Nutrient Management, Water Quality, and a Right-Sized Approach to Regulatory Compliance

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Ohio Water Environment Association Conference

June 24, 2015

A Right-Sized Approach to Regulatory Compliance

- Building a case for awareness, active involvement, and advocacy
- Nutrients
  - National
  - State
  - Nutrient Discharge Permitting
- Water Quality Modeling
- Tips to inform your approach

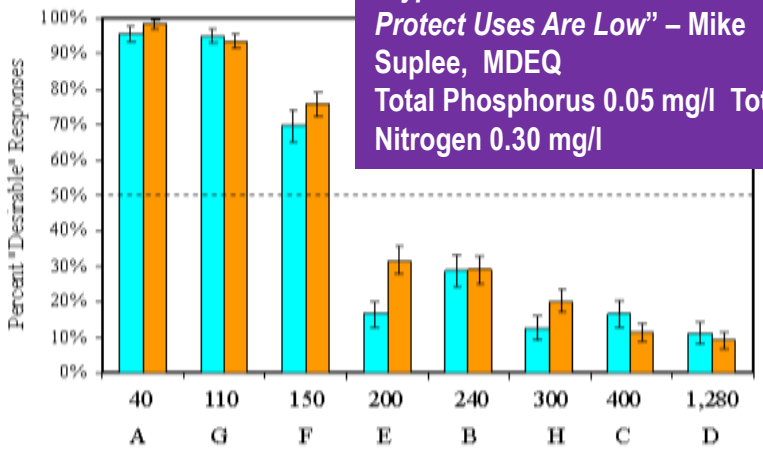
Numeric Nutrient Criteria ⇨ *Low N and P Concentration Endpoints*

Reference Stream Approach

- EPA's Ecoregion Nutrient Criteria

Stressor Response

- D.O., pH
- Chla, Benthic Algae
- Macroinvertebrates
- Fisheries
- Recreation
- Public Perception



"Typical Concentrations That Protect Uses Are Low" **– Mike Suplee, MDEQ**
Total Phosphorus 0.05 mg/l Total Nitrogen 0.30 mg/l

Scientific and Technical Basis for Montana's Numeric Nutrient Criteria

Challenges in establishing Nutrient Criteria

- Identifying Threshold of Harm to Beneficial Uses
  - Reference condition
  - Stressor-response
  - Mechanistic modeling
- Translation of In-stream Criteria to Effluent Discharge Permit Limits

Aggregate Level III Ecoregion – Corn Belt and Northern Great Plains VI

Rivers and Streams in Nutrient Ecogreion III (25th percentile)

Nutrient Parameter	Aggregate Nutrient Ecoregion Reference Conditions
Total Phosphorus (mg/L)	0.07625
Total Nitrogen (mg/L)	2.18
Chlorophyll a (ug/L)	2.70
Turbidity (NTU)	6.36

Lakes and Reservoirs in Nutrient Ecogreion III (25th percentile)

Nutrient Parameter	Aggregate Nutrient Ecoregion Reference Conditions
Total Phosphorus (mg/L)	0.0375
Total Nitrogen (mg/L)	0.781
Chlorophyll a (ug/L)	8.59
Secchi depth (meters)	1.356

- Western Ohio example
  - Eastern Corn Belt Plains

Numeric Nutrient Criteria and Limits of Wastewater Treatment Technology[1]

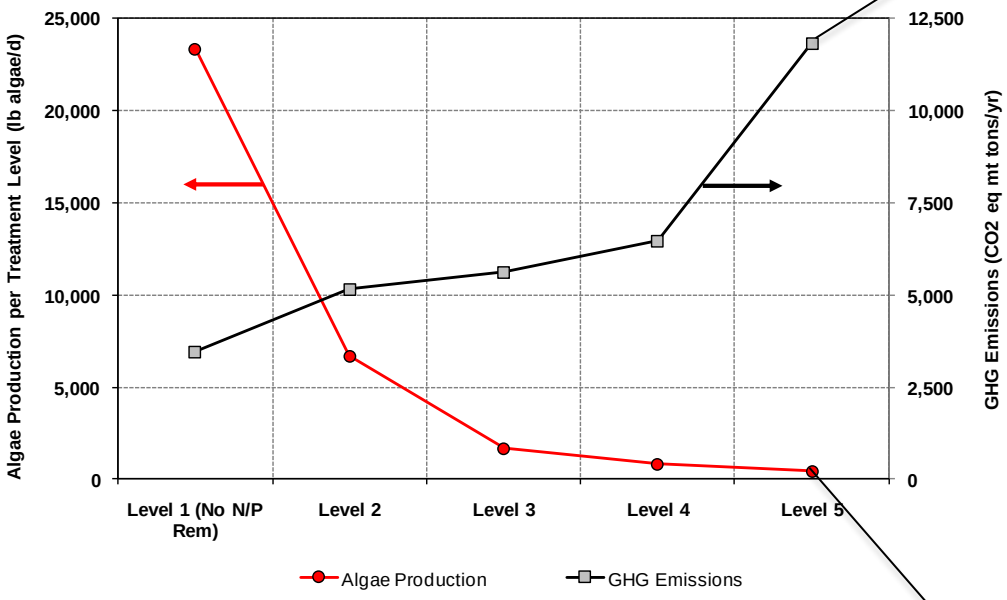
Parameter	Typical Municipal Raw Wastewater, mg/l	Secondary Effluent (No Nutrient Removal), mg/l	Advanced Wastewater Treatment [1]			Typical In-Stream Nutrient Criteria, mg/l
			Typical Biological Nutrient Removal (BNR), mg/l	Enhanced Nutrient Removal (ENR), mg/l	Limits of Treatment Technology, mg/l	
Total Phosphorus	4 to 8	4 to 6	1	0.25 to 0.50	0.05 to 0.07	0.01 to 0.076
Total Nitrogen	25 to 35	20 to 30	10	4 to 6	3 to 4	0.310 to 2.18

[1] *Ignoring Considerations of Variability and Reliability of Wastewater Treatment Performance*

Water Environment Research Foundation (WERF) "*Nutrient Management: Regulatory Approaches to Protect Water Quality, Volume 1 – Review of Existing Practices*," Project #NUTR1R06i

Sustainable Nutrient Removal and Balanced Decision Making – Net Benefit?

Advanced Nutrient Removal Treatment
Algal Production Potential v. Greenhouse Gas Production



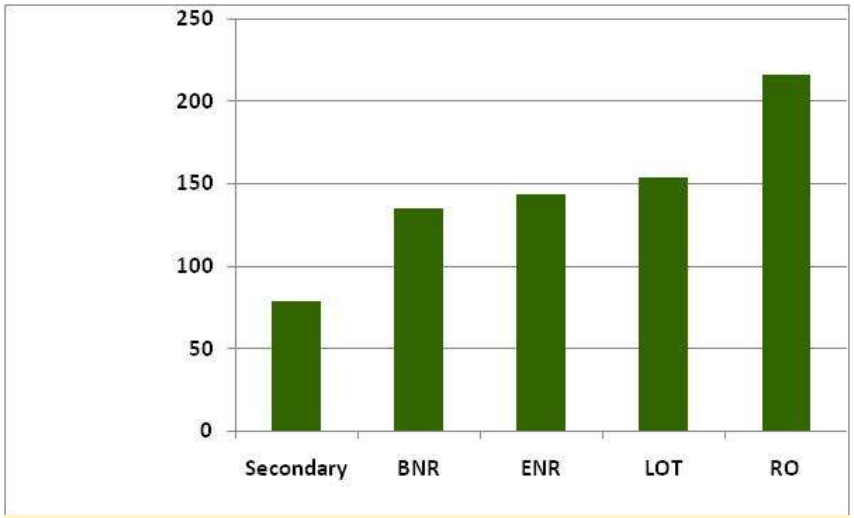
Increasing GHG Emissions

Water Environment Research Foundation (WERF)
"*Striking the Balance Between Wastewater Treatment Nutrient Removal and Sustainability*" November 2010

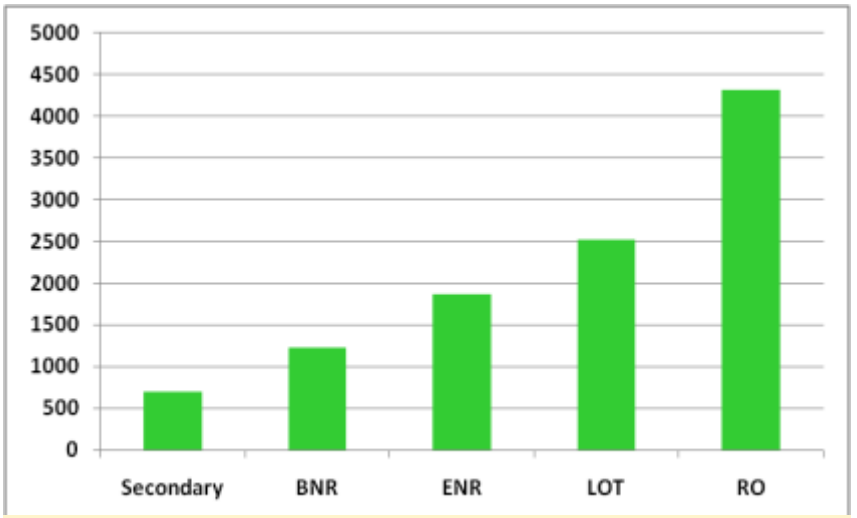
1. ***Secondary Treatment (No nutrient removal)***
2. ***Biological Nutrient Removal (BNR) TP 1 mg/L TN 8 mg/L***
3. ***Enhanced Nutrient Removal (ENR) TP 0.1-0.3 mg/L TN 4-8 mg/L***
4. ***Limit of Treatment Technology (LOT) TP <0.1 mg/L TN 3 mg/L***
5. ***Reverse Osmosis (RO) TP <0.02 mg/L TN 2 mg/L***

Diminishing Water Quality Benefit

Treatment Costs Escalate Substantially Approaching Technology Limits



Estimated Capital Costs for 10 mgd Capacity (Million $)



Estimated O&M Costs for 10 mgd Capacity ($1,000/yr/10 MG Treated)

Water Environment Research Foundation (WERF) "*Striking the Balance Between Wastewater Treatment Nutrient Removal and Sustainability*" November 2010

1. *Secondary Treatment (No nutrient removal)*
2. *Biological Nutrient Removal (BNR) TP 1 mg/L TN 8 mg/L*
3. *Enhanced Nutrient Removal (ENR) TP 0.1-0.3 mg/L TN 4-8 mg/L*
4. *Limit of Treatment Technology (LOT) TP <0.1 mg/L TN 3 mg/L*
5. *Reverse Osmosis (RO) TP <0.01 mg/L TN 1 mg/L*

National and State Nutrient Regulatory Issues

NRDC Petition on Secondary Treatment Standards

- November 27, 2007, NRDC petition for rulemaking
  - EPA has unreasonably delayed publishing information on secondary treatment to remove excess nutrients
  - Nutrient control is properly included within "secondary treatment"

- ***NRDC states:***
  - ***TP 0.3 mg/l and TN 3 mg/l currently attainable***
  - ***TP 1 mg/l and TN 8.0 mg/l attainable only using biological processes***
  - ***EPA must assess whether this constitutes "secondary treatment"***

NRDC

November 27, 2007

Stephen L. Johnson
Administrator
U.S. Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Dear Administrator Johnson,

Enclosed please find a petition, along with attachments, seeking overdue and needed improvements to the Environmental Protection Agency's secondary treatment requirements for wastewater treatment plants.

This petition is filed on behalf of the following groups, many of which are membership organizations that are collectively supported by millions of individuals: the Natural Resources Defense Council, the Environmental Law and Policy Center of the Midwest, the Sierra Club, the Waterkeeper Alliance, the Missouri Coalition for the Environment, Midwest Environmental Advocates, the Prairie Rivers Network, the Iowa Environmental Council, the Minnesota Center for Environmental Advocacy, American Rivers, and the Gulf Restoration Network.

We would welcome the opportunity to discuss the materials presented in this petition with you and your staff.

Should you have any questions about the enclosed materials, please do not hesitate to contact me at (202) 289-2361.

Sincerely,

Senior Attorney
Clean Water Project
Natural Resources Defense Council

cc (without attachments):
Benjamin Grumbles, Assistant Administrator for Water (Mail Code 4101M)
Roger R. Martella, Jr., General Counsel (Mail Code 2310A)
James A. Hanlon, Director, Office of Wastewater Management (Mail Code 4201M)

NRDC Petition on Secondary Treatment Standards Denied

- December 14, 2012 EPA Response
  - EPA Conclusions
    - Nutrients at POTWs Highly Site-Specific
    - Not Suited to Uniform National Rule
    - Not All POTWs Nationwide Need Technology Based Effluent Limits (TBELs) for Nutrients
    - High Costs Nationally
  - EPA's Preferred Approach
    - Water Quality Based Provisions of CWA

Technology Based Effluent Limits

Benefits

- Simplicity in Effluent Discharge Permitting
- Select Effluent Limits at Levels Where Compliance is Assured

Limitations

- Lacks Direct Linkage with Receiving Water Quality Requirements
- Suggests Uniformity in Limits is Appropriate for all Receiving Waters
  - Contradicted by Site Specific Circumstances that Define the Actual Impact of Nutrients on Individual Waterbodies

Future Water Quality Based Effluent Limits for Nutrients in Ohio?

Summary Comparison of Select States Nutrient Discharge Permit Structure and Approach

State	Technology Based Limits	Rulemaking	Informs Permit Structure	Implementation	Variance	Site Specific, Response Variables, etc
Iowa	Yes	No	12 Month Average	~10 yrs + 10 yrs (Negotiable)	No	Yes & No
Colorado	Yes	Yes	Moving Annual Median	Delayed Implementation	Yes	No
Florida	No	Yes	-	-	No	Yes
Maine	No	Yes	-	-	No	Yes
Montana	Yes	Yes	Monthly Ave	Revised Limits 2016	Yes	Yes
Ohio	No	Yes		3 Permit Cycles	No	Yes
Wisconsin	Yes	Yes	Moving Annual Mean	4 Permit Cycles	Yes	No

Across the country, the plot thickens….. as in Iowa

- Des Moines Water Works Notice of Intent to Sue
  - 9 million acres of farmland
  - Drainage tiles that bring nutrients to water bodies
  - Seeks that drainage districts have federal oversight where agriculture is now exempt under CWA
  - Gov Terry Branstad notes, "*Des Moines is declaring war on rural Iowa*"….and calls the potential action "*Un-Iowan*".

Water Environment Research Foundation (WERF) Nutrient Challenge

www.werf.org

Original Objectives

- Provide science-based solutions and recommendations that:

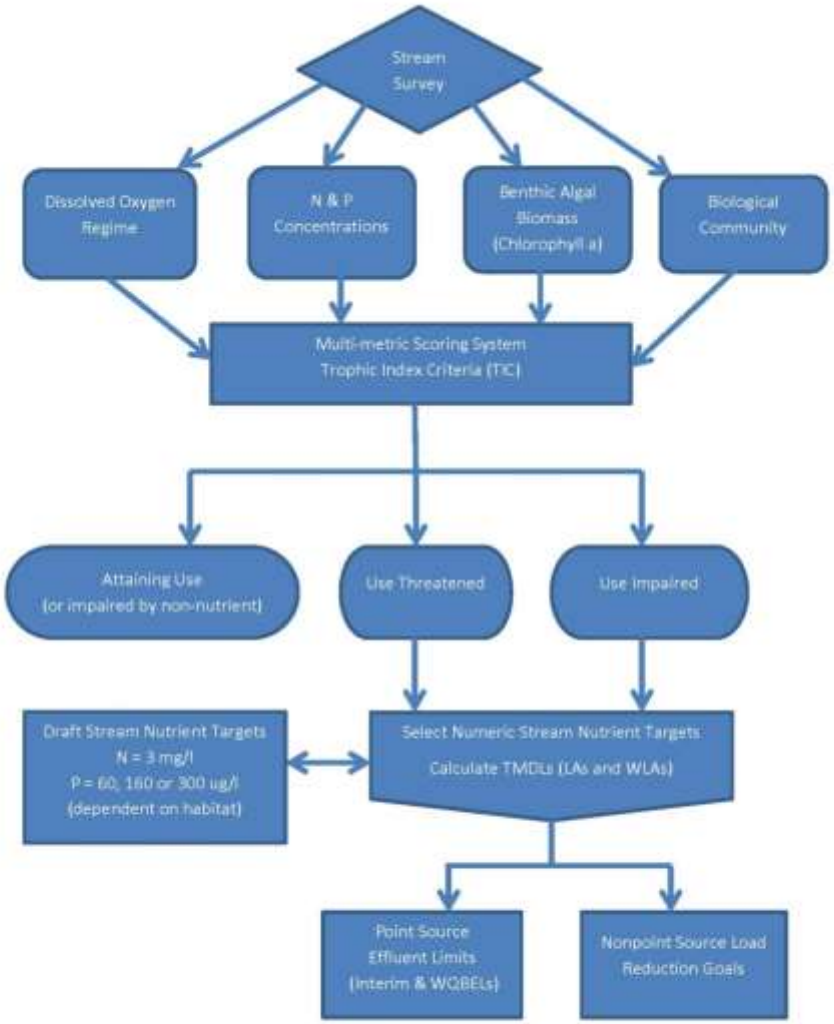
  (1) support utility decisions to use sustainable wastewater nutrient removal technologies and meet other wastewater treatment goals, and

  (2) inform regulatory decision making that is moving toward increasingly higher levels of nitrogen and phosphorus removal.

Go to **KNOWLEDGE AREAS: Nutrients**
>50 completed and ongoing projects

Meanwhile, in Ohio….

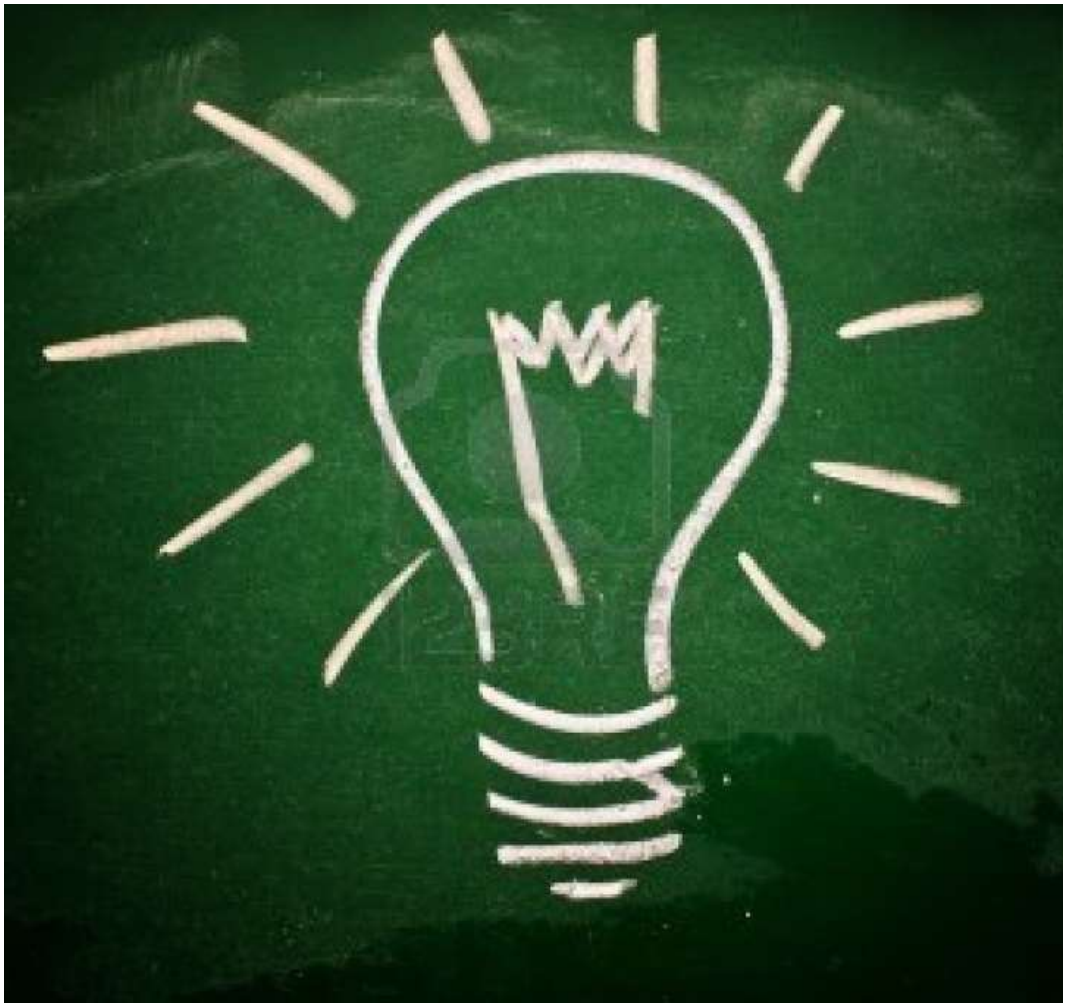
- Initial research 2009-2010
- 2011 Framework for Ohio's Strategy
- Point and Nonpoint Source work groups established – 2010; reports issued 2012
- Framework submitted to USEPA 2012, approved 2013 (included TIC)
- Nutrient TAG established
  - Adaptive mgmt, cost v benefit, consensus



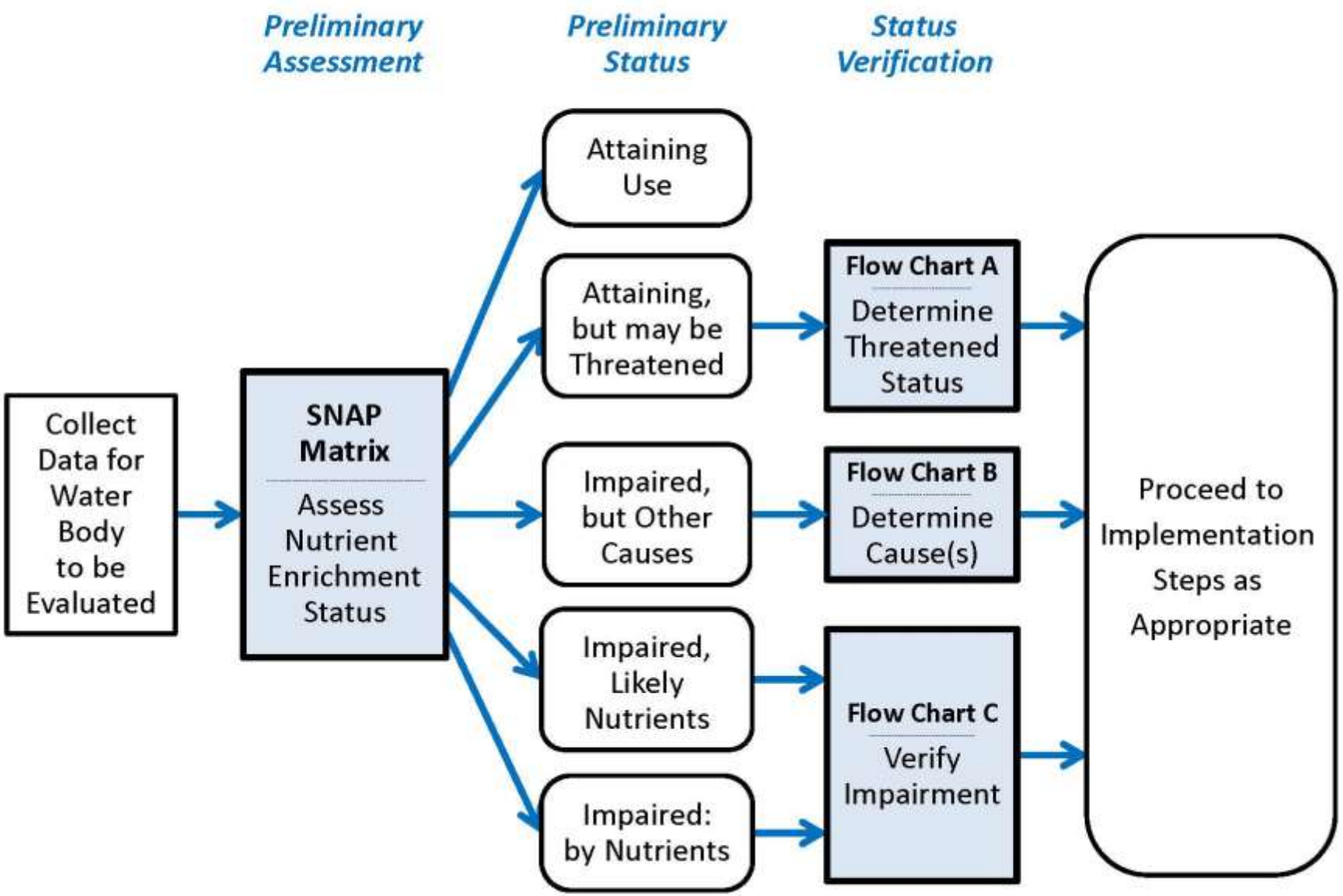
Conceptual design of the Trophic Index Criterion

Technical Advisory Group contributions

- Nutrient Measurements Rarely Provide a “Bright Line” Dose-Response” Relationship Linked to Use Impairment
- “Biological Health” Best Determined by Multiple Biological Indicators
- Recommended the SNAP



Stream Nutrient Assessment Procedure (SNAP)



Ohio Stream Nutrient Assessment Procedure (SNAP)

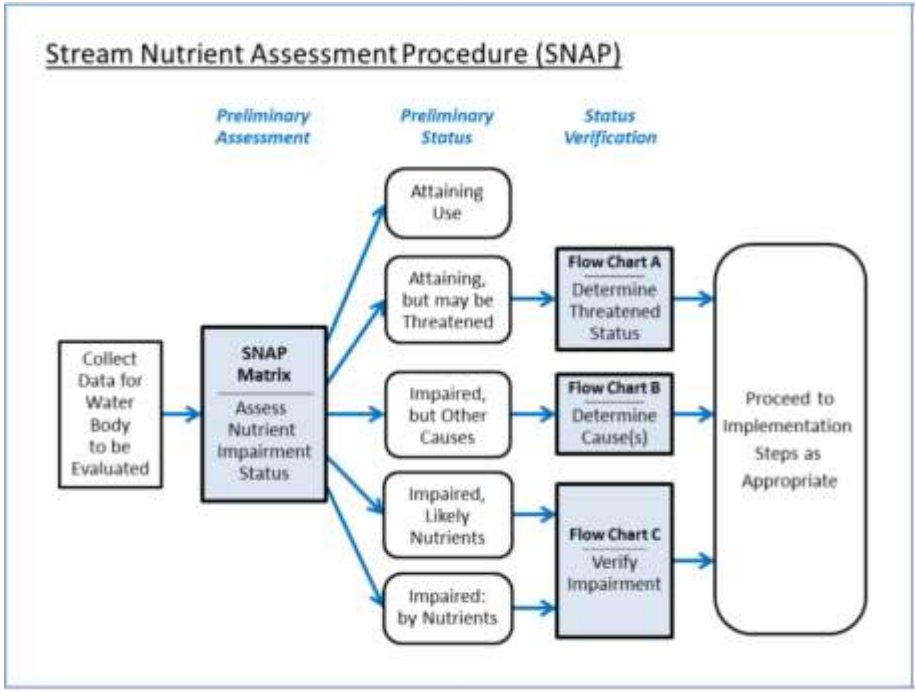
- Trophic Index Decomposed to Decision Matrix
  - Stepwise Evaluation of Key Indicators
    - ***Nutrient Concentration Removed***
    - 2 Key Response Variables
      - » Dissolved Oxygen Swing
      - » Benthic Chlorophyll
    - Ohio Biological Water Quality Criteria
      - » Biocriteria for Fish and Macroinvertebrates
        - IBI = Index of Biological Integrity
        - MIwb = Modified Index of Well-Being
        - ICI = Invertebrate Community Index
- SNAP Matrix of Trophic Conditions
  1. Attaining and not threatened
  2. Attaining, but may be threatened
  3. Impaired, but cause(s) other than nutrients
  4. Impaired, with nutrients as a likely cause
  5. Impaired, with nutrient enrichment as the cause

Proposed **Stream Nutrient Assessment Procedure (SNAP)**

1	2	3	4	
Biological Criteria	**DO Swing**	**Benthic Chlorophyll**	**Preliminary Assessment: Trophic Condition Status**	
All indices attaining or non-significant departure	Normal or low swings (≤6.5 mg/l)	Low to moderate (≤320 mg/m²)	Attaining use / not threatened	
		High (>320 mg/m²)	Attaining use, but may be threatened	*See Flow Chart A*
	Wide swings (>6.5 mg/l)	Low (≤182 mg/m²)		
		Moderate to high (>182 mg/m²)		
Non-attaining (one or more indices below non-significant departure)	Normal or low swings (≤6.5 mg/l)	Low to moderate (≤320 mg/m²)	Impaired, but cause(s) other than nutrients	*See Flow Chart B*
		High (>320 mg/m²)	Impaired / likely nutrient enriched	*See Flow Chart C*
	Wide swings (>6.5 mg/l)	Low (≤182 mg/m²)		
		Moderate to high (>182 mg/m²)	Impaired / Nutrient enriched	

Ohio Stream Nutrient Assessment Procedure (SNAP)

- Data Collection – gather it now
- Preliminary Nutrient Impairment Assessment
  - SNAP Matrix
- Preliminary Status
  - Attaining, Threatened, Impaired (Nutrients or Other Causes)
- Status Verification
- Implementation – work with others



Nutrient Discharge Permitting

Attainable and Protective Nutrient Permits

Preferred

- Improve Water Quality
  - Effective Nutrient Reduction
  - Linked to Standards or TMDL Wasteload Allocation
- Technically Achievable
  - Low Compliance Risk
- Economical
  - Affordable
- Flexible
  - Supports Watershed Solutions
- Sustainable

Avoid

- Inflexible Permit Structures
  - Unattainable N and P Limits
  - Over-specified Effluent Limits
    - Mass and Concentration
    - Monthly and Weekly Limits for POTWs
  - Immediate Compliance Requirements
- Social and Environmental Impacts
  - Large Increases in Energy, Chemical, Solids, Greenhouse Gas Emissions, etc
  - Marginal Incremental Water Quality Improvements

Clark, D.L. Hunt, G., Kasch, M.S., Lemonds, P.J., Moen, G.M., Neethling, J.B. (2010) "Nutrient Management Regulatory Approaches To Protect Water Quality – Volume 1 Review Of Existing Practices" WERF Nutrient Removal Challenge project NUTR1R06i.

Improving Basis for Nutrient Discharge Permitting

Now

- Treatment Technology Performance
  - Well Documented
- Understanding of Nutrient Speciation
  - Treatment Effectiveness
  - Water Quality Impacts
- ***State Solutions***
  - ***Near-term Remedies***
    - ***Technology Based Effluent Limits***

Developing

- Treatment Technology Advances
- Improved Water Quality Modeling
  - Speciation
  - Nutrient Bioavailability
- ***Long Term Reconciliation with Water Quality Based Effluent Limits***
  - ***In-stream Targets Lower Than Technology Can Achieve End-of-Pipe***
- ***Bioavailability***
- ***Sustainability***

Nutrient Permitting Challenges

Federal Regulations

- *40 CFR 122.45(d) requires that all permit limits be expressed as average monthly limits and average weekly limits for publicly owned treatment works (POTWs) and as both average monthly limits and maximum daily limits for all others, unless impracticable.*

Key Issues

- Effluent Variability
  - N and P Variable Even in Best Designed and Operated Facilities
- *"impracticable"* Determination
  - Individual Permit Writer's Interpretation
  - Guidance – 2004 Chesapeake Bay – annual effluent limits acceptable

Example Inconsistency in Permit Limits

– Relationship of Weekly to Monthly

Discharger	NPDES Permit Phosphorus Limits		Permit Ratio Weekly/Monthly
	Average Monthly, ug/L (lbs/d)	Average Weekly, ug/L (lbs/d)	
Boise – Lander	**70** (8.7)	**93** (11.6)	**1.33**
Boise – West	**70** (14)	**84** (16.8)	**1.2**
Caldwell	**70** (4.96)	**165** (11.7)	**2.36**
Greenleaf	**70** (0.14)	**105** (0.21)	**1.5**
Kuna	**70** (1.1)	**105** (1.65)	**1.5**
Notus	**70** (0.064)	**140** (0.128)	**2.0**
Sorrento	**70** (0.29)	**140** (0.58)	**2.0**

Know your Options!
Case Study Example: Spokane River Dischargers

Dissolved Oxygen TMDL

- Very Restrictive
  - Cumulative Anthropogenic D.O. Depression <0.2 mg/L
- TMDL Scenario
  - TP 0.042 mg/L
  - CBOD 4.2 mg/L
  - Ammonia-N 0.21 mg/L

NPDES Permit

- Seasonal Mass Loading Limits
  - TP, CBOD, NH_3N
    - Compliance Based on Season End Mass Discharged

S1.B.a Alternate effluent limits for oxygen consuming pollutants demonstrated to be equivalent to DO TMDL baseline effluent limits in S1.A (option 1)

Parameter	Seasonal Limit Applies March 1 to October 31 See notes f and g	
Carbonaceous Biochemical Oxygen Demand (5-day) ($CBOD_5$)	133.4 pounds/day (lbs/day) average	
Total Phosphorus (as P) March 1 to Oct. 31	3.34 lbs/day average	
Total Ammonia (as NH_3-N)	**Seasonal Limit**	**Maximum Daily Limit**
For "season" of March 1 to March 31	1067.5 lbs/day average	16 mg/L
For "season" of April 1 to May 31	66.7 lbs/day average	16 mg/L
For "season" of June 1 to Sept. 30	16.7 lbs/day average	8 mg/L
For "season" of Oct. 1 to Oct. 31	66.7 lbs/day average	16 mg/L
Parameter	**Average Monthly [a]**	**Average Weekly [b]**
Carbonaceous Biochemical Oxygen Demand (5-day) ($CBOD_5$). November 1 through February 29	2.0 milligrams/liter (mg/L) 133 pounds/day (lbs/day)	---

Variety of Successful Permit Structures Nationally for Nutrients

Location	Total Phosphorus Limits	Comments
Clean Water Services of Washington County, OR	0.100 mg/l	Monthly Median, May 1 to Oct 31 Watershed Permit
Las Vegas, Clark County, Henderson, NV	334 lbs/day (130/174/30 lbs/day)	Mar 1 to Oct 31 Cooperative Agreement to Share for Flexibility
Alexandria, VA	0.18 mg/l and 37 kg/day 0.27 mg/l and 55 kg/day	Monthly Average Weekly Average

- Concentration Only, Mass Only, Both
  - Seasonal Limits
  - Mean or Median
  - Shared Capacity

Think about the Future: Permit Structure Comparison

Effluent Limits	Technically Attainable		Supports Creative Effluent Management and Watershed Solutions	
	Now	Future	Trading and Offsets	Reuse, Recharge, Restoration, etc (Load Diversions)
Concentration Only	Yes	?	No	No
Concentration and Mass	Yes	?	No	No
Mass Only	Yes	Perhaps	Yes	Yes

Example: Future Effluent Limits Drop from 1 mg/L to 0.5 mg/L

- Concentration Only Limits: Plant Effluent 0.5 mg/L
- Mass Only Limits: Plant Effluent 1 mg/L + Offset/Trade/Reuse

Regulatory Issues

- 40 CFR 122.45(d) requires that all permit limits be expressed as average monthly limits and average weekly limits for publicly owned treatment works (POTWs) and as both average monthly limits and maximum daily limits for all others, unless “impracticable.”

Permit Flexibility for Trading, Offsets, Reuse, etc.

Mass Based Effluent Limits

- Straightforward Trades
  - Simple and Clear

S1.B.a Alternate effluent limits for oxygen consuming pollutants demonstrated to be equivalent to DO TMDL baseline effluent limits in S1.A (option 1)

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Concentration Based Limits

- Requires Calculations

	Average Monthly Limit	Average Weekly Limit
Total Phosphorus[2] **May 1 – Sept 30**	70 µg/L 14 lbs/day	84 µg/L 16.8 lbs/day

Note 2. The permittee may meet the effluent limits for total phosphorus using the Dixie Drain offset. See Part I.B.6.

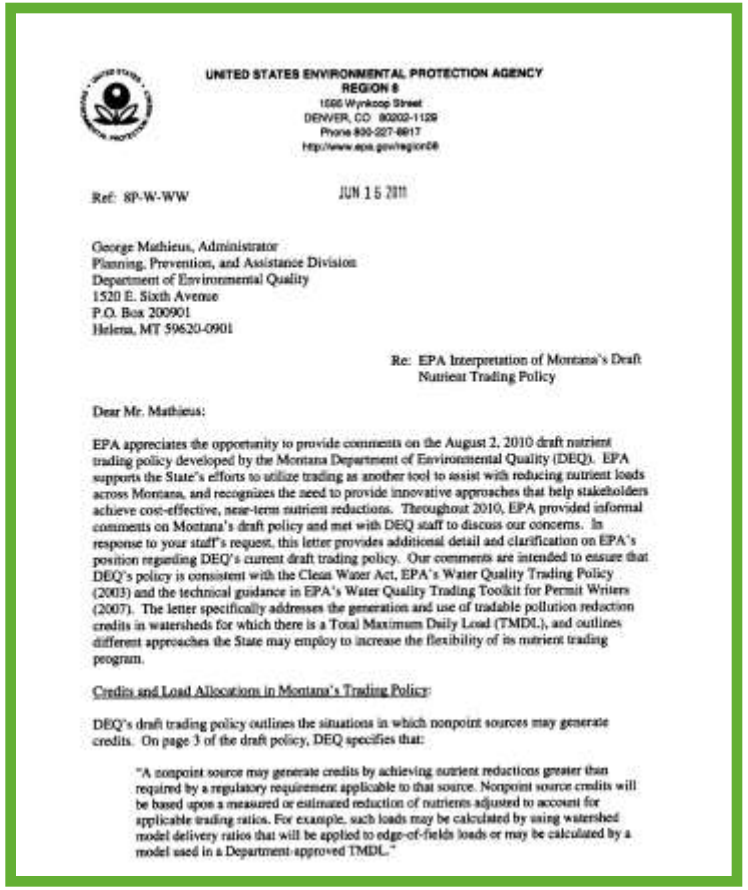
b) Offset Pounds. For each pound of total phosphorus the West Boise Treatment Facility discharges in excess of 70 µg/L, the Permittee must remove a minimum of 1.5 pounds of total phosphorus at the Dixie Drain Facility. The pounds of total phosphorus the West Boise Treatment Facility discharges in excess of 70 µg/L are calculated as: (Average Monthly Effluent Concentration – 70) × Average Monthly Flow × 8,340 ÷ 1,000

The monthly offset ratio which is defined as the pounds of total phosphorus removed at the Dixie Drain Facility divided by the pounds of total phosphorus the West Boise Treatment Facility discharges in excess of 70 µg/L must be greater than 1.5.

$$\frac{Pounds\ Removed\ Dixie\ Drain\ Facilty}{Pounds\ Disharged\ \ at\ West\ Boise\ in\ Excess\ of\ 70\ \mu g/L} > 1.5$$

Qualifying Credits and TMDL Load Allocations

- *"Because TMDL load allocations (LAs) are not part of DEQ's nonpoint source baseline, the proposed trading policy would allow for generation of trading credits before a nonpoint source LA has been met. While EPA understands and agrees with DEQ's position that any nutrient reduction benefits the environment, we differ on what constitutes an allowable trading credit.*
- *"Generating trading credits before a nonpoint source LA has been met is problematic because of the relationship between TMDLs and the permitting process."*
- *Under its draft Trading Policy, DEQ could issue a permit that allows the permittee to buy credits from nonpoint sources to meet its permit limits, even though the nonpoint sources have not met their LAs under the TMDL.*



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
1595 Wynkoop Street
DENVER, CO 80202-1129
Phone 800-227-8917
http://www.epa.gov/region08

Ref: 8P-W-WW

JUN 15 2011

George Mathieus, Administrator
Planning, Prevention, and Assistance Division
Department of Environmental Quality
1520 E. Sixth Avenue
P.O. Box 200901
Helena, MT 59620-0901

Re: EPA Interpretation of Montana's Draft Nutrient Trading Policy

Dear Mr. Mathieus:

EPA appreciates the opportunity to provide comments on the August 2, 2010 draft nutrient trading policy developed by the Montana Department of Environmental Quality (DEQ). EPA supports the State's efforts to utilize trading as another tool to assist with reducing nutrient loads across Montana, and recognizes the need to provide innovative approaches that help stakeholders achieve cost-effective, near-term nutrient reductions. Throughout 2010, EPA provided informal comments on Montana's draft policy and met with DEQ staff to discuss our concerns. In response to your staff's request, this letter provides additional detail and clarification on EPA's position regarding DEQ's current draft trading policy. Our comments are intended to ensure that DEQ's policy is consistent with the Clean Water Act, EPA's Water Quality Trading Policy (2003) and the technical guidance in EPA's Water Quality Trading Toolkit for Permit Writers (2007). The letter specifically addresses the generation and use of tradable pollution reduction credits in watersheds for which there is a Total Maximum Daily Load (TMDL), and outlines different approaches the State may employ to increase the flexibility of its nutrient trading program.

Credits and Load Allocations in Montana's Trading Policy:

DEQ's draft trading policy outlines the situations in which nonpoint sources may generate credits. On page 3 of the draft policy, DEQ specifies that:

"A nonpoint source may generate credits by achieving nutrient reductions greater than required by a regulatory requirement applicable to that source. Nonpoint source credits will be based upon a measured or estimated reduction of nutrients adjusted to account for applicable trading ratios. For example, such loads may be calculated by using watershed model delivery ratios that will be applied to edge-of-fields loads or may be calculated by a model used in a Department-approved TMDL."

Region 8 EPA Letter to Montana DEQ, June 15, 2011

Nonpoint Source Credits Available Only After TMDL Nonpoint Source Load Allocation Has Been Met

‘Model’ Nutrient NPDES Permit

Features

- Substantial Nutrient Reduction
- Long Averaging Periods
  - Seasonal or Annual Preferred
- Mass Loadings
  - Supports Trading, Offsets, Reuse, etc.
- Include Compliance Schedule
  - Watershed Perspectives
    - Adaptive Management

Benefits

- Water Quality Improvements
- Successful Compliance
- Technically Achievable
- Adaptive Management Opportunities
  - Monitor Receiving Water Response
  - Adapt Treatment Process Over Time
  - Develop Trades and Offsets
  - Quantify and Manage Nonpoint Sources
  - Consider Sustainability

Nutrient Permitting Recommendations

Maintain Watershed Perspective

- Early Engagement in Process
  - State Numeric Nutrient Criteria Development
  - Watershed TMDLs
  - Individual Permits
- Technical Input and Support
  - Capabilities of Treatment
  - Effluent Characterization
- Long-term Support
  - Lay Foundation for Regulatory "Solutions"
  - Sustained Watershed Perspective
    - Compliance Schedule and Beyond
  - Design Treatment Process for Adaptability

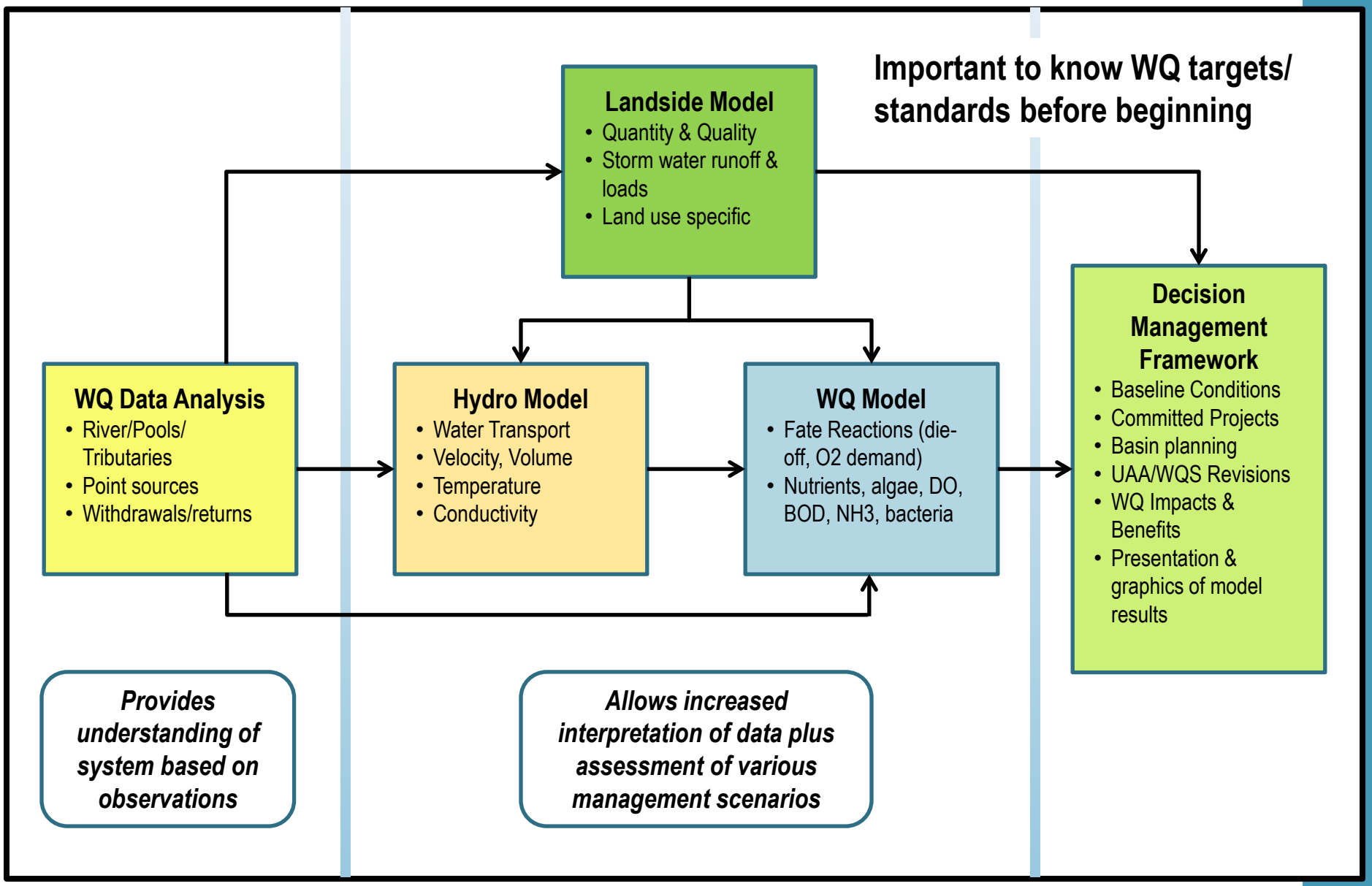
Permit Structure Development

- Dialog with Regulators
  - Permit Writers
- Solution Orientation
  - Technology Exchange
  - Foster Shared Understanding
    - Treatment Capabilities
    - Limitations
- Apply Regulatory "Solutions" When Necessary
  - Avoid Unattainable Effluent Limits
    - Compliance Schedules, Variances, Site Specific Criteria, etc.
- Invest the Time
  - NPDES Renewal Period Alone is Inadequate

Clark, D.L., Hatch, L., Falconer, H.F., Kasch, M.S., Lemonds, P.J., Neethling, J.B. (2015) "Nutrient Management Volume III: Development of Appropriate Permitting Frameworks " WERF Nutrient Removal Challenge project NUTR1R06x

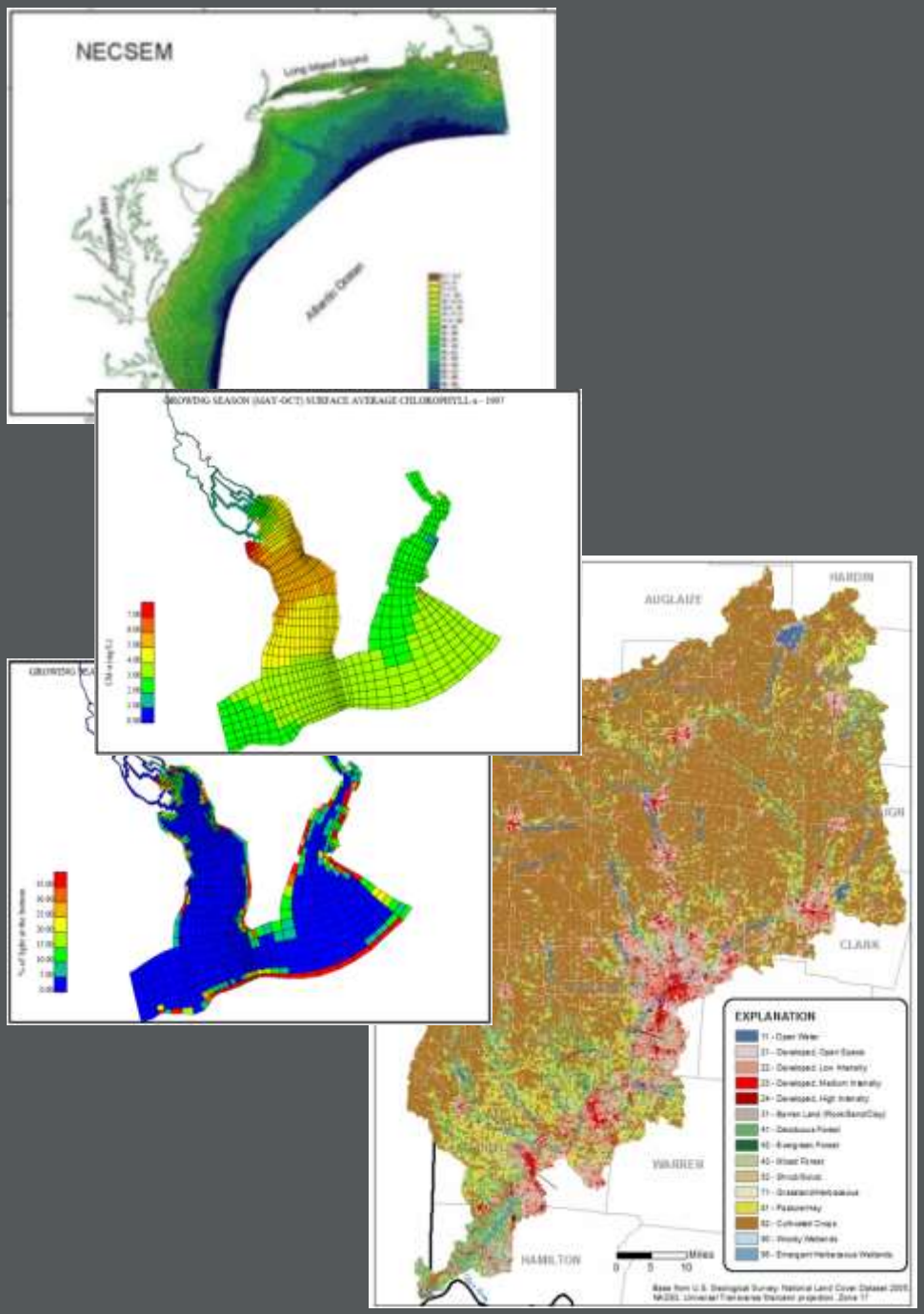
02 Holistic Approaches to Water Quality

MODELING APPROACH

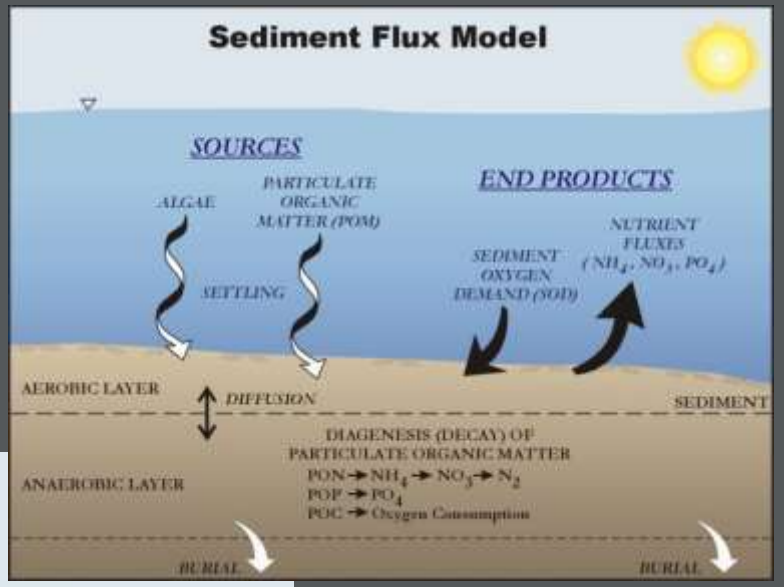


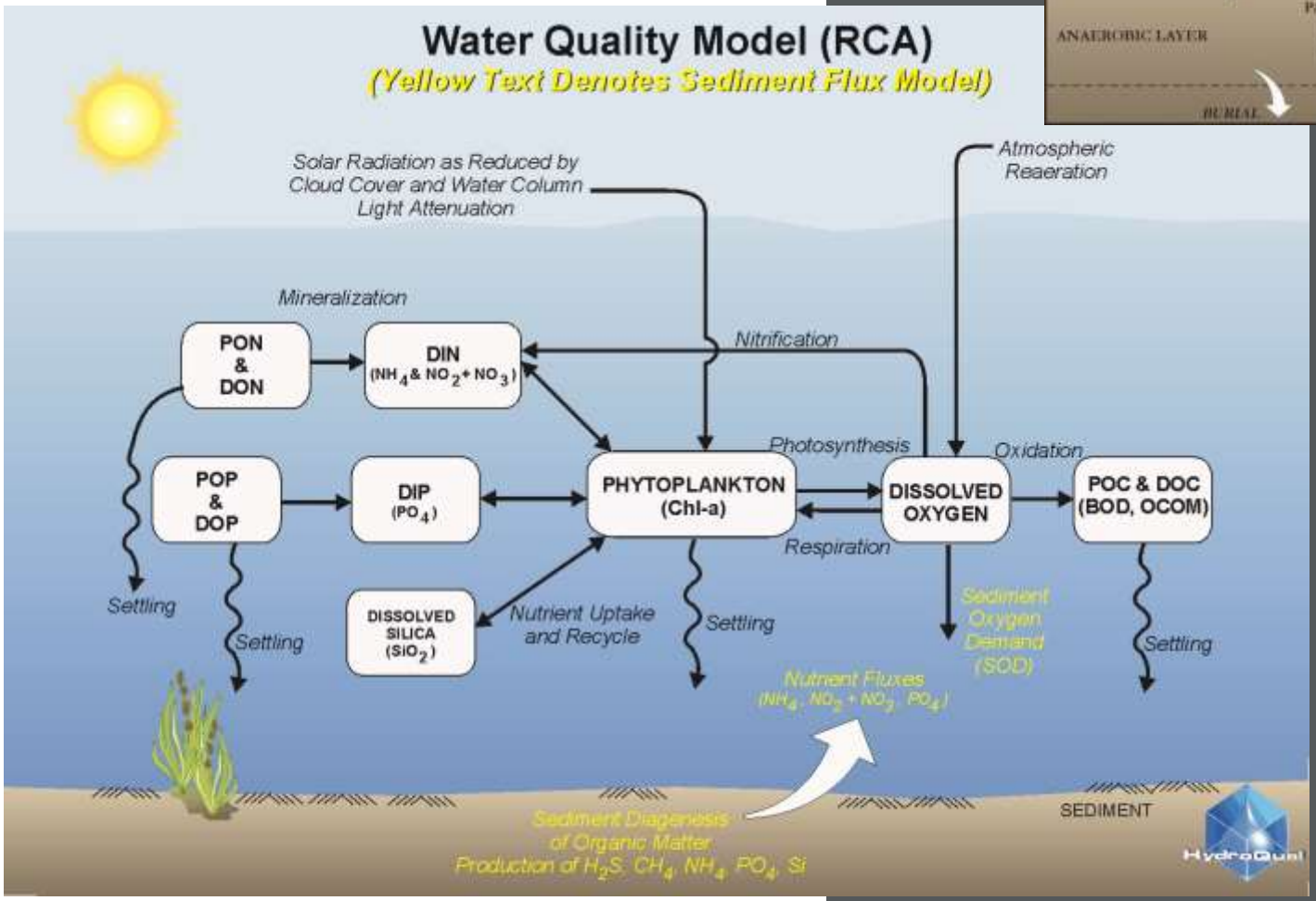
WATER QUALITY MODELING APPROACH

- Phased approach
  - Compile/analyze available data
  - ID data gaps/plan to fill
  - Model selection
- Model calibration
- Model projections
  - “Natural background” scenario
  - LOT + best BMPs
  - Knee of curve analysis to find most cost-effective solution
- Model as a tool



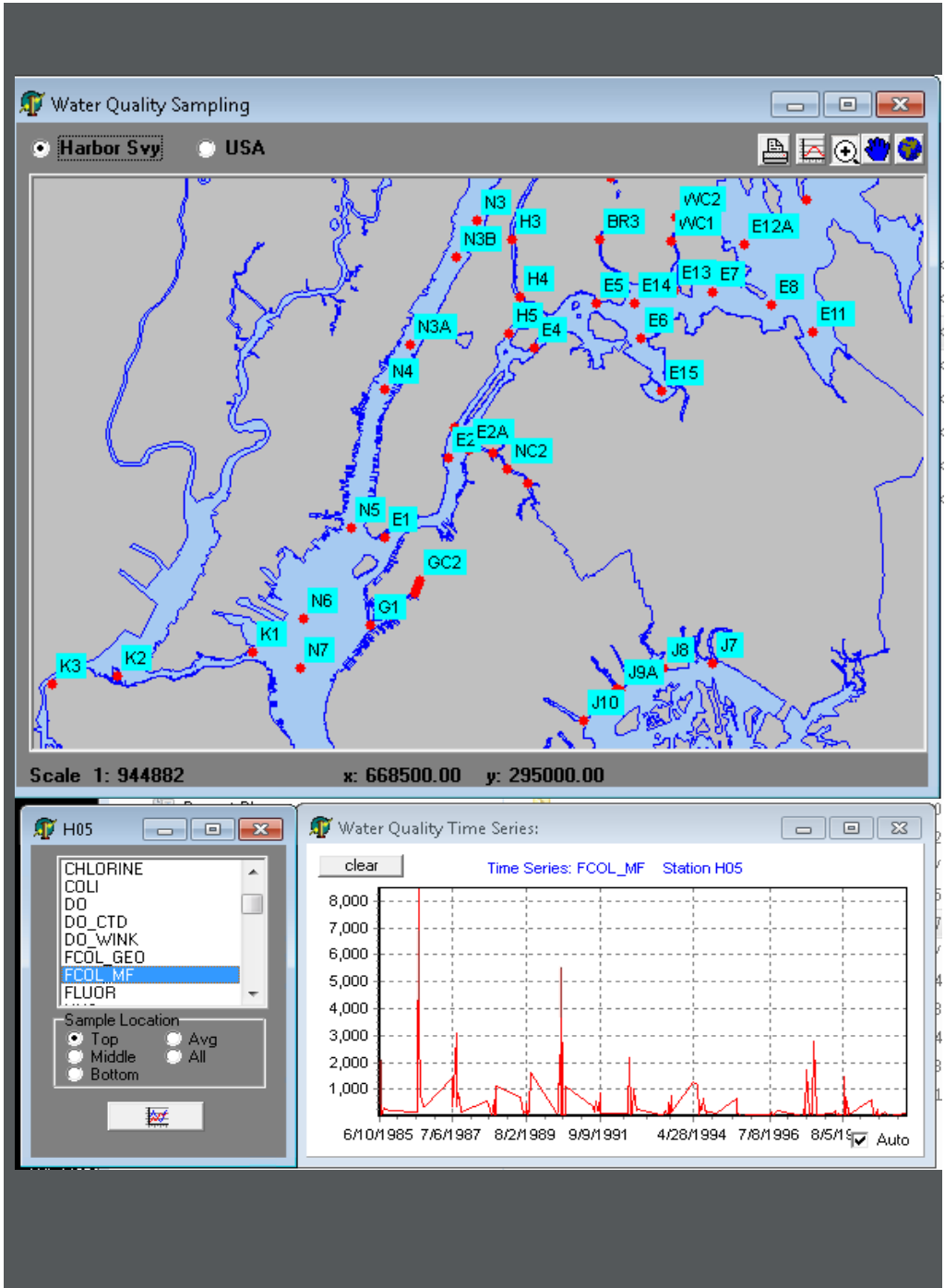
MODEL WATER QUALITY KINETICS



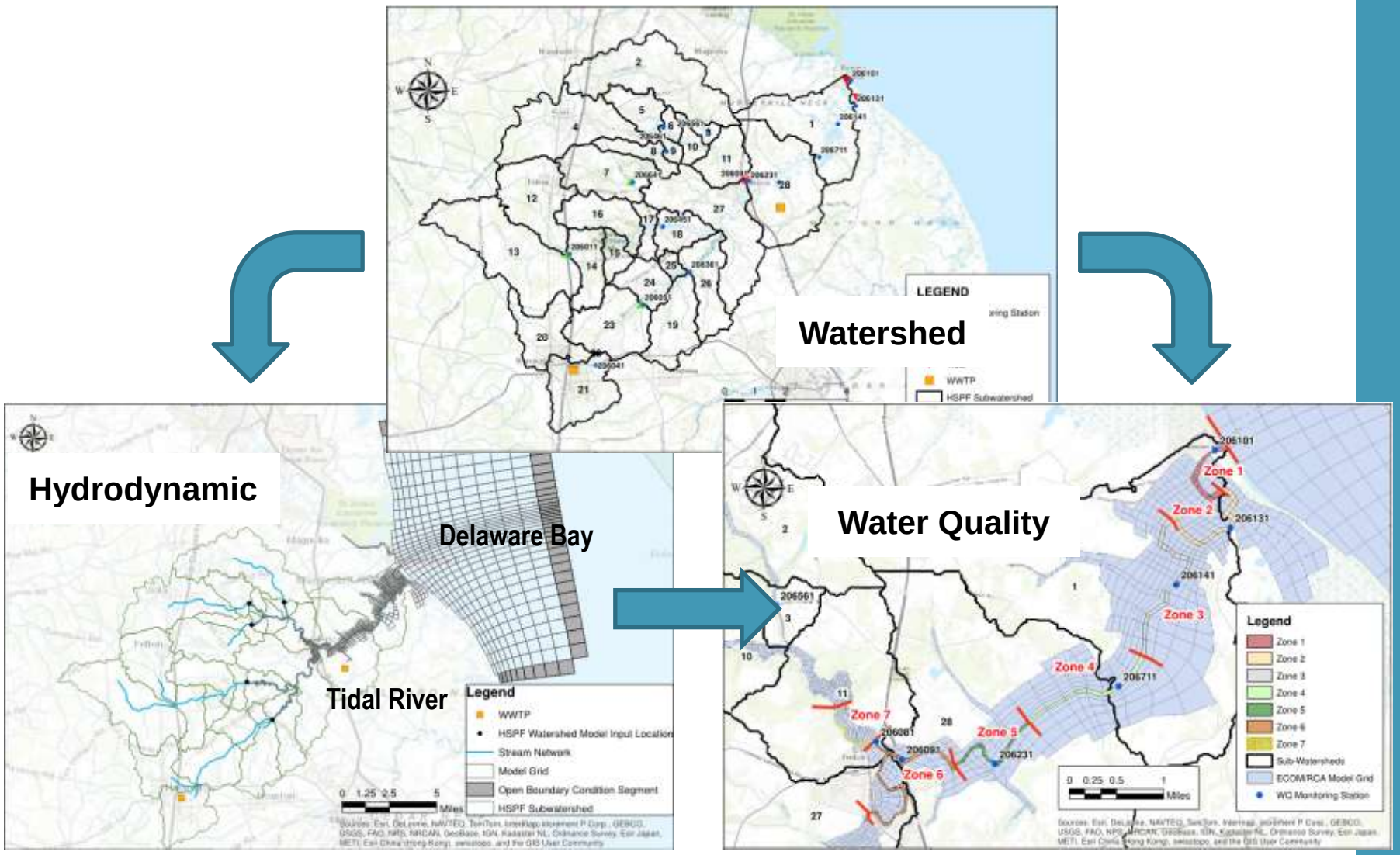


MODEL CONSIDERATIONS

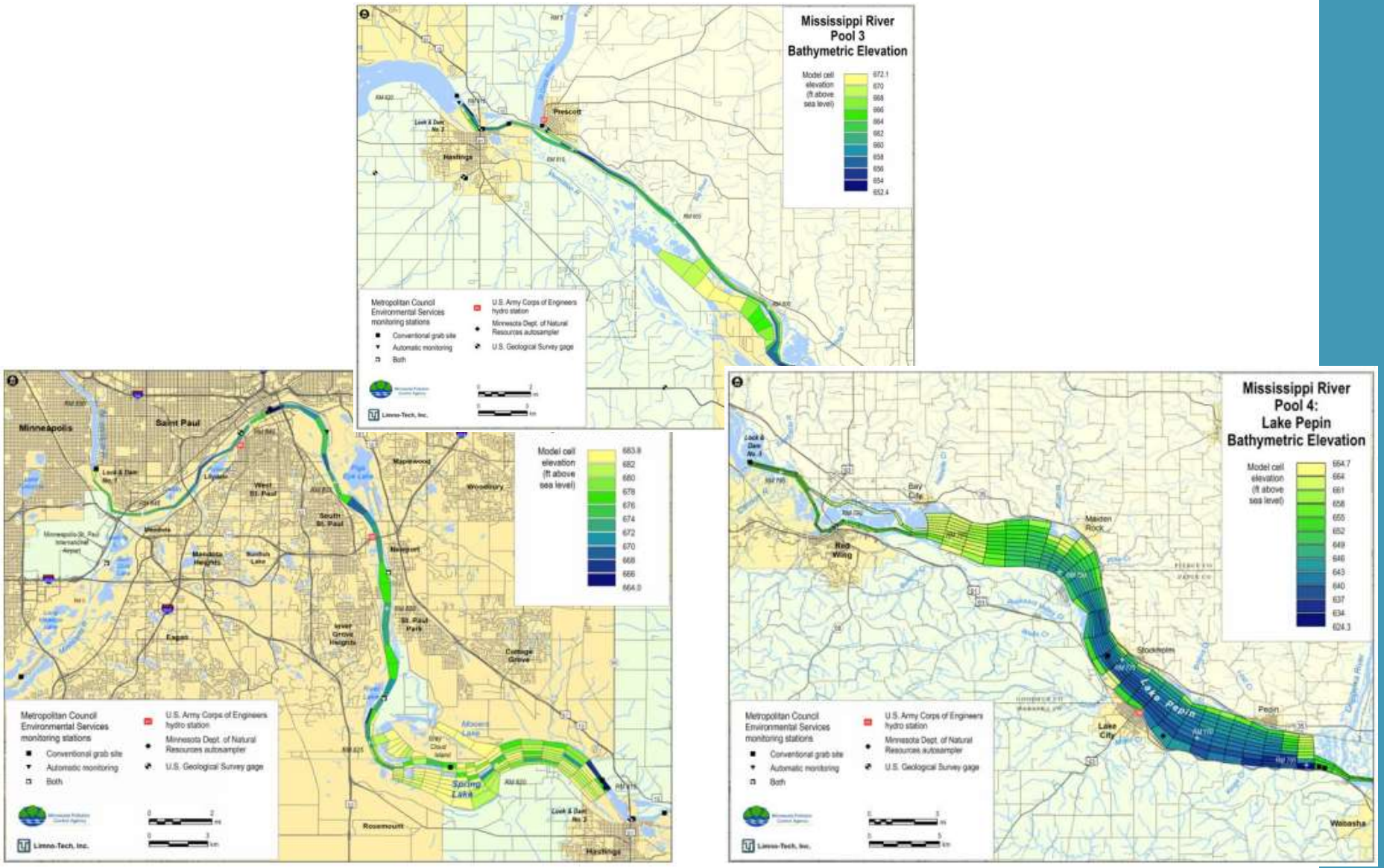
- Steady-state or dynamic
- Dimensions
- Loading Source Representation
  - Watershed (NPS), Drainage tiles, Internal sediment cycling
- Model Calibration
- Model Projection Scenarios
  - Baseline condition
  - “Natural Background”
  - LOT with BMPs
  - Most cost-effective solution
- Transparency



MODEL LINKAGE



STATE-OF-THE-ART EUTROPHICATION MODEL
(Upper Mississippi River, MN – River/Pool Reaches)



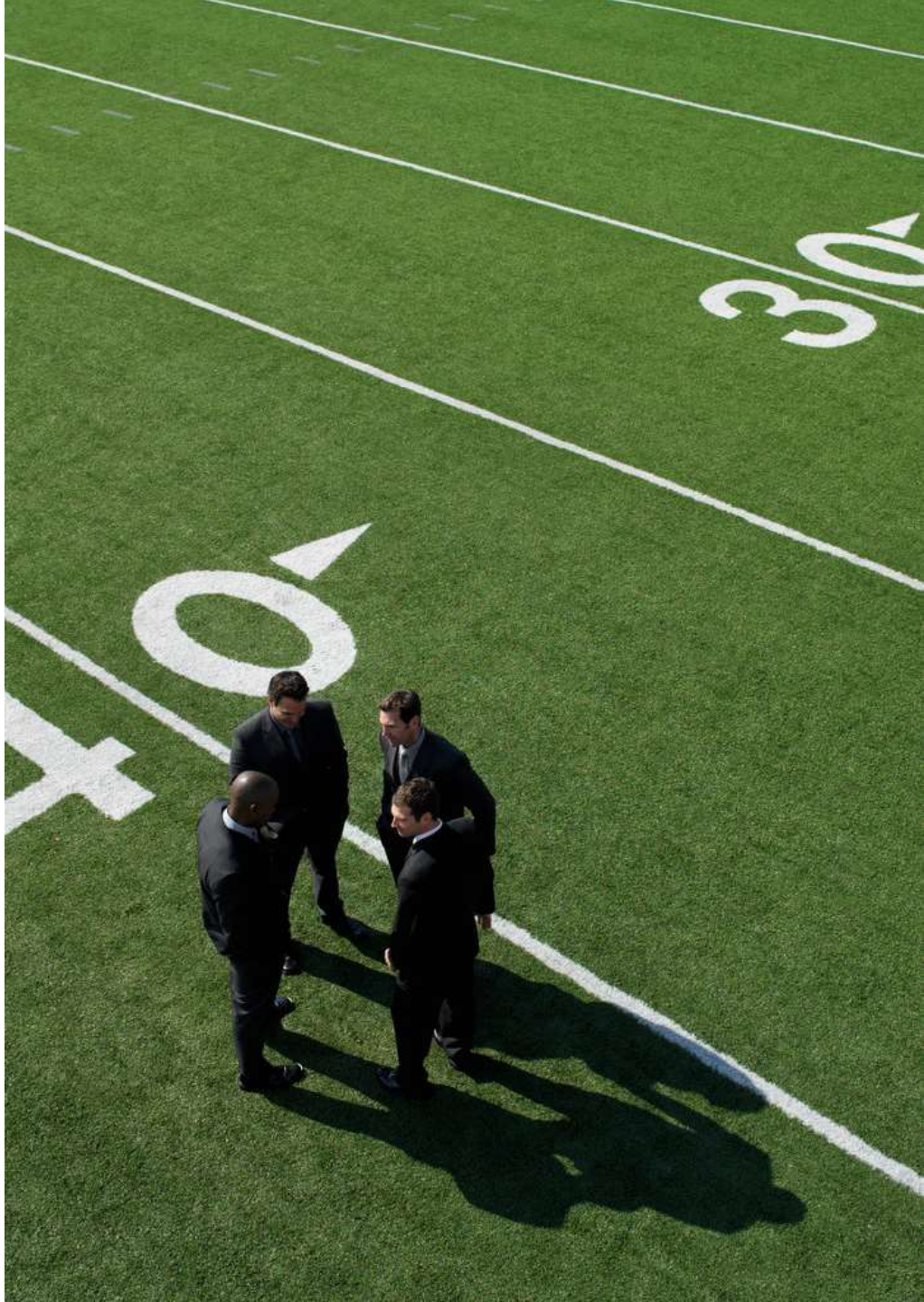
03 Right-Sizing Your Approach for Net Environmental Benefit

So now what?
Take Stock!

- Goals, desired outcomes
- Available time (permit cycle, TMDL, other)
- Data
- Communication
- Financial considerations
- Know ‘required’ versus ‘available’ actions

Some more ideas to discuss…..

- ‘Interim limits’ concept
- Investment stability period
- Technology workshops
- Ways to acknowledge NPS
- Trading programs
- Multi-POTW strategies



Right-sized approach involves…

- Technology and treatment capability assessments
- Permit writing, permit structure, data management
- Balance (utility management, water quality, aquatic ecosystem, sustainability, affordability)
- Open, collaborative dialogue and data sharing

……**to *proactively* chart POTW course for nutrient management in Ohio watersheds.**

Nutrient Management, Water Quality, and a Right-Sized Approach to Regulatory Compliance

Jennifer A. Frommer, P.E., HDR Engineering, Inc.

Ohio Water Environment Association Conference

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