National Biological Assessment and Criteria Workshop

Advancing State and Tribal Programs

Coeur d'Alene, Idaho
31 March – 4 April, 2003

TALU 202

Implementation of Tiered Aquatic Life Uses: Ohio Rivers and Streams, 1978 - present

Presented by

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Jeffrey E. DeShon, Ohio Environmental Protection Agency

Development via Implementation

Narrative to Numeric Biocriteria

- 1978: tiered uses replace general use.
- 1980: systematic biosurveys initiated; narrative bioassessment “criteria”.
- 1983-84: Stream regionalization project - first use of regional reference concept.
- 1987: first numeric biocriteria proposed.
- 1990: numeric biocriteria adopted in Ohio WQS; formal rotating basin approach
- 1990s: various technological improvements

Aquatic Life Use

Definition:

A designation (classification) assigned to a waterbody based on the ***potential*** aquatic community that can realistically be sustained given the regional reference condition and the level of protection afforded by the applicable criteria.

Aquatic Life Designated Uses

Ohio Water Quality Standards

- Uses are portrayed as narratives.
- Chemical and biological criteria are assigned to each in accordance with the attributes ascribed by the designated use narrative.

Uses Are Assigned Based on Demonstrated Potential (in order of importance)

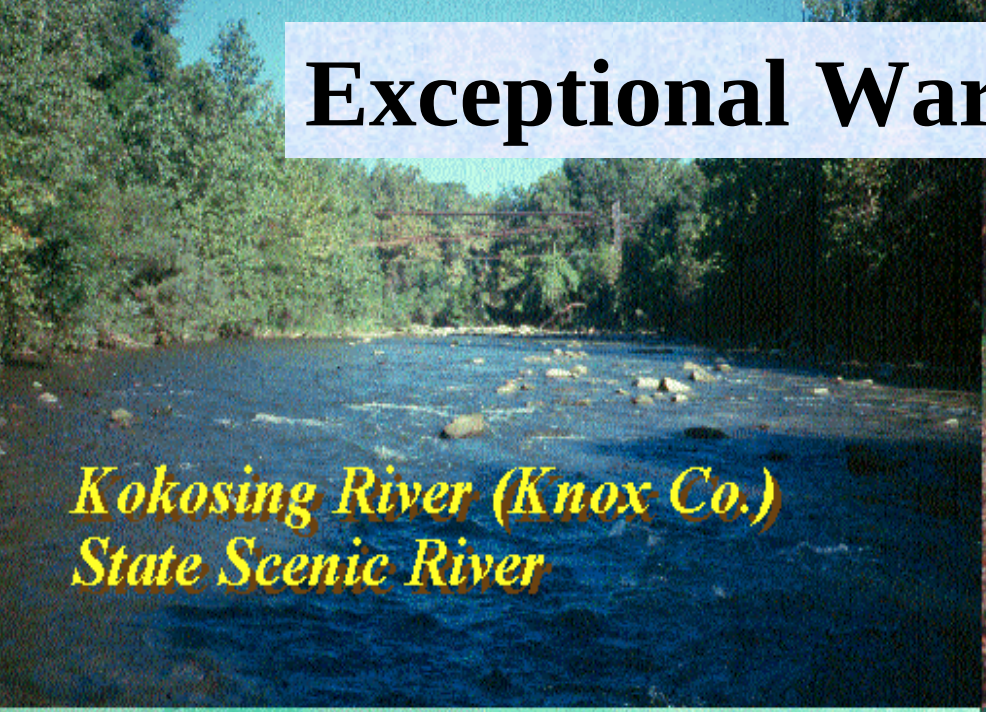
- Attainment of the biological criteria.
- Habitat assessment demonstrates the potential to attain the designated use.
- Attainment of uses is tracked in State 305[b] reports.

Aquatic Life Use Designations: Ohio WQS

Based on Biological Community Attributes

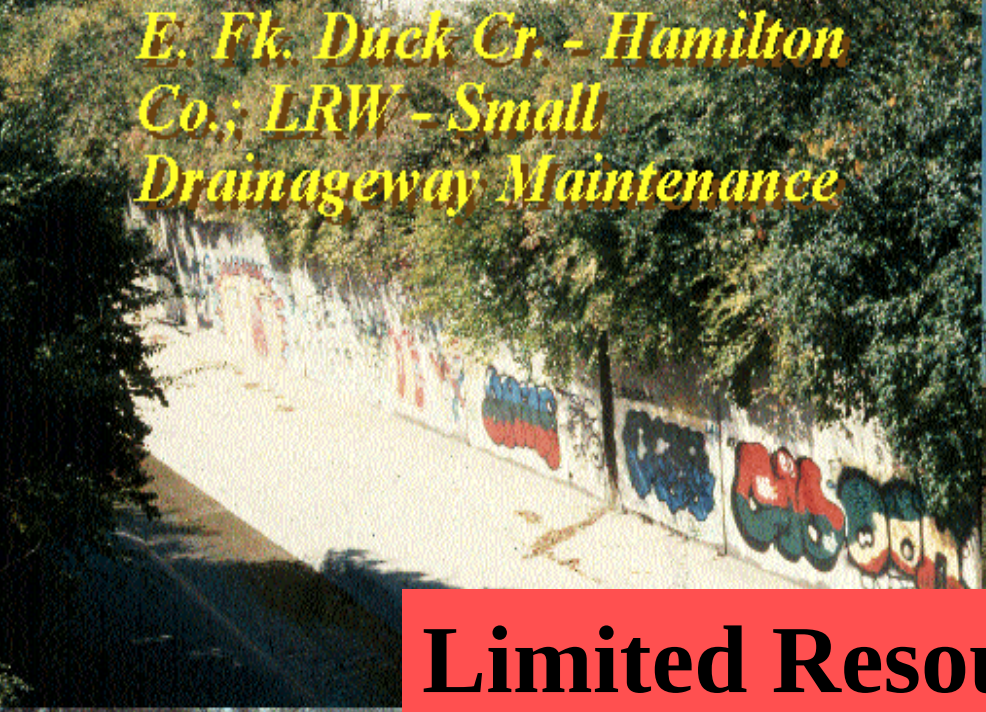
- Exceptional Warmwater Habitat (EWH): **preserve** & maintain existing high quality.
- Warmwater Habitat (WWH): basic **restoration** goal for most streams.
- Modified Warmwater Habitat (MWH): **attainable** condition for streams under drainage maintenance or other essentially permanent hydromodifications (*e.g.*, impoundments).
- Limited Resource Waters (LRW): essentially irretrievable, human induced (*e.g.*, widespread watershed modifications) or naturally occurring conditions (*e.g.*, ephemeral flow).

Exceptional Warmwater Habitat

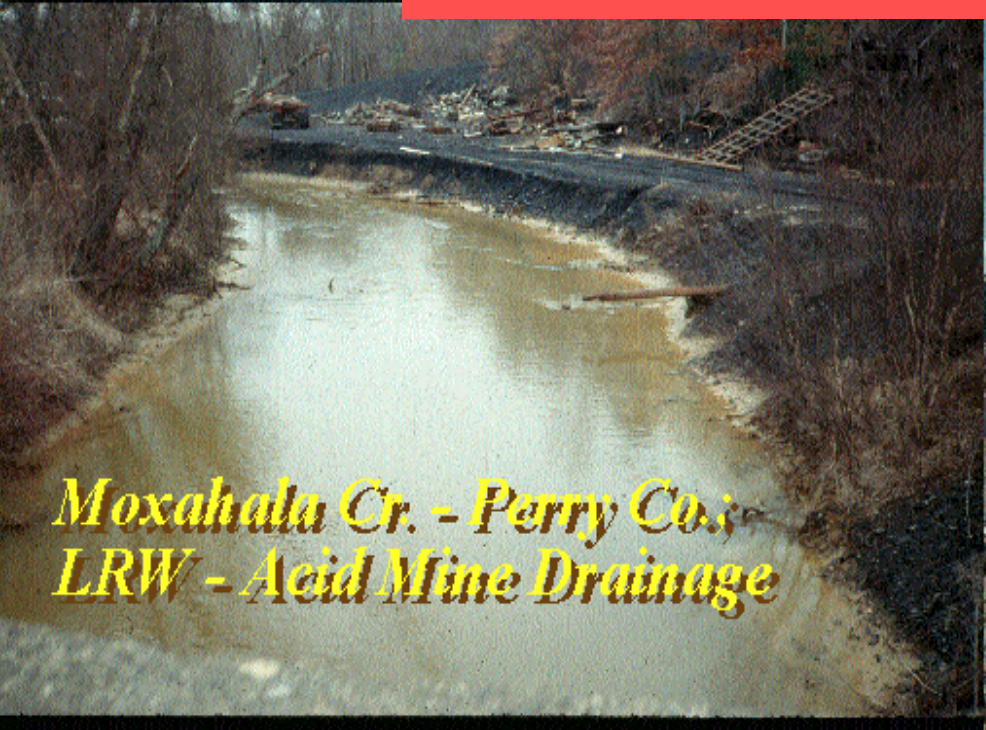



Bokengehalas Cr. (Logan Co.)
E. Corn Belt Plain Ecoregion
Powell Creek (Definace Co.)
Huron/Erie Lake Plain
Warmwater Habitat
Wolf Creek (Summit Co.)
Erie/Ontario Lake Plain Ecoregion
Duck Cr. Subbasin (Wash. Co.)
W. Allegheny Plateau Ecoregion

Modified Warmwater Habitat



Limited Resource Waters



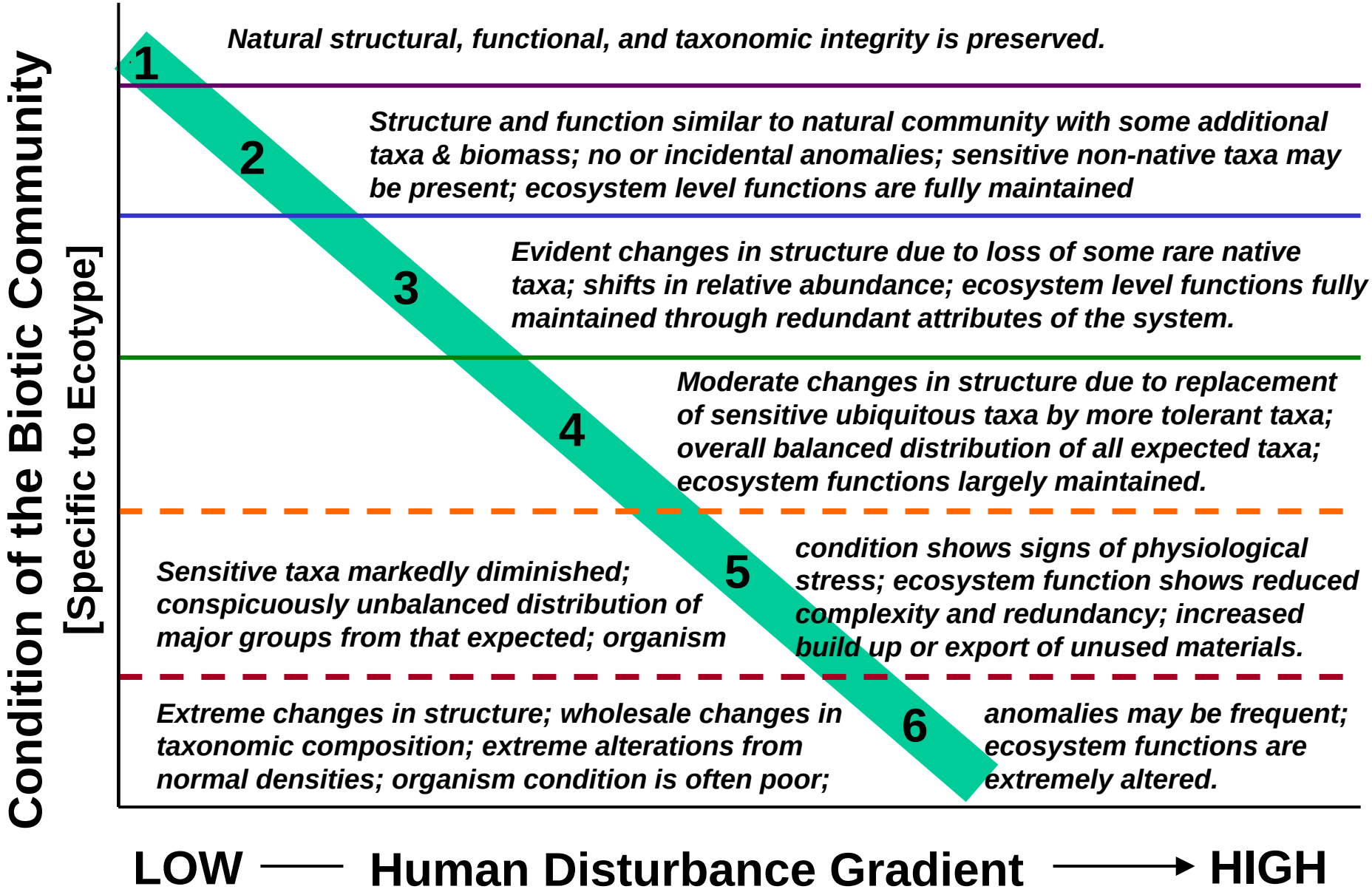
Why Tiered Uses?

Rationale for Tiered Uses in 1978

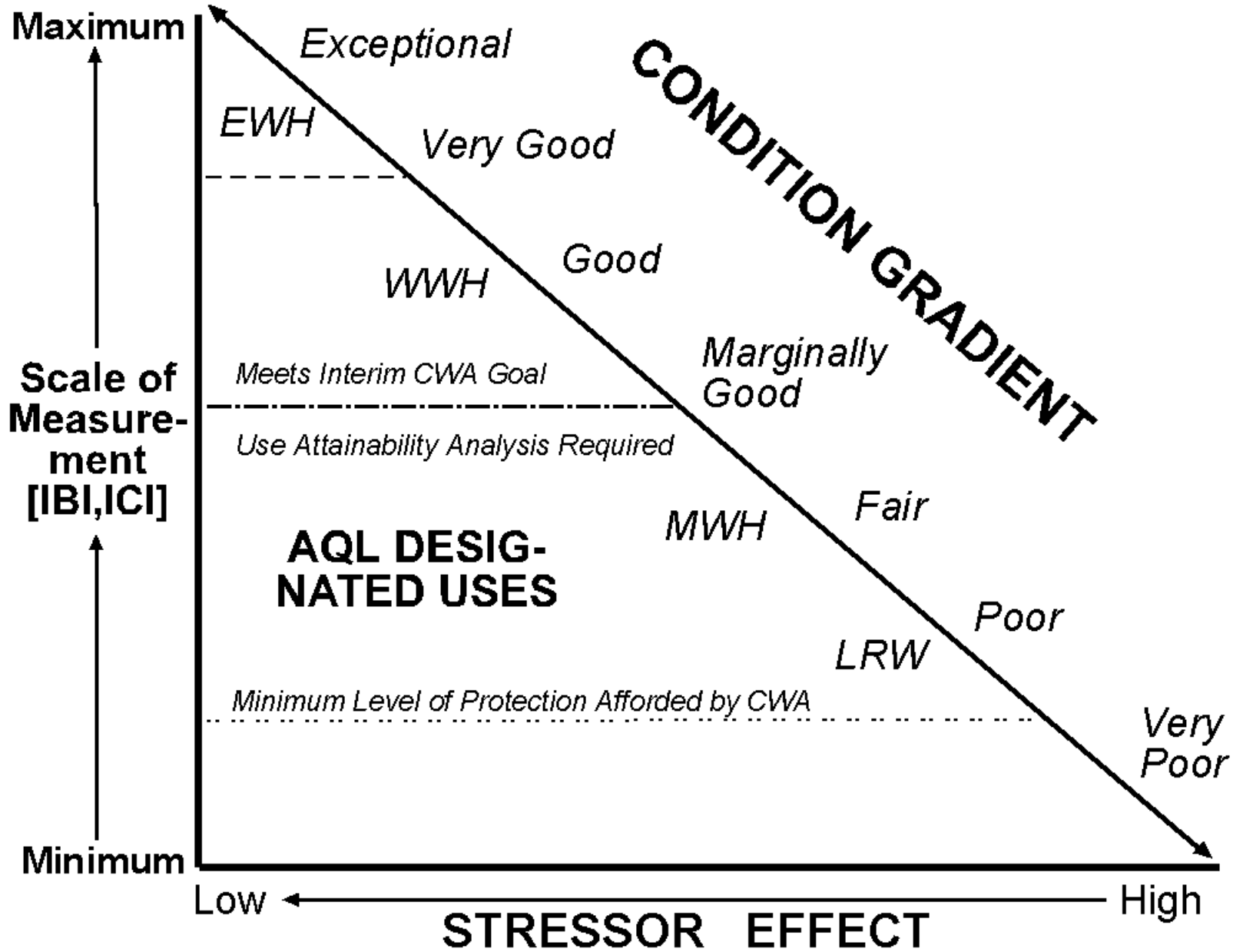
- Natural history - published texts conveyed a general knowledge of variable, yet distinguishable ecological attributes.
- One-size-fits-all does not “sell”
- Promised customized and cost-effective water quality management outcomes (WQS, permits, etc.).

Tiered Aquatic Life Use Conceptual Model: Draft Biological Tiers

(10/22 draft)



DESIGNATED USE OPTIONS ALONG THE BIOAXIS AND BIOLOGICAL CONDITION GRADIENT



Ohio Biological Criteria: Adopted May 1990 (OAC 3745-1-07; Table 7-14)

Huron Erie Lake Plain (HELP)

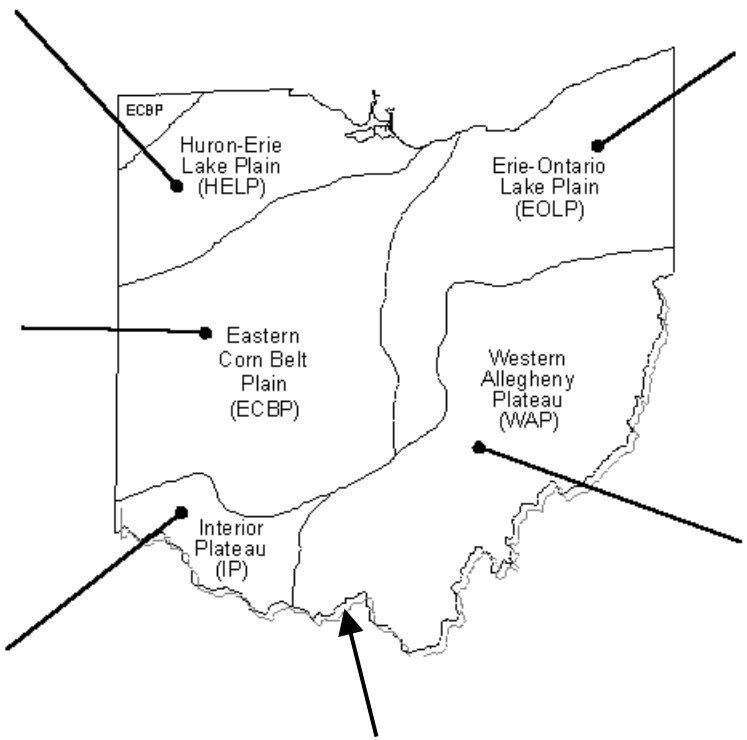
Use	Size	IBI	MIwb	ICI
WWH	H	28	NA	34
	W	32	7.3	34
	B	34	8.6	34
MWH-C	H	20	NA	22
	W	22	5.6	22
	B	20	5.7	22
MWH-I	B	30	5.7	NA

Eastern Corn Belt Plains (ECBP)

Use	Size	IBI	MIwb	ICI
WWH	H	40	NA	36
	W	40	8.3	36
	B	42	8.5	36
MWH-C	H	24	NA	22
	W	24	6.2	22
	B	24	5.8	22
MWH-I	B	30	6.6	NA

Interior Plateau (IP)

Use	Size	IBI	MIwb	ICI
WWH	H	40	NA	30
	W	40	8.1	30
	B	38	8.7	30
MWH-C	H	24	NA	22
	W	24	6.2	22
	B	24	5.8	22
MWH-I	B	30	6.6	NA



Statewide Exceptional Criteria

Use	Size	IBI	MIwb	ICI
EWH	H	50	NA	46
	W	50	9.4	46
	B	48	9.6	46

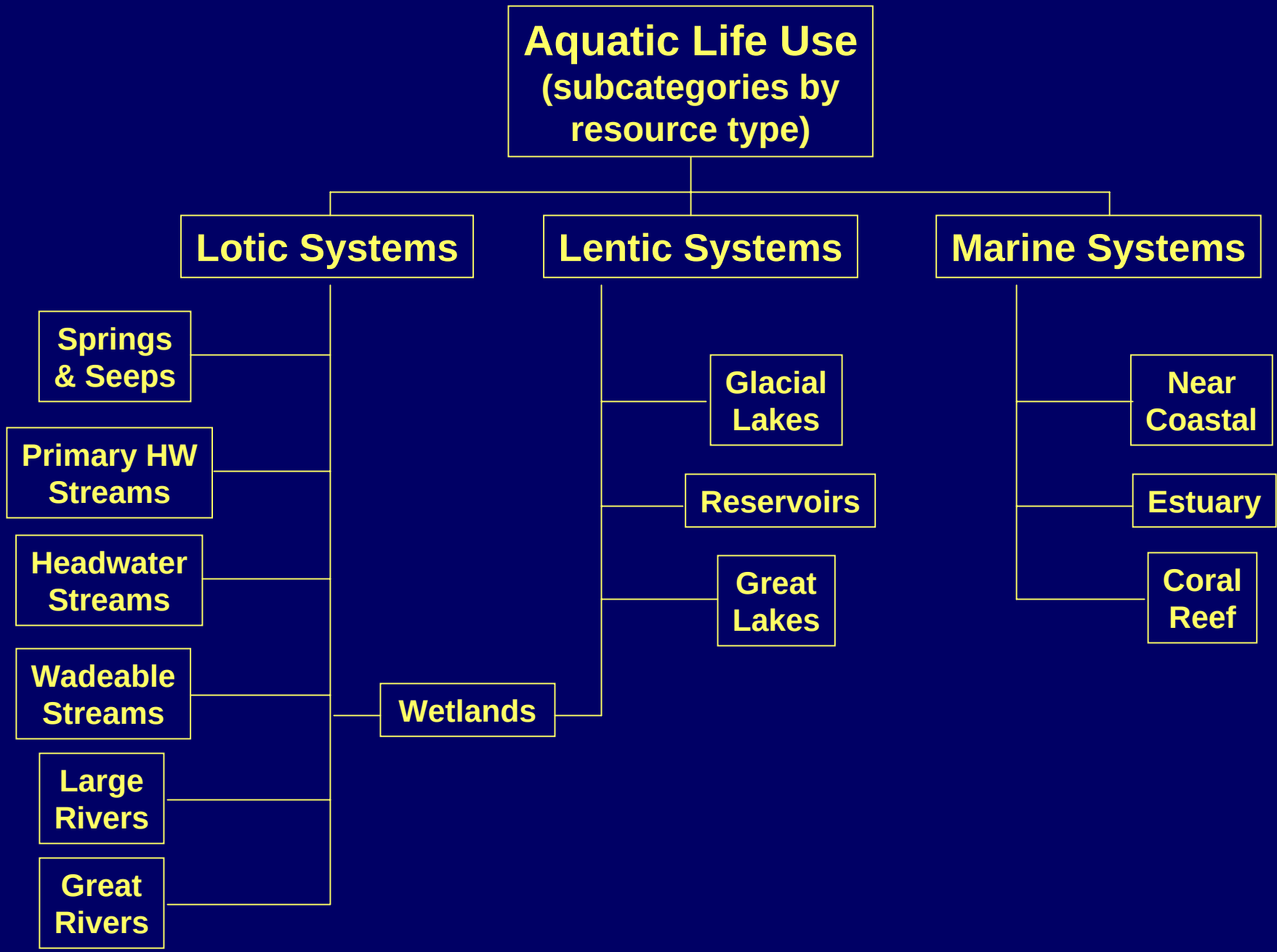
Erie Ontario Lake Plain (EOLP)

Use	Size	IBI	MIwb	ICI
WWH	H	40	NA	34
	W	38	7.9	34
	B	40	8.7	34
MWH-C	H	24	NA	22
	W	24	6.2	22
	B	24	5.8	22
MWH-I	B	30	6.6	NA

Western Allegheny Plateau (WAP)

Use	Size	IBI	MIwb	ICI
WWH	H	44	NA	34
	W	44	8.4	34
	B	40	8.6	34
MWH-C	H	24	NA	22
	W	24	6.2	22
	B	24	5.8	22
MWH-A	H	24	NA	30
	W	24	5.5	30
	B	24	5.5	30
MWH-I	B	30	6.6	NA

GENERAL TEMPLATE FOR STRATIFYING RESOURCE TYPES



OHIO SPECIFIC TEMPLATE FOR STRATIFICATION

Warmwater Lotic Systems

Primary HW Streams (<1-3 mi²)
- Class A
- Class B
- Class B Modified
- Class C

Headwater Streams (1-20 mi²)
- EWH
- WWH
- MWH
  - 2 Types: -Channel mod. --Non acidic MD
- USH
- LRW
  - 2 Types: -Drainage maint. -AMD

Wadeable Streams (20-300 mi2)
- EWH
- WWH
- MWH
  - 2 Types: -Channel mod. --Non acidic MD
- USH
- LRW
  - 2 Types: -Drainage maint. -AMD

Large Rivers (>200-300 mi²)
- EWH
- WWH
- MWH
  - 3 Types: -Impounded -Channel mod. --Non acidic MD
- LRW
  - 1 Type: -Other (case specific)

Great Rivers (>6000 mi²)
- Shoreline Habitat Types (A,B,C)
- Modified Habitat

Adopted in WQS
Assessment Tool
Under Study
ORSANCO

Wetlands – Freshwater Lentic and Lotic systems

Isolated Depressions
open or closed mineral or organic soils

Riparian Mainstem Depressions
3rd order or >

Riparian Headwater Depressions
1st or 2nd order

Riverine
perennial connection to stream

Slope
riparian isolated fringing

Fringing
Lakes other than L. Erie

Lake Erie Coastal
restricted
unrestricted

Swamp forest, Vernal pool, marsh, sedge-grass community, shrub swamp, calcareous fens, sphagnous bogs

- ***Superior Wetland Habitat***
- ***Wetland Habitat***
- ***Restorable Wetland Habitat***
- ***Limited Quality Wetland Habitat***

Special Use Designations
A Recreation
B Education
C Fish reproduction habitat
D Bird Habitat
E Flood Storage
F Water Quality Improvement

Biological Criteria: Maintenance & Development Tasks

- Reference sites “re-sampling” linked to basin monitoring cycle (10 yr. process); keep tabs on reference condition.
- “Adapt” uses to emerging issues.
- Update data analysis consistent with new technologies.
- Development and improvement of stressor thresholds, gradients, and signatures.

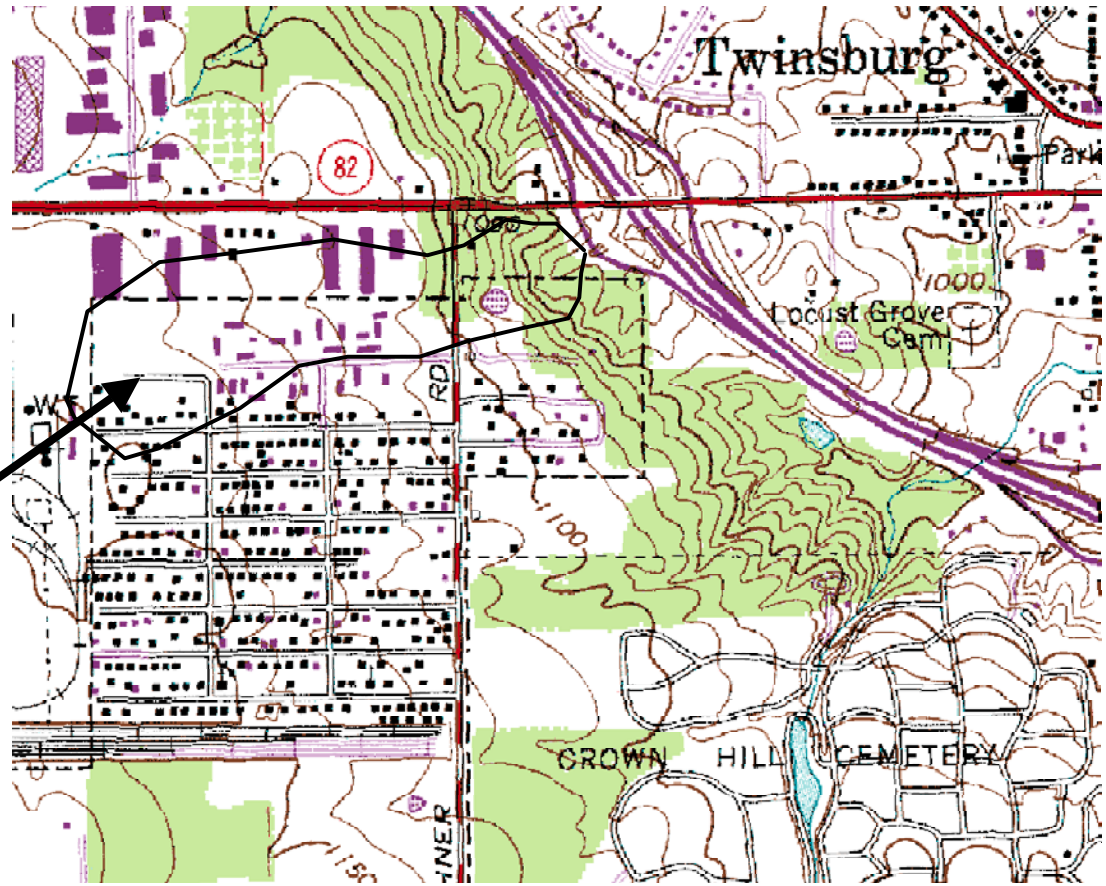
Ohio EPA
Division of Surface Water

Primary Headwater Stream Initiative

- Robert D. Davic
- Steve Tuckerman
- Paul Anderson
- Mike Bolton

Desktop Primary Headwater Stream Identification – Importance of Scale

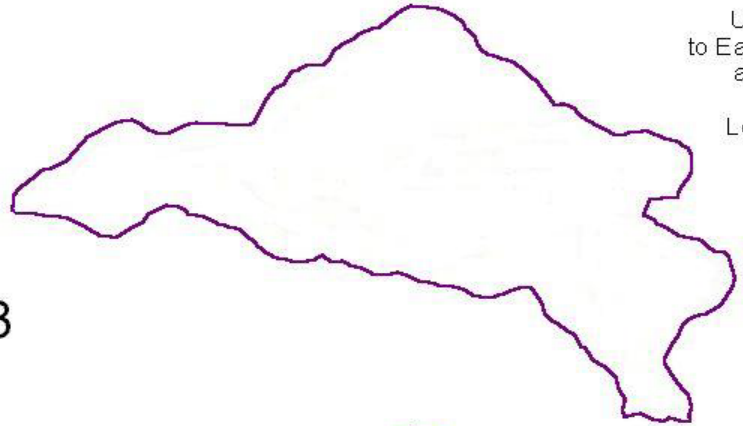
- **USGS 1: 24,000 Topographic Mapping Scale**



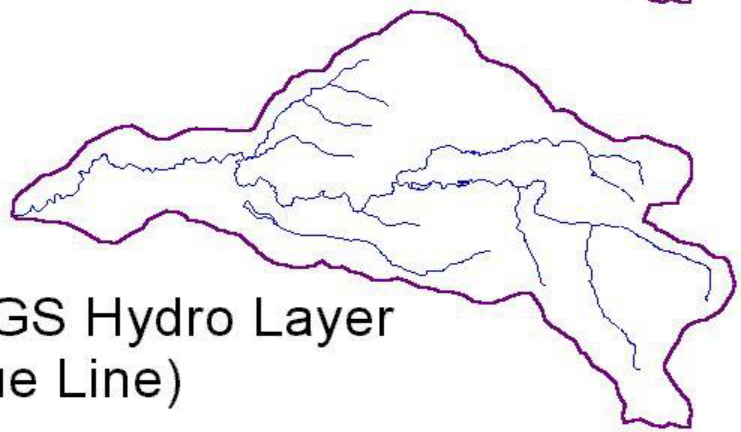
Stream Mapping Scale

Unnamed Tributary
to East Branch Black River
at River Mile 22.65

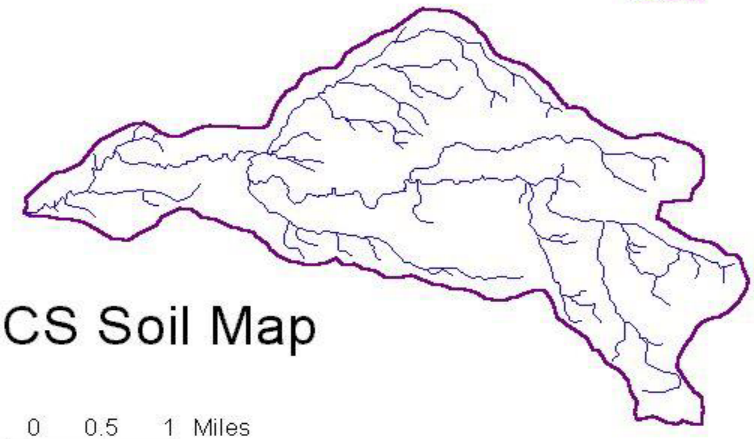
Lorain County, Ohio



RF3



USGS Hydro Layer
(Blue Line)



NRCS Soil Map

0.5 0 0.5 1 Miles

N

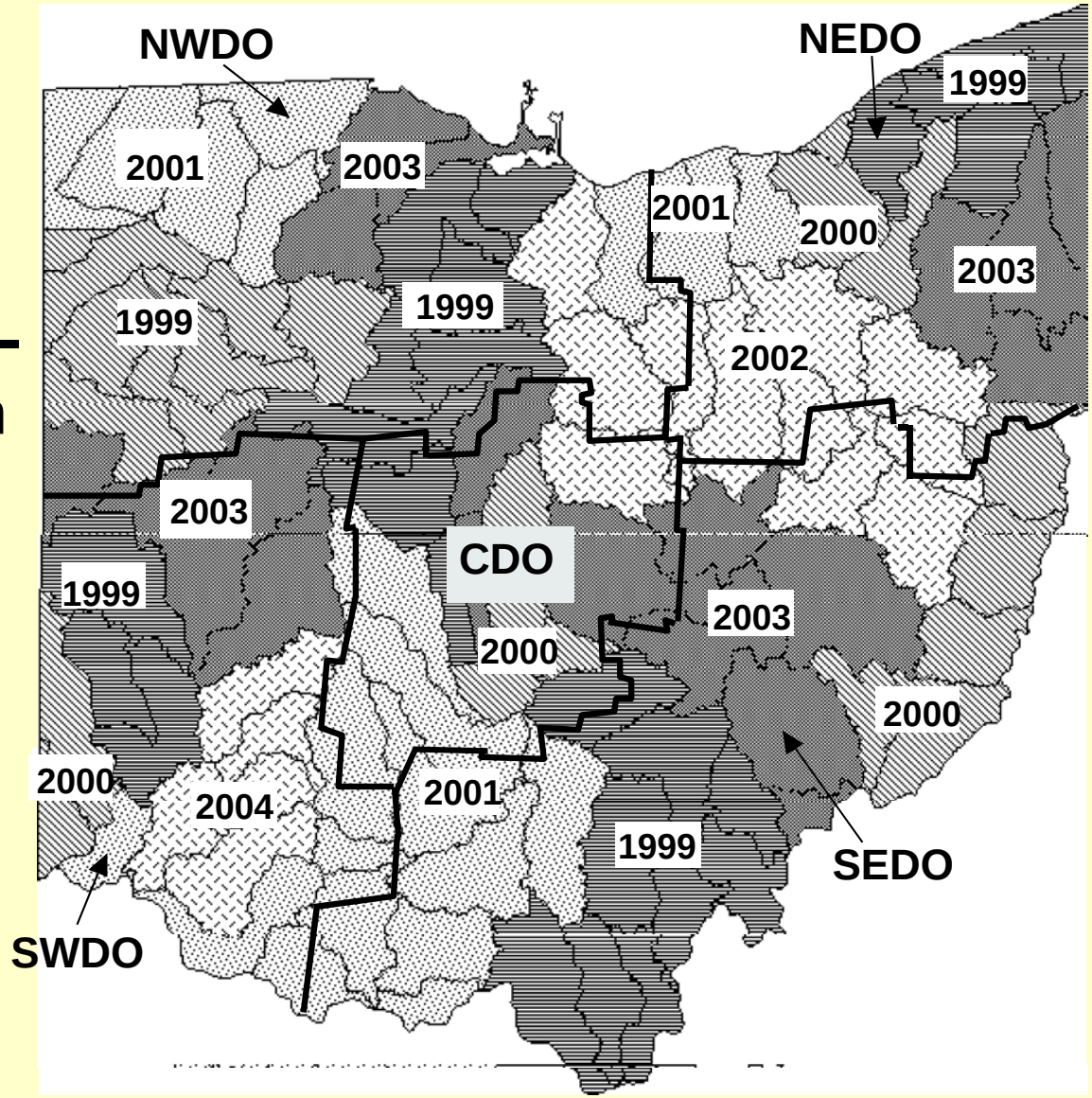
Monitoring & Assessment Should Be a Determinant in How WQ is Managed

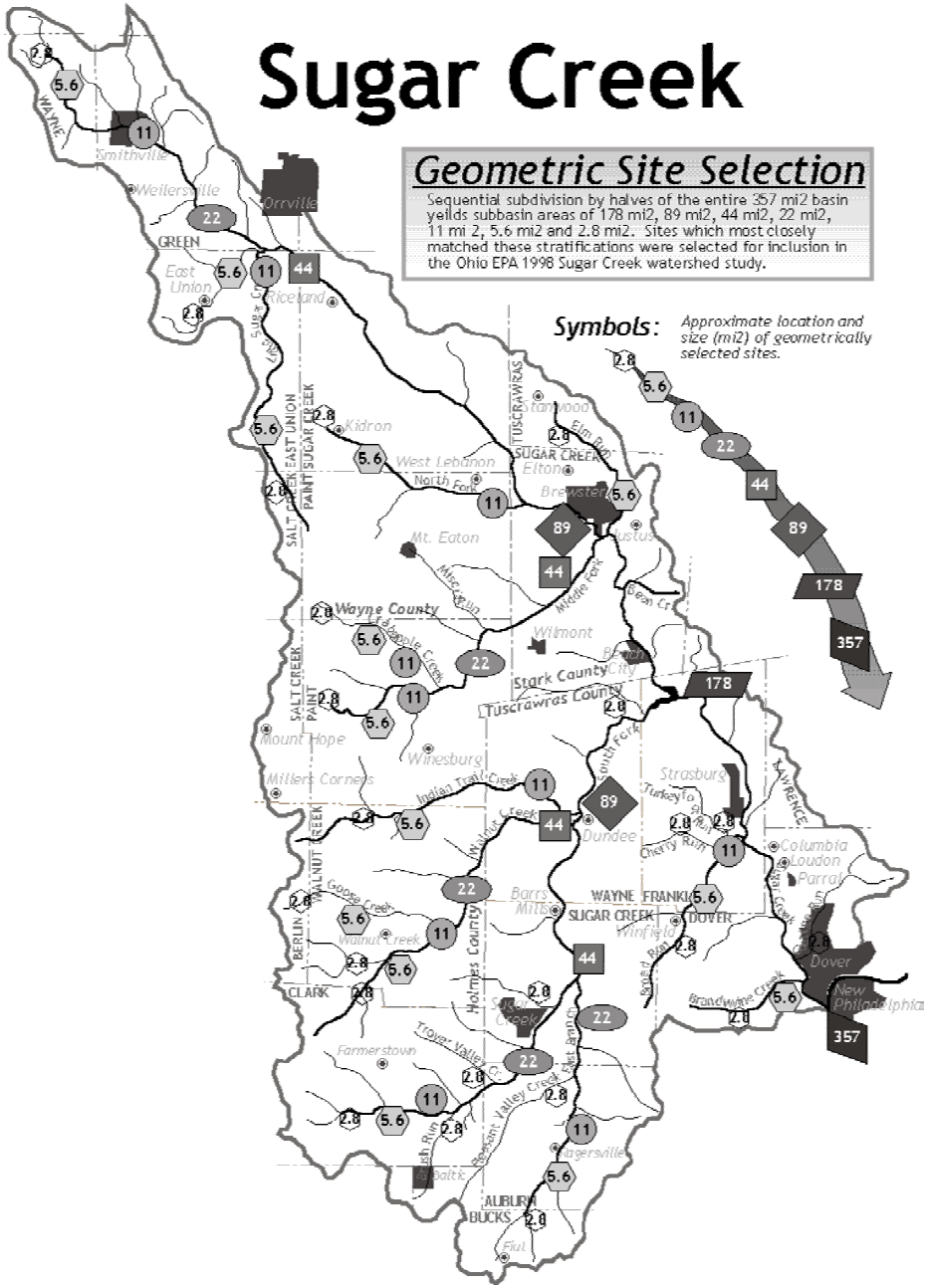
- Problem identification and characterization.
- Policy/program and legislation development.
- Criteria development and application.
- Demonstrate WQ management program effectiveness, *i.e.*, manage for environmental results.

Develop monitoring & assessment as an overall function of WQ management, not on a piecemeal basis.

Ohio EPA 5-Year Basin Approach for Monitoring & Assessment

- Rotating basin approach for determining annual monitoring activities.
- Correlated with NPDES permit schedule.
- Supports annual WQS use designation rule-making.
- Aligned with 15 year TMDL schedule.





Sugar Creek Subbasin: Example of Geometric Site Selection Process

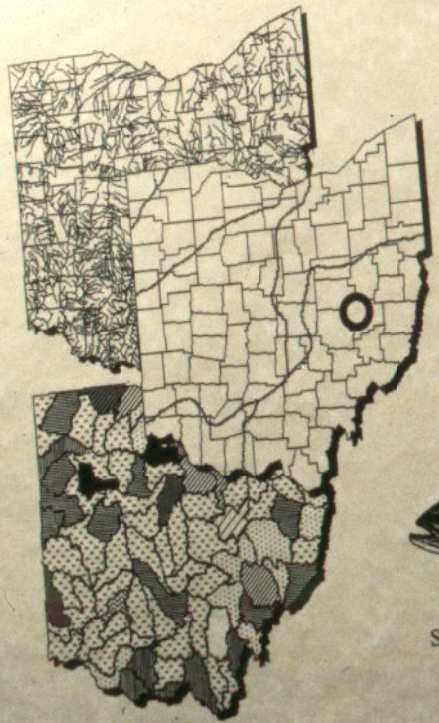
- Part of 15 yr. TMDL development schedule beginning in 1998
- Augmented by 5 -year basin approach process (1980-1997)
- Increased miles of assessed streams & rivers annually
- **Resolve undesignated streams**
- **Support UAAs for all waters**
- **Close 305b/303d listing gaps**
- **Generate broader database for development of improved tools**

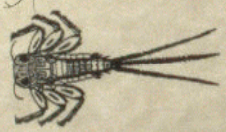
State of Ohio
Environmental Protection Agency

Monitoring and Assessment Section
Division of Surface Water

Biological and Water Quality Study of Wills Creek and Selected Tributaries

Guernsey, Coshocton, and Muskingum Counties, Ohio





Mayfly (*Stenacron sp.*)

Smallmouth Bass (*Micropterus dolomieui*)

October 31,1995

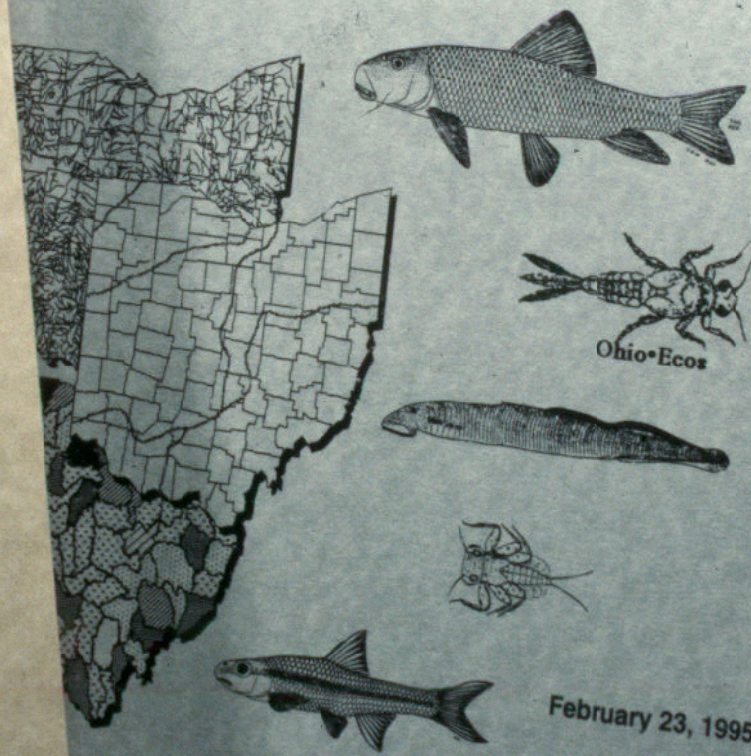
P.O. Box 1049, 1800 WaterMark Dr., Columbus, Ohio 43215-1099

State of Ohio
Environmental Protection Agency

Monitoring & Assessment Section
Division of Surface Water

Ohio EPA Technical Report Series

The Role of Biological Criteria in Water Quality Monitoring, Assessment, and Regulation



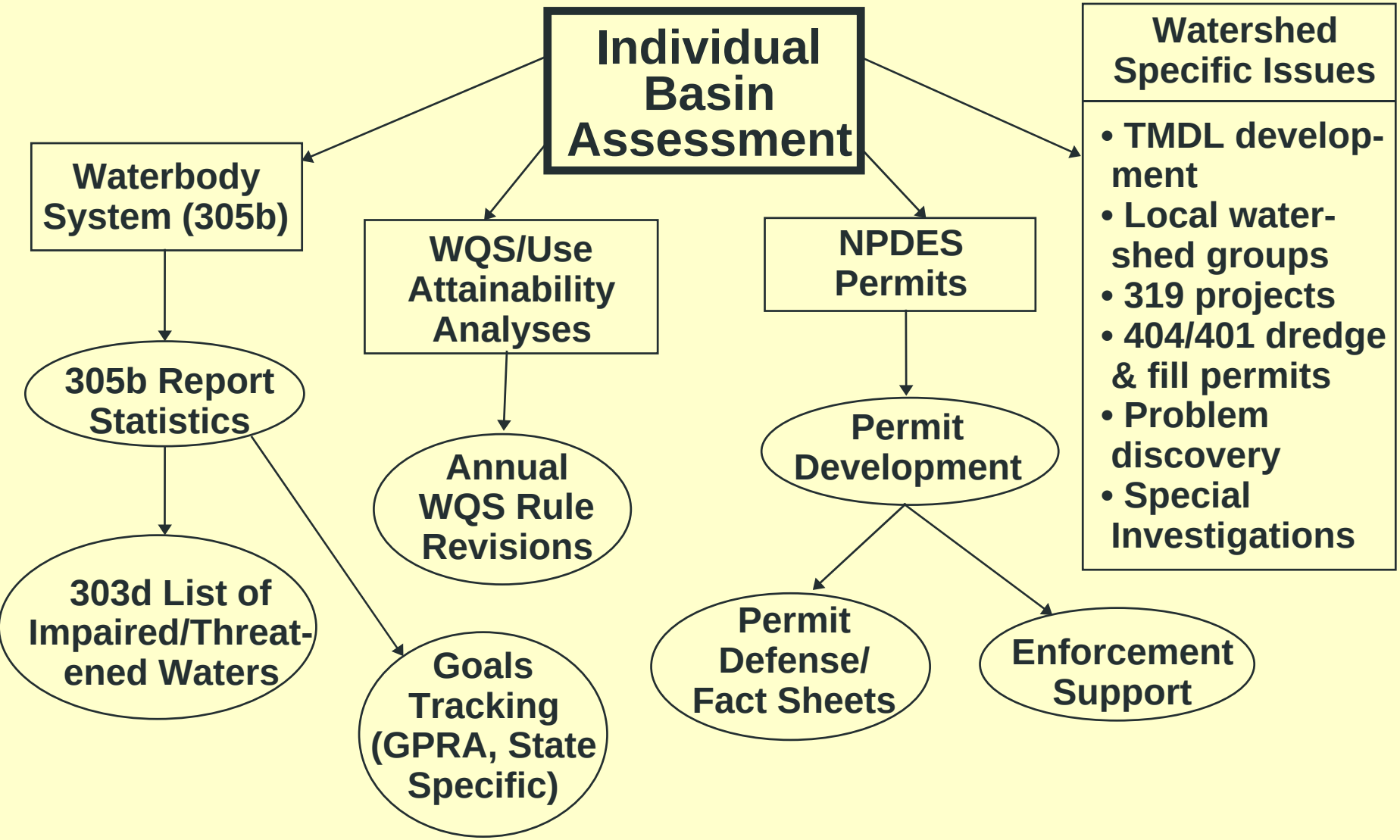
Ohio•Ecos

February 23, 1995

Environmental Regulation in Ohio
Institute of Business Law
Cleveland, Ohio

Mark Dr., Columbus, Ohio 43216-1049

Functional Support Provided by Annual Rotating Basin Assessments



Aquatic Life Designated Uses

Ohio Water Quality Standards

- Uses are portrayed as narratives.
- Chemical and biological criteria are assigned to each in accordance with the attributes ascribed by the designated use narrative.

Uses Are Assigned Based on Demonstrated Potential (in order of importance)

- Attainment of the biological criteria.
- Habitat assessment demonstrates the potential to attain the designated use.
- Attainment of uses is tracked in State 305[b] reports.

Aquatic Life Use Attainment

Definition:

The condition when a waterbody has demonstrated, through use of ambient biological and/or chemical data, that it does not significantly violate biological or water quality criteria for that use.

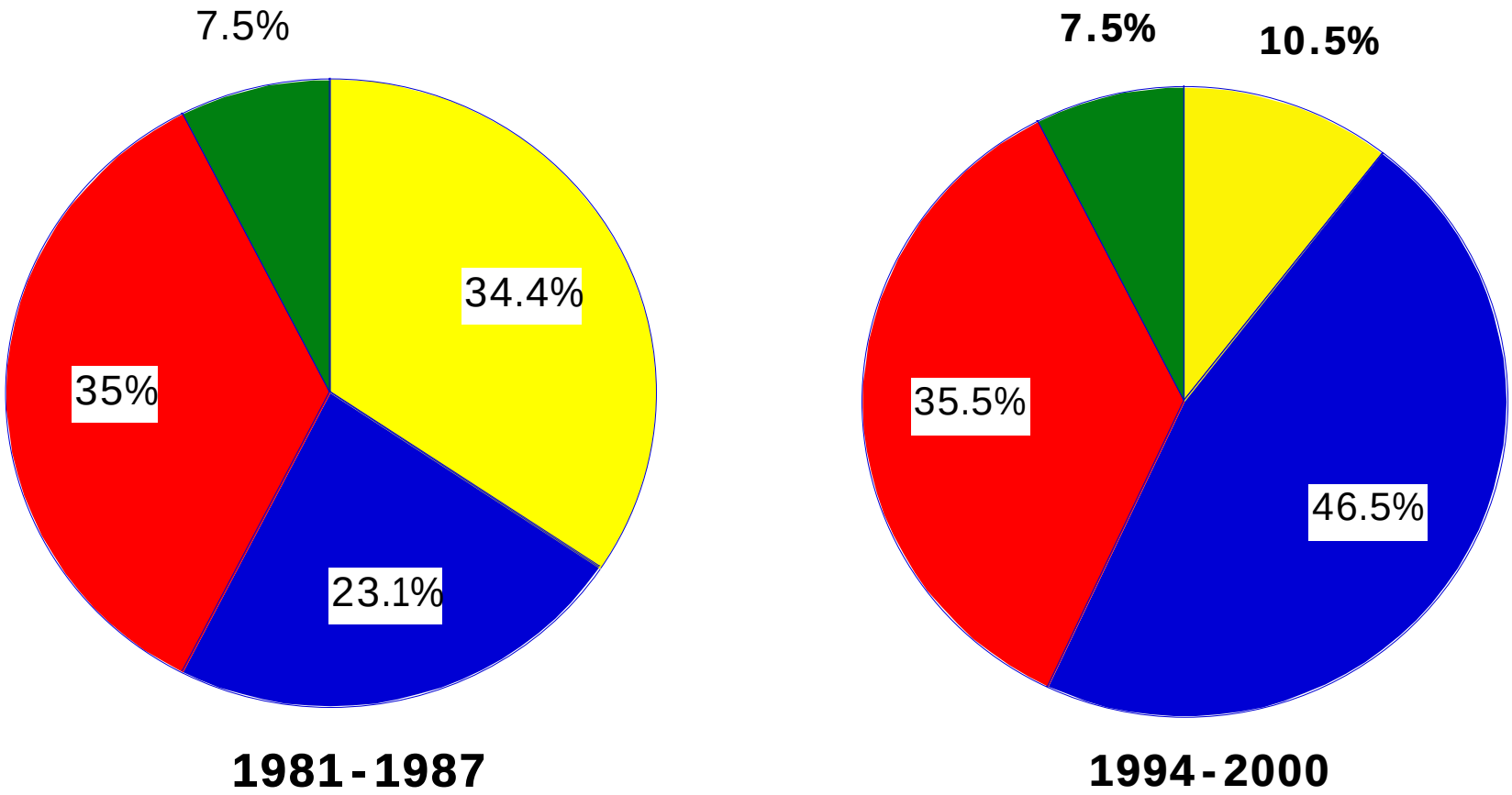
(1990 305b Report, Volume I)

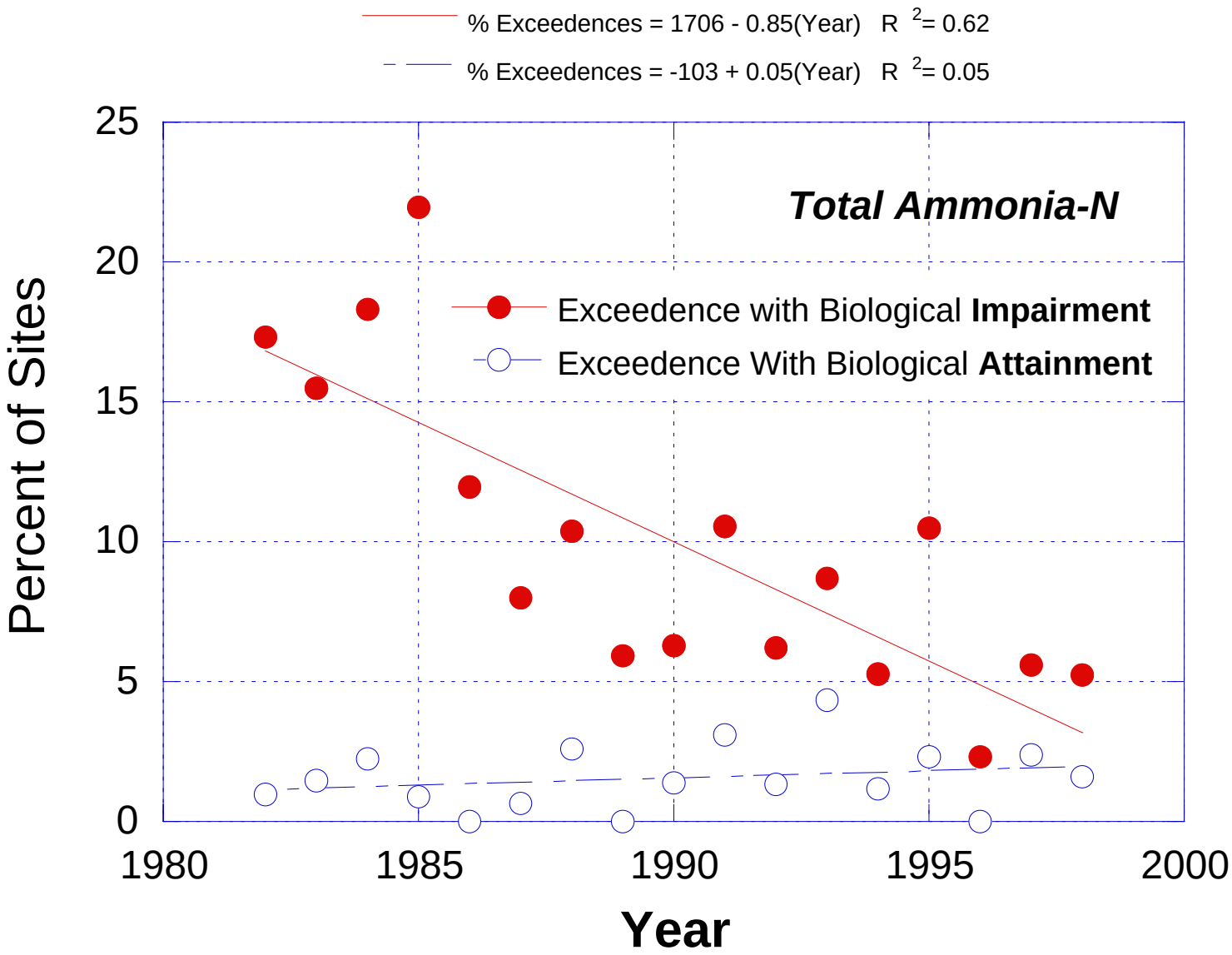
How to Measure?

Early Implementation Issues

- Chemical criteria only in 1978
- Vision for eventual bioassessment
- 1980 305[b] report reality check
- Spurred concerted effort to develop biological assessment tools and biocriteria
- Later analyses of statewide database led to continuing refinements of all indicators.

COMPARATIVE ANALYSIS OF CHEMICAL & BIOLOGICAL ASSESSMENT FOR ALUS: OHIO RIVERS & STREAMS




% Exceedences = 1706 - 0.85(Year) R 2= 0.62
% Exceedences = -103 + 0.05(Year) R 2= 0.05
Total Ammonia-N
Exceedence with Biological Impairment
Exceedence With Biological Attainment
Percent of Sites
25
20
15
10
5
0
1980
1985
1990
1995
2000
Year

Determining Use Attainment Status With Biocriteria

FULL ATTAINMENT

- **ALL** biological indices are at or within non- significant departure of the applicable biocriterion

PARTIAL ATTAINMENT

- A MIX of biological index scores at or within non-significant departure **and** below the applicable biocriterion

NON-ATTAINMENT

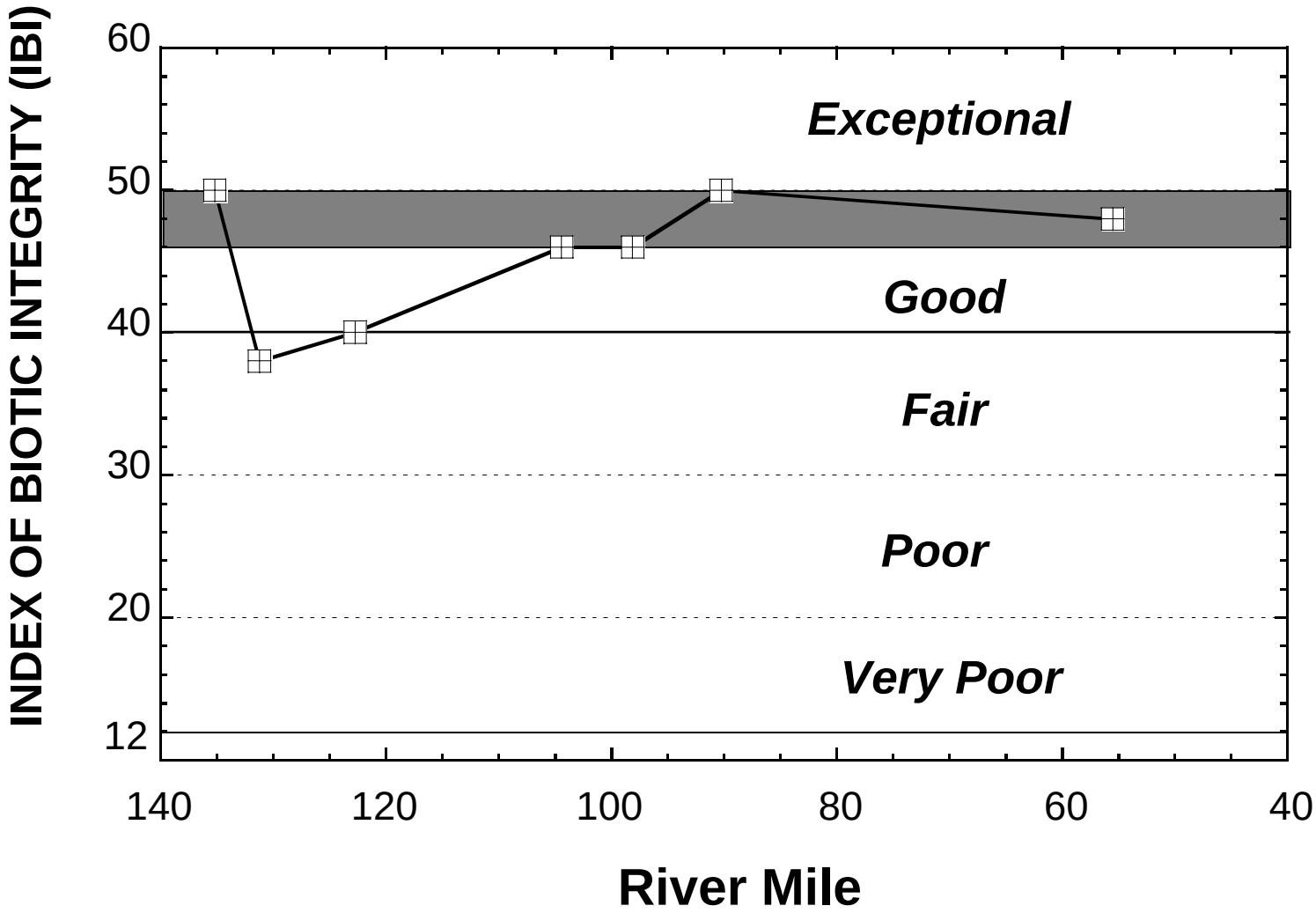
- **NONE** of the biological indices are at or within non-significant departure of the applicable biocriterion **OR** one organism group reflect poor or very poor quality

Demonstrating Aquatic Life Use Attainment/ Non-attainment With Biocriteria

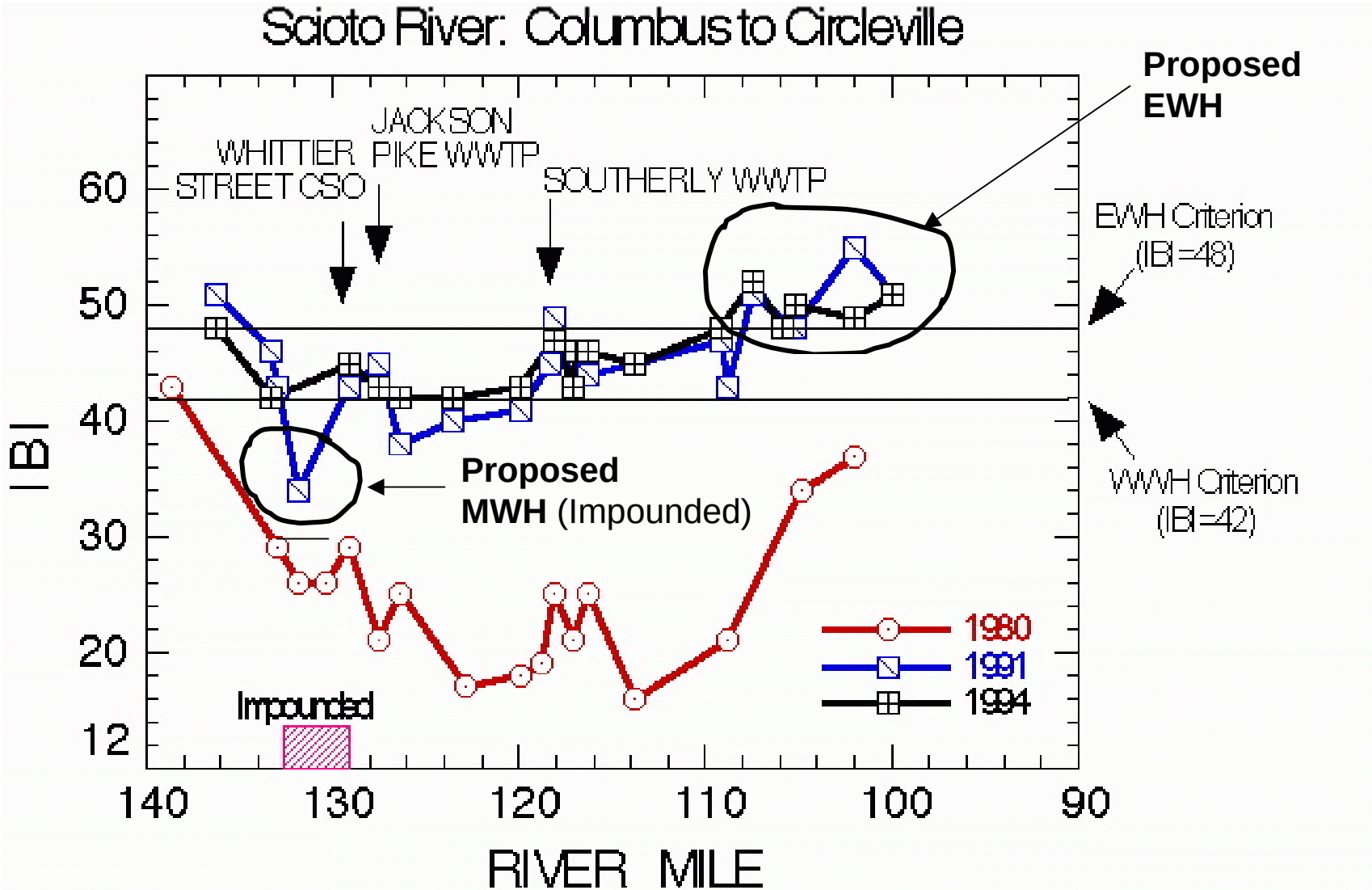
Aquatic Life Use Attainment Table Format:

River Mile	IBI	MIwb	ICI	QHEI	Attainment Status	Comment
20.2/20.0	44	8.9	40	68	**FULL**	Ust. Anyplace WWTP
19.5/19.7	30*	8.0^{ns}	34^{ns}	60	**PARTIAL**	WWTP Mixing Zone
17.0/16.8	22*	6.3*	8*	62	**NON**	Dst. Anyplace WWTP
12.6/12.3	36^{ns}	8.4	32*	70	**PARTIAL**	
9.5/9.0	40	8.8	42	56	**FULL**	
5.2/5.7	42	9.2	44	75	**FULL**	
0.5/ -	32*	7.6*	--	45	**(NON)**	Backwater effect

* - significant departure from ecoregion biocriteria; poor and very poor performing values are underlined.
^{ns}- insignificant departure from ecoregion biocriteria (4 IBI or ICI units; 0.5 MIwb units).


INDEX OF BIOTIC INTEGRITY (IBI)
60
50
40
30
20
12
Exceptional
Good
Fair
Poor
Very Poor
140
120
100
80
60
40
River Mile

Demonstrating Changes Through Time: Scioto River 1980 - 1994

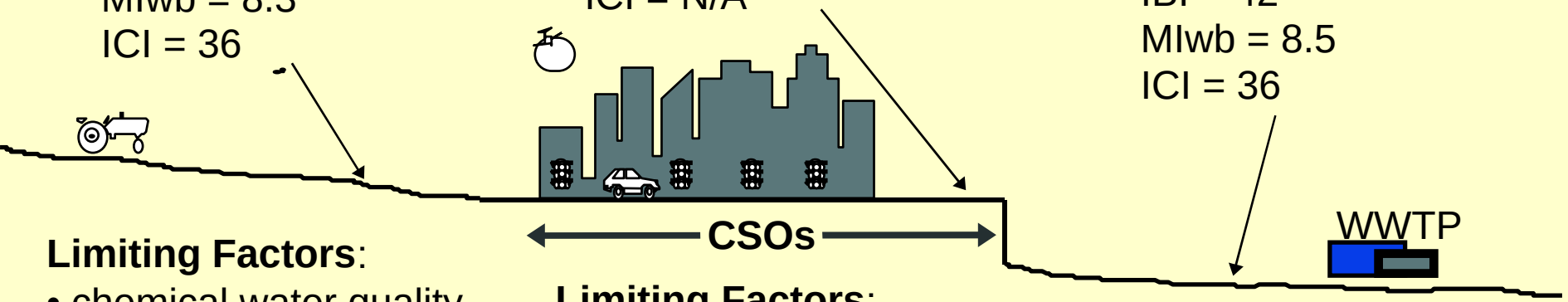


Application of Biocriteria in Complex Settings

1. Free-flowing river (**WWH** use designation):
Upstream from urban area ECBP Ecoregion - Wading site type:
IBI = 40
MIwb = 8.3
ICI = 36

2. Impounded river (**MWH** use designation):
Within urban area ECBP Ecoregion - Boat site type:
IBI = 30
MIwb = 6.6
ICI = N/A

3. Free-flowing river (**WWH** use designation):
Downstream from urban area
ECBP Ecoregion - Boat site type:
IBI = 42
MIwb = 8.5
ICI = 36



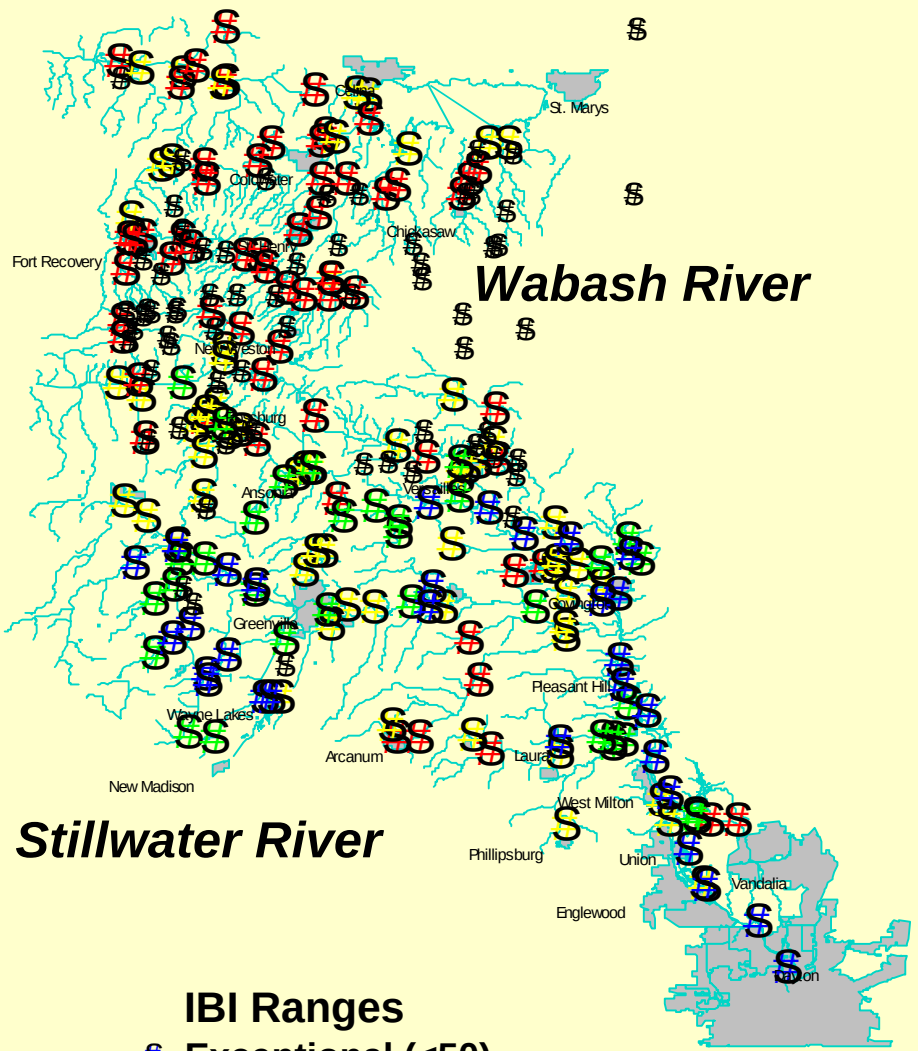
Limiting Factors:
- chemical water quality
- physical habitat
- flow/energy dynamics

Limiting Factors:
- physical habitat
- energy/flow dynamics
- chemical water quality

Limiting Factors:
- chemical water quality
- energy/flow dynamics
- physical habitat

Flow Direction →

USING BIOASSESSMENTS TO DESCRIBE WATERSHED HEALTH



IBI Ranges

- Exceptional (<50)
- Good (40-49)
- Fair (29-39)
- Poor/V. Poor (12-28)
- Permitted CAFOs

The Stillwater R. is classified and attains exceptional status (EWH) in the larger mainstem.

The cumulative effects of hydro-modification, riparian encroachment, and nutrient enrichment are associated with widespread impairment in the upper Stillwater and all of the Wabash subbasins.

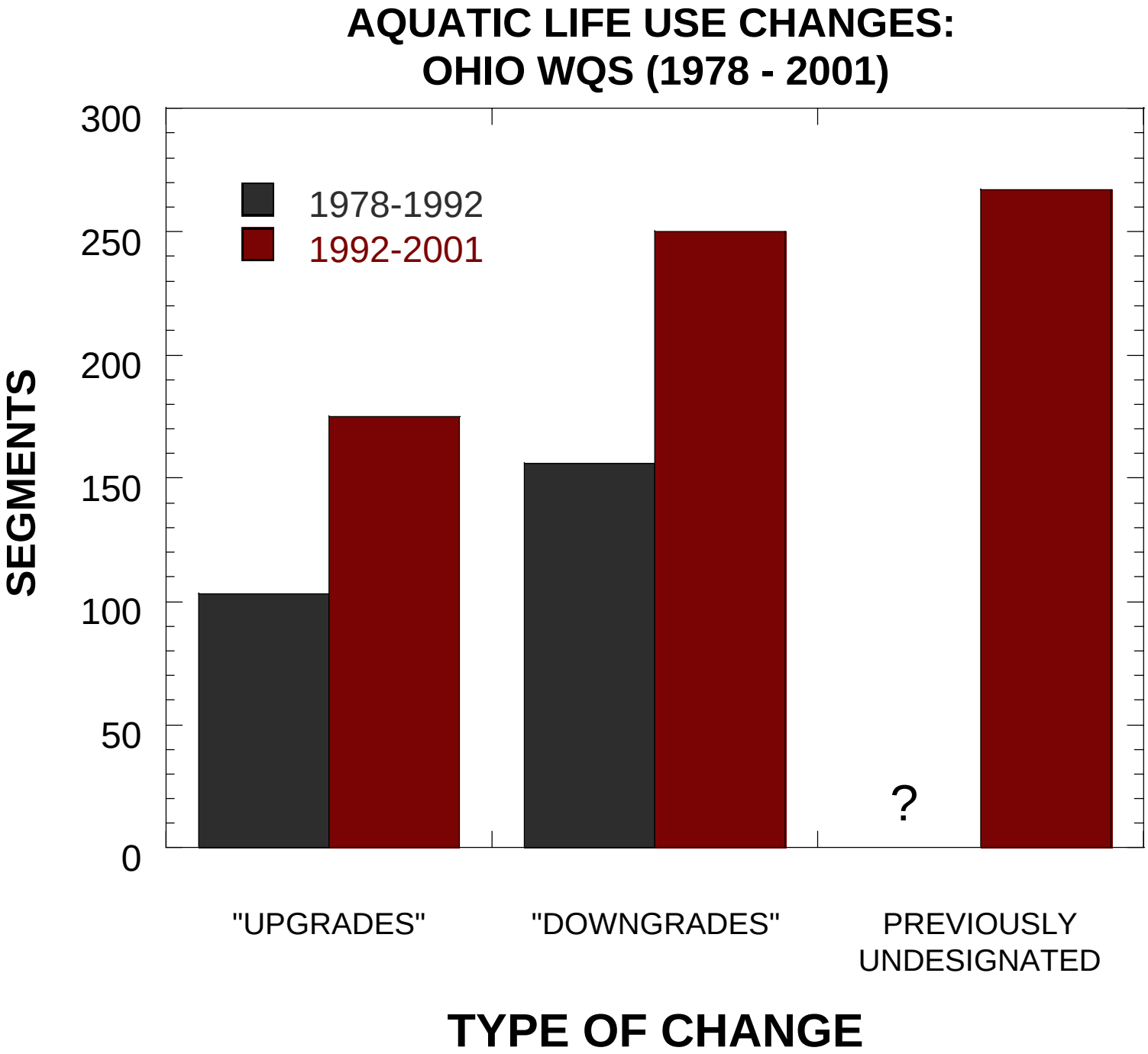
Use Attainability Analysis I: Are CWA Goal Uses Attainable?

U.S. EPA regulations allow lower than CWA goal uses where precluded by:

- naturally occurring pollutant levels;
- natural flow conditions (i.e., ephemeral)**;
- human-induced conditions which cannot be remediated;
- hydrological modifications (dams, diversions, channel modifications) which cannot be operated in a manner consistent with the CWA goal use;
- natural physical features (substrate, flow, depth);
- controls to attain use would cause widespread, socioeconomic impacts.

**** - does not apply when flow is augmented by an effluent discharge.**

Source: 40 CFR Part 131.10 (g)(1-6)


AQUATIC LIFE USE CHANGES:
OHIO WQS (1978 - 2001)
300
250
200
150
100
50
0
SEGMENTS
1978-1992
1992-2001
?
"UPGRADES"
"DOWNGRADES"
PREVIOUSLY
UNDESIGNATED
TYPE OF CHANGE

Use Attainability Analysis II: Process and Information Requirements**

Use attainability analysis requires the following information and knowledge:

- existing status of waterbody based on biocriteria;
- habitat assessment to evaluate potential;
- reasonable relationship between impaired state and precluding activity based on assessment of multiple indicators used in appropriate roles;
- recommendation subject to WQS rulemaking process
- < CWA uses reviewable every three years - a "temporary" designation.

**** - All data collection and analysis must conform to Ohio WQS and Five-Year Monitoring Strategy data and design quality objectives.**

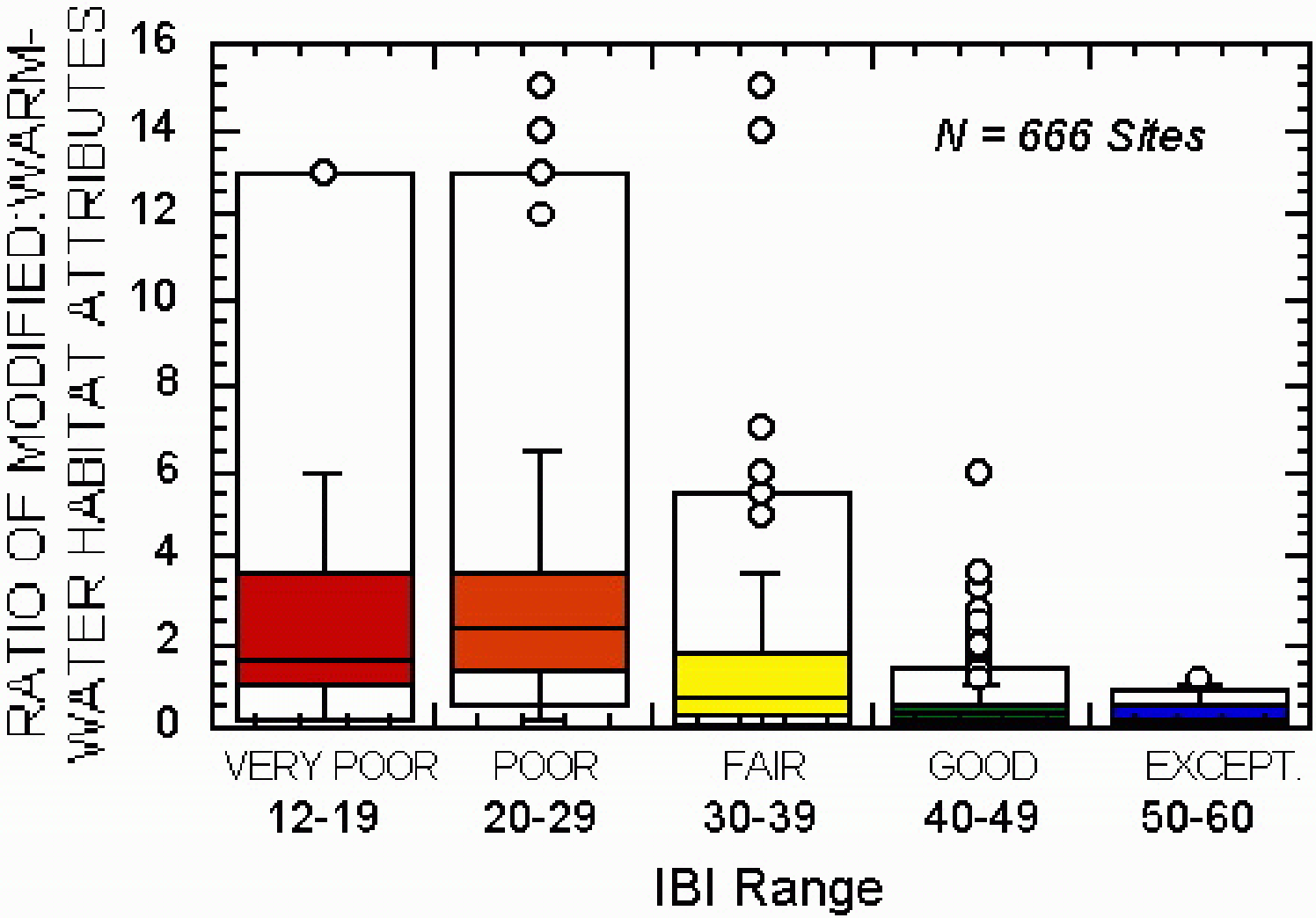
The Qualitative Habitat Evaluation Index (QHEI)

QHEI Includes Six Major Categories of Macrohabitat

- Substrate - types, origin, quality, embeddedness
- Instream Cover - types and amounts
- Channel Quality - sinuosity, development, stability
- Riparian/Bank Stability - width, quality, bank erosion
- Pool/Riffle/Run - max. depth, current types, morphology, substrate embeddedness
- Gradient - local gradient (varies by drainage area)

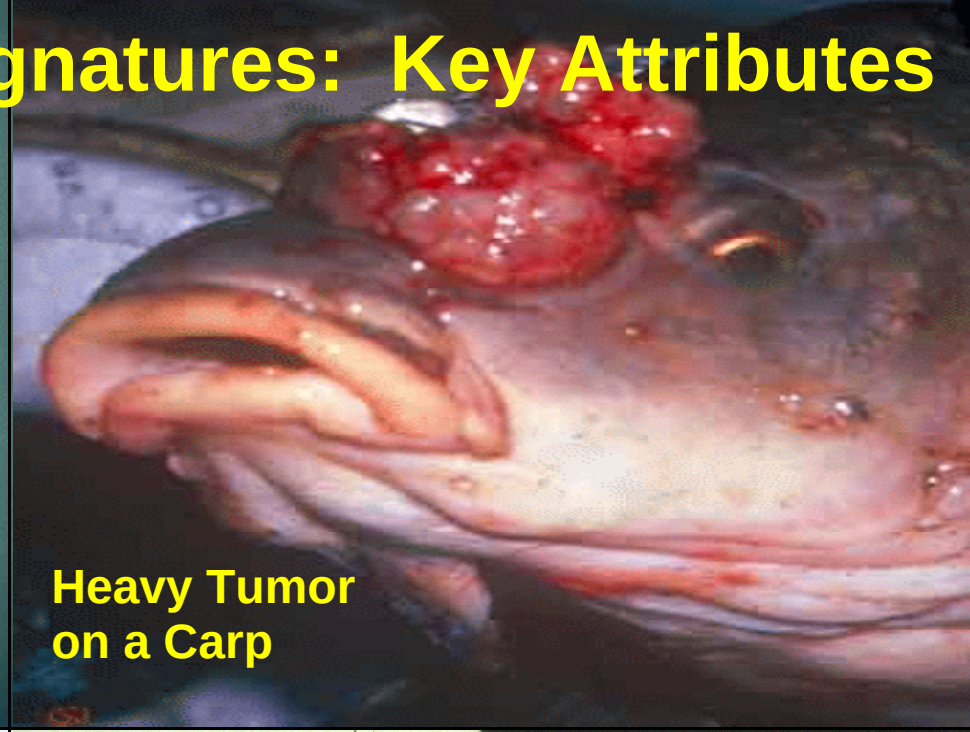
Source: The Qualitative Habitat Evaluation Index (Rankin 1989)

Influence of Modified Habitat Attributes on the IBI and Biological Integrity



Biological Response Signatures: Key Attributes

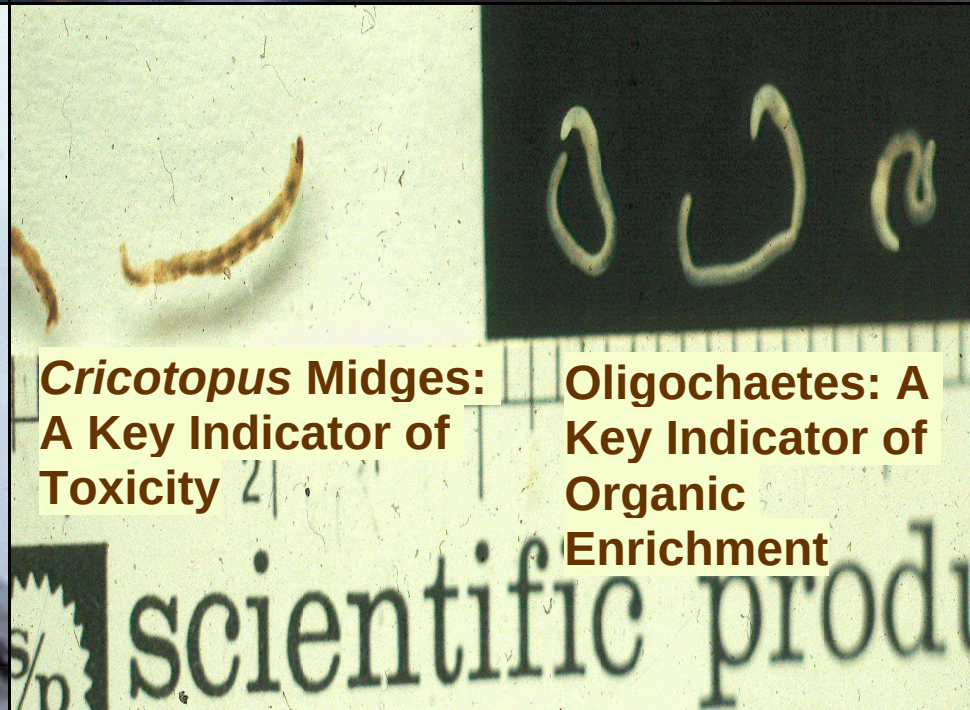
Heavy Erosion on a Silver Redhorse



Heavy Tumor on a Carp

Heavily Eroded Barbels & Deformities on a Yellow Bullhead

Normal Barbles on a Yellow Bullhead



Cricotopus Midges: A Key Indicator of Toxicity

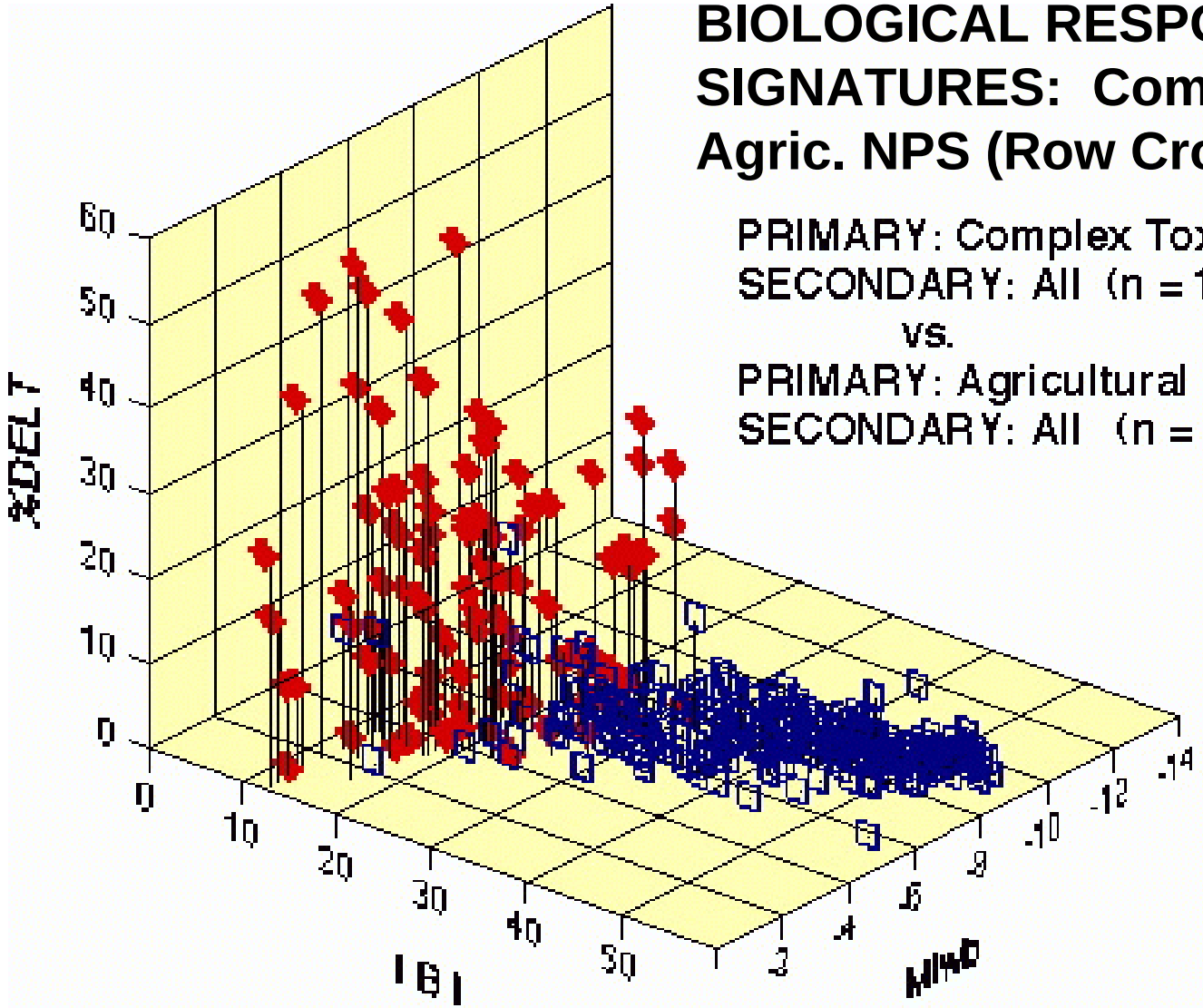
Oligochaetes: A Key Indicator of Organic Enrichment

BIOLOGICAL RESPONSE SIGNATURES: Complex Toxic vs. Agric. NPS (Row Crop)

PRIMARY: Complex Toxic
SECONDARY: All (n = 106)

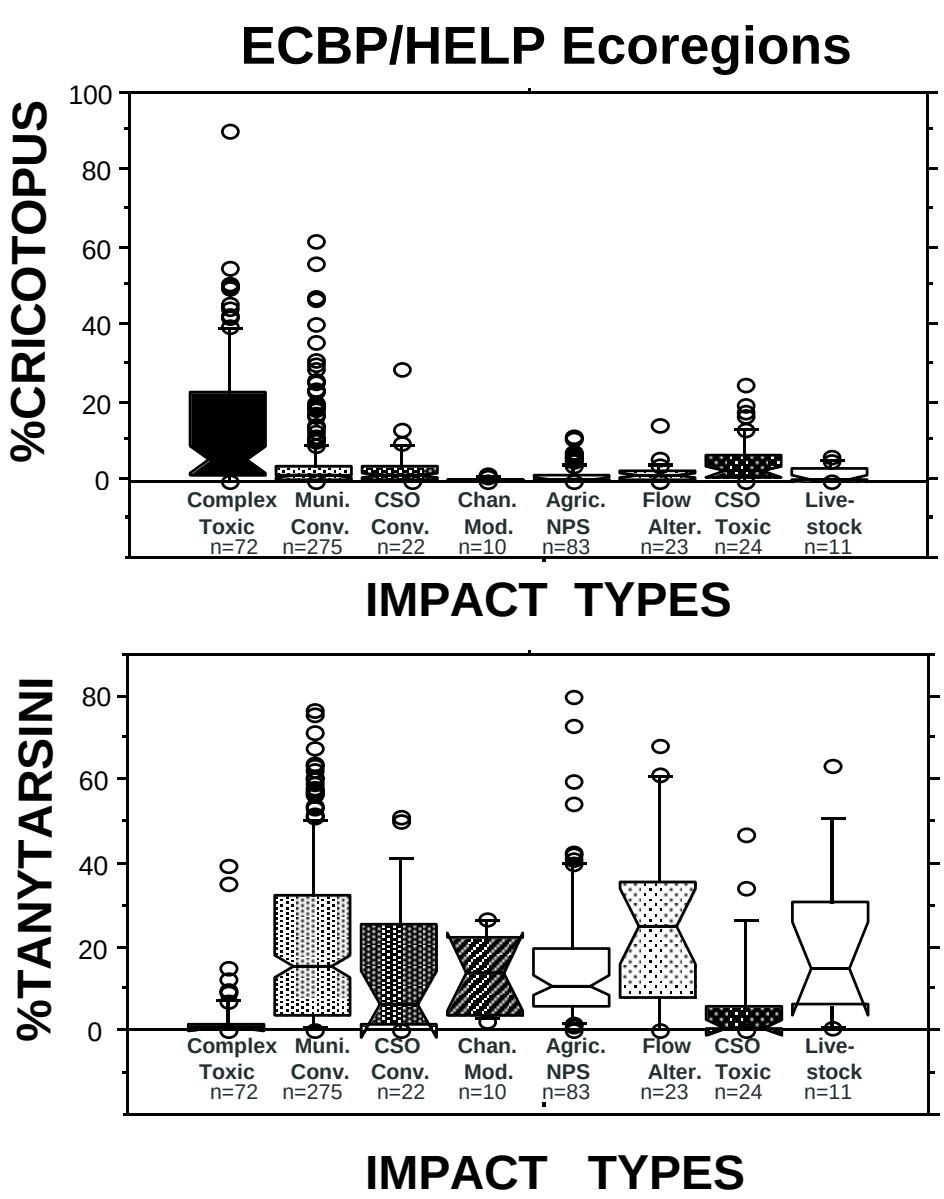
vs.

PRIMARY: Agricultural NPS
SECONDARY: All (n = 381)



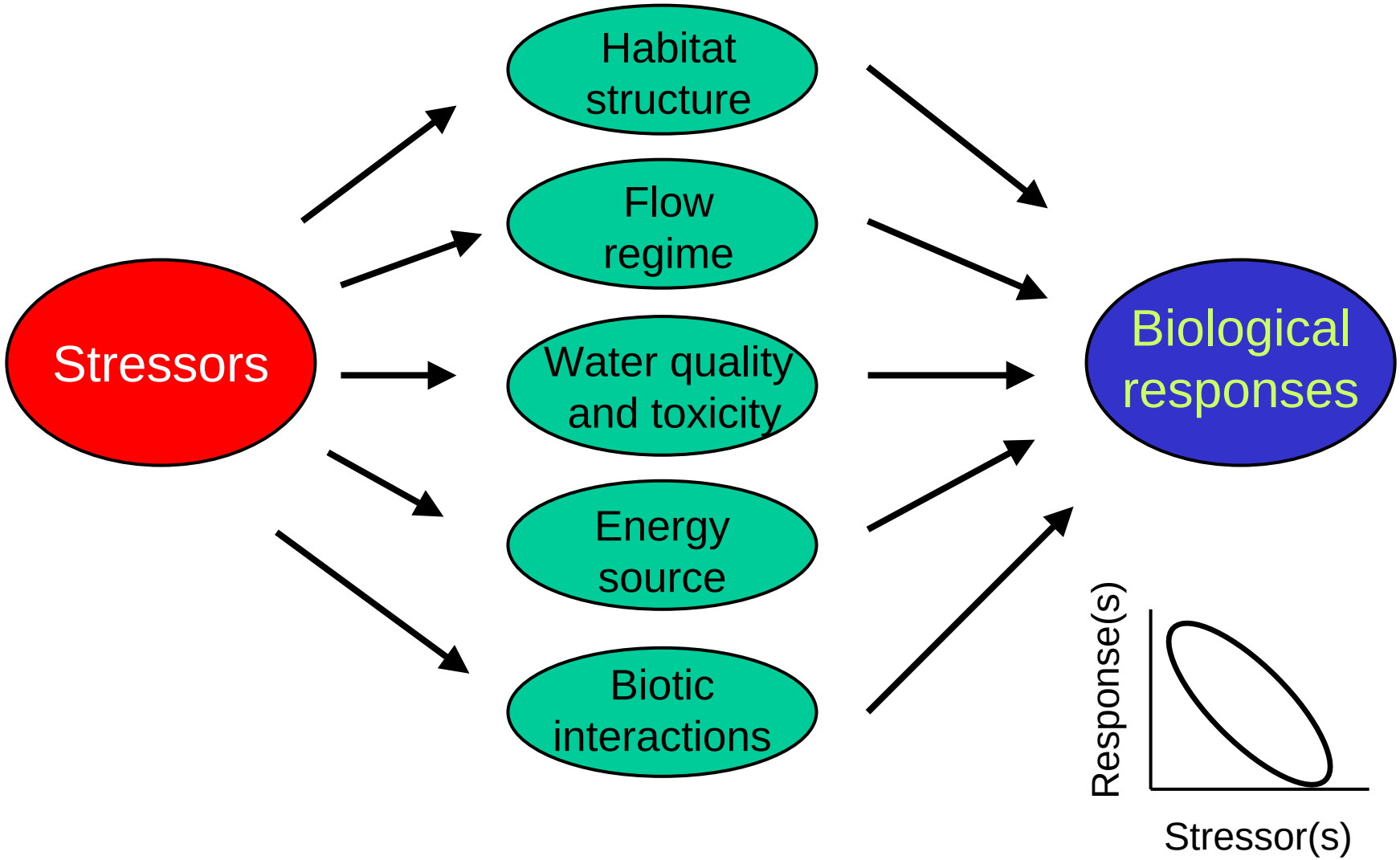
HELP/ECBP Ecoregions

after Yoder and Rankin (1995)



Biocriteria Metrics and Attributes Aid in Distinguishing Different Types of Impacts

- **Two aggregations of the midge family Chironomidae show starkly differing responses to different stressors.**
- **%Tanytarsini midges are indicators of good water quality and serve as a metric of the ICI.**
- **%Cricotopus midges are indicators of toxic conditions and poor water quality.**
- **Genus level taxonomic resolution is required *at a minumum* to benefit from macroinvertebrate data in this manner.**



Human activity: "the drivers" → **Altered water resource features** → **Biological endpoint**

Measuring and Managing Environmental Progress: Hierarchy of Indicators

Indicator Levels

1: Management actions

2: Response to management

} ***Administrative Indicators*** *[permits, plans, grants, enforcement]*

3: Stressor abatement

} ***Stressor Indicators*** *[pollutant loads, land practices]*

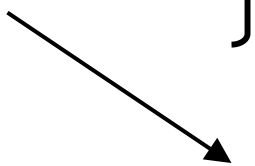
4: Ambient conditions

5: Assimilation and uptake

} ***Exposure Indicators*** *[pollutant conc., habitat, ecosystem process, fate & transport]*

6: Biological response

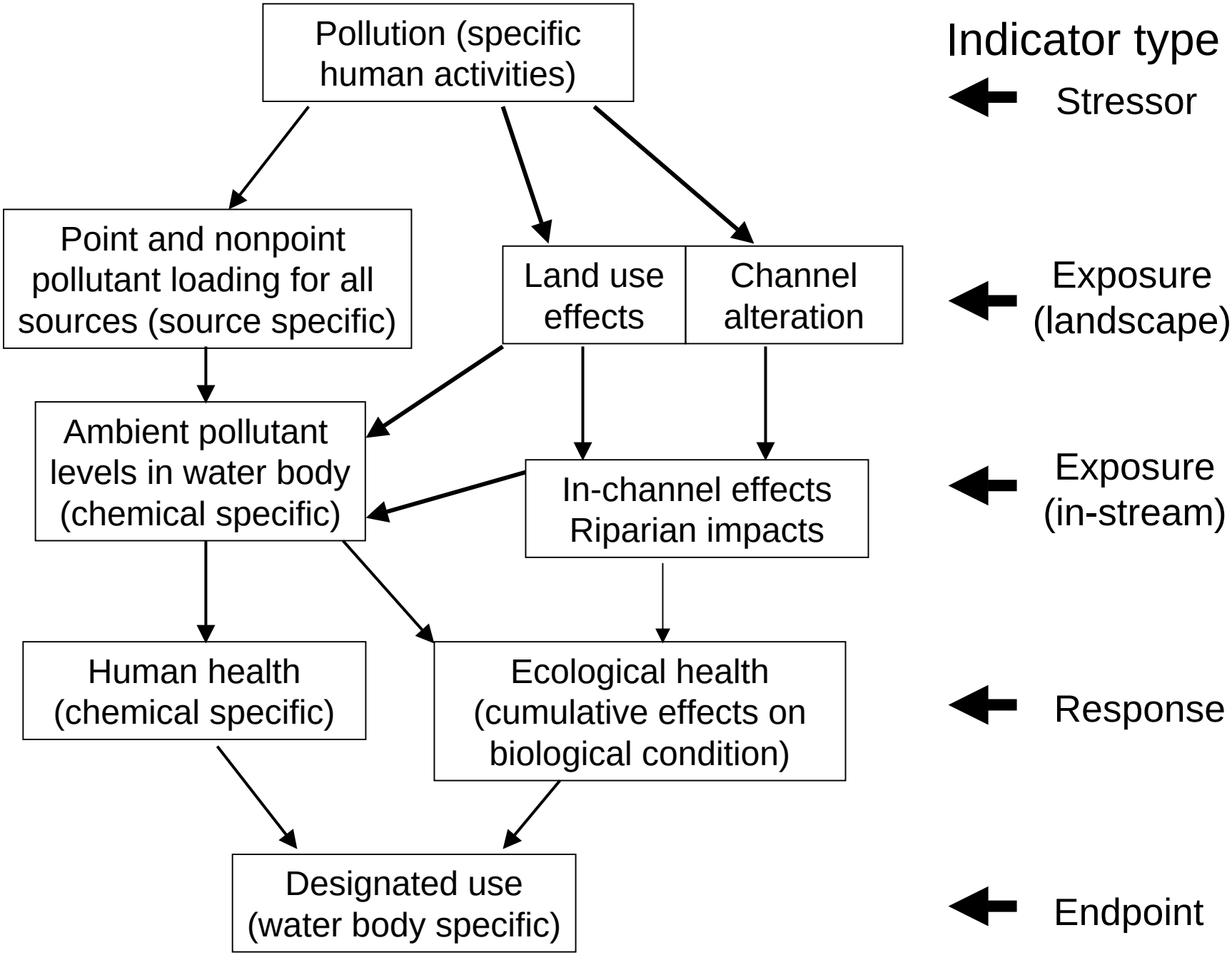
} ***Response Indicators*** *[biological assemblage indices, other attributes]*



The "Ecological Health" Endpoint

Multiple Indicators Matrix: Ottawa River

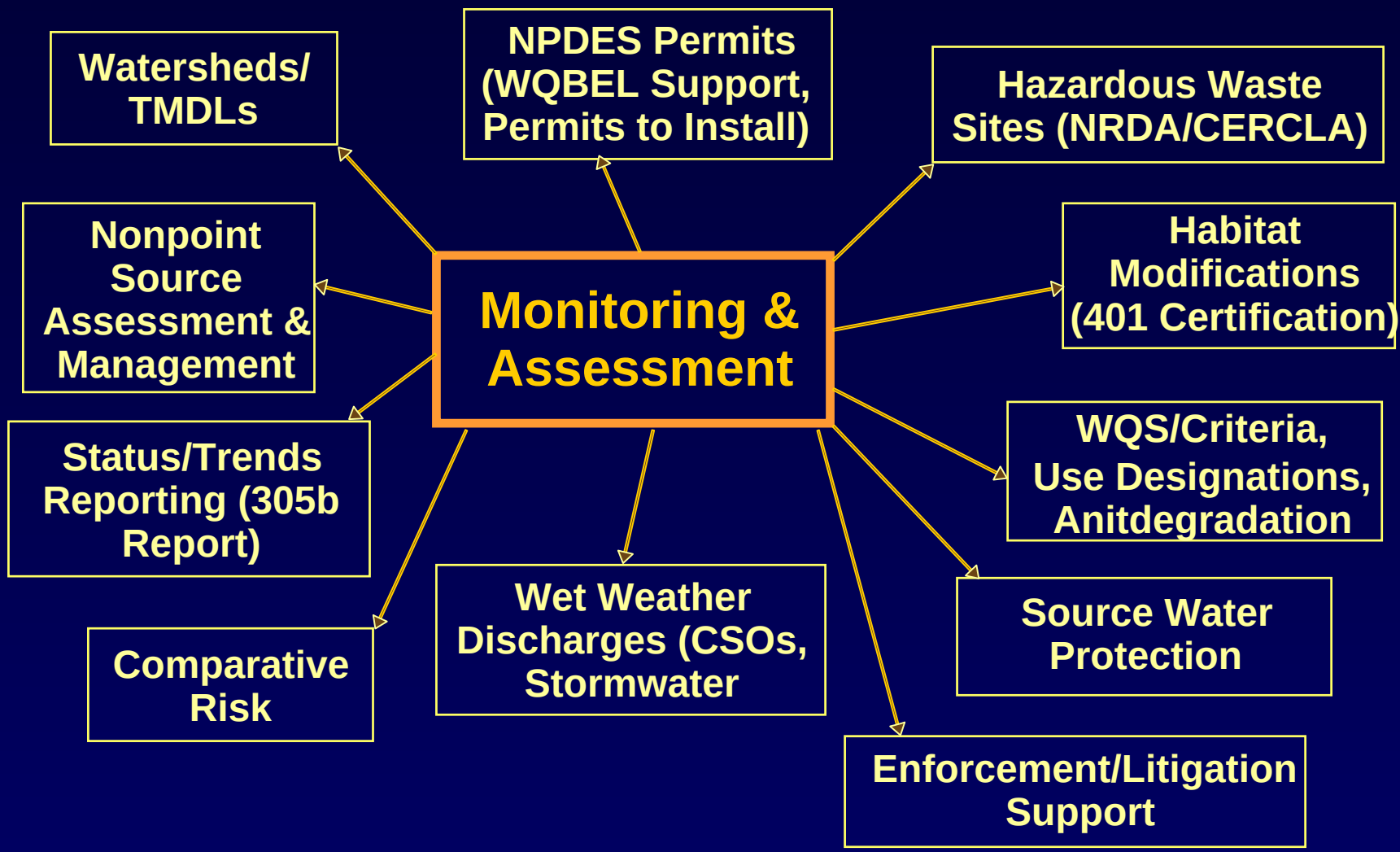
SEGMENT	DES. USE	RESPONSE INDICATORS				EXPOSURE INDICATORS						STRESSORS				
	Attain-ment Status	QHEI	IBI	MIwb	ICI	Water Chem.	Sedi-ment Chem.	Tox-icity	% DELT	Fish Tiss.	Bio-marker	# Dams/ Pools	Urban-Indust. Landuse	Cumulative Loads	Spills	CSO SSOs
Ottawa River mainstem - 1996																
Thayer Rd to Sugar St.	FULL-PART.	68	Fair-Good	Fair-Good	Good	Nitrates	Low	NA	Mod-High	Mer-cury	Low	Mod-e	Low	Low	Low	Low
Sugar St. to Lima WWTP	**NON**	47	**Poor** to Fair	**Poor** to Fair	**Poor** to M.G.	CBOD TSS D.O.	As,Cr Cd,Cu Ni,Zn	Mod-erate	**High**	Pesti-cides	BUN Naph B(a)p	**High**	**High**	Mod-erate	Mod-e	**High**
Lima WWTP Allentown dam	**NON**	72	**Poor**	**Poor** to Fair	Fair to Good	Amm. CBOD TSS D.O. Nitrates Phos Chrom. PAH Pesticid	As,Cr Cd,Cu Ni,Zn PAH	Mod-erate	**Very High**	Selen-ium Pest-icides	EROD Naph B(a)p BUN	Mod-e	**High**	**High**	**High**	**High**
Allentown dam to Kalida	PAR-TIAL	69	**Poor** -Fair	Fair-Good	Good -Exc.	TSS	Low	NA	**High**	Pesti-cides	Low	Low	Low	**High**	Low	Low
Kalida to mouth	FULL	69	Good	Good	Exc.	TSS	Low	NA	**Very High**	Pesti-cides	Low	Low	Low	**High**	Low	Low


Pollution (specific human activities)
Point and nonpoint pollutant loading for all sources (source specific)
Land use effects
Channel alteration
Ambient pollutant levels in water body (chemical specific)
In-channel effects Riparian impacts
Human health (chemical specific)
Ecological health (cumulative effects on biological condition)
Designated use (water body specific)
Indicator type
Stressor
Exposure (landscape)
Exposure (in-stream)
Response
Endpoint

Essential Elements and Processes for Tiered AQL Uses and UAAs

- Biological condition axis - merges conceptual framework with a *reliable* measurement system anchored by regional reference condition.
- Data Driven Process - via Adequate Monitoring and Assessment framework.
- Integration of WQ management program areas - supported by M&A.
- Data generation and custody issues - build intra-institutional capacity; no‘‘handoffs’’.
- Disciplinary framework - indicator roles and hierarchy of indicators process.

Better Monitoring & Assessment Supports All Water Quality Management Programs



SUPPORT FOR WQ MANAGEMENT INCREASES THROUGH TIME

Time Period	Status	Trends	WQS/ Uses, UAAs	WQS/ Biocrit-eria	TMDL/ Listing, Develop.	NPS/ 319/CREP	NPDES/ WQBELs	NPDES/ Storm-water	NPDES/ Other
1980 to 1987	😐 😐😐	-- 😐	😐 😐😐	-- 😐😐	-- --	-- 😐	-- 😐 😐😐	-- --	-- 😐 😐😐
1988 to 1992	😐😐 😐😐😐	😐😐 😐😐😐	😐😐 😐😐😐	😐😐😐 😐😐😐	-- --	😐😐 😐😐😐	😐😐😐 😐😐😐	-- --	😐😐 😐😐😐
1993 to 1998	😐😐😐 😐😐😐	😐😐😐 😐😐😐	😐😐😐 😐😐😐	😐😐😐 😐😐😐	-- 😐😐😐	😐😐😐 😐😐😐	😐😐😐 😐😐😐	😐😐 😐😐😐	😐😐😐 😐😐😐
1998 to Present	😐😐😐 😐😐😐	😐😐😐 😐😐😐	😐😐😐 😐😐😐	😐😐😐 😐😐😐	😐😐😐 😐😐😐	😐😐😐 😐😐😐	😐😐😐 😐😐😐	😐😐😐 😐😐😐	😐😐😐 😐😐😐

-- Inadequate for program support due to limited accuracy, resolution, detail, and power of assessment.

😐 Insufficient to provide the level of detail and resolution needed to go beyond pass/fail assessments; accuracy is limited and little or no resolution for determining severity and magnitude and for causal associations.

😐😐 Capable of providing program support, but cannot provide sufficiently robust, detailed, or accurate assessment information in all cases or at all scales; determination of causal associations may be limited in given instances.

😐😐😐 Comprehensively fulfills program support role by providing robust and complete assessment including scientific certainty, accuracy and relevancy of condition assessment, and causal associations.

Bioassessment and Biocriteria Program Development Timeline

INITIAL DEVEOPMENT PHASE

0-18 MONTHS

INITIAL IMPLEMENTATION PHASE

12-24 MONTHS

INITIAL ASSESSMENT PHASE

18 MO – 6 YEARS

FULL ASSESSMENT PHASE

5 – 10 YEARS

Start-Up Tasks: Logistics

Acquire Staffing:
- Professional biologists with expertise & training
- Database manager
- Interns/technicians (field work, lab tasks

Acquire Facilities & Equipment:
- Outfit laboratory and field facility
- Office accommodations
- Database support infrastructure

Methods Development:
- Review and select candidate methods and protocols
- Consider MQO/DQO needs
- Test methods for applicability
- Analyze test results – select methods

Start-Up Tasks: Implementation

Initiate Field Sampling:
- Review spatial designs
- Develop QA/QC and QAPP
- Develop sampling plans in accordance with monitoring strategy
- Pilot assessments

Classification Issues:
- Consider spatial stratification issues
- Develop and test reference condition approach
- Select and sample reference sites
- Develop index development and calibration strategy

Program Implementation

Biocriteria Development:
- Select candidate metrics and/or assessment tools
- Develop refined uses - narratives
- Test metrics and develop calibrated indices
- Evaluate via bioassessments

Water quality Program Support:
- Develop capacity to support WQ programs (WQS/UAAs, TMDLs, permits, planning)
- Formalize water quality program support as capacity is developed

Program Maintenance

Biocriteria Development:
- Refine metrics and develop calibrated indices
- Develop reference benchmarks for calibrated indices according to classification scheme and by major aquatic ecotype

Water quality Program Support:
- Fully functioning bioassessment program supports WQS (UAAs, aquatic life use support) and basic program needs (305b/303d)
- Program development should be fully initiated – e.g., integrated chemical, physical, and biological database supports criteria & policy development

Continuously evaluate program

Quality Improvement Process

Evaluate effectiveness of initial decisions – make needed adjustments