

ASSESSMENT OF INFILTRATION PERFORMANCE AND MAINTENANCE OF PAVEDRAIN PAVEMENTS FOR TWO APPLICATIONS IN LOUISVILLE, KY



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**CENTER FOR
INFRASTRUCTURE RESEARCH**

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PROJECT BACKGROUND

- ❖ MSD's Consent Decree
to decrease the number and volume of overflows from
Louisville's combined sewer system
- ❖ CSO Mitigation by use of Green
Infrastructure Stormwater Controls
- ❖ CSO130 Sewershed Project

PROJECT BACKGROUND

❖ Monitoring Effort

- ✓ Multi-year effort to evaluate and establish long term trends
- ✓ Standardize Design and Maintenance Criteria
- ✓ Partnership
- ✓ USEPA monitoring of green management practices



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PROJECT BACKGROUND

❖ The Center for Infrastructure Research Role

- ✓ Monitoring Planning
- ✓ Instrumentation installation
- ✓ Maintenance support
- ✓ Hydrological Performance and Maintenance Assessment



PROJECT DESCRIPTION

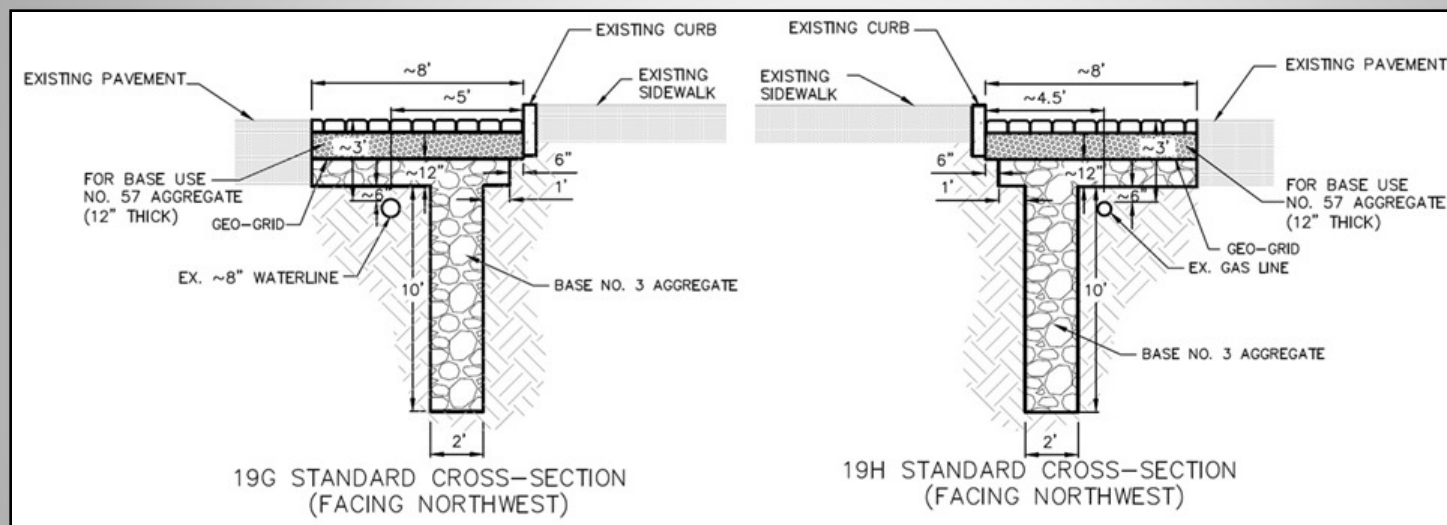
❖ CSO130 Sewershed

- ✓ Initial phase of the project started by installing two permeable pavement controls in December 2011



PROJECT DESCRIPTION

❖ CONTROLS 19G and 19H



Characteristic	Control 19H	Control 19G
Drainage Area (acre)	0.27	0.72
Impervious %	59%	61%
Impervious Area: Control's Area	<u>16:1</u>	<u>20:1</u>
Control's Length (ft)	55	120
Control's Width (ft)	8	8

PROJECT DESCRIPTION



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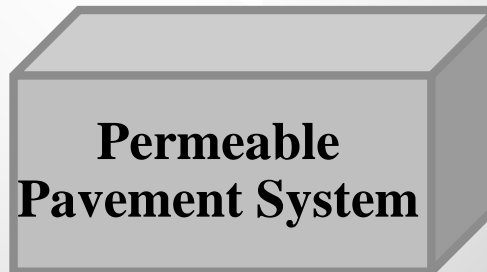
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MONITORING EFFORT

❖ Hydrological Performance

**Rainfall and
Storm Runoff**

**Infiltration
Capacity**



**Exfiltration
Performance**

MONITORING EFFORT

❖ Infiltration Capacity Monitoring

✓ Manual Surface Infiltration Measurements

Modified ASTM C1701

Four Locations Along the Curb Side

Tests were repeated periodically and within one week before and after each maintenance treatment



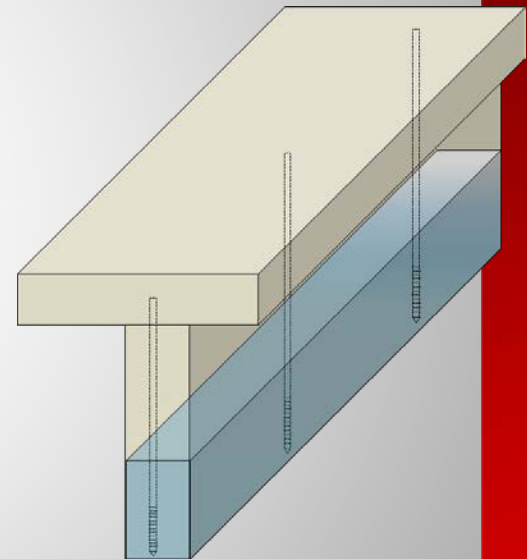
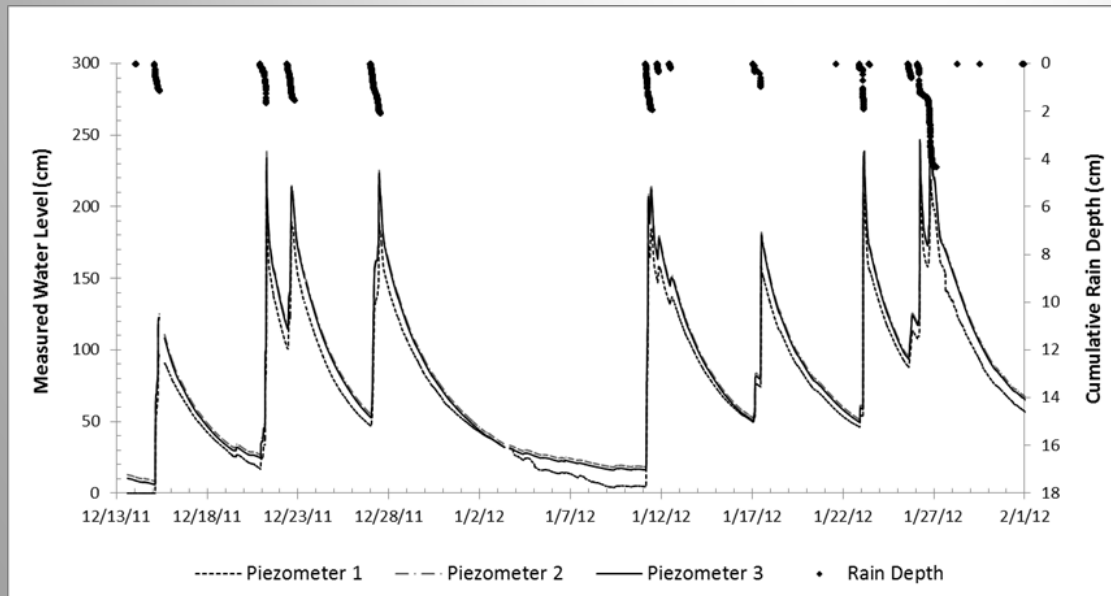
MONITORING EFFORT

❖ Infiltration Capacity Monitoring

✓ Electronic Measurements

Piezometers (water level logger)

Three locations at the bottom of the trench



MONITORING EFFORT

❖ Infiltration Capacity Monitoring

✓ Electronic Measurements

Based on the piezometer data a model was developed

The developed model predicts the ideal performance of the control and compares it to recorded data

This assessment technique is used to quantify the infiltration capacity and effectiveness of maintenance treatments

MONITORING EFFORT

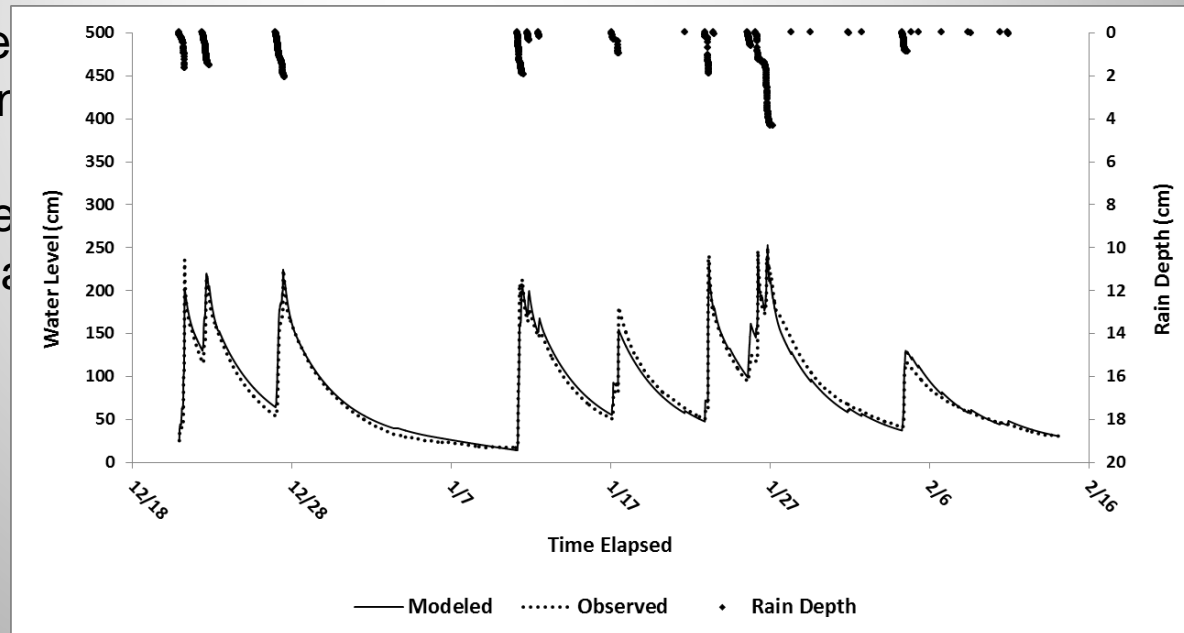
❖ Infiltration Capacity Monitoring

✓ Electronic Measurements

Based on the piezometer data a model was developed

The development of
control and

This assessment of
capacity and



BASELINE PERFORMANCE

❖ Surface Infiltration Tests

Average baseline infiltration rates: 1250 in/hr (3200 cm/hr)

❖ Electronic Measurements

Developed model confirmed that both GI controls captured 100% of the storm runoff

During the first 10 events controls 19G and 19H cumulatively captured 40,000 gallons of storm runoff.

Ratio of volume captured to runoff volume: 1:1

ADVANCEMENT OF CLOGGING

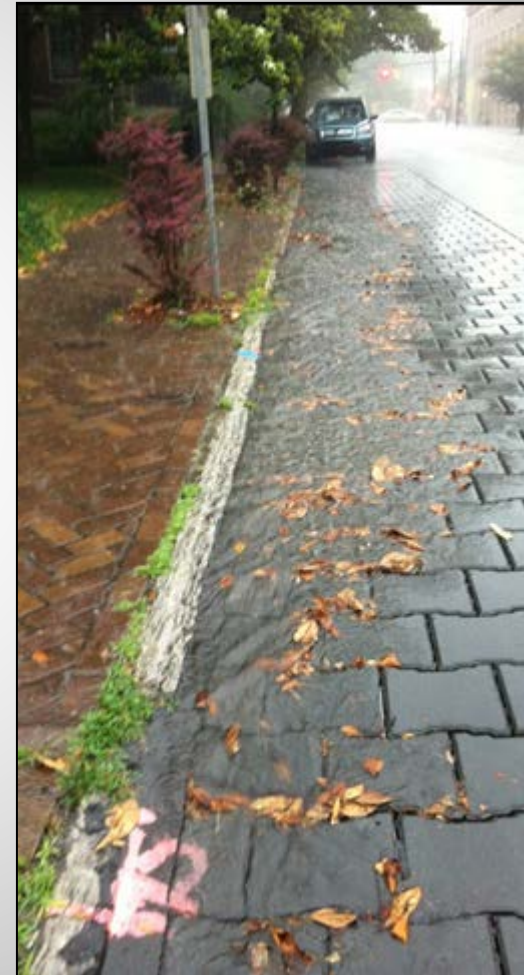
❖ Visual Inspections

Clogging advanced from the upgradient edge towards the downgradient edge and along the curb side

❖ Electronic Measurements

rate of clogging progression equal to:
10ft per an inch of rainfall

Once the clogging reached the downgradient edge the ratio of volume captured to runoff volume decreased (<1)... it was time for **maintenance!**



MAINTENANCE METHODS

❖ Three types of maintenance during 2012 and 2013

- ✓ Vacuum and Sweeping
- ✓ Pressurized Airjet
- ✓ Vac-Head

Maintenance Type	Number of Treatments
Vacuum & Sweeping	1
Pressurized Airjet	3
Vac-Head	1



MAINTENANCE METHODS

❖ Concerns with Airjet method



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MAINTENANCE METHODS

❖ Vac-Head Method

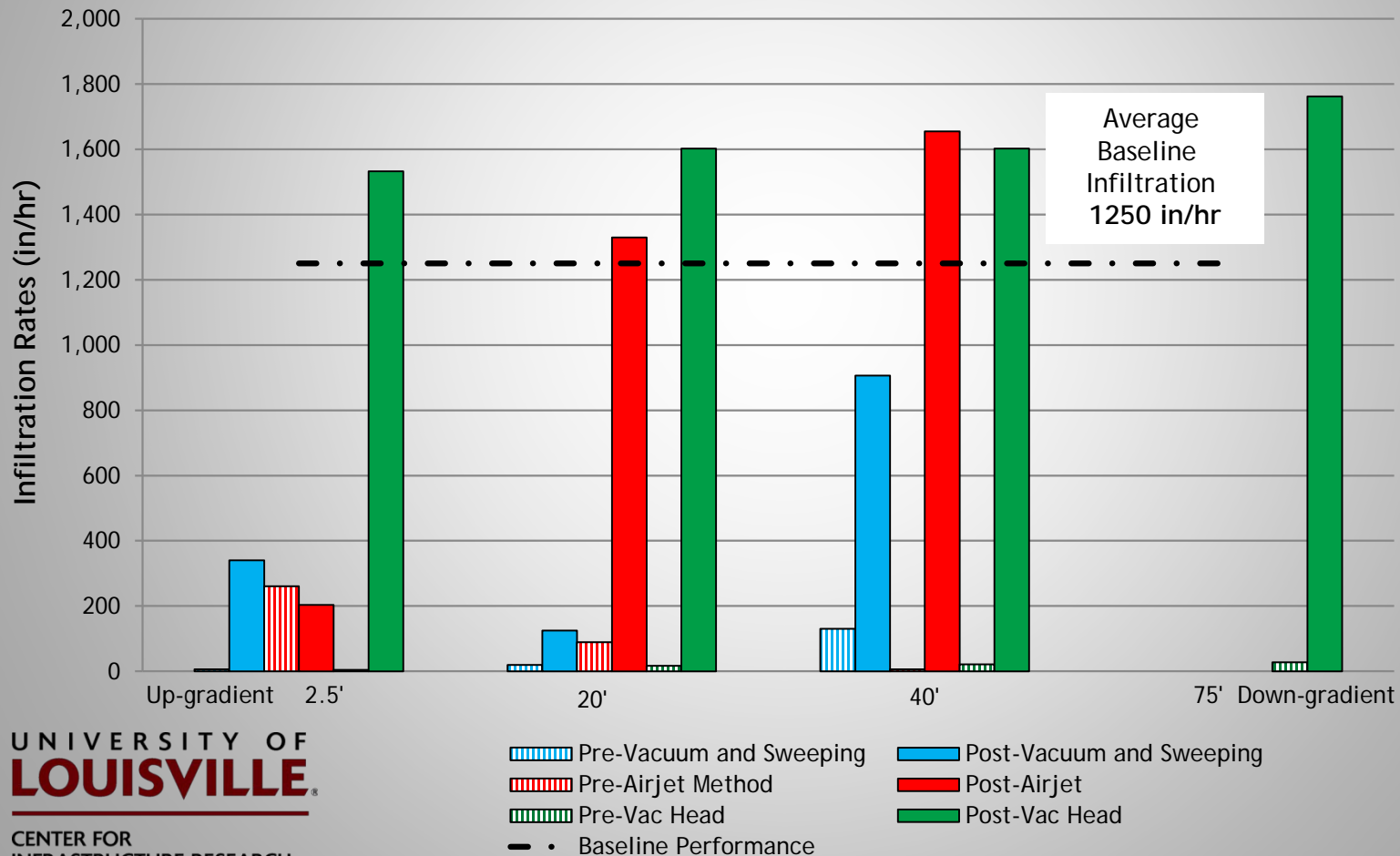


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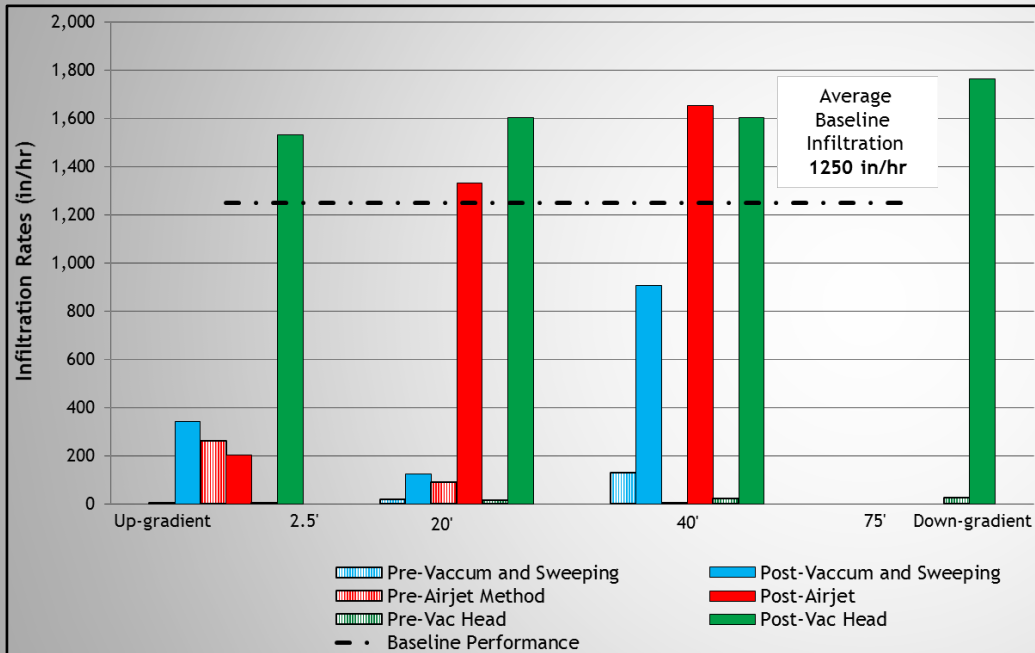
MAINTENANCE EFFECTIVENESS

❖ Surface Infiltration Tests Results (Control 19G)



MAINTENANCE EFFECTIVENESS

❖ Surface Infiltration Tests Results (Control 19G)



- Vacuum & Sweeping was **not** effective
- First airjet method was effective in most locations except for the up-gradient side
- Effectiveness of airjet method was decreased in second and third applications (not shown in the graph)

- **Vac-Head** method was able to restore the infiltration rates in **all** locations including the up-gradient side

MAINTENANCE EFFECTIVENESS

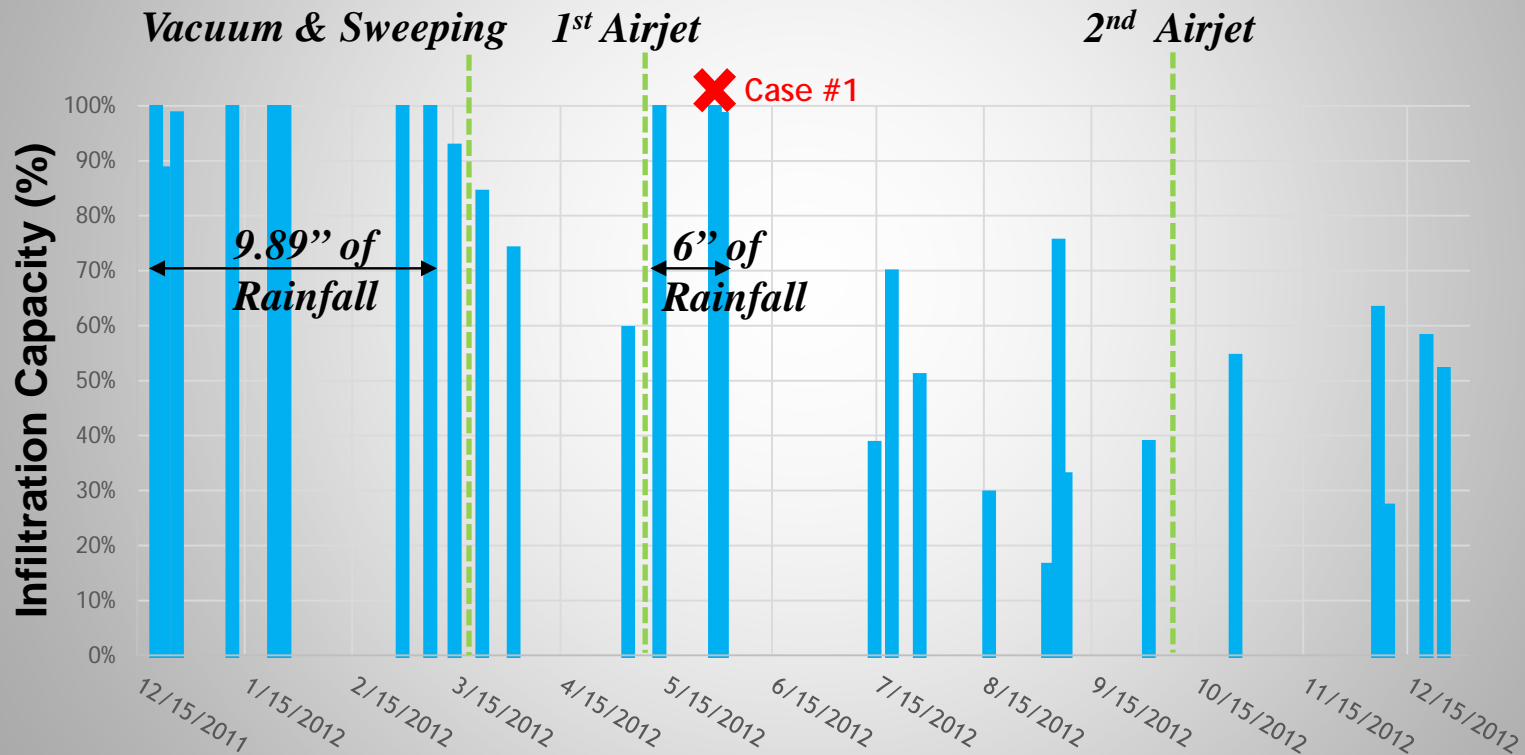
❖ Developed Model Results

Comparing the infiltration performance with baseline infiltration performance:

- ✓ How infiltration capacity changes with time?
- ✓ How effective surface maintenance treatments are?

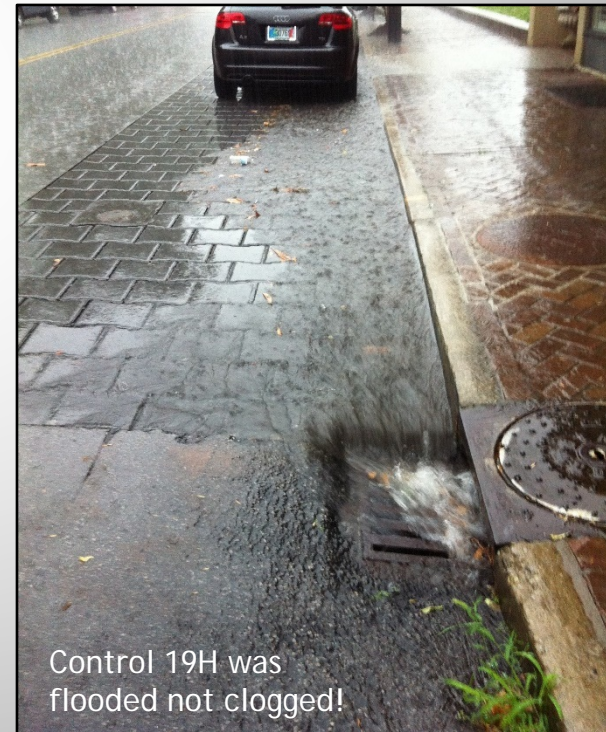
MAINTENANCE EFFECTIVENESS

❖ Developed Model Output (Control 19G)

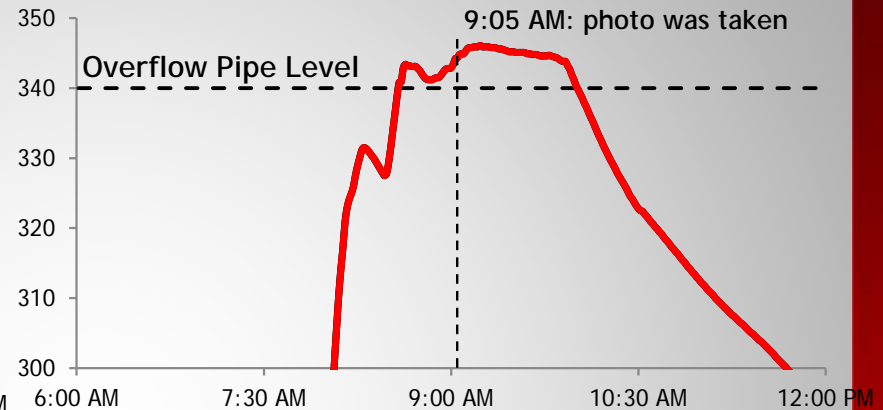
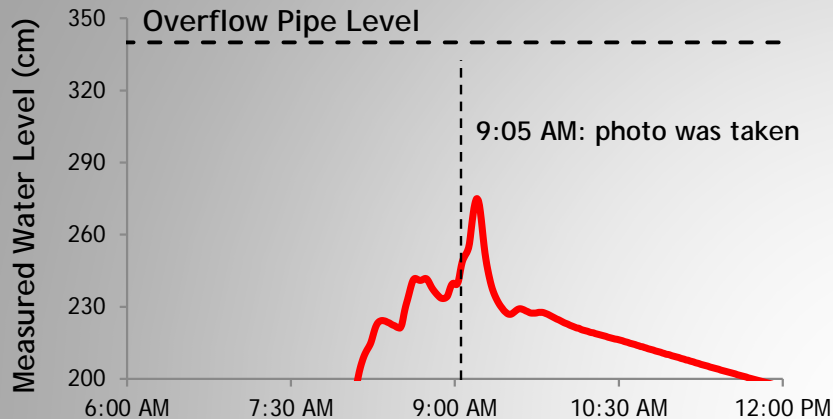


CASE #1: STORM EVENT 5/29/12

- ✓ Rainfall depth: 2.26 in
- ✓ Duration: 7 hours
- ✓ Max Intensity: 1.20 in/hr
- ✓ Controls 19G & 19H cumulatively captured: 16,181 Gallons
- ✓ 19G captured all runoff
- ✓ The only time that control 19H flooded

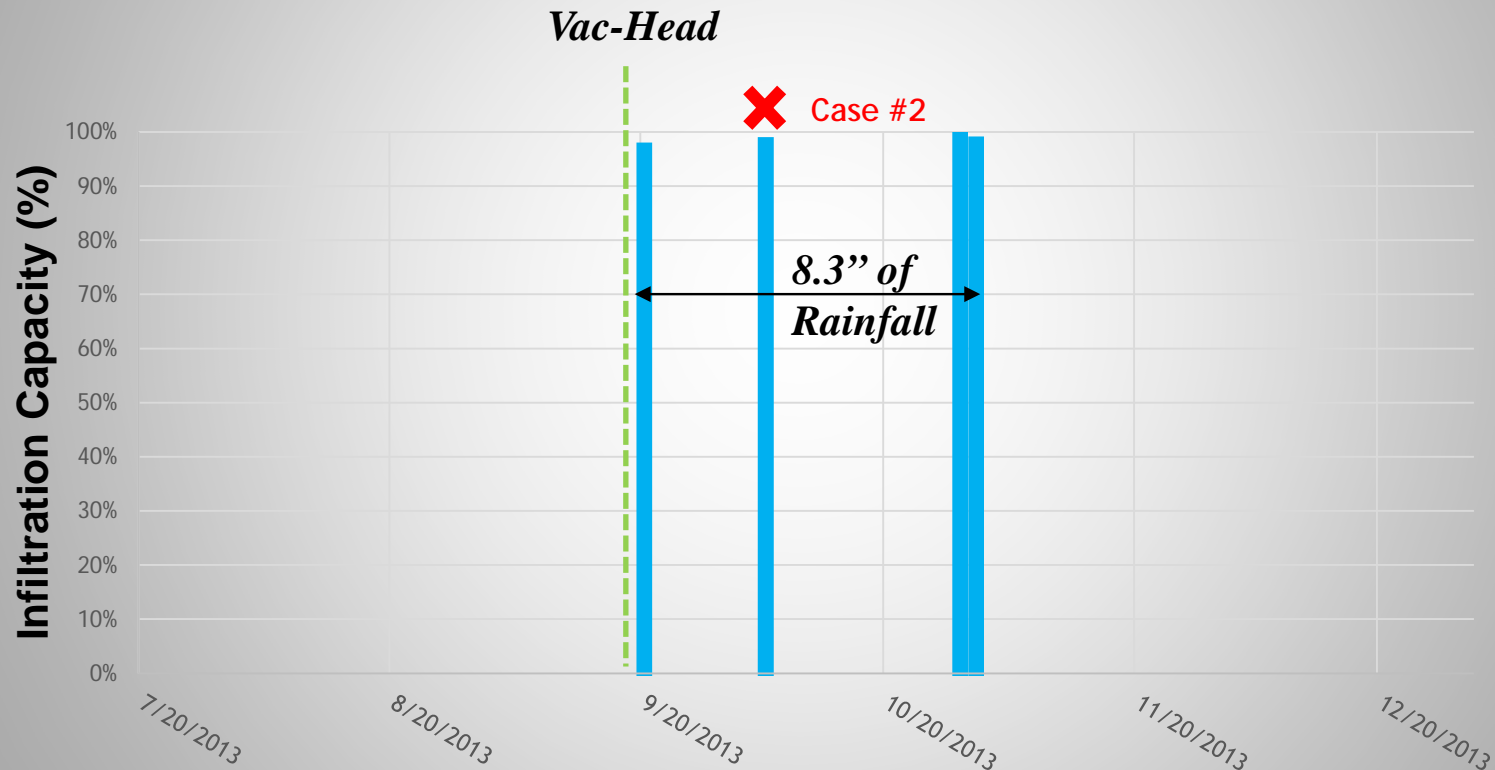


CASE #1: STORM EVENT 5/29/12



MAINTENANCE EFFECTIVENESS

❖ Developed Model Output (Control 19G)



CASE #2: STORM EVENT 10/5/13

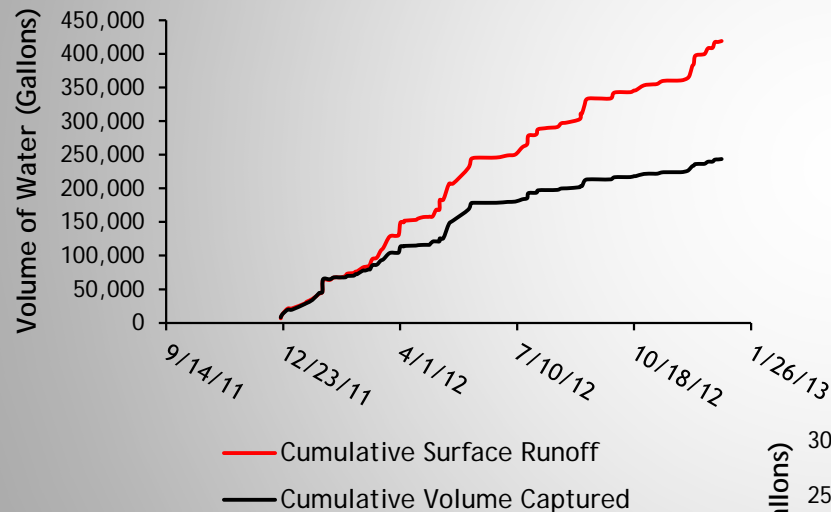
- ✓ Rainfall depth: 4.47 in
- ✓ Duration: 35 hours
- ✓ Max Intensity: 1.68 in/hr
- ✓ Controls 19G captured all surface runoff from its drainage area
- ✓ Volume Captured: 15,700 Gallons
- ✓ Control 19G was cleaned with Vac-Head method 17 days ago



Control 19G

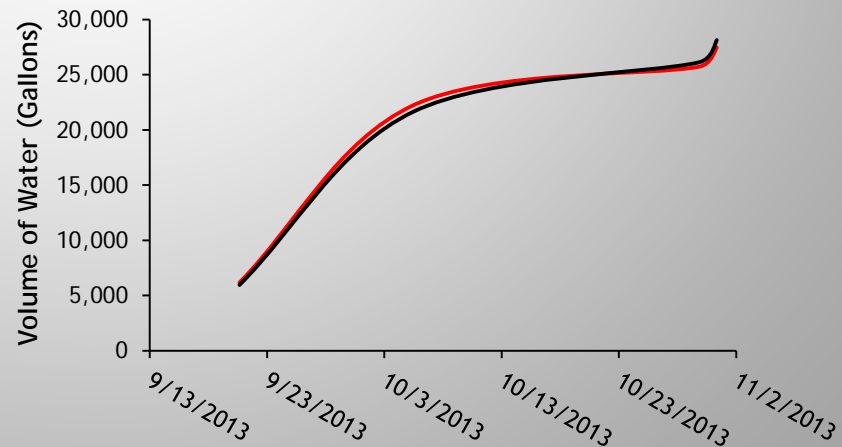
CONCLUSIONS

- ❖ Results indicate that unclogged and properly maintained PaveDrain® blocks, were able to capture all stormwater runoff flowing into GI controls 19G & 19H



Infiltration Rates:
1250 in/hr - 1600 in/hr

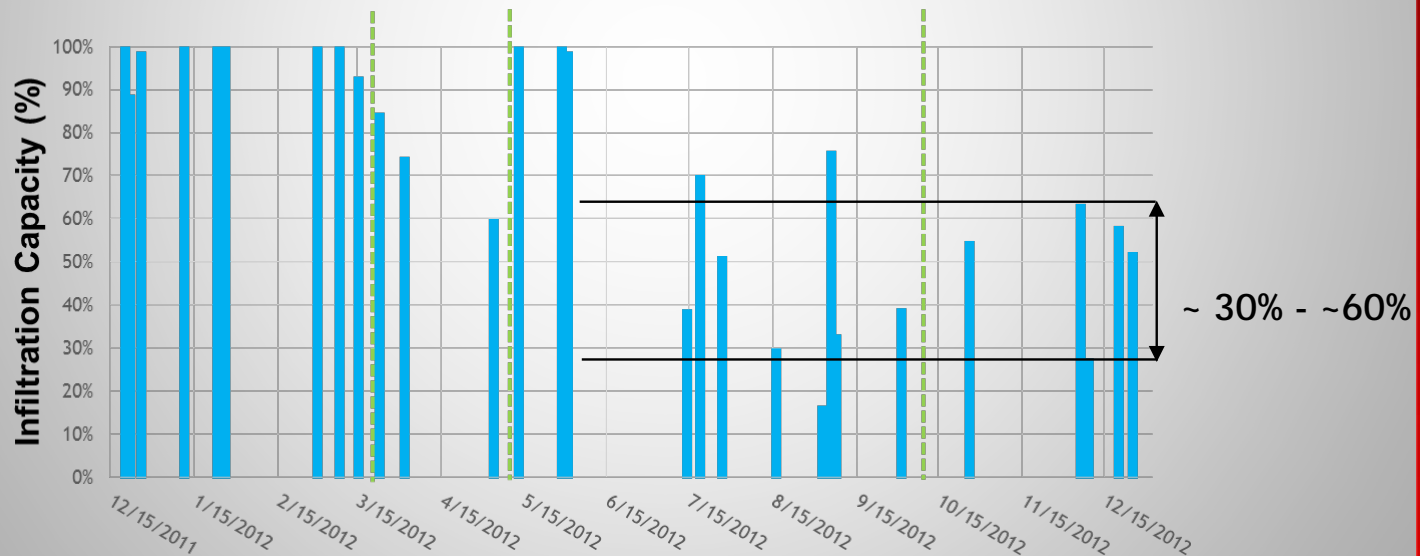
Volume Captured in 1st year:
~250,000 Gallons



CONCLUSIONS

❖ Clogged but still functional!

- ✓ Minimum Infiltration Rates: 4-15 in/hr
- ✓ Infiltration Capacity: 30% - 60%



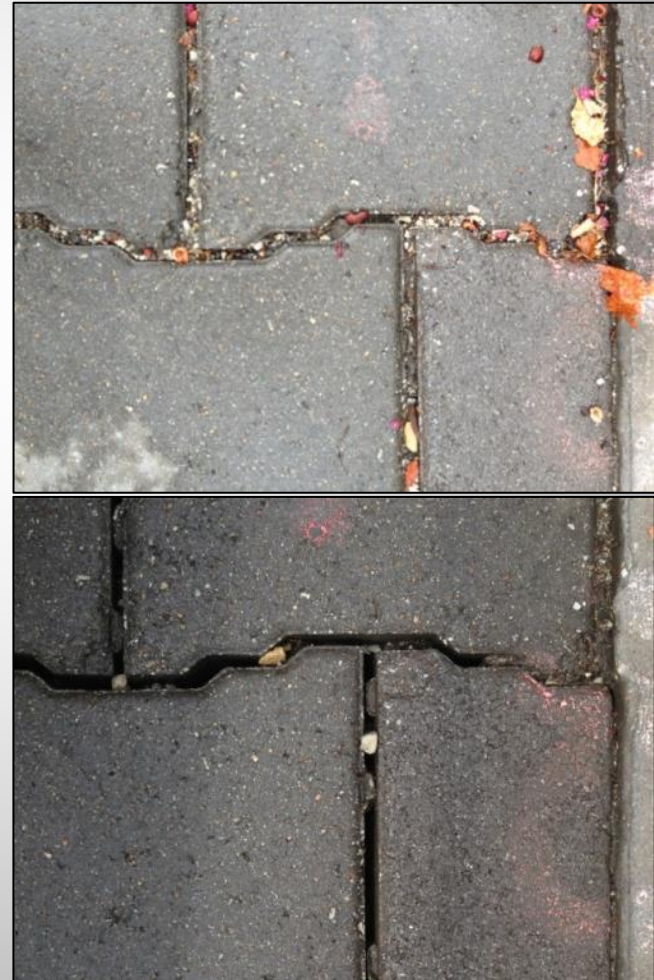
Infiltration capacity: ratio of initial (unclogged) infiltration performance to current infiltration performance
Each maintenance is identified with a vertical green line.

CONCLUSIONS

❖ Infiltration Capacity Can be Restored!

❖ Type of Maintenance treatment is important

❖ Pre & Post Maintenance
Vac-Head Method ➡



THANK YOU!

❖ Questions?



❖ Contact Info

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