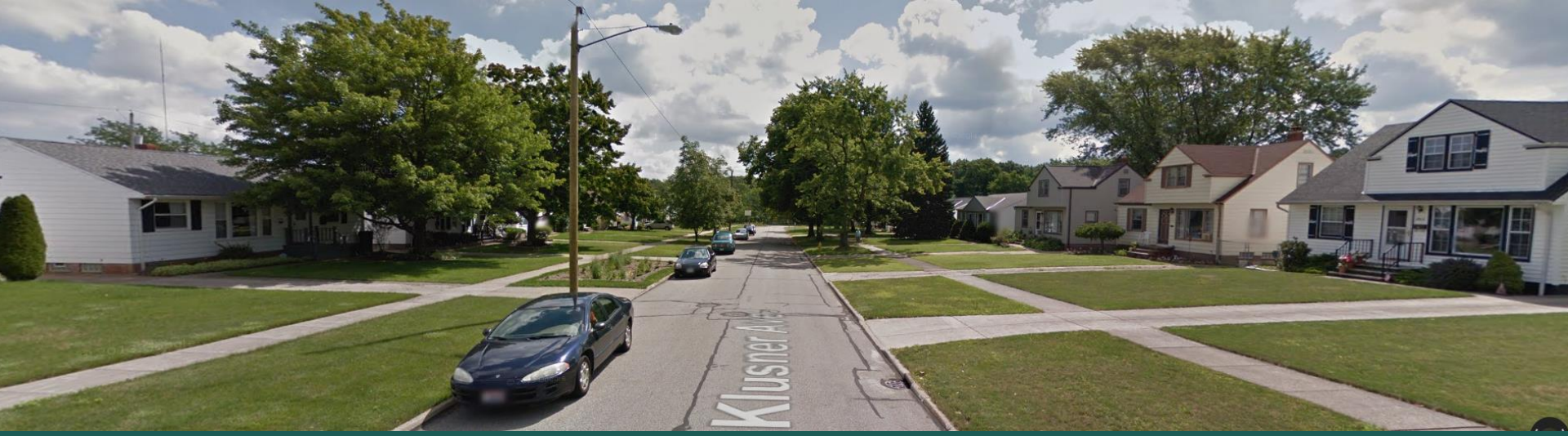

Retrofitting stormwater retention on headwater streets:

hydrologic effects of catchment-scale green infrastructure

#GSA2015

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Great Lakes RESTORATION

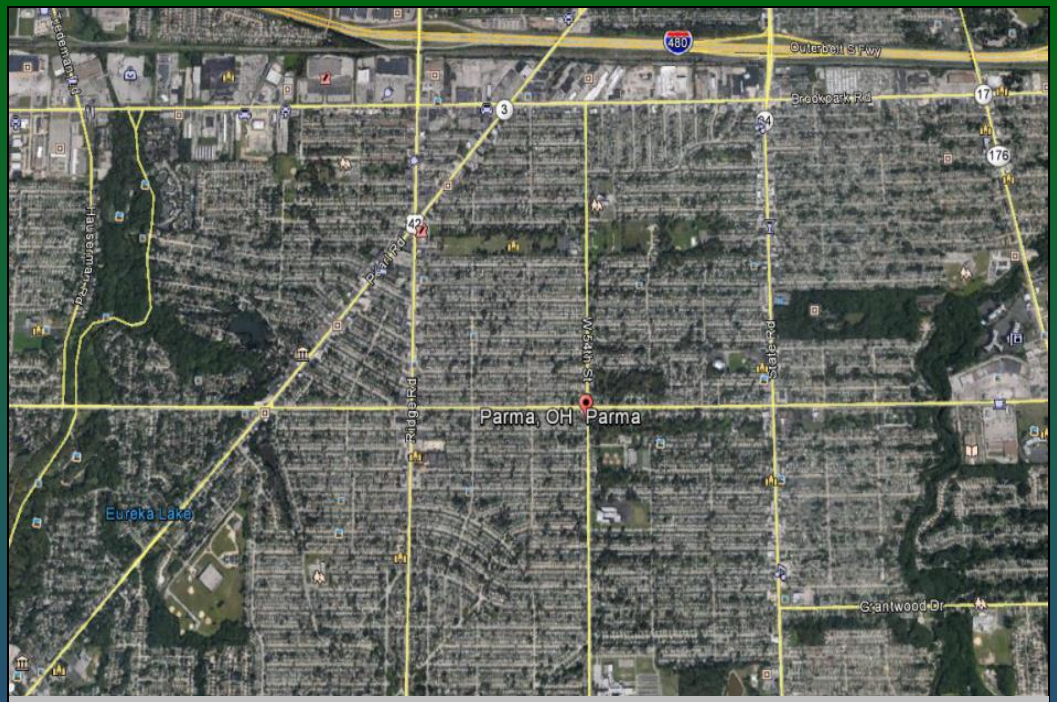
Green infrastructure

(aka low impact development, distributed stormwater management, source control)

Goal: disconnect impervious surfaces from sewer or stream to maintain pre-development hydrograph and water balance

Retrofitting stormwater controls

Already urbanized watersheds may require distributed approaches.



Parma, Ohio: Fully developed since 1950s

How effectively can green infrastructure mitigate urban stormflow?

- What effects do street scale green infrastructure investments including, rain gardens, street side bioretention, and rain barrels have on peak and total stormflows?
- What are the human dimensions of the story?

Jarden, Jefferson, and Grieser. *In press.* Assessing the effects of catchment-scale green infrastructure retrofits on hydrograph characteristics. *Hydrological Processes, doi: 10.1002/hyp.10736.*

Parma, Ohio
West Creek
(tributary to Cuyahoga)
35% impervious

West Creek

Control

Treatment

Mazepa Trail

Parkhaven Dr

Park Dr

Bruening Dr

Center Dr

Stanfield Dr

Klusner Ave

Esper Ave

Edgecliff Dr

Marda Dr

Jourden Ave

Broadview Rd

Treatment

Control

Klusner Ave.
55.5% impervious

37 Rain Barrels
7 Rain Gardens
16 Bioretention

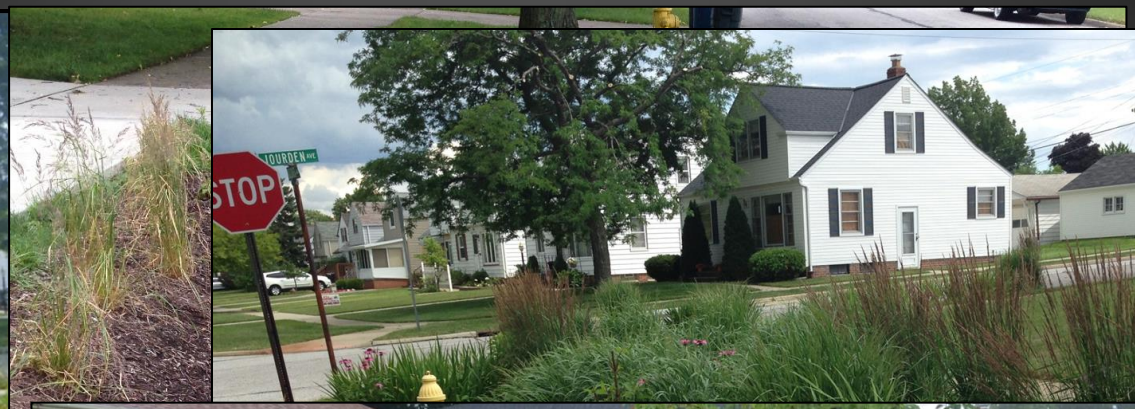
12.5% homeowner participation

Parkhaven Dr.
26.4% impervious

21 Rain Barrels
3 Rain Gardens
7 Bioretention

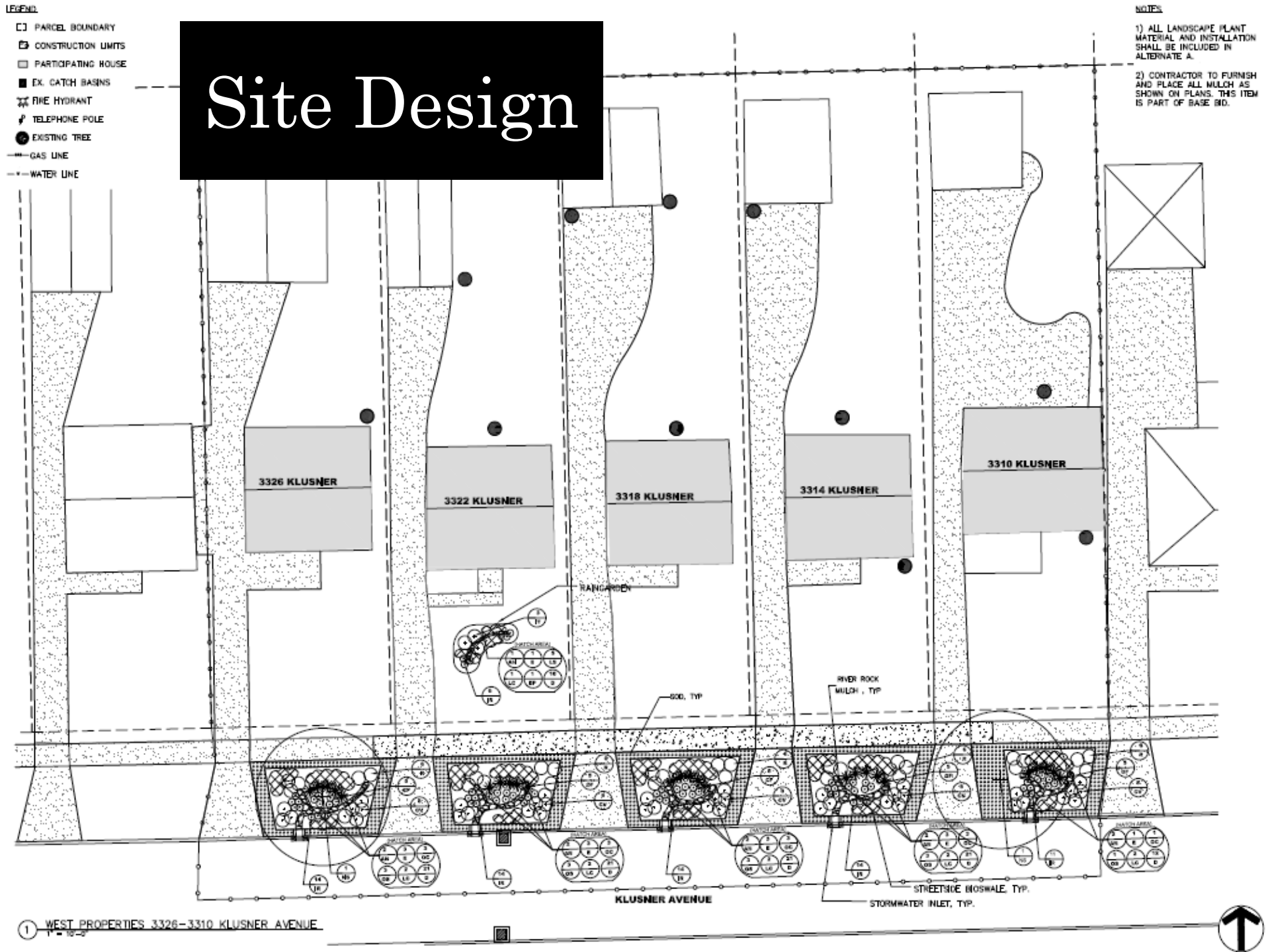
32.2% homeowner participation

Klusner Ave – Hetzel Dr



Parkhaven Dr – Mazepa Trail

Site Design


LEGEND
PARCEL BOUNDARY
CONSTRUCTION LIMITS
PARTICIPATING HOUSE
EX. CATCH BASINS
FIRE HYDRANT
TELEPHONE POLE
EXISTING TREE
GAS LINE
WATER LINE
NOTES
1) ALL LANDSCAPE PLANT MATERIAL AND INSTALLATION SHALL BE INCLUDED IN ALTERNATE A.
2) CONTRACTOR TO FURNISH AND PLACE ALL MULCH AS SHOWN ON PLANS. THIS ITEM IS PART OF BASE BID.
3326 KLUSNER
3322 KLUSNER
3318 KLUSNER
3314 KLUSNER
3310 KLUSNER
RAINGARDEN
SOD, TYP
RIVER ROCK MULCH , TYP
STREETSIDE BIOSWALE, TYP.
STORMWATER INLET, TYP.
KLUSNER AVENUE
1 WEST PROPERTIES 3326-3310 KLUSNER AVENUE
1" = 10'-0"

GI substantially reduced total stormflow.

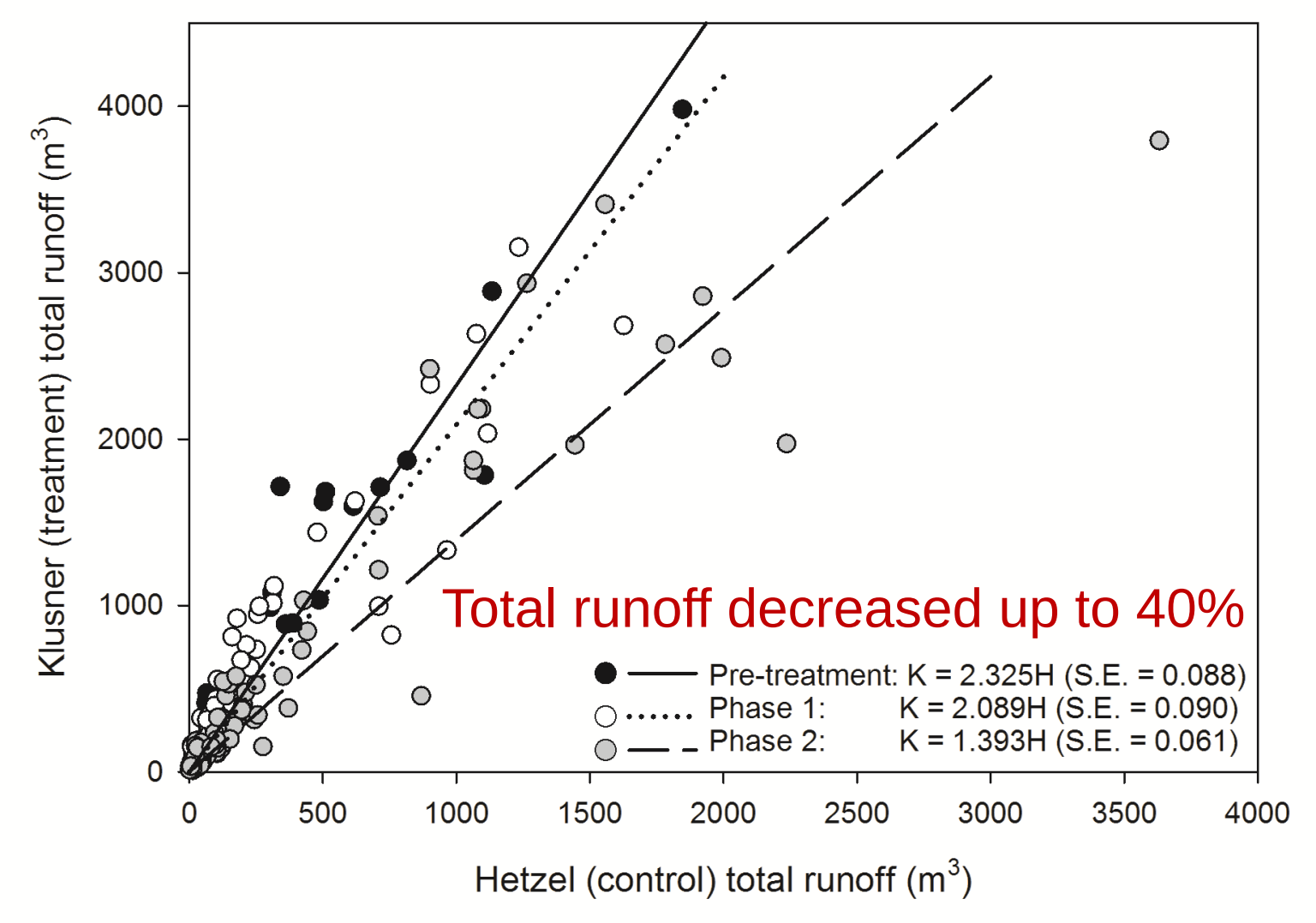
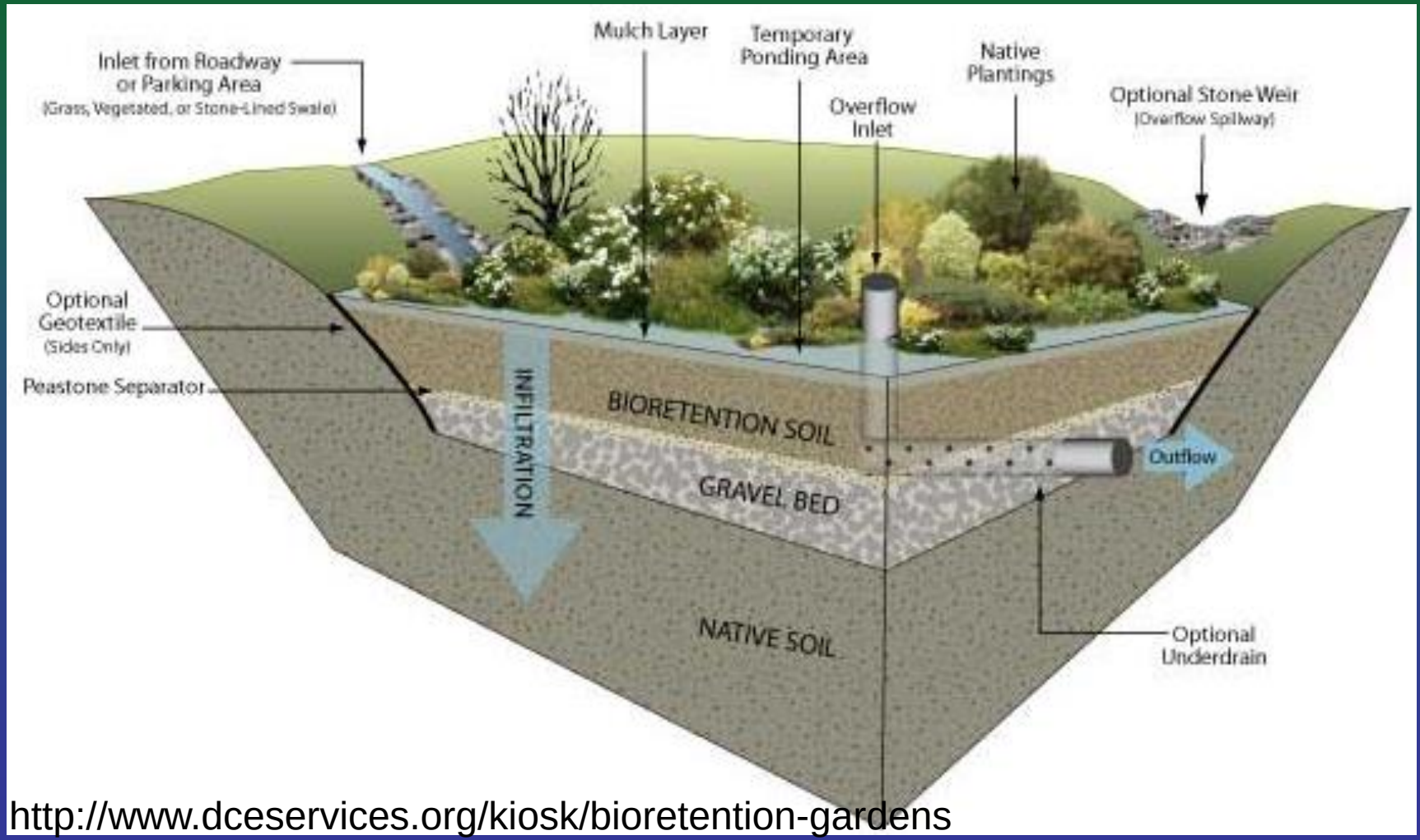


Figure 4

Jarden, Jefferson, and Grieser. *In press.* Assessing the effects of catchment-scale green infrastructure retrofits on hydrograph characteristics. *Hydrological Processes, doi: 10.1002/hyp.10736.*

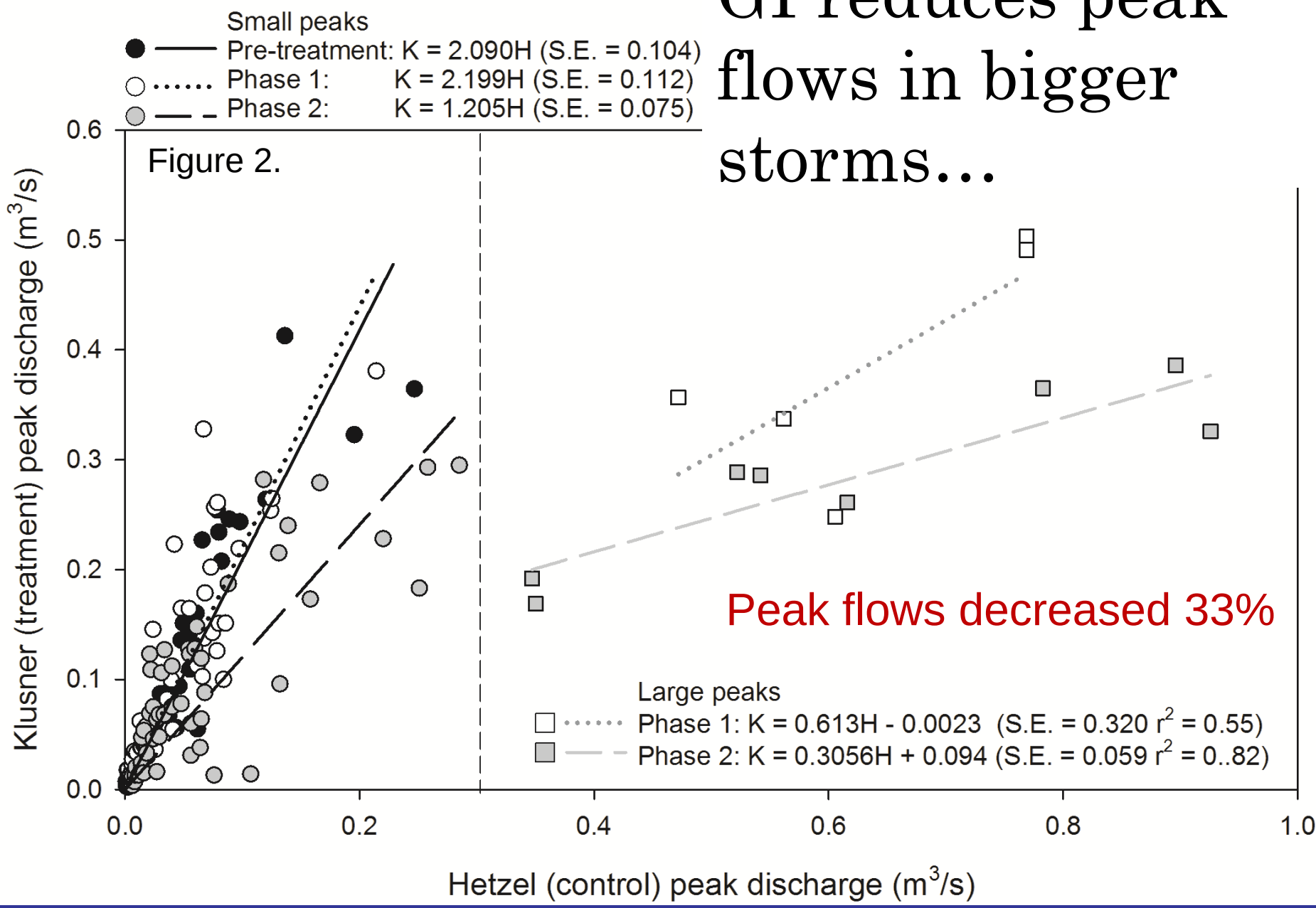
Why is Phase 2 so much better?

No Underdrains



http://www.dceservices.org/kiosk/bioretention-gardens

GI reduces peak flows in bigger storms…



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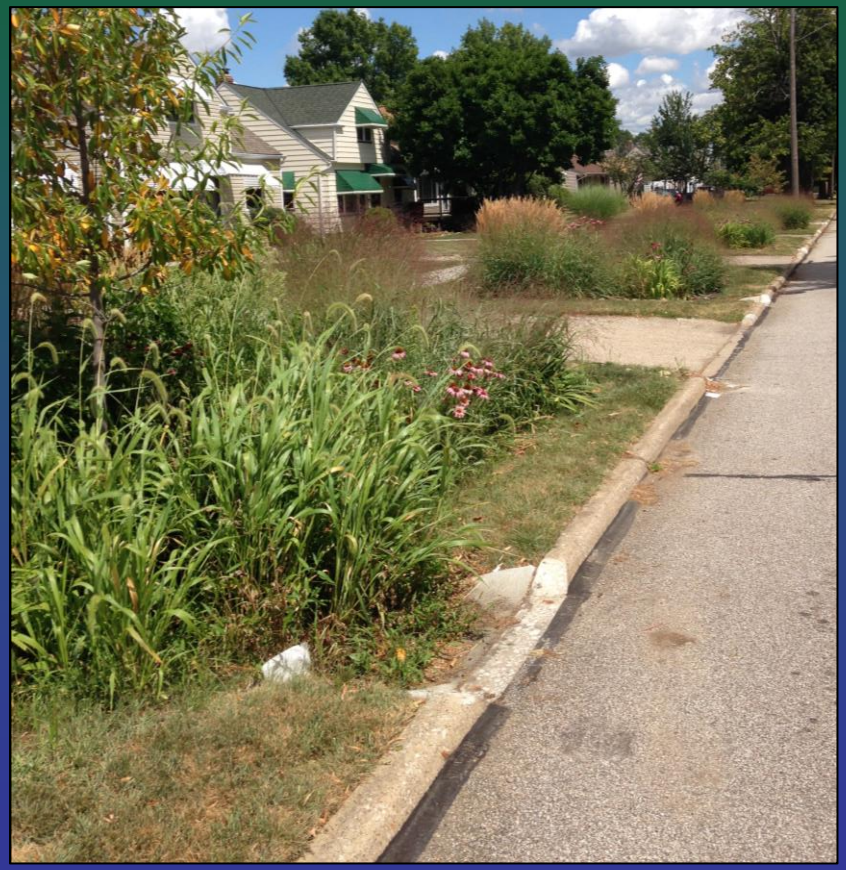
Slight design & construction differences matter.



Phase 1

Lag Time Analysis Shows Value of Underdrained GI

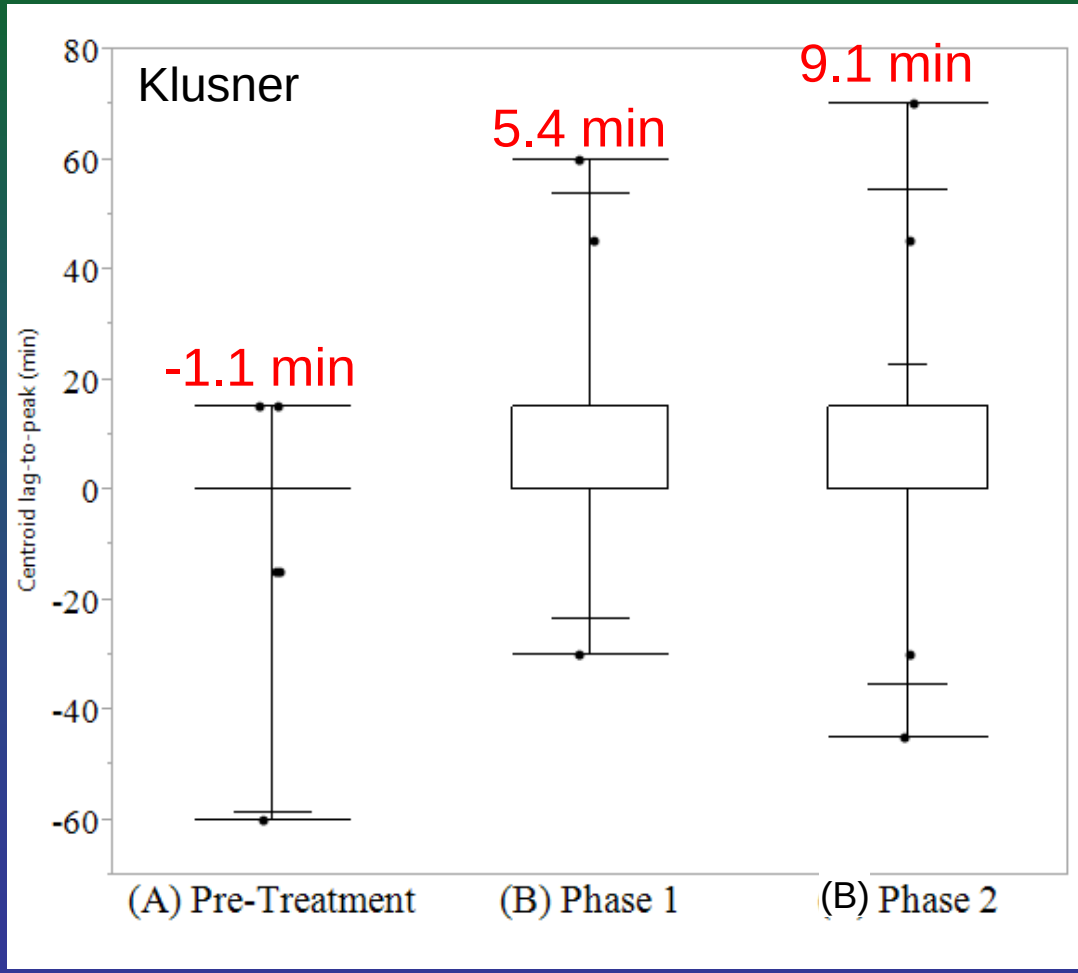
Centroid lag-to-peak

- Time from the centroid of precipitation to the peak of discharge (T_{LPC})

Compare Control to Treatment Street: C_{LPC} - T_{LPC}

- 0 if streets peak at same time

Adding GI with underdrains slowed down flow. Adding GI without underdrains didn't.



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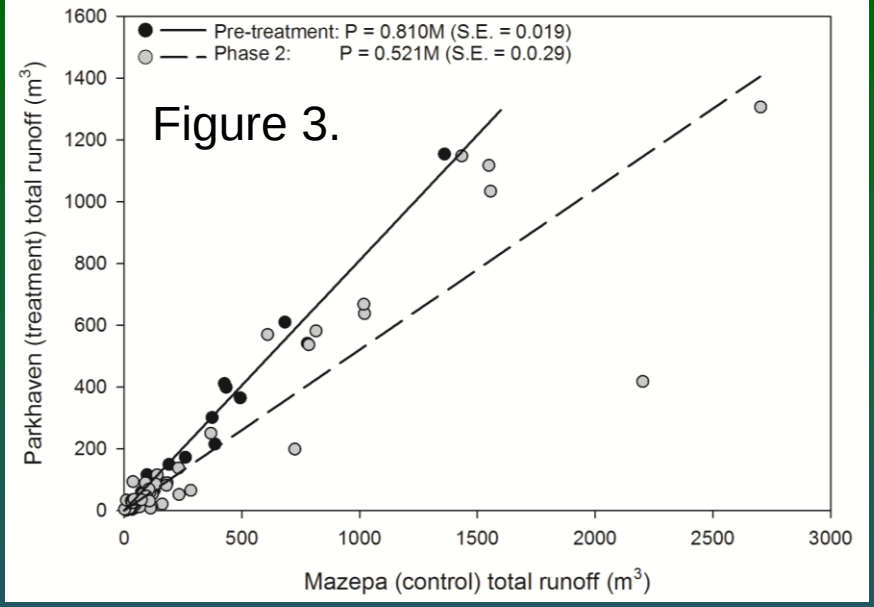

Figure 3.

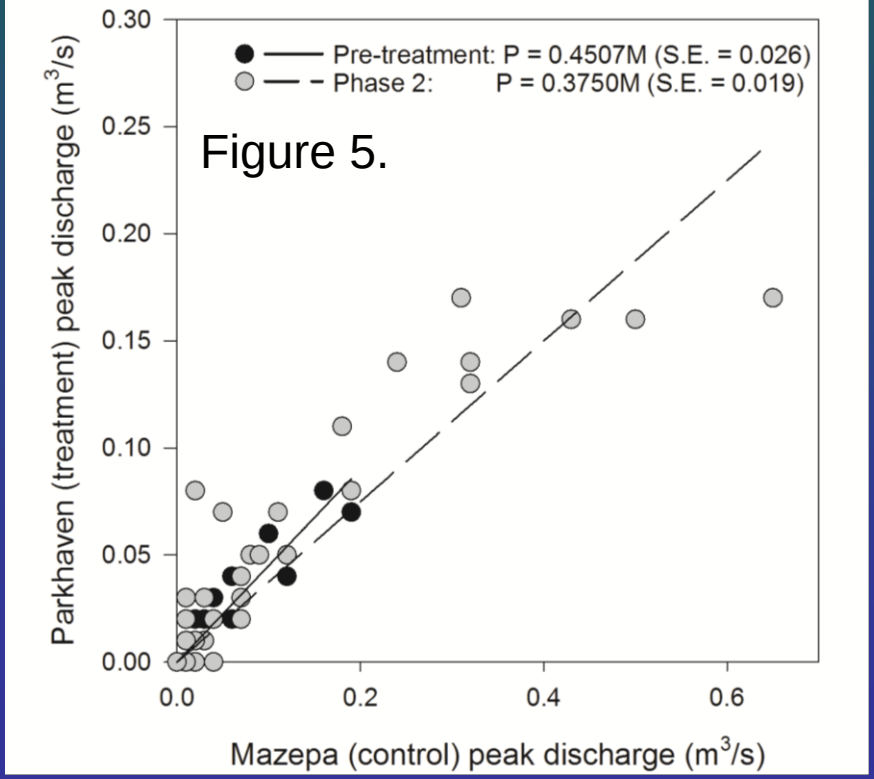

Figure 5.

Lower TI, higher GI street

Did road repairs offset the effect of the GI? Or did the GI not work?

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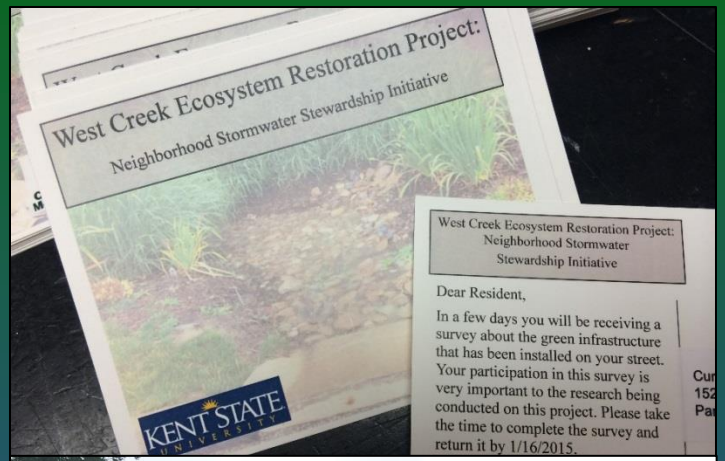
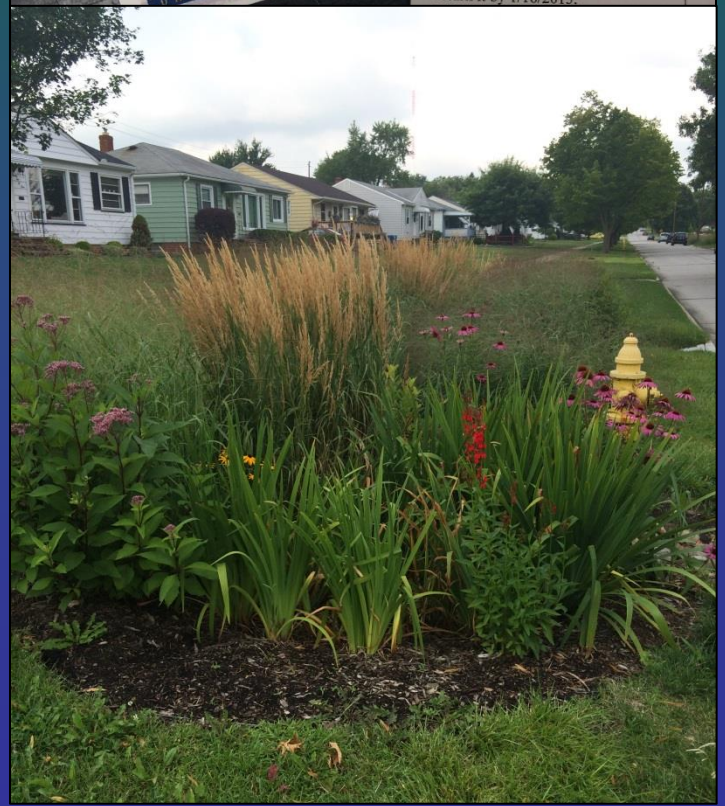
Scaling up to a (bigger) watershed

- 0.1% of watershed affected by this $300,000 project.
- 12 – 30% homeowner participation, even with incentives.
- Resident opinions sharply divided.
- Open question about long term performance.





How effectively can green infrastructure mitigate urban stormflow?

- Reductions in stormflow volumes & peak flows can be significant for street-scale green infrastructure retrofits.
- Need to achieve big hydrologic changes at street-scale and apply over large areas to see watershed-scale effects.

Real barriers to green infrastructure effectiveness may be humans.