

# Enhanced Adaptive Management Approach for South River Remediation

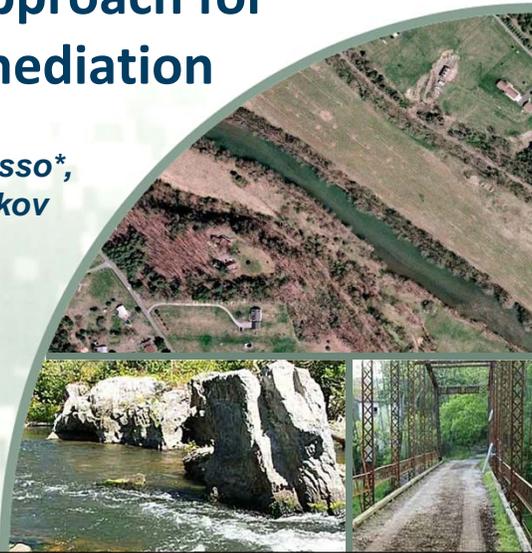
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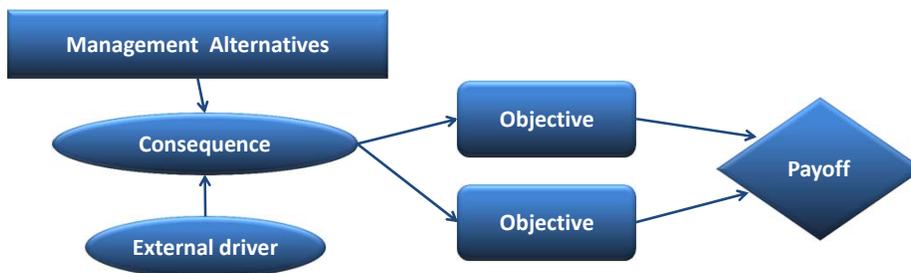
\*DuPont Corporate Remediation Group

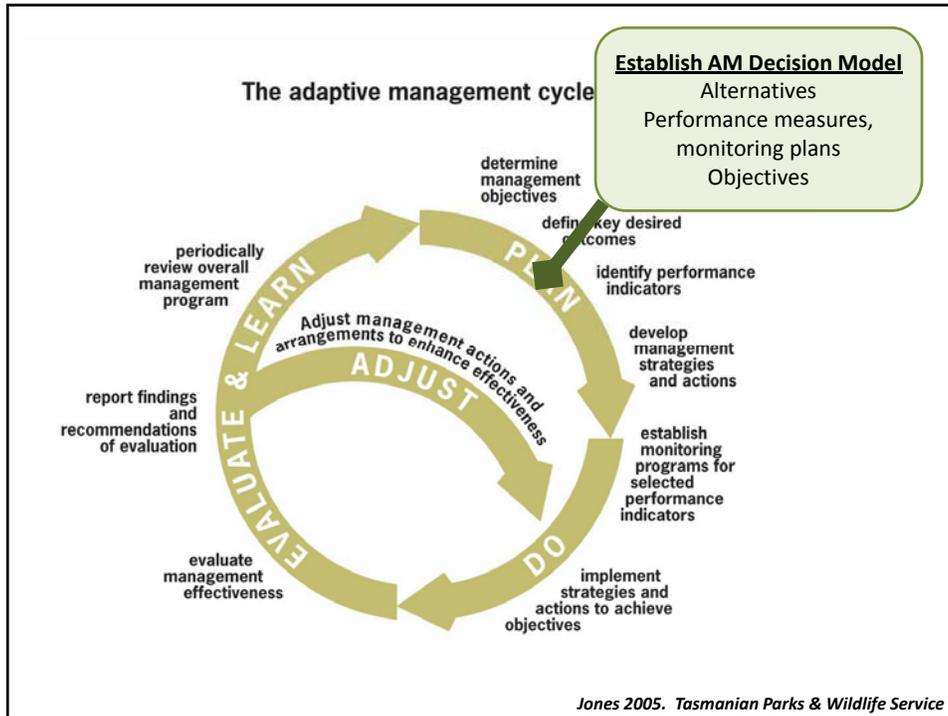


## Bottom Line...

*Development of a quantitative decision model for adaptive  
management (Enhanced Adaptive Management, EAM):*

- *aids identification of plan of action with available information*
- *archives predicted effects and outcomes to allow learning  
with implementation*
- *reduces time in adjusting course of action as monitoring  
results are collected*

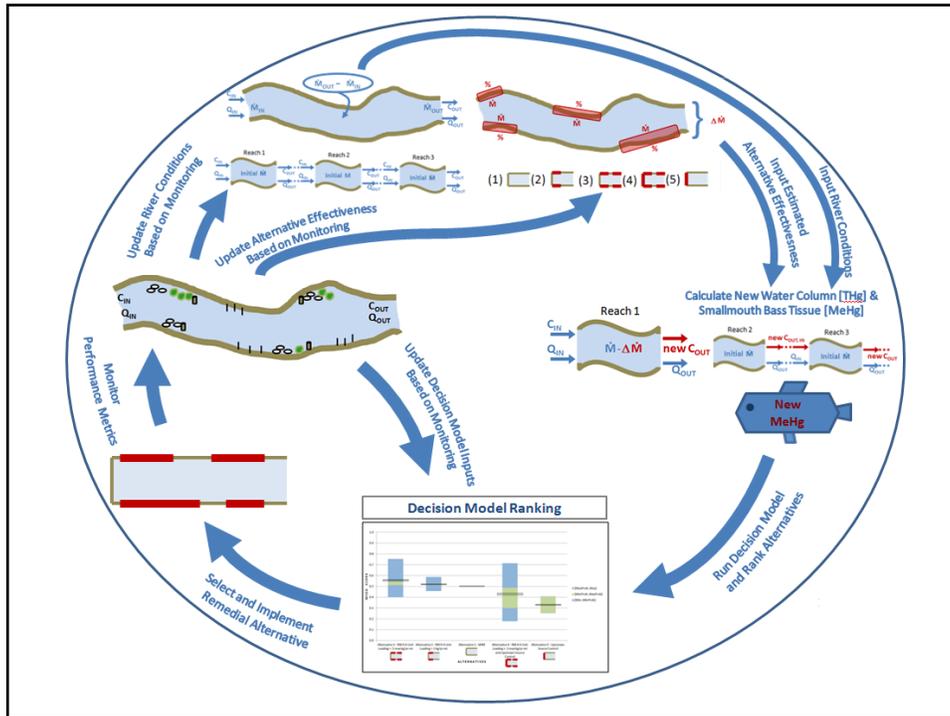




## EAM Benefits

- Encourages preferred action under uncertainty
- Provides a framework on which to learn from current actions
- Focuses monitoring and research needs on the reduction of uncertainty
- Allows development of anticipated effects in time under phased implementation

Engineer Research and  
Development Center



## Conceptual Objectives

Effectiveness (40)

Anticipated future MeHg in Smallmouth Bass

Ecological Effects (25)

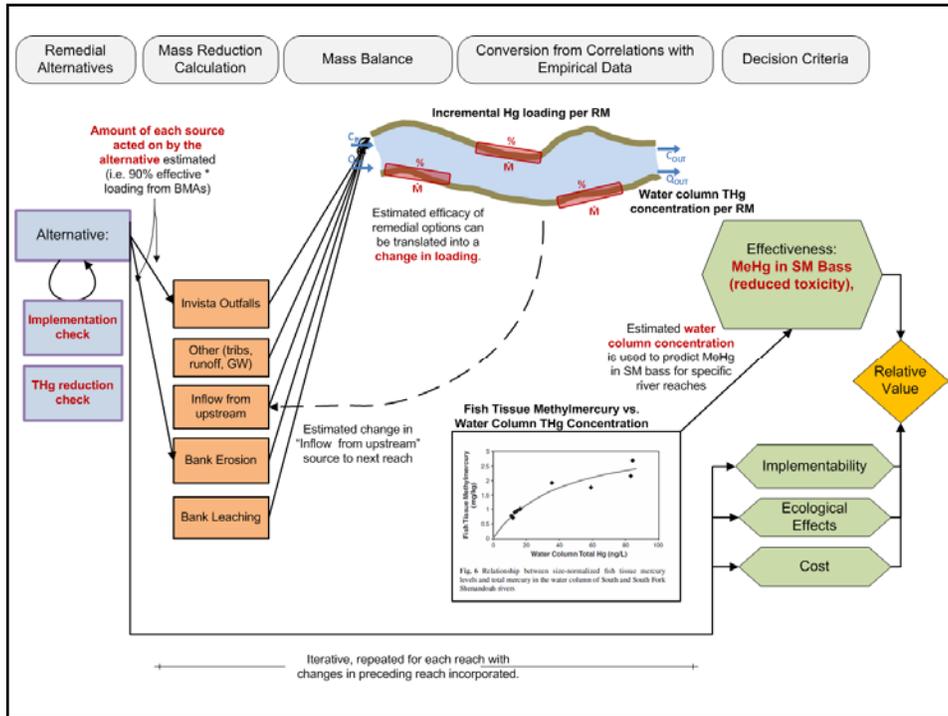
Habitat creation and Community risk

Implementability (25)

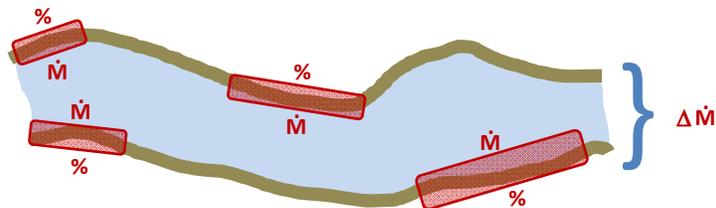
Structural performance and Land owner approval

Cost (10)

Implementation and Maintenance

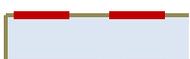


## Conceptual Alternative Plans

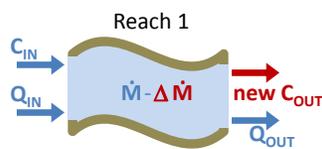


- Estimate loading rate and hypothesize percent effectiveness for each component activity.
- Determine the range of cost for implementation and maintenance.
- Estimate the relative mechanical performance risk for this group of activities, and the level of landowner approval and cooperation.
- Estimate the relative ecological benefits in terms of habitat creation and risks in terms of community disruption.

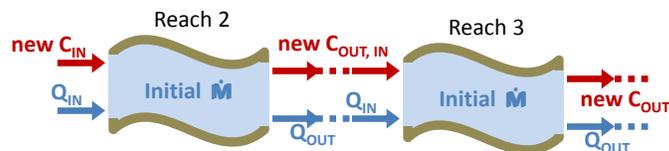
## *Conceptual* Case Study

Symbol	Description of Alternatives
	(1) Monitored Natural Recovery (MNR)
	(2) Enhanced vegetative bank stabilization of banks in river mile 0-4 with loading > 1 kg/yr-mi
	(3) Enhanced vegetative bank stabilization of banks in river mile 0-6 with loading > 0.5 kg/yr-mi
	(4) Enhanced vegetative bank stabilization of banks in river mile 0-6 with loading > 0.5 kg/yr-mi, in addition to upstream source control
	(5) Upstream source control

## Hypothesize Change in Loading



## Calculate Downstream Concentrations



## Estimate Bass MeHg

From the concentration prediction [for each reach](#), develop estimate of fish tissue MeHg for median fish size based on [Brent and Kain \(2011\)](#).

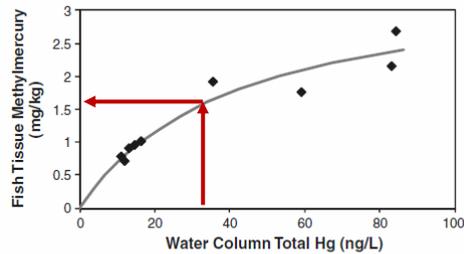
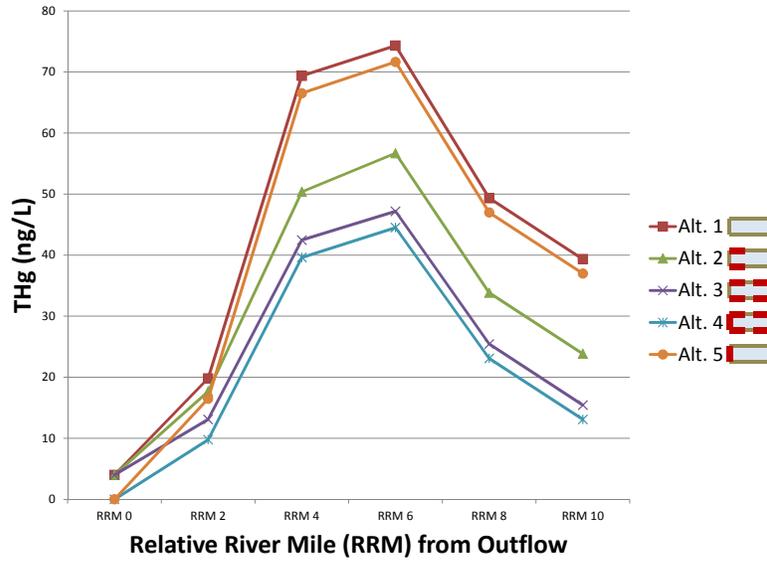


Fig. 6 Relationship between size-normalized fish tissue mercury levels and total mercury in the water column of South and South Fork Shenandoah rivers

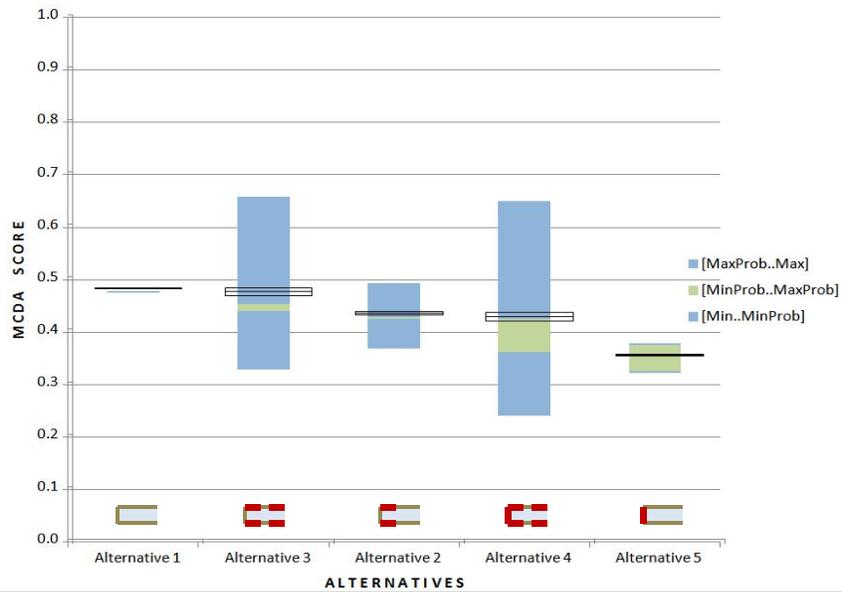
## Incorporate Uncertainty

- Fuzzy numbers (trapezoid function) for:
  - THg concentration in water column
  - Flow rate
  - Loading from bank management areas
  - Implementation and maintenance costs
  - Estimates of implementability
  - Estimates of ecological impacts

## Anticipated Water [Hg]



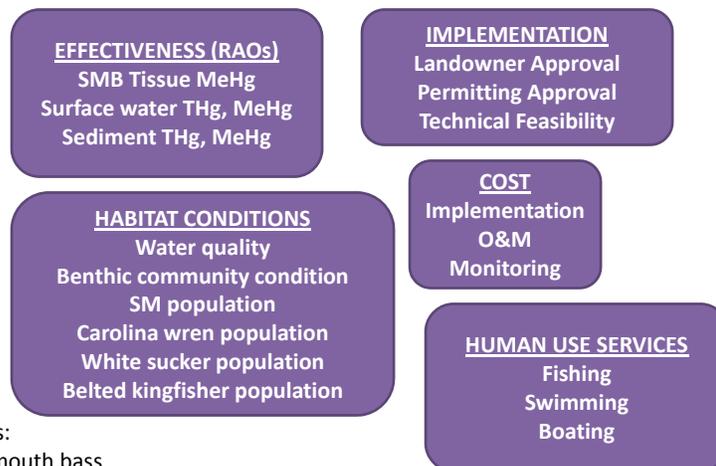
## Alternative Performance



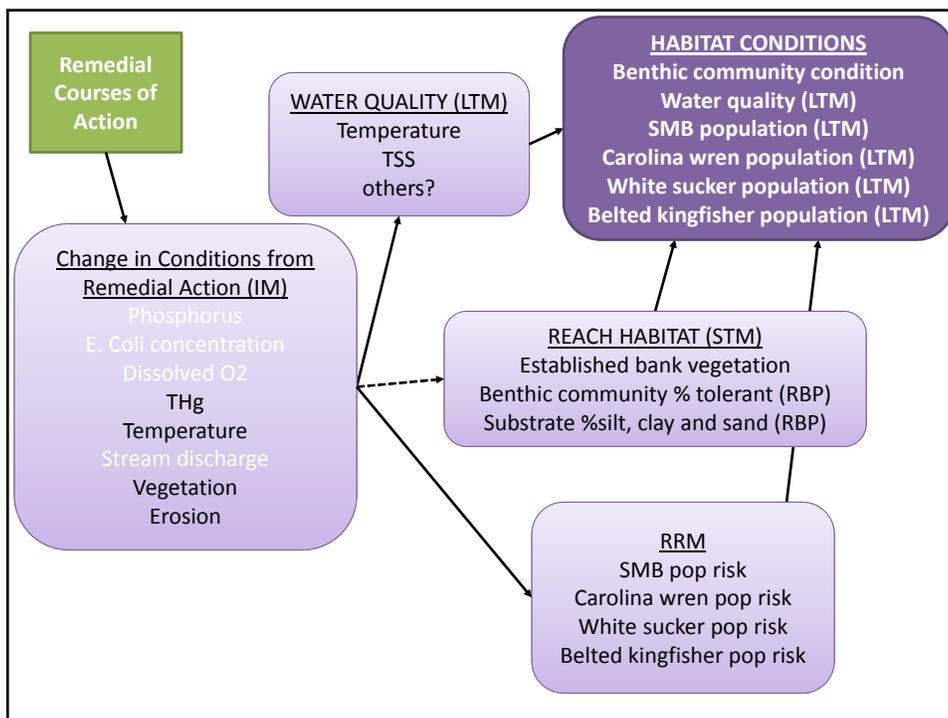
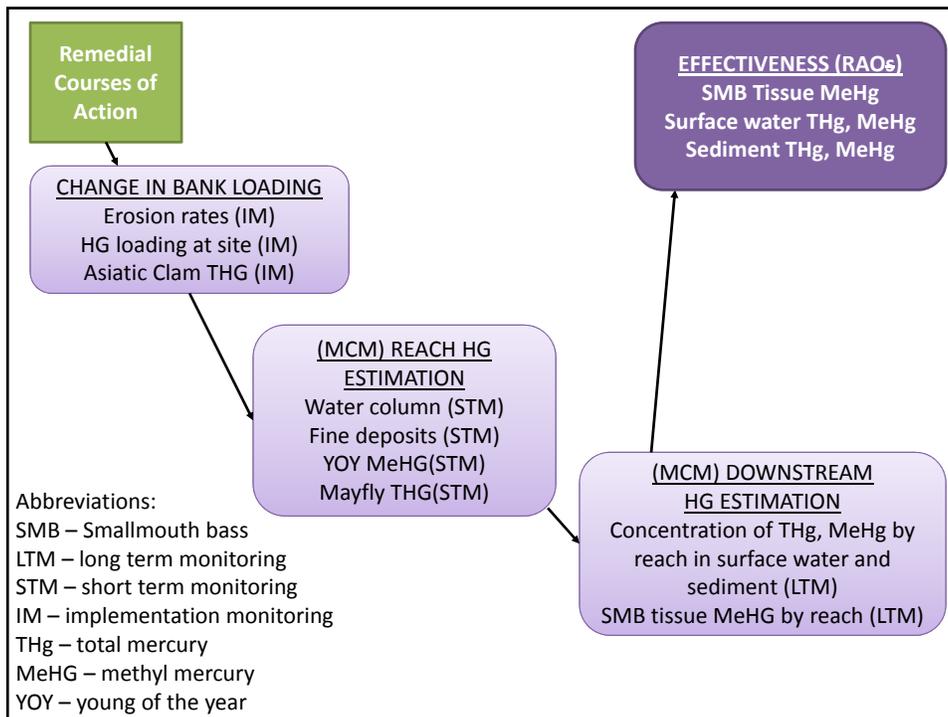
## Integrating EAM, MCM, RRM and Monitoring

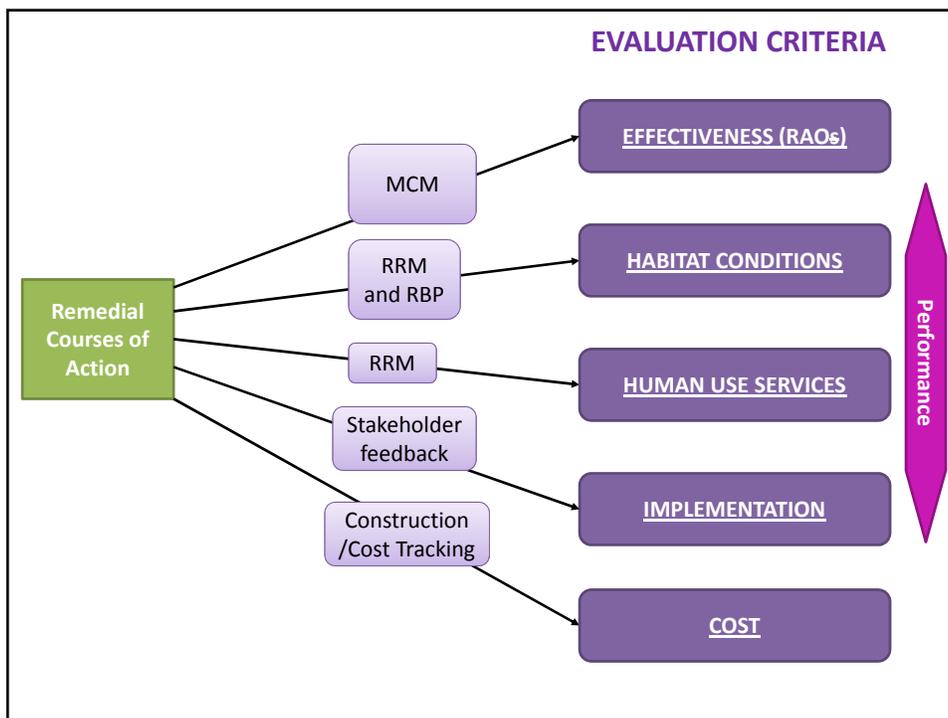
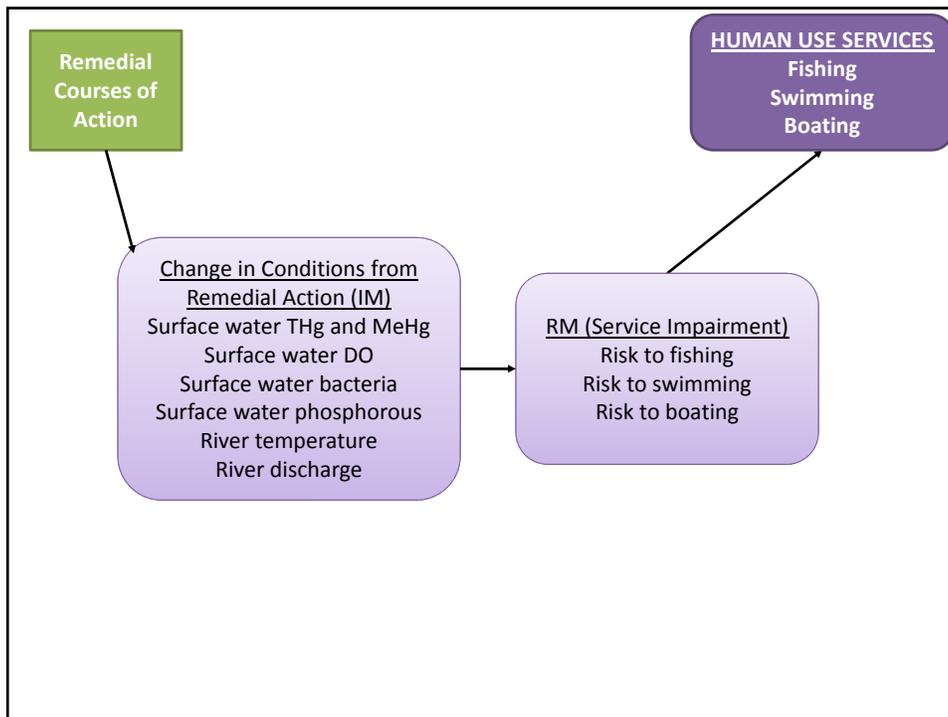
- (1) Identify a comprehensive list of evaluation criteria
  - i.e. any aspect that would constitute a success or would be considered in the decision to choose remedial action.
  - Include RAOs and RRM receptors
- (2) Characterize the metrics that best inform each criterion.
- (3) Choose an initial set of remedial plans to compare
- (4) Use the models – and other sources of information – to predict the effects of each remedial plan on each metric.

### ***DRAFT EVALUATION CRITERIA***



Abbreviations:  
 SMB – Smallmouth bass  
 LTM – long term monitoring  
 STM – short term monitoring  
 IM – implementation monitoring  
 THg – total mercury  
 MeHG – methyl mercury  
 YOY – young of the year





## EAM Integration – Next steps

- (1) Ensure the evaluation criteria and metrics are accurate and comprehensive
- (2) Choose an initial set of remedial plans to compare
- (3) Identify the input parameters for MCM, RRM, etc. that need to be estimated for each alternative remedial plan.
- (4) Characterize the model outputs (their form, i.e. uncertainty) so they go be added smoothly to the EAM.
- (5) Develop a frame for accepting all the information in the EAM.

## Conclusions



- The effort required to develop this approach results in a rigorous, transparent framework.
- Performance of different plans on specific criteria can be visualized.
- The anticipated effects provide a benchmark against which to compare implementation outcomes.
- Differences allow a better understanding of the system, and a reduction in uncertainty.