

Big Spring Run Legacy Sediment Removal and Aquatic Ecosystem Restoration Project

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For
Chesapeake Bay Commission
September 8, 2016

Big Spring Run Before Wetland Restoration



8 April 2005

Big Spring Run After Wetland Restoration



Restoration completed November 2011

Big Spring Run Floodplain Wetland Restoration



13 June 2012

Big Spring Run Floodplain Wetland Restoration



12 August 2016

Big Spring Run Legacy Sediment Removal and Aquatic Ecosystem Restoration Project

Pre- to post-restoration monitoring metrics (partners, dates) include:

- Hydrology, with 3 gage stations (USGS, 2008-2016)
- Fluvial Geomorphology (F&M, USGS: 2004-2016)
- Vegetation (PADEP, Johns Hopkins Univ.: 2008-2016)
- Macroinvertebrates (Millersville: 2008-2013)
- Nitrogen (USEPA, Penn State, F&M: 2008-2013)
- Carbon (F&M, EPA: 2008-2016)
- Phosphorus (F&M: 2006-2016)
- Sediment (F&M, USGS: 2008-2016)
- Biogeochemistry (USEPA, Penn State: 2008-2016)
- Surface & Ground Water (USEPA, USGS, F&M: 2008-2016)
- Ecogeomorphology (vegetation, flow, and sediment transport) (UC Berkeley: 2009-2016)
- Amphibians (Elizabethtown College: 2010-2016)
- Diatoms (PNAS/Drexel & F&M: 2010-2016)
- Fish (PADEP: 2010-2016)
- 2-D Flow Modeling and Basal Shear Stresses (Univ of Louisville and F&M, 2010-2016)

February 10, 2012



Removal of ~20,000 cubic yards of legacy sediment uncovered the pre-European settlement landscape and restored ~4.5 acres of palustrine wetland dominated ecosystems with herbaceous plant communities typical of wet meadows .



May 1, 2013

Motivation for Big Spring Run Restoration Approach

1. Eroding stream banks and high sediment loads

Banks have high % of silt and fine sand



April 3, 2009

Big Spring Run, PA – High suspended sediment load, 303d list.



October 5, 2009



October 17,

Big Spring Run, PA – High suspended sediment load, 303d list.



January 1, 2011

Motivation for Big Spring Run Restoration Approach

1. Eroding stream banks and high sediment loads
2. Buried ecosystems (primarily wetlands) and springs

Big Beaver Creek, PA – Buried landscapes (Smith/Shultz mill, <1730)



Piney Run, MD – Buried landscapes, DeVries mill – early 1800s



Piney Run, MD



Alyisma plantago—
Pond, shallow water



Carex scoparia—
marsh, wet meadow



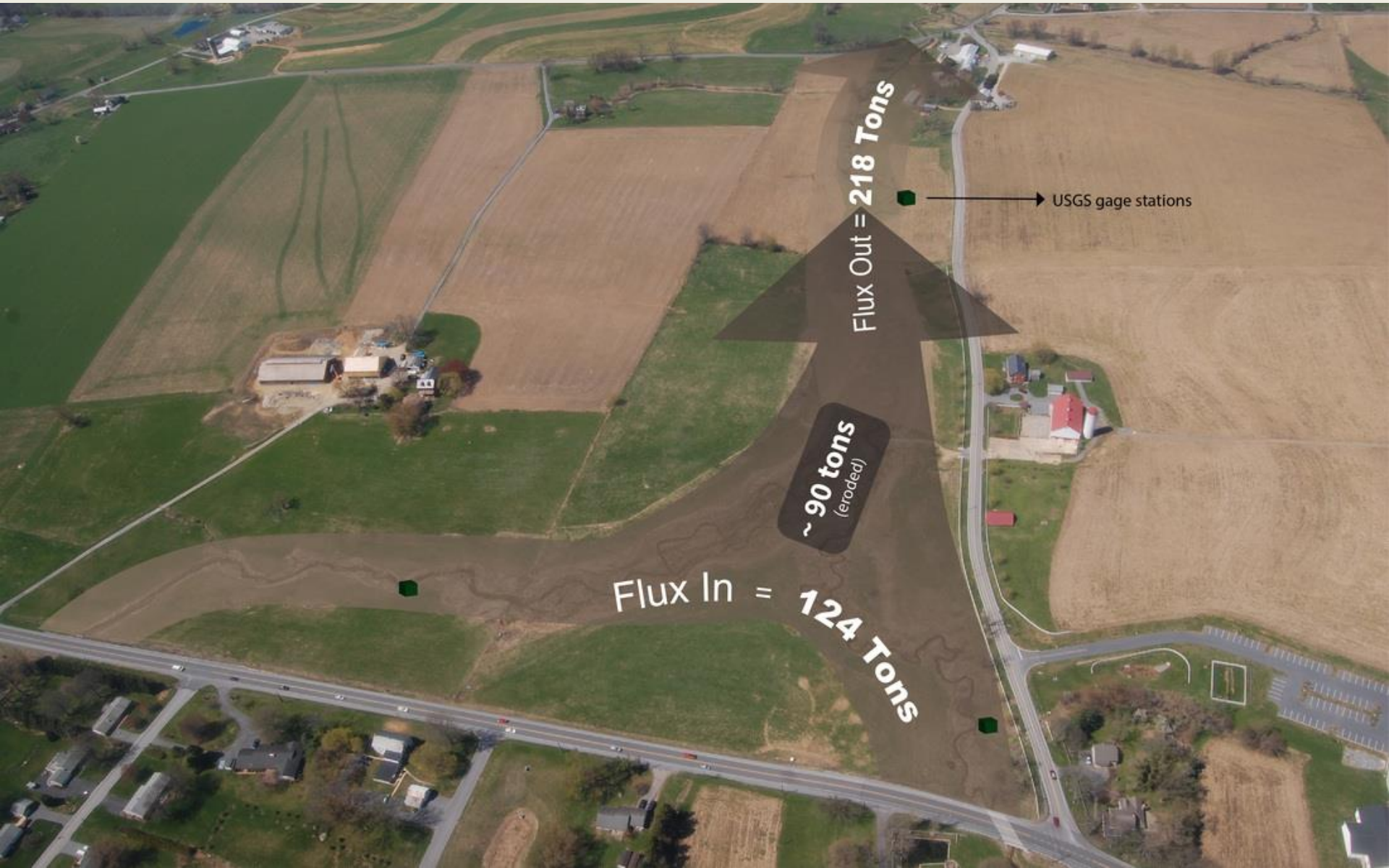
Modern analog buried black soil: Marsh, wet meadow (Great Marsh, Chester County)



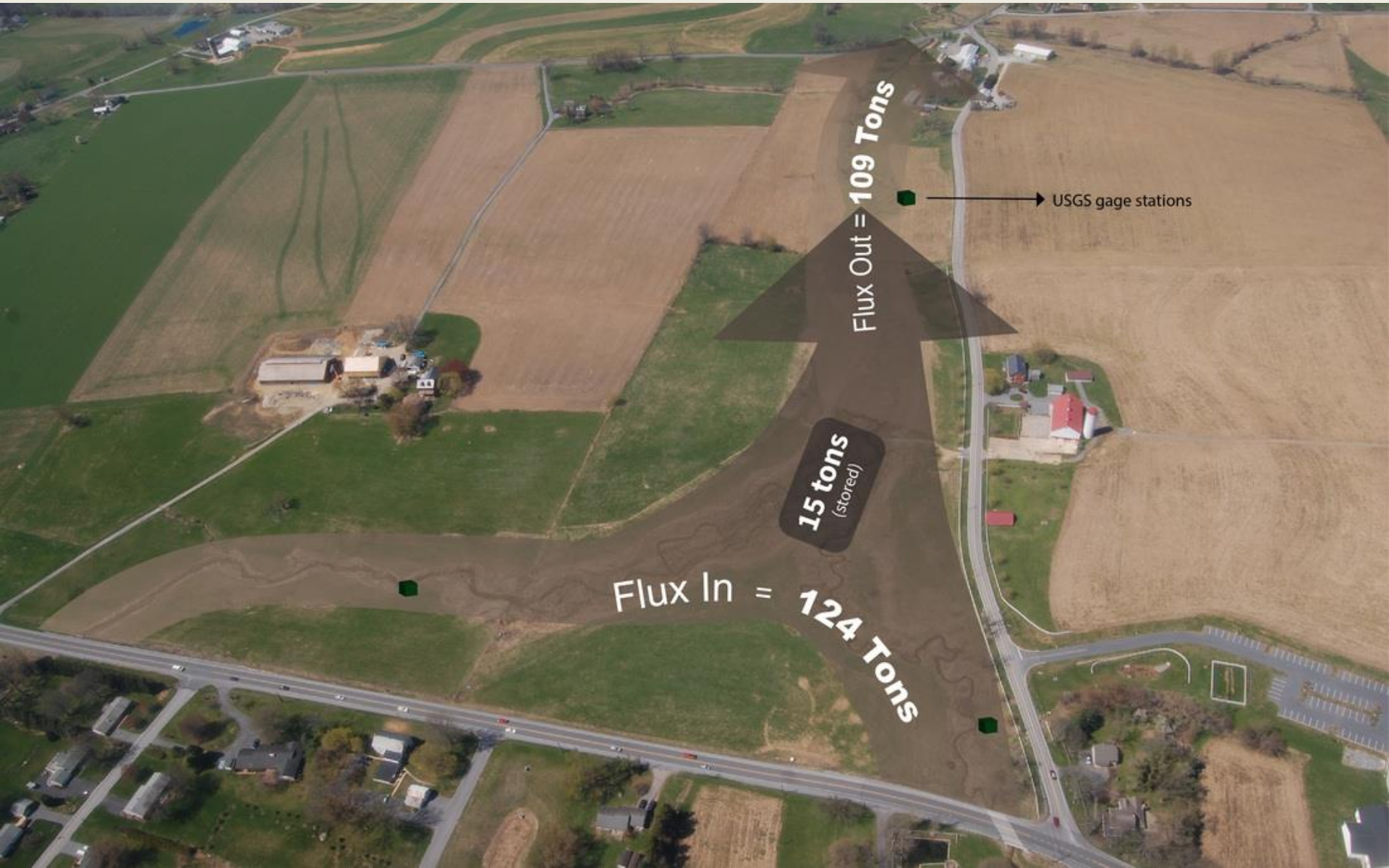
Outcomes/Improvements from Big Spring Run Restoration

1. Reduced sediment loads
2. Aquatic ecosystem restoration
3. Total Phosphorus reduction
4. Total Nitrogen reduction
5. Nitrate reduction
6. Surface water temperature reduction
7. Storm water retention and increased groundwater-surface water interaction
8. Amphibian recovery
9. Diatoms and water quality
10. Beneficial soil re-use

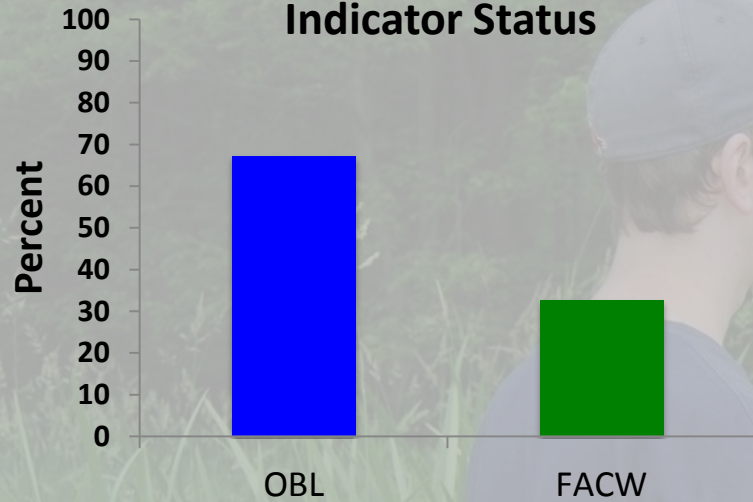
Big Spring Run High Pre-Restoration Sediment Loads (USGS)



Big Spring Run Post-Restoration Sediment Loads Reduced (USGS)

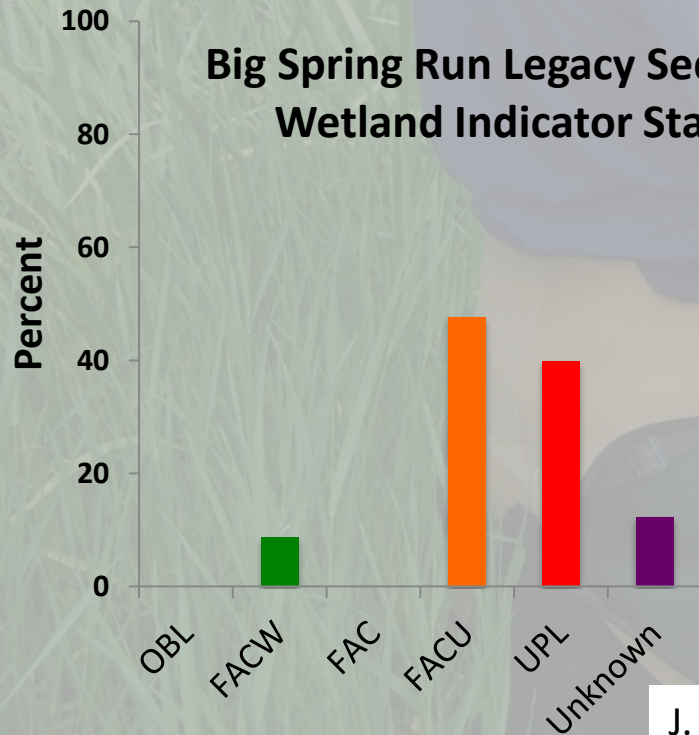


Great Marsh Wetland Indicator Status



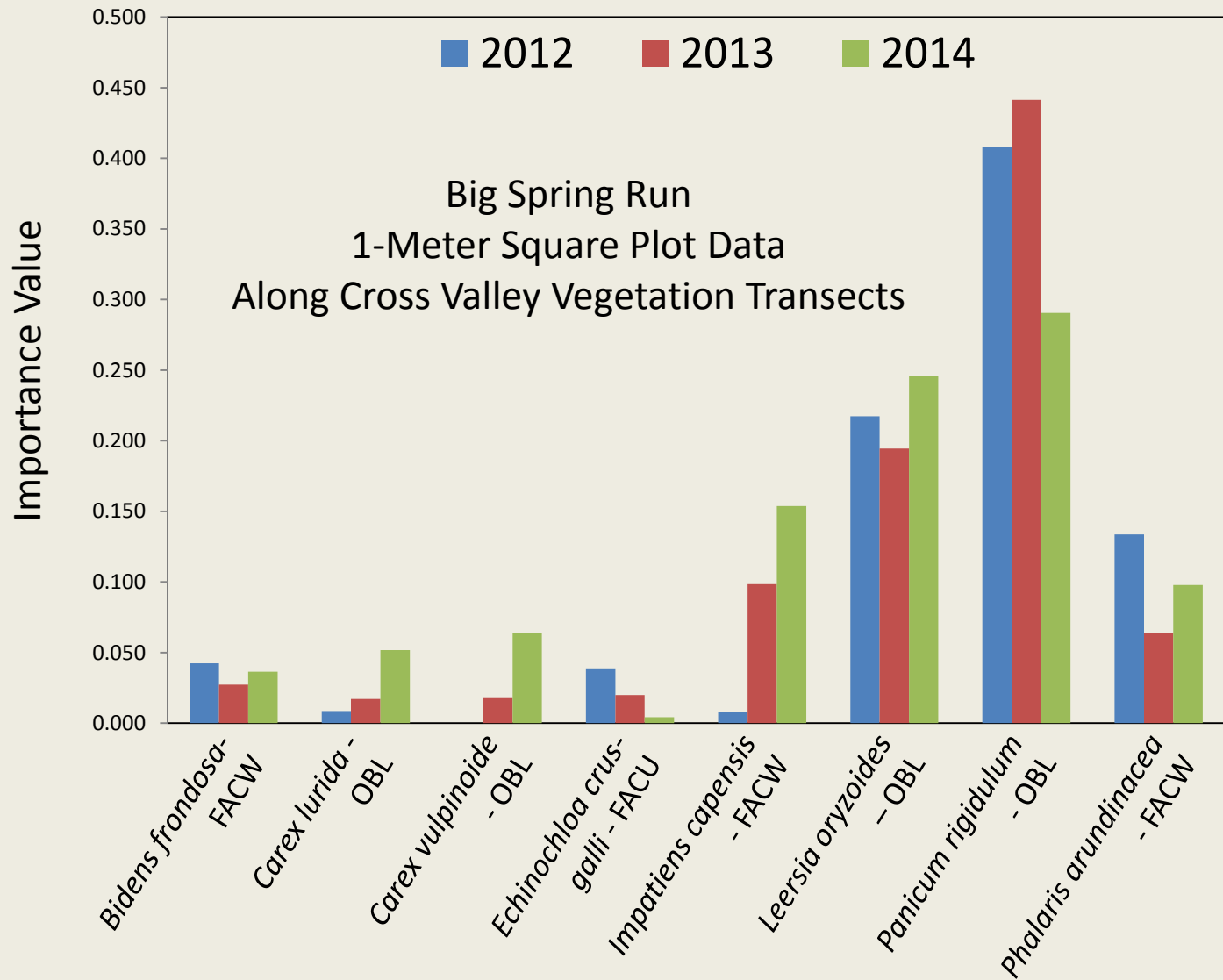
Wetland Indicator Status

Big Spring Run Legacy Sediment Wetland Indicator Status



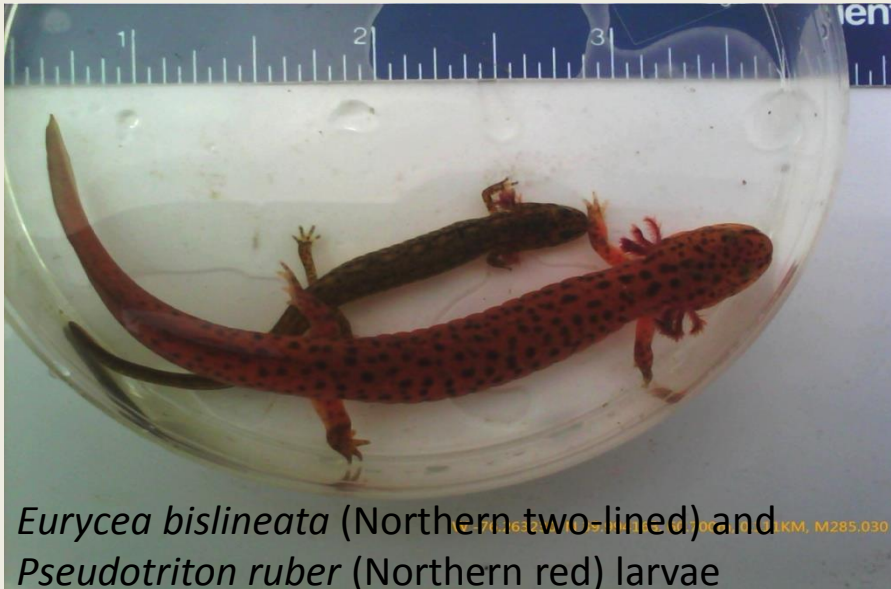
Big Spring Run Aquatic Ecosystem Restoration





Importance Value is the sum of relative percent cover and relative frequency for each species.

Big Spring Run Amphibians



Big Spring Run, Stormwater Retention



Courtesy Telemonitor, Inc.

September 18, 2012 @ 3:30 PM

Post-Restoration

Big Spring Run, Stormwater Retention



Courtesy Telemonitor, Inc.

September 18, 2012 @ 4:30 PM

Post-Restoration

Big Spring Run, Stormwater Retention



Courtesy Telemonitor, Inc.

September 18, 2012 @ 4:35 PM

Post-Restoration

Big Spring Run, Stormwater Retention



Courtesy Telemonitor, Inc.

September 18, 2012 @ 5:00 PM

Post-Restoration

Big Spring Run, Stormwater Retention



Courtesy Telemonitor, Inc.

September 18, 2012 @ 8:30 PM

Post-Restoration

Big Spring Run, Stormwater Retention



Courtesy Telemonitor, Inc.

September 20, 2012 @ 10:00 AM

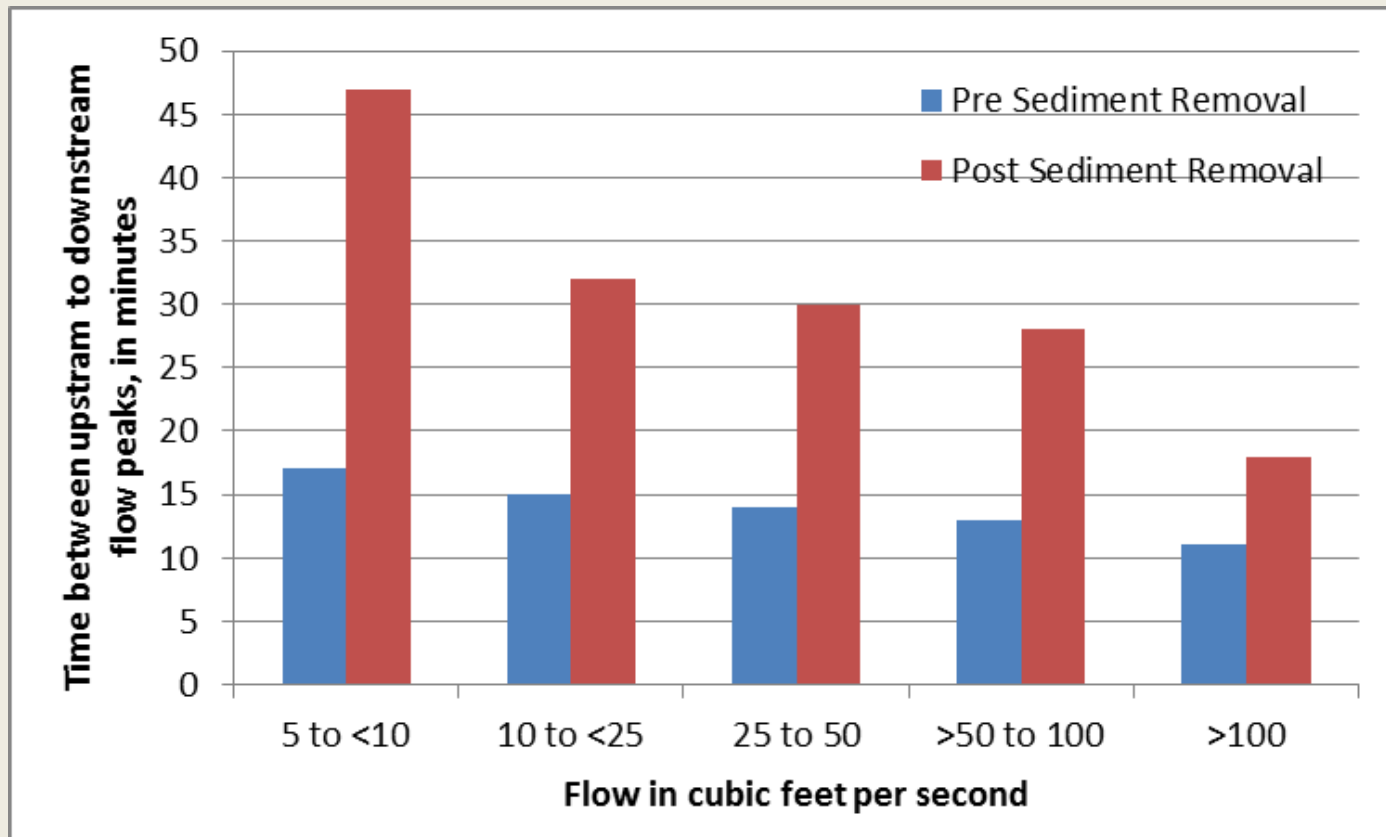
Post-Restoration

~~Change in Water-storage from Sediment Removal~~
~~at Big Spring Run 2009-2015~~

Period	Surplus flow into storage (gallons)	Percent change
Pre non-growing	152,000	
Post non-growing	265,000	74
Pre growing	212,000	
Post growing	488,000	130
Pre restoration	197,000	
Post restoration	2428,000	170

?

Note the substantial change in storage of water during the growing season (130%) due to more biota to slow and hold back water, and overall change from pre- to post-restoration (170%). [USGS data; provided by M. Langland.]



The largest increase (>30 minutes) in time between flow peaks from upstream to downstream gages at in the Big Spring Run restoration area is at the lowest flow class. Lower flows fill the evacuated area more slowly. As flows increase in magnitude, the evacuated area fills more quickly, hence delay times decrease. Pre-restoration lag times (blue bars) most likely represent storage within the incised channels and some of the floodplain, while post-restoration data (red bars) represent areas that can hold water as a result of sediment removal.

[USGS data; provided by M. Langland.]



One day after Tropical Storm Hanna (9/7/08)



Before Restoration - Suspended Sediment Load = 218 T/yr



After restoration- No Banks – Sediment load reduced by 109 T/yr

Big Spring Run Floodplain/Wetland Restoration Outcomes

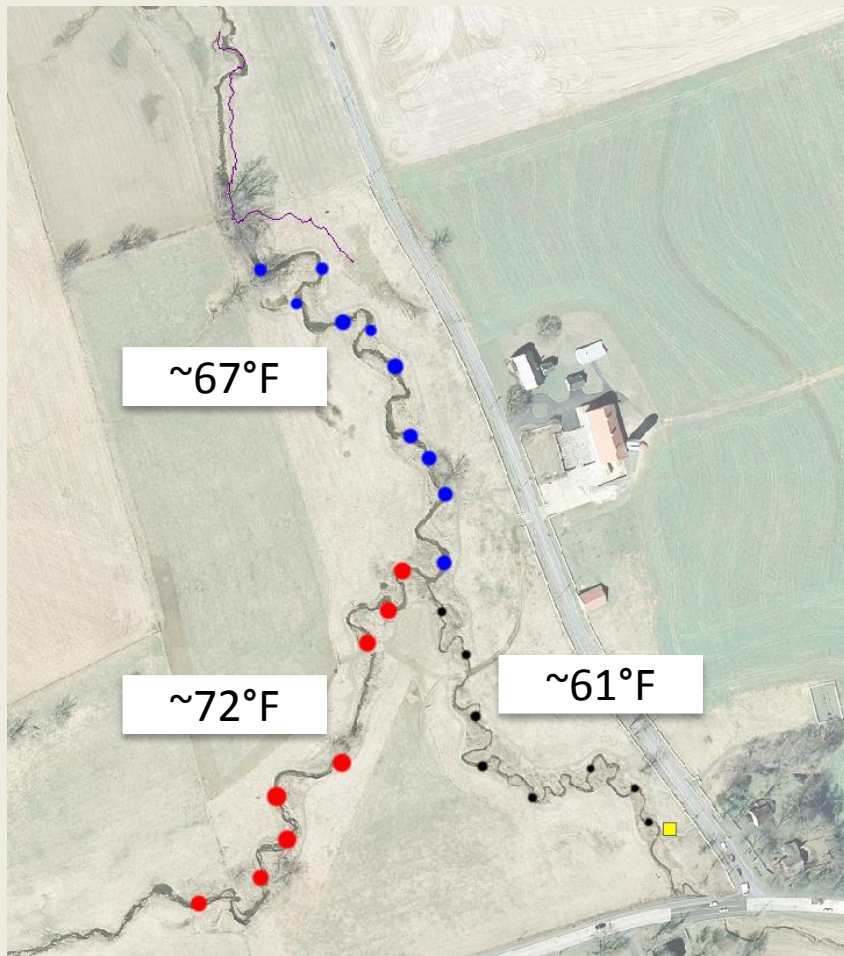


**Restoration
Reach
(3,200 ft)**

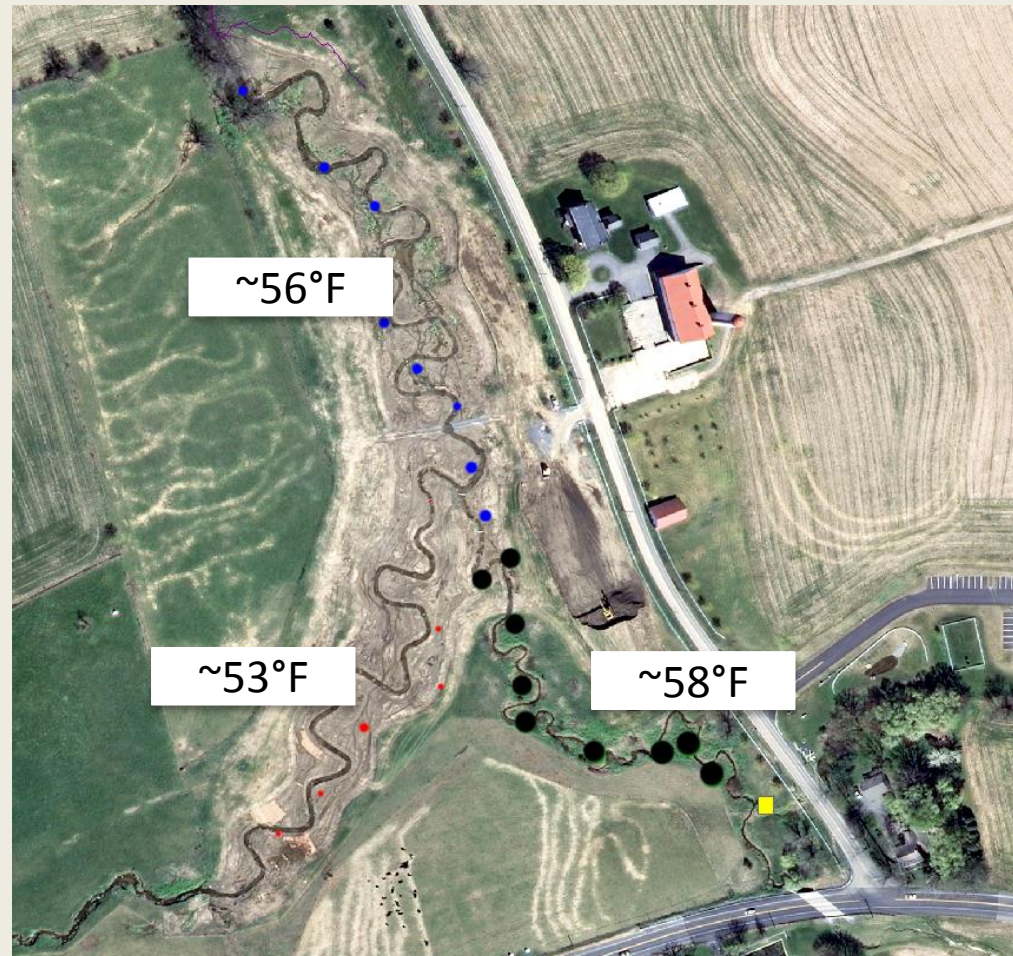
NCALM lidar DEM

- **Sediment Removed:** ~21,955 tons
- **Sediment Source:** ~63% from Banks
(~100% from within restoration reach)
- **Sediment Load Reduction:** ~109 tons/yr
- **Total P Removed:** ~50,500 lbs
- **Total Sorbed P Removed*:** ~35,128 lbs
(P Load Reduction = 174 lbs/yr)
- **Total N Removed:** ~63,600 lbs (N
Load Reduction = 316 lbs/yr)
- **Nitrate Reduction:** 11% in sfc water
- **Carbon Storage:** 7,300 lbs/yr
 - Increased DOC on floodplain
- **Groundwater:** 20% more input
- **Biological Indicators:** Vegetation - shift
from upland, invasive to
obligate/facultative wetland.
Amphibians and Diatoms – increased

Pre- & Post-Restoration Temperature



April 7, 2010 (Post-Winter)



October 19, 2015 (Post-Summer)

9/7/16 (Air T = 87°F)

66.0 Gage

63.5

63.7

61.7

59.2

59.0

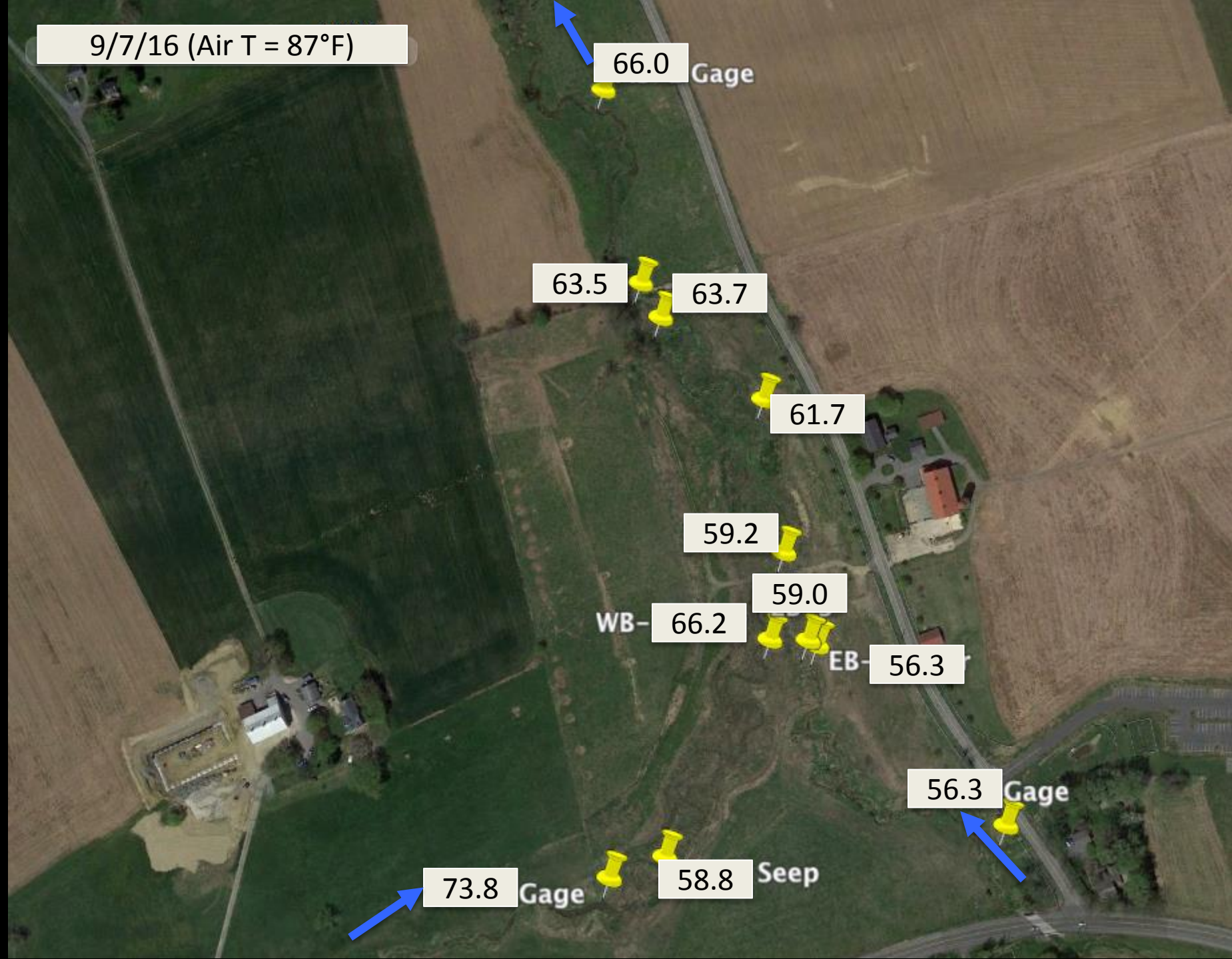
WB- 66.2

EB- 56.3

56.3 Gage

73.8 Gage

58.8 Seep



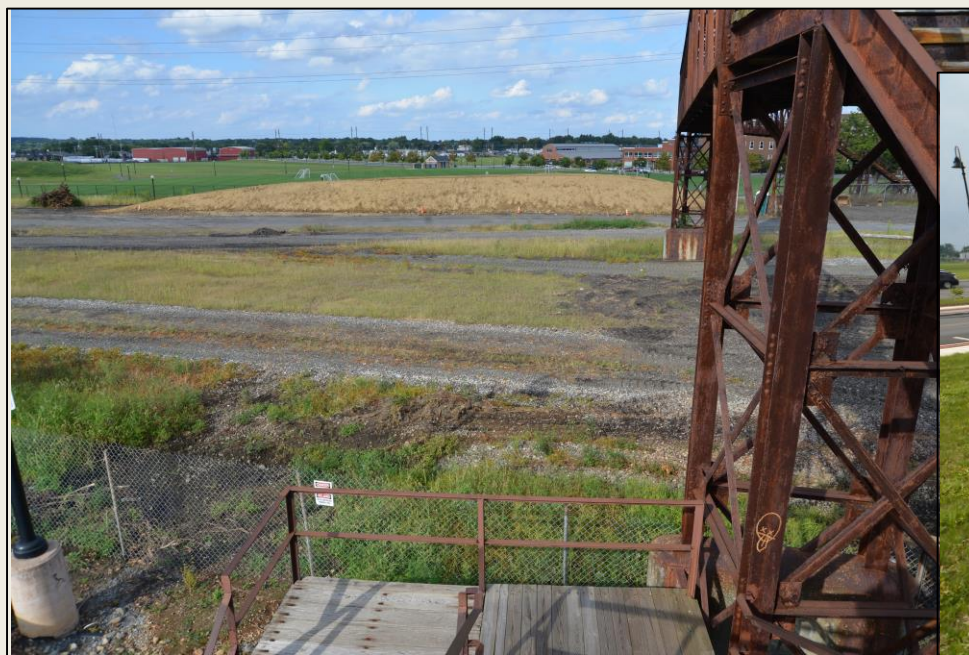
Stream Restoration Targets*

Applied to Big Spring Run

1. Hydrology – Slow down stream velocity
2. Add DOC
3. Reconnect floodplain wetlands with surface water and groundwater
4. Combined with infrastructure improvements:
e.g., sewer line relocations

***EPA/CBP Panel on Stream Restoration**

Beneficial Reuse of Legacy Sediment



During (9/1/14)



After (6/14/16)

Brownfield Reclamation Project – Norfolk Southern Rail Yard – Lancaster PA
Franklin & Marshall College and Lancaster General Hospital



Home
Restoration
Research
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Partners

The **BSR** Project
Aquatic Ecosystems Restoration Research
Big Spring Run, Lancaster PA

www.BSR-project.org

Website launched February 2015 (*designed by **Kayla B. Schulte***)

BSR Restoration Research and Funding Partners



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OF NATURAL SCIENCES
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