Monitoring Storm Water Volume Reduction in a Permeable Surficial Aquifer System, Gary, Indiana

Dave Lampe and E. Randall Bayless, U.S. Geological Survey Ohio-Kentucky-Indiana Water Science Center

Partnering with the Gary Sanitary District and Funded through the Great Lakes Restoration Initiative

U.S. Department of the Interior
U.S. Geological Survey

Stormwater reduction monitoring

- Great Lakes Restoration Initiative (GLRI) Focus Area 5, Adaptive Management
  - Stormwater Reduction Assessments
- Projects assessing Stormwater reduction in three cities in the Great Lakes Basin
- Project will measure direct volume reduction through monitoring before and after installation
- Results will be compared to modeled estimates currently used to estimate benefit

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PROVISIONAL DATA

This information is preliminary and is subject to revision. It is being provided to meet the need for timely best science. The information is provided on the condition that neither the U.S. Geological Survey nor the U.S. Government may be held liable for any damages resulting from the authorized or unauthorized use of the information.

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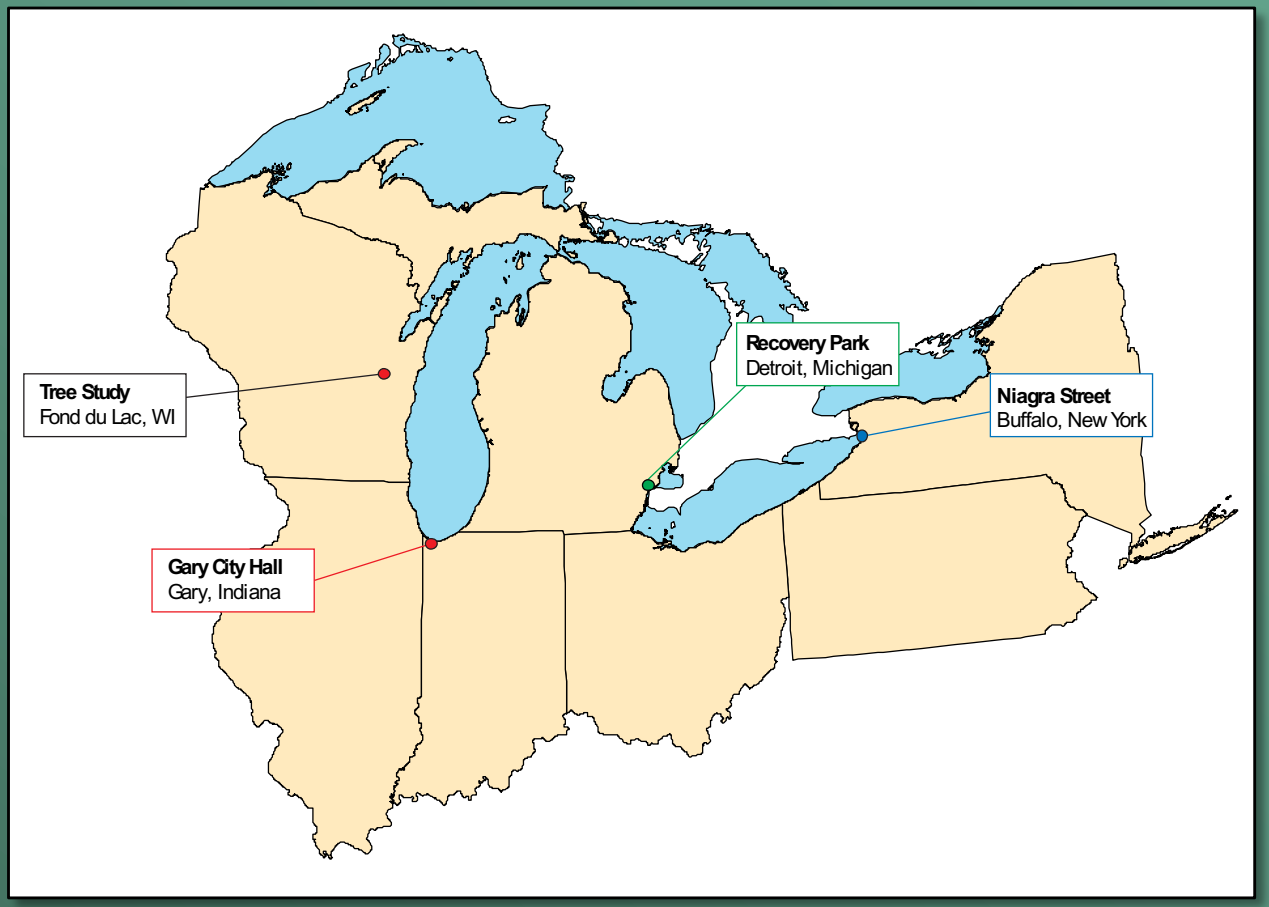
Current Sites

- Great Lakes Restoration Initiative (GLRI) Focus Area 3: Nonpoint Source Pollution: Impacts on Nearshore Health – Storm Water Volume Reduction Assessments
- Four sites currently monitored
- Projects have been assessing volume reductions in Storm Water thus far. Water Quality assessments will be added this fall.



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Challenges

- Need to monitor all compartments of the water budget.
  - Working with local partners early in the process is key.
- Storm data is most important. Measurement frequency must capture as much as possible.
- Use of the newest technology.
- Maintenance and quality assurance.

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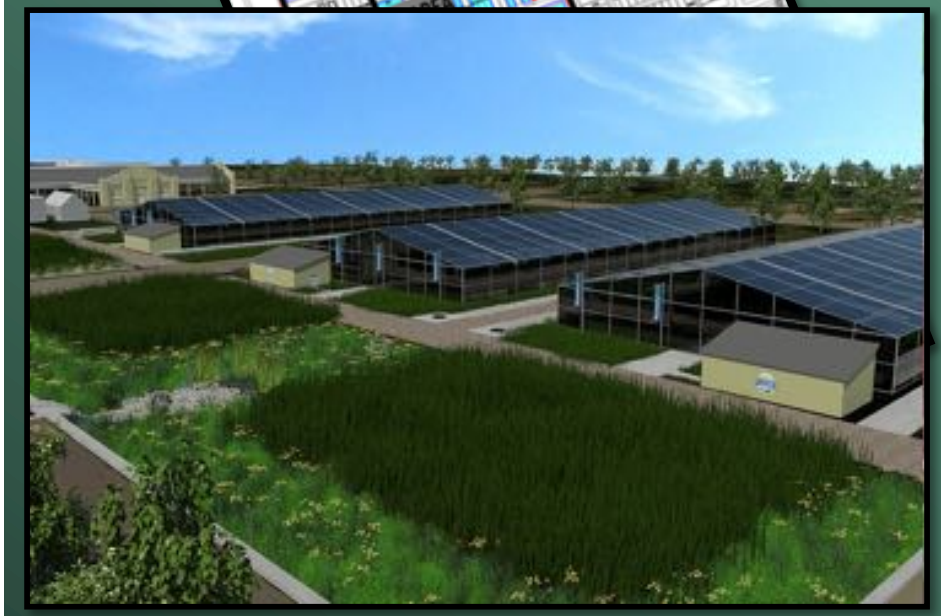
Recovery Park – Detroit, MI

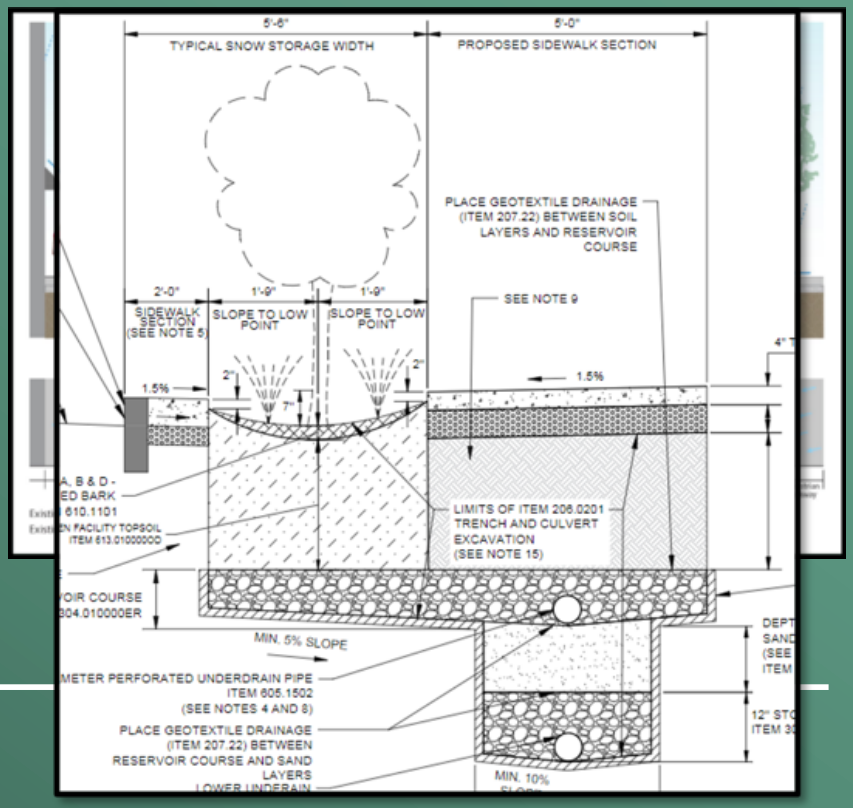


- 32 acres of abandoned urban area are being incorporated into an urban farm known as “RecoveryPark”
- Project design will feature green infrastructure
- Objectives of RecoveryPark include:
  - Generate beneficial land use
  - Revitalize the neighborhood
  - Create job opportunities (estimate to be 18 people/acre)
  - Reduce and (or) eliminate CSOs
  - USGS study objectives:
    - Document stormwater volume reduction by quantifying different aspects of the urban water cycle before and after implementation of green infrastructure

Graphic obtained from RecoveryPark Web site at https://www.recoverypark.org/media-kit

Niagara River Greenway – Buffalo, NY

- Revitalizing Niagara Street corridor
- Installing and monitoring effects of stormwater planters and sand filters on peak flows.
- USGS monitoring:
  - Flow into planters
  - Total flow in storm sewer
  - GW response



Tree study - Fond du Lac, WI

- Measuring impact of trees on stormwater reduction
- Monitoring before and after removal of Ash Trees prior to impacts of EAB
- USGS monitoring:
  - Storm sewer flow
  - GW response
  - Water level in adjacent swales
- Partnering with UW and US Forest Service
  - Monitoring sap flow, sway and precipitation fall through

Gary City Hall

- Built in 1927
- Neighboring Sheraton Hotel demolished in 2014
- Plans for park / market / event space

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Gary City Hall

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Gary City Hall – Google Street View

USGS

Source Google Maps


HUDSON-CAMPBELL
SPORTS & FITNESS CENTER

City Hall Monitoring Before Construction

- Weather Station, four monitoring wells and 12 soil moisture probes installed in May 2016
  - Two monitoring wells on city hall property
  - One monitoring well at two background sites
- Flow from three existing parking lot drains monitored from May-August 2016
- Measured conditions will be compared to runoff predicted from design model results

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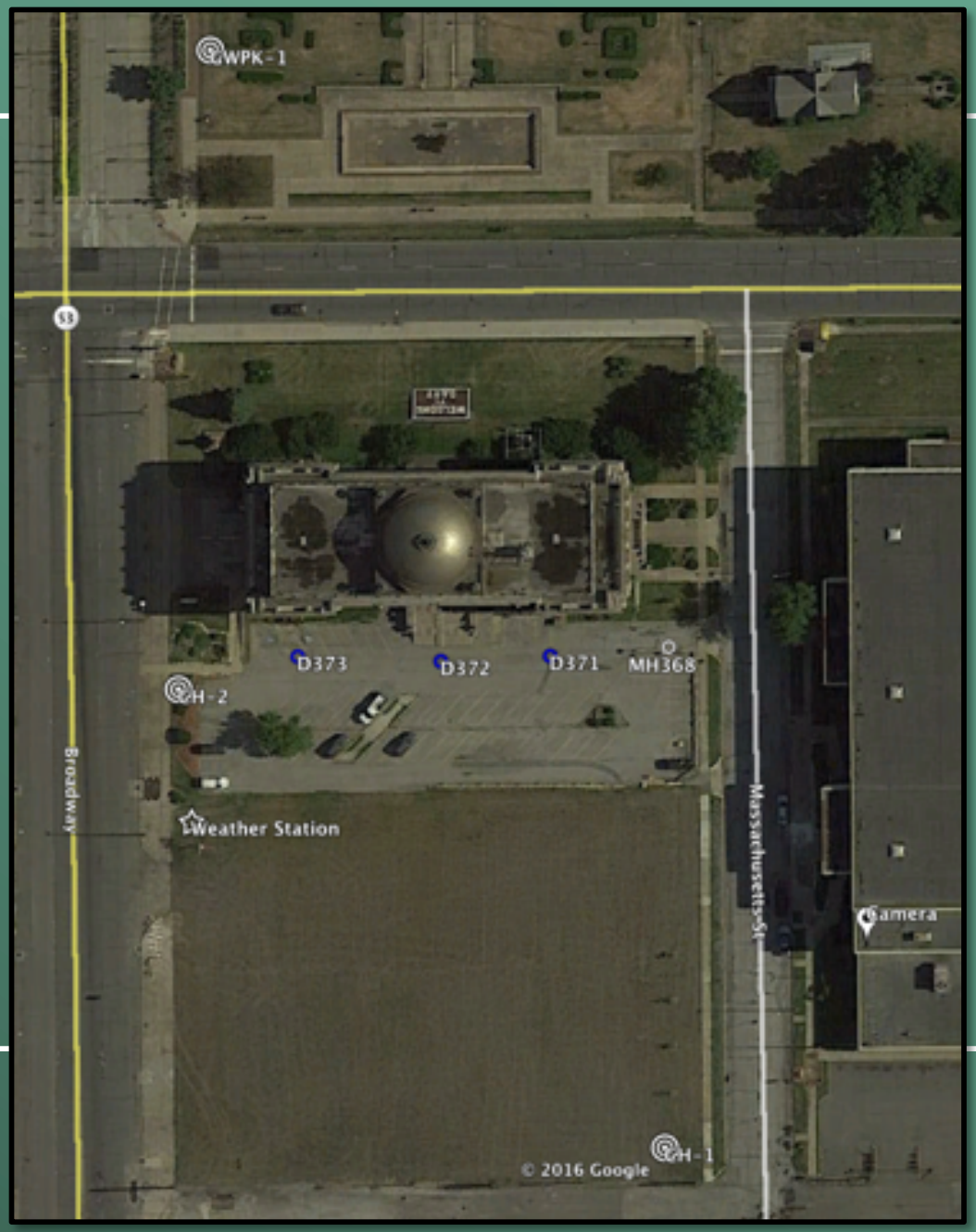
City Hall Monitoring Before Construction



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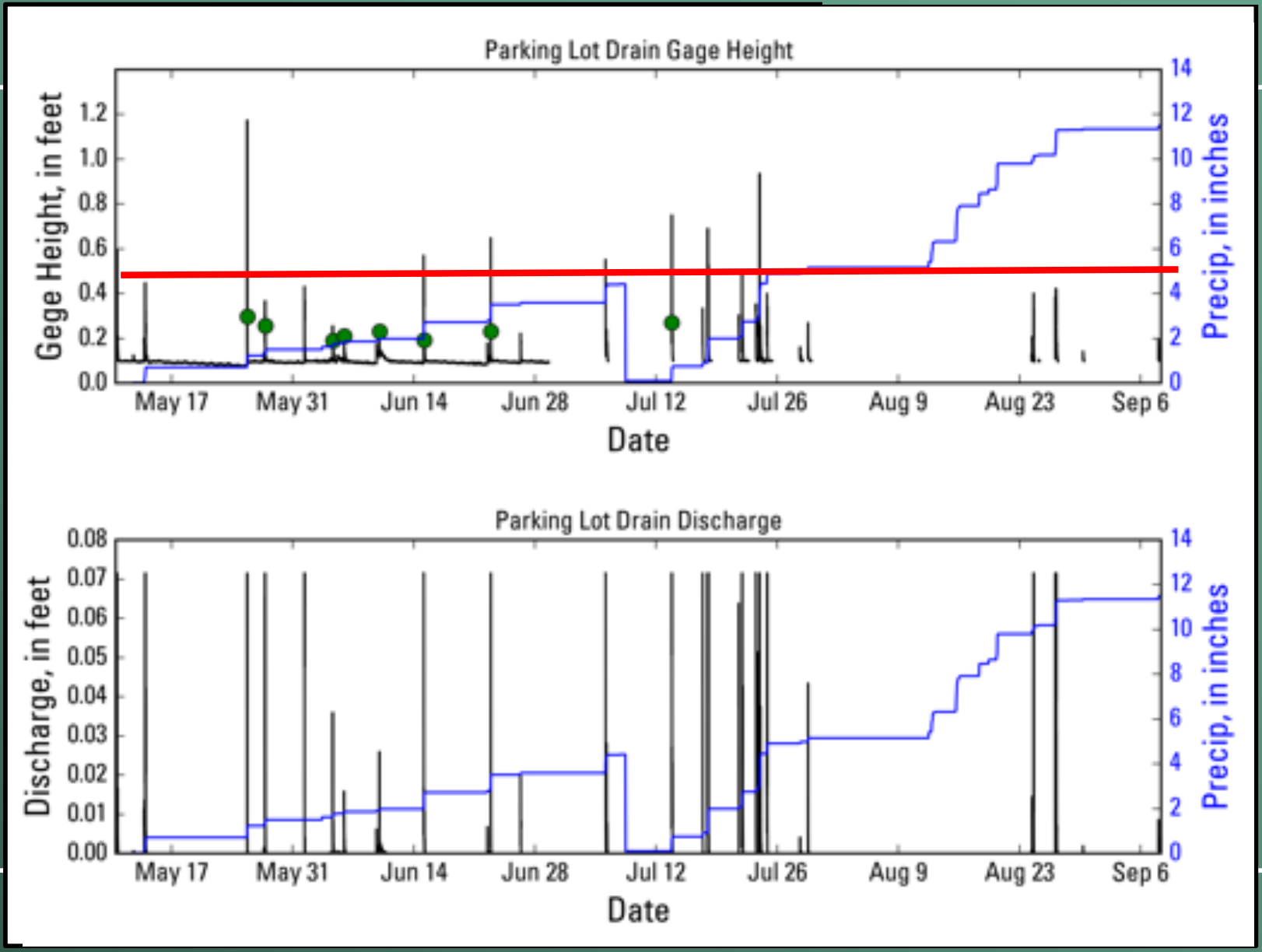
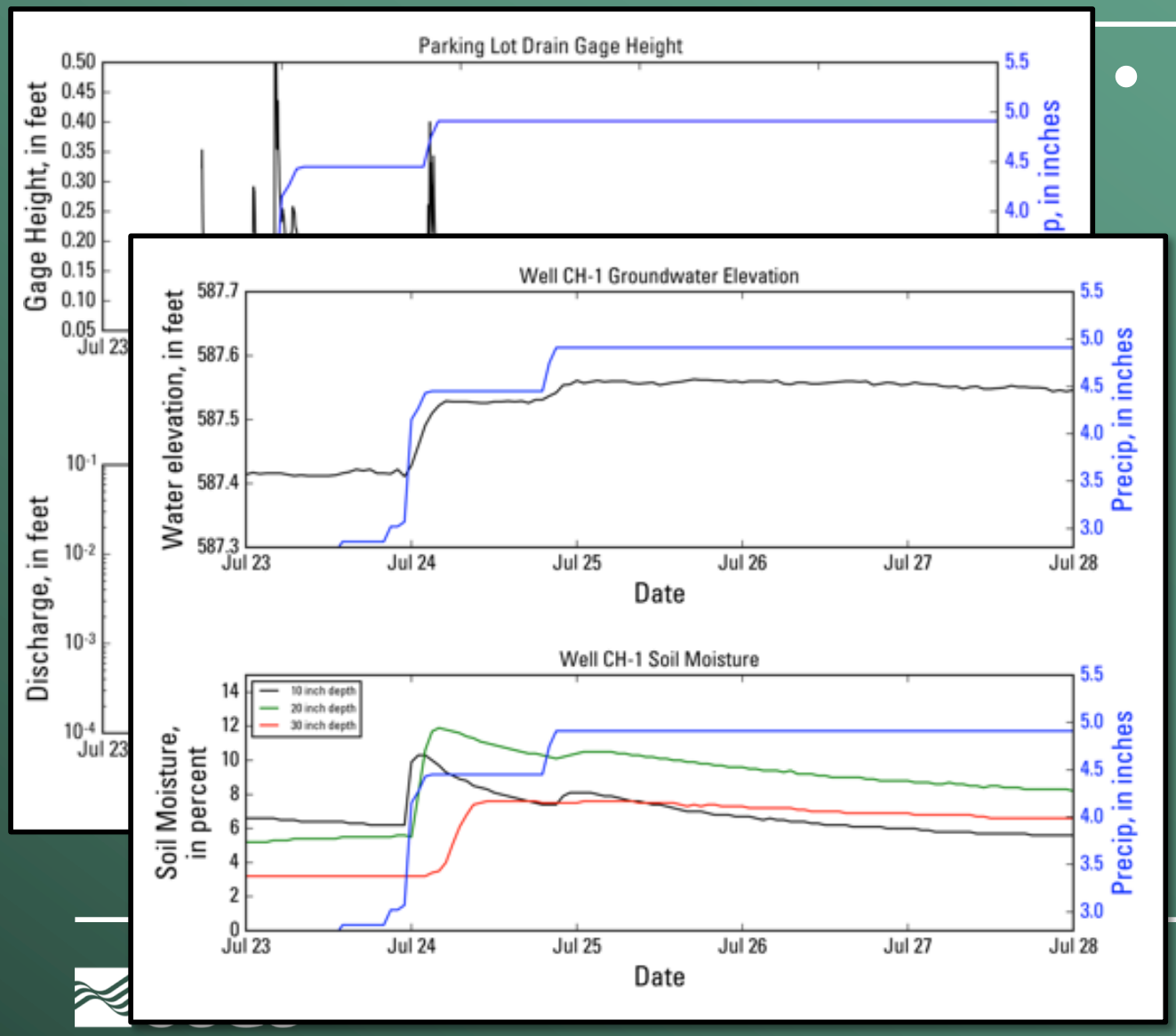
Drain Monitoring

Drain monitoring

PROVISIONAL DATA



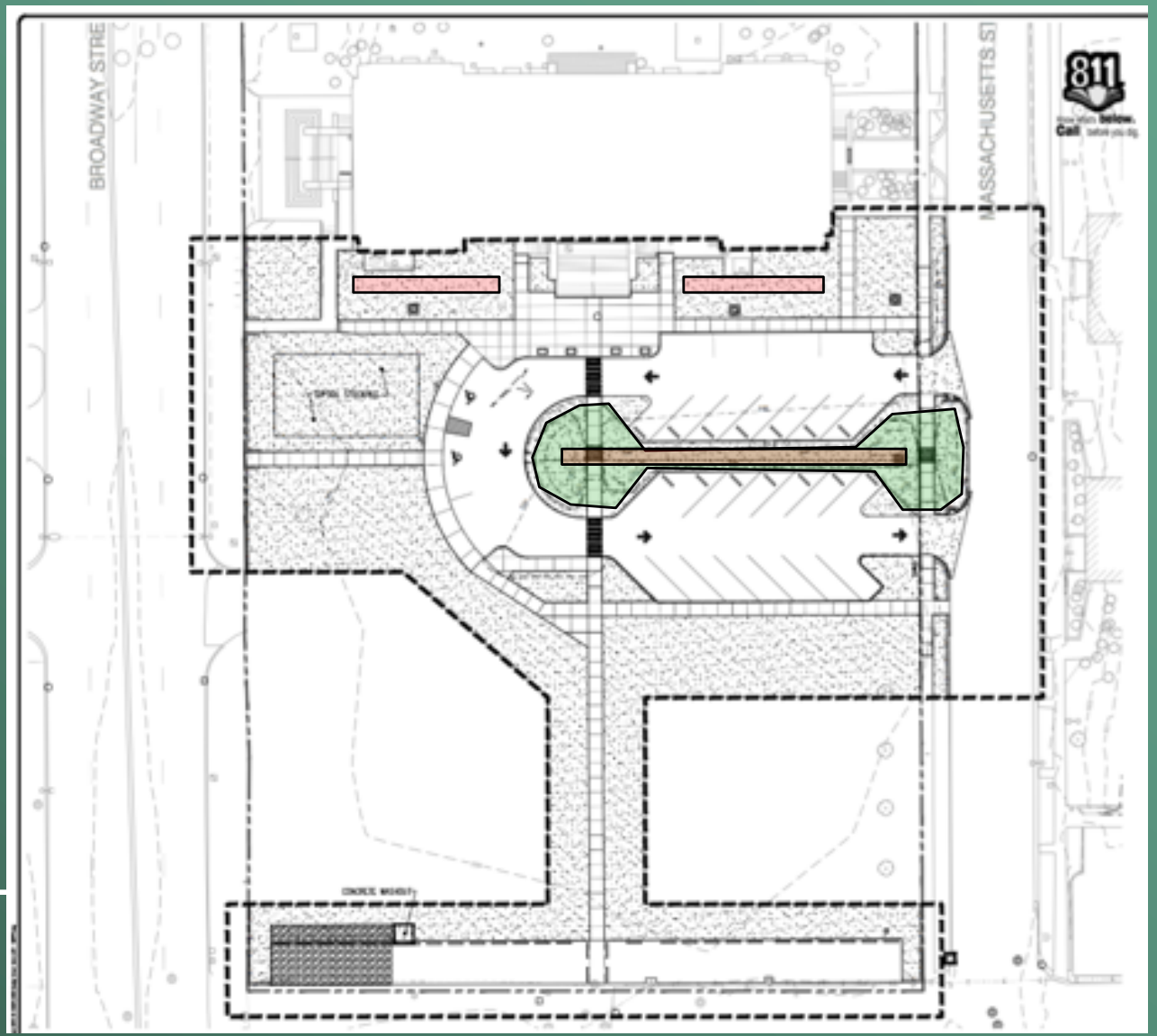
Groundwater monitoring – single storm



- 2 inches over 2 days
- **Groundwater response**

Site Construction

- ~4,000 ft^2 rain garden
- Sub-grade storage basins –disconnected from sewer
  - Below rain garden
  - Below grassy areas near City Hall



Base credit: Brenda Scott-Henry, written commun., 2017

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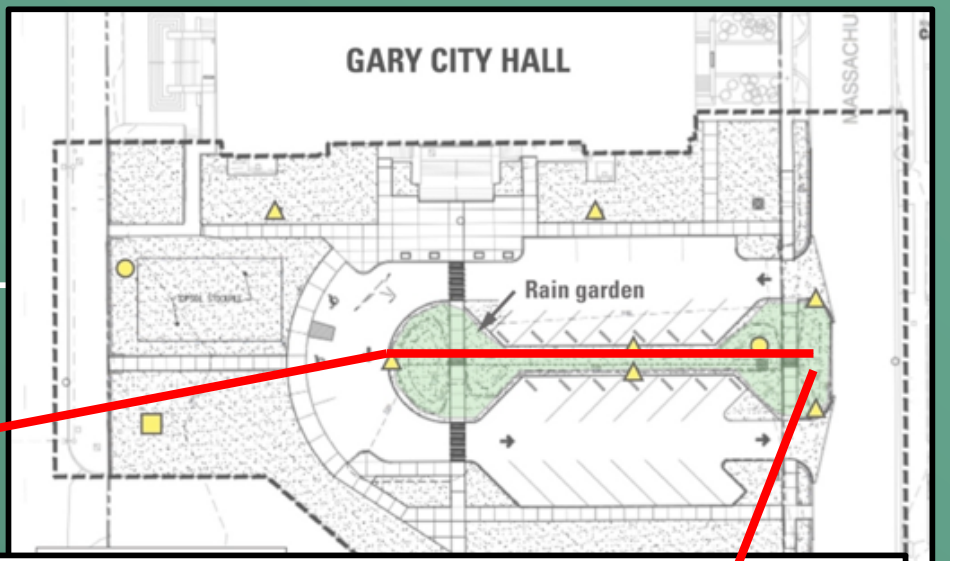
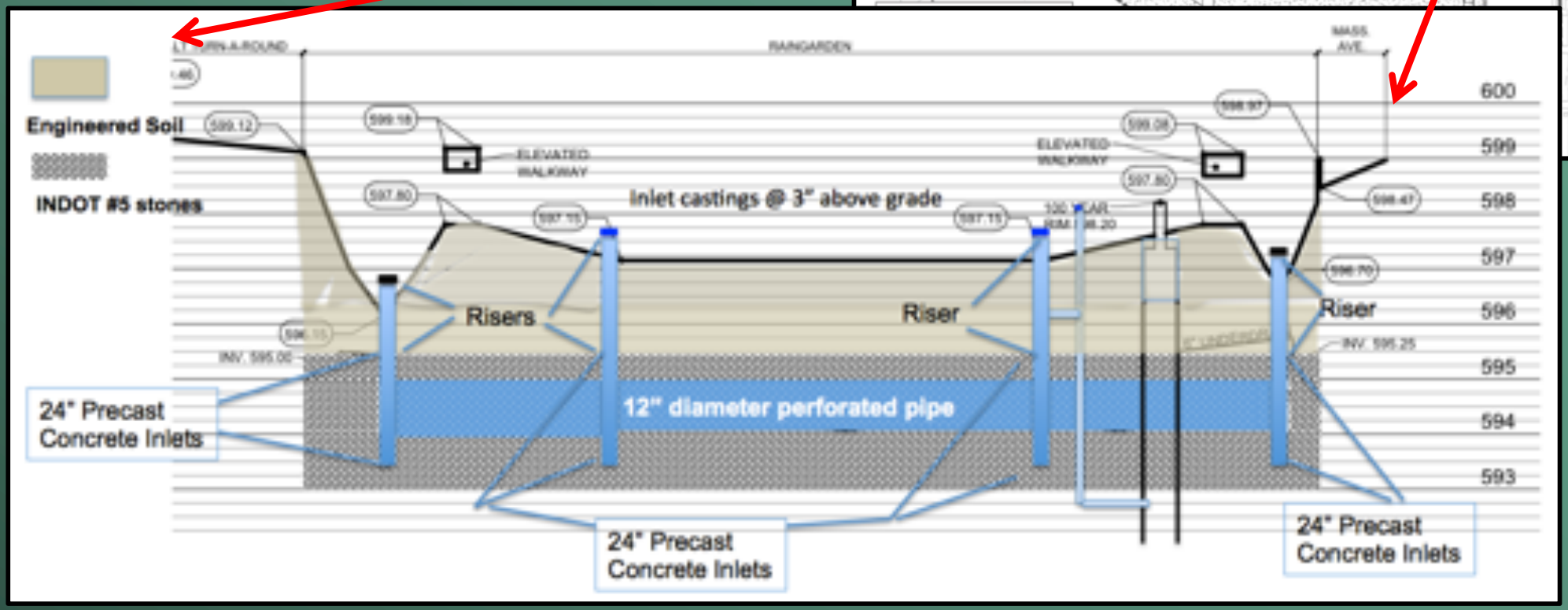
Subdrainage

Schematic of plan view and cross-sectional profile of proposed rain garden to replace a section of impervious parking lot





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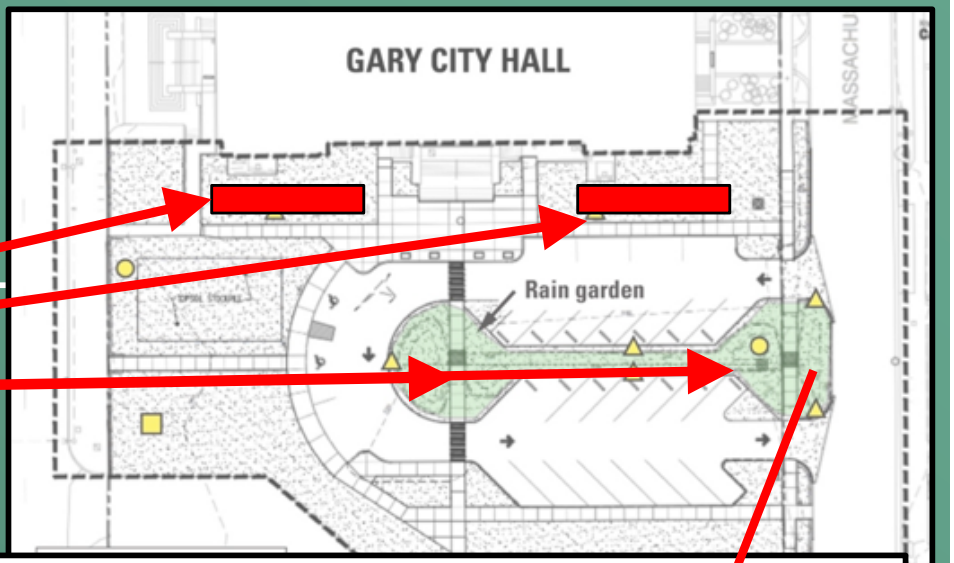

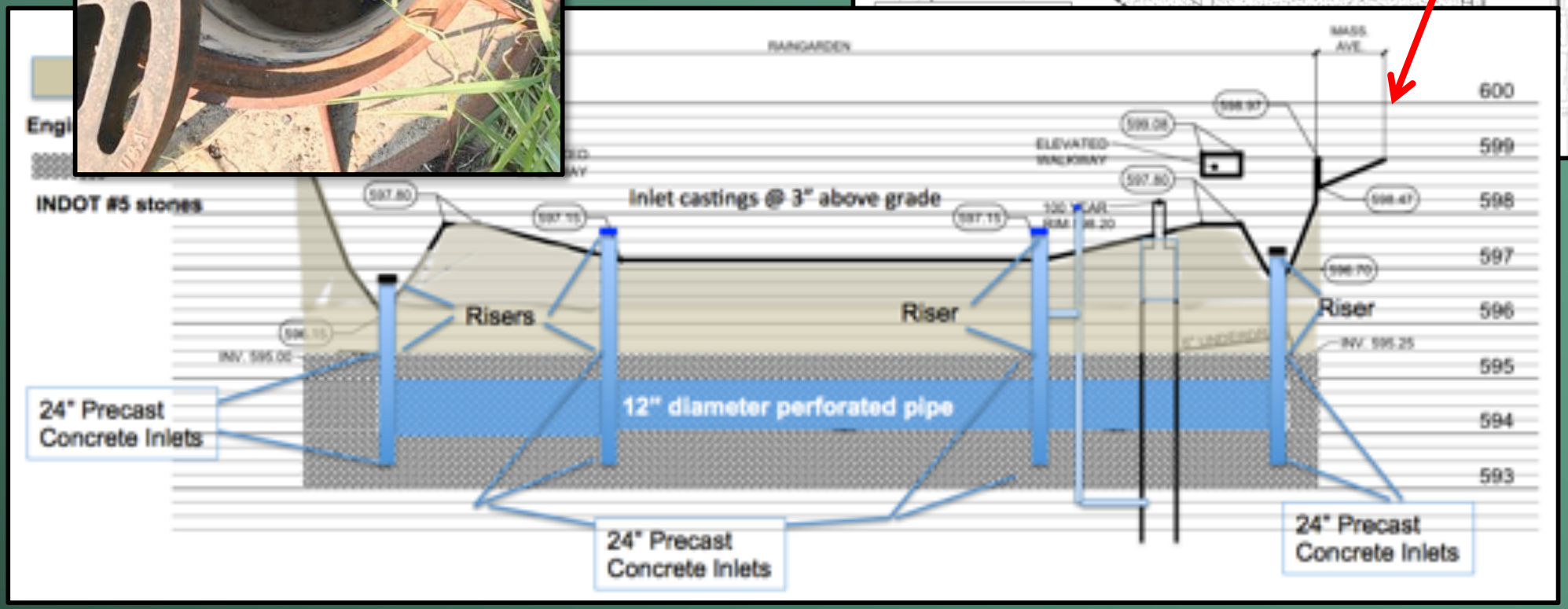

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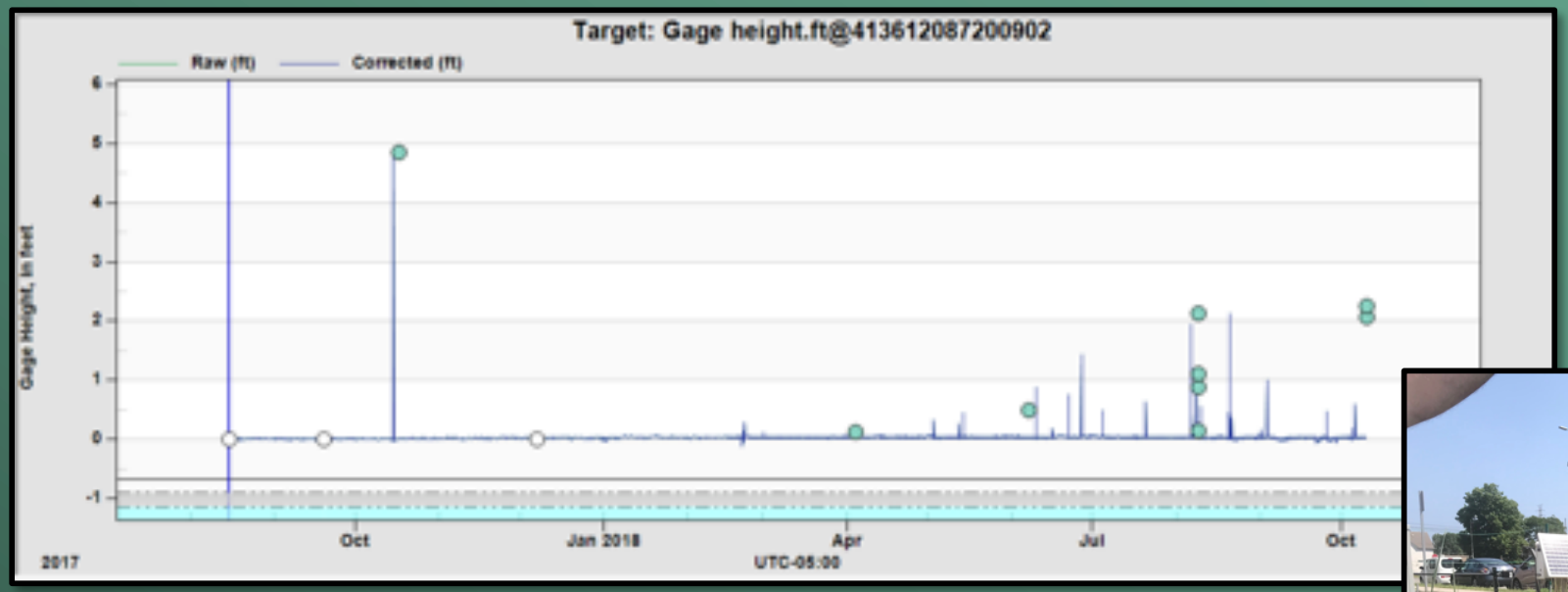
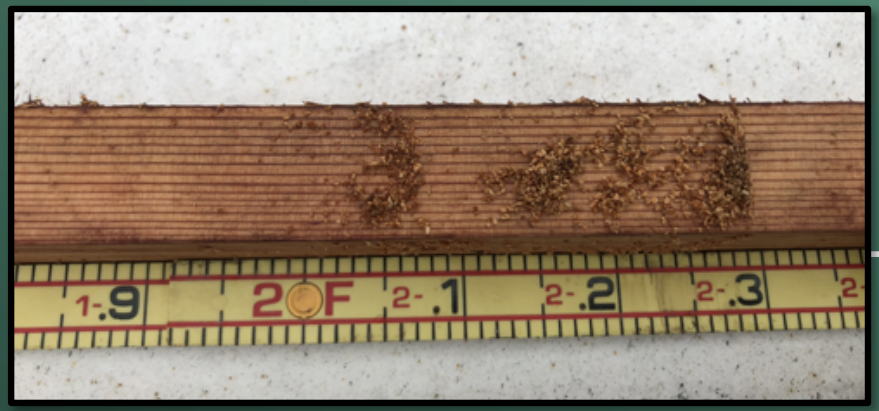
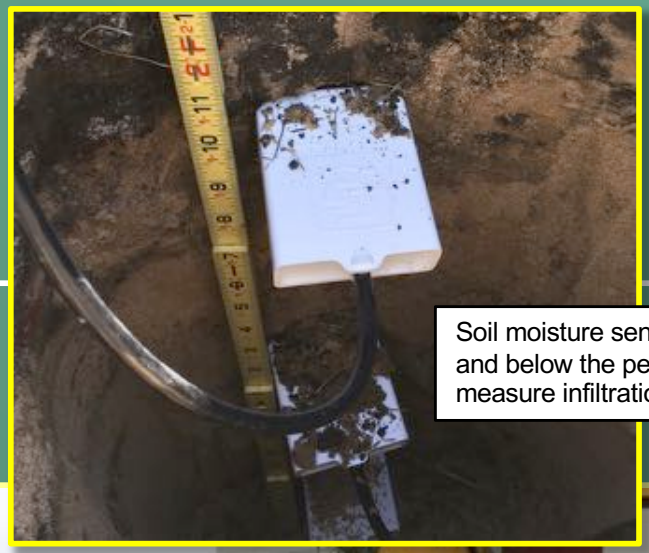
Sub Drainage CSGs

PROVISIONAL DATA





Installing perforated drain at base of rain garden



Soil moisture sensors were installed above and below the perforated drain in order to measure infiltration.

Adding aggregate and filter fabric around perforated drain

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All photos: USGS

Construction

https://www.youtube.com/watch?v=83olKiPF0FU

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City hall parking lot in August, 2016, prior to construction looking northwest

All photos: USGS

City hall parking lot following construction in May, 2017 looking northwest

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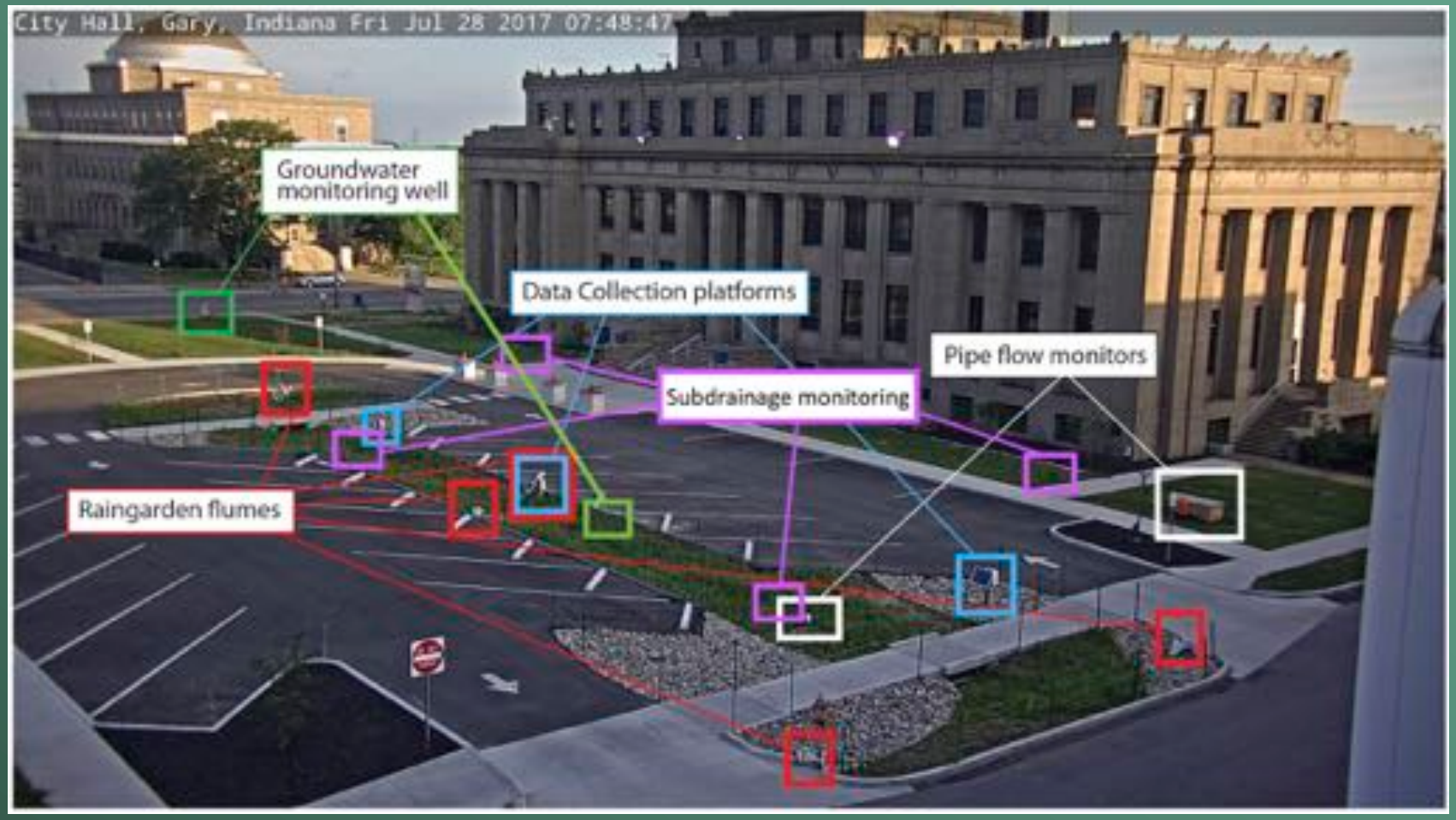
Monitoring Following Construction



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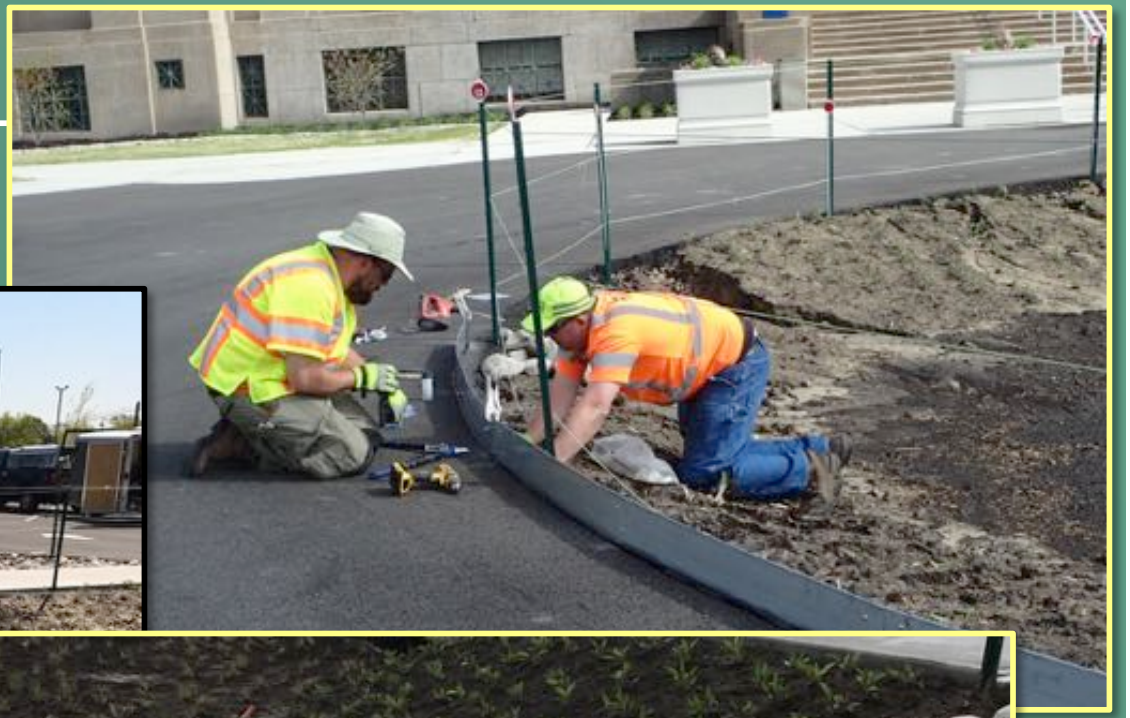
Flume installation

Installation of flumes and barriers around rain garden to measure the volume of stormwater entering the rain garden.



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All photos: USGS

Groundwater Monitoring

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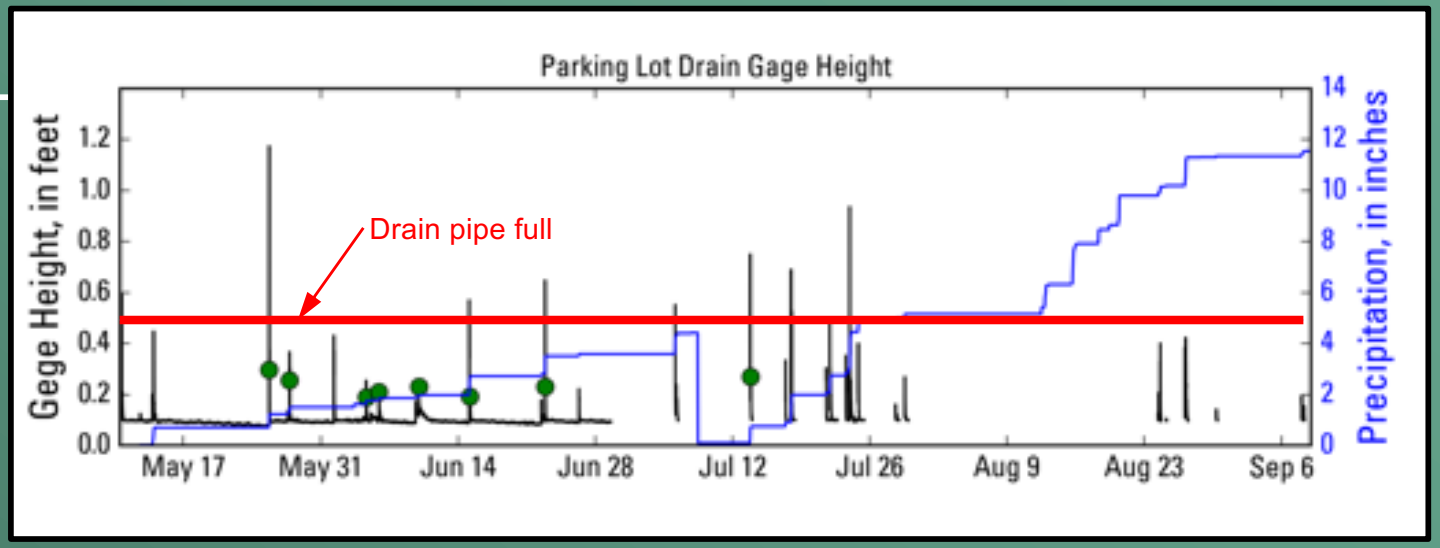
Groundwater monitoring wells measuring the response of groundwater levels to storm events near the rain garden

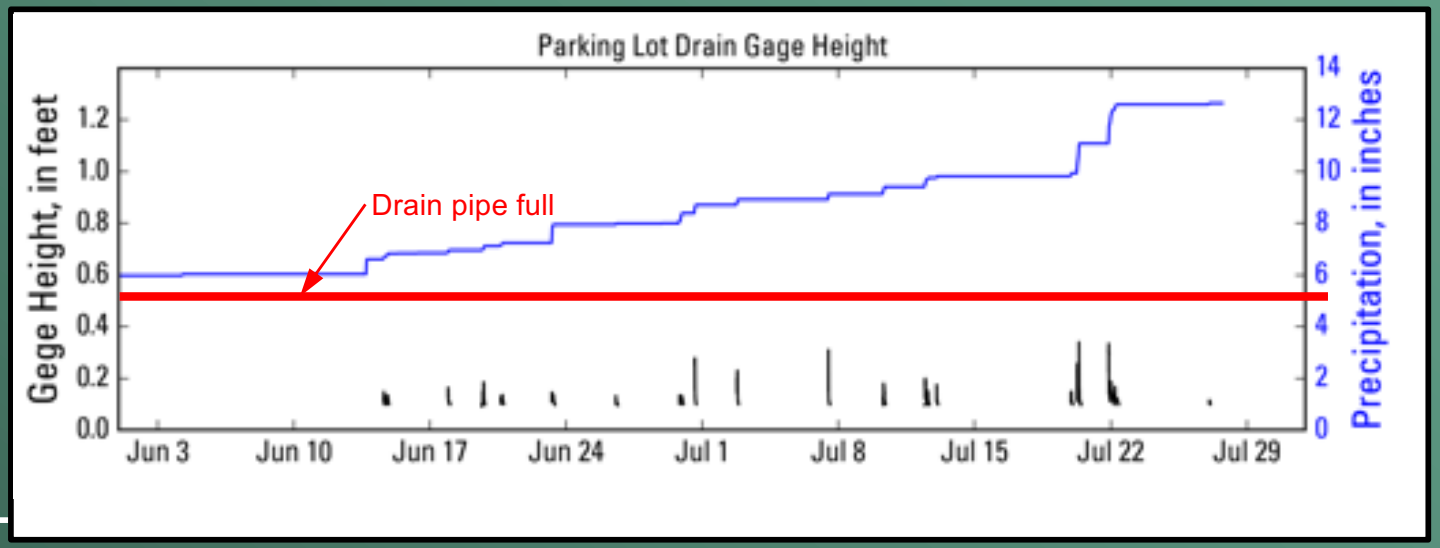
All photos: USGS

Rainfall-runoff before and after construction of rain garden

PRE-CONSTRUCTION
(2016)



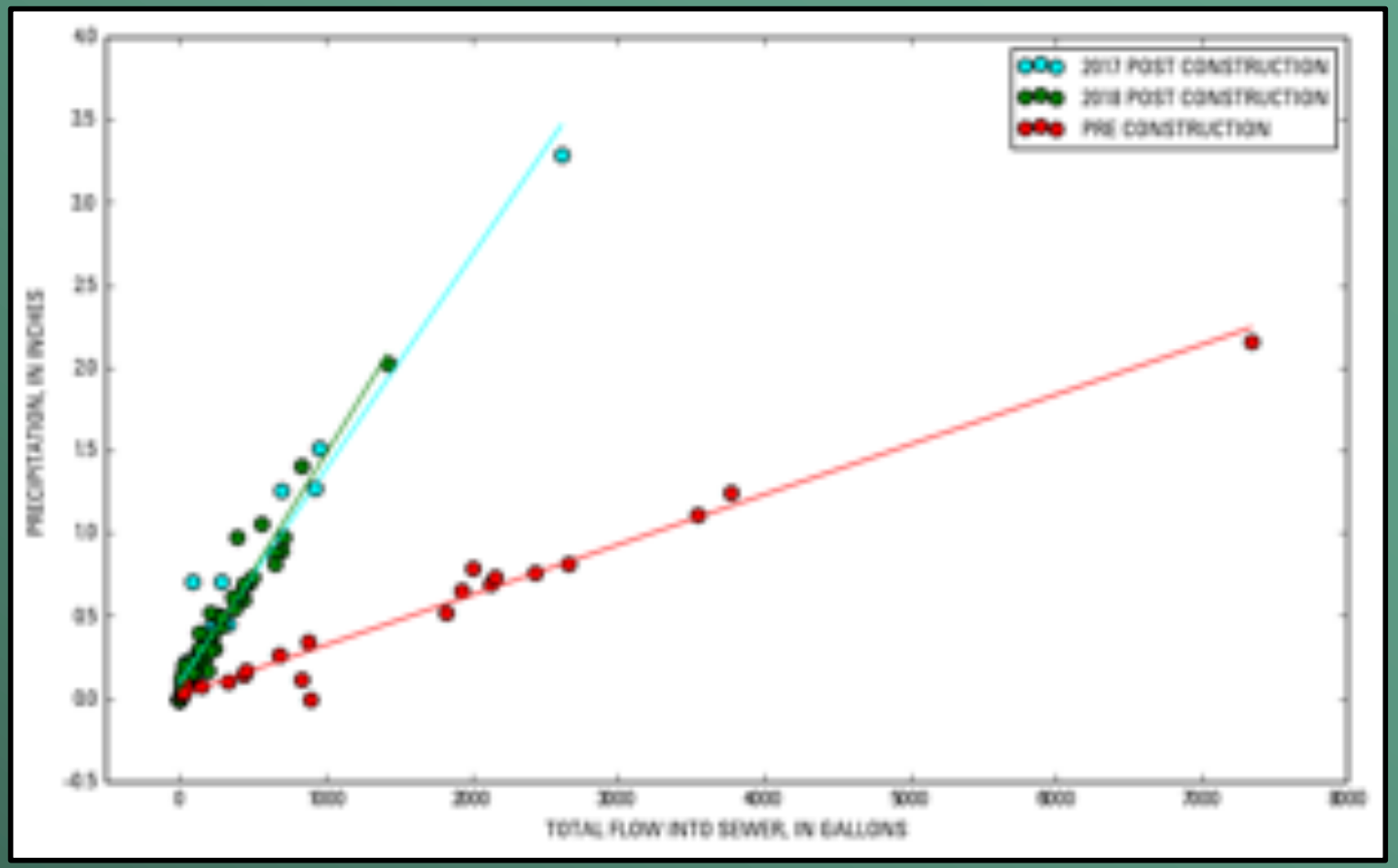
POST-CONSTRUCTION
(2017)



Analysis – Discharge to Storm Sewer

PROVISIONAL DATA

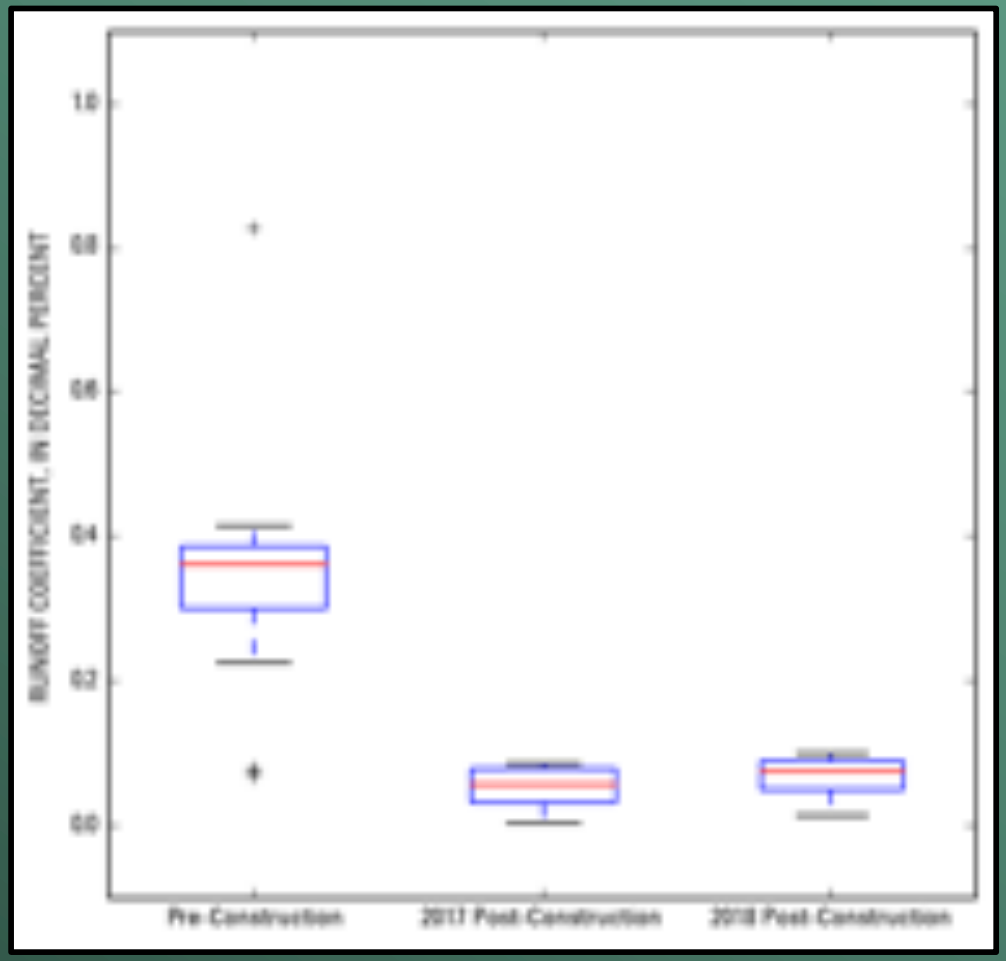
- Pre-Construction Red
- Post-Construction Blue and Green



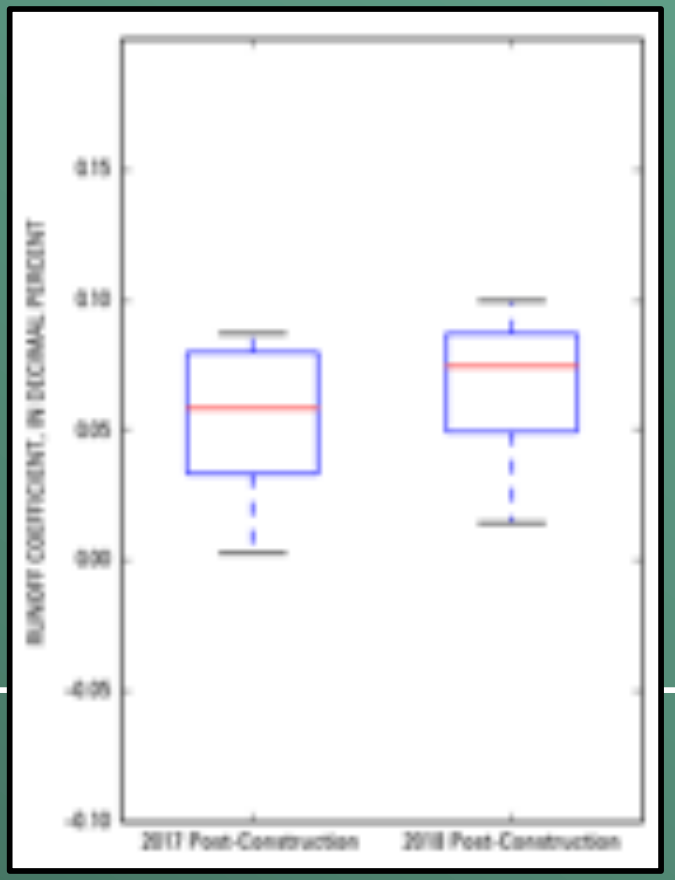
Less total flow into sewer after construction (blue and green) than before construction (red line)

Analysis – Runoff Coefficients

PROVISIONAL DATA



$$RC = \frac{Total\ Q}{Precip * Drainage\ Area}$$



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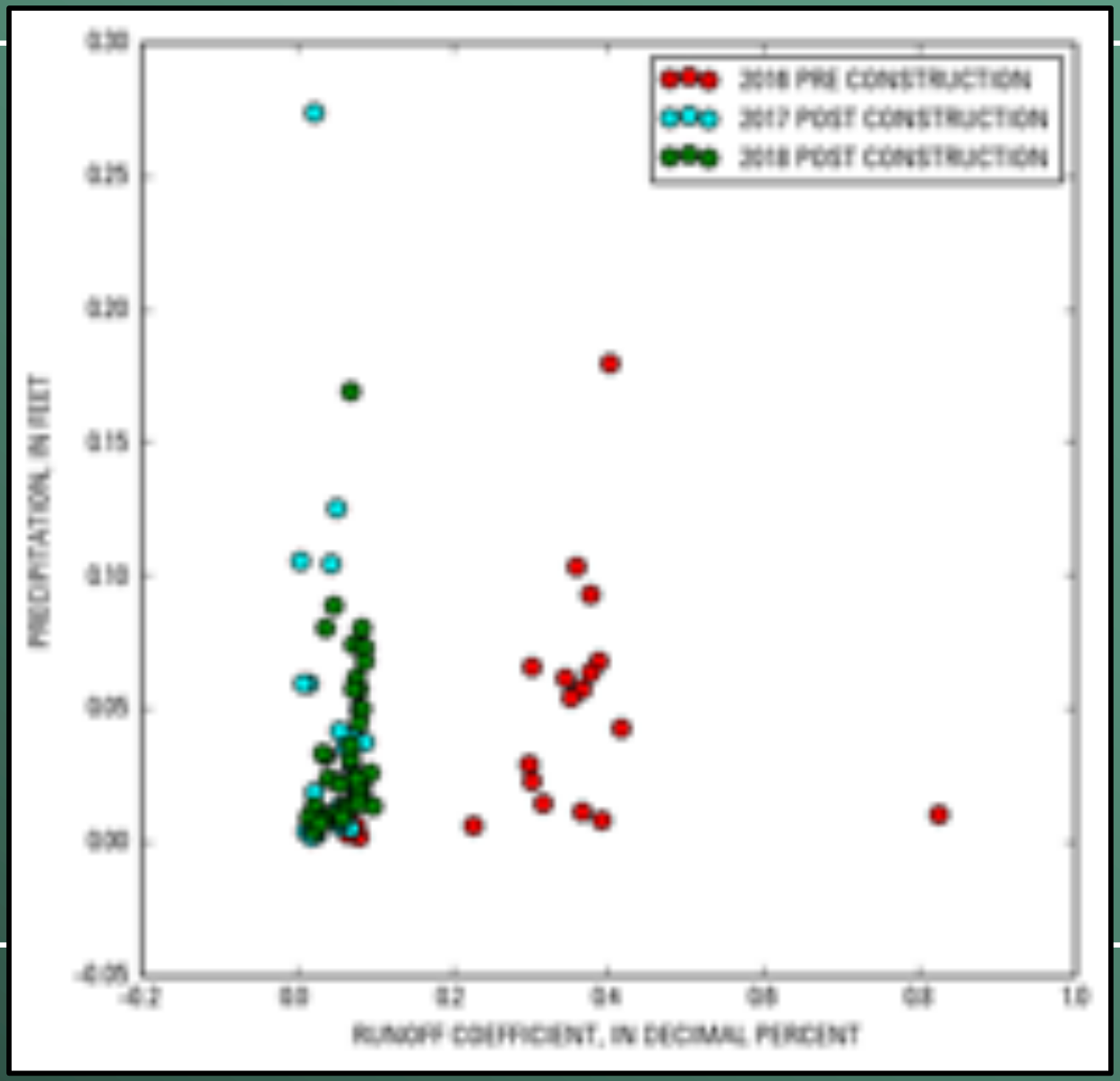
Runoff Coefficients

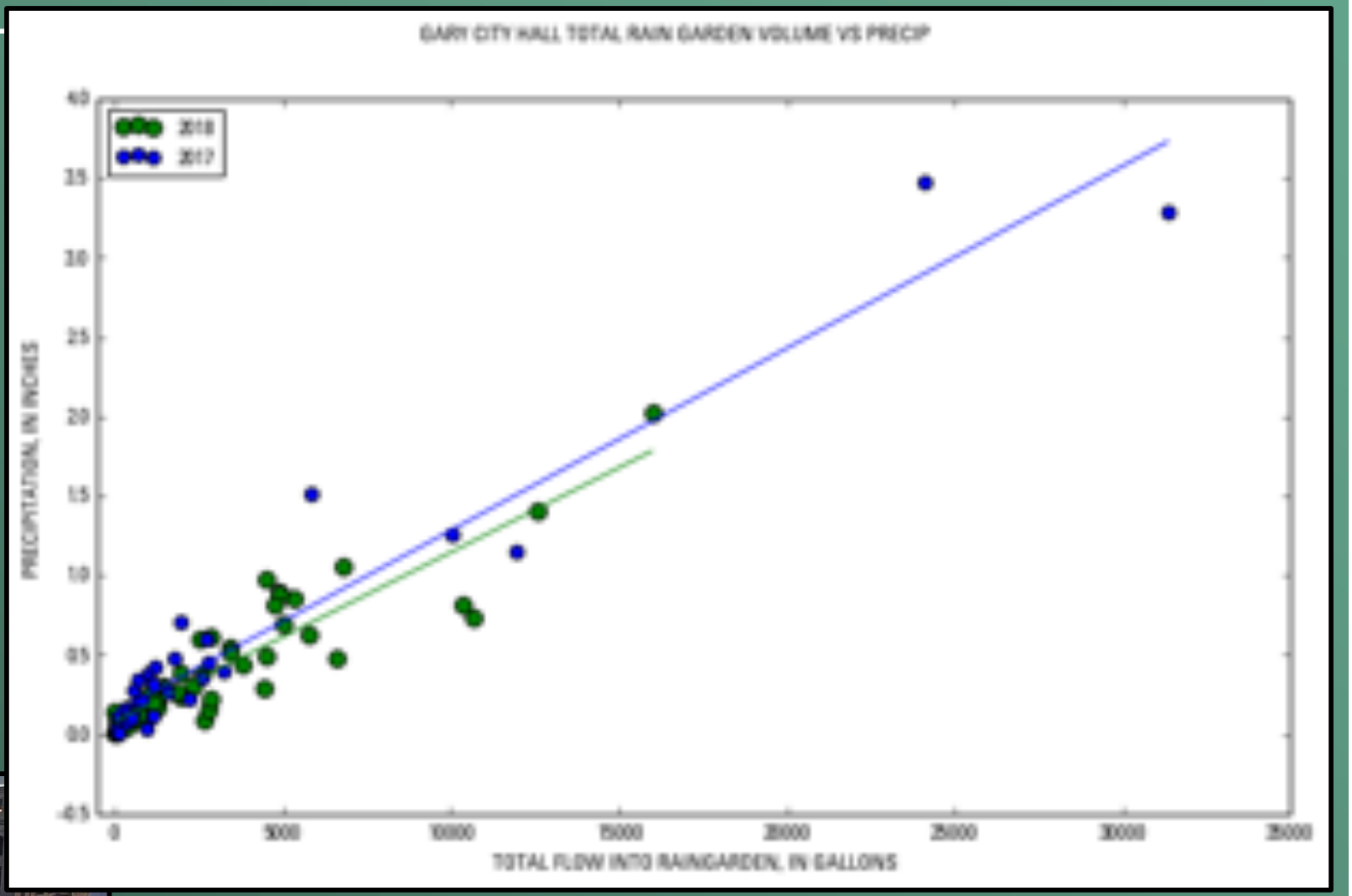


Runoff coefficients were approximately 10% across a range of precipitation depths after construction of the rain garden, compared to approximately 30% before construction.

Analysis – Discharge to Rain Garden

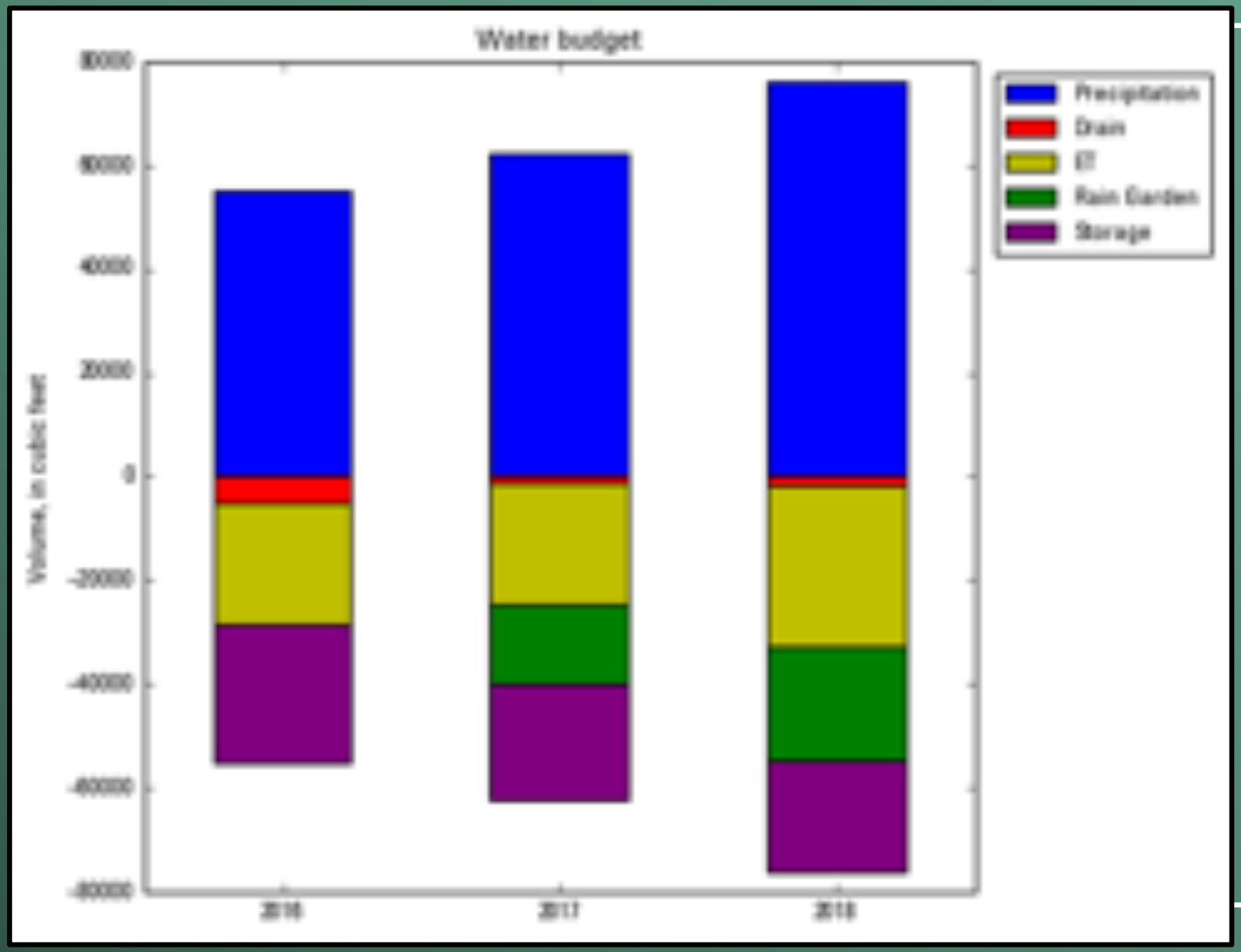
PROVISIONAL DATA

- **Total discharge from all five rain garden flumes**



Analysis – Water Budget

PROVISIONAL DATA



Analysis – Water Budget

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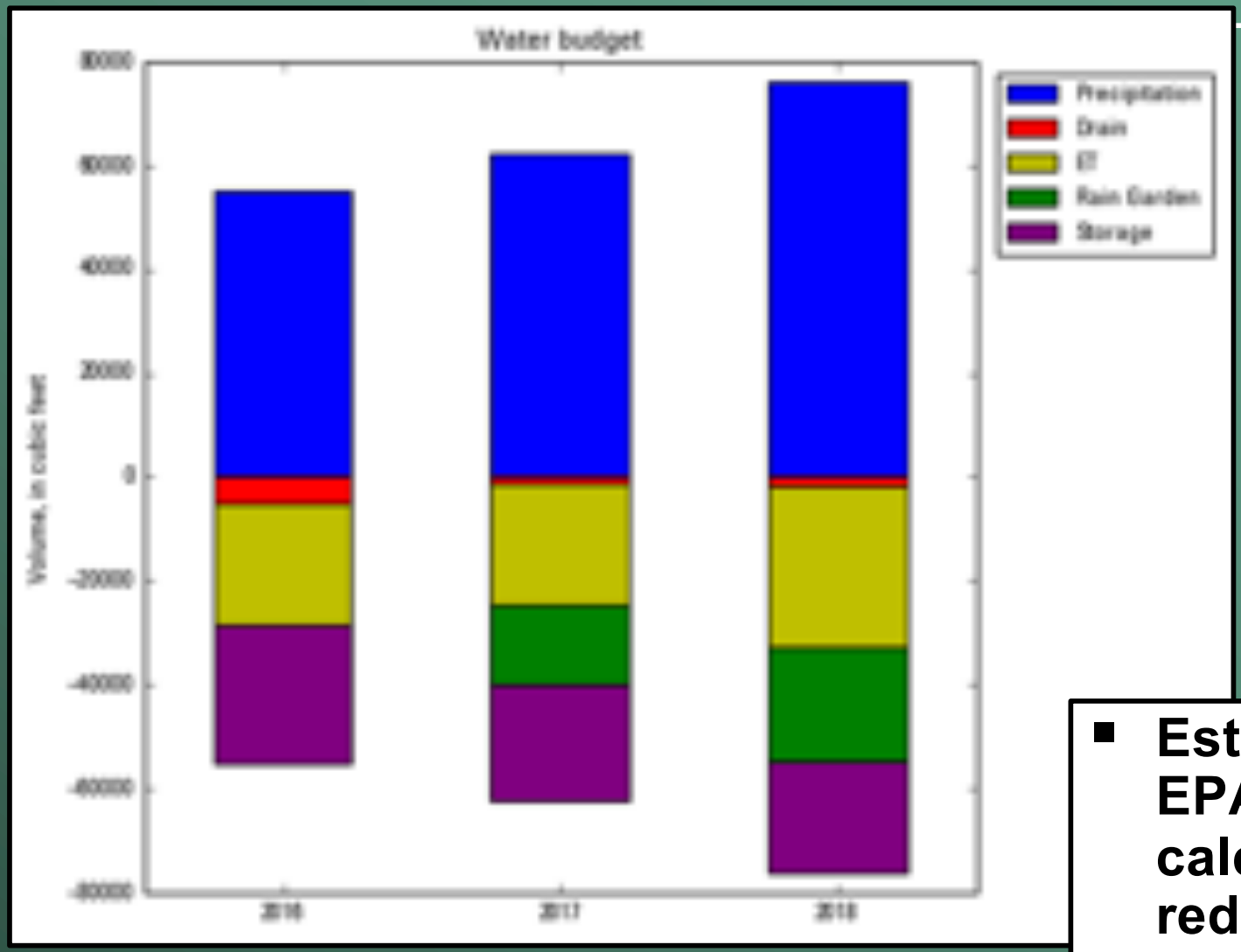
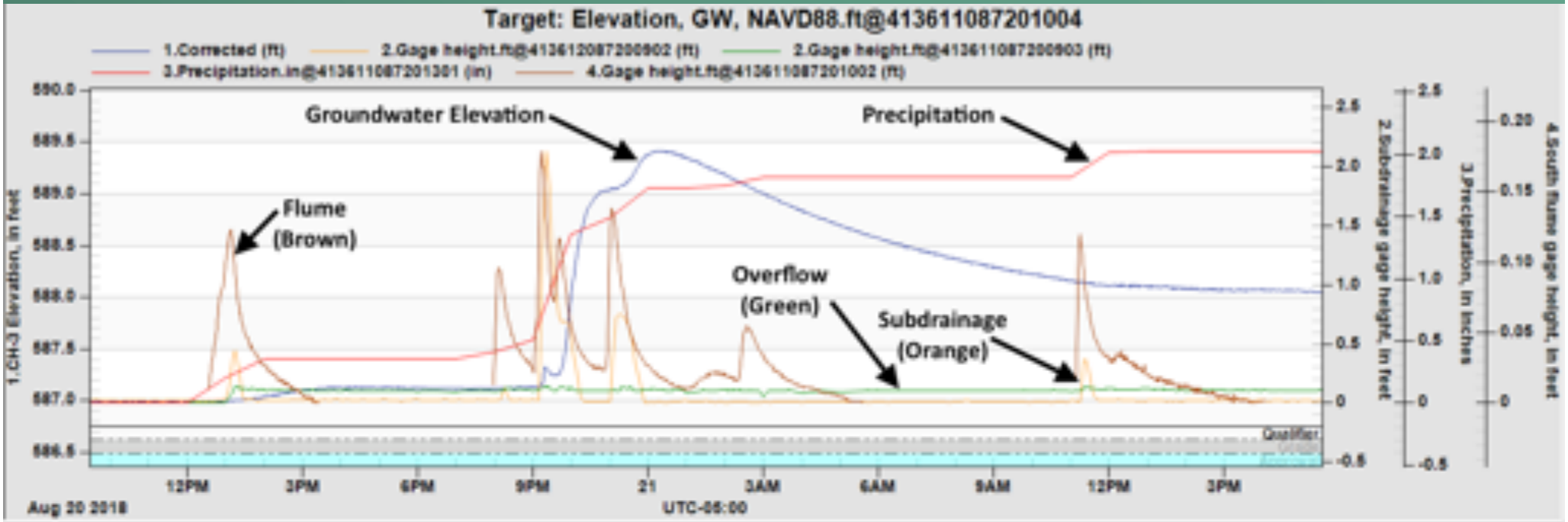
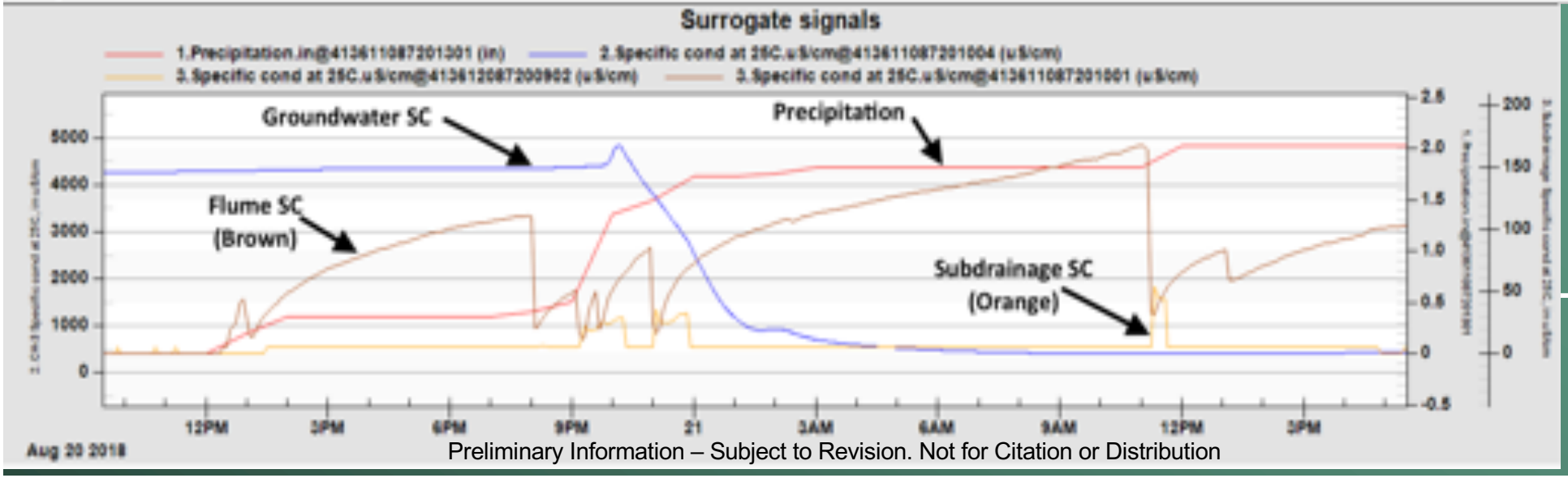


- **Estimates from EPA stormwater calculator show reduction of ~20,000 cfs**

Storm Event – Specific Conductance





Products thus far

- Story map
  - https://wim.usgs.gov/geonarrative/GLRI_urban_stormwater/
- Project Websites
  - GLRI Urban Stormwater Monitoring (main website) https://www.usgs.gov/centers/wisconsin-water-science-center/science/glri-urban-stormwater-monitoring
  - Niagara River Greenway Project (Buffalo, NY) https://www.usgs.gov/centers/wisconsin-water-science-center/science/assessing-stormwater-reduction-using-green-0
  - RecoveryPark (Detroit, Mich.) https://www.usgs.gov/centers/wisconsin-water-science-center/science/assessing-stormwater-reduction-through-green
  - Gary City Hall (Gary, Ind.) https://www.usgs.gov/centers/wisconsin-water-science-center/science/assessing-stormwater-reduction-using-green

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Thank you

David Lampe

dclampe@usgs.gov

Randy Bayless

ebayless@usgs.gov


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