Environmental Monitoring and Assessment Program Great River Ecosystems (Great Rivers EMAP)

David Bolgrien

Ted Angradi, Brian Hill, Jack Kelly, Janet Keough, Billy Schweiger

EPA Office of Research & Development

Mid-Continent Ecology Division

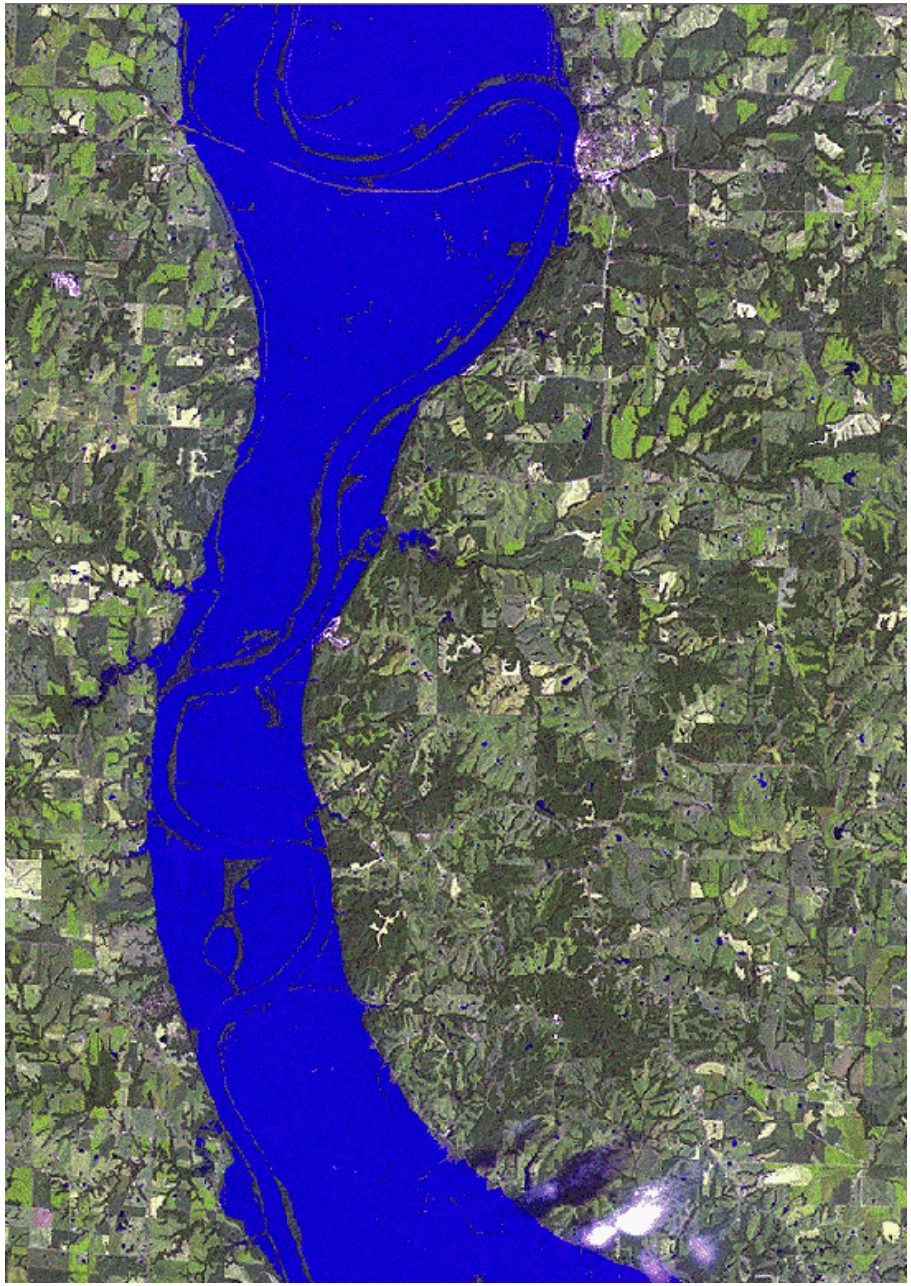
Duluth, MN

RESEARCH & DEVELOPMENT

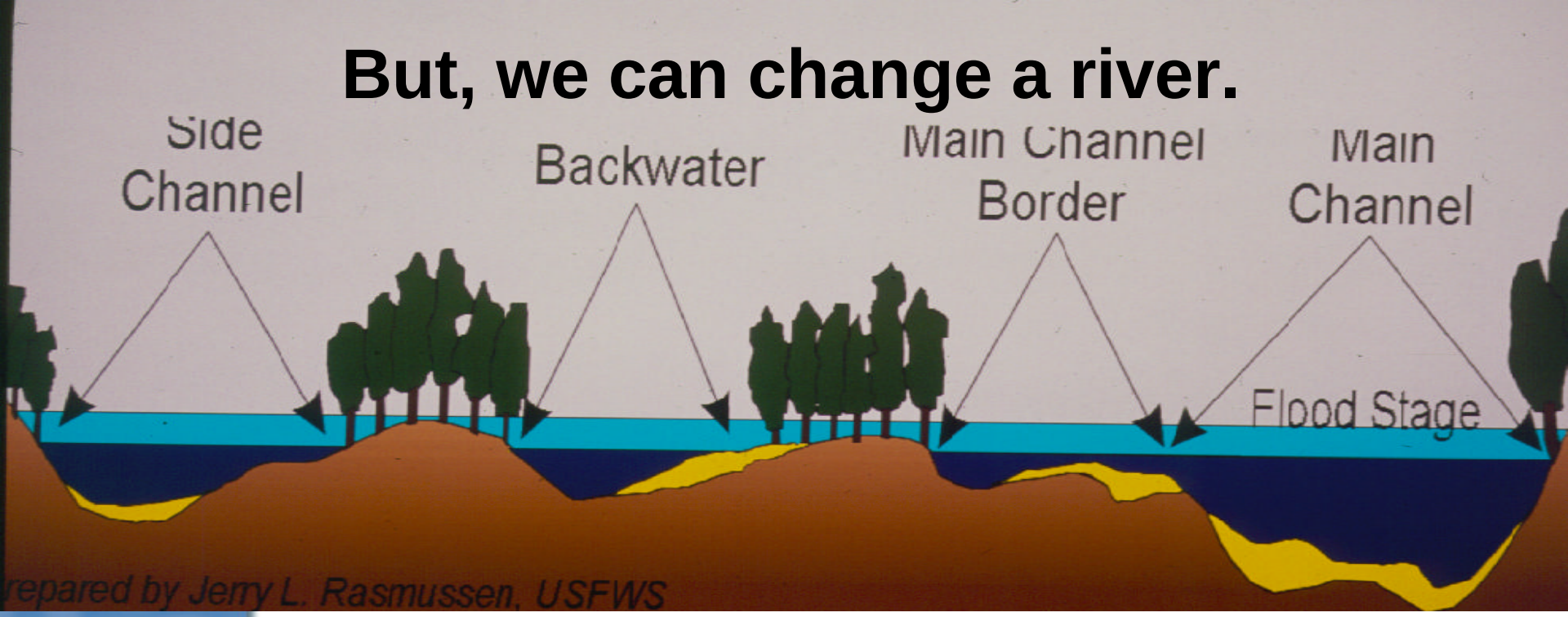
Building a scientific foundation for sound environmental decisions

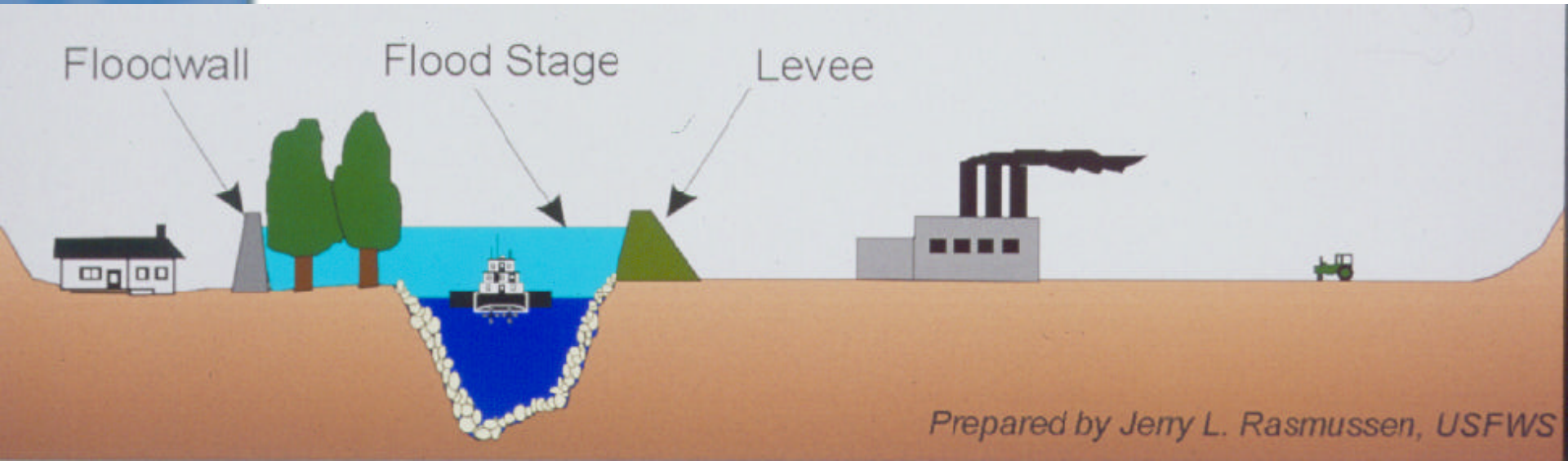
We can change a river.

Sometimes it changes back



But, we can change a river.





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Changes make Great Rivers the epitome of multiuse resources.

Uses

- Power production
- Navigation
- Irrigation
- Water supply
- Water quality
- Flood control
- Recreation
- Wildlife
- Commercial harvests

Impacts

- Flows reduced & shifted later in season.
- More clear and cool water.
- Static channels.
- Static riverbed.
- Disconnected & developed floodplains.
- Disconnected reaches.
- Altered food chains.

Multiple uses means responsibility to manage.

Management needs data. DaData begets informed management.

- Census
  - Maybe point-sources or dischargers
  - NPDES
- Rotations
  - Dense/ targeted coverage
  - NAWQA
- Reactionary
  - Specific to site, time, parameters
  - Spill response
- Fixed stations
  - Loading & trends
  - NASWQAN
- Probability
  - Flexible, defined coverage
  - LTRMP, ORSANCO, EMAP
- Models

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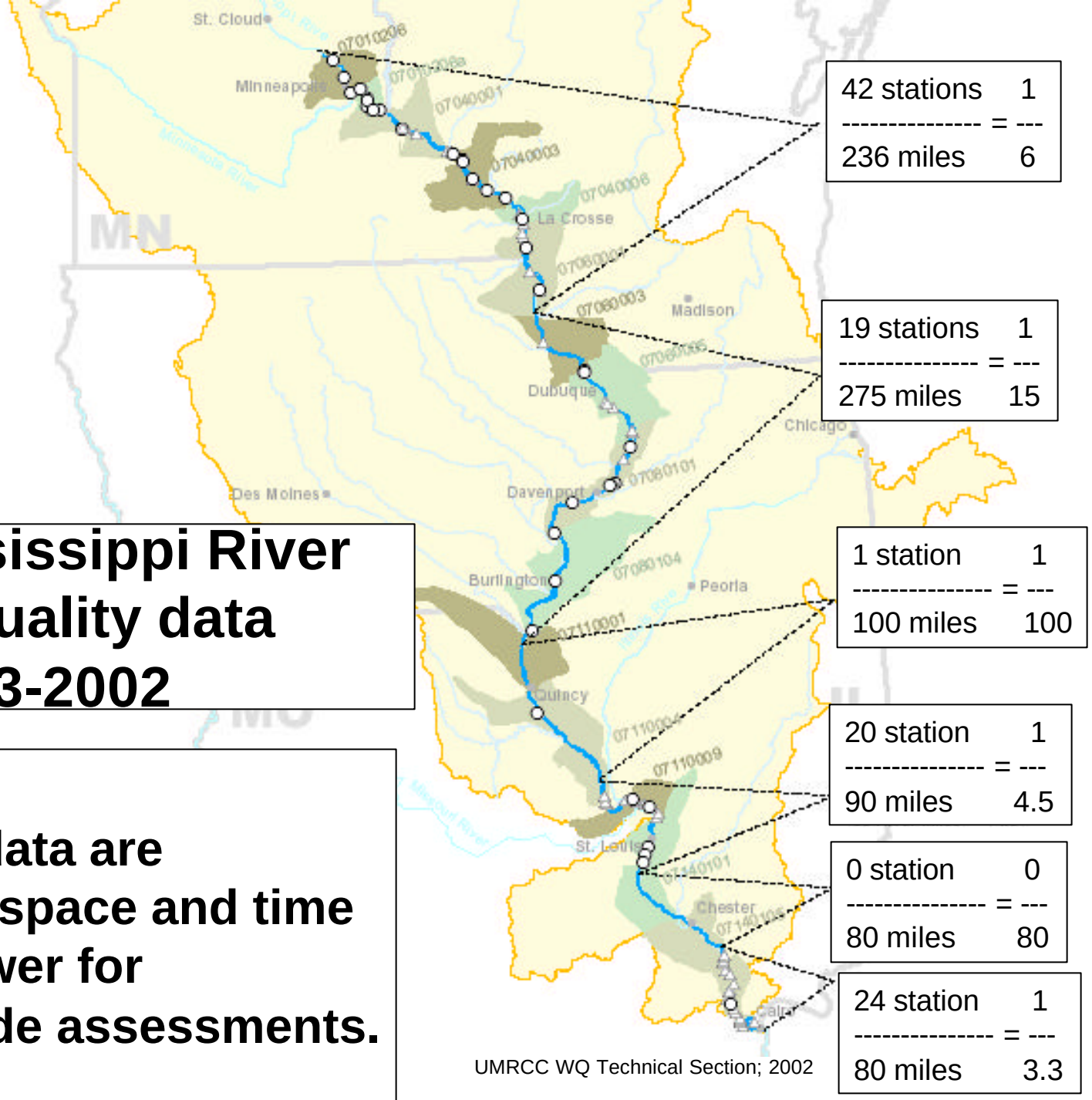
Upper Mississippi River Water Quality data 1953-2002



UMRCC WQ Technical Section; 2002

Monitoring data are scattered in space and time and lack power for resource-wide assessments.

Lessons learned from managing Great Rivers.

- Endangered Species Act, restoration, and conservation drive information needs.
- Site-specific targeting of individual chemical, conditions, or species is big driver.
- States not able to describe water quality or use impairments as required by the Clean Water Act.
- It is difficult to determine impact of management actions because data are not coherent.
- It is difficult to analyze patterns because data can not be aggregated in space or time.
- Stakeholders must be identified and involved.
- Approaches must work across boundaries.
  - Focusing on the *boundaries of environmental problems* helps identify the science and interests that should participate and facilitate solutions. Interstate strategies are important (Mike Leavitt – EPA Administrator)

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EPA's Environmental Monitoring and Assessment Program (EMAP) is a response to these lessons.

- Develop & demonstrate the science needed for state-based monitoring frameworks to determine condition and detect trends in condition for Great River ecosystems.
- Transfer this technology in a useable form so it adoptable to States, Tribes, and regions.
  - ***EMAP is not EPA's monitoring program.***
- EMAP surveys infer conditions from sample.
  - Demonstrations yield baseline assessments.
  - Surveys through time = monitoring.
- Great Rivers EMAP is a step towards completing a national stream assessment strategy.
  - Supports CWA with biological focus supported with water quality, physical and chemical data.
  - Field sampling 2004-2005.
  - Analyses (including more sampling) 2005-2007.

EMAP Q&A

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

Resource	*Unit*	*Condition*	*Indicator*
River-mile	State	Good	Biotic integrity
Reservoir area	Ecoregion	Bad	Water Quality
Wetland area	Watershed	Marginal	Stressors
Backwater area	County	Poor	Habitat Integrity
Floodplain area	Reach	Threatened	
Shoreline-mile	River	Impaired	
Sandbars	Pool	Whacked	
	Reservoir		
	EPA Region		
	Water district		
	Reservation		
	United States		

Using this format is new for Great Rivers.

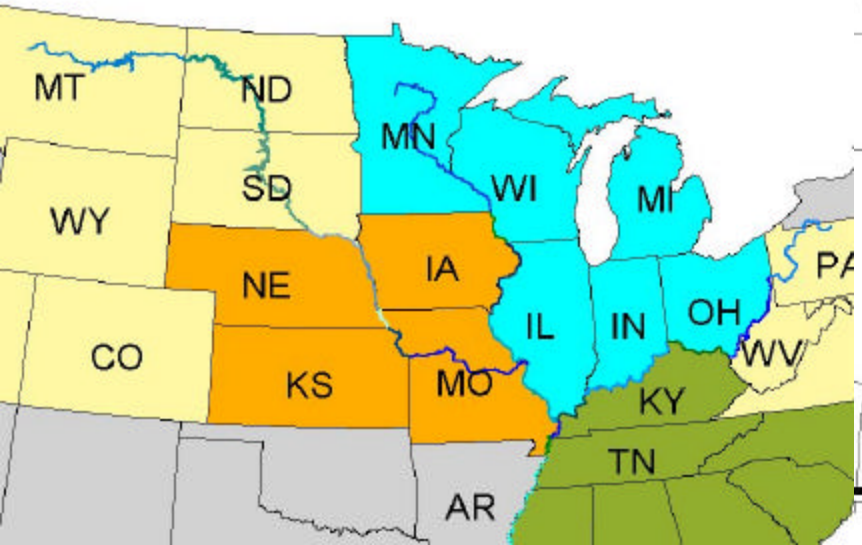
Geography of Great Rivers EMAP

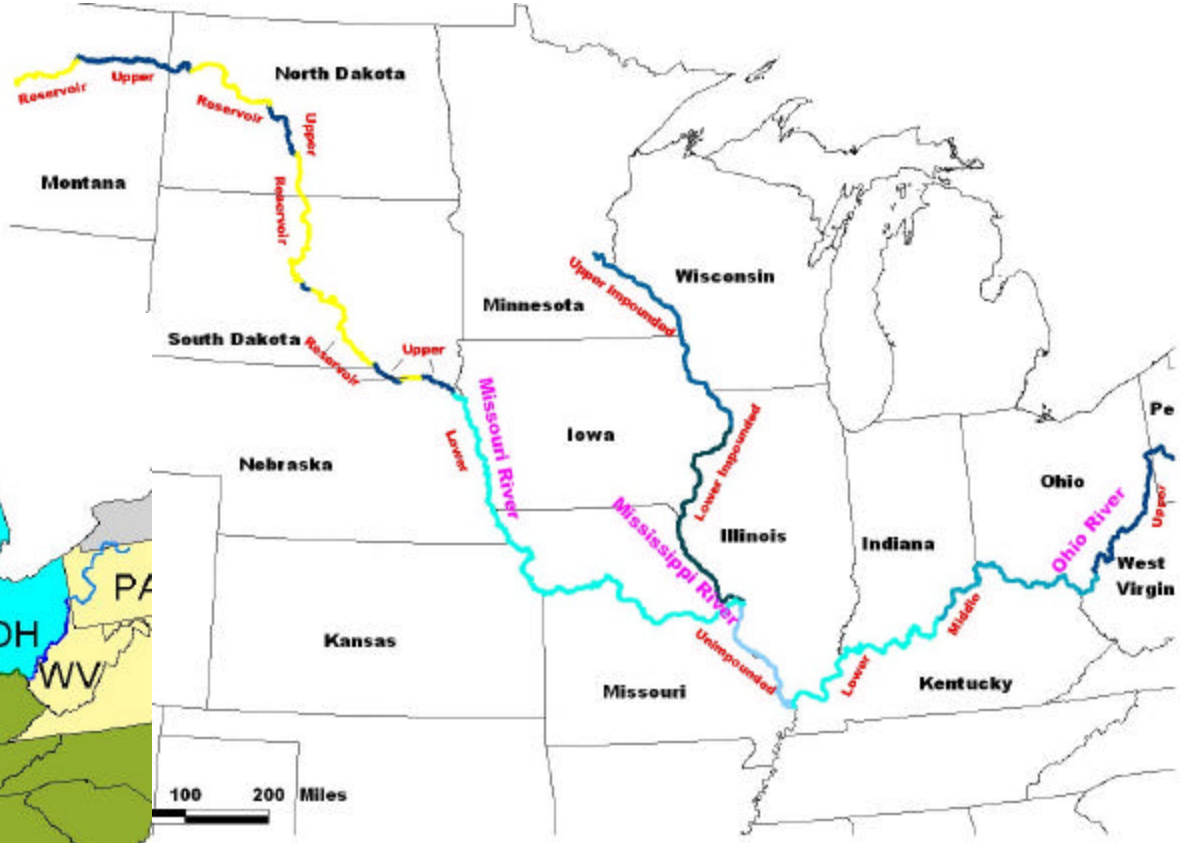
Scope is big.

Boundaries are many.

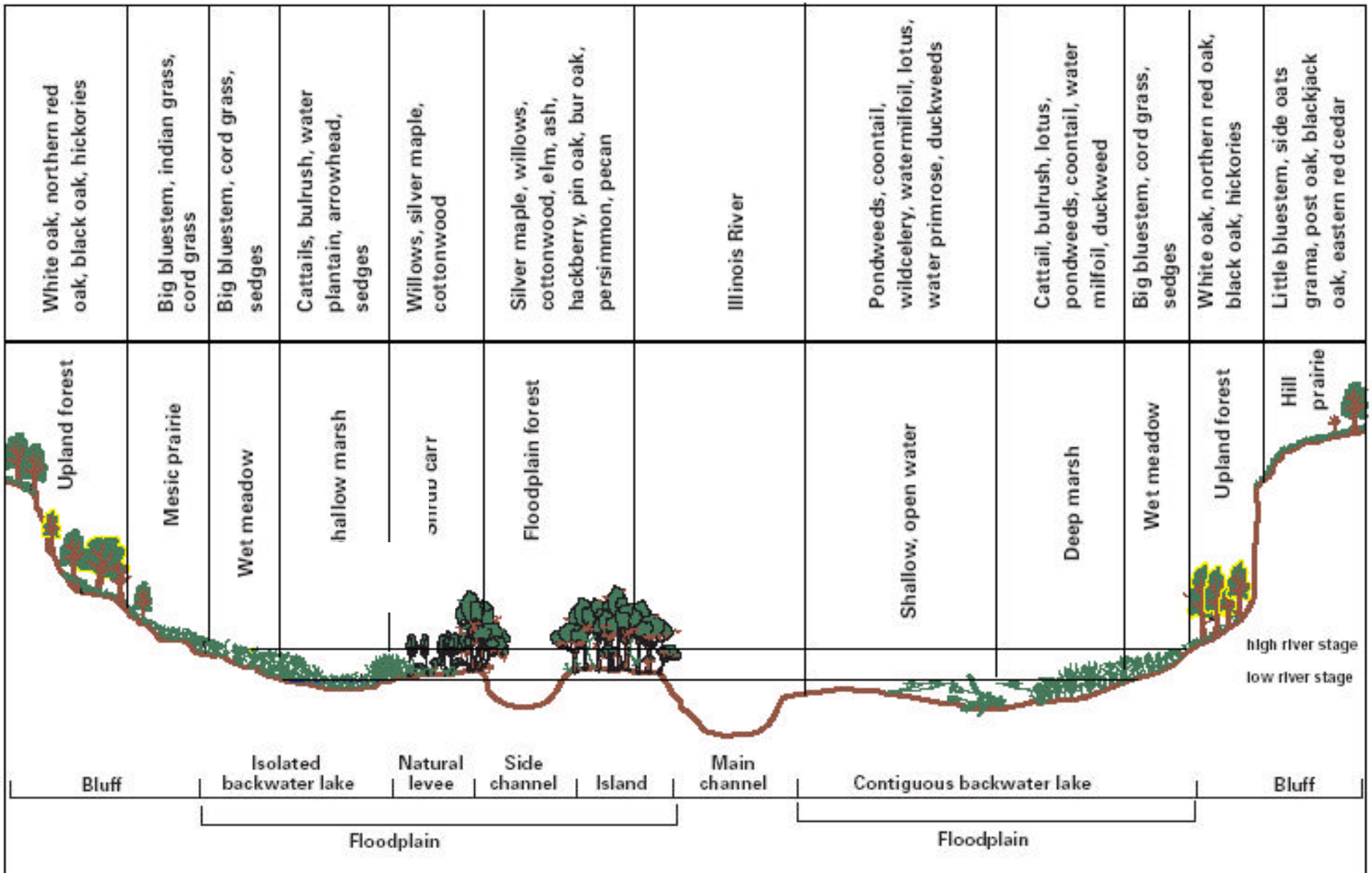
1 Interstate agency
3 EPA Regions
6 Reservoirs
8 River reaches
8 ACOE Districts
12 Ecoregions
15 States
36 Locks/Dams & Pools

Fort Peck to Pittsburgh - St. Paul to Cairo





Ecosystem & management concerns are complex, dynamic, and political.



Great Rivers EMAP Organization

EPA ORD NHEERL Director
Associate Director for Ecology
EMAP Director

MED (Duluth) Division Director

Technical Lead

Management Team	
Project Administration	Quality Assurance
Health & Safety	Extramural Funding

Science Teams	
Sample Design	Methods/ training
Information Management	Data Analysis / Assessment

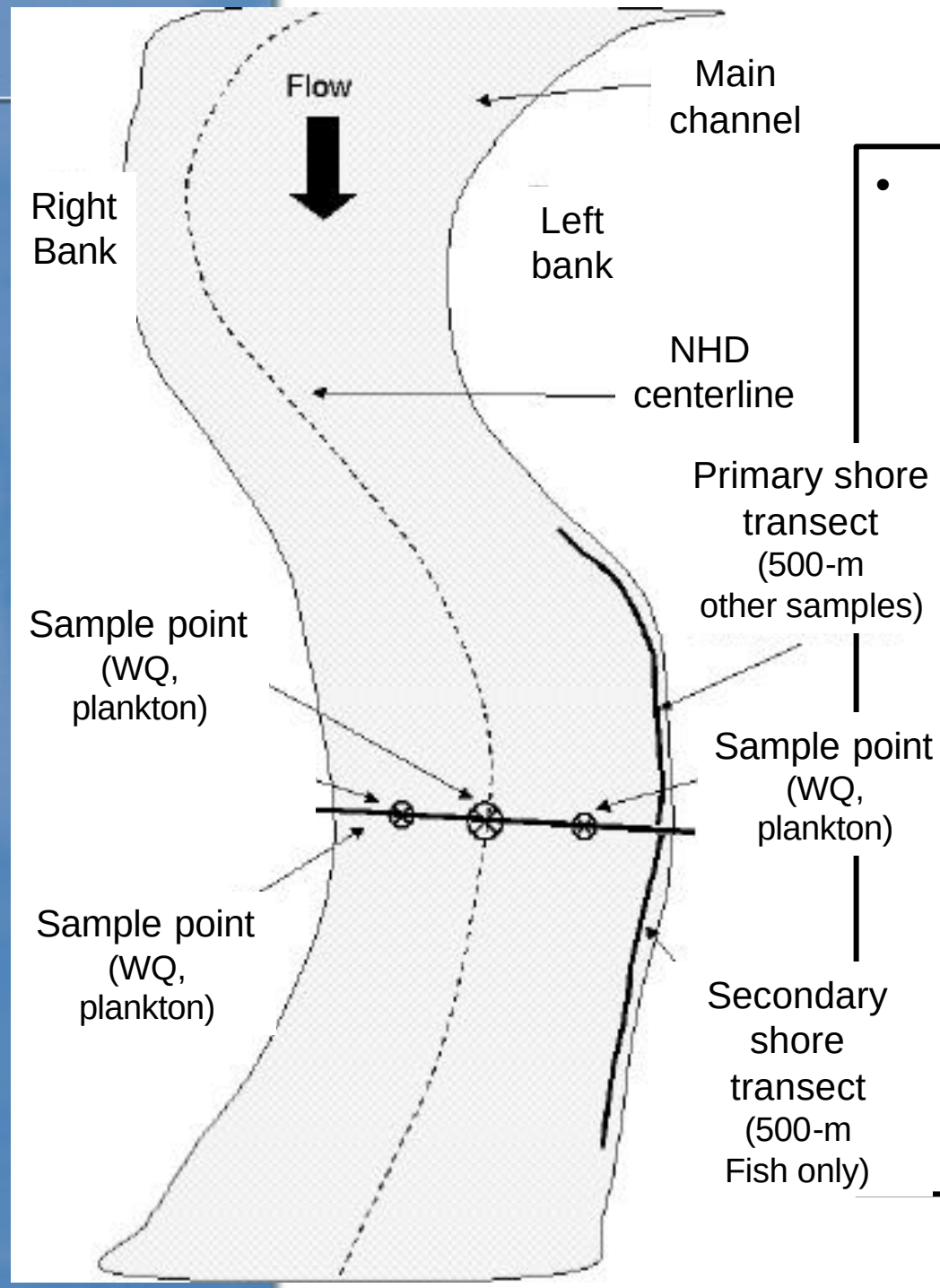
Partners

Upper Missouri River	Lower Missouri River	Upper Mississippi River	Ohio River	Analyses
Ongoing EMAP projects *EPA MED* *EPA Region 8* *Fort Peck Tribe* *South Dakota DENR* USGS WRD at North Dakota & Montana North Dakota Dept Health	USGS WRD in Missouri, Iowa, Kansas, Nebraska Missouri Dept of Conversation Nebraska Game & Fish Commission	USGS Upper Midwest Environmental Sciences Center Wisconsin DNR Minnesota DNR Iowa DNR Illinois Natural History Survey Missouri Dept Conservation	EPA NERL EPA Region 3 EPA Region 5 ORSANO SoBran Inc	University of Louisville Stroud Water Center Southwest Missouri State University USGS UMESC EPA NERL

Metrics and Indicators

- **Water Quality**
  - Dissolved oxygen
  - Dissolved N (NOx, ammonia)
  - Conductivity
  - pH
  - Metals (As, Pb, Se, CU, Fe, Ni, Zn, not Hg)
  - Temperature
  - Anions & Cations
  - Turbidity, Suspended matter
  - Alkalinity
  - Total & Dissolved P, N, & C
  - Silica
  - Elemental particle analysis
  - Particulate stable isotopes
- **Sediment**
  - Enzyme activity
  - Toxicity
  - Grain size
  - Total and volatile matter
  - Chemistry (organics, inorganics)
- **Biotic Assemblages**
  - Fish
    - Tissue contaminants
  - Invertebrates
    - Shoreline kicks
    - Snags
  - Zooplankton
  - Phytoplankton
  - Periphyton
  - Submersed aquatic vegetation
- **Habitat**
  - Littoral
    - Vegetation cover
    - Substrate (fish cover)
    - Depth
    - Velocity
    - Woody debris
  - Riparian
    - Vegetation cover
    - Development
    - Invasive/exotic species

Sample Design



- Probability Design
  - Based on National Hydrologic Data.
  - Sample sites are coordinates on centerlines using Generalized Random Tessellation Stratified (GRTS) survey design for a linear resource with reverse hierarchical ordering (www.epa.gov/nheerl/arm/).
  - Selects bank to sample.
  - Stratified by river.
  - Assign minimum sample size is 30 per state.
    - Except some Ohio River valley states and MT and ND.
    - Data may be aggregated.
  - Programs inter- and intra-annual re-visit schedule at rate of 20%.
  - Dossiers for each site.
  - Rules for site replacement and layout adjustments.

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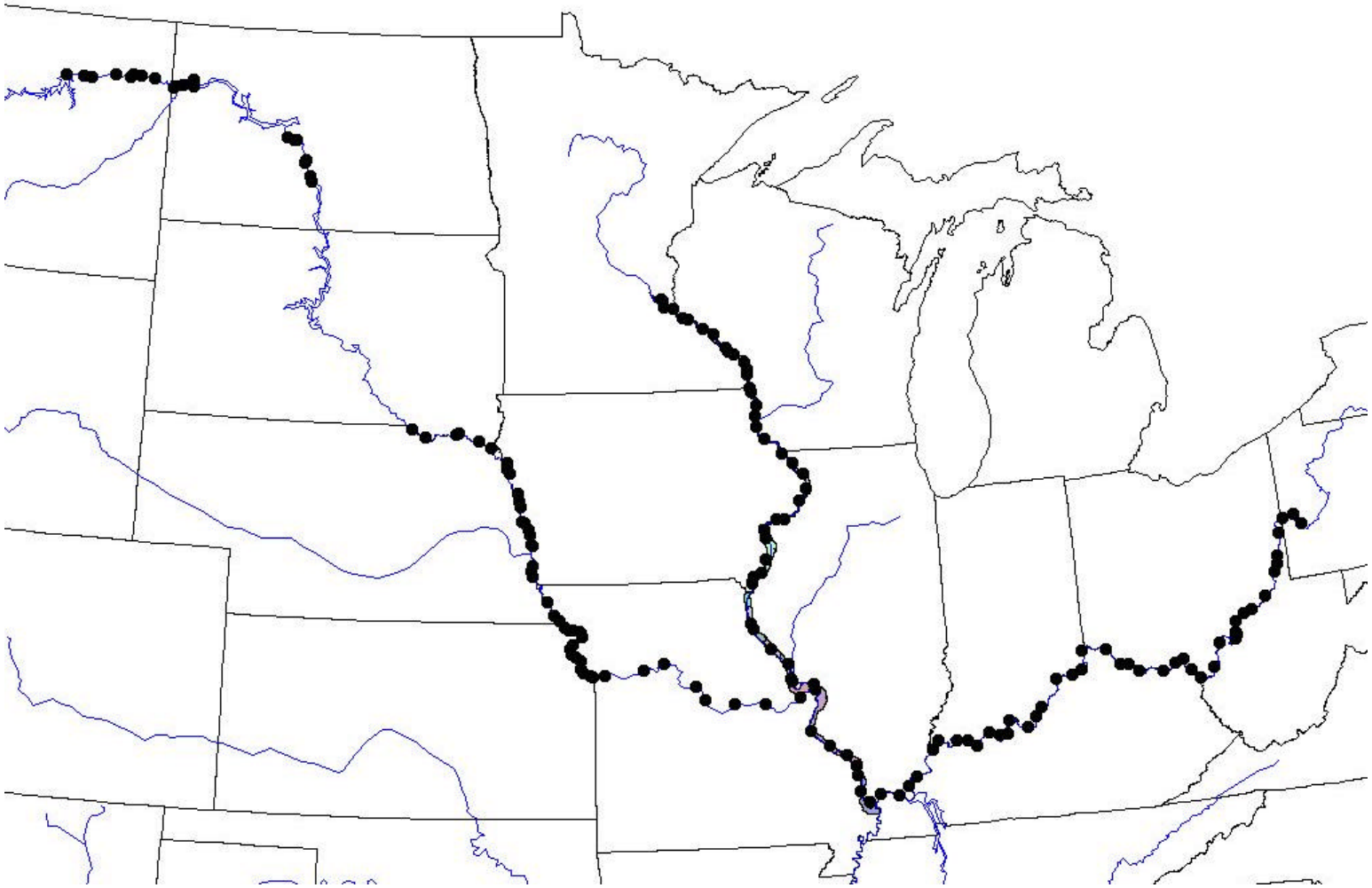
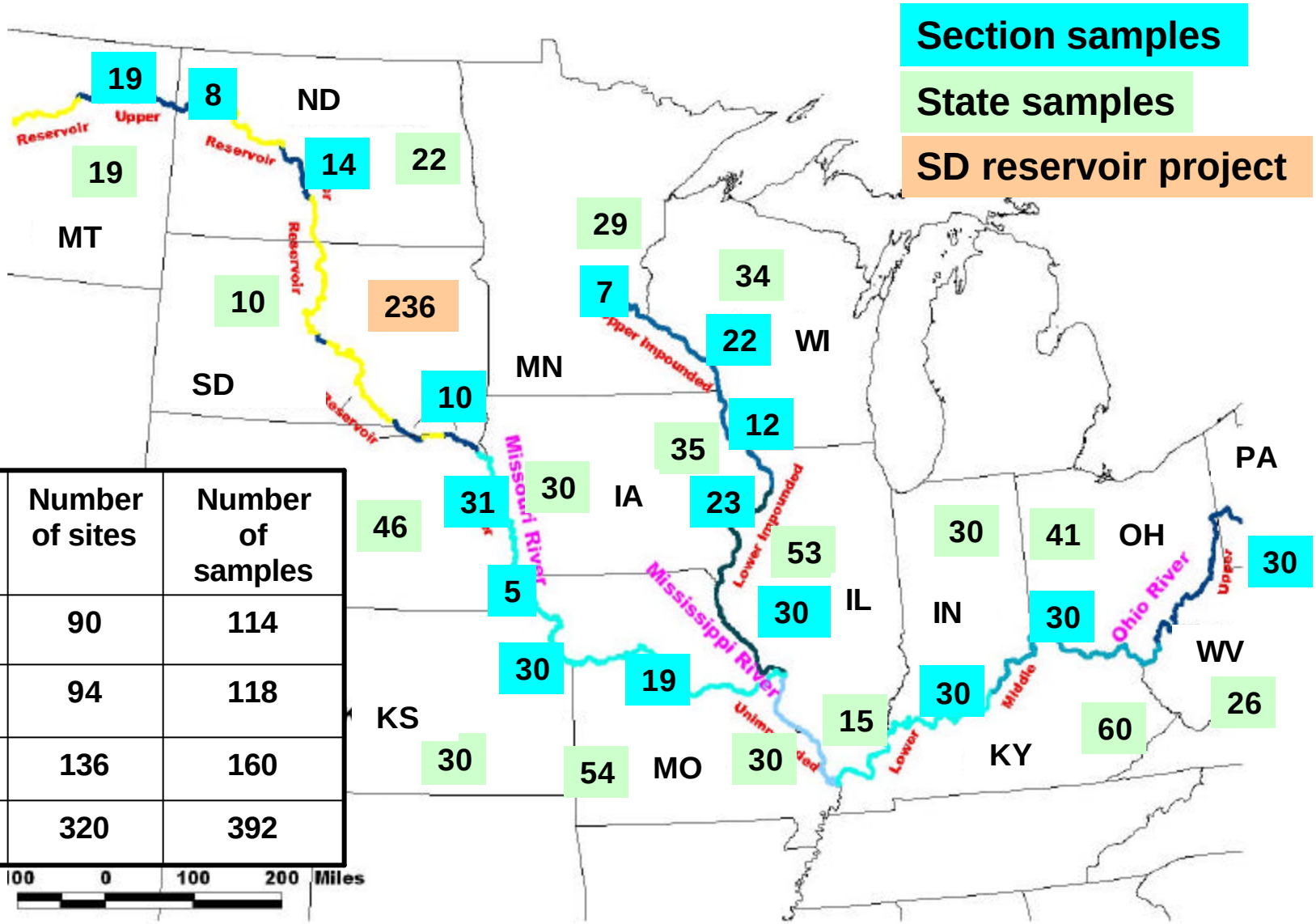
Great Rivers EMAP Sites

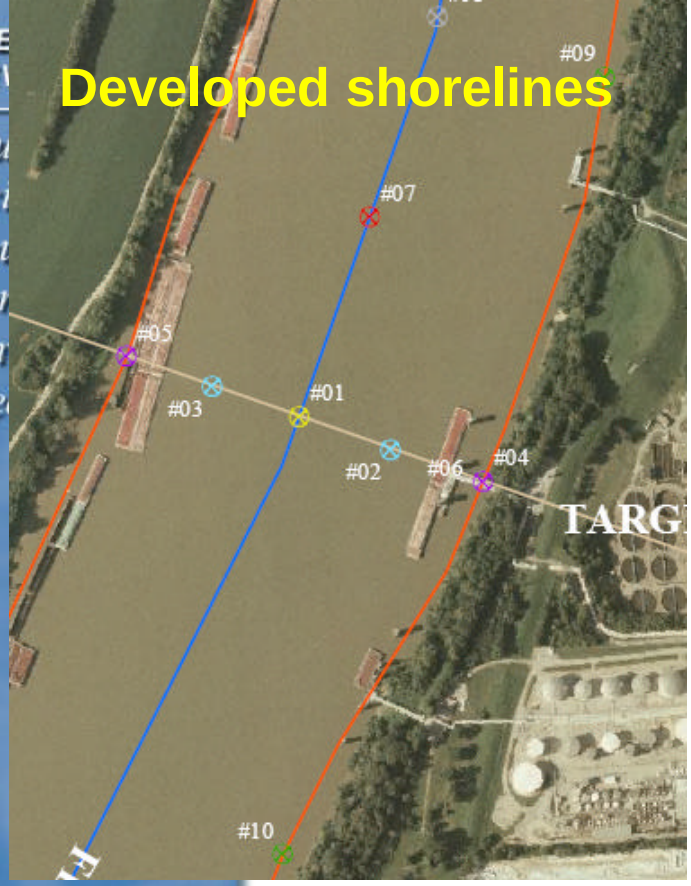


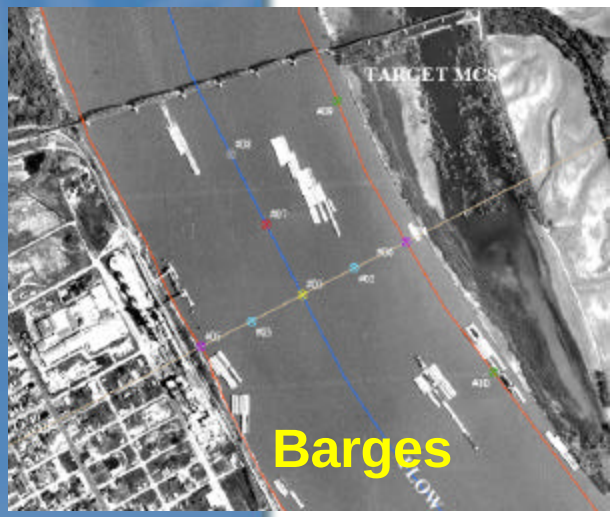
Great Rivers EMAP Sites for 2004-2005

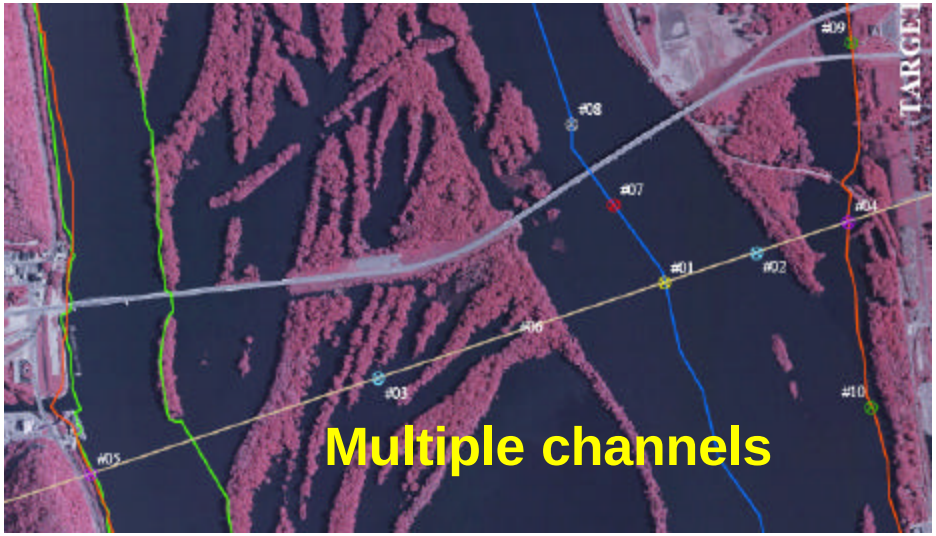


River	Number of sites	Number of samples
Ohio River	90	114
Mississippi	94	118
Missouri	136	160
Total	320	392

Problems with reality







Site Dossiers

- Navigation information
- Preliminary site layout
- Potential hazards

EMAP-GRE Site Dossier

GRW04449-282

River Thalweg _Shoreline Transect
Points Lines: Attribute Information

NAME	SECTION	SAMPLE BANK	CLOSEST RIVER MILE	# PLANNED VISITS	POOL/REACH	NED ELEVATION
Mississippi River	Illinois Iowa	Left	372	1	Pool 19	155

DETAIL	TRAN	ID	LON_DD	LAT_DD	OR_AZ	SB_DIST	NSB_DIST	CH_WIDTH
X-Site	X	#01	-91.3656	40.5043	--	--	--	--
1/3 Point	X	#02	-91.3613	40.5048	--	--	--	--
2/3 Point	X	#03	-91.3699	40.5037	--	--	--	--
Cross Channel Transect/MCS Int.	X	#04	-91.3570	40.5054	--	--	--	--
Cross Channel Transect/MCS Int.	X	#05	-91.3742	40.5032	--	--	--	--
Transect X	X	#06	--	--	257.47	736.27	731.81	1468.08
250m Site	Y	#07	-91.3661	40.5065	--	--	--	--
500m Site	Z	#08	-91.3669	40.5086	--	--	--	--
Primary 500m Upstream MCS Transect	X	#09	-91.3580	40.5097	--	--	--	--
Secondary 500m Downstream MCS Transect	X	#10	-91.3558	40.5010	--	--	--	--

DATA DICTIONARY

DETAIL = Description
TRAN = Transect
ID = ID number from dossier page 2
LON_DD = Longitude in decimal degrees
LAT_DD = Latitude in decimal degrees
OR_AZ = Orthogonal azimuth (degrees clockwise from north)
SB_DIST = Distance to sample bank [meters]
NSB_DIST = Distance to non-sample bank [meters]
CH_WIDTH = Total width of channel [meters]

**NED Elevation value is in meters.
**All distance values are in meters.
**All azimuth values are in degrees.
**All coordinate values were derived using:
Projection: Geographic
Datum: NAD83
Spheroid: GRS1980
Units: Degrees

Semimajor Axis: 6378137.000000000000000000
Semiminor Axis: 6356752.314140356100000000
Inverse Flattening: 298.257222101000020000

US EPA, Mid-Continent Ecology Division
1201 Congdon Blvd
Duluth, MN 55804

Map layout produced under the FAIR II Contract
10-W-00-032 Task Order 2024

EMAP-GRE Site Dossier

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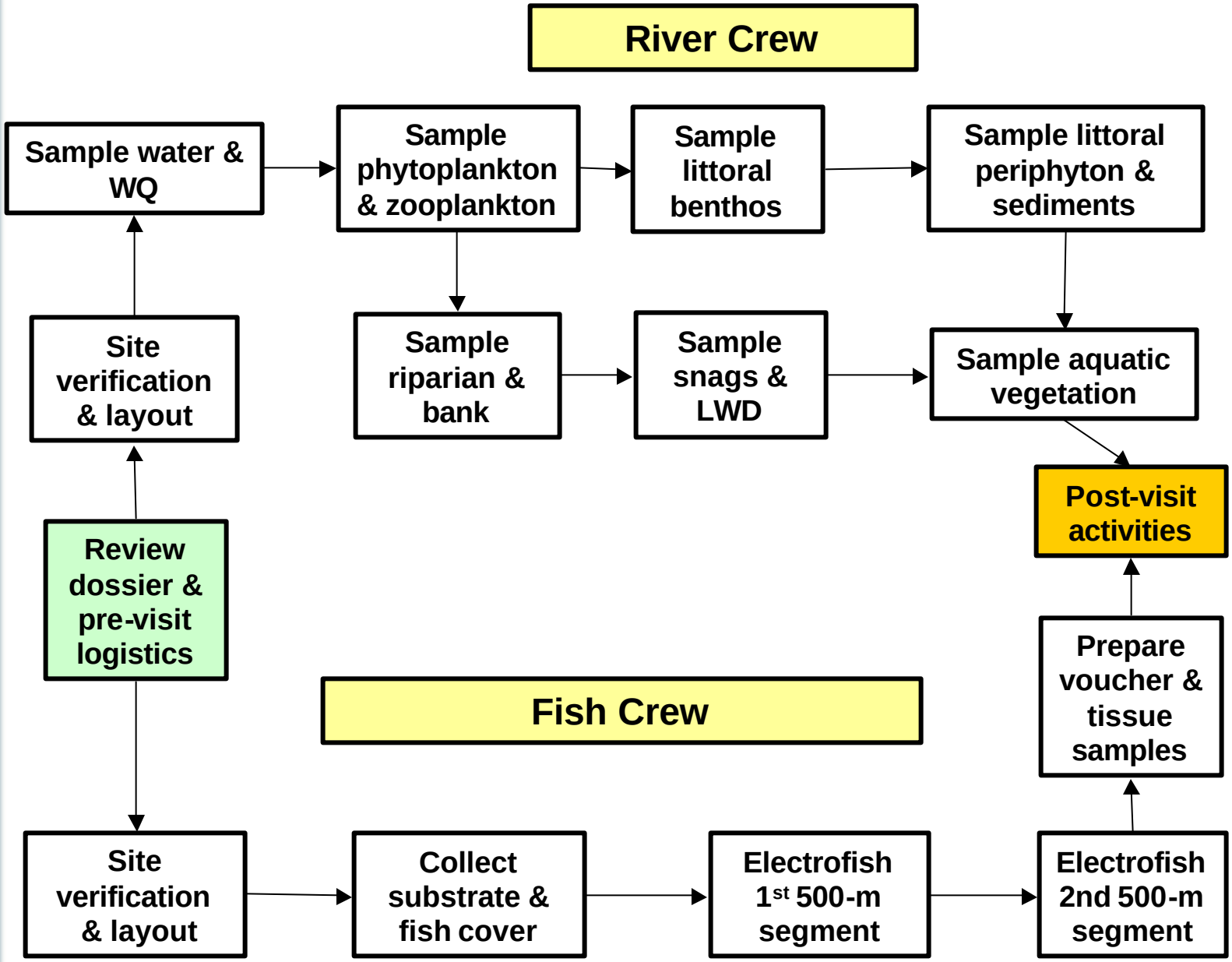
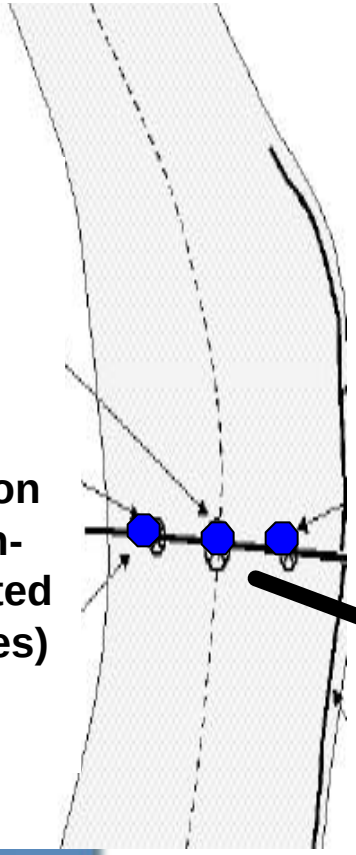
Site Activities

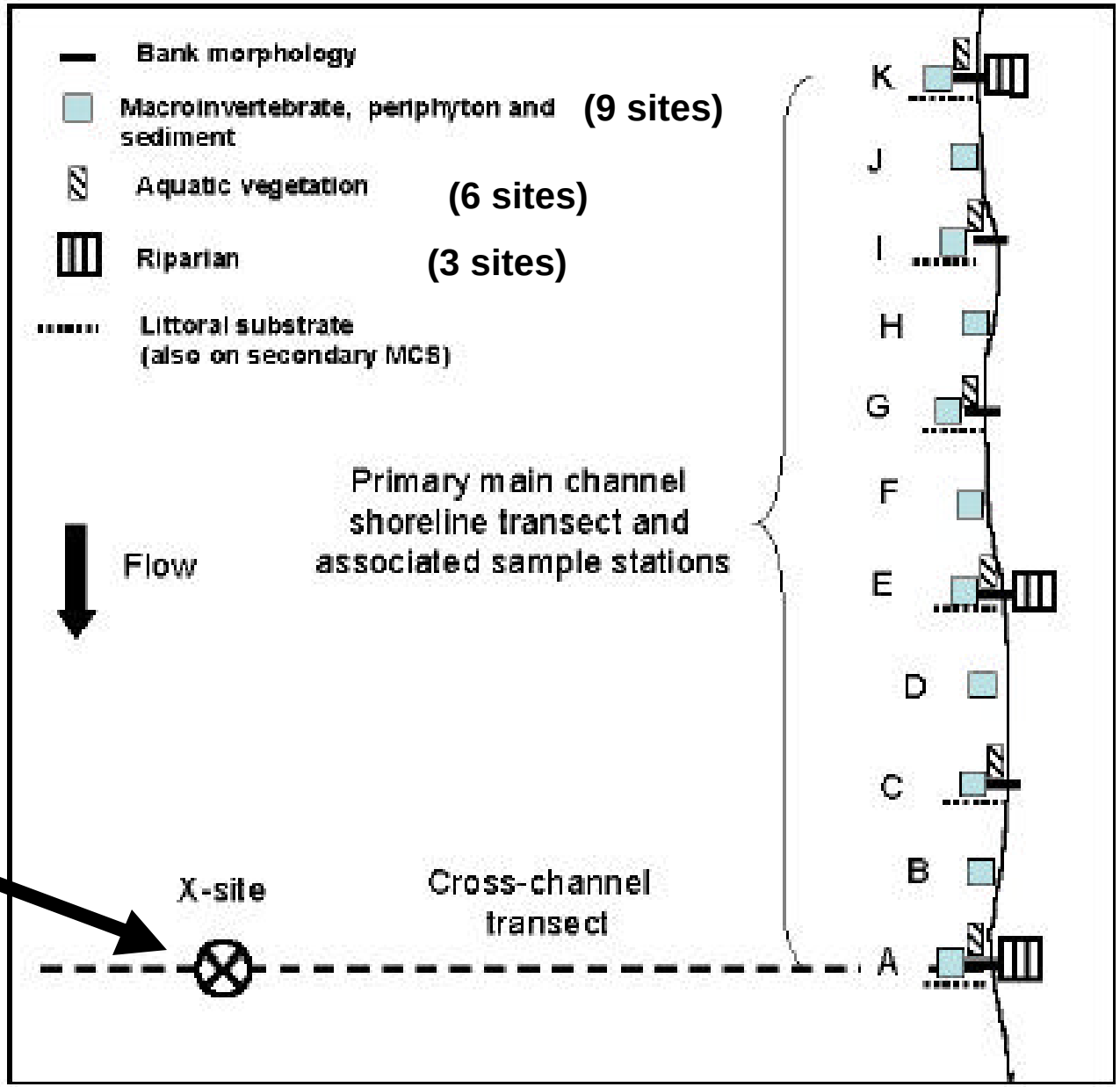


Site layout

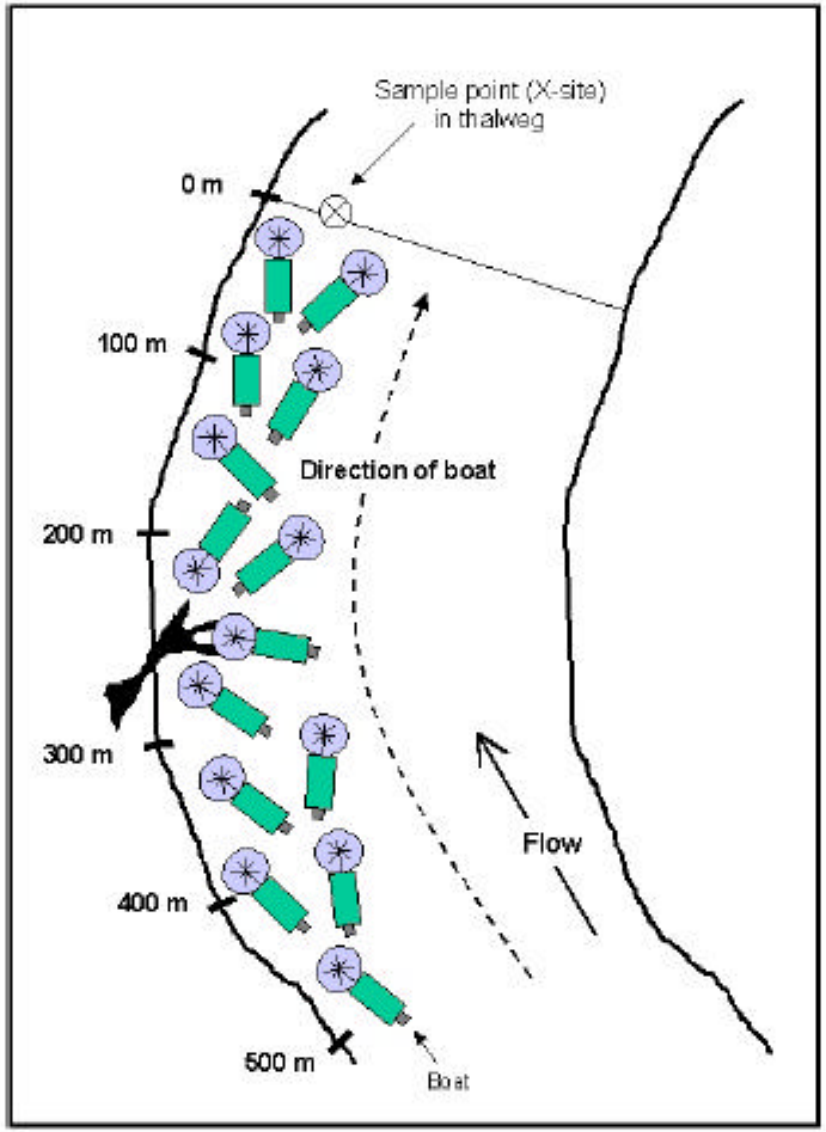
X-site

WQ Plankton (depth-integrated at 3 sites)

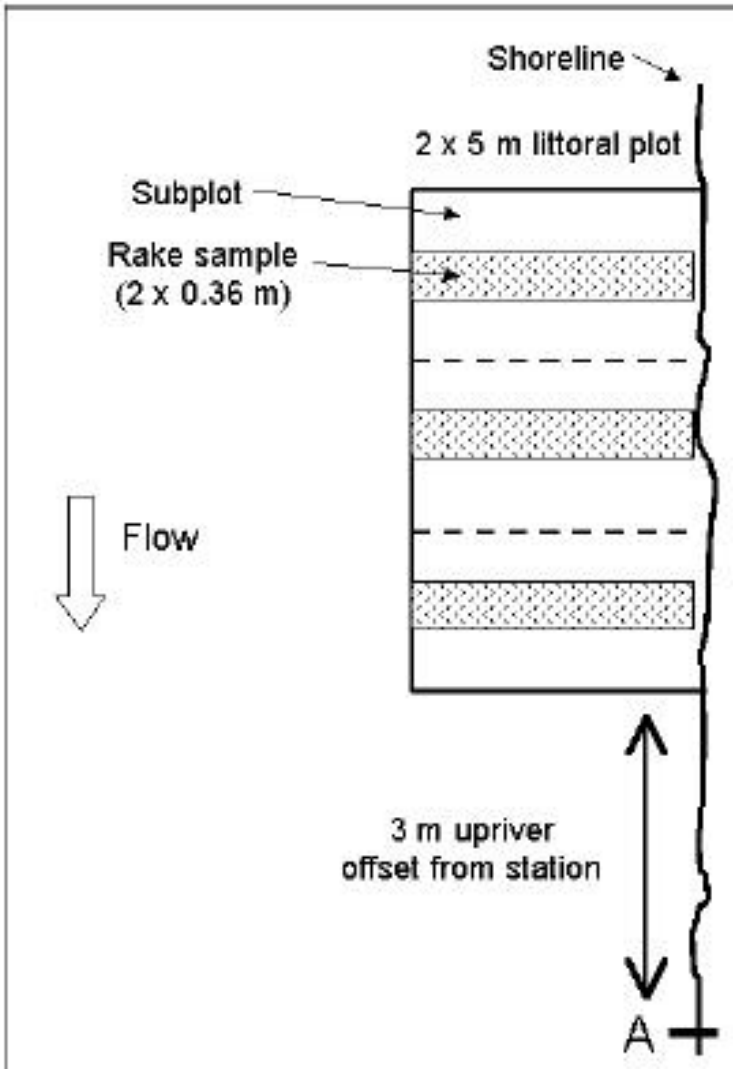




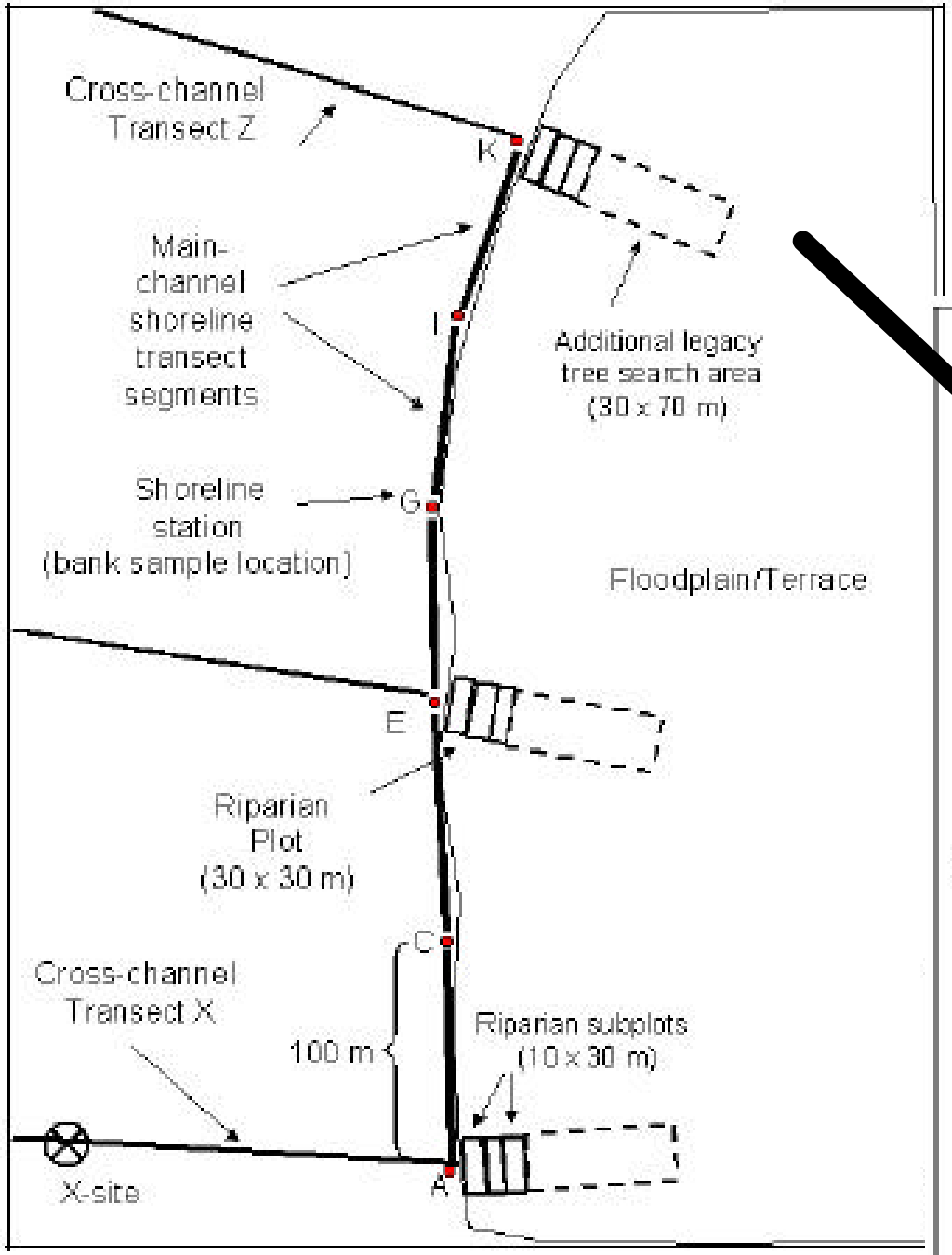
Electrofish
Two 500 m segments
(single pass; single gear)

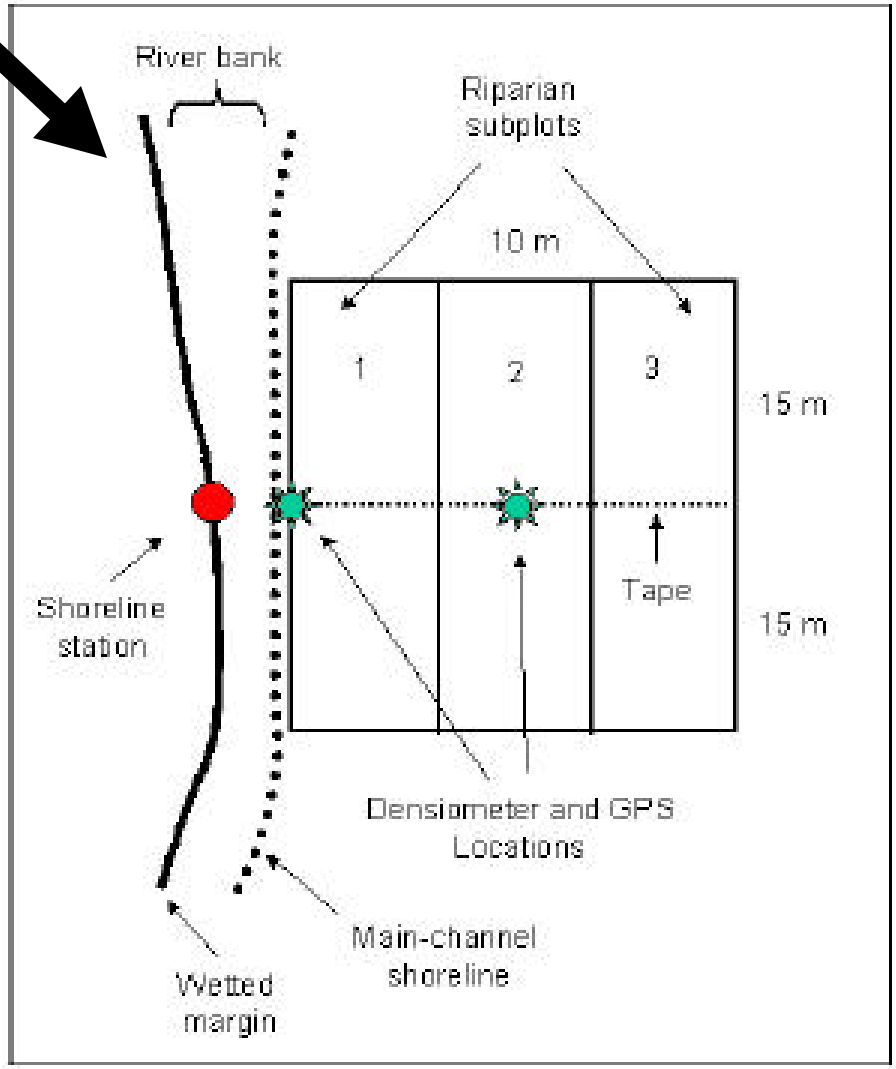


Submersed aquatic vegetation
(raking 3 plots at 6 sites)



Riparian sampling (3 plots at 3 sites)





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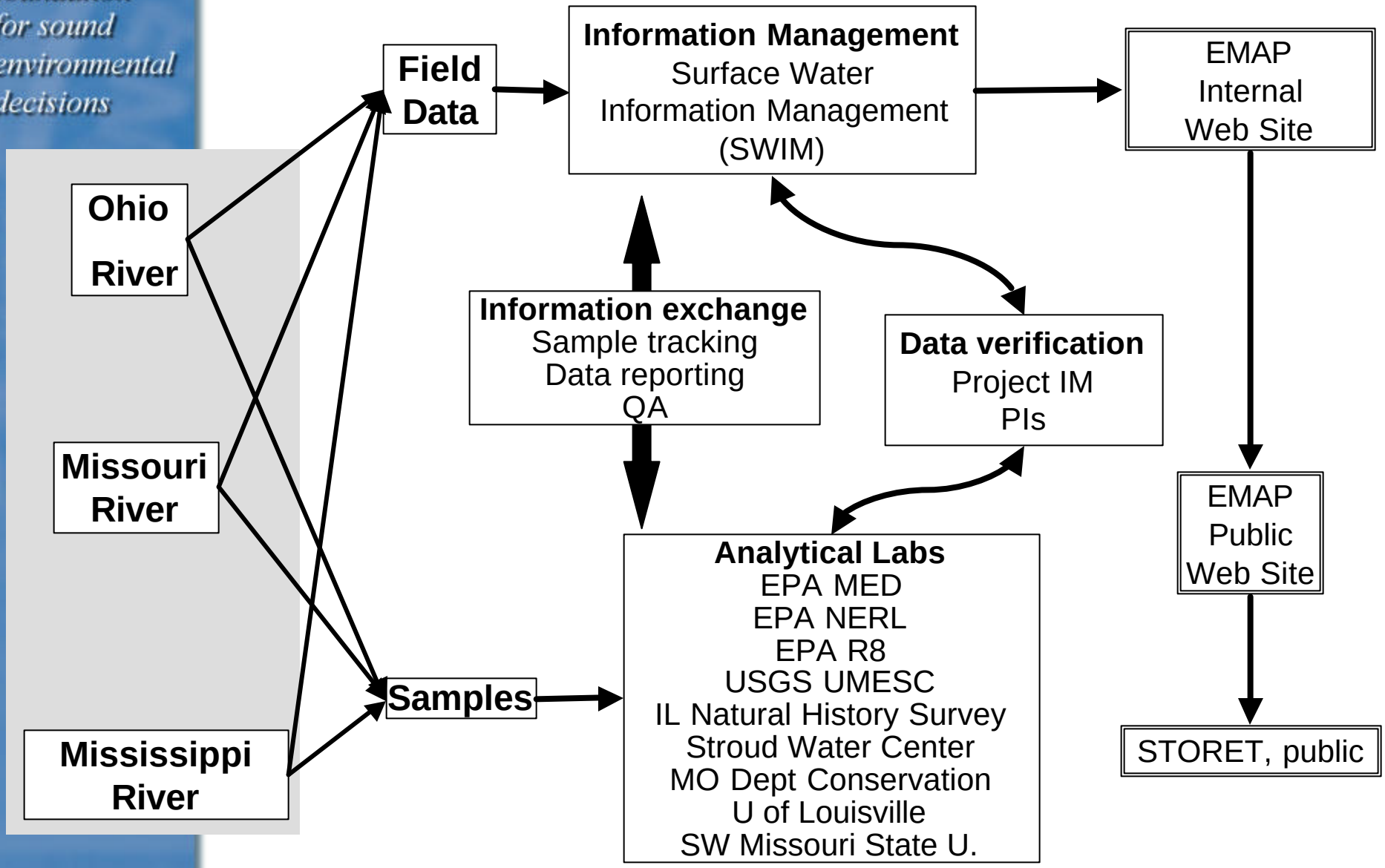
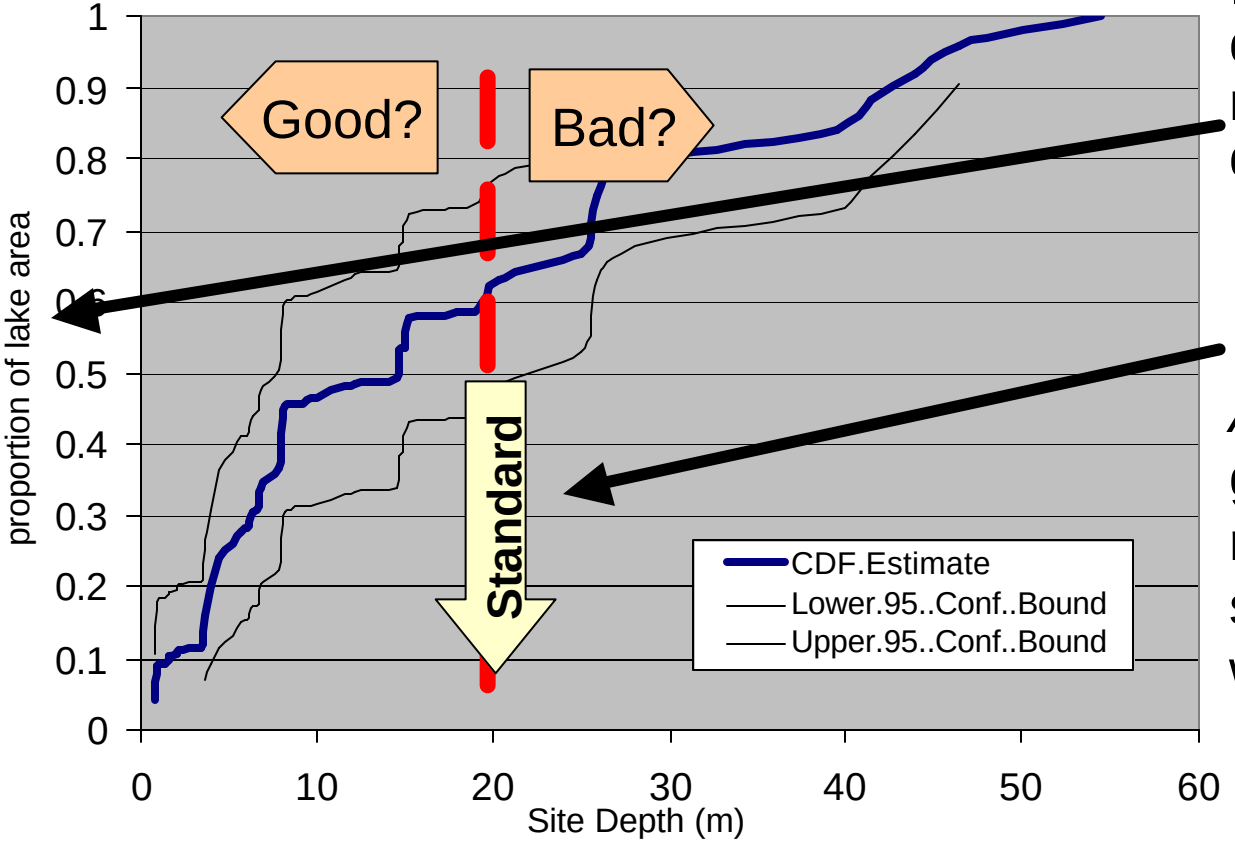
Data Flow in Great Rivers EMAP



Data Analysis (remember the format?)

What % of [resource] in [unit] is in [condition] as indicated by [indicator] ?

	Sample-based	Design-based
Mean (m)	**13.54**	**18.47**
Std Dev	**13.34**	**2.35**
Inference	**unknown**	**precise & accurate**



GR EMAP will estimate the proportion of area or length of resources in a condition.

Indicators may not be well developed. Metrics may not inform management decisions.

AND

Assessing condition as good or bad depends on reference conditions or standards that may not be well developed.

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Program Outcomes

Evaluate sample framework and indicators.

Establish partnerships.

Assessment sampling.

Reference condition sampling.

Report on design and methods.

Initial condition report.

Initial stressors report.

Support transfer approach to partners.

Assist indicator development.

Assist criteria development.

National design, methods, and indicators for Great River assessments.

Integrate Great River assessments into national assessment framework.

2003	2004	2005	2006	2007	2008	…	…	…	…

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Questions?