USGS Chesapeake Bay Watershed EDC Science: Integration and Synthesis

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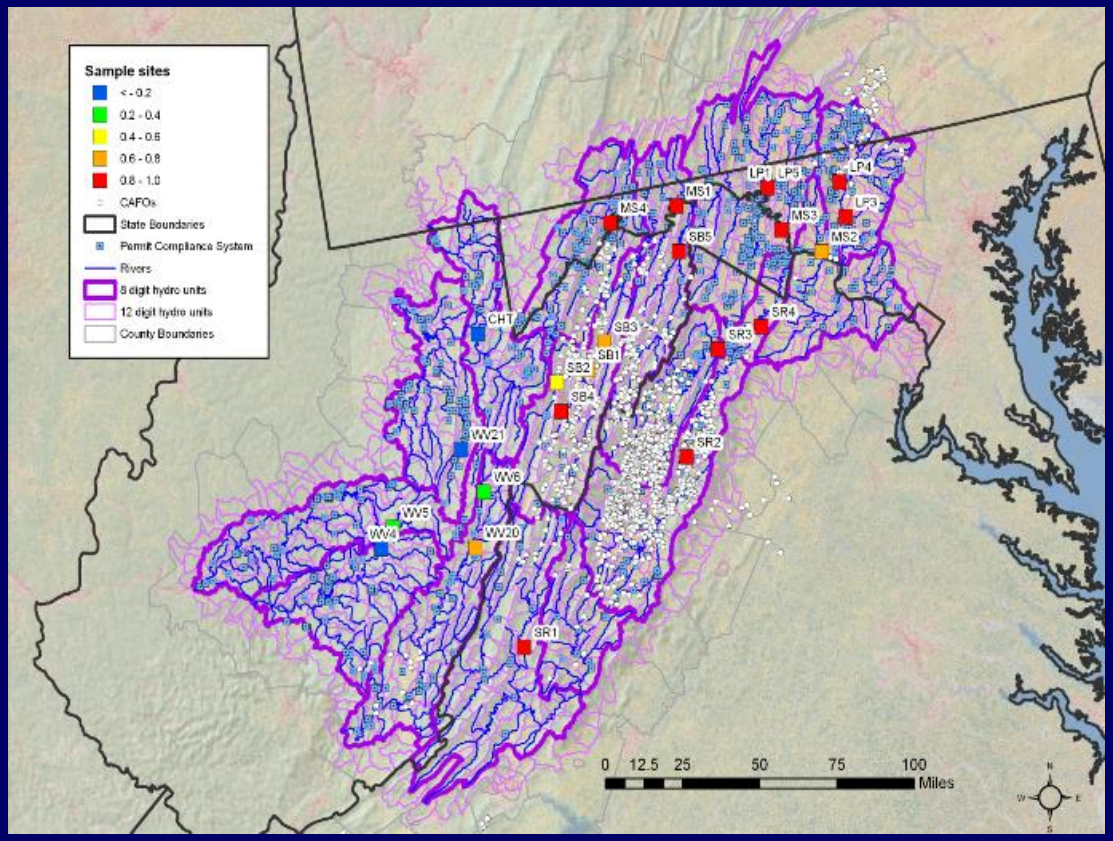
Toxics Contaminant Workgroup
October 11, 2017

2003 Potomac Watershed: Cause for Concern?



- Multiple bacterial pathogens
- Parasite/fungal infections
- Skin lesions
- Largemouth Bass virus
- High prevalence of intersex

- Immunosuppression
- Causes?

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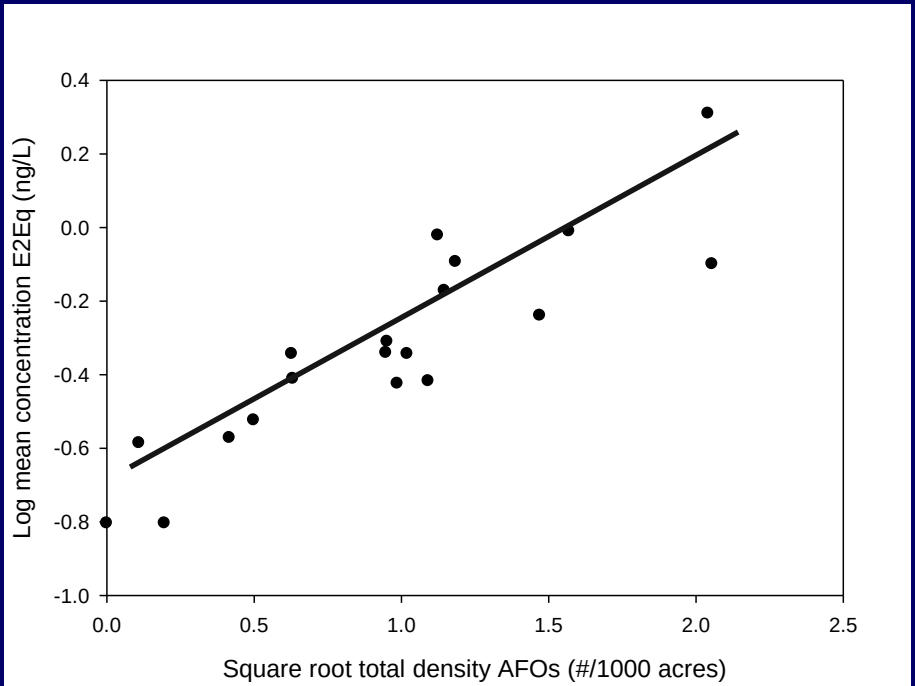
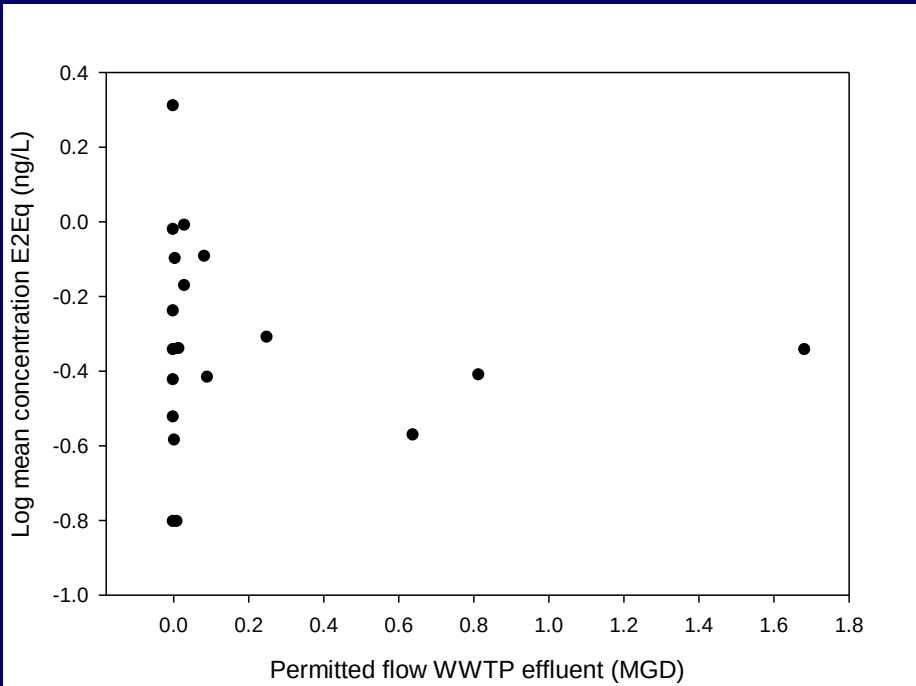
Estrogenicity (EEQ) of Water Extracts Smaller Tributaries of Shenandoah Drainage

Agriculture



WWTP Effluent



Ciparis, S. L.R. Iwanowicz and J.R. Voshell. 2012. Effects of watershed densities of animal feeding operations on nutrient concentration and estrogenic activity in agricultural streams. Sci. Total Environ. 414:268-276.

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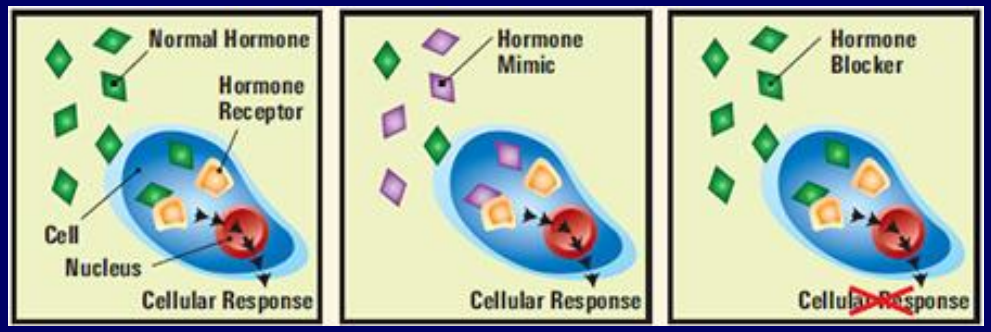
What is an Endocrine Disrupting Chemical?

Compounds within an ecosystem with the potential to interfere with the endocrine function of natural populations of fish and wildlife, resulting in deleterious effects on development, metabolism, reproduction, immuno-competence or other biological outcomes.



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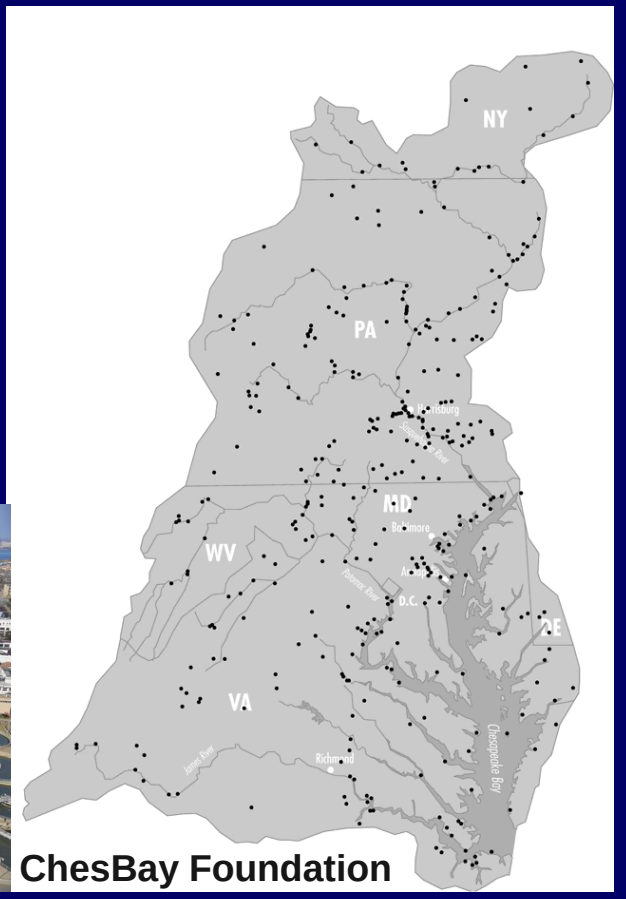
Examples of EDCs

- Pharmaceuticals (human or veterinary)
- Naturally occurring estrogenic compounds
- Pesticides
- Plasticizers
- Flame retardants
- POPs (PCBs, dioxins/furans)



ChesBay Foundation

Concept for Determining Highest Priorities for Research to Increase Understanding Impacts and Mitigation Options for Toxic Contaminants (Color codes are examples)

Contaminant Groups	Occurrence	Concentrations	Sources	Effects
PCBs				
Dioxins/Furans				
PAHs				
Petroleum Hydrocarbons				
Pesticides				
Bio. Hormones				
Pharms.				
HPCP				
PBDEs				
Metals				
Mixtures				

Uncertainty

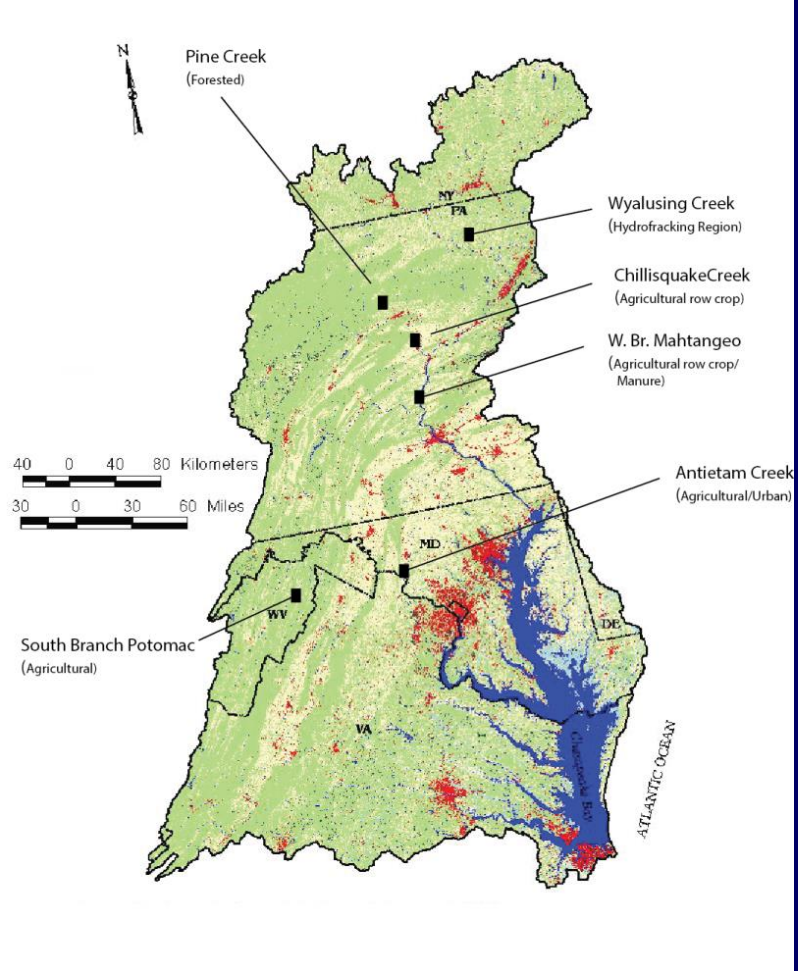
Small

Mid

Large

Priorities for an agenda to increase certainty?

Identify the sources and complex interactions of environmental stressors on fish and wildlife

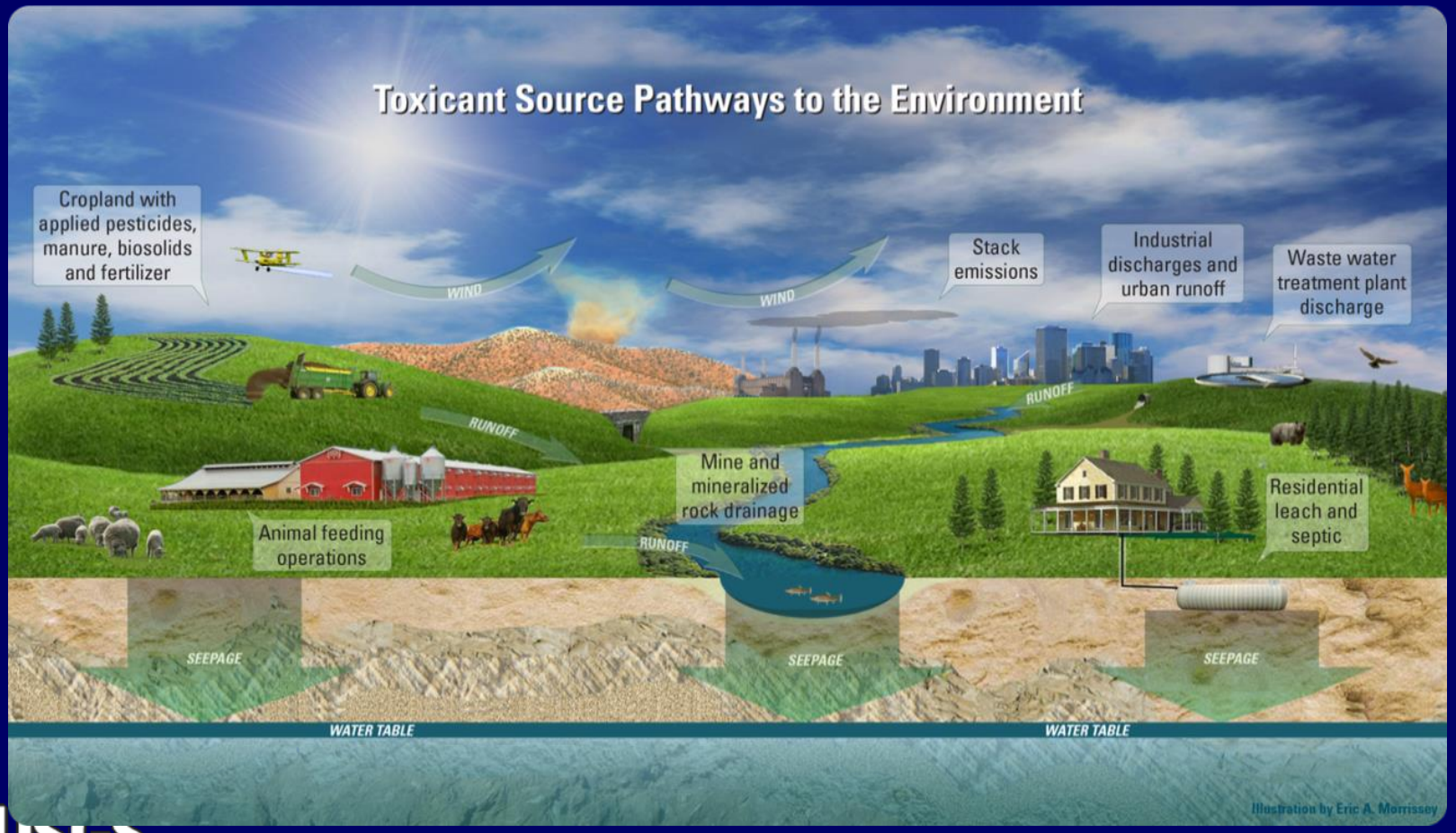


Focused field studies in agricultural watersheds 2013-2017 with emphasis on fish health, chemistry, landscape data and population dynamics

Retrospective analysis of fish health in the Susquehanna and Potomac Rivers

Broad Strategic Goals

1. Identify and quantify the sources, fate, transport, distribution and exposure of EDCs to fish



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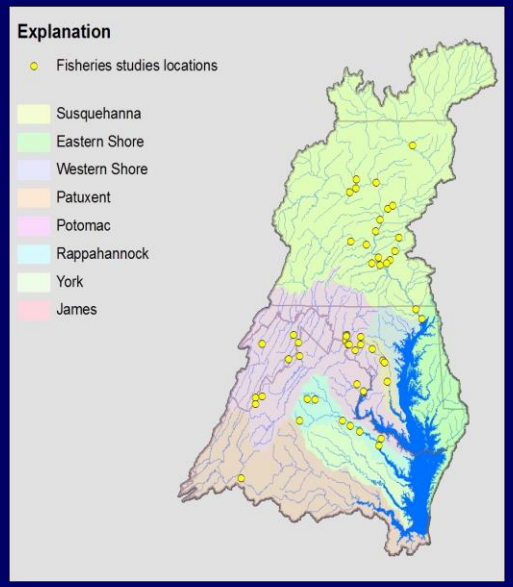
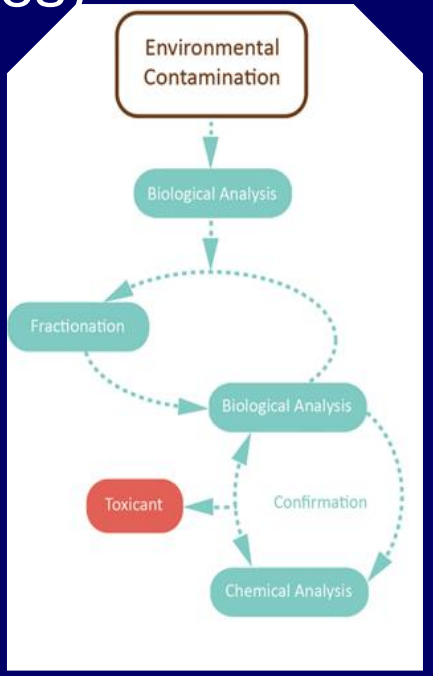
Sources, fate, transport, distribution, and exposure of EDCs



- Synthesize and release of historical environmental chemistry data (192 sites)
- Characterize the concentrations of EDCs in water and sediment (4-6 ag sites)
- Identify the chemical(s) or chemical classes responsible for causing ED in fishes



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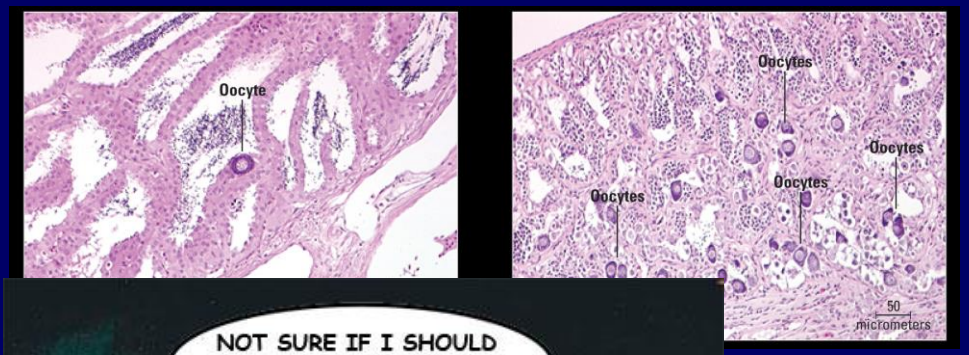
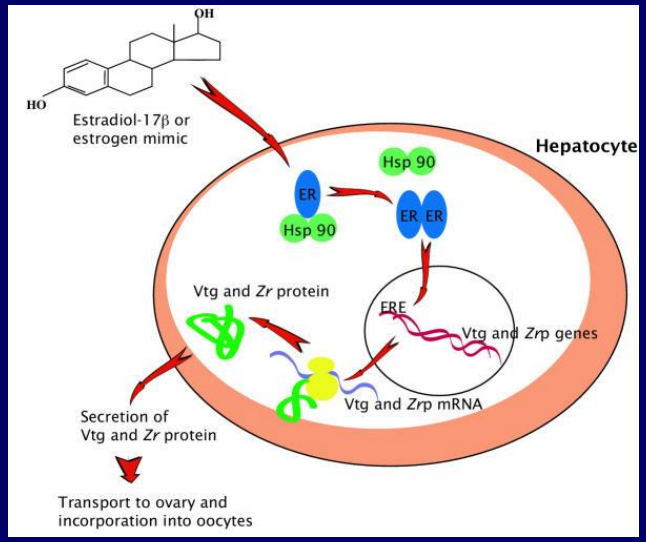
Burgess et al. 2013. ET&C 32:1935-1945

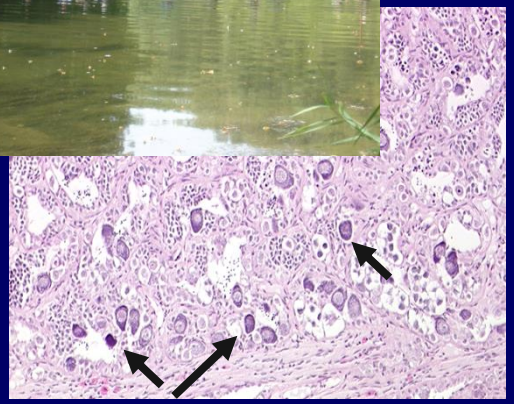
2. Evaluate the effects of EDCs on fish health in the environment

3. Determine the mechanism(s) and threshold for adverse effects on fish





Effects of EDCs and mechanisms of exposure



- Synthesize and release historical biological effects data
- Assess ED and mechanisms of effects in wild fish
- Examine the relationship between fish Hg concentrations and ED
- Identify causal agents of ED under laboratory conditions
- Provide a detailed characterization of effect of EDCs on fathead minnows

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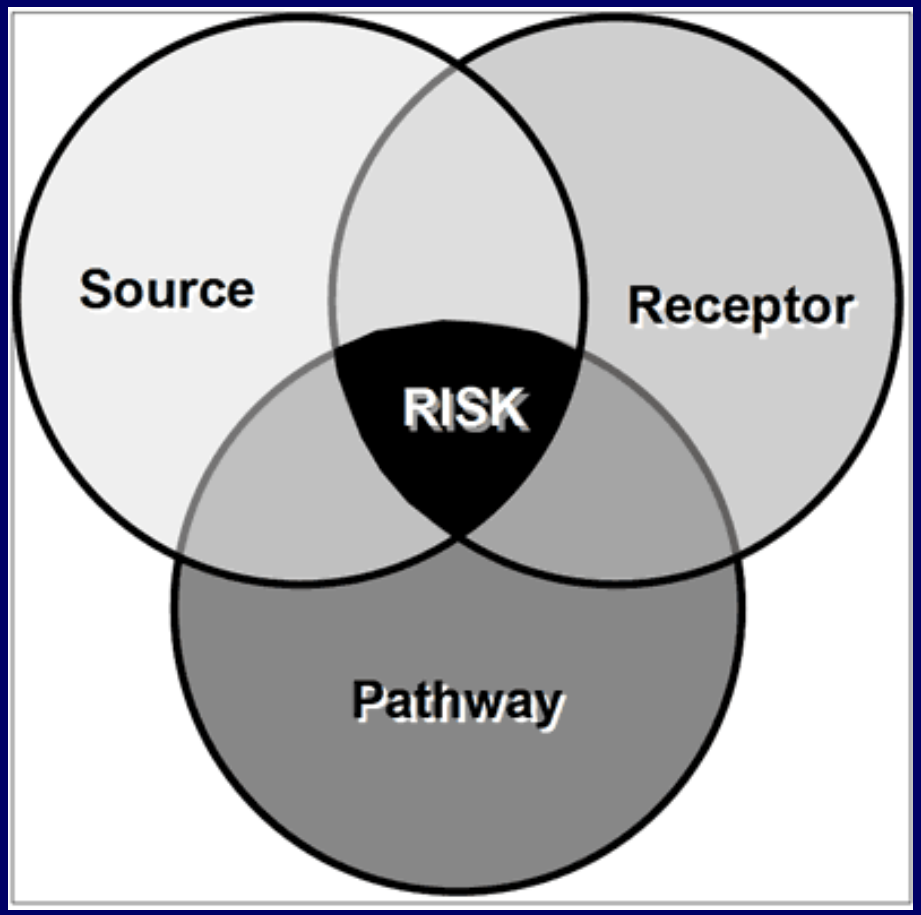
4. Develop appropriate assessment tools and models for risk evaluation of EDCs



SOURCE
"Control"

PATHWAY
"Manage"

RECEPTOR
"Protect"

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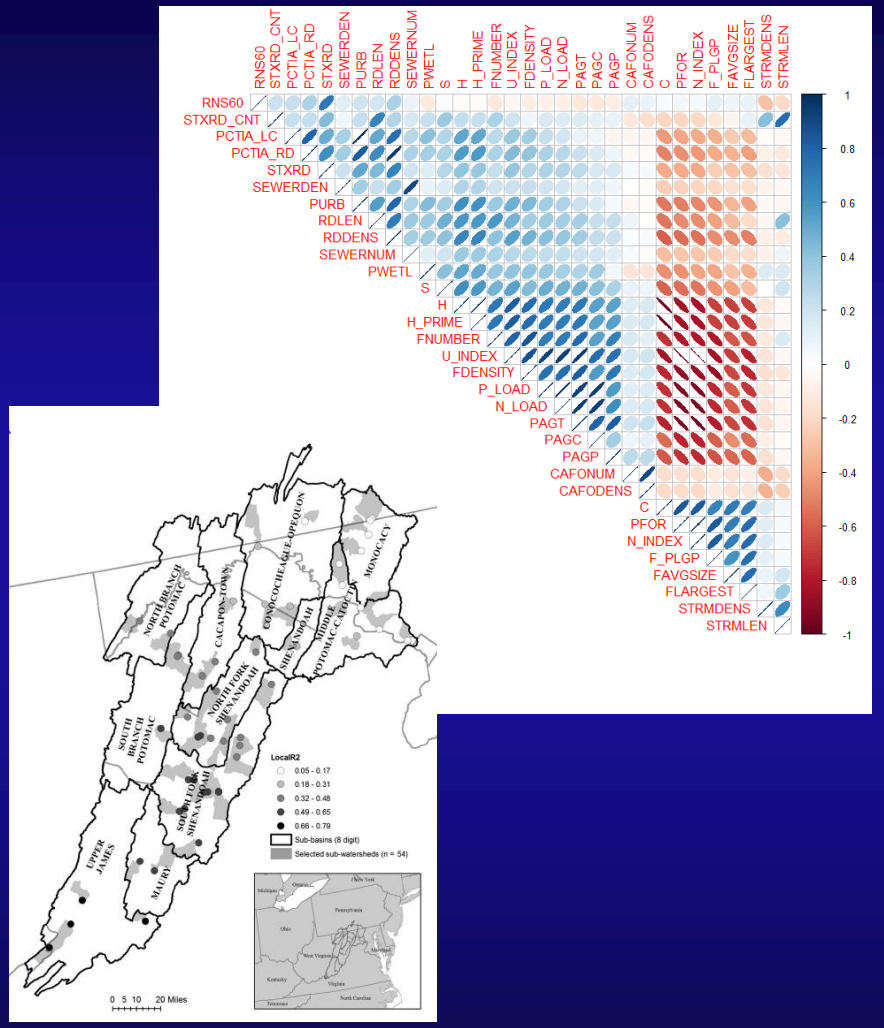
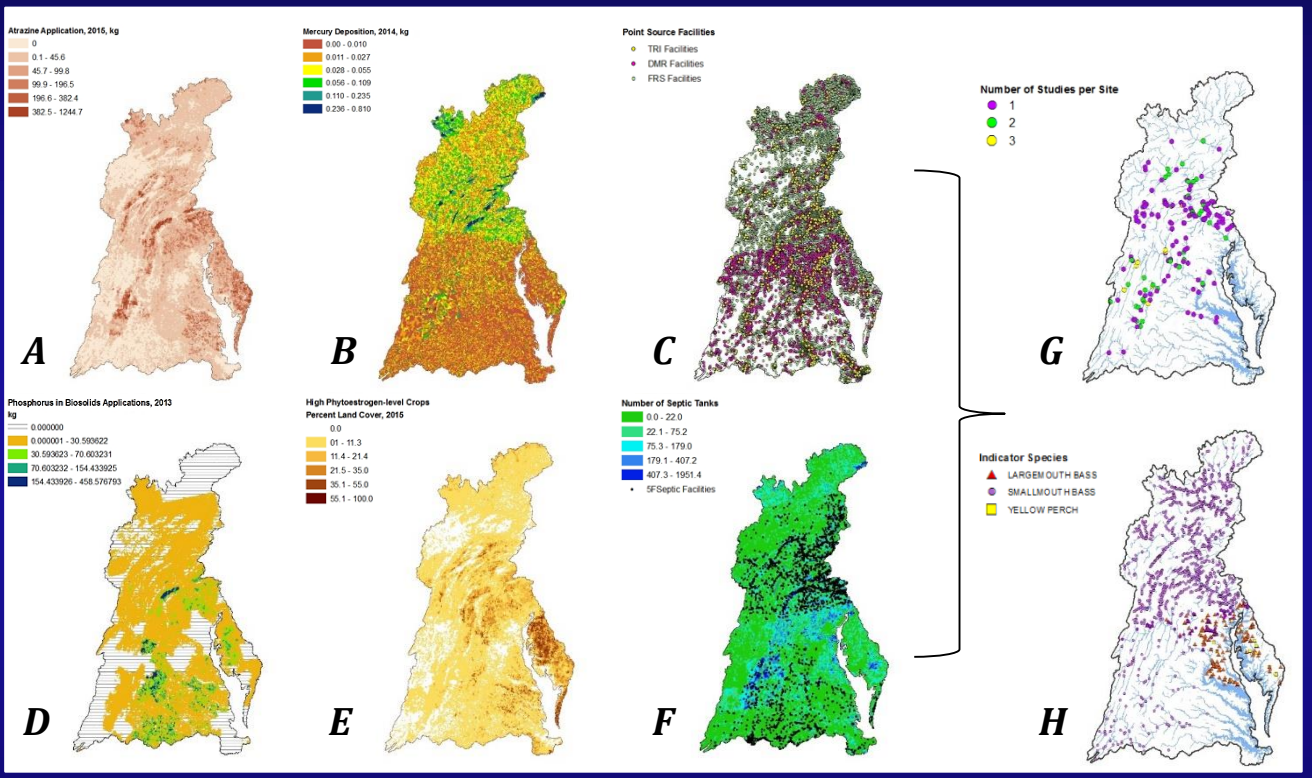
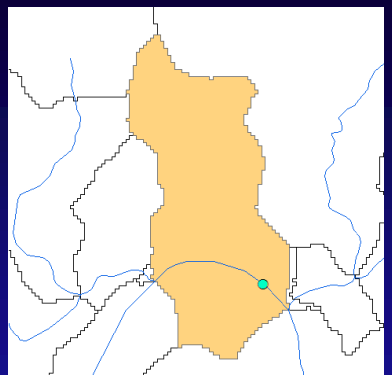
Geospatial Tools

- Explore correlations and landscape gradients (Young et al. 2014)
- Quantify relationships with field collected data
- Develop metrics for vulnerability/risk assessment

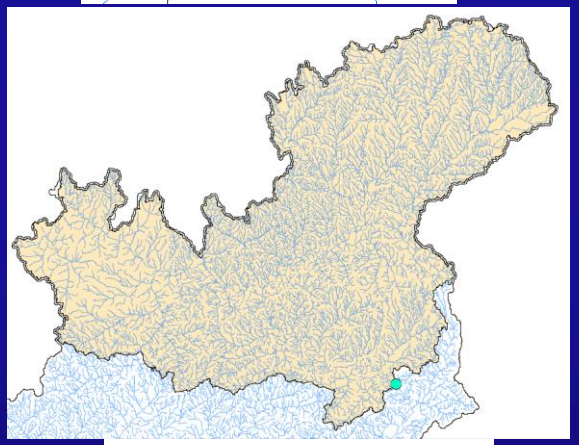


Geospatial source characterization





Immediate Catchment



Upstream Catchment

- 192 sampling locations (chemistry, biology, passive sampler) compiled and related to landscape indicators (308 variables)
- Immediate and upstream catchments
- Bay-wide data release **in review**

Integration Topics

Charge from the Chesapeake Bay Program Toxics Contaminant Research Outcome

- Understand the influence of contaminants degrading the health and contributing to the mortality of fish

- Document the occurrence, concentrations and sources of contaminants

- Assess the relative risk of contaminants and options for mitigation to inform policy and prevention strategies.

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Integration Topic #1

Understand the influence of contaminants degrading the health and contributing to the mortality of fish

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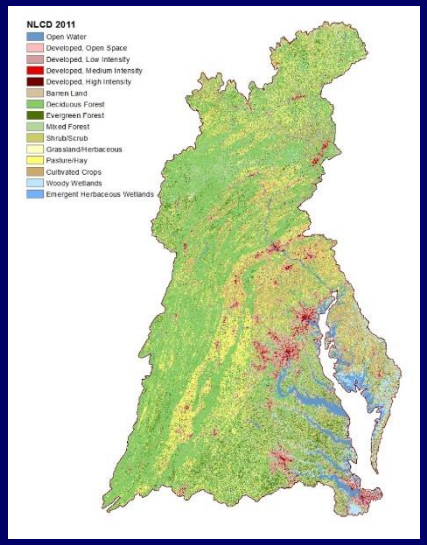
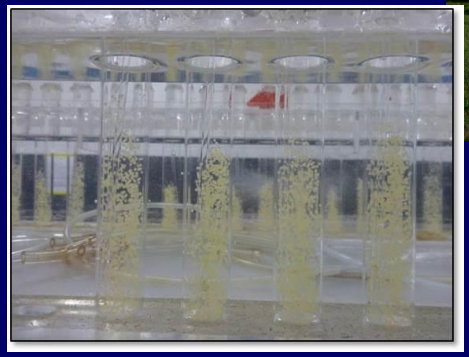
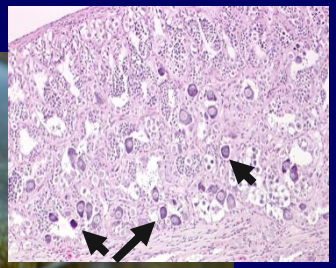
LANDSCAPE (sources/chemistry)



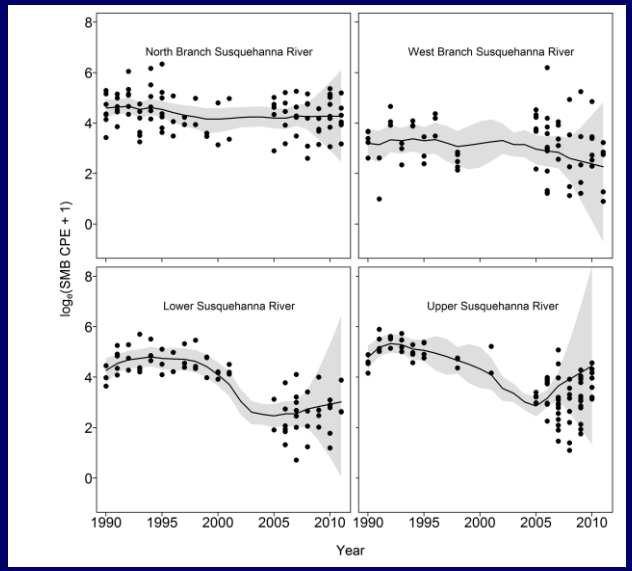
SIMULATED EXPOSURES



INDIVIDUAL HEALTH



POPULATION DYNAMICS



Schall and Wagner

Integration Topic # 2

Document the occurrence, concentrations and sources of contaminants

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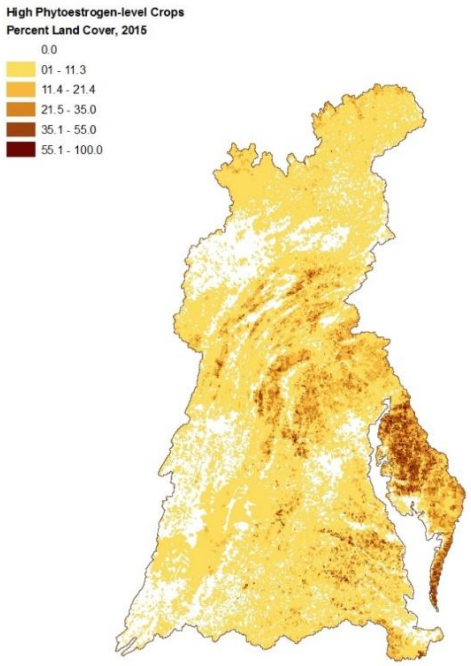

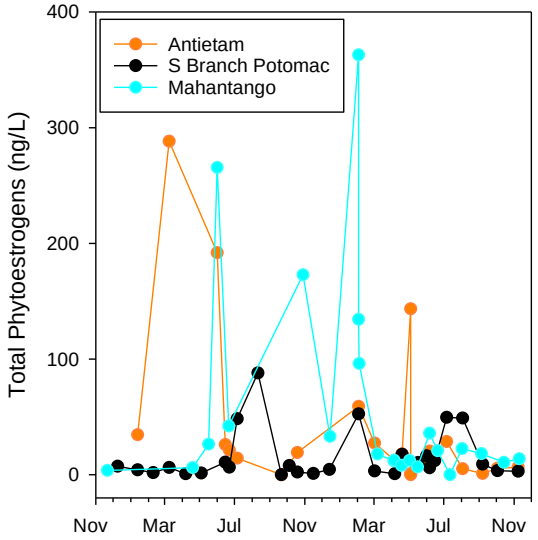

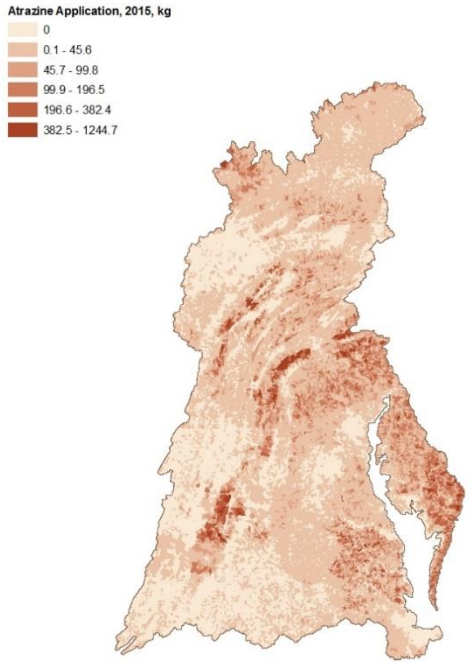

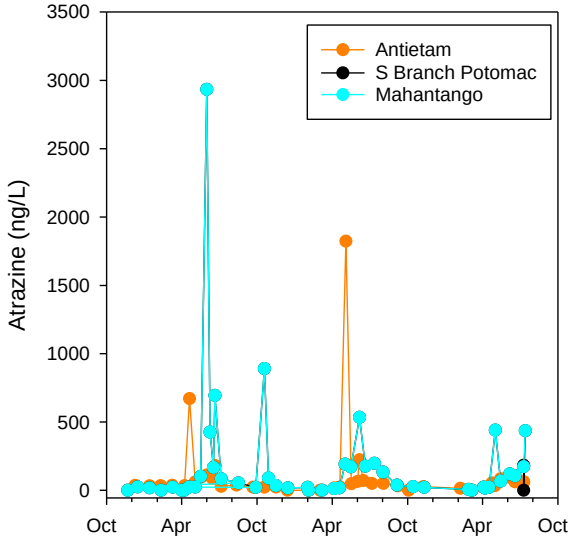

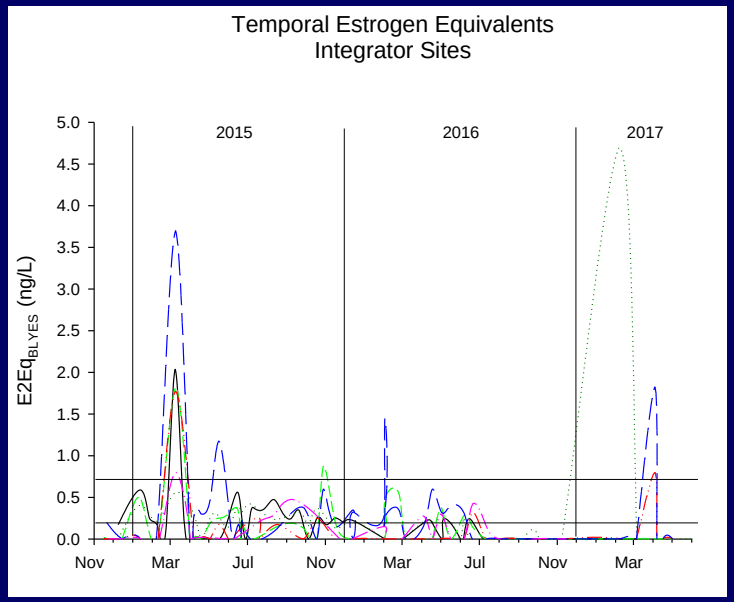

Jones and Gordon

Integration Topic # 3

Assess the relative risk of contaminants and options for mitigation to inform policy and prevention strategies.

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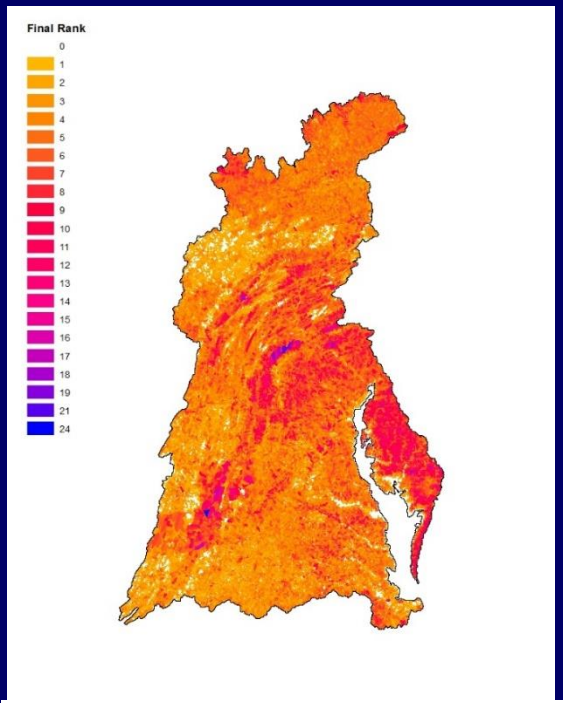
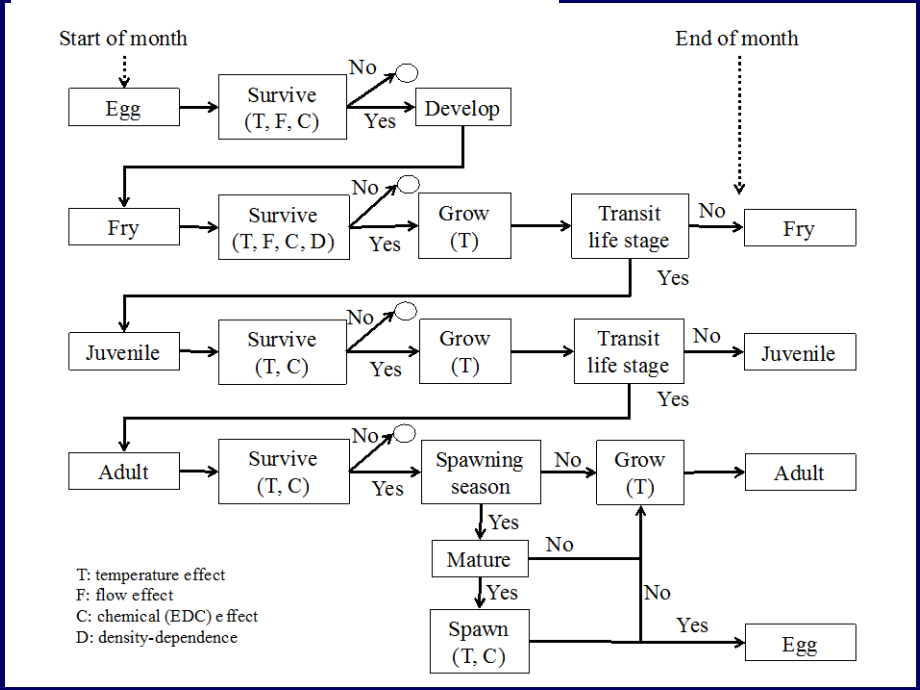
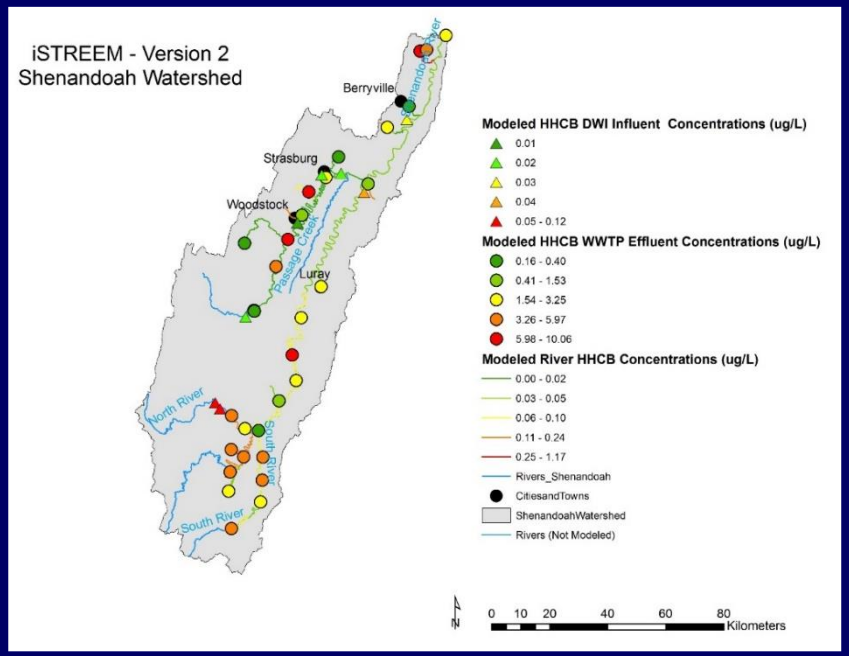


- Metric development
- Population dynamics model
- Individual based model for SMB
- Hydrologic modeling of EDCs





Outcomes

To inform management actions to improve WQ and the health of fish and wildlife in the Chesapeake Bay watershed

- Synthesis of historical information
- Series of high level power point presentations for stakeholders including historic synthesis and three integration questions
- Series of scientific publications
- Geospatial layers for entire watershed
- Population dynamics model

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