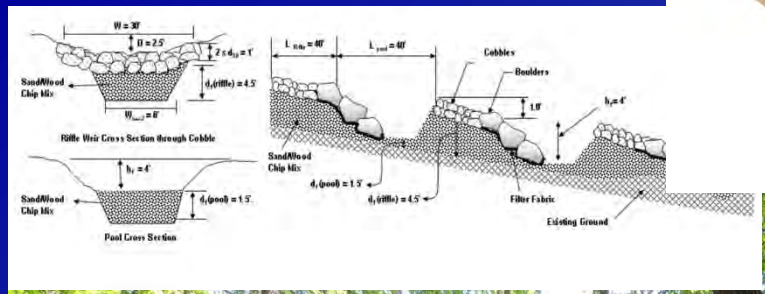
Monitoring Stream Restoration Performance in the Rock Creek Watershed, Washington DC

Michael Williams
Smithsonian Environmental Research Center

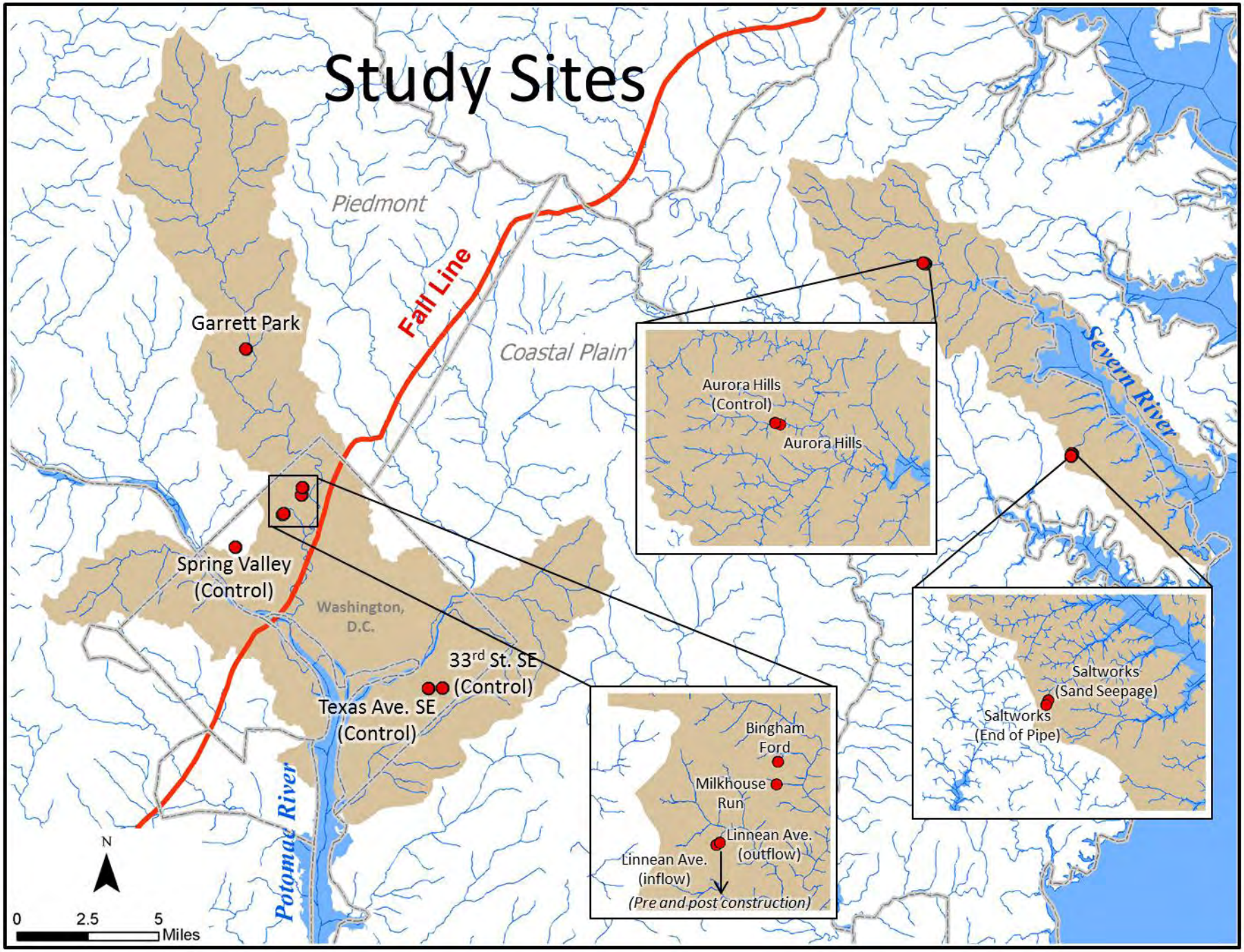
Regenerative Stormwater Conveyance (RSC) Design

- Best management practice (BMP) intended to create habitat, reduce runoff, recharge groundwater, etc.
- Fill soil is used in badly incised channels to raise the grade
- Mixture of 80% sand and 20% organic matter (soil, wood-chips, and leaves) place on top
- Boulder weirs (Ironstone, also called Bog Iron) and silica-cobble are used to create a series of stepped pools separated by riffles

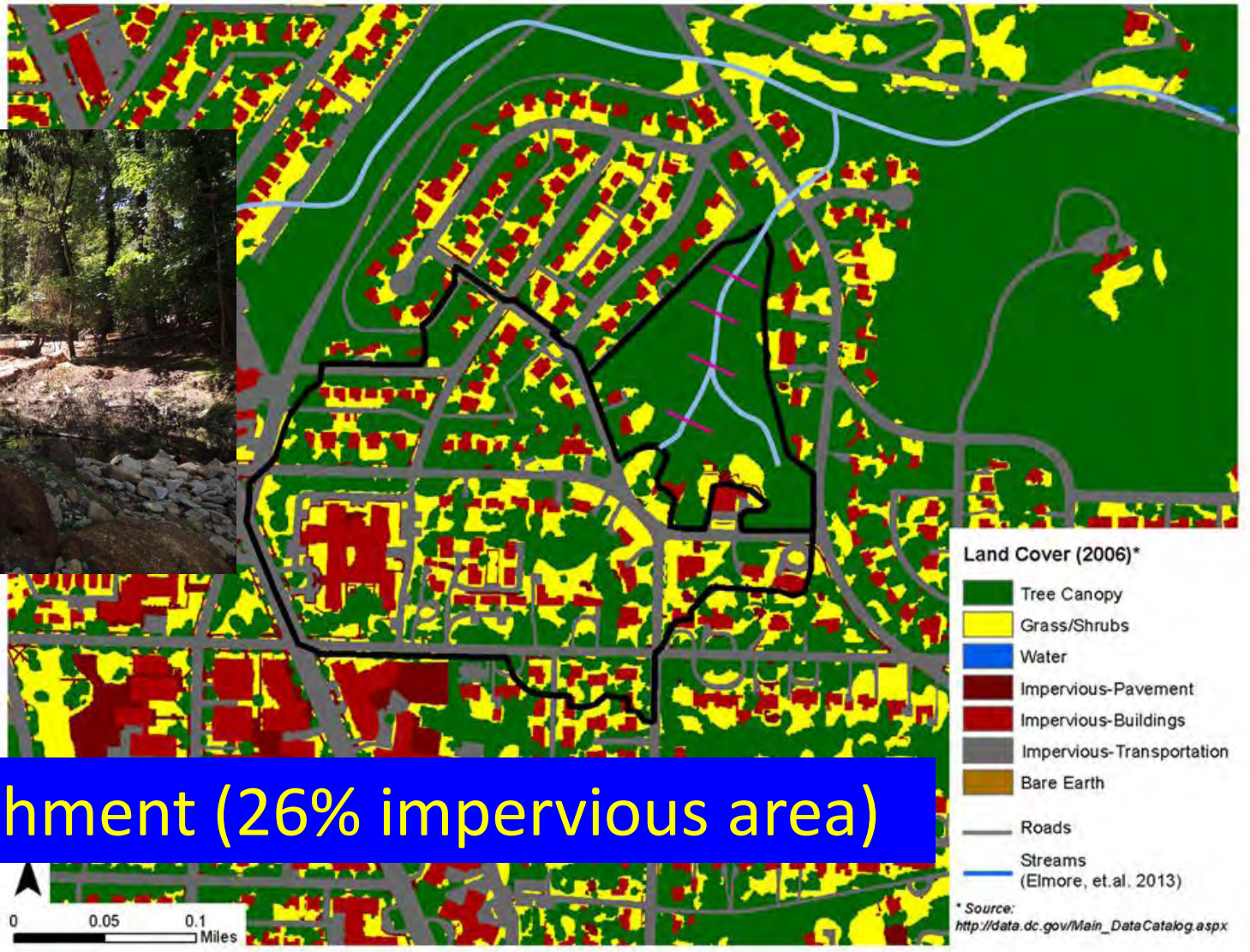


Monitoring Objectives

- Before After Control Impact (BACI) experimental design
- Measure solute concentrations and discharge to estimate solute fluxes from the Linnean (RSC restoration catchment) and Spring Valley (control catchment)
- Determine the effectiveness of RSC at reducing solute loads (i.e., nutrients, sediments, trace metals, and bacteria), as well as effects on aquatic macroinvertebrates and groundwater recharge.
- Both sites are located in the NW DC area in the Piedmont physiographic province.

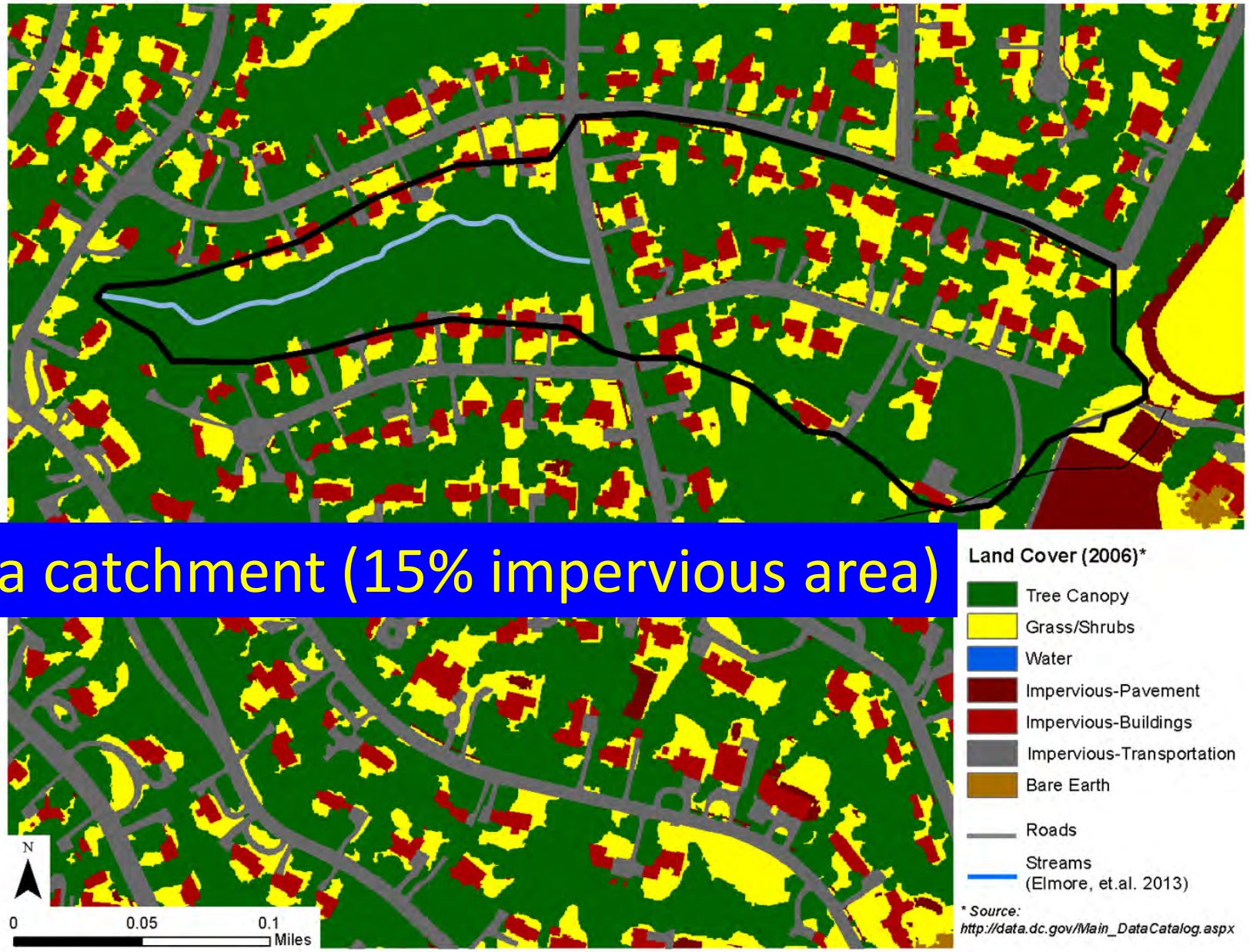

Study Sites
Piedmont
Fall Line
Coastal Plain
Garrett Park
Spring Valley
(Control)
Washington,
D.C.
33rd St. SE
(Control)
Texas Ave. SE
(Control)
Potomac River
Aurora Hills
(Control)
Aurora Hills
Severn River
Saltworks
(Sand Seepage)
Saltworks
(End of Pipe)
Bingham
Ford
Milkhouse
Run
Linnean Ave.
(outflow)
Linnean Ave.
(inflow)
(Pre and post construction)
N
0
2.5
5
Miles

BEST Urban BMP in the Bay (BUBBA) Award Winner in 2015
First Place in Stream Restoration Category
Daylighting of Broad Branch and Restoration of Linnean Park Tributary

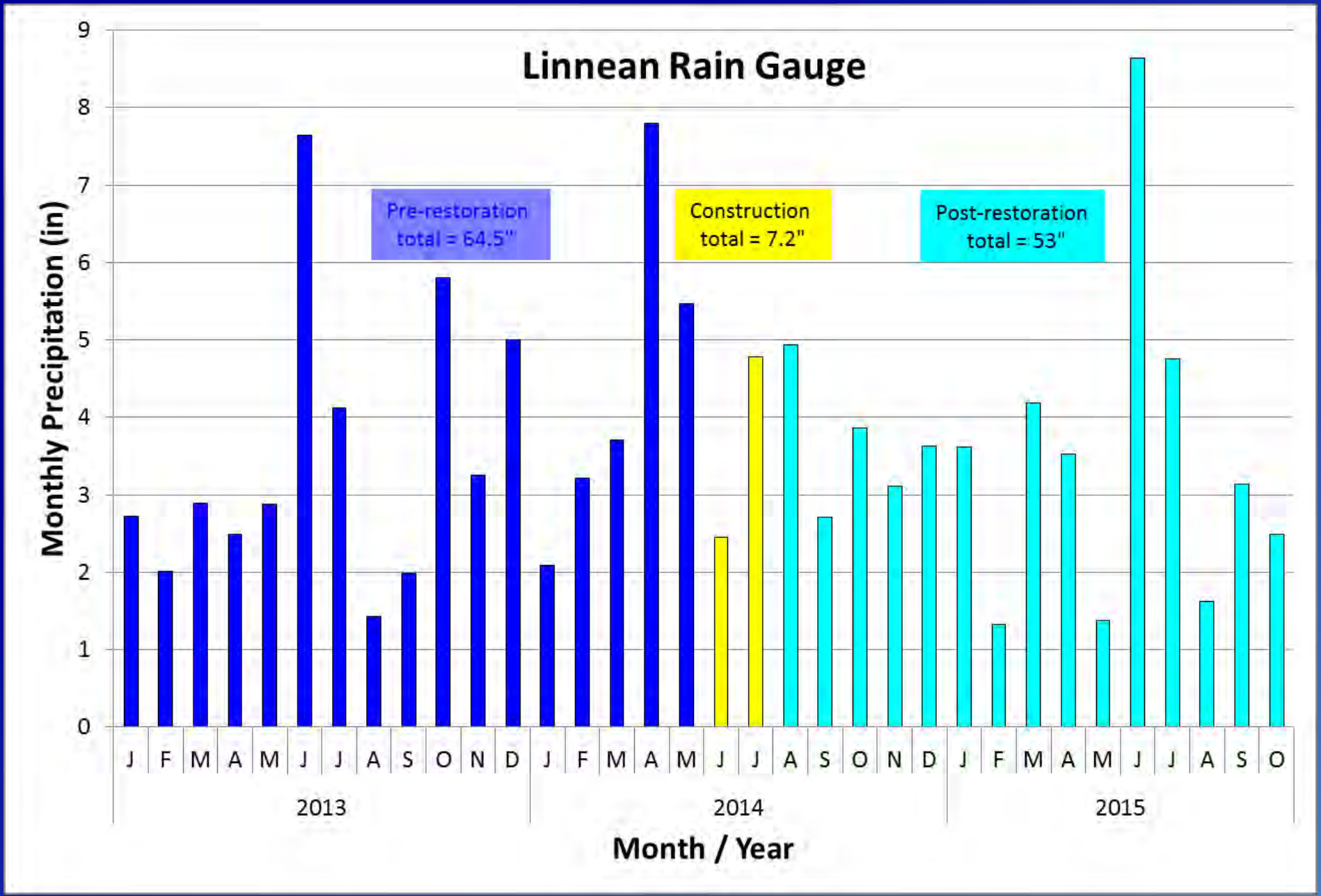


14 ha catchment (26% impervious area)

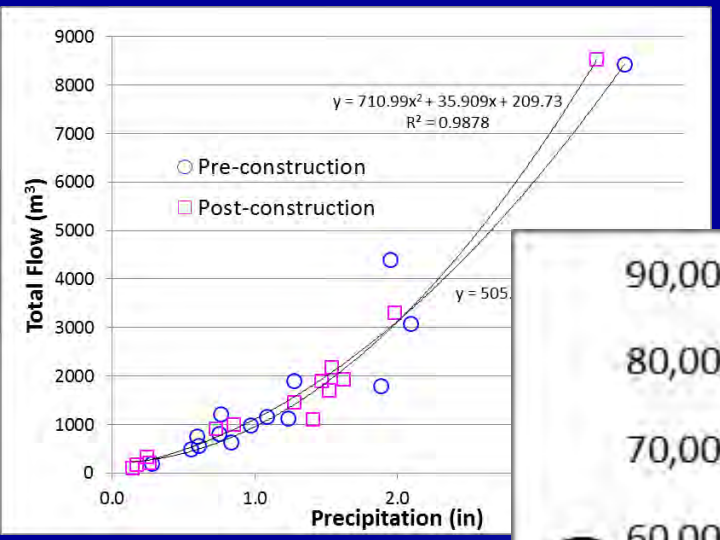
Spring Valley Control Site

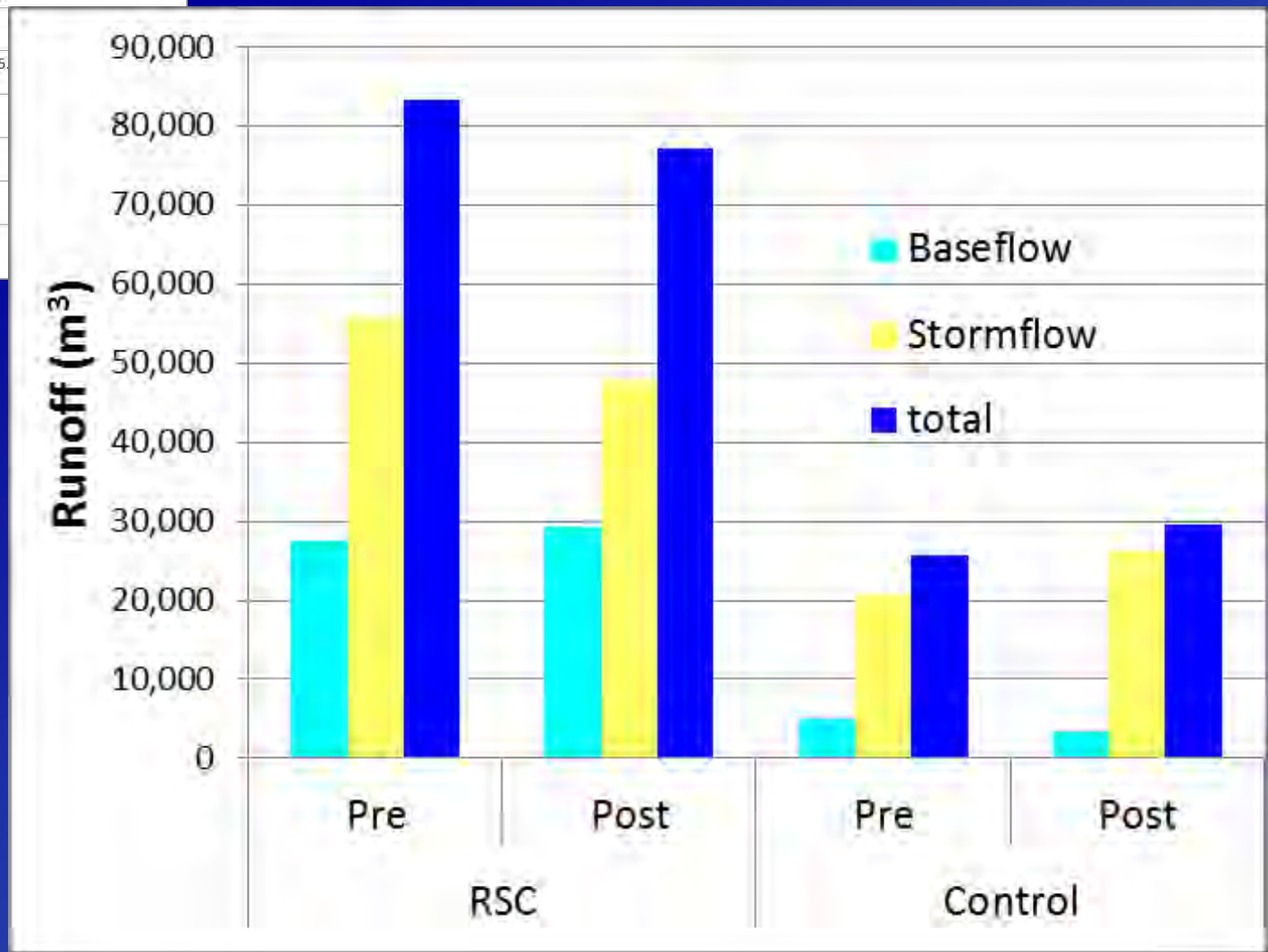


Precipitation



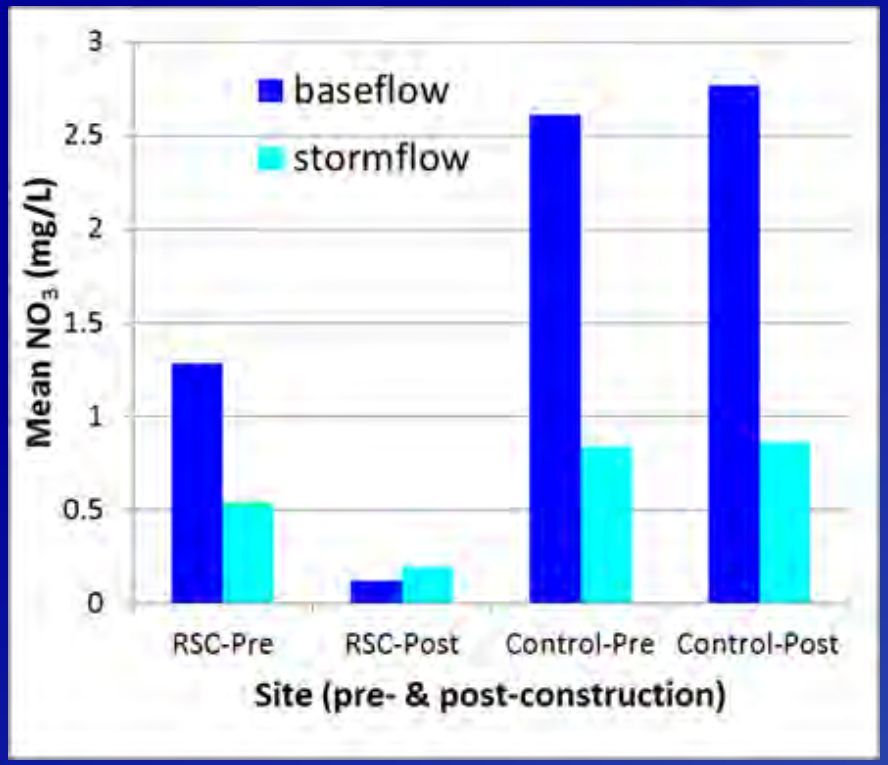
Baseflow and Stormflow



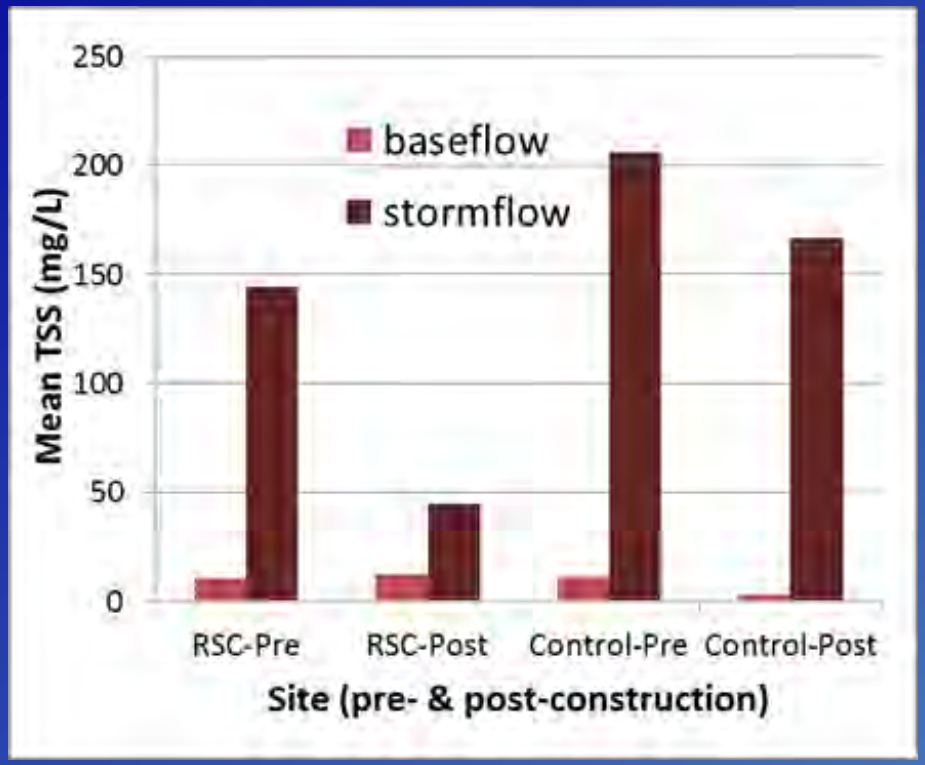


Nutrients and Sediments Volume-weighted Means

Nitrate



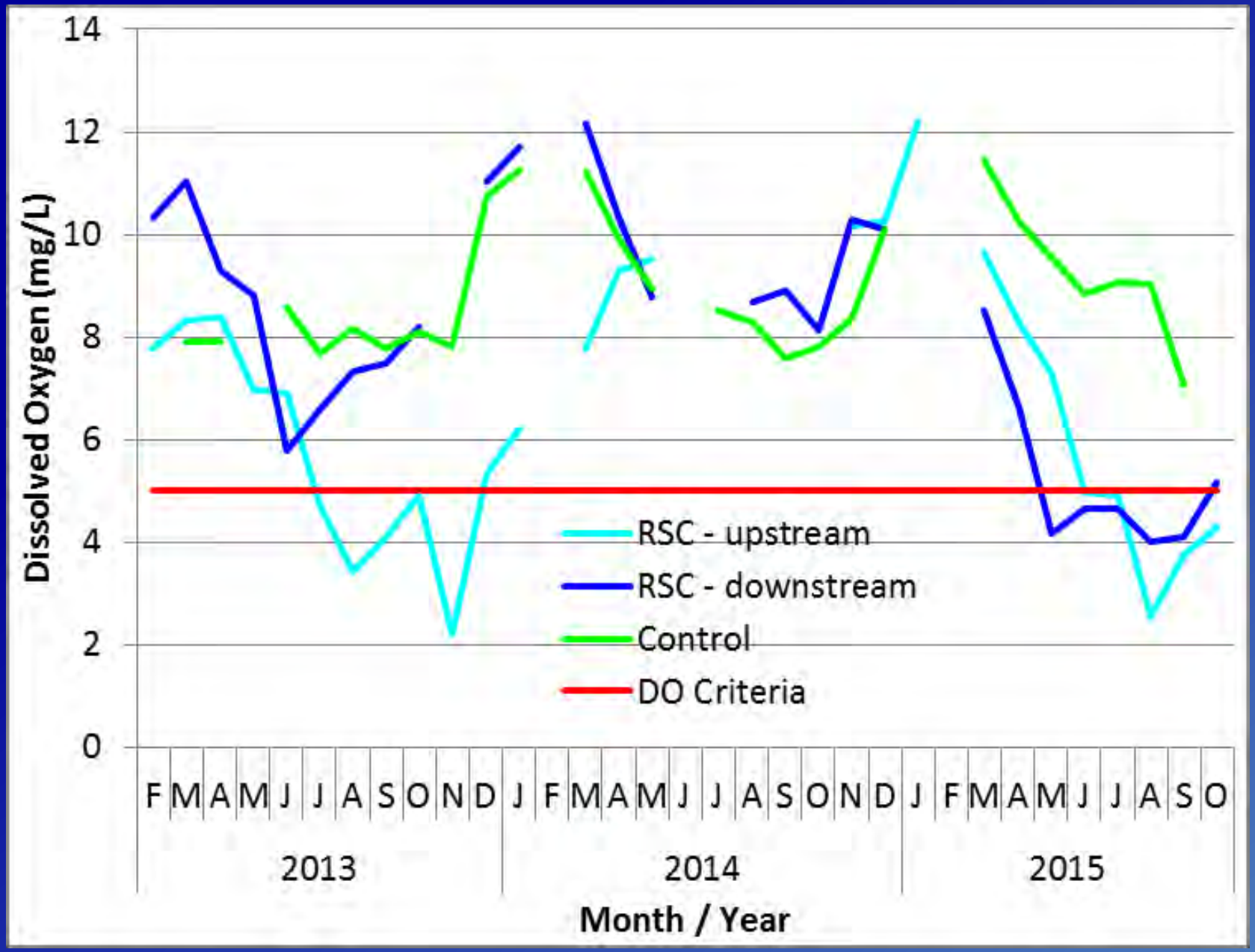
Total Suspended Solids



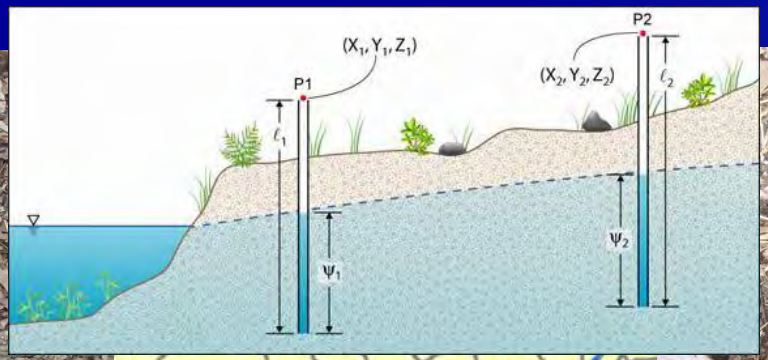
Changes in Area Yields

	RSC			Control		
	kg ha^{-1} yr^{-1}			kg ha^{-1} yr^{-1}		
Parameter	Pre	Post	+/-	Pre	Post	+/-
Area (ha)	13.44	14.73		7.8	7.8	
Runoff (m^3)	83,401	77,304	-6,097	25,599	31,765	6,166
TSS	620.9	169.4	-451.5	599.2	560.1	-39.1
NO_3-N	4.91	0.88	-4.03	3.91	4.88	0.97
PN	3.9	1.40	-2.50	4.43	2.55	-1.88
TN	11.96	5.14	-6.82	9.63	9.50	-0.13
TP	1.58	0.84	-0.74	1.34	1.17	-0.17
Fe	0.5	2.1	1.6	0.2	0.4	0.2

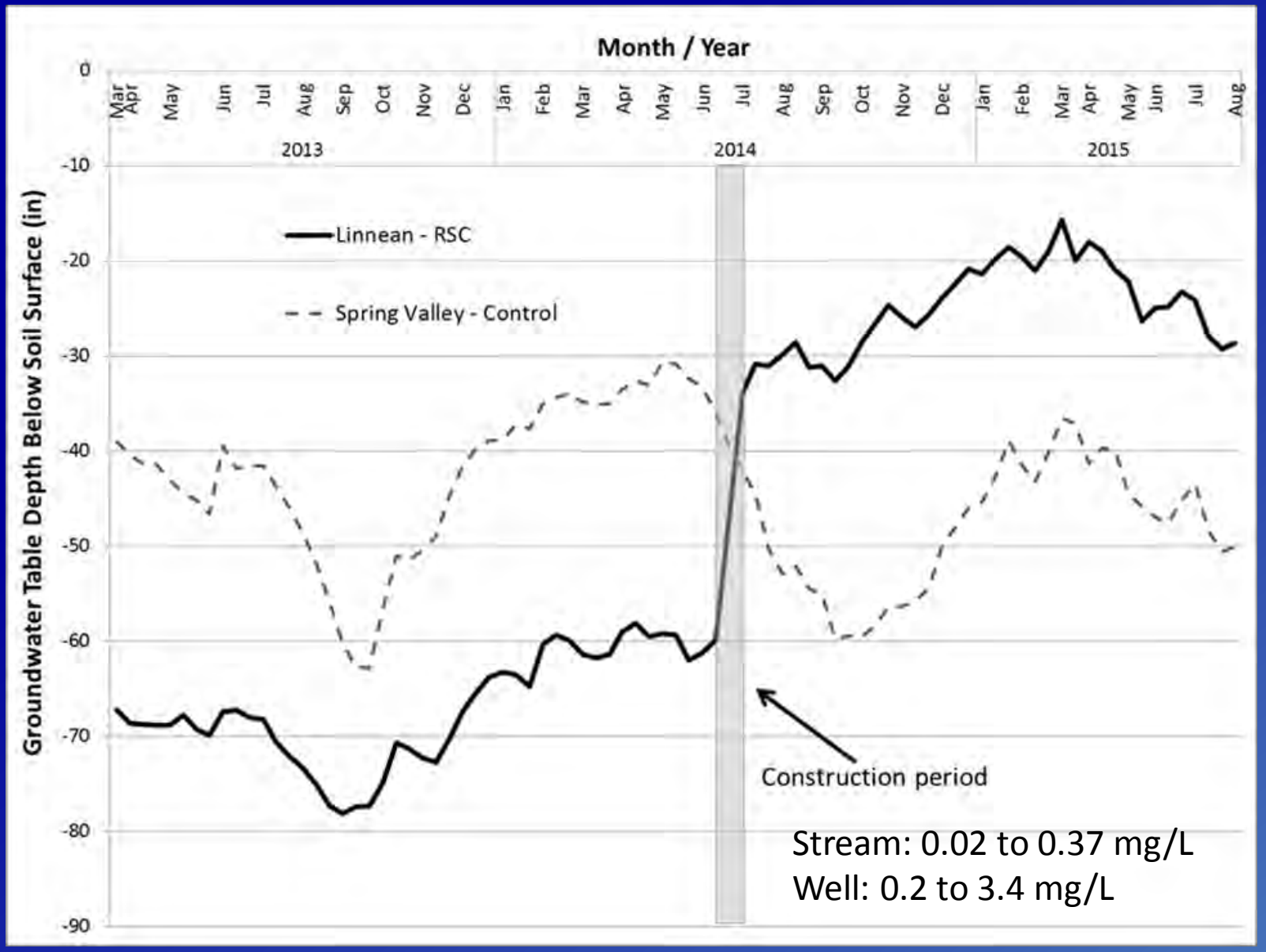
Dissolved Oxygen



Linnean Well Transects

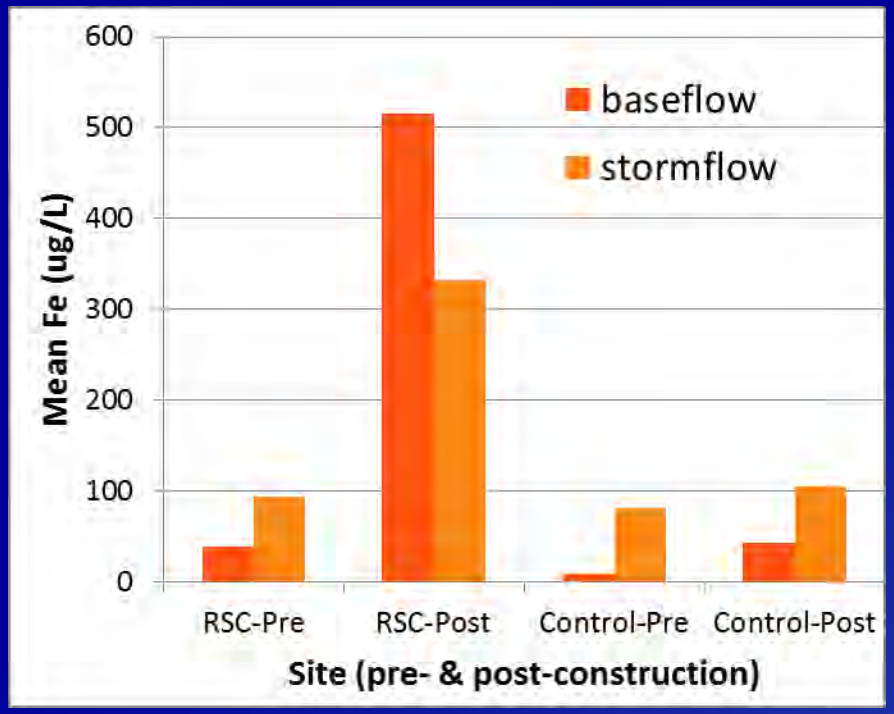


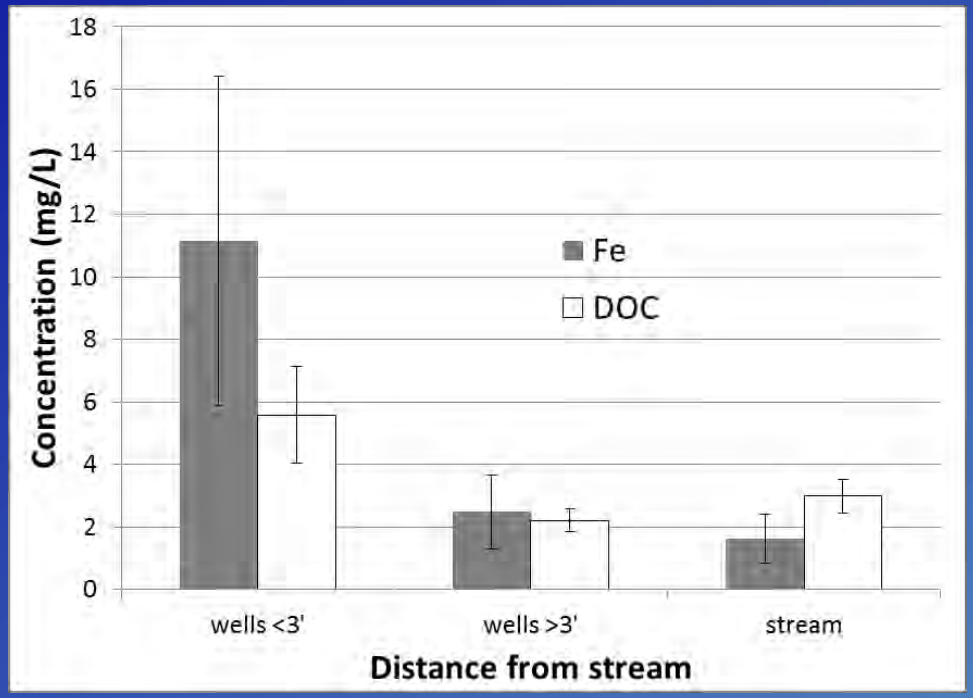
Groundwater Recharge



- Groundwater table & [Fe] in wells and surface water increased

Iron (Fe) in Streamwater & Well Transects

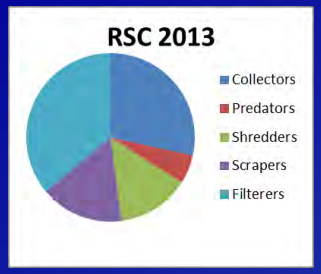




Macroinvertebrates

Hilsenhoff Biotic Index (HBI) - measure of how pollution-tolerant the macroinvertebrate community is.

Verbal score – describes water quality based on the macroinvertebrate tolerance/intolerance.



Hilsenhoff Biotic Index Verbal Score	2013	2014	2015
Excellent	---	---	---
Very Good	---	---	---
Good	---	---	---
Fair	---	---	---
Fairly Poor	Control	---	RSC
Poor	RSC	Control	---
Very Poor	---	RSC	Control

The Shannon-Wiener Diversity Index - measure of the diversity of the macroinvertebrate community, weighted by the abundance of each taxa.

Shannon-Wiener Diversity Index Verbal Score	2013	2014	2015
Excellent	---	---	---
Very Good to Good	---	---	---
Good to Fair	RSC, Control	---	Control
Fair to Poor	---	RSC, Control	RSC
Poor to Very Poor	---	---	---

Highlights

- The RSC resulted in an average recharge of the groundwater system by about 2.5’.
- Annual runoff decreased by 7% in the RSC, increased by 16% in the control.
- Area yields of TN, TP and TSS decreased 53, 4 and 12 times more, respectively, in the RSC compared to the control catchment.
- DO in RSC stream decreased below 5 mg/L criteria threshold during the summer and fall.
- Macroinvertebrate populations remained in the fair to poor range.

Acknowledgements

- Thanks to Rosemary Ury and Jake Kames for field and lab work
- Support: District Department of Energy and Environment (DOEE) (grant #12G-12-NFWF-UMCES/WPD-2 to Williams & Filoso).
- Additional support: NOAA and Maryland Sea Grant (REU program).