Overview of Research Project: Assessing Discharges of Endocrine Disruption in the Potomac River

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Potomac River Basin Drinking Water Source Protection Partnership, February 24, 2015

Potomac Observations of EDC Activity

Associations of Land-use with Intersex (Spawning Study 2007)

Site	Human Density[1]	WWTP[2]	WWTP Flow[3]	% Ag[4]	AFO[5]	Animal Numbers[6]	Intersex[7]
Gauley River	0.06	0	0	0.5	0	464	11.3% 0.02 (0.07)
South Branch Petersburg	0.07	3	0.95	16.4	296 (296)	1,450,120	74.3% 0.97 (0.95)
South Branch Moorefield	0.07	4	1.43	15.2	497 (496)	7,384,685	54.5% 0.50 (0.50)
South Branch Springfield	0.08	5	1.93	15.2	565 (562)	8,719,093	82.2% 1.02 (0.76)
Shenandoah North Fork	0.28	50	1.59	32.7	1,174 (960)	11,757,596	90.0% 1.16 (0.78)
Shenandoah Mainstem	0.43	101	25.66	32.6	3,655 (2,539)	33,928,442	93.0% 1.64 (0.93)
Shenandoah South Fork	0.56	19	20.84	35.9	2,029 (1,176)	14,788,173	100.0% 1.83 (0.65)
Conococheague Creek (lower)	0.69	13	8.31	50.3	10 (1)	1,819,225	87.5% 1.03 (0.78)

The Washington Post

Health & Science

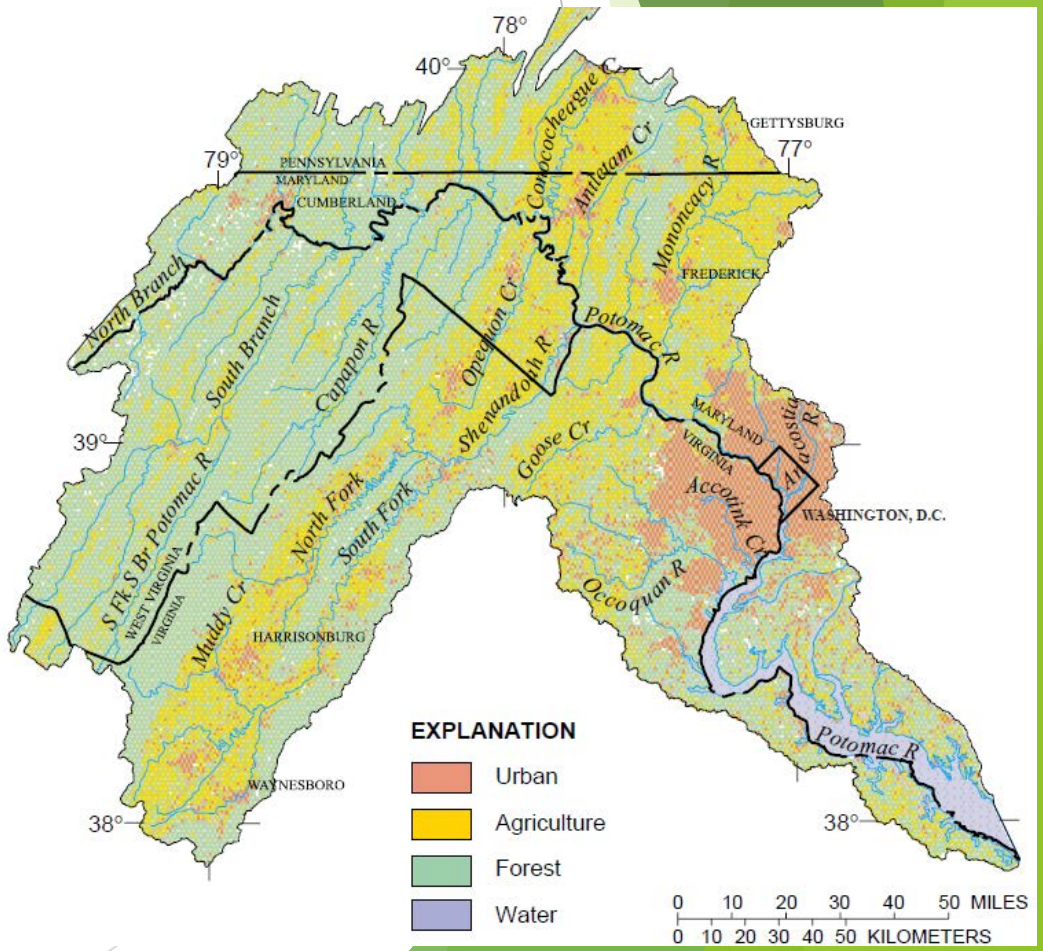
Bay's smallmouth bass under siege, report says

Impacts of Point and Non-point Sources

Comparing Land Use and Observed Intersex Activity

Land-use	Intersex prevalence r^2	Intersex prevalence p	Intersex severity r^2	Intersex severity p
Human population density	0.39	0.10	0.42	0.08
Number of WWTPs	0.22	0.24	0.34	0.13
WWTP flow	0.32	0.15	**0.63**	**0.02**
Percent agricultural land use	**0.63**	**0.02**	**0.50**	**0.05**
Number of animal feeding operations	0.28	0.17	**0.56**	**0.03**
Number of poultry houses	0.27	0.18	**0.50**	**0.05**
Total number of animals	0.27	0.18	0.48	0.06
Animal density	**0.49**	**0.05**	**0.58**	**0.03**

Modified from Blazer et al., 2011



Assessing Discharges of Endocrine Disruption in the Potomac River

DC Council Funded through DC DOE,

DC Water Managed Research Project

Project Objectives

- Evaluate the upstream and downstream impacts from nutrient control, agriculture management, stormwater management and wastewater treatment strategies

- Evaluate EDC impact in receiving waters attributed to point versus non-point sources

Project Team – A unique collaboration

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DC Water

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Hazen and Sawyer

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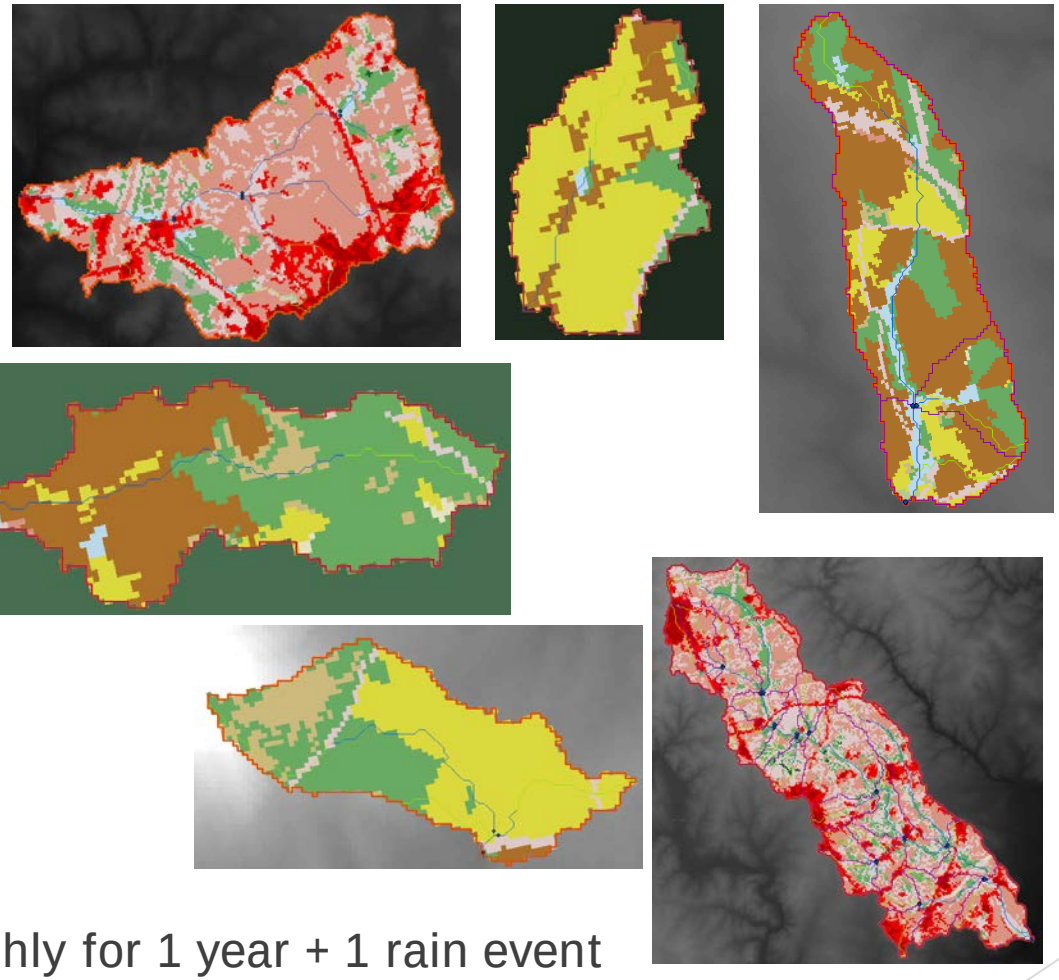
Luke Iwanowicz, Ph.D., USGS

Diana Aga, Ph.D., Univ. of Buffalo

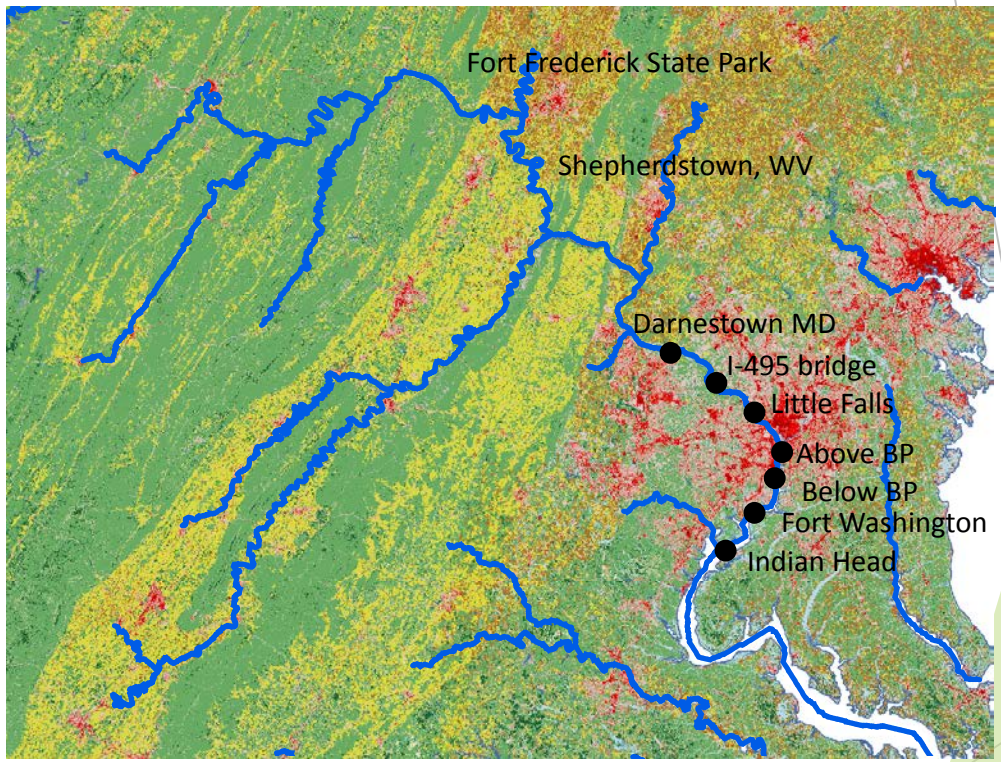
Phase 1 Sampling

- Locations include:
  - Blue Plains
  - Another WWTP
  - CSOs in Alexandria, VA
  - Agriculture
    - Dry Seneca Creek
    - Little Monocacy River
  - Urban Stormwater
    - Anacostia Watershed
- Sampling Frequency is bimonthly for 1 year + 1 rain event



Phase 2 Sampling

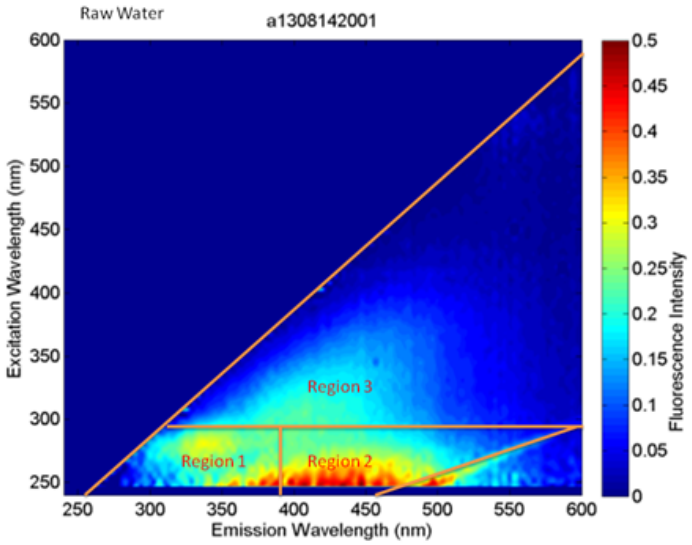
- Deployment and Collection of POCIS Passive Sampling Devices
- Transects of the Potomac
- 3 events over the course of the study



Methods – Chemical and WQ Endpoints

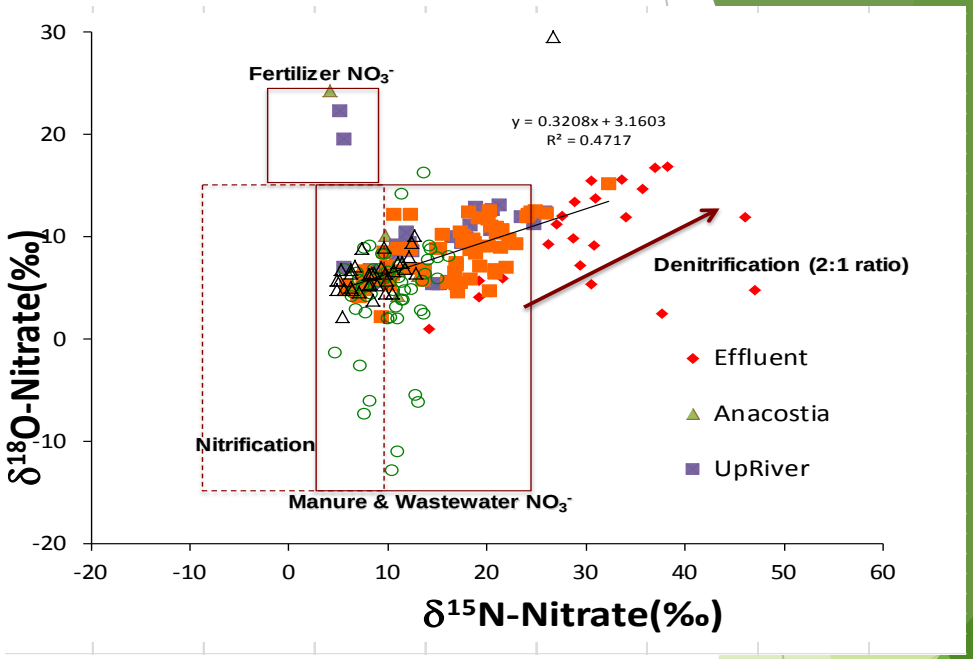
Analytical Detection

- Hormones *and* metabolites
- EDC linked pesticides



Advanced NOM Characterization

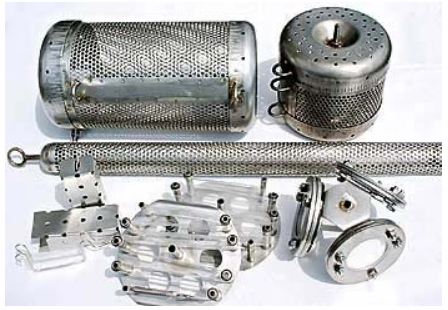
- Fluorometry
- Succesfully linked w/WQ (ie DBP precursors)



Nutrient Isotopes

- Source Tracking
- Transformation

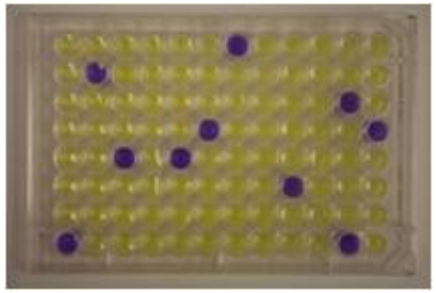
Bioactivity



Passive sampler extract

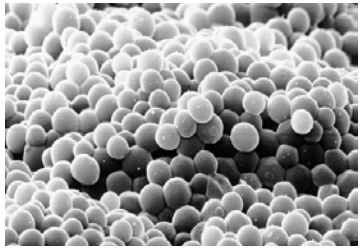
Grab water sample
(sold phase extraction)

Bacteria-based



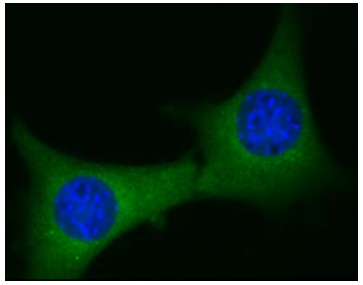
- Genotoxicity
- Mutagenicity
- Cytotoxicity (MicroTox)

Yeast



- Bioreporter (steroid hormones)
- Estrogen, Androgen, Glucocorticoid
- Cytotoxicity

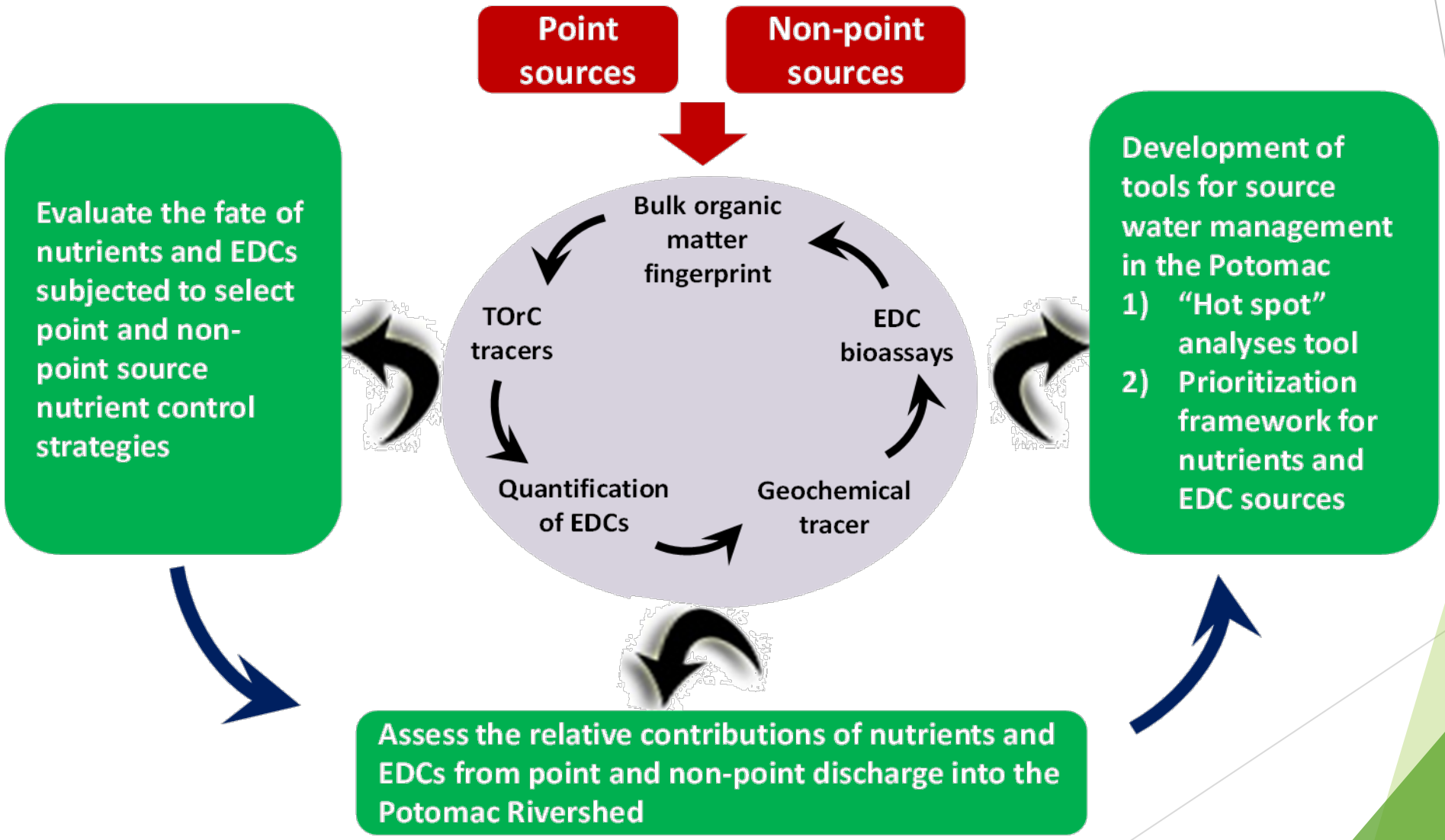
Reporter Cell line



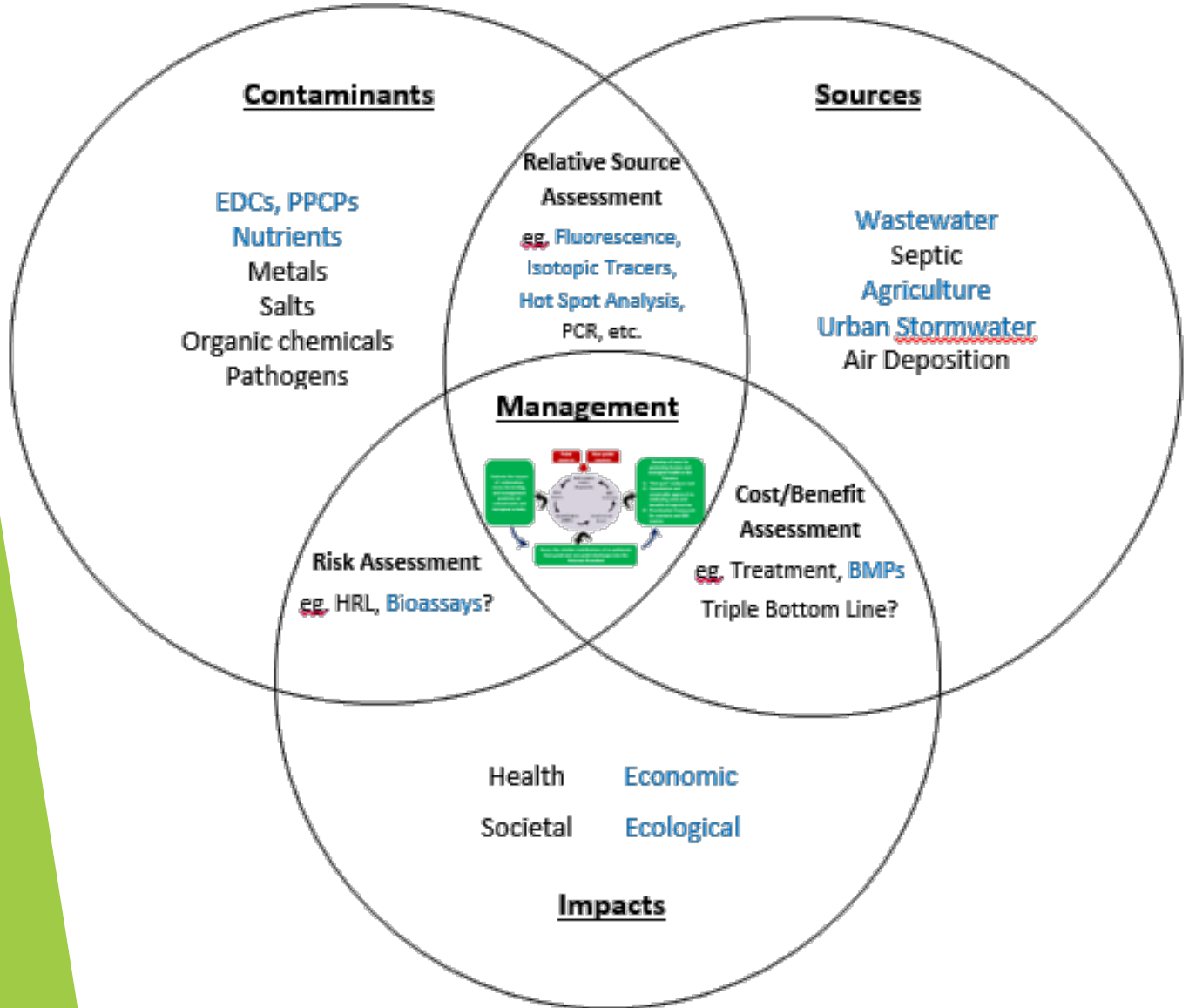
- Luciferase-based NR reporter
- Nuclear translocation assays
- Gene expression (CYP1A/ MTT)

USGS
science for a changing world

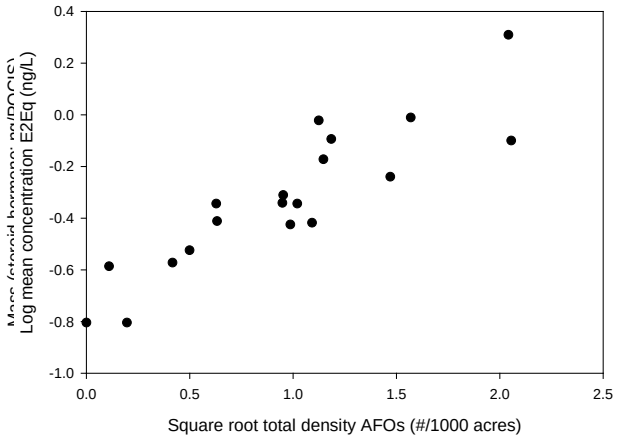
Towards Managing Co-pollutants



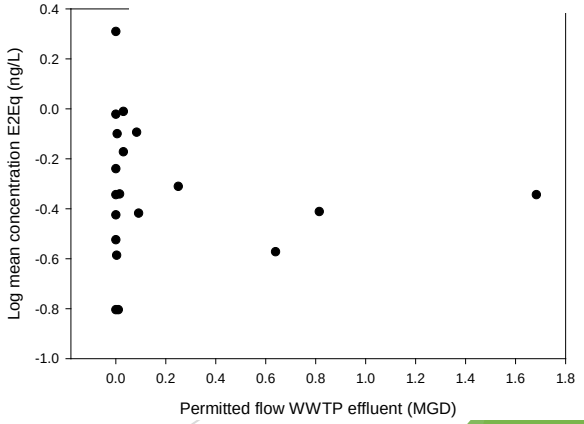
End Goal – Co-management of Pollutants?



Agriculture



WWTP Effluent



Shenandoah Drainage 2009

Ciparis et al. (2012) Effects of watershed densities of animal feeding operations on nutrient concentrations and estrogenic activity in agricultural streams. Science of the Total Environment, 414: 268-276