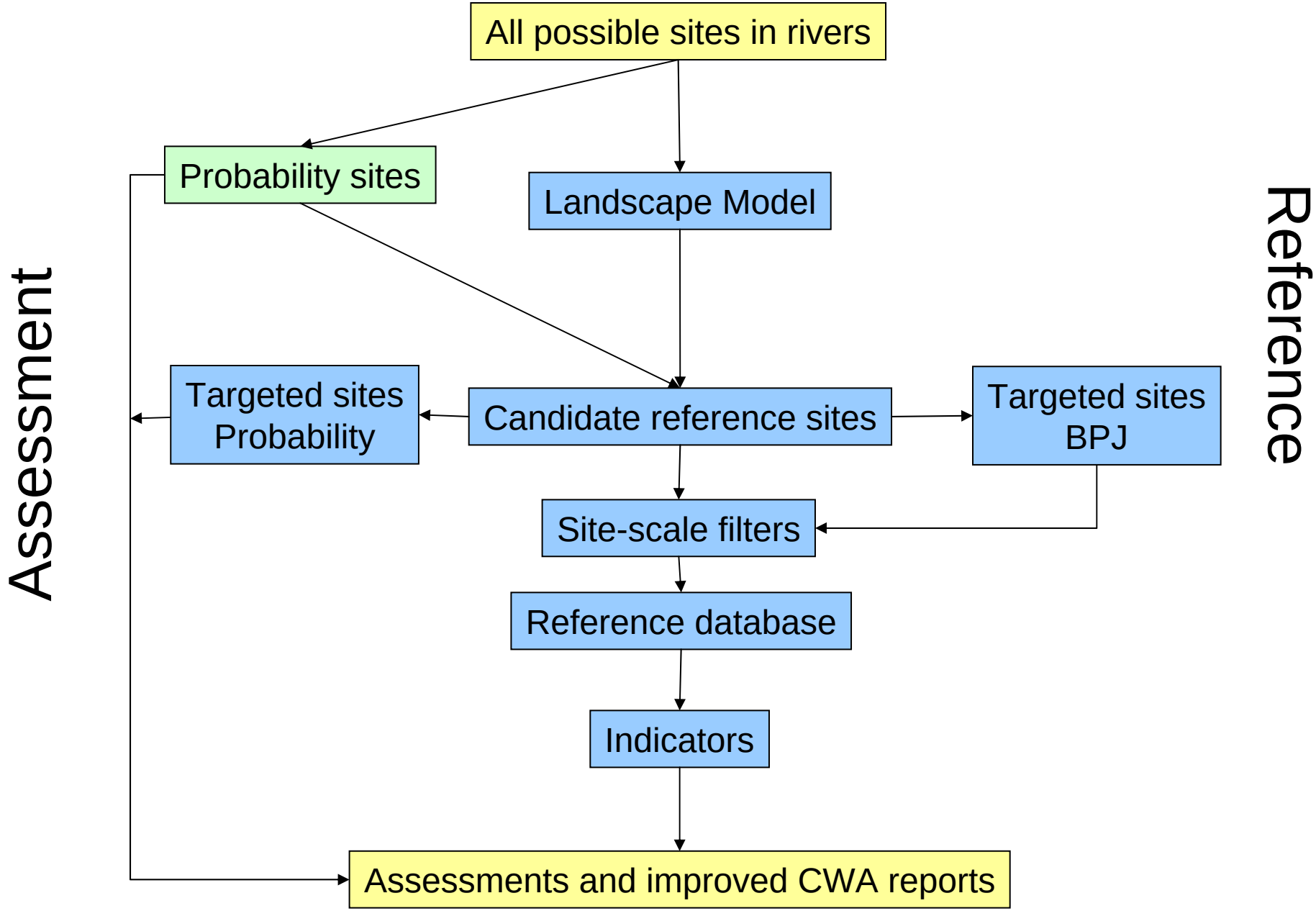
Program Components

Field Operations Manual



Sample Analysis
Data Analysis
Design Support
Training
Information Management

Assessment Approach



EMAP-GRE

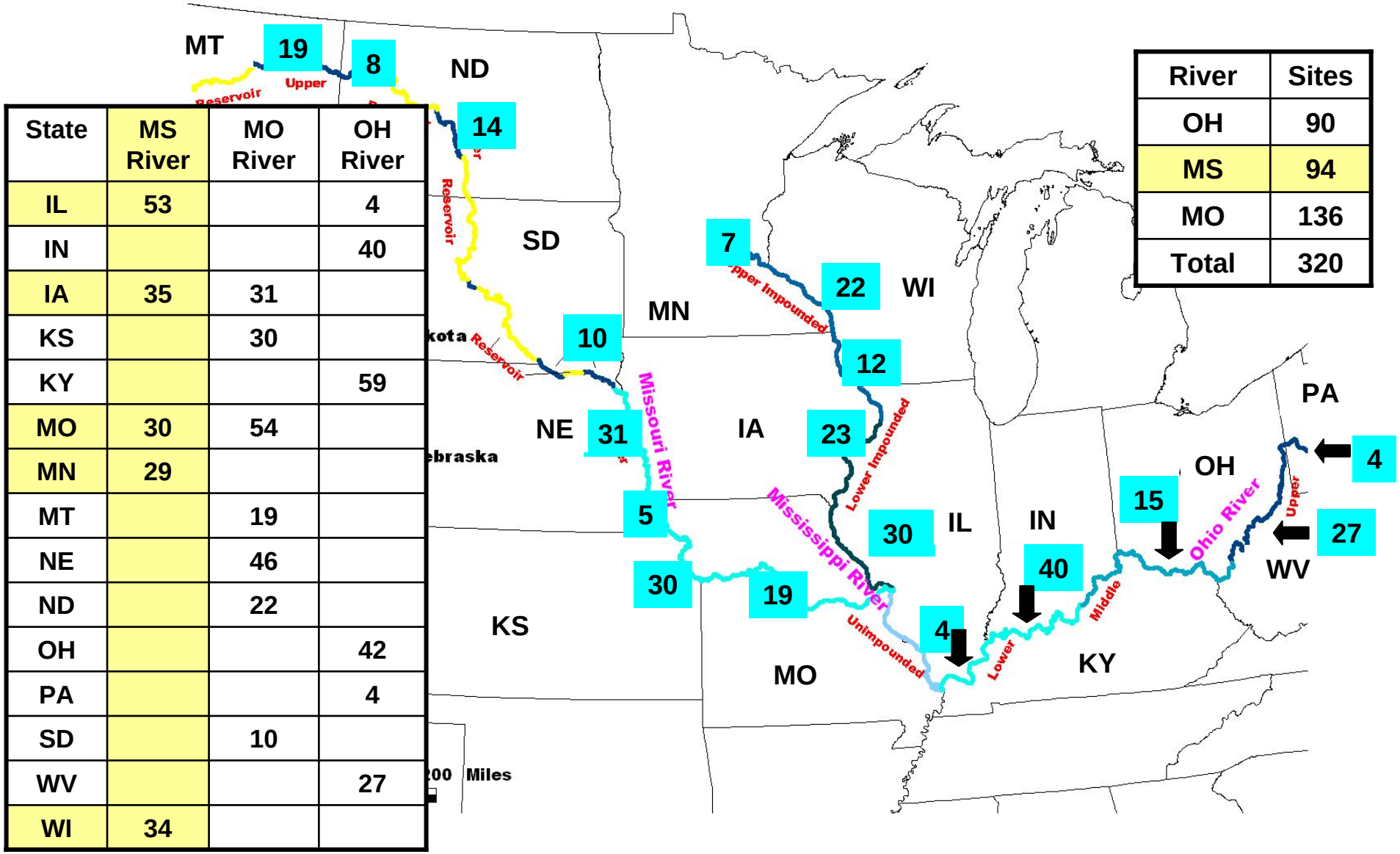
- Probability design based on National Hydrologic Data.
- Missouri River reservoirs were excluded.
- Target shoreline is randomly selected.
- Nominal minimum sample size is 30 sites for river within a state. Data aggregation depends on sample size.
- Limitations
  - Only main-channel and main-channel shorelines sampled.
  - No loading estimates.
  - Sampling done independent of hydrograph.

Methods characterize sites.

Designs characterize populations.

Base EMAP-GRE Design

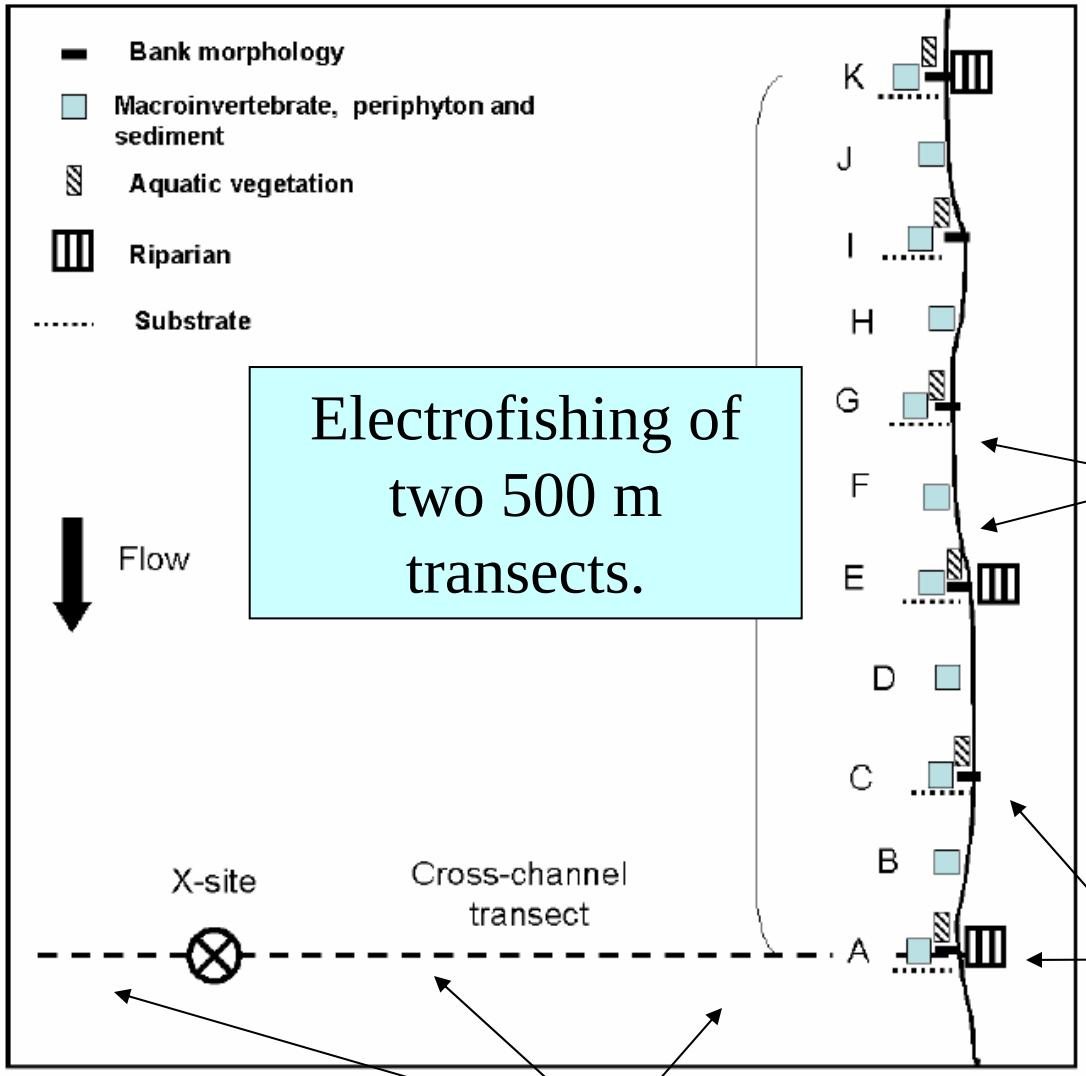
Number of sites in river sections



River	Sites
OH	90
MS	94
MO	136
Total	320

State	MS River	MO River	OH River
IL	53		4
IN			40
IA	35	31	
KS		30	
KY			59
MO	30	54	
MN	29		
MT		19	
NE		46	
ND		22	
OH			42
PA			4
SD		10	
WV			27
WI	34		

EMAP-GRE field methods



Electrofishing of two 500 m transects.

Composite benthos, sediment, and periphyton samples, and habitat data collected at 50 m intervals.

Aquatic and riparian vegetation, and bank morphology data collected at 100 m intervals.

Composite water chemistry, phytoplankton, zooplankton, DO, turbidy samples

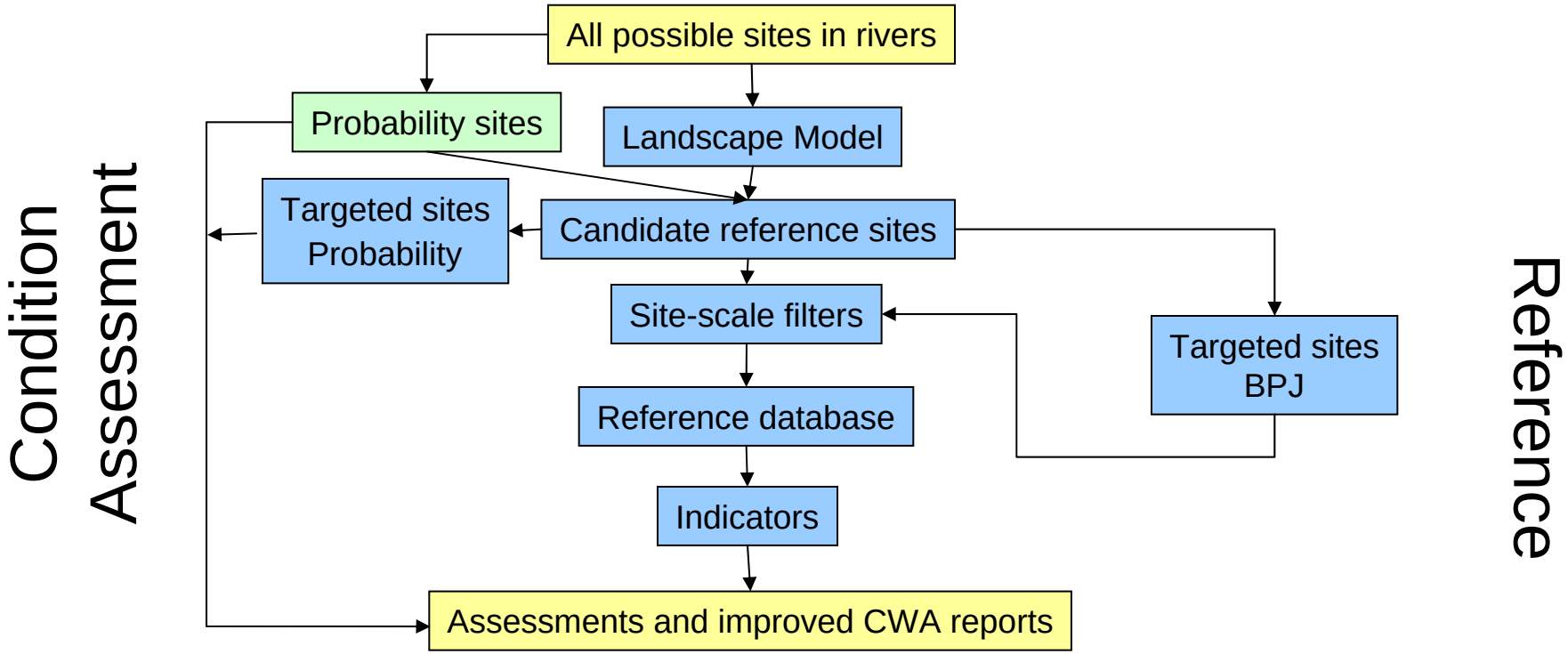
Metrics and Indicators for EMAP-GRE

- **Water Quality**
  - Dissolved oxygen
  - Dissolved N (NO_x, ammonia)
  - Conductivity
  - pH
  - Metals (As, Pb, Se, CU, Fe, Ni)
  - Temperature
  - Anions & Cations
  - Turbidity, suspended matter
  - Alkalinity
  - Total & Dissolved P, N, & C
  - Elemental particle analysis
  - Particulate stable isotopes
  - Chlorophyll
- **Sediment**
  - Enzyme activity
  - Toxicity
  - Total and volatile matter
  - Chemistry
- **Biotic Assemblages**
  - Fish
    - Tissue contaminants
    - DNA
  - Invertebrates
    - Littoral benthos
    - Snags
  - Zooplankton
  - Phytoplankton
  - Periphyton
  - Submersed aquatic vegetation
- **Habitat**
  - Littoral
    - Vegetation cover
    - Substrate
    - Woody debris
  - Riparian
    - Vegetation cover
    - Invasive/exotic species

Indicators, standards, biocritiera, and reference conditions are not well developed for great rivers.

EMAP-GRE & Reference Condition

- Reference data are needed to move from *statements* of condition ("This is what we found") to *assessments* of condition ("What we found was good.").
- An empirical Least Disturbed Conditions works for EMAP because consistent methods are used over entire system and the entire range of conditions is sampled.
- Reference approaches are not universally accepted. Multiple and diverse reference expectations necessitates multiple and diverse approaches.



Next steps for EMAP-GRE

- **Expand the approach to new user-defined assessment units and resource types.**
  - **New resource types: off-channel habitats, floodplains, and tributaries.**
  - **New units: Lower Mississippi River and large coastal rivers.**
- **Work with regional & multi-state partners to produce data, designs, reference conditions, and indicators that transcend political and temporal boundaries and are meaningful for system-wide management goals.**
- **Promote, through successful science, legitimate advocates of integrated monitoring of great rivers.**