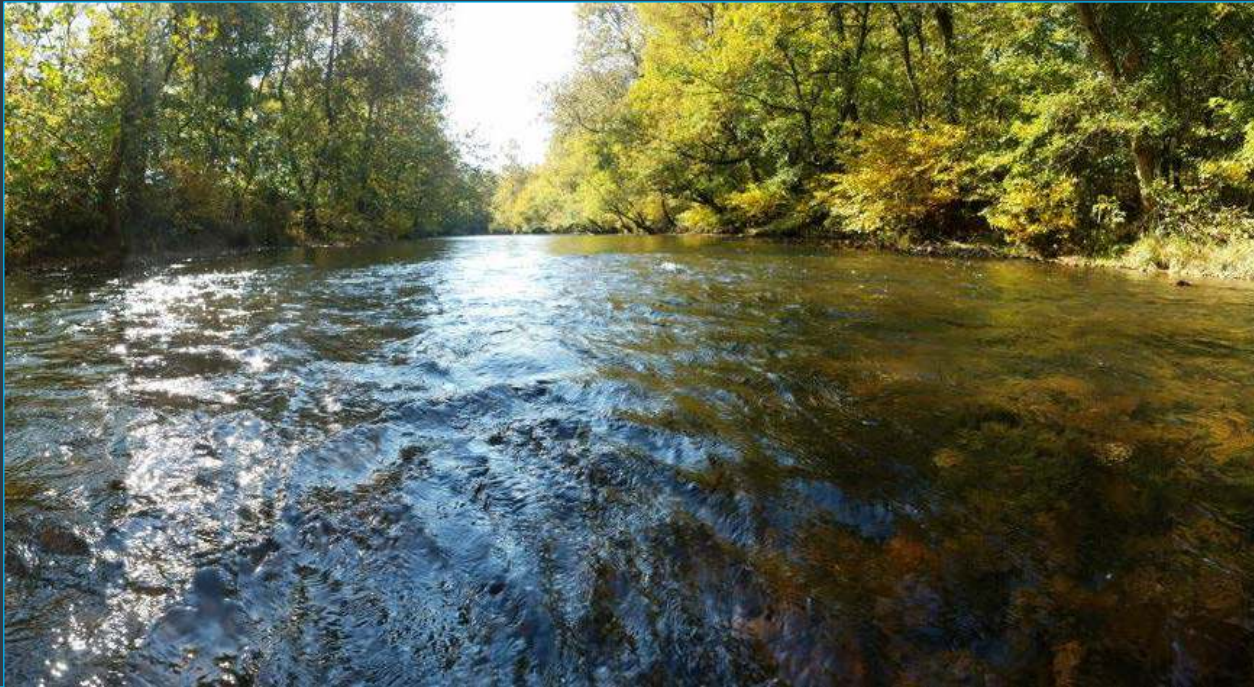




Relative Risk Models Using Bayesian Networks: Application, Communication and Regulatory Use

Sagar Thakali Ph.D., Andrew Miano, Josh Collins, Ceil Mancini (AECOM); Ralph G. Stahl Jr., Ph.D., D.A.B.T., Michael R. Liberati (DuPont Corporate Remediation Group)

November 5, 2018

Outline

- Background
- Objectives
- Modeling Framework
- Case Study: South River, VA
 - Public/regulatory acceptance
 - Transparency/communication
- Concluding Remarks



Relative Risk Model (RRM) Background

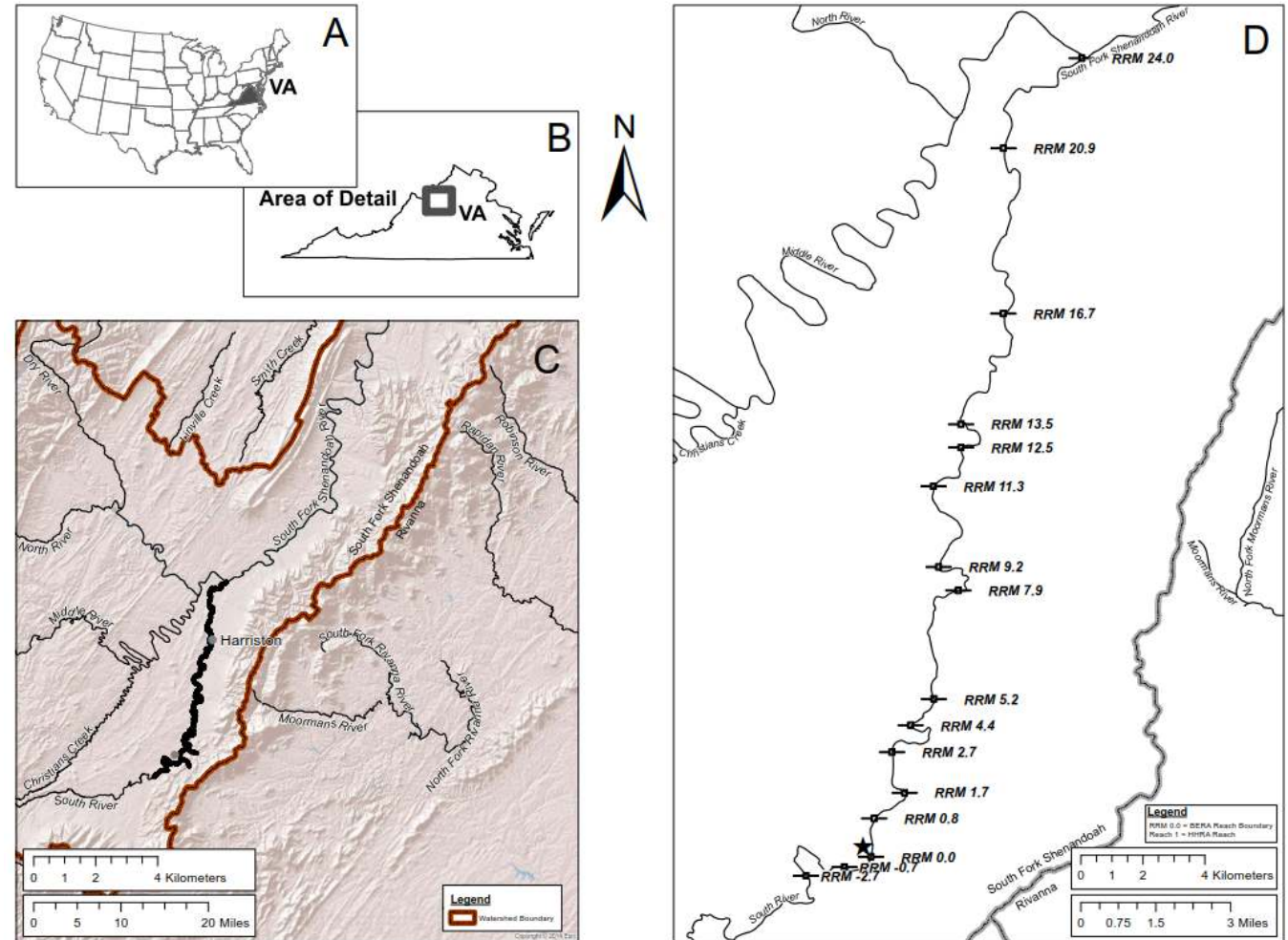
- What is it?
 - Scoring / ranking process based on *traditional* ecological risk assessment
 - Based on probabilistic approach (Bayesian Networks) with more quantitative (robust) estimates of “risk”
- Capabilities
 - Combine literature data, field data, and expert judgment
 - Assessment of multiple stressors and endpoints
 - Model habitats and/or receptors in a specific location; or more holistically across a watershed
 - Accommodate stakeholder values
 - Ecosystem services framework



Objectives

- BN-RRM Case Study
- Share Experiences:
 - Public/Regulatory Acceptance
 - Transparency/Communication
 - Overall Utility

South River, Waynesboro, VA



Considerations for Public / Regulatory Acceptance

- Program objectives:
 - RCRA
 - Non-RCRA
 - EAM
- Site-specificity:
 - Receptors
 - System uses
 - Risk regions

						
STATE	FEDERAL	CITY	ENVIRONMENTAL GROUPS	ACADEMIA	EXPERT PANELISTS	DUPONT
VDEQ VDGIF VDH	EPA (Region III) USFWS	Waynesboro	Friends of Shenandoah Virginia Conservation Council Virginia Save Our Streams Trout Unlimited Shenandoah River Keeper Chesapeake Bay Foundation	William & Mary James Madison Virginia Tech Delaware Waterloo Colorado State Western Washington Texas Tech	William Clements David Hirschman Ralph Turner	Engineers Geologists Risk Assessors

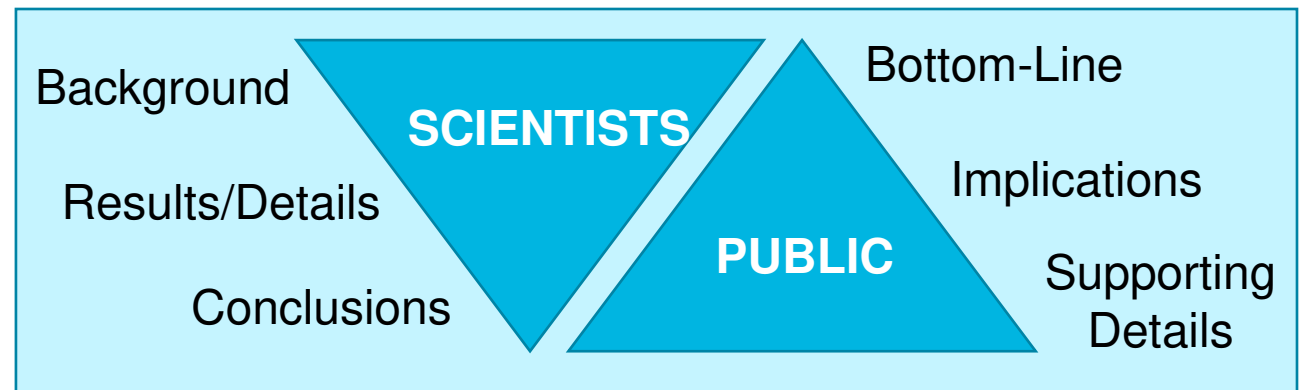
Communication & Transparency

- **Communication:**

- *Who:* SRST, EPA/VDEQ/City and, and public)
- *When:* Development to application
- *What:* Model, results, implications
- *How:* Presentations, publications, demonstrations, discussions

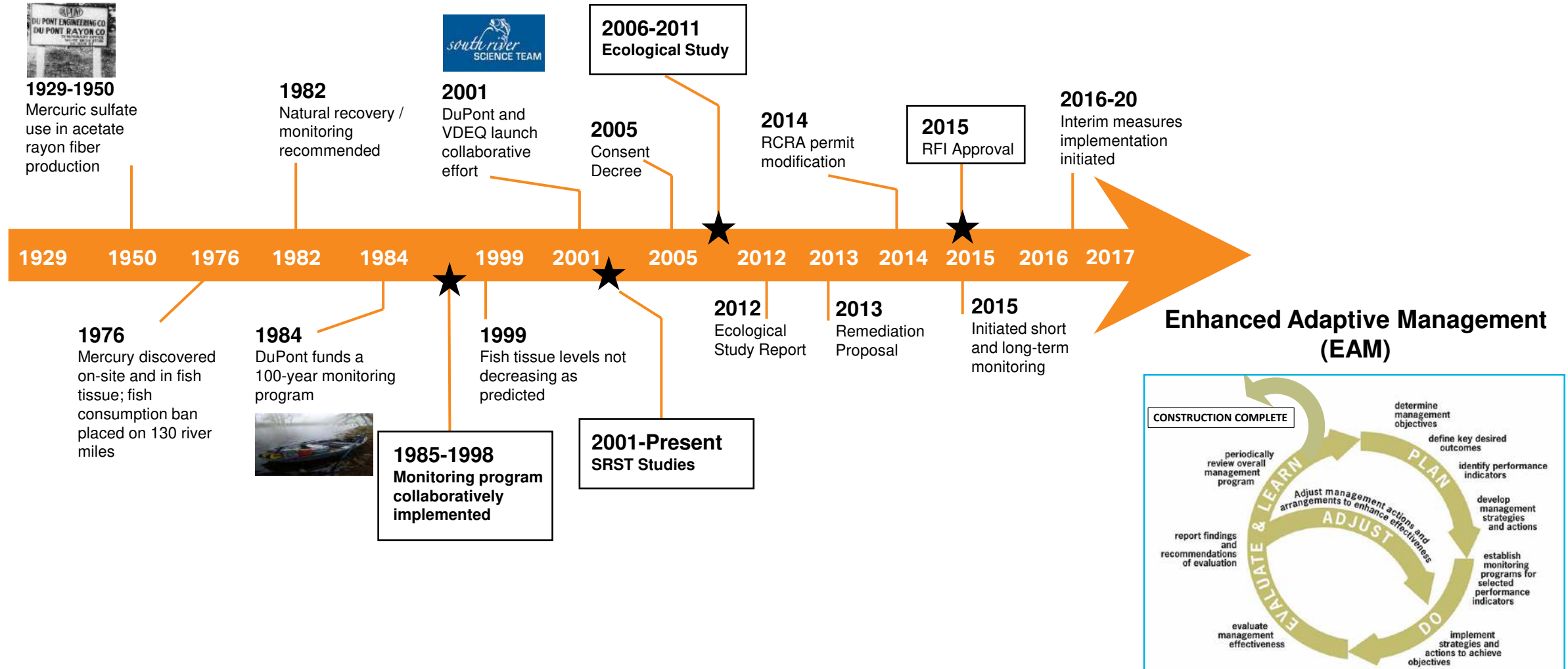
- **Transparency:**

- Assumptions
- Inputs
- Limitations
 - BN-RRM is ***simply a tool*** and provides ***one*** line of evidence



MODEL $\neq$ **REALITY**

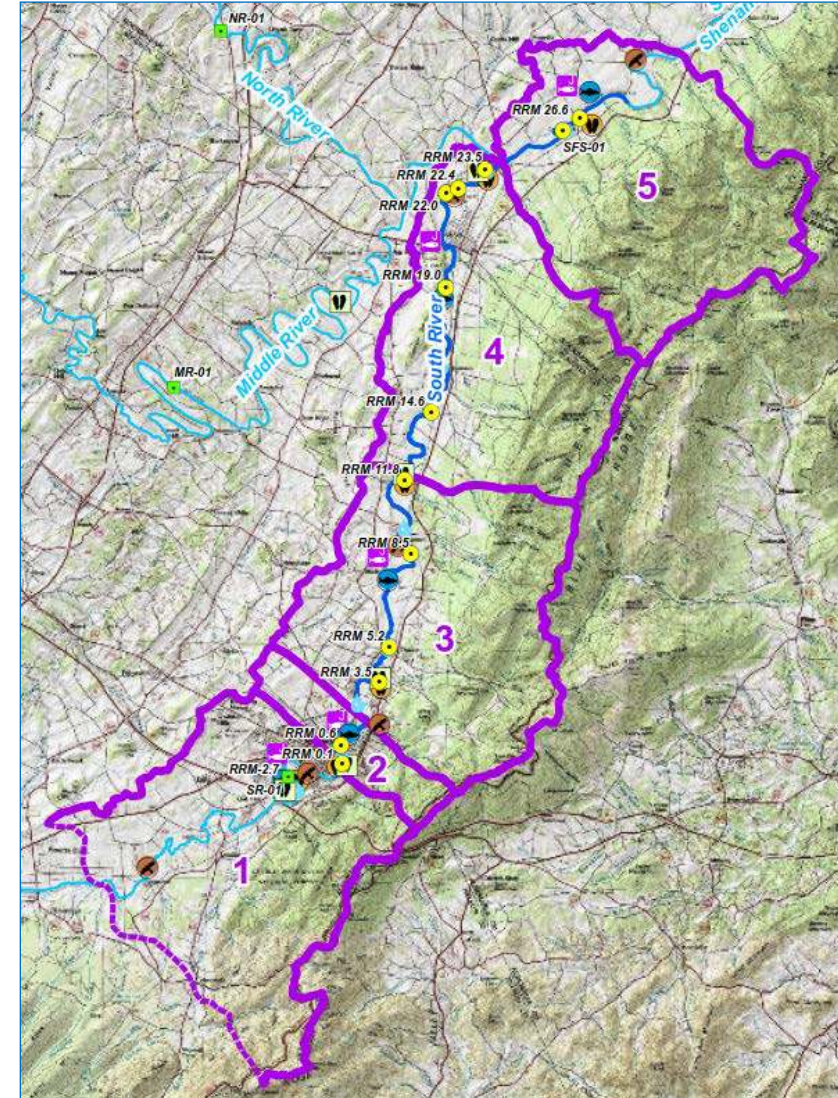
Case Study – Site History



Adapted from Jones (2005), *Tasmanian Parks & Wildlife Service*

Model Framework

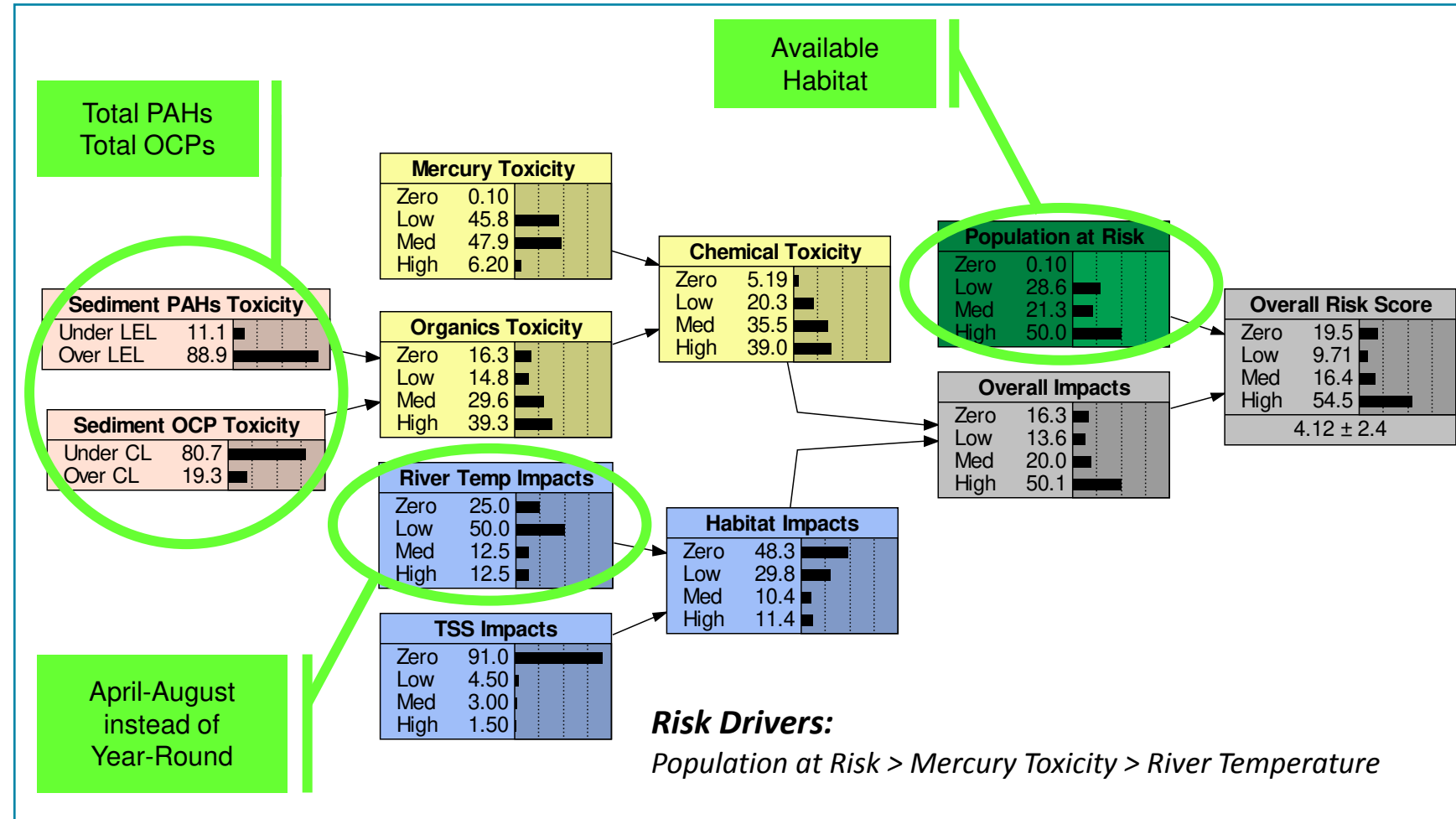
- 5 Risk Regions:
 - One upstream reference and four downstream study regions (2-5)
 - Consistent with:
 - Natural breaks in land use and hydrogeology
 - Upstream-to-downstream remedial approach and
 - Existing short- and long-term monitoring stations
- Ecological Receptors:
 - Smallmouth Bass
 - Carolina Wren
- System Uses:
 - Fishing
 - Swimming & Boating



RRM Structure

- Non-mercury chemical exposure
- Physical stressors
- Exposed population
- Conditional probabilities

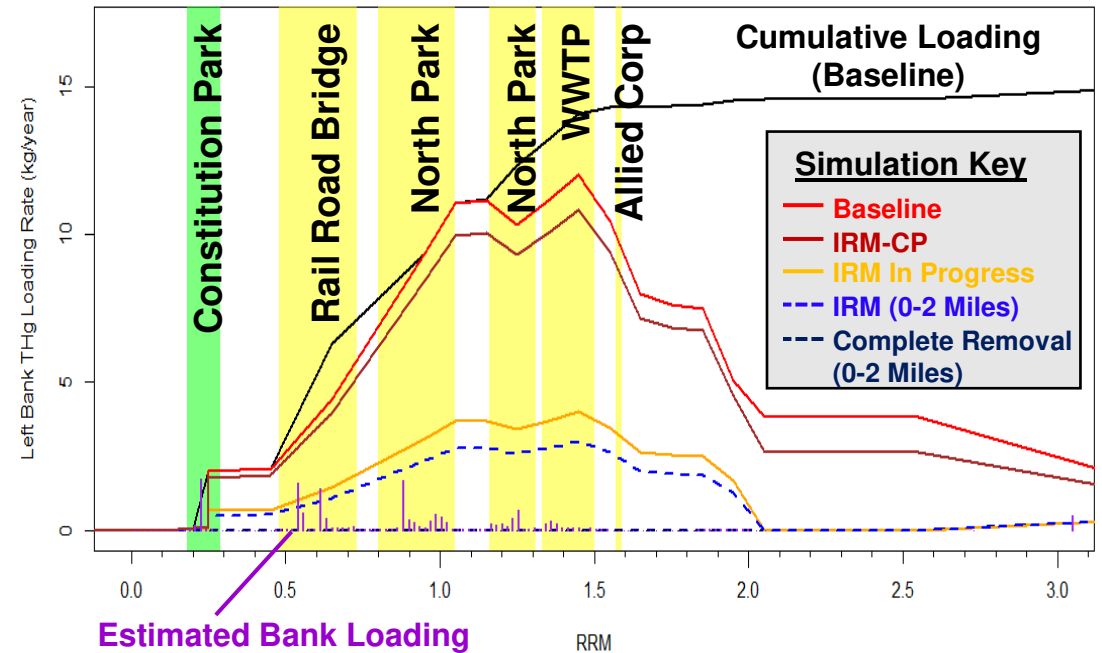
BN-RRM for Smallmouth Bass (SMB)



Modified from Landis et al. (2017). Integr. Environ. Assess. Manag. 13:85–99

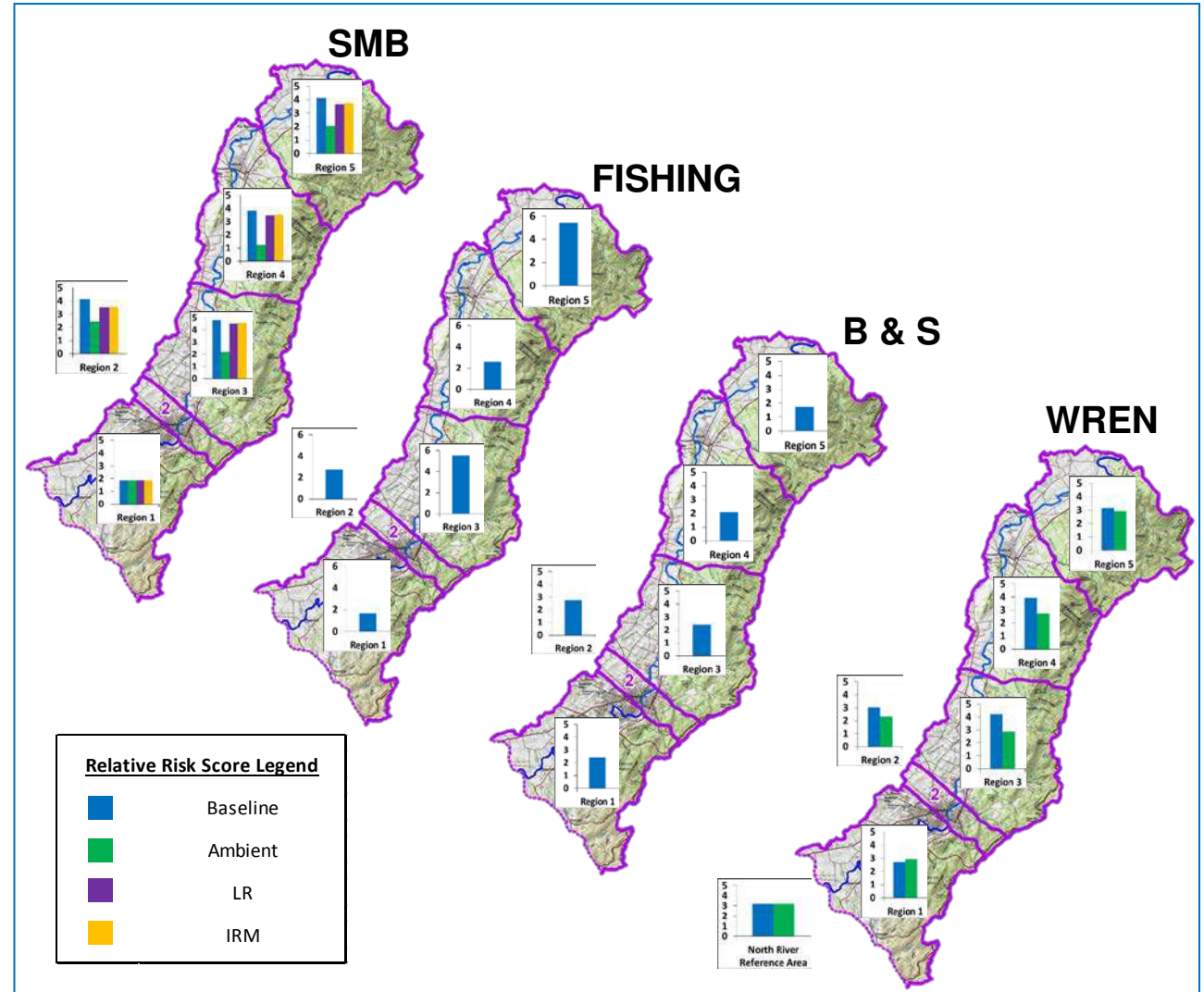
Evaluation

- Existing conditions (Baseline)
- Simulations for two mercury load reduction (**LR**) **scenarios**:
 - *Load Reduction (LR)*, representing a focus on load reduction only
 - *Interim Remedial Measure (IRM)*, representing the selected approach to balance load reduction and preservation of riparian habitat.
- Hypothetical “Ambient” conditions (as applicable)



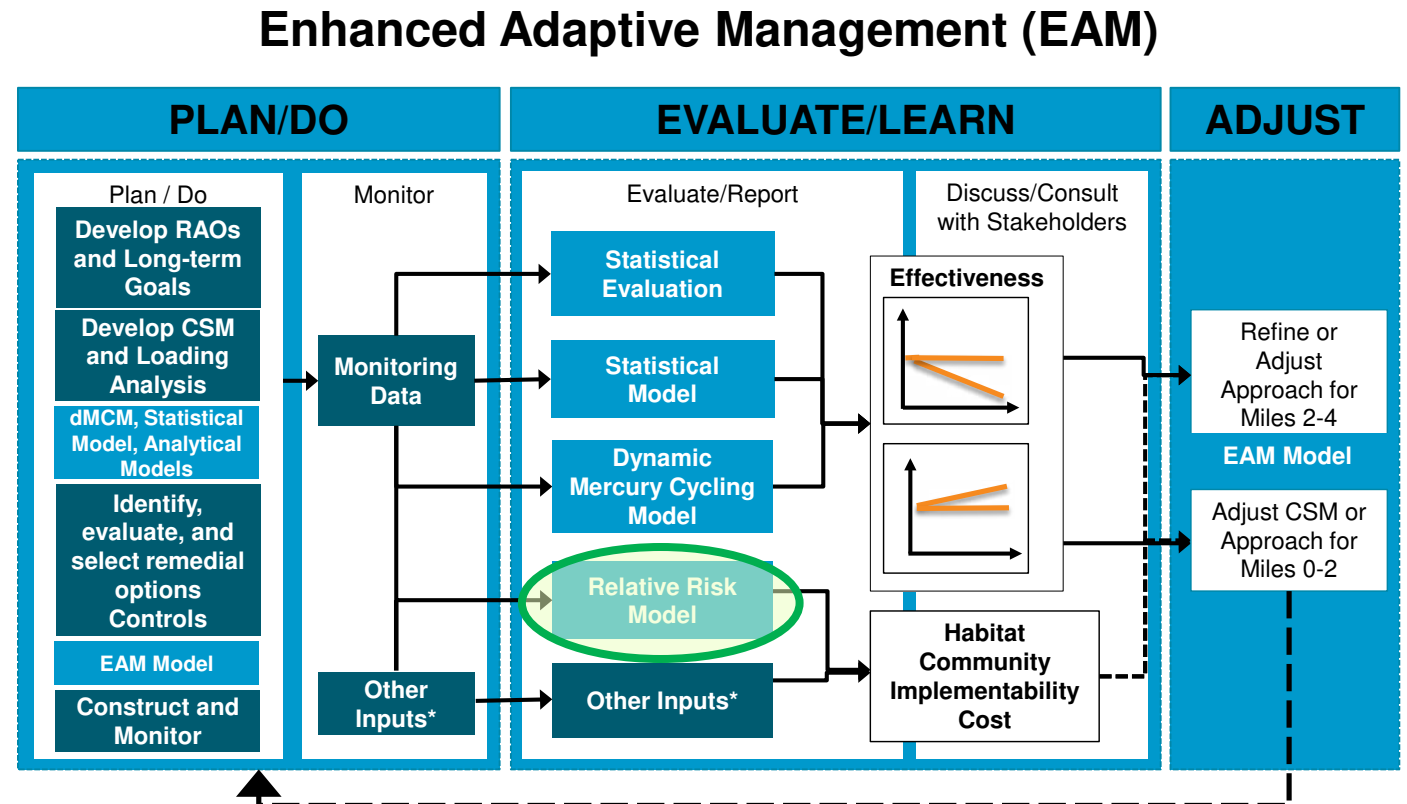
Results and Findings

- Mercury is the primary chemical stressor, but other environmental factors (e.g., water quality and habitat suitability) contribute to system risks
- Relative risks vary by risk regions owing to their spatial differences; and
- Remedial measures to mitigate potential risk from mercury may also achieve varying degrees of overall risk mitigation due to multiple stressors and factors



Concluding Remarks

- Overall reception of BN-RRM enhanced because of:
 - Site-specificity
 - Alignment with program objectives
 - Transparency
 - Interactive communication
- Models were useful in creating awareness on
 - Non-mercury factors
 - Need for and capability of integrated assessments
 - Use as one of many tools



SETAC North America 39th Annual Meeting
4-8 November 2018 / Sacramento, CA, USA

Thank You!

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