Monitoring Stormwater Control Measures

OWEA Watershed Workshop

November 12, 2015

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Goals

- What are stormwater control measures
- Why monitor
- The challenges of monitoring
- Some examples of site installations with monitoring
- Some results
- Questions?

Stormwater Control Measures (SCM)

- Green infrastructure & Best Management Practices
- SCMs are designed to reduce or delay stormwater runoff and improve water quality
- There is growing interest in GI SCMs; however, there are relatively little high-quality data available on their operational characteristics

SUDS, LID, BMPs, WSUD and more – The evolution and application of terminology surrounding urban drainage

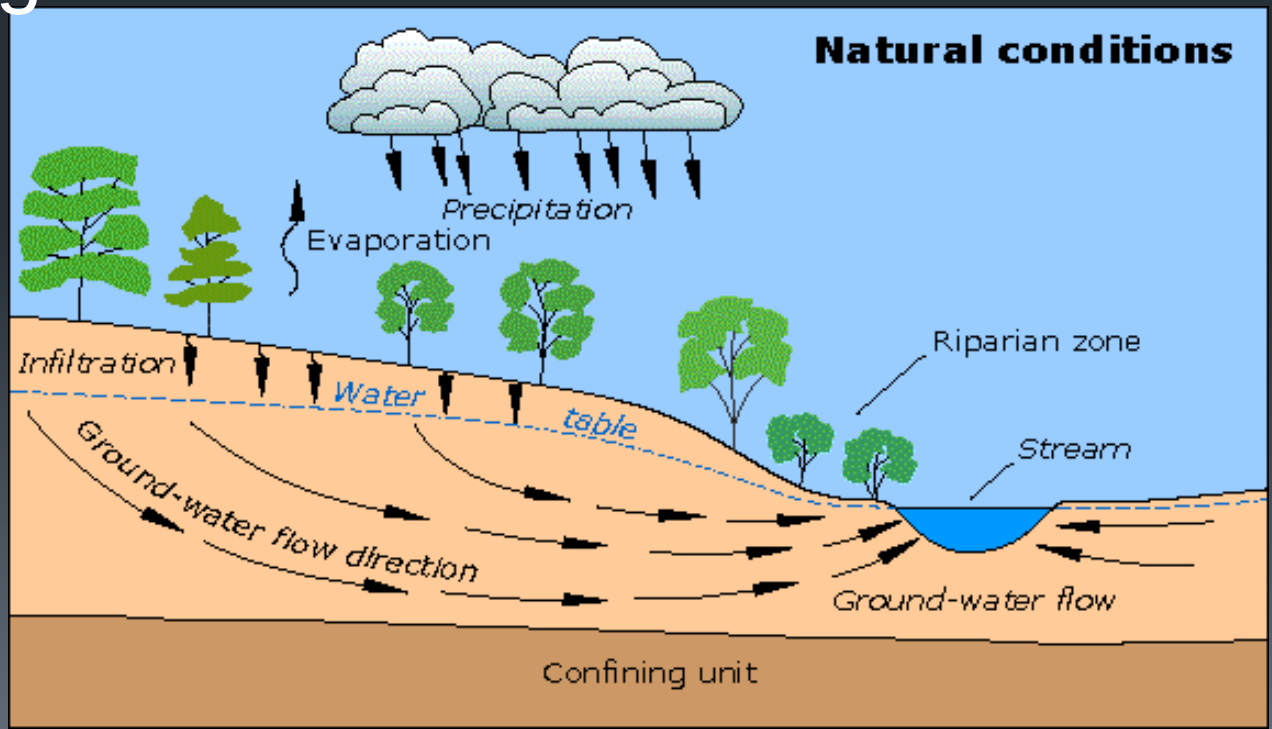
Urban Water Journal, 2014
http://dx.doi.org/10.1080/1573062X.2014.916314

Why monitor SCMs?

- Consent decrees to eliminate/reduce CSOs
- Grey & Green infrastructure
  - Do they work in different hydrologic settings?
  - Do they work as designed?
  - Does efficiency degrade with time?
- Large Scale effects

The Plan

- Measure as much of the water budget as possible
- Determine efficiency of different SCMs by comparing water IN vs. water OUT



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The Challenges

- Urban settings → everything happens fast
- Most flows are relatively small (<1cfs)
- Pipe-flow
- Local weather conditions
- Soil conditions
- Groundwater
- Multiple types of monitoring at each site

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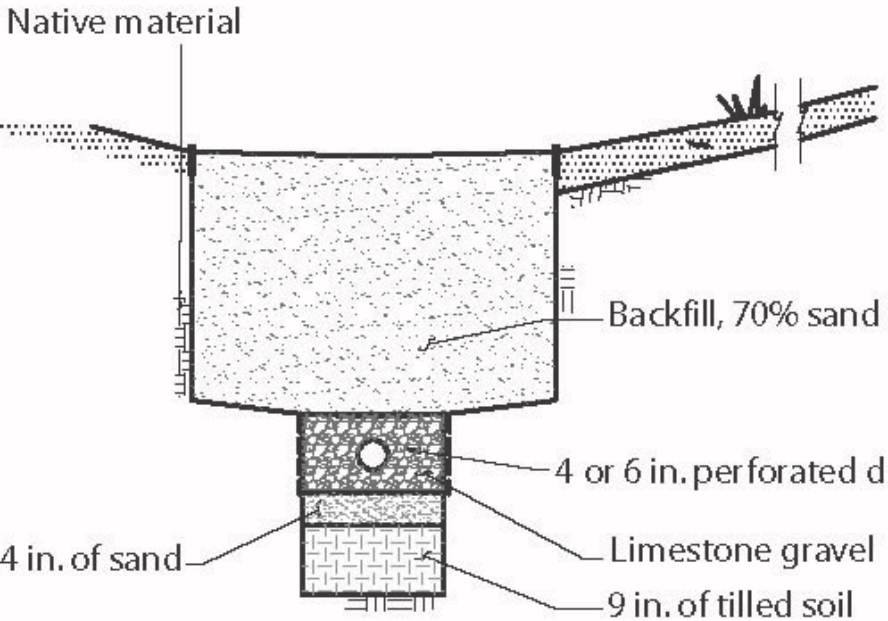
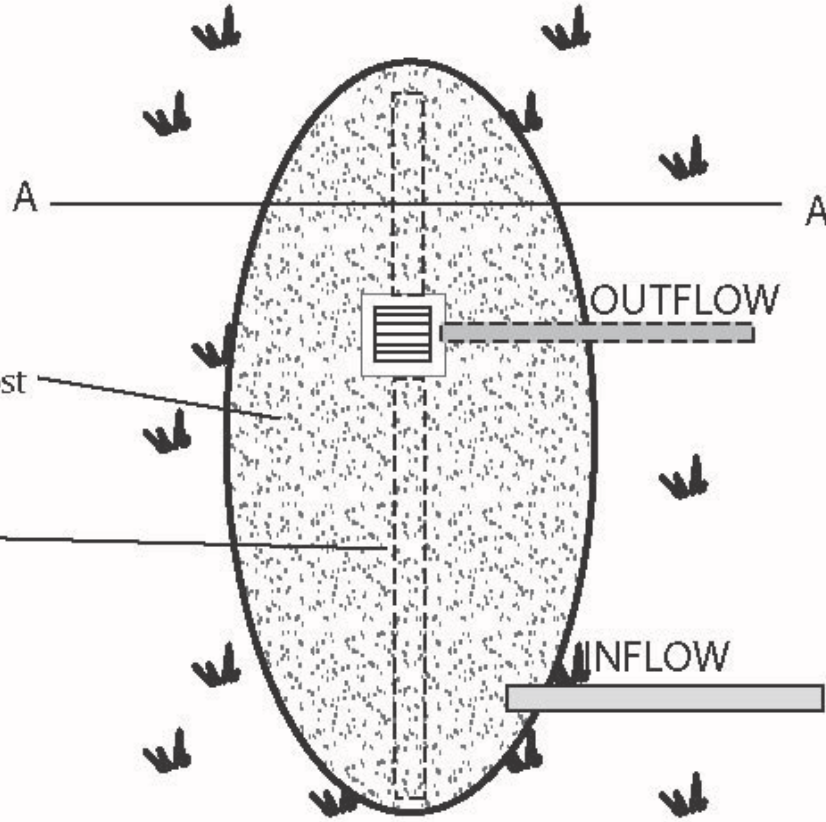
Typical construction



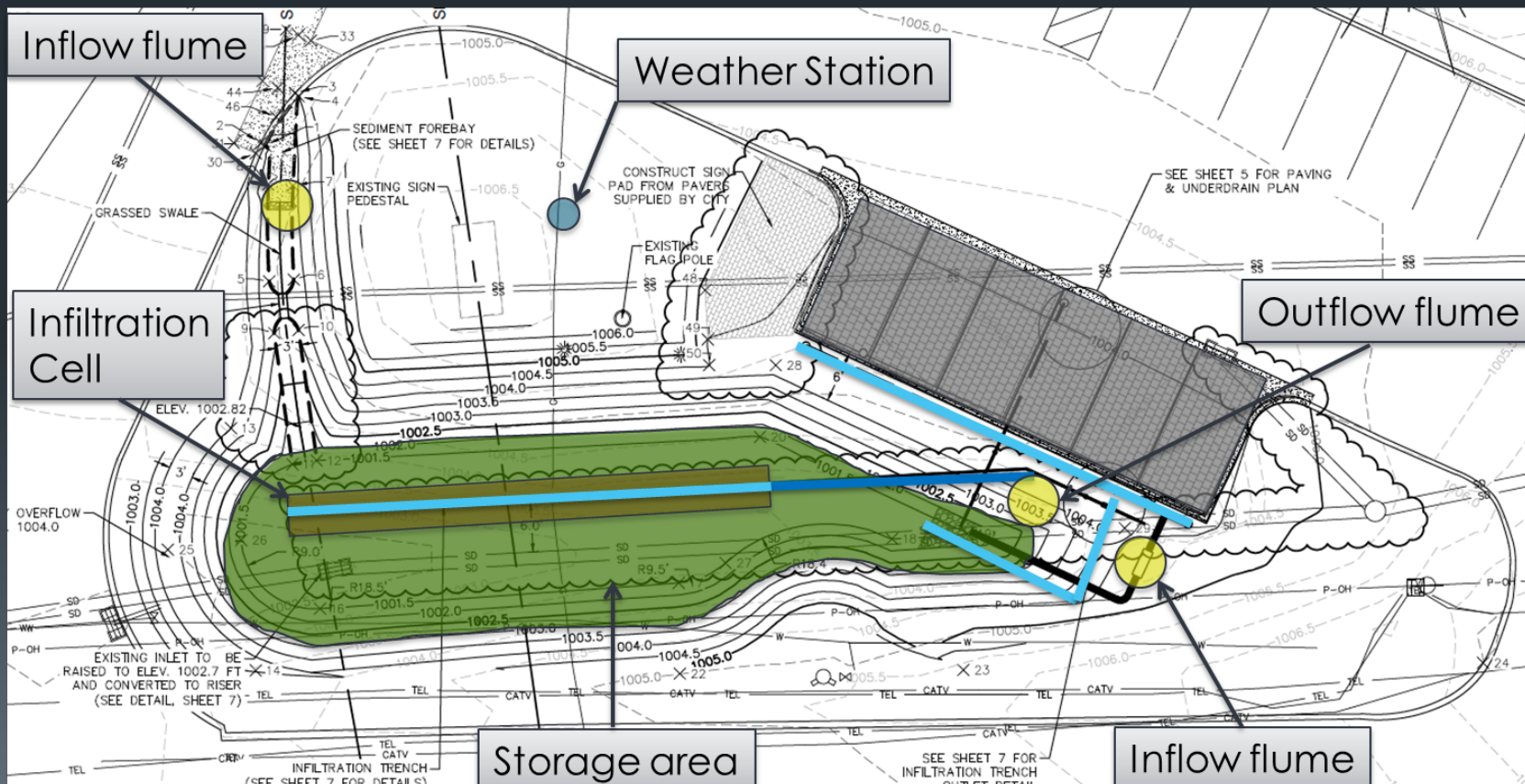
Typical rain garden detail section A-A'



Plan view of bioswale-rain garden system

Omaha, NE

- Drainage area ~ 1 acre
- 2,200 sq. ft. bio-retention (rain garden)
- 1,000 sq. ft. permeable pavers



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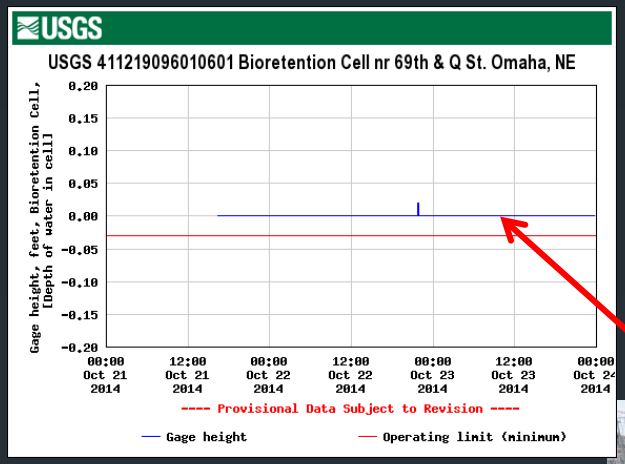
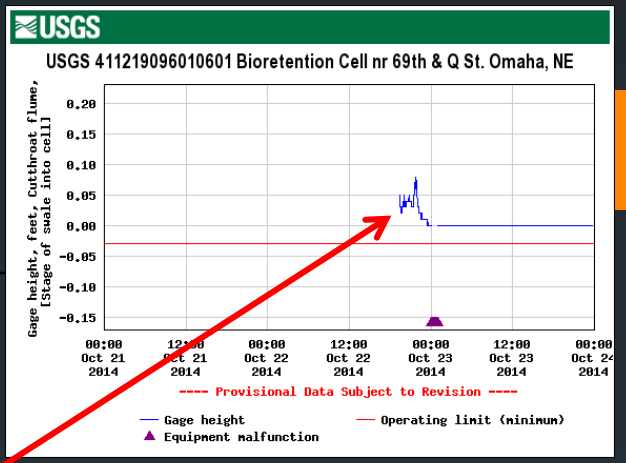
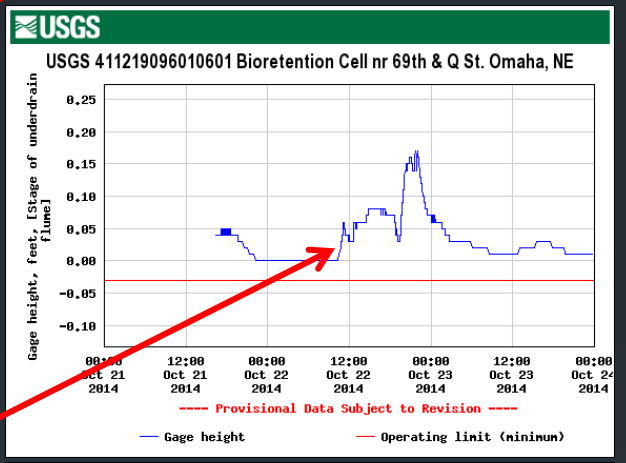
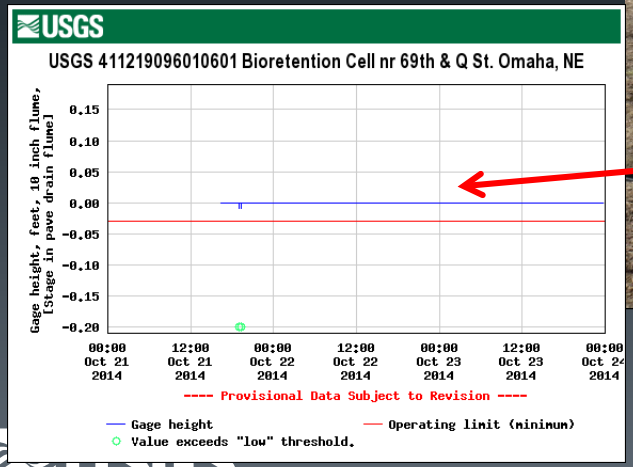
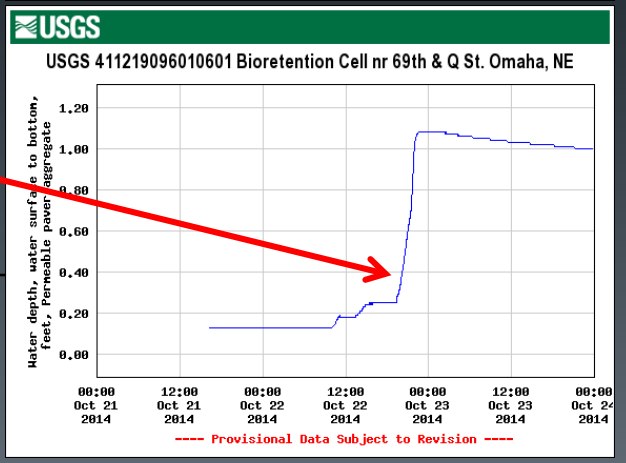
First Monitored Storm: 10/22/2014











Griggs Reservoir Rain Garden

- Franklin Soil & Water Conservation District
- City of Columbus

- Rain Garden with an area of 8,500 ft^2
- Receives water from ~26 acres
- 1 ft. of gravel covered by 2 ft. of engineered soil
- Subsurface drains connected to an overflow

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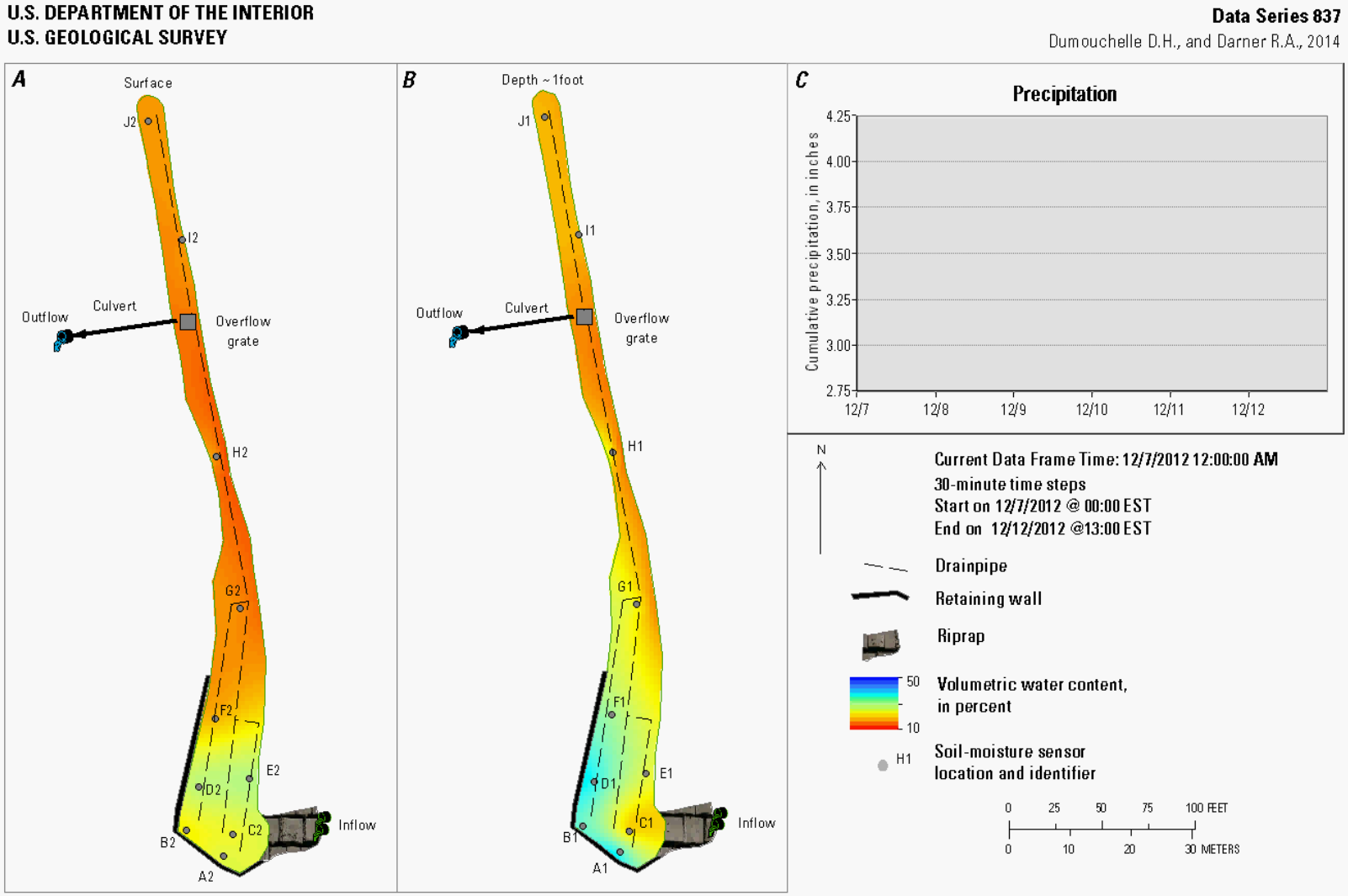
Griggs Reservoir Rain Garden

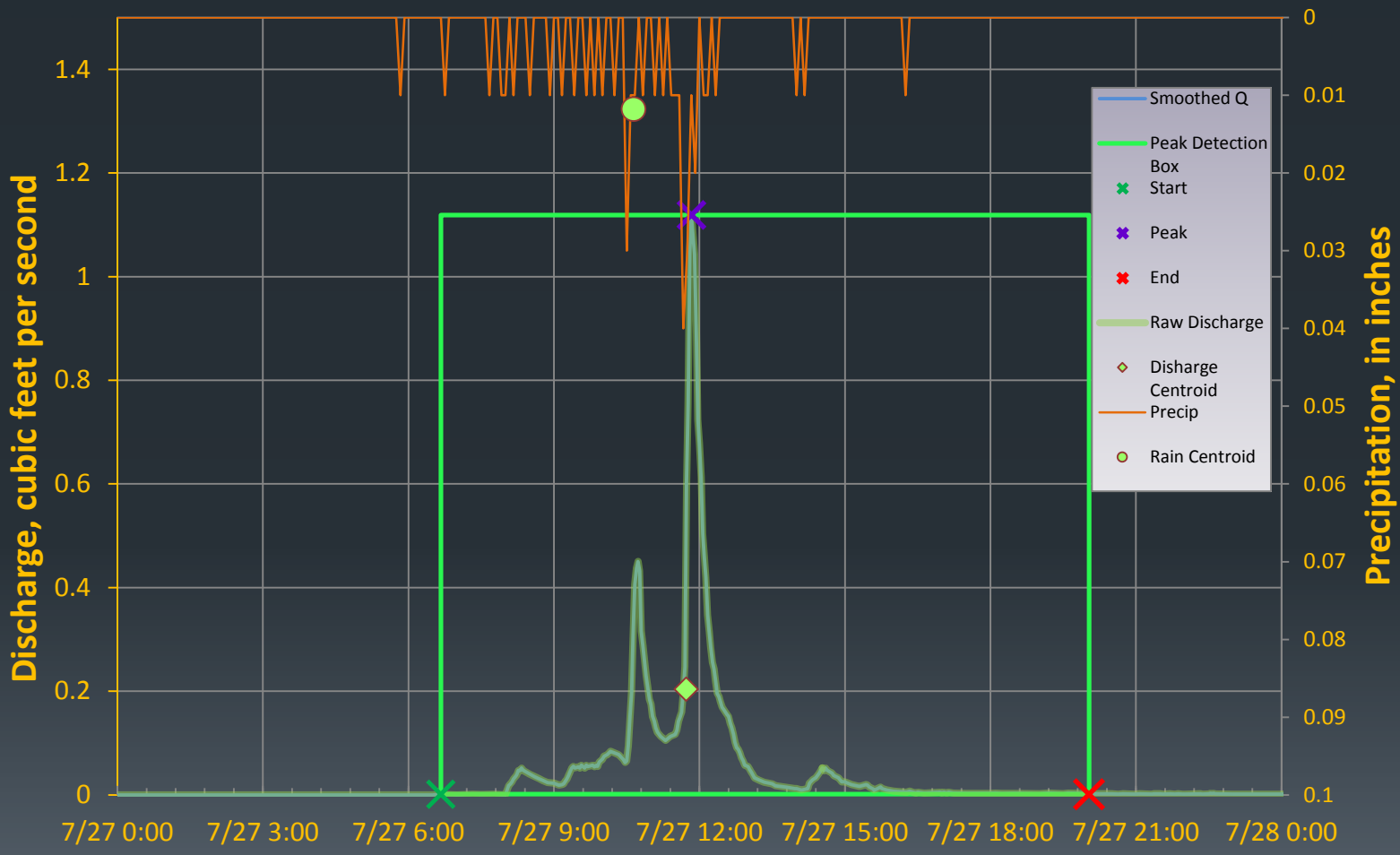
Columbus, OH

Griggs Reservoir Rain Garden



Visualization 2. Animation of changes in soil moisture in the rain garden at the Griggs Reservoir site, Columbus, Ohio, December 2012.

Griggs Reservoir Rain Garden



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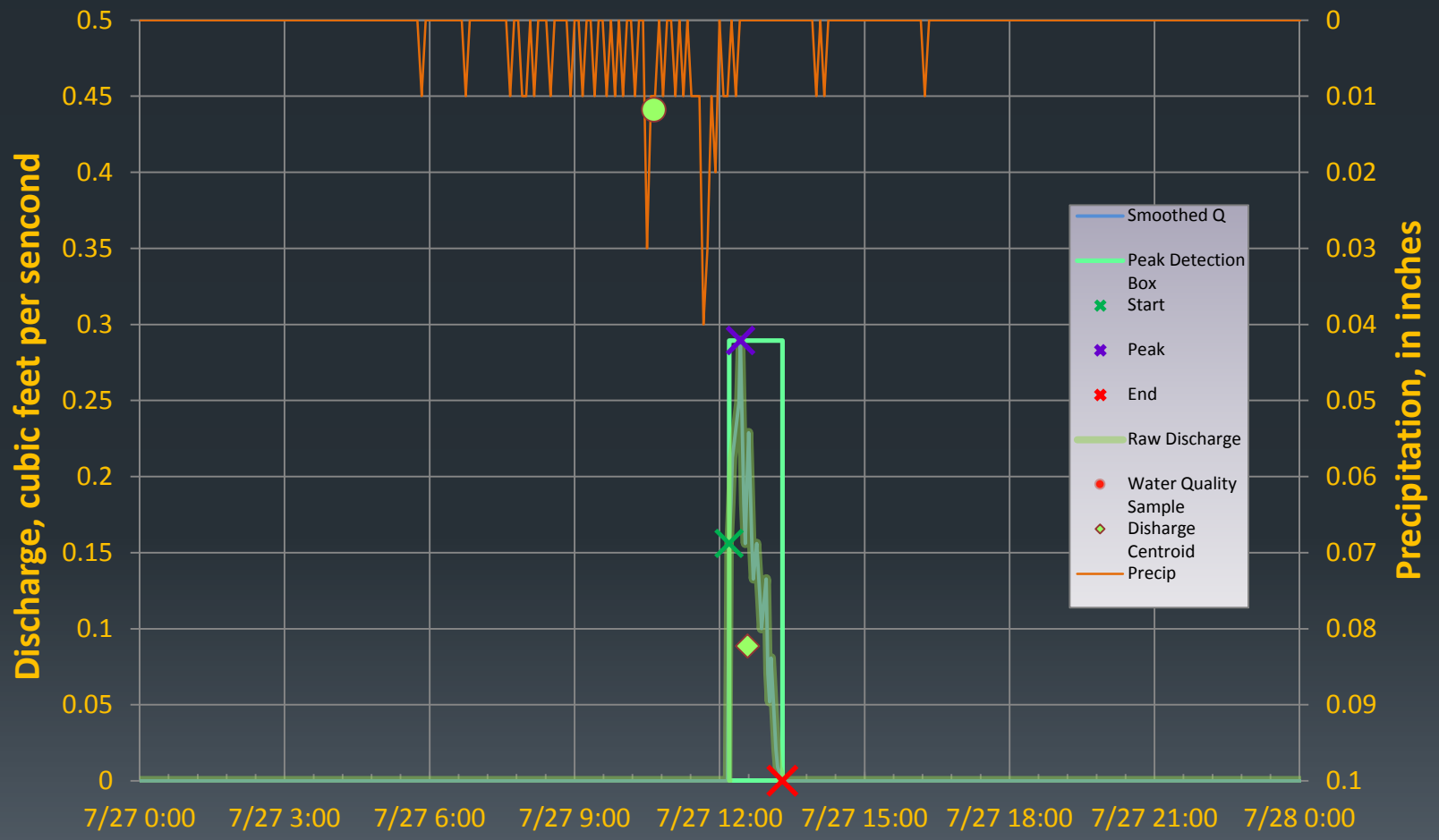
Flow IN

Griggs Reservoir Rain Garden



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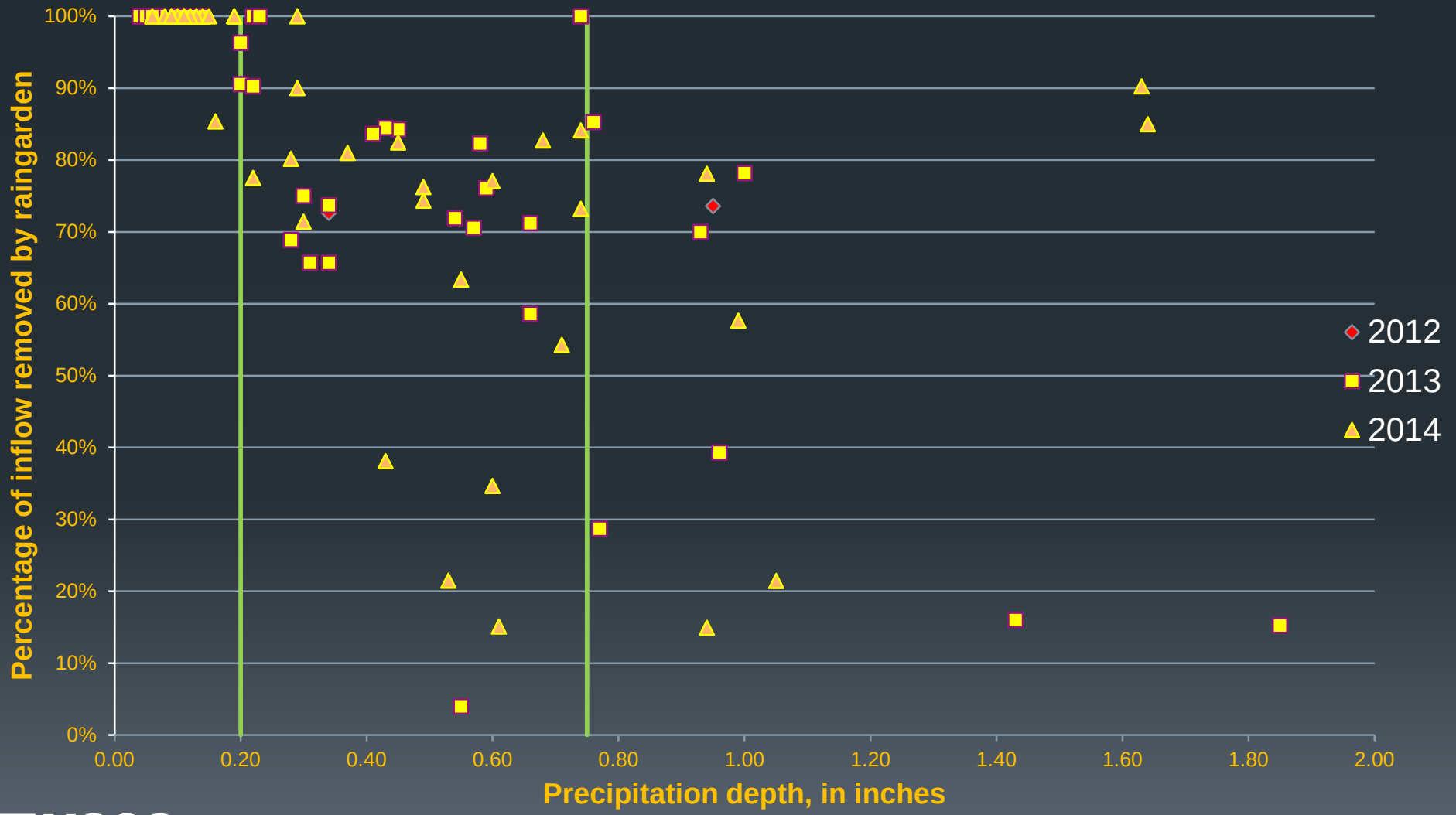
Flow OUT

Griggs Reservoir Rain Garden



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Data from non-freezing precipitation events

Griggs Reservoir Rain Garden

- Standpipes were added to the drains
- Should add more storage capacity in subsurface
- Monitoring will continue
- The USGS is assisting FSWCD in collecting representative water quality sample

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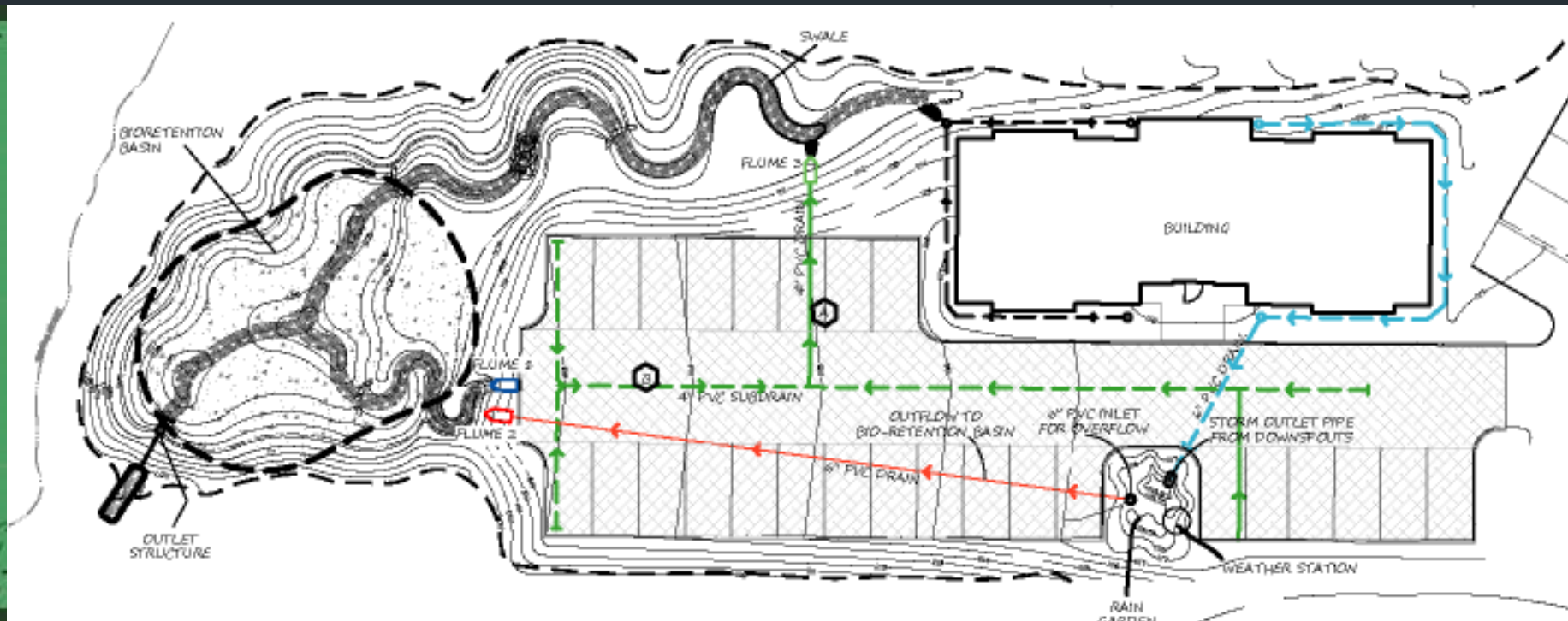
Cleveland, OH

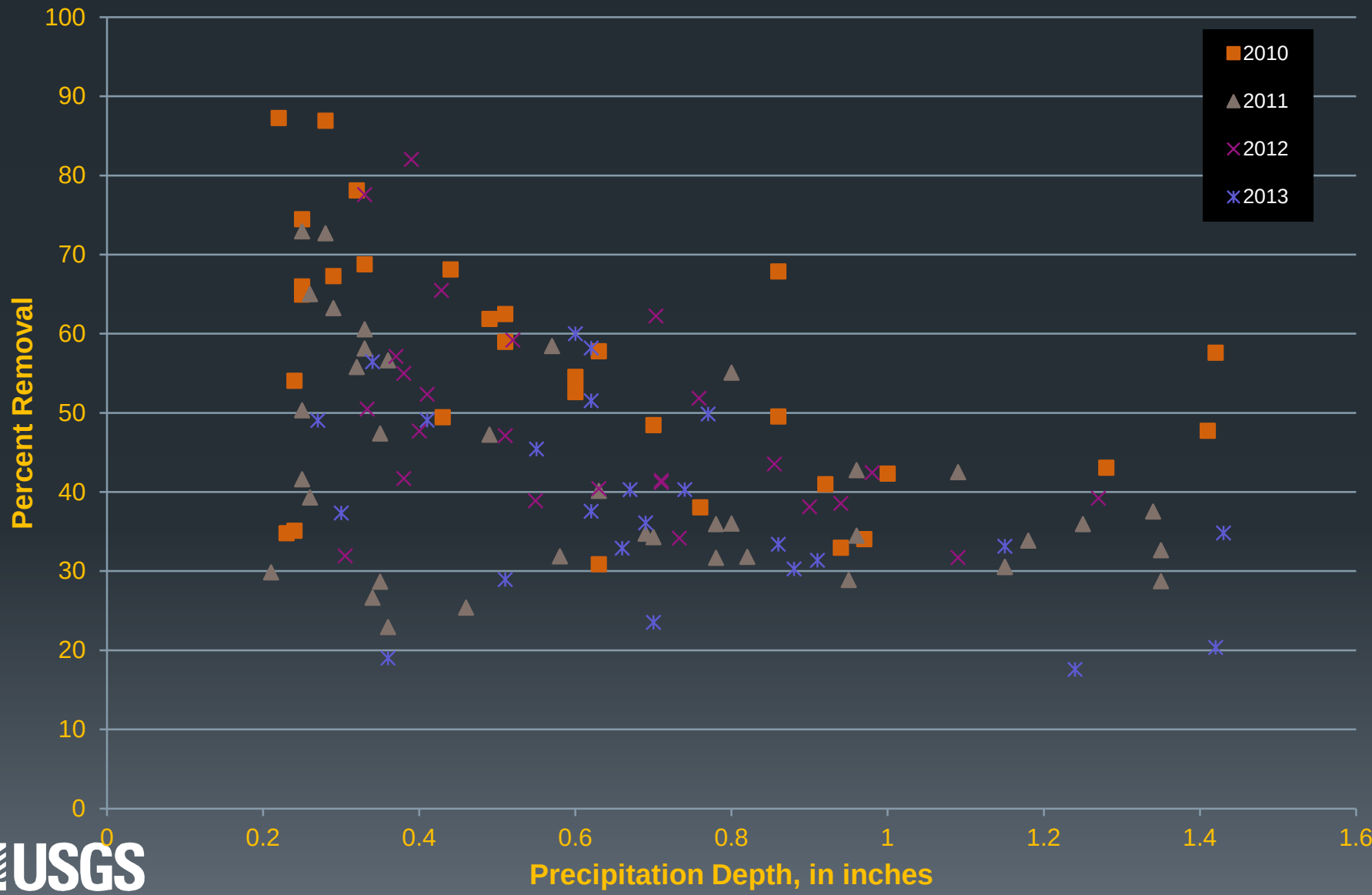
Cawrse and Assoc.

- Pervious pavers on parking lot with underdrains
- Roof runoff diverted to rain garden with overflow drain



Cawrse and Assoc.

Cleveland, OH



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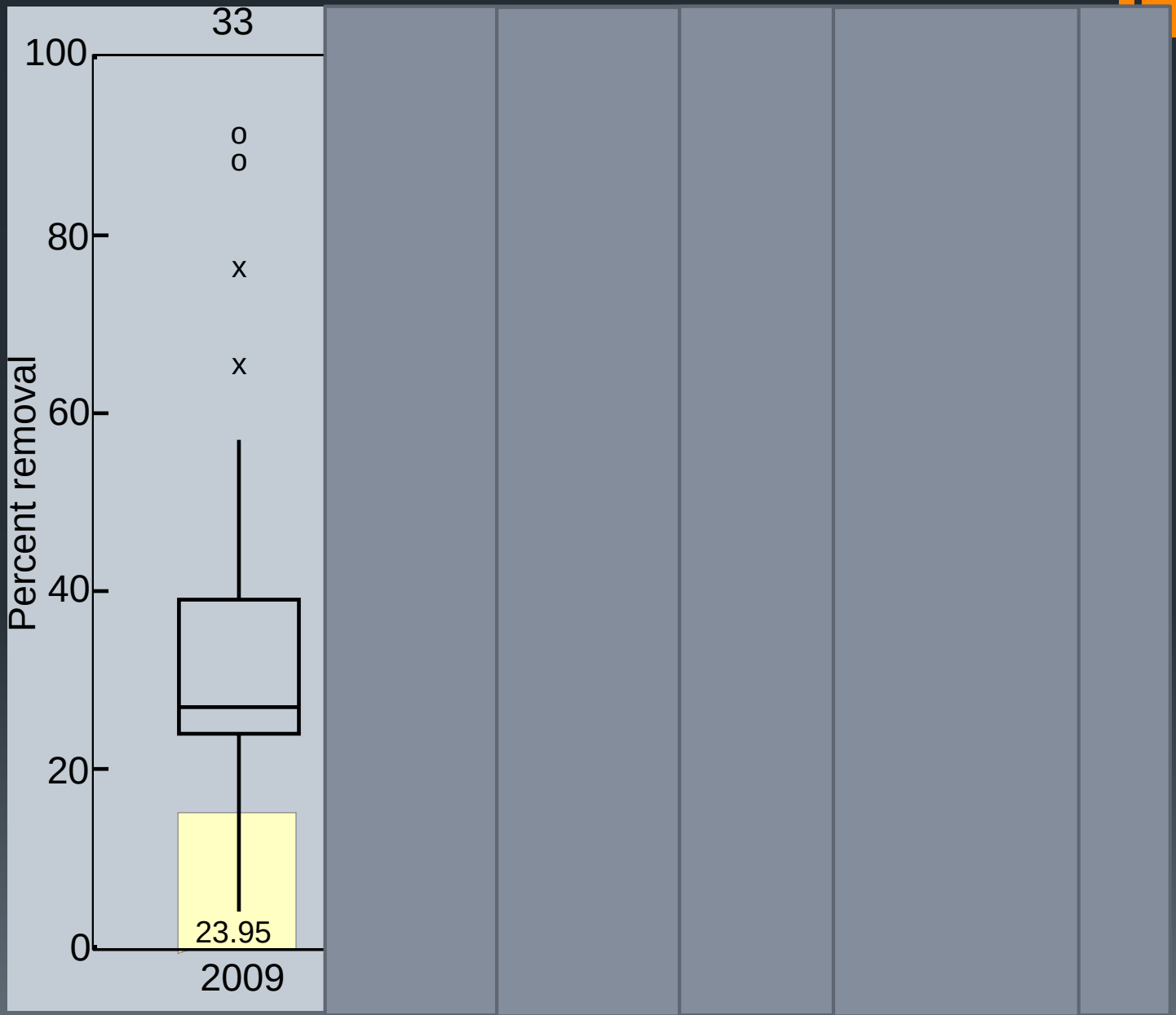
Cleveland, OH

Cawrse and Assoc.



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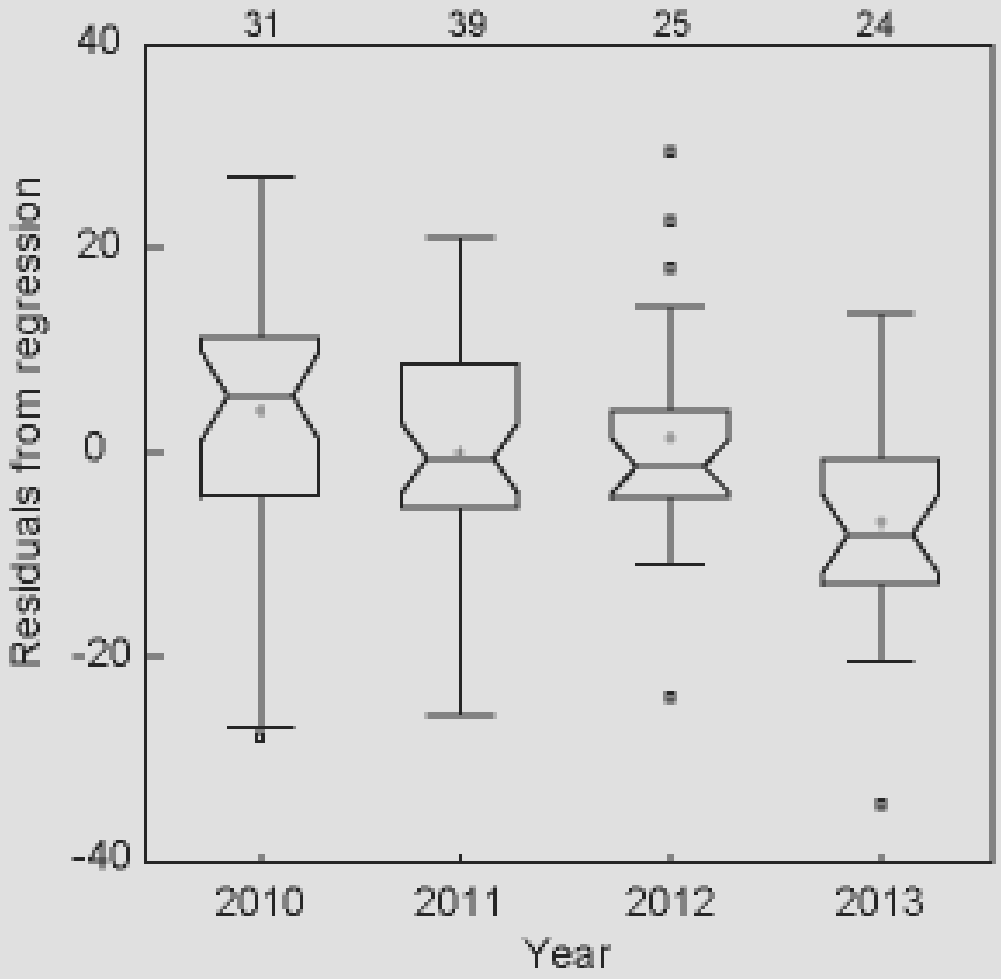
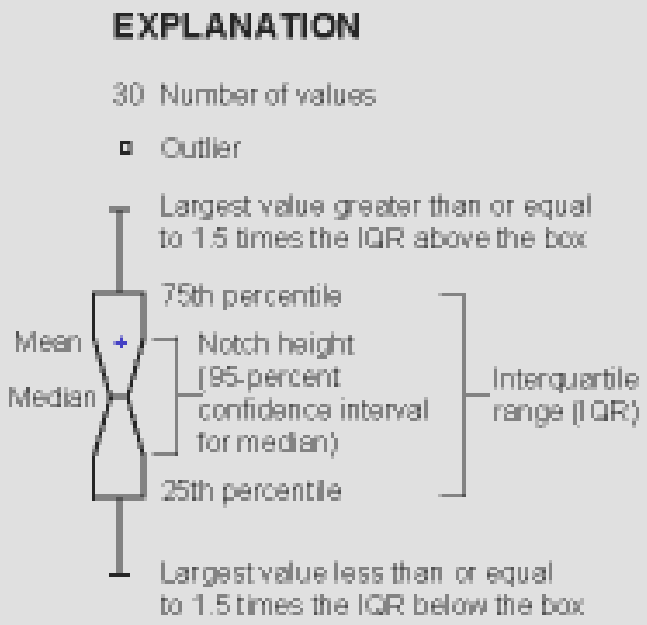
Cawrse and Assoc.

Cleveland, OH





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USGS SIR 2015-5030 Figure 9

St. Francis

Cincinnati, OH

- Stepped RG with an area of ~6,000 ft^2
- Receives water from parking lot and about 2.2 acres
- 1 ft. of gravel covered by 2 ft. of engineered soil
- Subsurface drains connected to an overflow

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Map data ©2012 Google, USDA Farm Service Agency
State Plane projection (feet), Ohio South

EXPLANATION

Culverts

N

0 20 40 60 80 FEET

0 5 10 15 20 METERS

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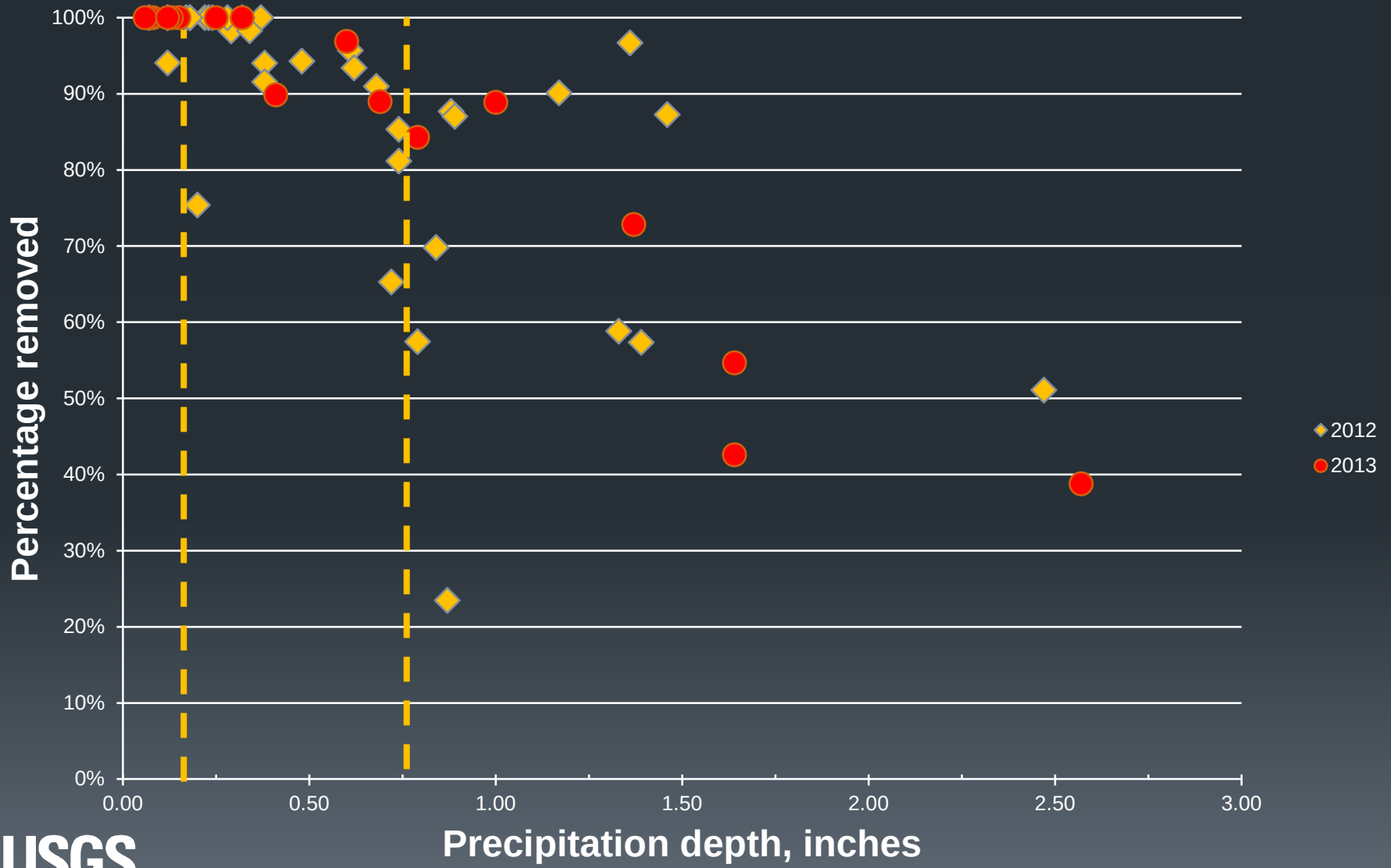
St. Francis

Upper Rain Garden



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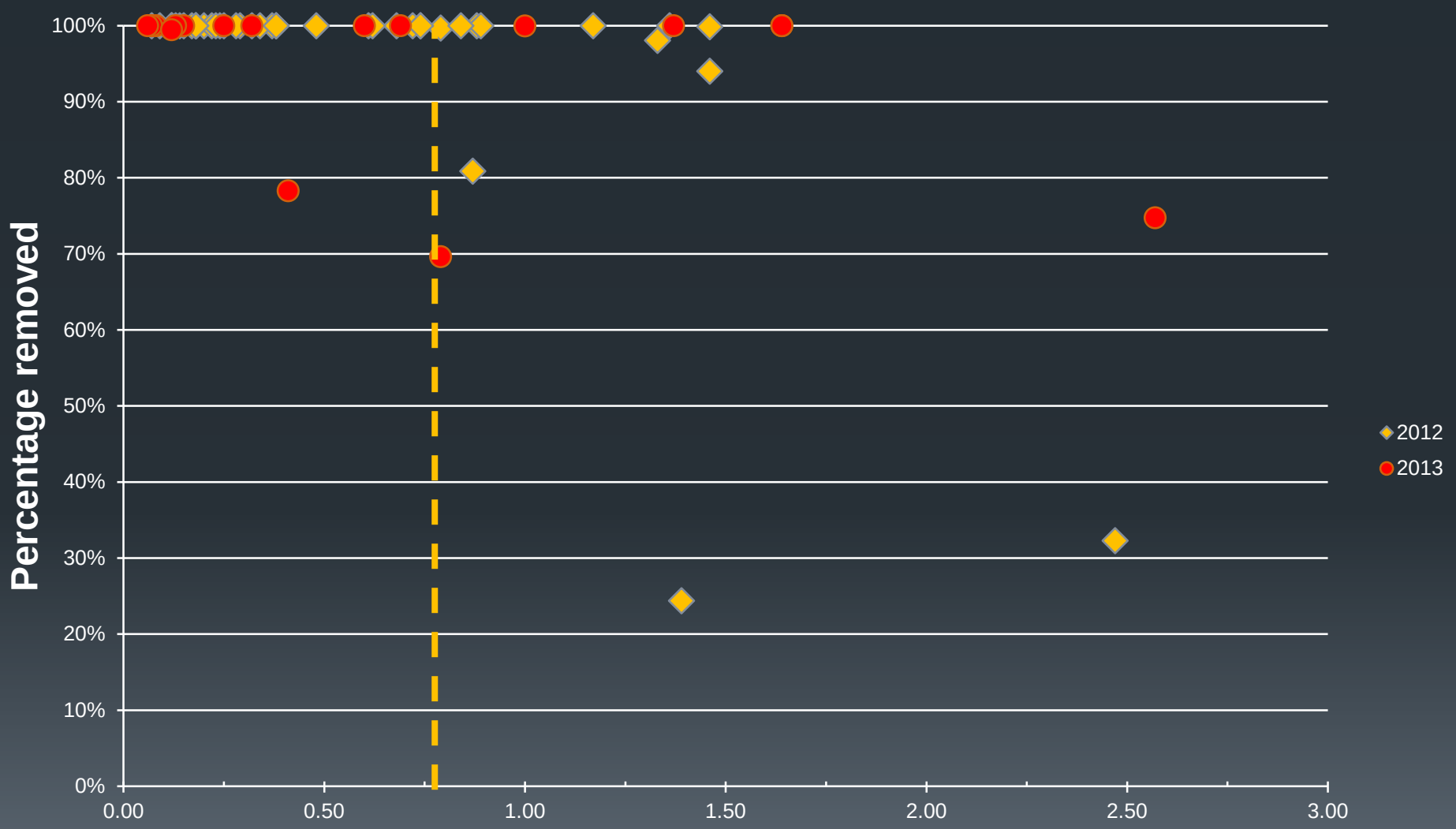
St. Francis Lower Rain Garden



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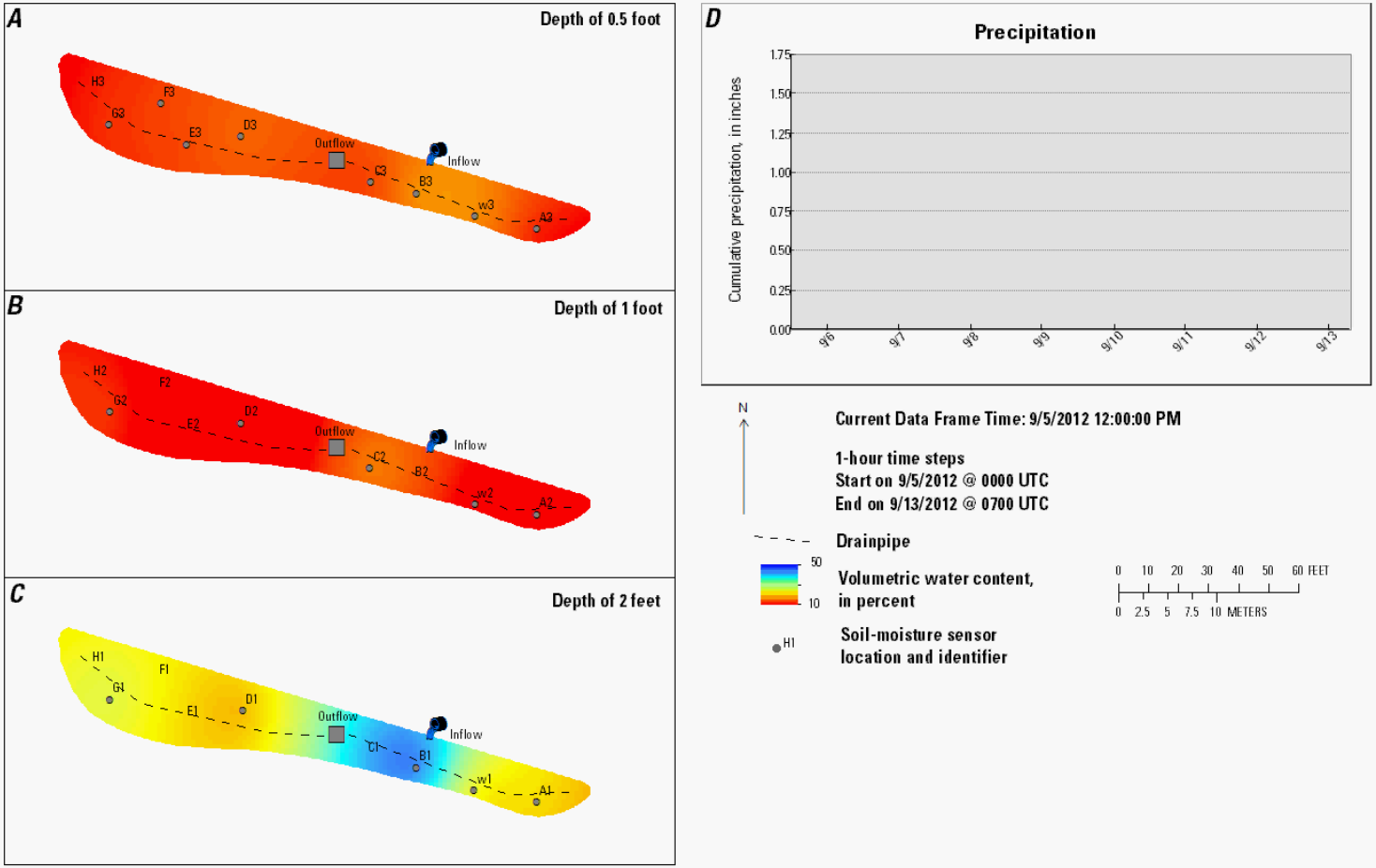
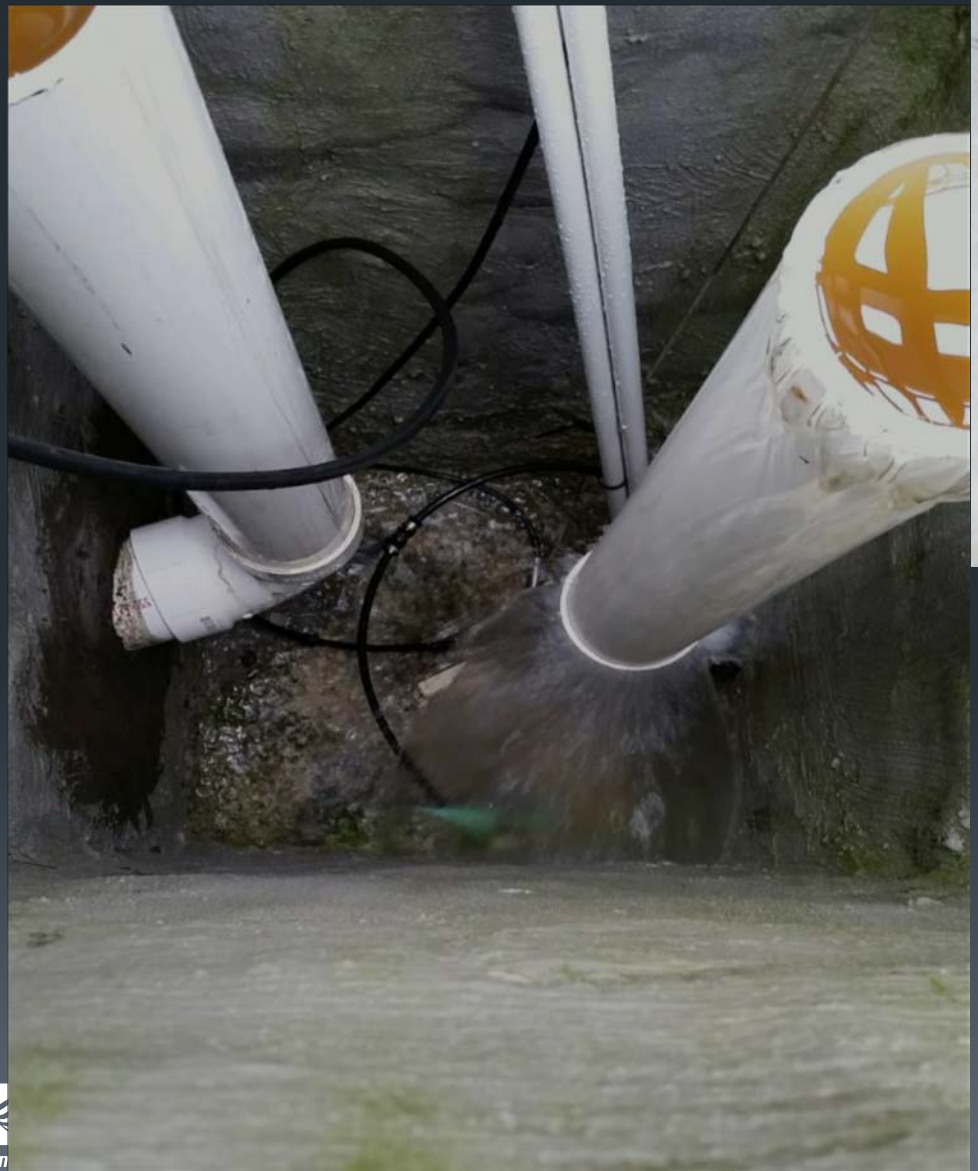
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Data Series 837
Dumouchelle D.H., and Darner R.A., 2014



Visualization 1. Animation of changes in soil moisture at three depths in the rain garden at the St. Francis site, Cincinnati, Ohio, September 2012.



Cleveland, OH

Slavic Village

- Urban renewal project
- Influence of SCMs on water table
  - 5 regional wells
- Influence of SCMs on localized groundwater
  - 15 local wells
- Each well instrumented with water level sensor (and temperature)
- Two wells with specific conductance sensor (roadsalt)

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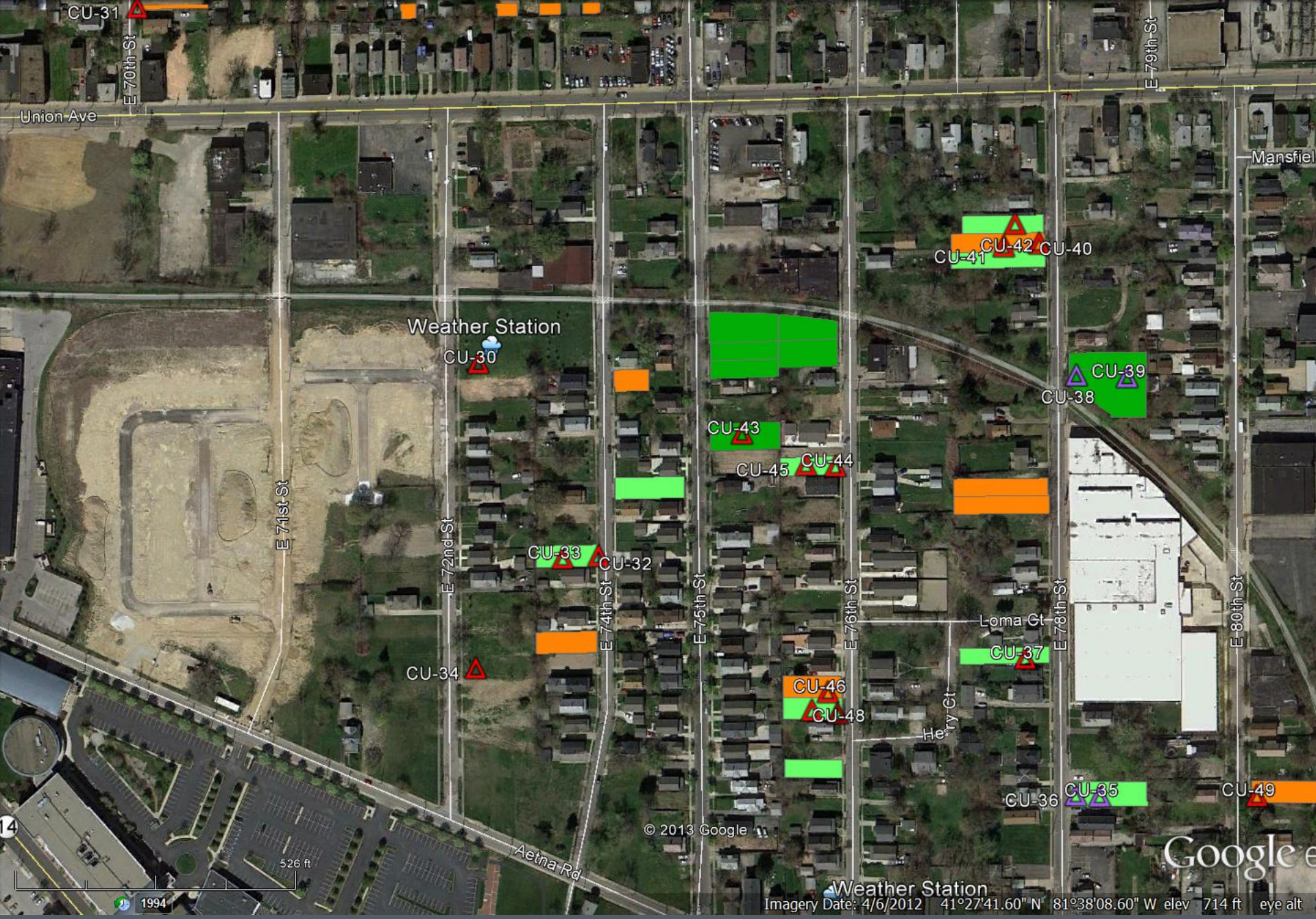
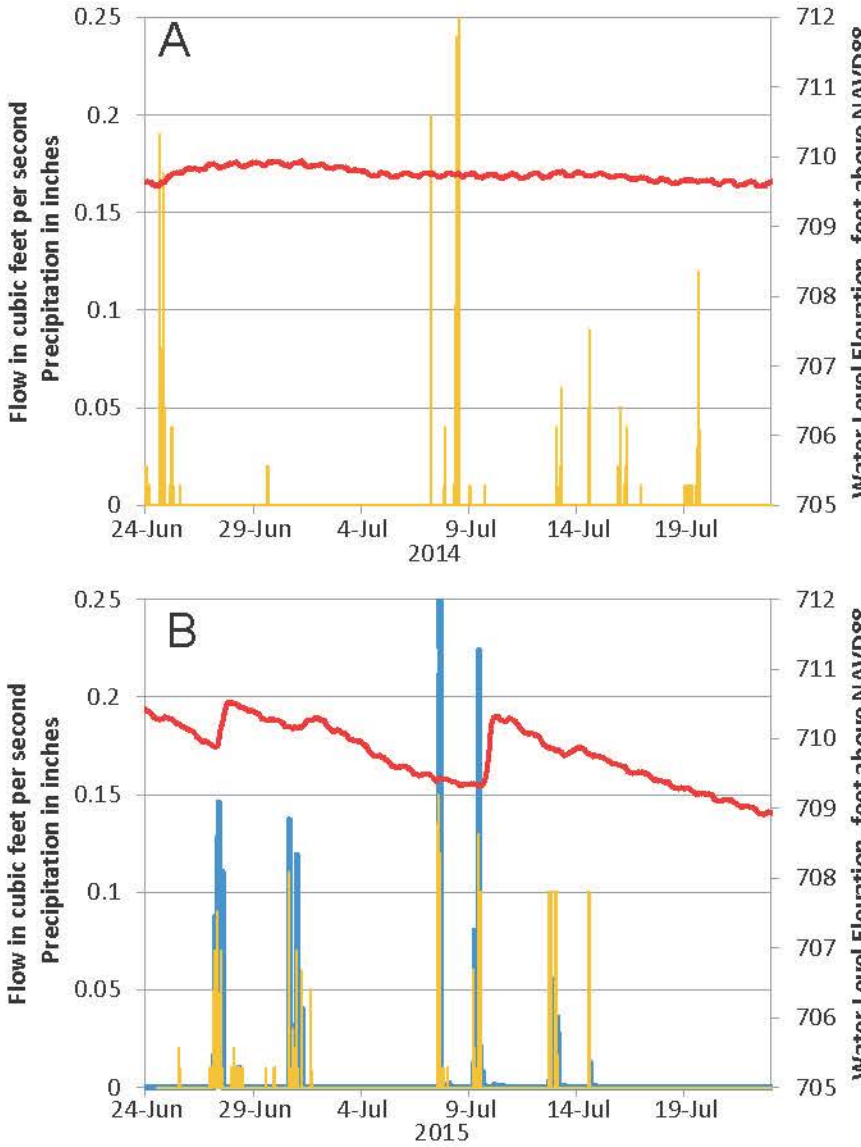
Cleveland, OH

Slavic Village

- Additional instrumentation
- Two raingardens instrumented to monitor flow and peak depth and duration of ponding.
- Two weather stations
- Topographic survey of area to better define drainage areas.
- Plans to instrument additional rain gardens as brought online

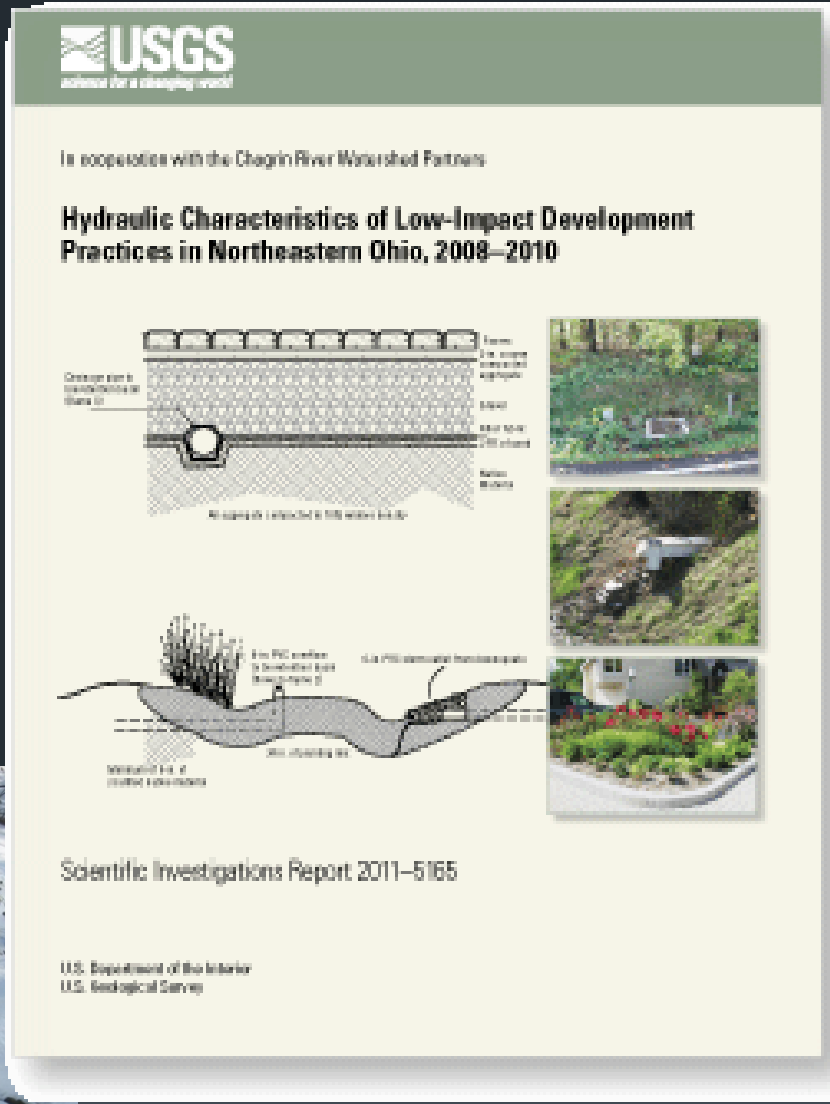




Site map, precipitation, flume flow, and water level at 75-South site, Cleveland, Ohio. Chart A is June 24 - July 23, 2014 before installation of the rain garden; Chart B is June 24 - July 23, 2015 after installation of the rain garden.

Reports

- USGS SIR 2011-5165
- USGS SIR 2015-5030
- USGS DS 837
  - Soil moisture animations



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