

# SMART MONITORING



# SMART Monitoring Networks

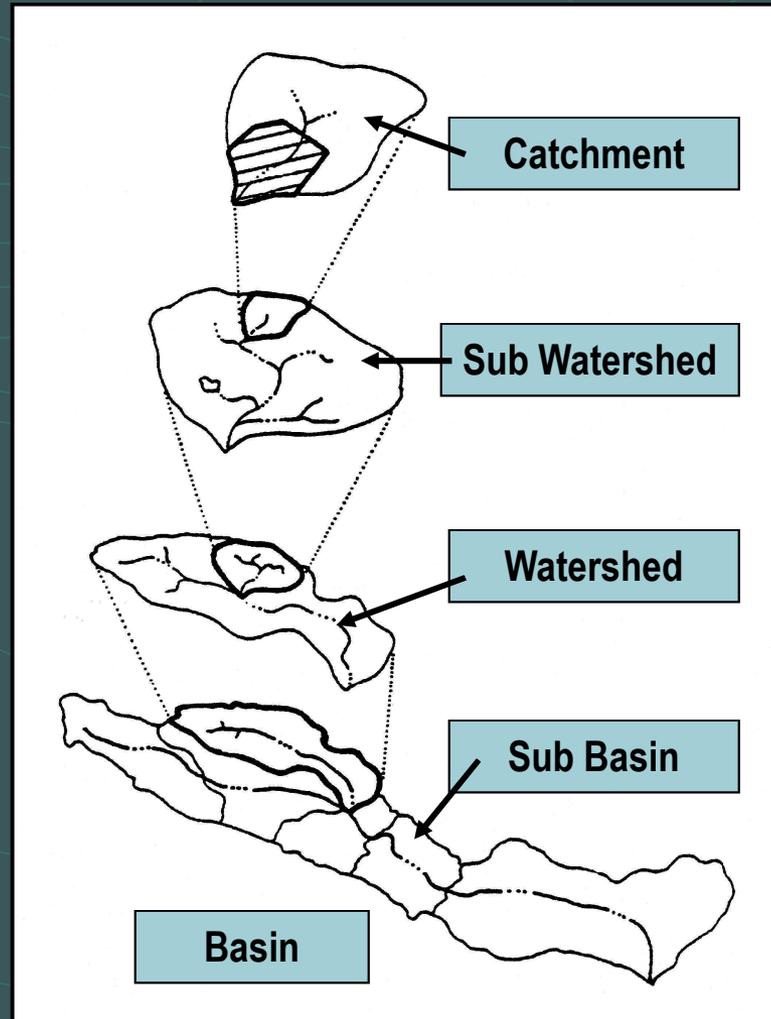
Tier	Schedule	Scale
Statewide	Continuous	Large scale/long term
Basins	Rotating Basin	NPDES /5 year cycle
Local	Flexible	Small scale/ rain events

# Three Time/Space Scales

Local

Basins

Statewide



# Defining Monitoring Goals

## Question

- What is the condition of the resource?
- Is the condition changing over time?
- How do we restore and enhance the resource?
- How do we protect and maintain the resource?
- How do we improve our programs?

## Goal

- Status
- Trends
- Restoration
- Protection
- Program Support

# Monitoring Strategies

- Sampling sites

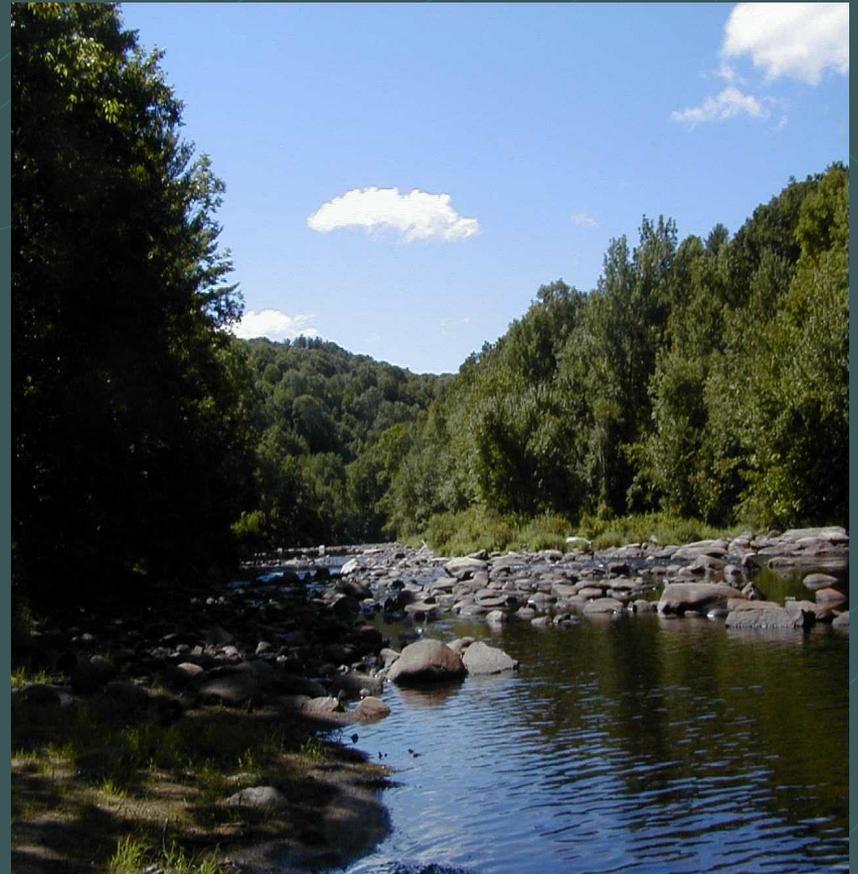
- where

- Sampling frequency

- when

- Indicators

- what



# Sampling Strategies

Goal	Segments	Frequency	Indicators
Status	All	Low Flow	Response
Trends	Impaired	Continuous	Exposure
Restoration	PS Impaired	Low Flow	Exposure
	NPS Impaired	Annual Cycle Rainfall	Exposure
Protection	Clean	Continuous	Exposure
Programs	All	Continuous	Exposure

# MA Program Strategy

Goal	Segments	Frequency	Indicators
Status	All	Low Flow	Response
Trends	Impaired	Continuous	Exposure
Restoration	PS Impaired	Low Flow	Exposure
	NPS Impaired	Annual Cycle Rainfall	Exposure
Protection	Clean	Continuous	Exposure
Programs	All	Continuous	Exposure

# MA Program Success

Goals	Attained	Issues
Status	18% river miles	82% unmonitored
Restoration	Point Sources	NPS
Trends	No	\$ 4.5 Billion in WWTF's
Protection	No	Acid Rain Mercury
Programs	No	Nutrients Toxics

# What's Missing?

Goal	Segments	Frequency	Indicators
Status	All	Low Flow	Response
Trends	Impaired	Continuous	Exposure
Restoration	PS Impaired	Low Flow	Exposure
	NPS Impaired	Annual Cycle Rain/events	Exposure
Protection	Clean	Continuous	Exposure
Programs	All	Continuous	Exposure



# 5 Year Rotating Basin Approach

## Gain Spatial Density

- 5-6 basins/year
- **Multiple sites**
- 15 years for trends
- Avoid clean sites
- Avoid small streams

## Lose Temporal Continuity

- **Multiple visits/site**
- Seasonality
- Hydrograph
- Long term cycles (El Nino)

# MA Monitoring Program

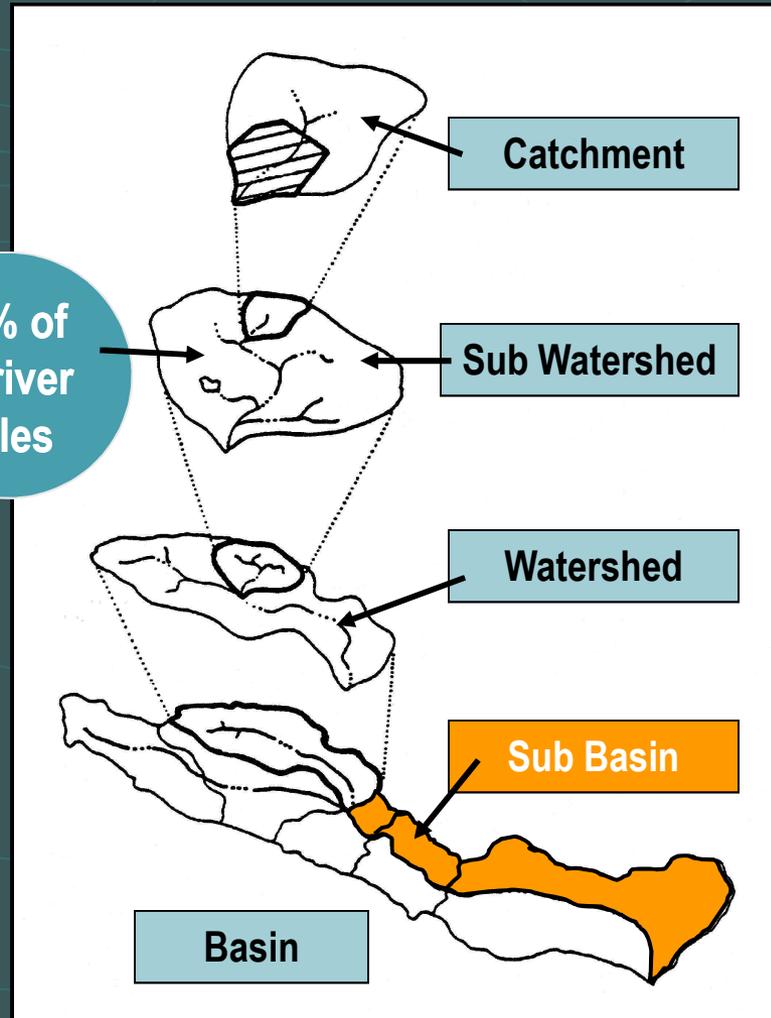
## EFFECTS

NONPOINT  
SOURCE  
POLLUTION

POINT  
SOURCE  
POLLUTION

TRENDS

75% of  
all river  
miles



## USE

BMP's,  
Site Design

NPS  
Assessment

Land Use  
Zoning

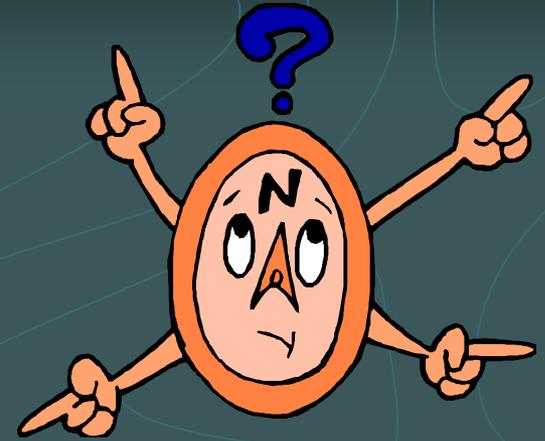
Basin  
Planning

Basin  
Planning

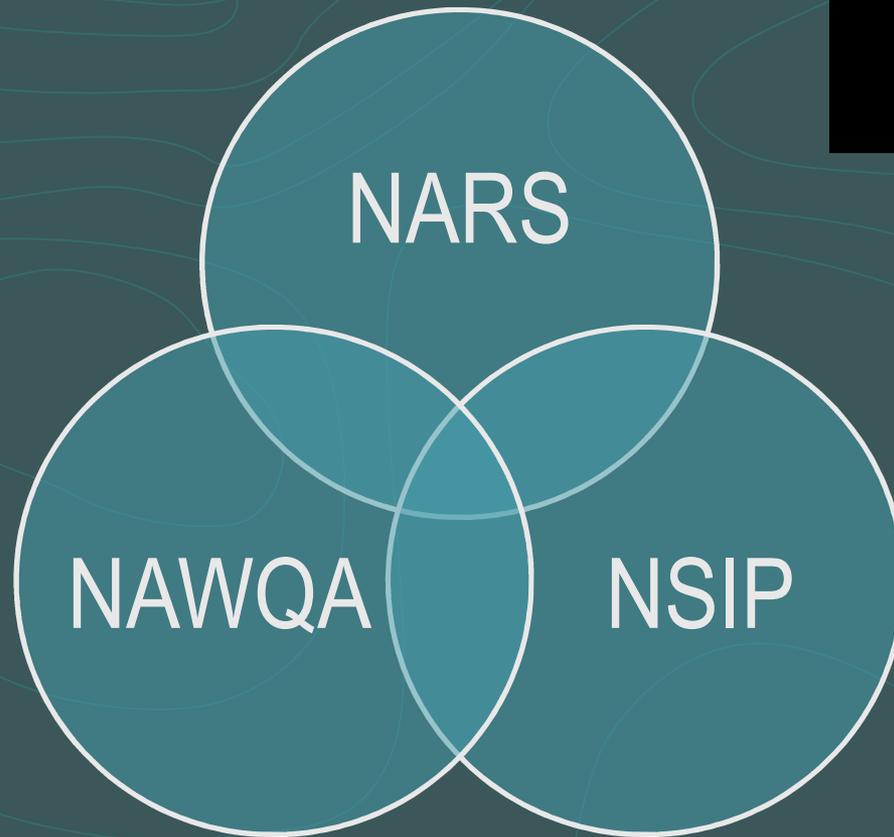
# Large Scale Programs

- NAWQA
- NASQUAN
- NARS
- NEON
- NSIP
- FEMA
- Nat. Weather Service
- Climate Change

- FERC
- TMDL
- STREON
- HBN
- COE Flood Control
- MWRA Reservoirs
- LTM
- 305b



# Multipurpose Monitoring





# Stream Gages are the Workhorses

- Frequency
  - Continuous-Long term
- **Continuous Flow Monitoring**
  - Hydrologic context
  - Real time reporting
  - Surrogate sampling

# Types of Sites

Goal	Segments	Frequency	Indicators
Status	All	Low Flow	Response
Trends	Impaired	Continuous	Exposure
Restoration	PS Impaired	Low Flow	Exposure
	NPS Impaired	Annual Cycle Rain/events	Exposure
Protection	Clean	Continuous	Exposure
Programs	All	Continuous	Exposure

# 50 Strategic Sites

Goal	Sites	Purpose
Trends	18 Abatement projects	Point Source Success
Trends	19 Loading (67% land area)	NPS Success Nutrient Loadings
Protection	13 Ecoregions	Climate Change Urbanization Acid Deposition
Programs	All 50	Criteria/Policy

# Statewide Strategic Network

Goal	Segments	Frequency	Indicators
Status	All	Low Flow	Response
Trends	37	Continuous	Exposure
Restoration	PS Impaired	Low Flow	Exposure
	NPS Impaired	Annual Cycle Rain/events	Exposure
Protection	13	Continuous	Exposure
Programs	50	Continuous	Exposure

# Current Monitoring Program

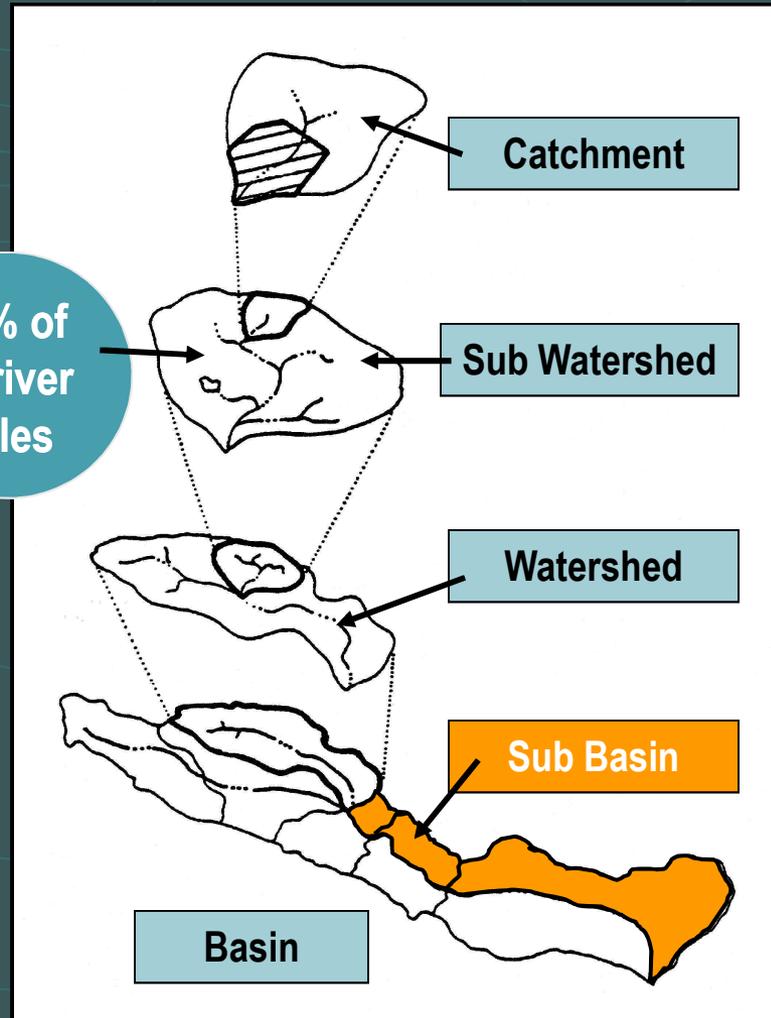
## EFFECTS

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TRENDS

75% of  
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## USE

BMP's,  
Site Design

NPS  
Assessment

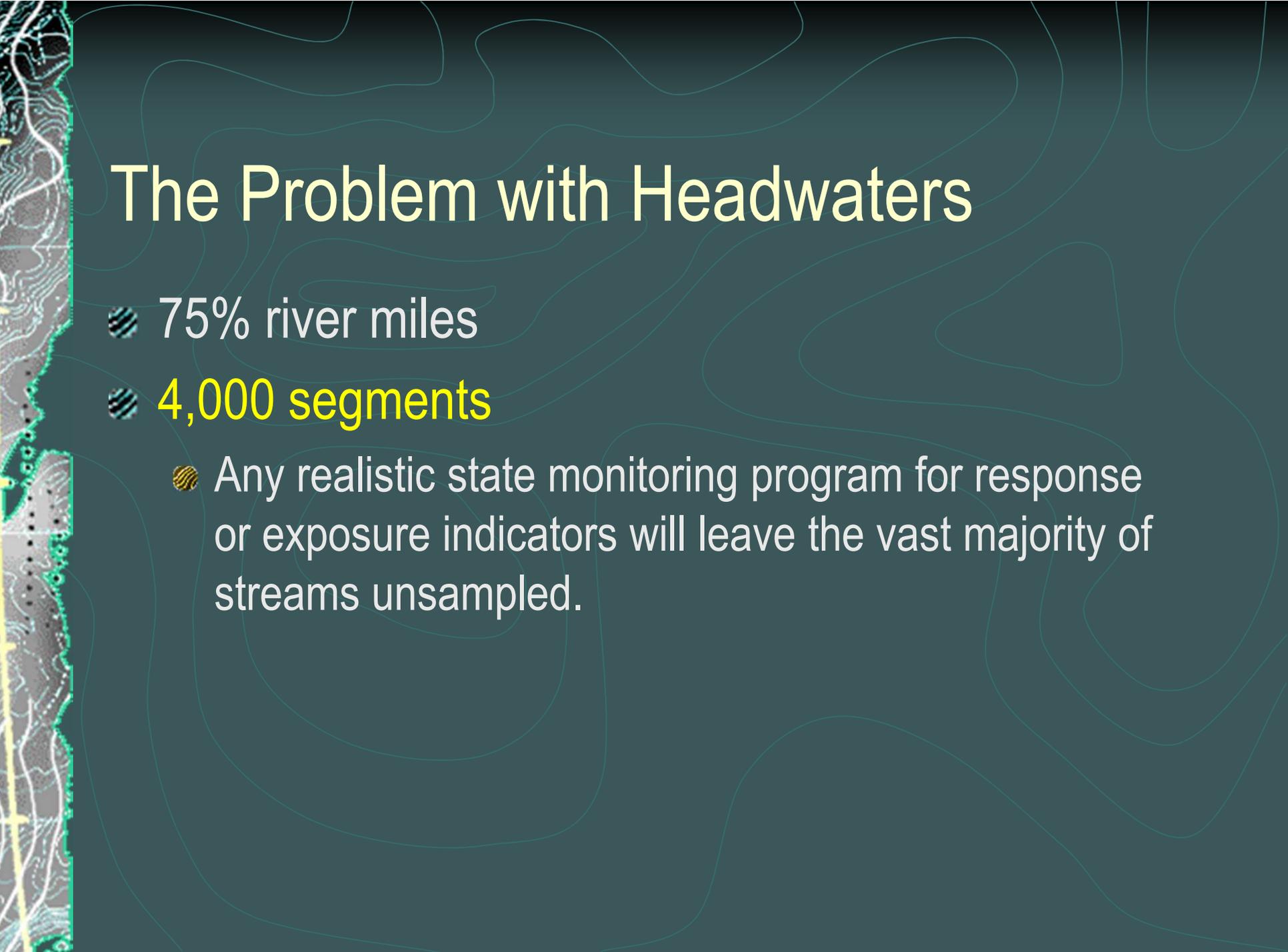
Land Use  
Zoning

Basin  
Planning

Basin  
Planning

# Local Network

Goal	Sites	Frequency	Indicators
Status	All	Low Flow	Response
Trends	Impaired	Continuous	Exposure
Restoration	PS Impaired	Low Flow	Exposure
	NPS Impaired	Annual Cycle Rainfall	Exposure
Protection	Clean	Continuous	Exposure
Programs	All	Continuous	Exposure



# The Problem with Headwaters

- 75% river miles
- **4,000 segments**
- Any realistic state monitoring program for response or exposure indicators will leave the vast majority of streams unsampled.

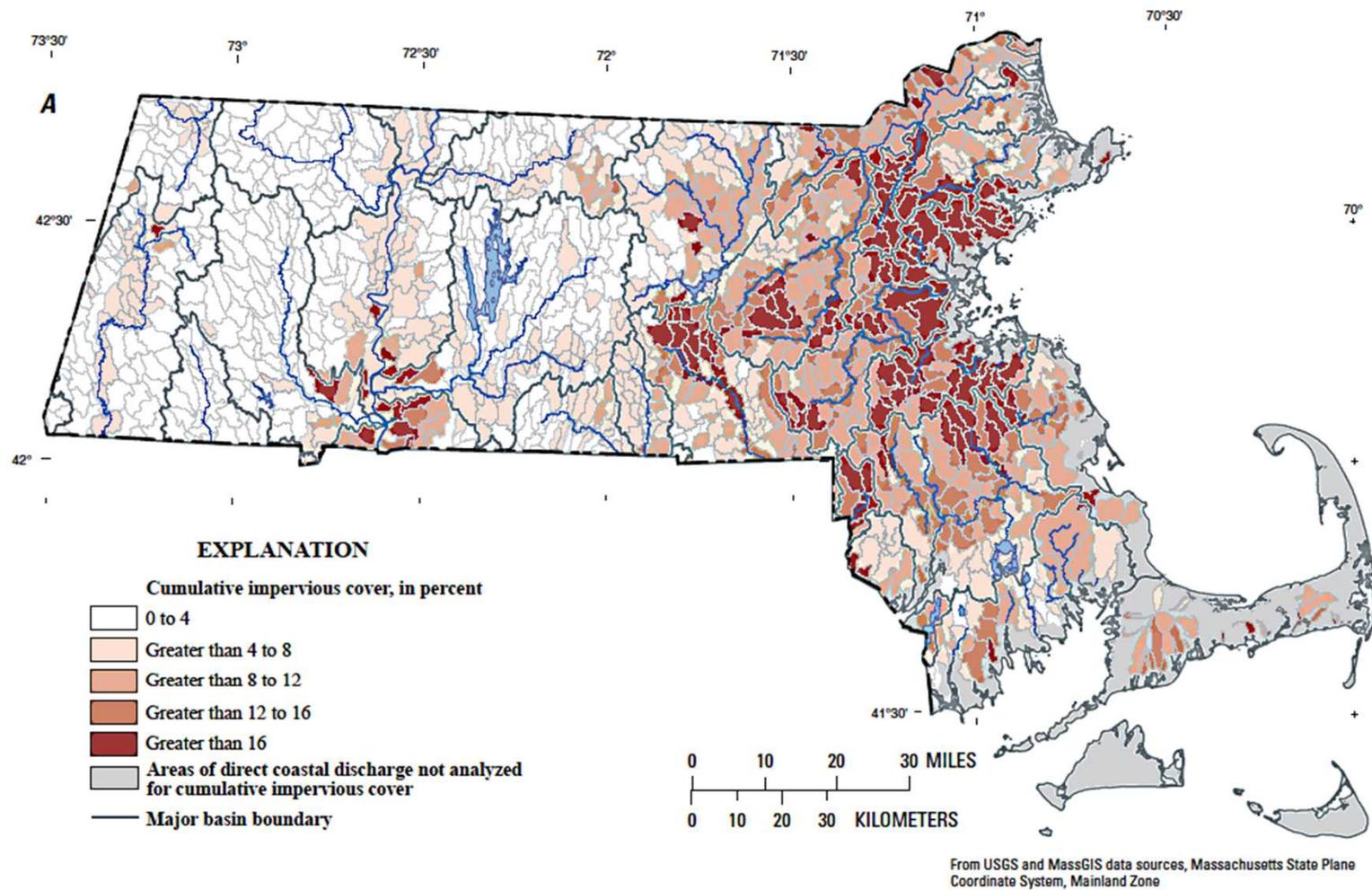


# Headwater Monitoring Options

- Probabilistic (generic)
  - ID problems
  - ID Threats
- Targeted (site specific)
  - Geo-target solutions
  - Diagnose and fix
  - Track Improvements

# Indicator Levels

Response	Biota Bacteria
Exposure	Water Chemistry Sediment Chemistry Flow Regime Physical Habitat Fish Tissue
Stressor	Land Use Loadings
Administrative	Permits WWTF Construction



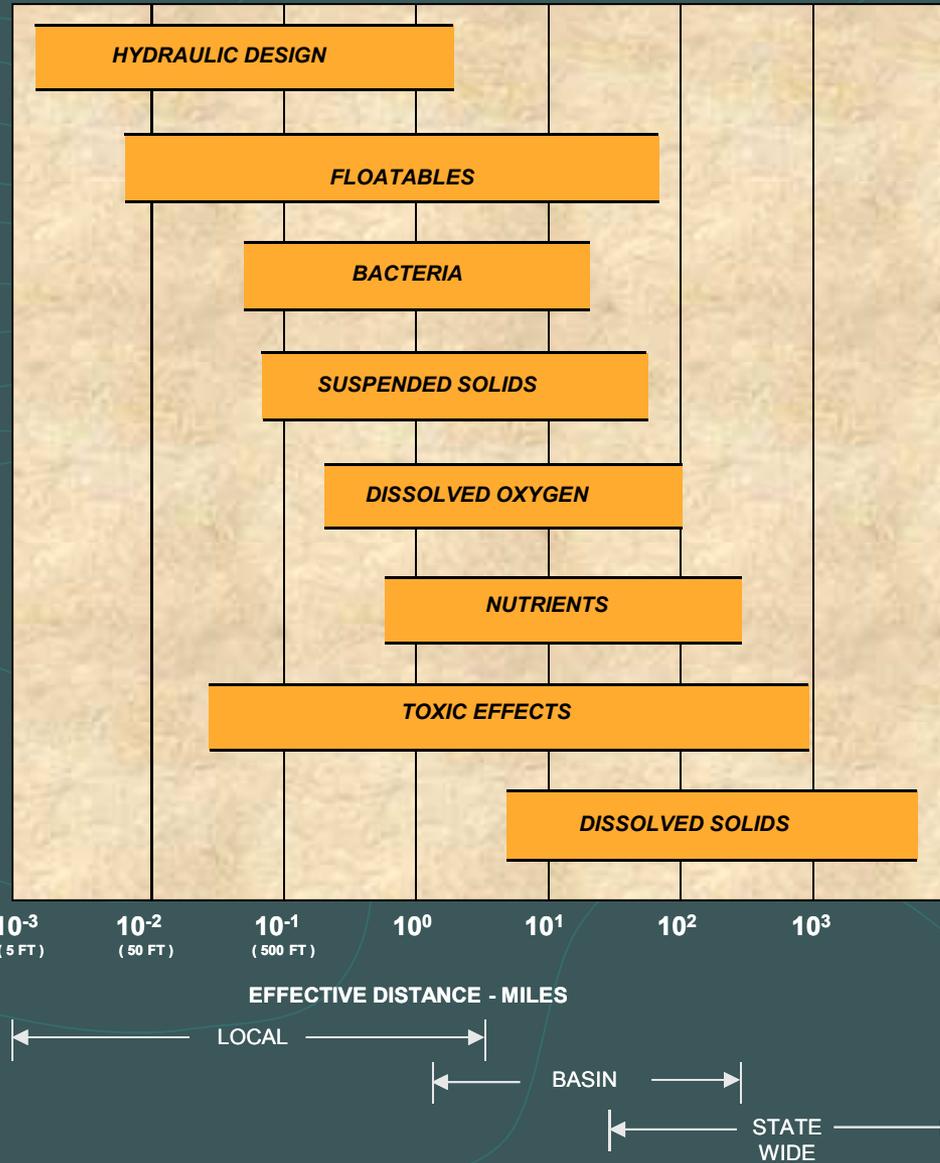
**Figure 24.** (A) Cumulative percent impervious cover in Massachusetts subbasins. (B) Cumulative percent impervious cover in Massachusetts 12-digit Hydrologic Unit Code (HUC-12) basins.



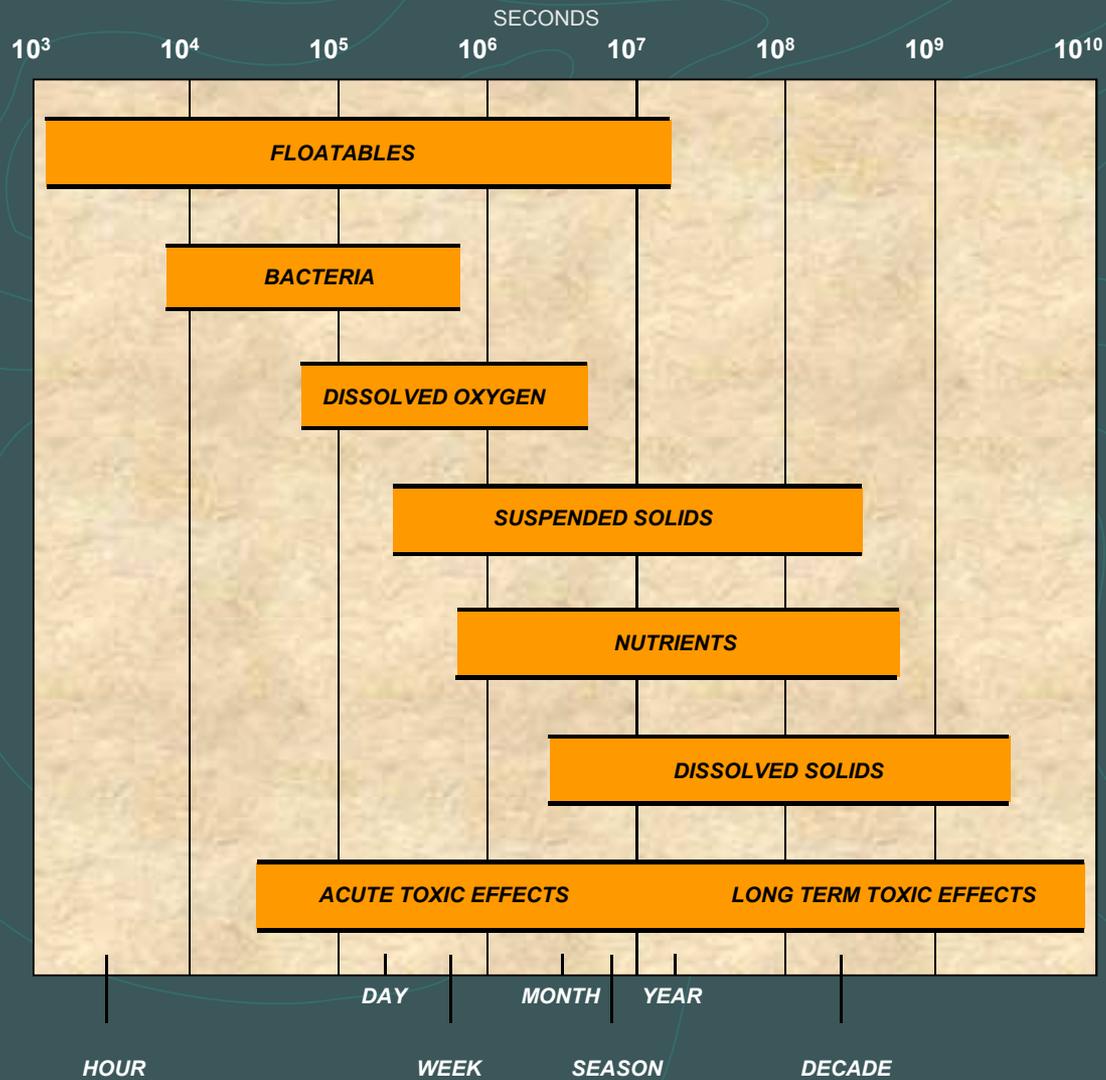
# Headwaters Strategy

Goals	Strategy
Status Trends	Impervious Cover Model Probabilistic Monitoring
Restoration Protection Program Support	Impervious Cover Model Statewide Network Volunteer Monitoring

# Space Scales



# Time Scales



# Overall Time and Space Scales

<b>SPACE SCALE</b>	Dissolved Solids	Toxicity	Nutrients	Suspended Solids	Dissolved Oxygen	Bacteria	Habitat
1 Statewide	X	Chronic	X	(X)	(X)		
2 Basins	(X)		X	X	X	(X)	(X)
3 Local		Acute		(X)	(X)	X	X
<b>TIME SCALES</b>							
1 Decade	X	Chronic	X				X
2 Year	X		X	X			X
3 Season			X	X	(X)		X
4 Month			X	X	X		
5 Week				X	X	X	
6 Day				X	X	X	
7 Hour		Acute				X	

A vertical strip on the left side of the slide shows a topographic map of a stream network. The map features contour lines, a network of streams, and a yellow line indicating a specific path or boundary. The background of the slide is a dark teal color with faint, light blue contour lines.

# Volunteer Monitoring

- Local space scales
- Visual and low tech methods
  - Habitat - "Unified Stream Assessment" (USA)
  - Bacteria - Coliert™
  - Aesthetics- "Stream Walks"
- **Not chemistry or biology**

# SMART Networks

Goal	Segments	Frequency	Indicators
Status	All (75% P.M.)	Low Flow	Response
Trends	37	Continuous	Exposure
Restoration	PS Impaired	Low Flow	Exposure
	NPS Impaired (ICM)	Annual Cycle Rain/events	Stressor
Protection	13	Continuous	Exposure
Programs	50	Continuous	Exposure

# SMART Networks Summary

Tier	Schedule	Purpose
Statewide	Continuous	Trends Protection Program Support
Basins	5 year Cycle	Point Source Restoration
Local	Flexible	Nonpoint Source Restoration

# Natural Partnerships

Program	Partners	Indicators
Statewide	Federal/State	Flow Sediment Nutrient loading
Basins	State/Municipal	Biology Chemistry
Local	State/Local	Habitat Bacteria Aesthetics



