THE OHIO STATE UNIVERSITY

Commercial GI Retrofits: Construction, Performance, and Maintenance

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Meijer Background

- 237 stores in six states
- 5 distribution centers and 6 food manufacturing plants

Current LID/GI Practice

meijer

ST279 Manistee, MI:

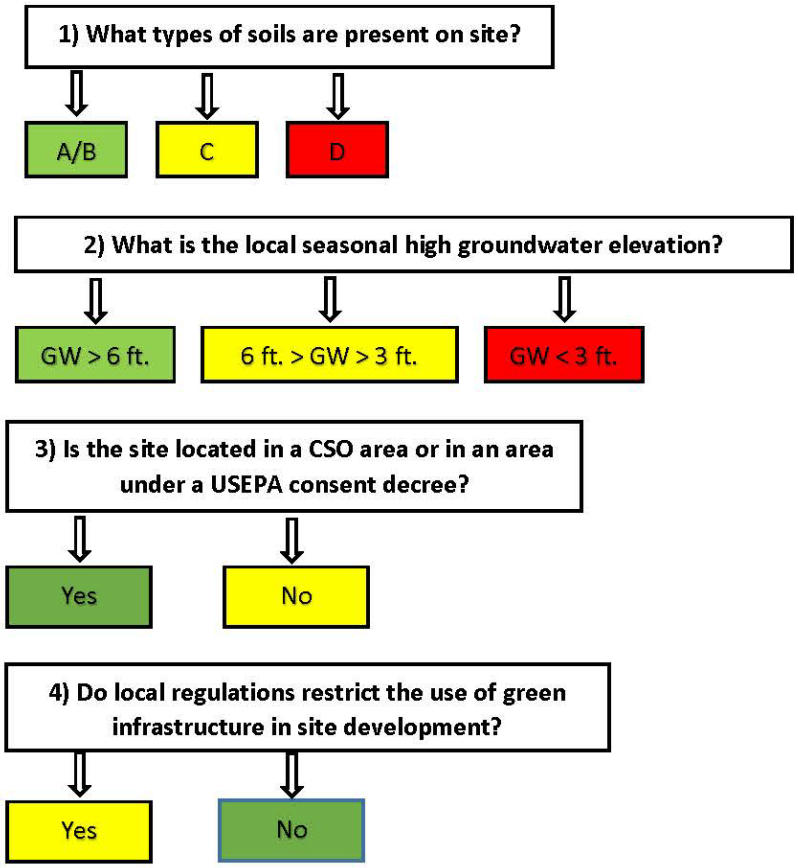
- Test site for porous pavement
- Additional LID/GI practices
- **Cost competitive**
- **Comparable maintenance**

Meijer Goals

- Document site data requirements for incorporating GI into the environmental site screening process.
  - Minimize overall data collection efforts and expenses during site screening and assist early site design efforts.
- GI site suitability manual, GI design guidance manual, and supporting documents and tools.
- Develop test case sites for GI
  - Collect performance/maintenance data

Site Suitability – Meijer

Site Suitability for Green Infrastructure Flowchart

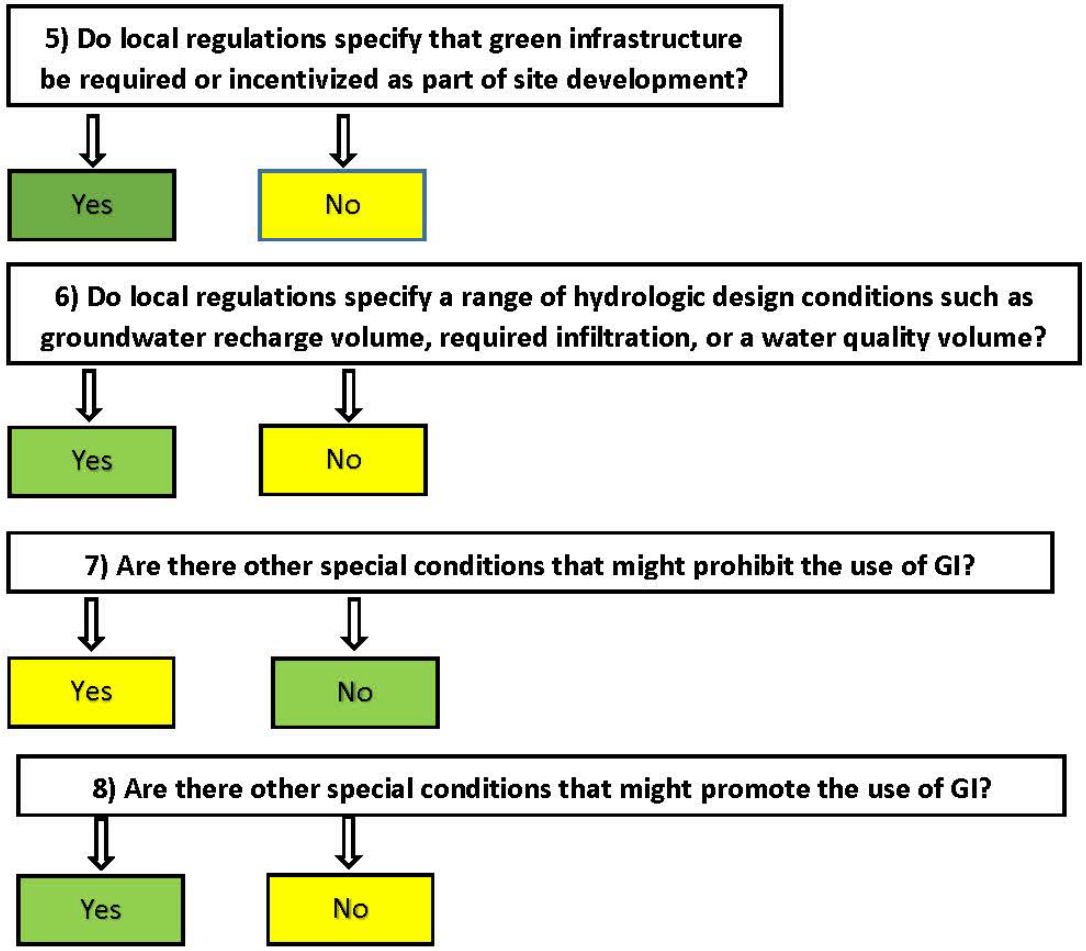


NOTE: The flow chart does not represent a full set of considerations or questions on whether GI will meet local permitting requirements.

LEGEND:

- Green = Favorable condition for GI implementation.
- Yellow = GI is possible but the design or regulatory approval process might be more difficult.
- Red = Difficult condition for GI implementation.

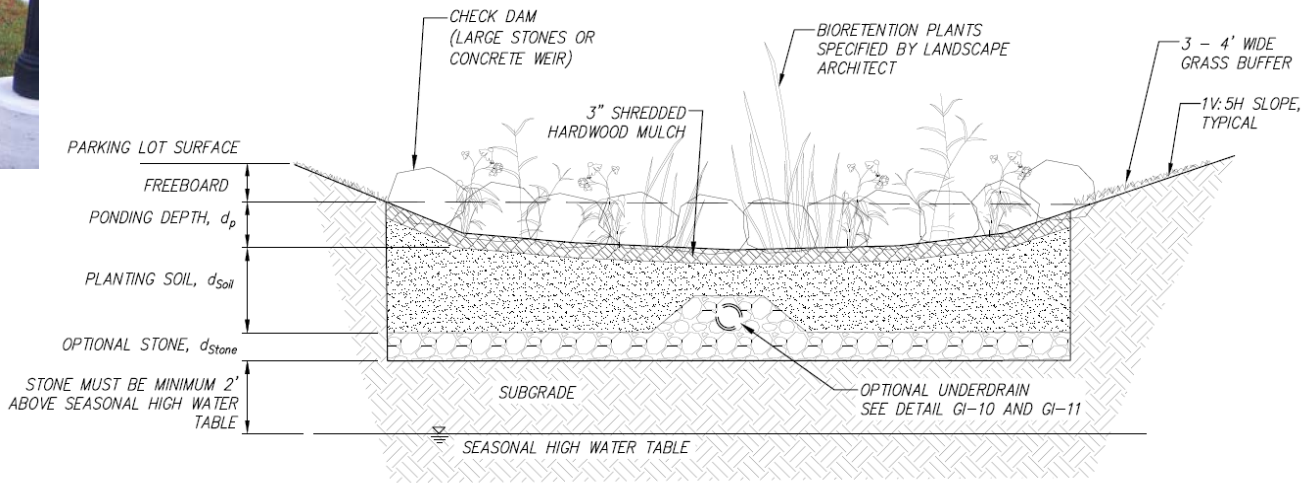
Site Suitability – Meijer



Meijer Guidance Manual

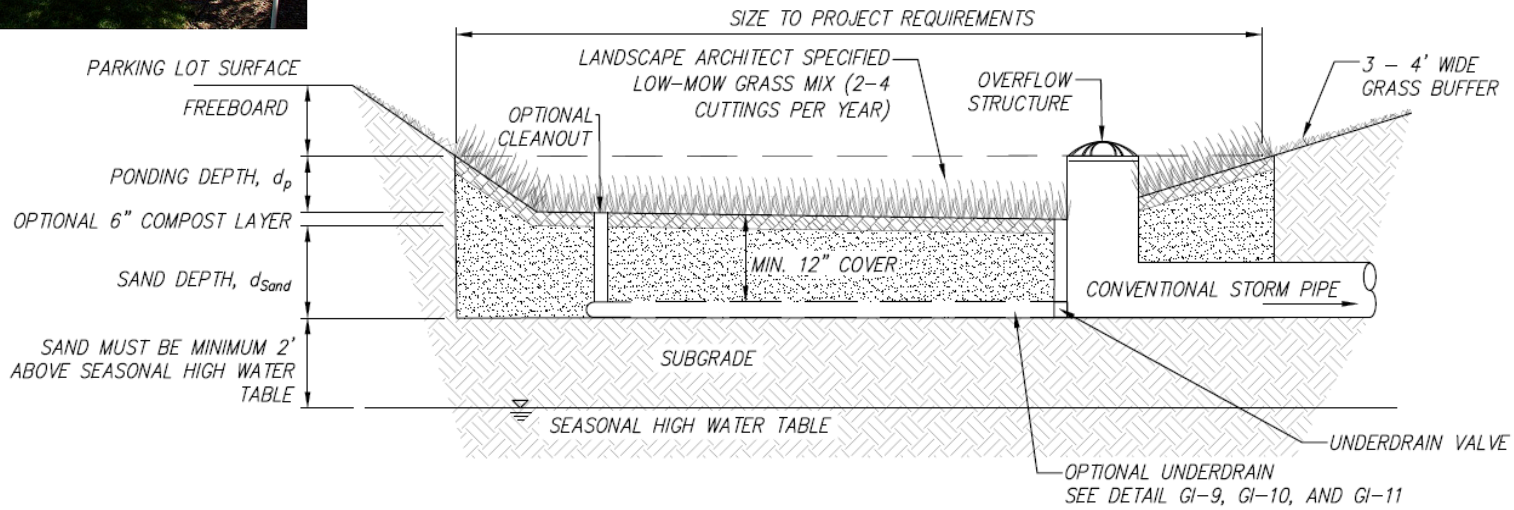
- Introduction to GI techniques and tools for Meijer Site Adapt Civil Consultants
- Infiltration based GI design guidance and prototype elements
- Cost estimate information
- Maintenance information

Bioswales

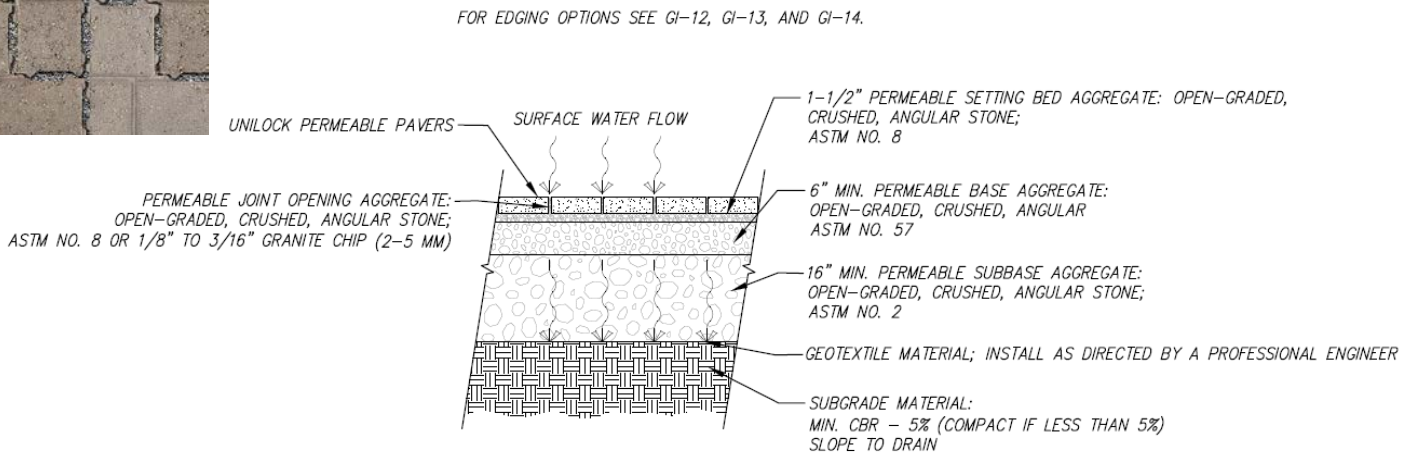


GI–5 BIOSWALE TYPICAL SECTION
NTS

Infiltration Basins



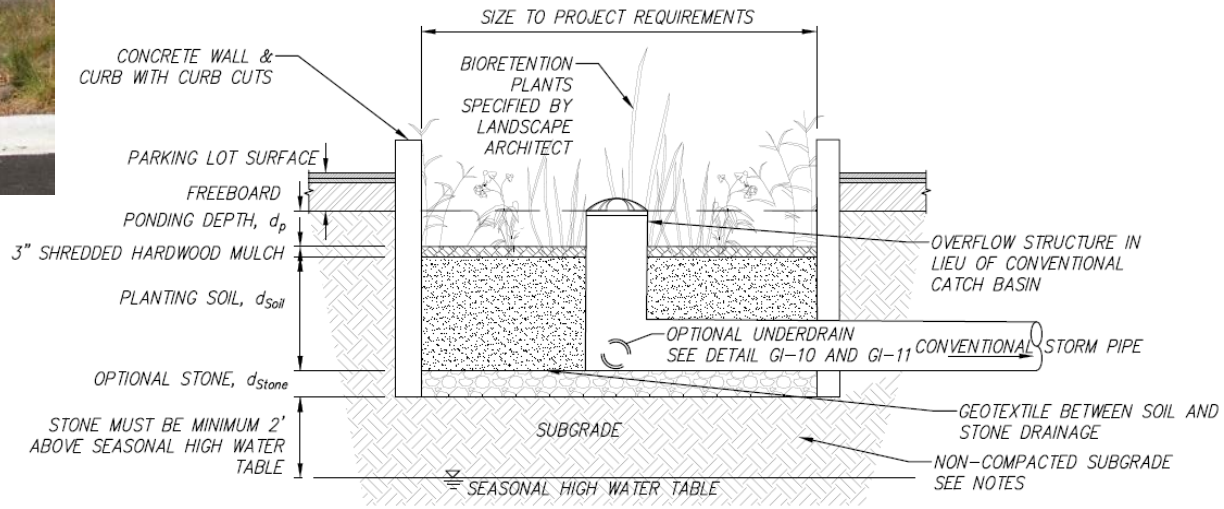
Permeable Pavement



GI–16 UNILOCK HD–HIGH INFILTRATION PERMEABLE PAVER SECTION

NTS

Bioretention Cells

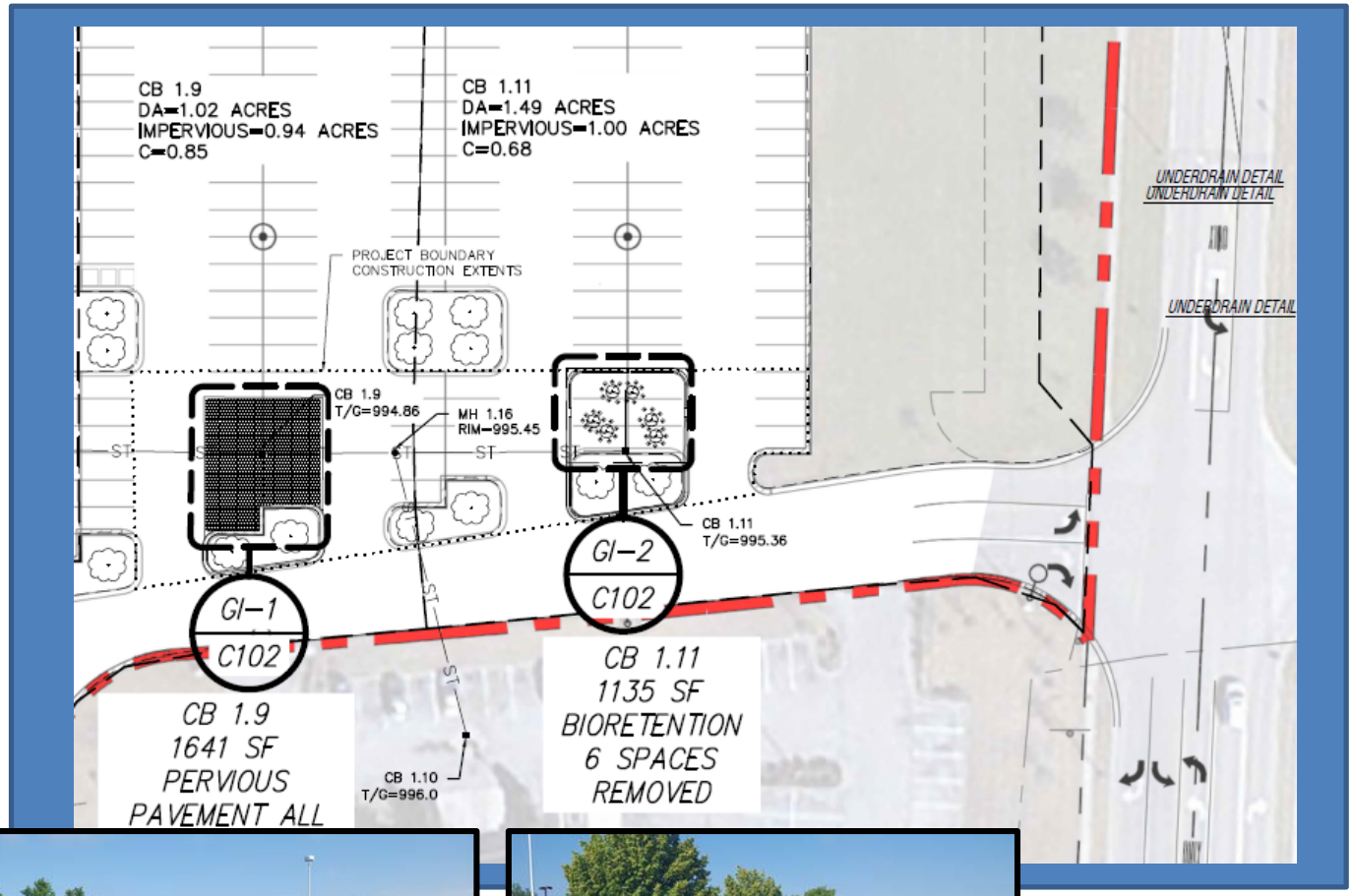


GI-1 PARKING LOT BIORETENTION CELL TYPICAL SECTION

NTS

Reynoldsburg Meijer

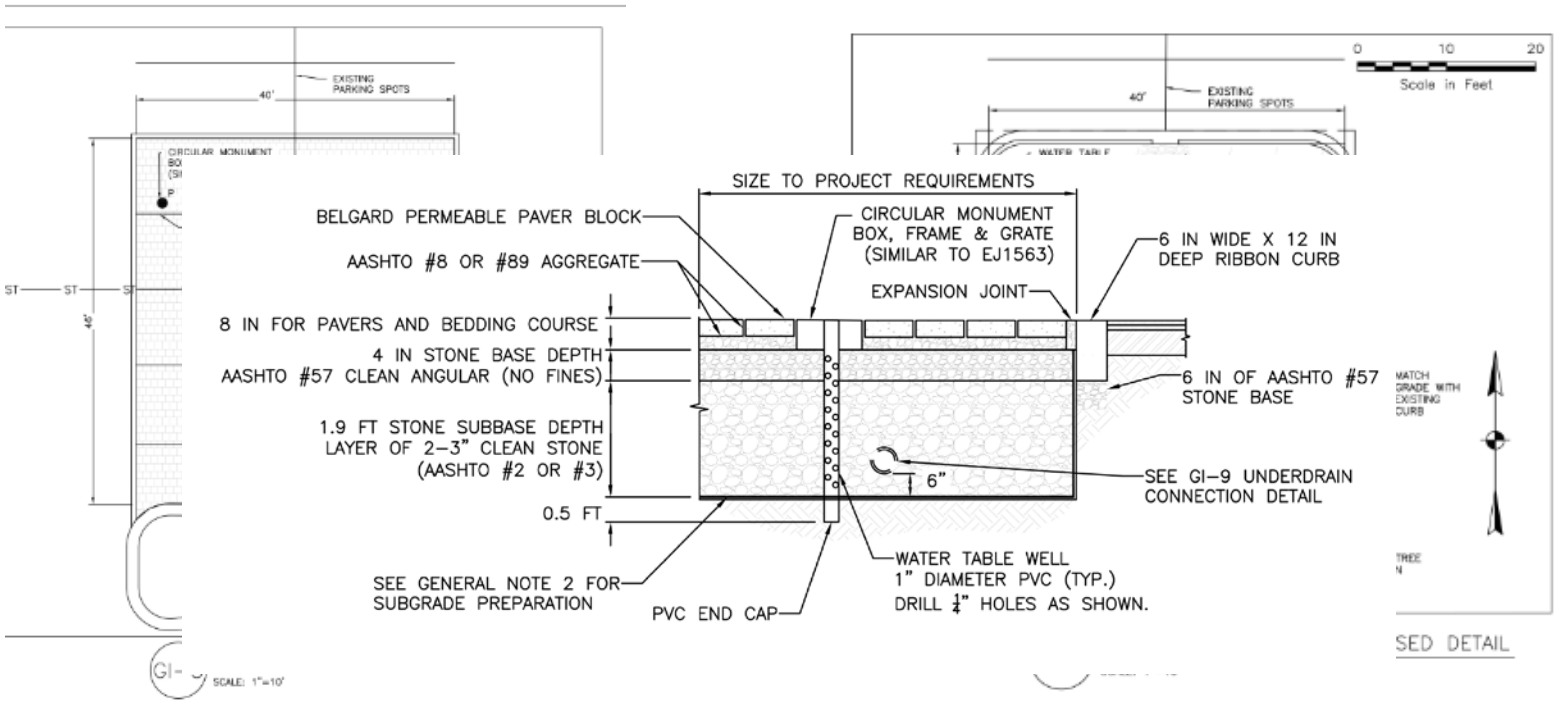
Meijer Parking Lot Retrofit



GI Design

Permeable Pavement

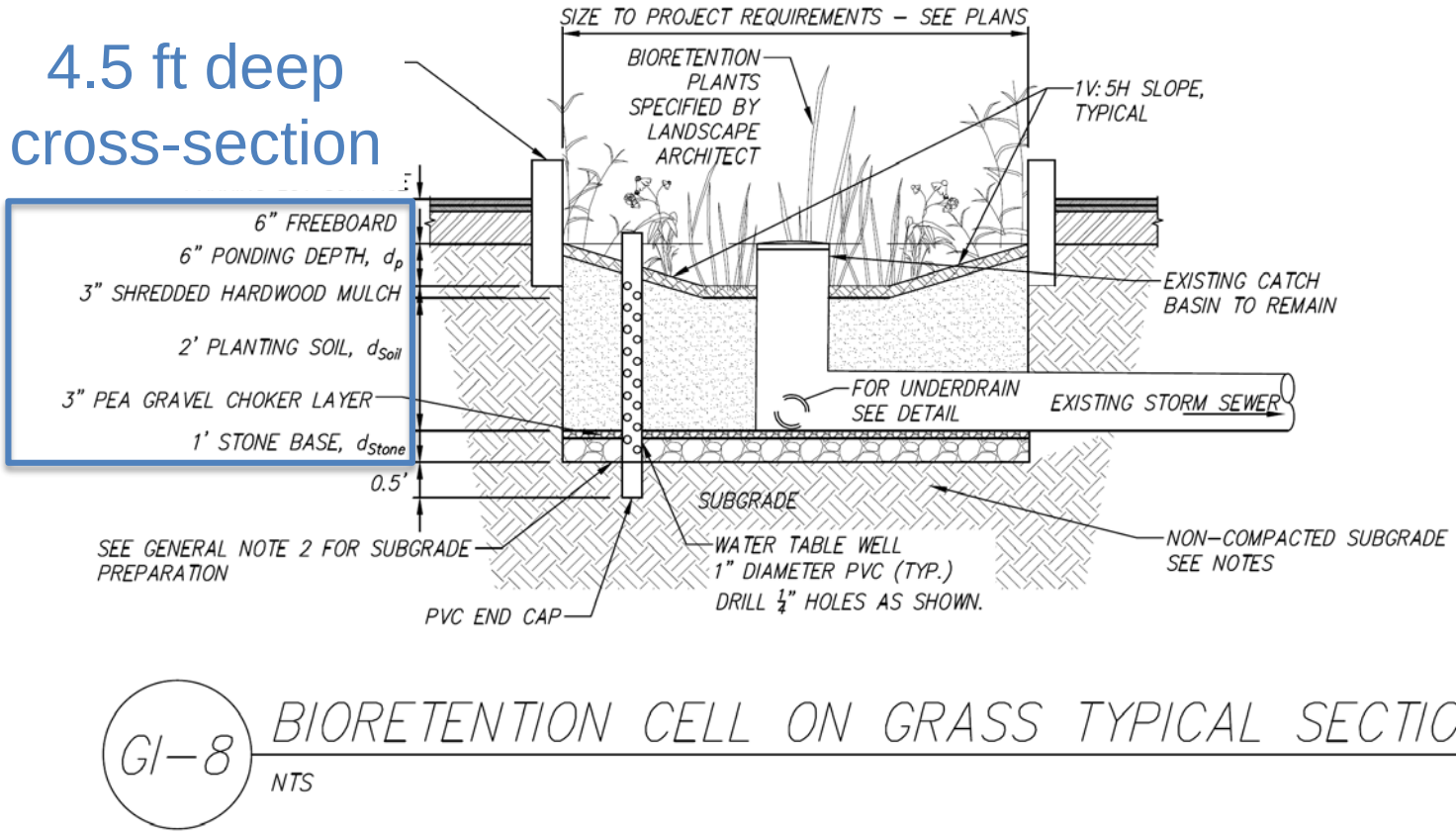
Bioretention



Permeable Pavement Construction

Initial Bioretention Design

4.5 ft deep cross-section



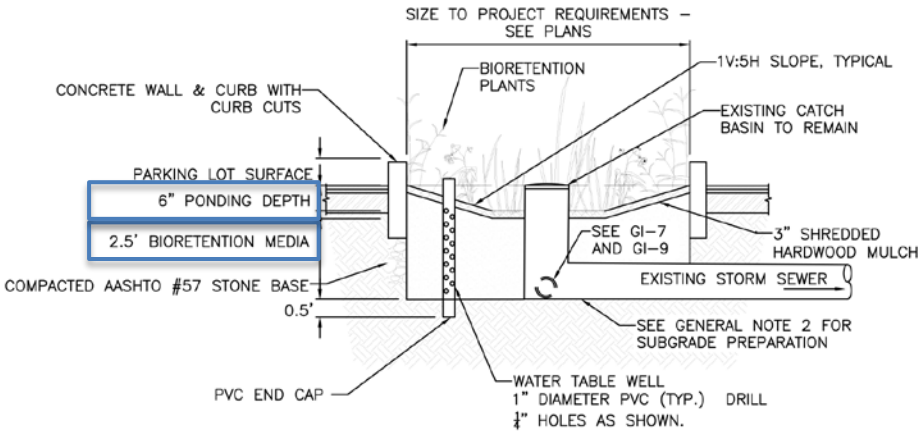
GI-8 BIORETENTION CELL ON GRASS TYPICAL SECTION

NTS

Site Soil Conditions

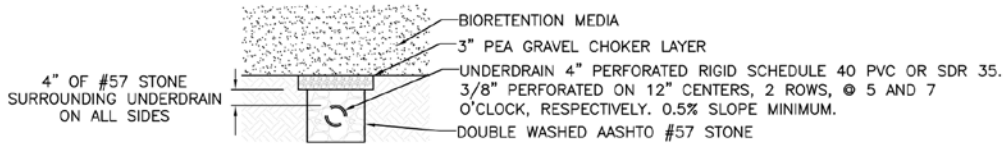
- Organic layer to 18”
- Clay soil below 18”
- Water table at ~5 ft bgs

Changes to Design: High Water Table



GI–6 BIORETENTION CELL TYPICAL SECTION
NTS

2 ft of separation from SHWT



GI–7 UNDERDRAIN DETAIL
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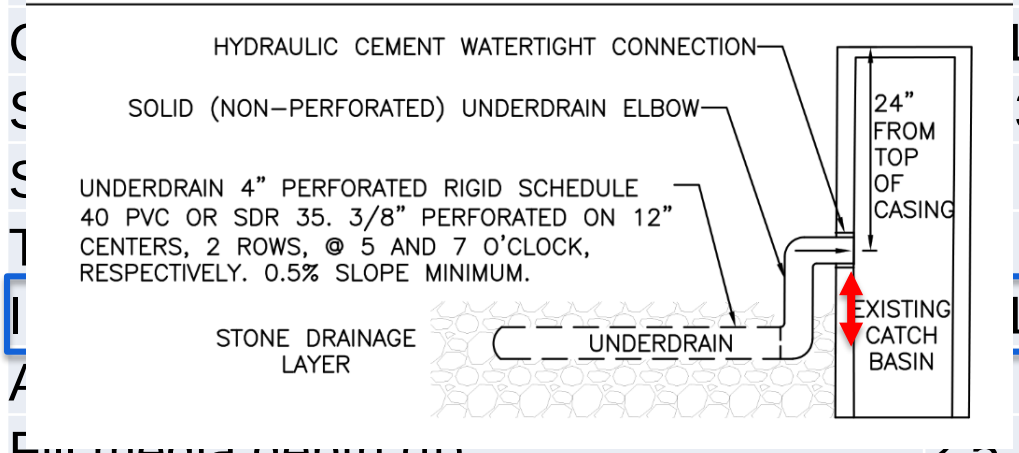
Bioretention Construction

GI Characteristics

Characteristics	Bioretention Cell	Permeable Pavement
Catchment area (ac)	1.49	1.02
C	L	92.2
S	3	1641
S		0
T		1575
I	L	25:1
A		0
Fill media depth (ft)	2.5	0
Gravel thickness (ft)	1	2.4
IWS zone thickness (ft)	12	6
Underdrain diameter (in)	4	4
Vegetation	Shrubs and Forbs	None



Monitoring Design

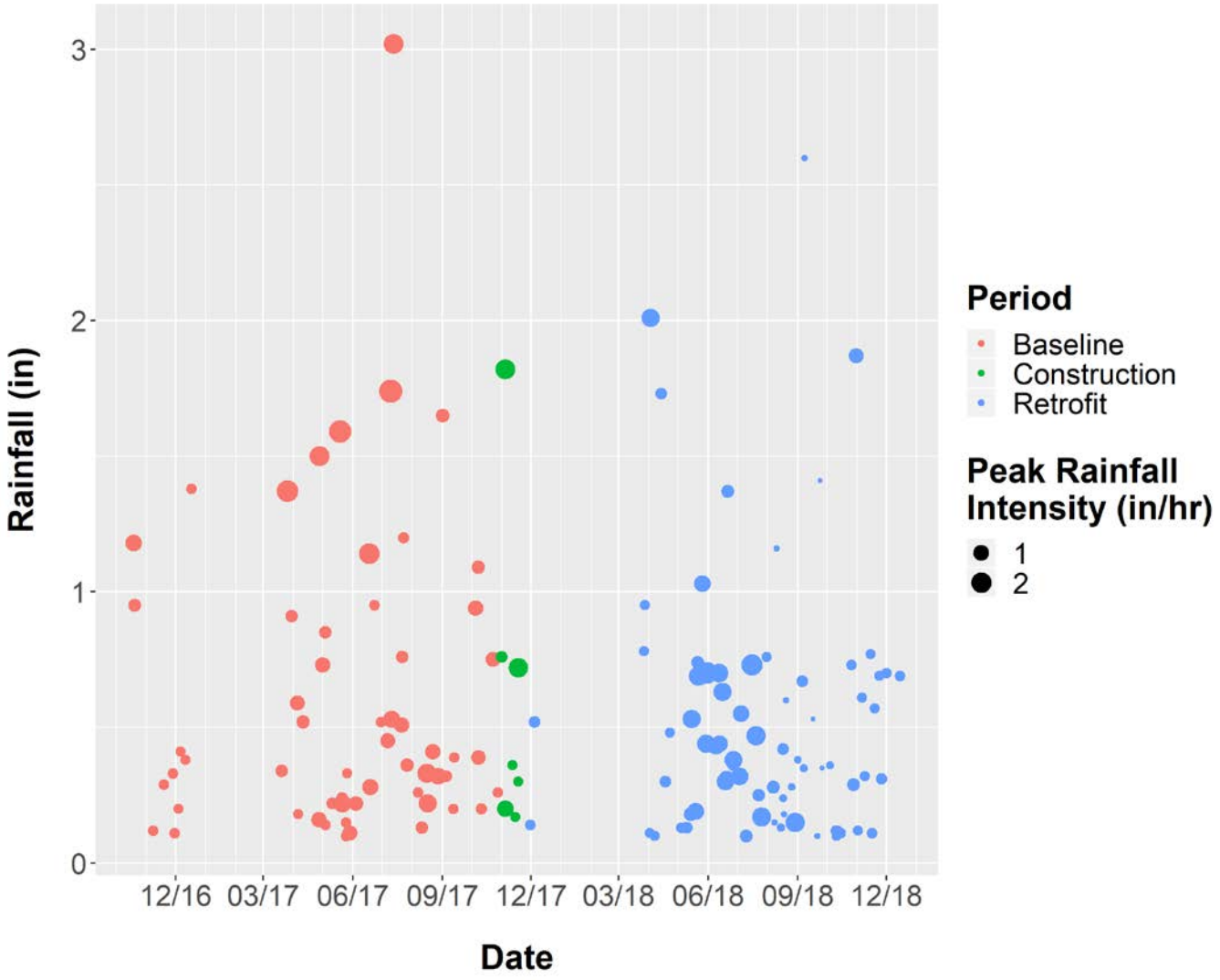
Monitoring Design

- Tipping bucket & manual rain gauges
- Weir & pressure transducer in 4 catch basins
  - Weir equation used to determine hydrograph
- 1-minute interval measurements

Project Timeline

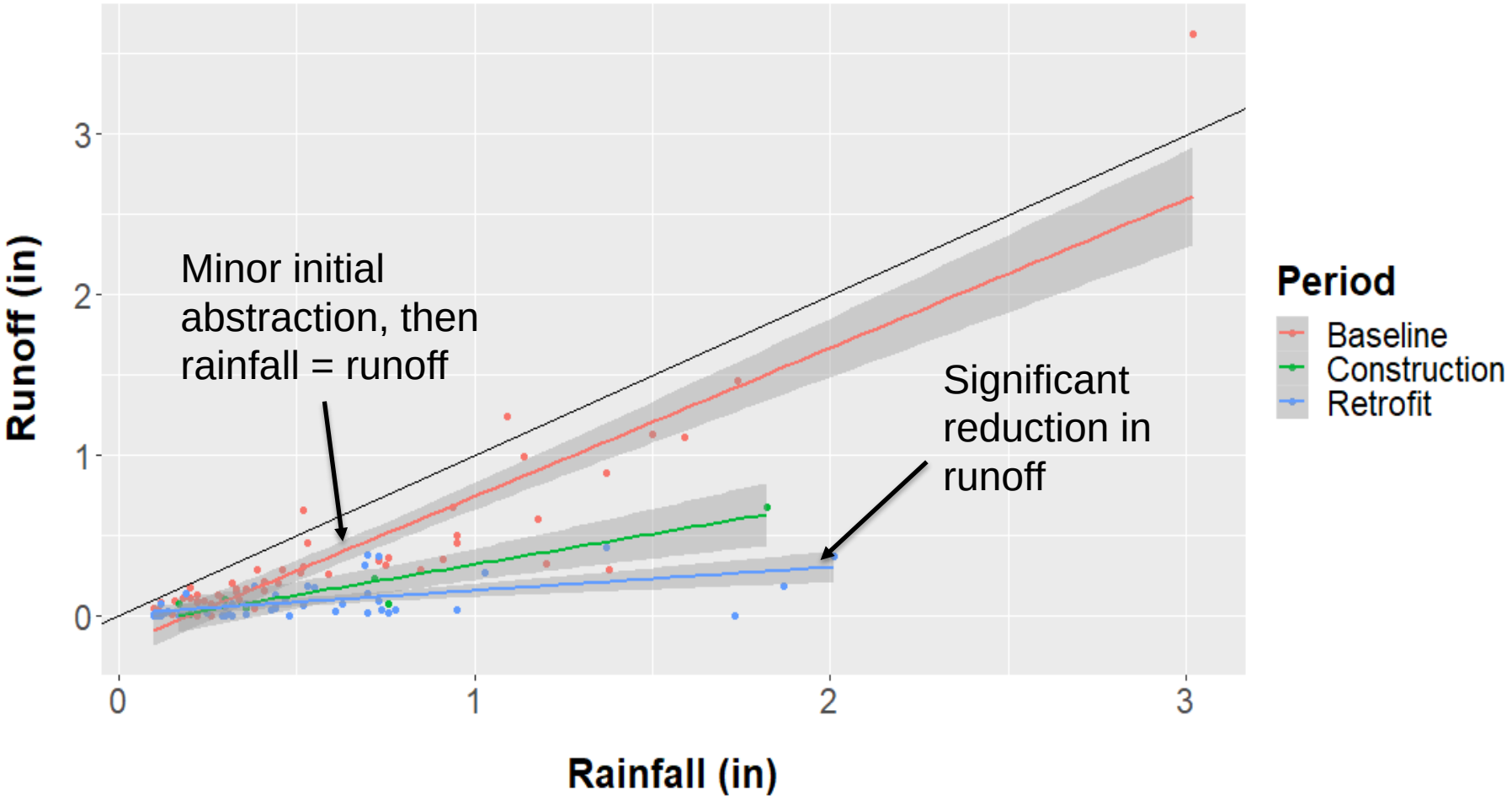
- Monitoring equipment installed Oct 2016
  - Data collection consistent throughout project
- 3 week construction window
- Baseline and retrofit monitoring periods both ~1 year

Observed Rainfall Events



Runoff Volume

Bioretention



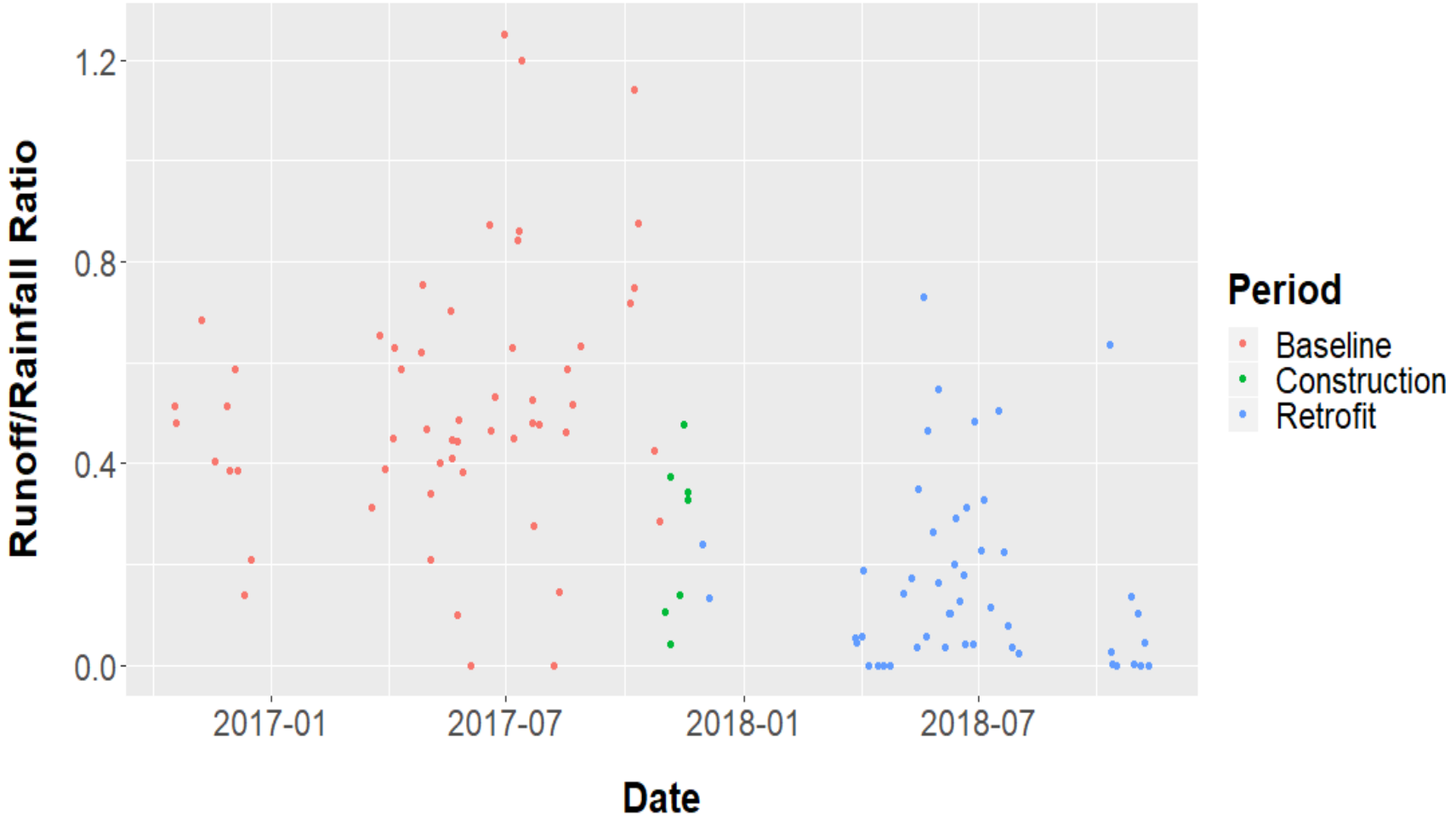
Runoff Volume

Bioretention

Period	Rainfall (in)	Bioretention Outlet (in)	% Reduction
Baseline	33.04	30.74	7.0
Construction	4.33	1.84	57.4
Retrofit	24.31	6.61	72.8

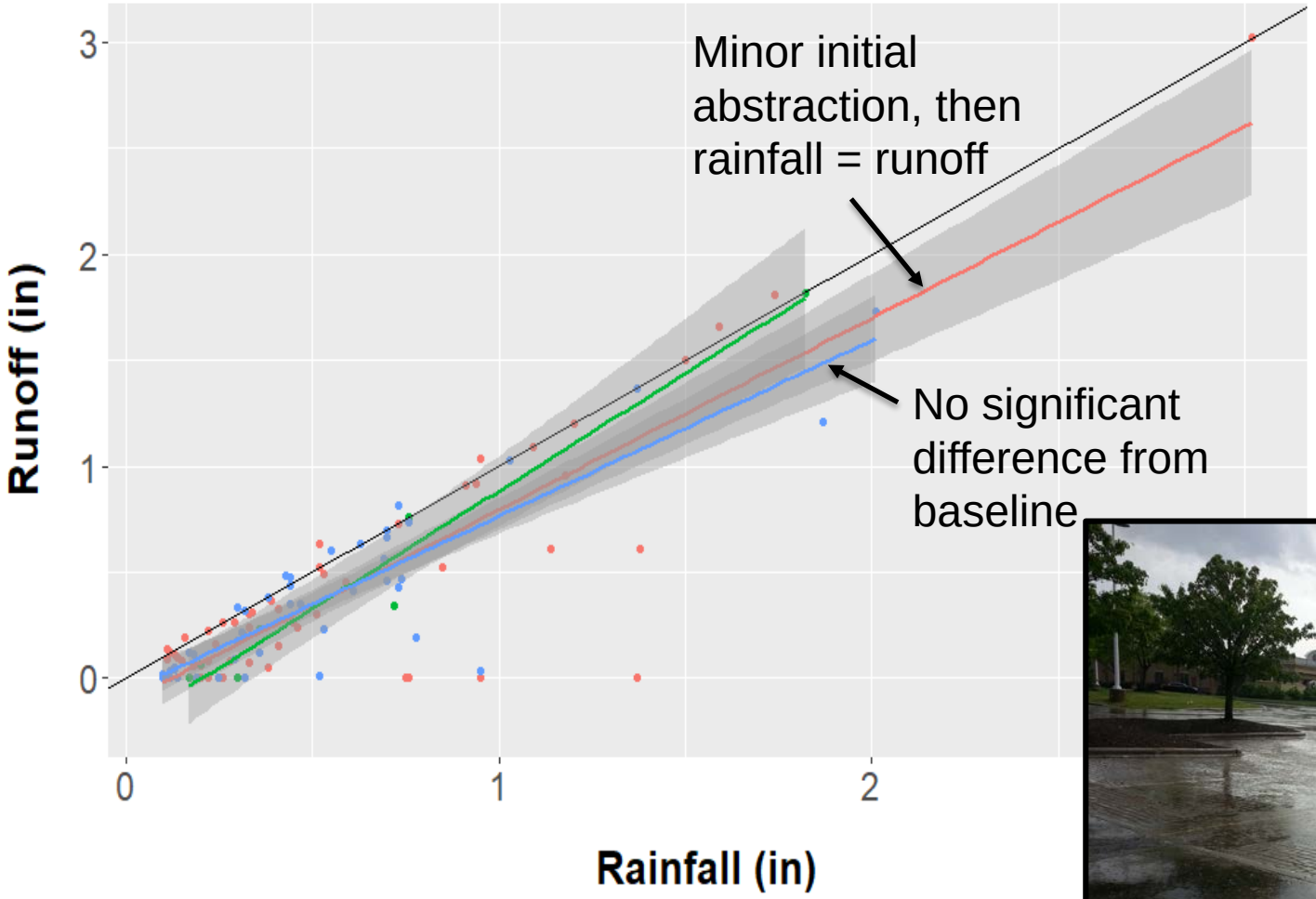
Runoff Volume with Time

Bioretention



Runoff Volume

Permeable Pavement



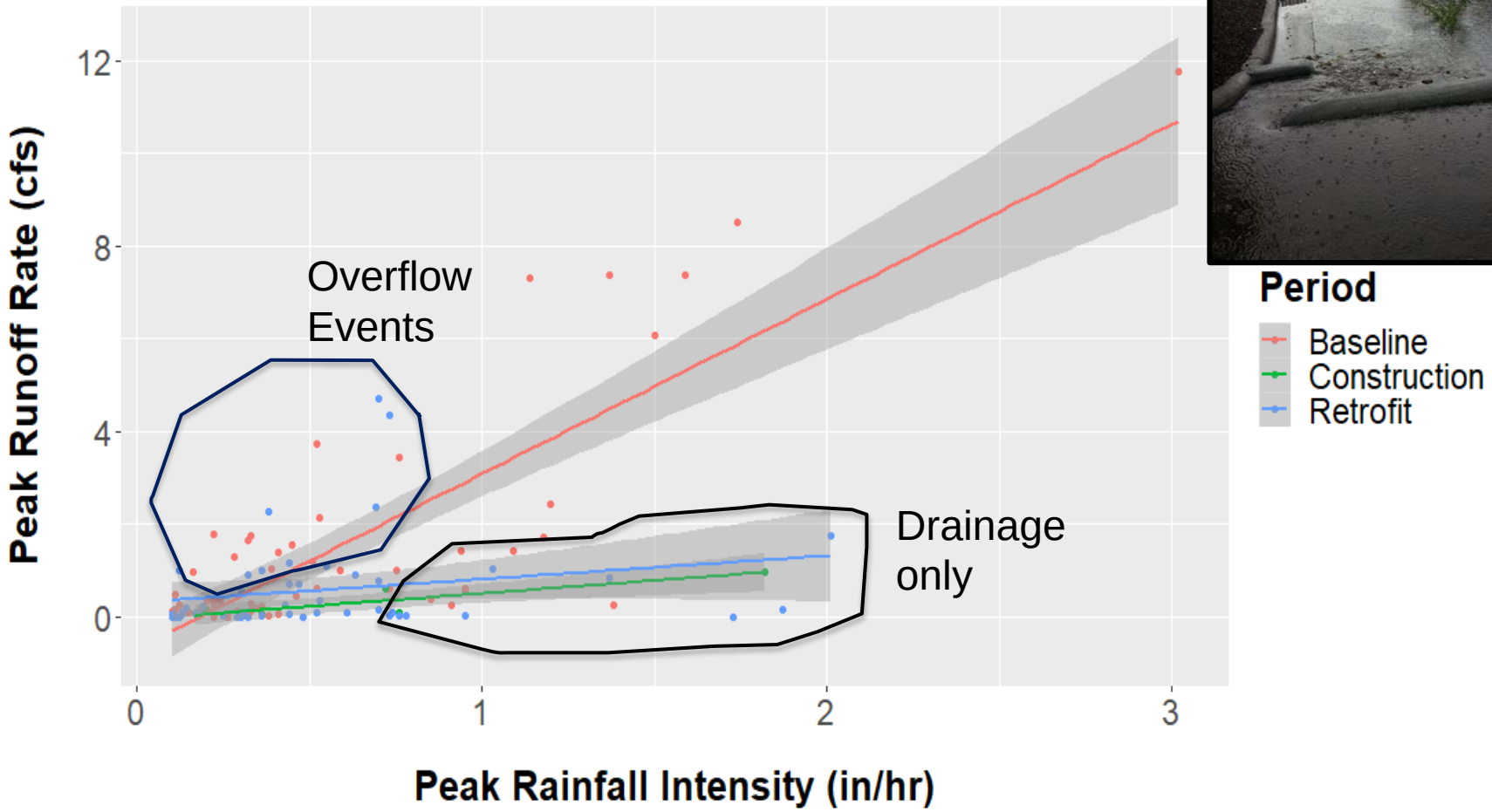
Runoff Volume

Permeable Pavement

Period	Rainfall (in)	Perm. Pave. Outlet (in)	% Reduction
Baseline	33.04	30.35	8.2
Construction	4.33	3.99	7.9
Retrofit	36.02	31.82	11.7

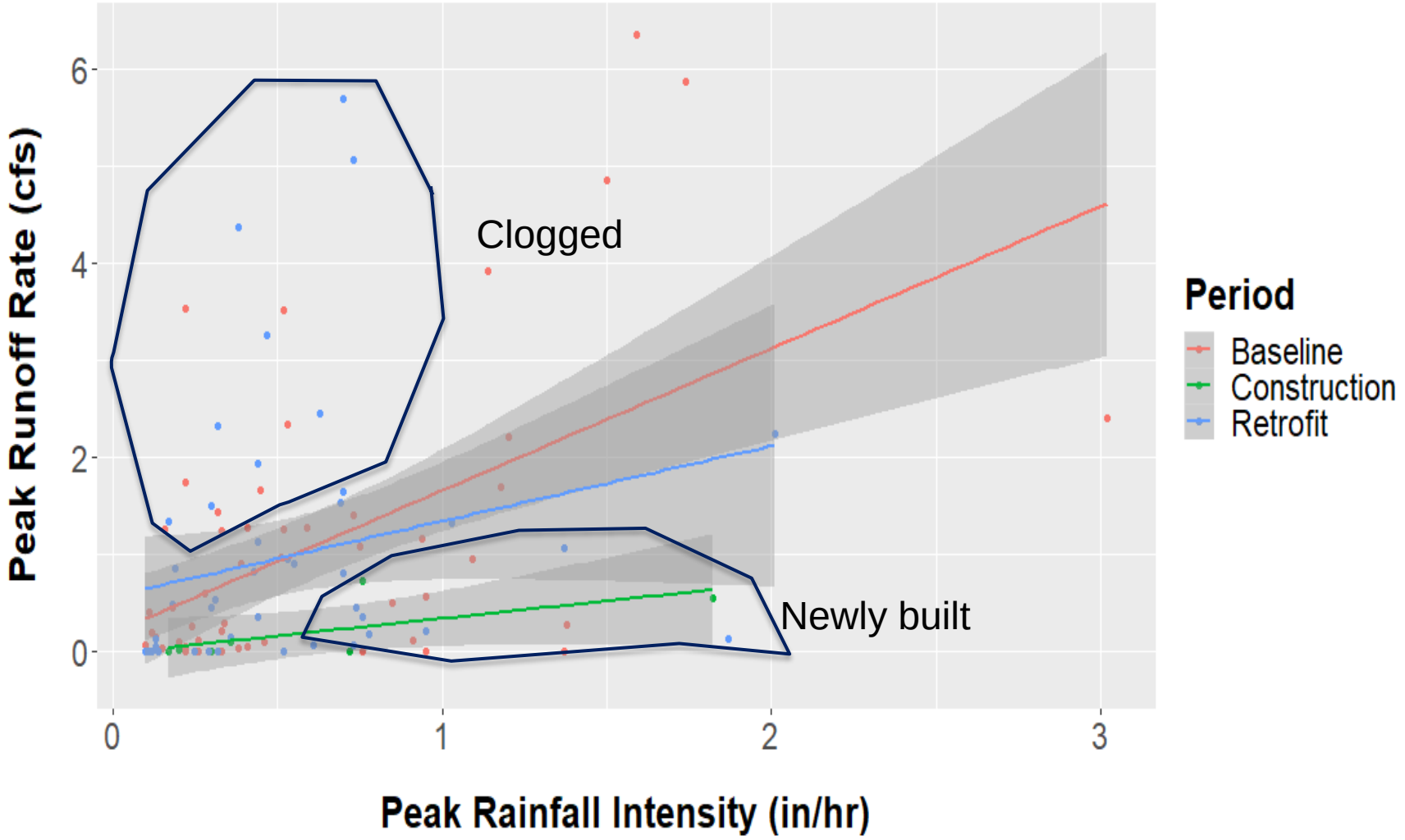
Peak Flow

Bioretention



Peak Flow

Permeable Pavement



Practical Challenges

- SOP for plow drivers:
  - Move snow as far from store as possible
  - Often adjacent to parking lot islands
  - Near drain to prevent re-freeze
  - Particularly for bioretention, created a storage spot for them!

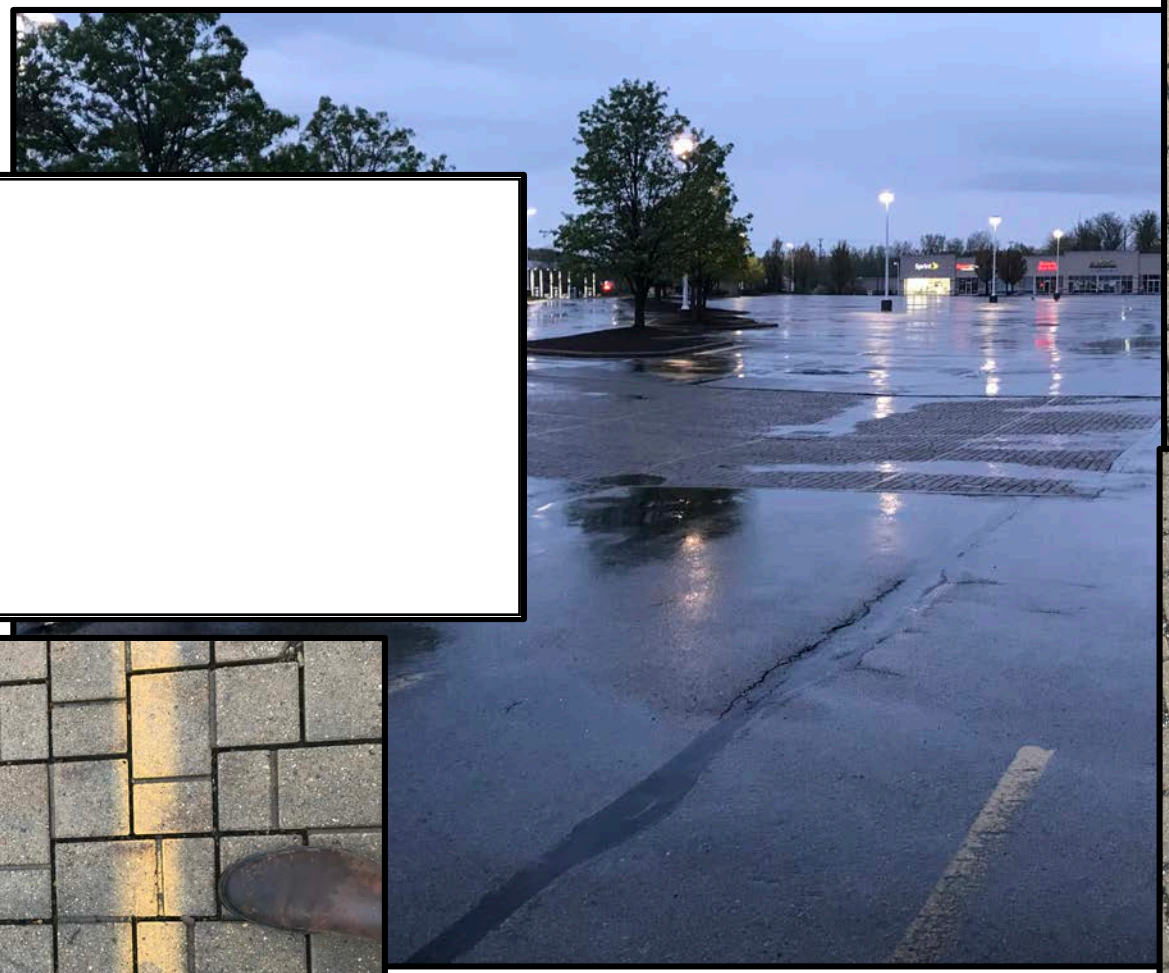
Surface Infiltration Rate Testing

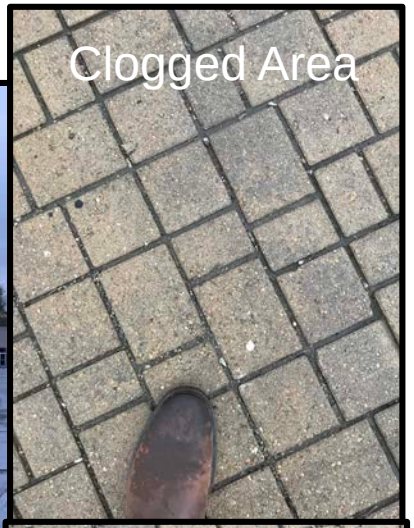
- Quarterly testing at 6 locations
  - Inform maintenance
  - Hot spots for clogging

Maintenance Test

- Site was 17 months old at time of maintenance
  - No previous maintenance
  - Moderately clogged (5-150 in/hr)
  - Maintenance performed April 25, 2019
  - 5-15 passes with regenerative air street sweeper
  - Maintenance took 45 mins + 15 mins to add new chip stone

Maintenance





Maintenance Results

ASTM Test

Location	Date	Inf Rate (in/hr)		Date	Inf Rate (in/hr)
1	4/24/2019	27.7	4/25/19 Maintenance	4/30/2019	2.1
2		142.3			10.4
3		5.7			4.2
4		44.8			9.7
5		53.8			35.2
6		27.8			10.5

Simple Infiltrometer

Location	Date	Inf Rate (in/hr)		Date	Inf Rate (in/hr)
1	4/24/2019	20.7	4/25/19 Maintenance	4/30/2019	7.2
2		144.7			25.5
3		5.2			5.7
4		24.4			10.9
5		92.0			55.9
6		26.1			11.6

Summary of Maintenance

- Decline in infiltration rate following maintenance at 5/6 testing locations
  - Have not observed this in ~5 rounds of pre/post infiltration testing since 2014 when using a regenerative air sweeper
  - Perhaps related to rain during maintenance?

The Path Forward…

- Continue to monitor and maintain GI at Reynoldsburg store in support of Meijer's sustainability mission
- Does bioretention performance get better with time?
- Understand long-term permeable pavement maintenance frequency/cost
- See you at a future OH SWC!


Questions?
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