

Making it Rainproof: Reimagining New Jersey's Water Infrastructure

Christopher C. Obropta, Ph.D., P.E.

Email: obropta@envsci.rutgers.edu

www.water.rutgers.edu



RUTGERS UNIVERSITY
Water Resources Program
New Jersey Agricultural Experiment Station



Rutgers Cooperative Extension

Rutgers Cooperative Extension (RCE) helps the diverse population of New Jersey adapt to a rapidly changing society and improves their lives through an educational process that uses science-based knowledge.





Water Resources Program



Our mission is to identify and address water resources issues by engaging and empowering communities to employ practical science-based solutions to help create a more equitable and sustainable New Jersey.

New Jersey

- Most densely populated state
- 21 counties, 565 municipalities
- 95% of our waterways are impaired
- 21 Combined Sewer Communities
- Harmful Algal Blooms (HABS) in many of our lakes
- Hammered by Ida, Henri, Sandy, and a bunch of nor'easters
- Climate change is real – more severe storms and sea level rise



Main Cause of Water Resources Problems in New Jersey

Urban/Suburban Land Use
Existing Development



Rutgers Role

- Engage communities in stormwater management planning
- Design demonstration projects
- Implement demonstration projects
- Empower community to do more
- Creating local champions

Let's talk about Combined Sewers and Climate Change

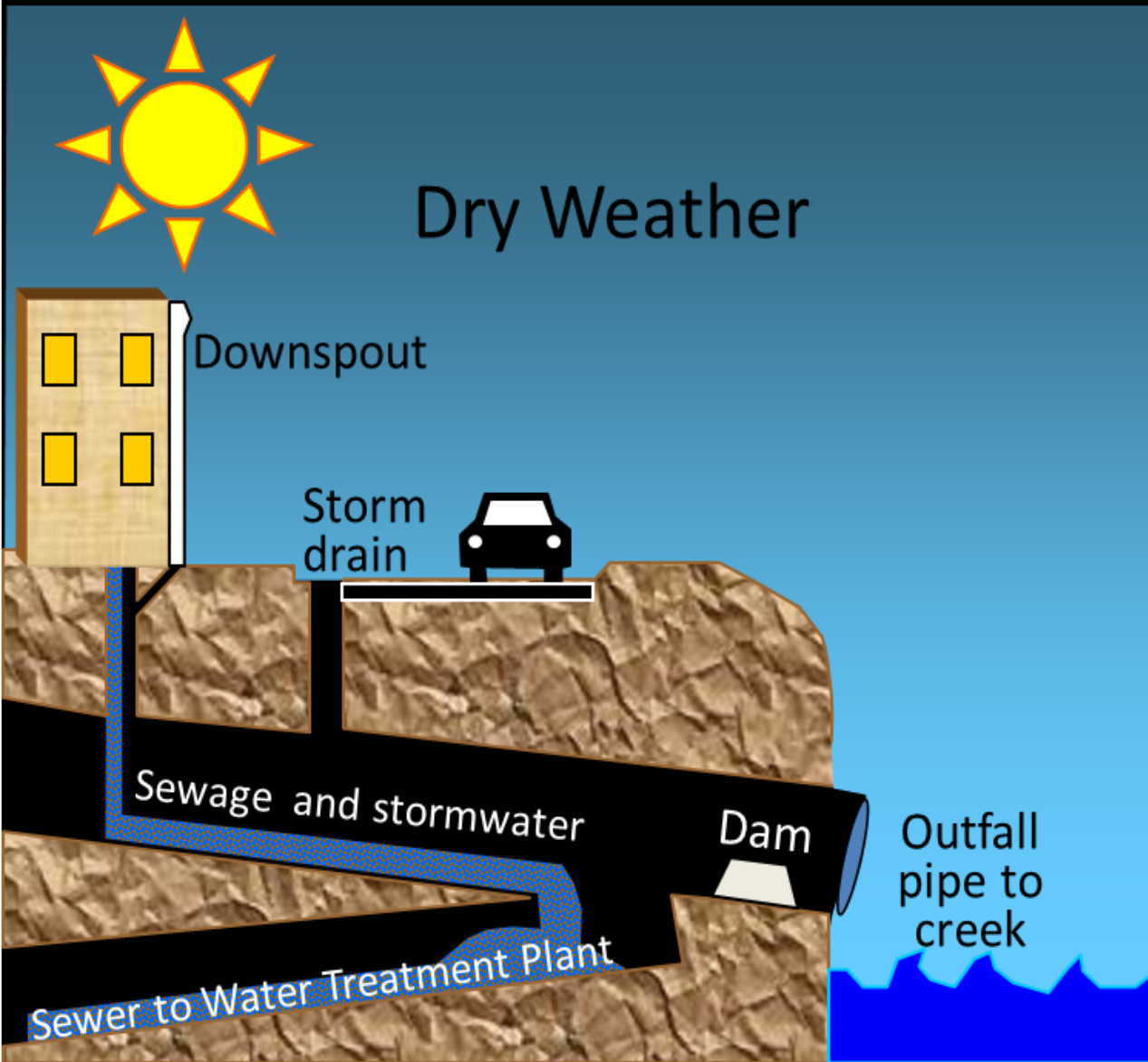


Combined Sewer Overflows (CSOs)

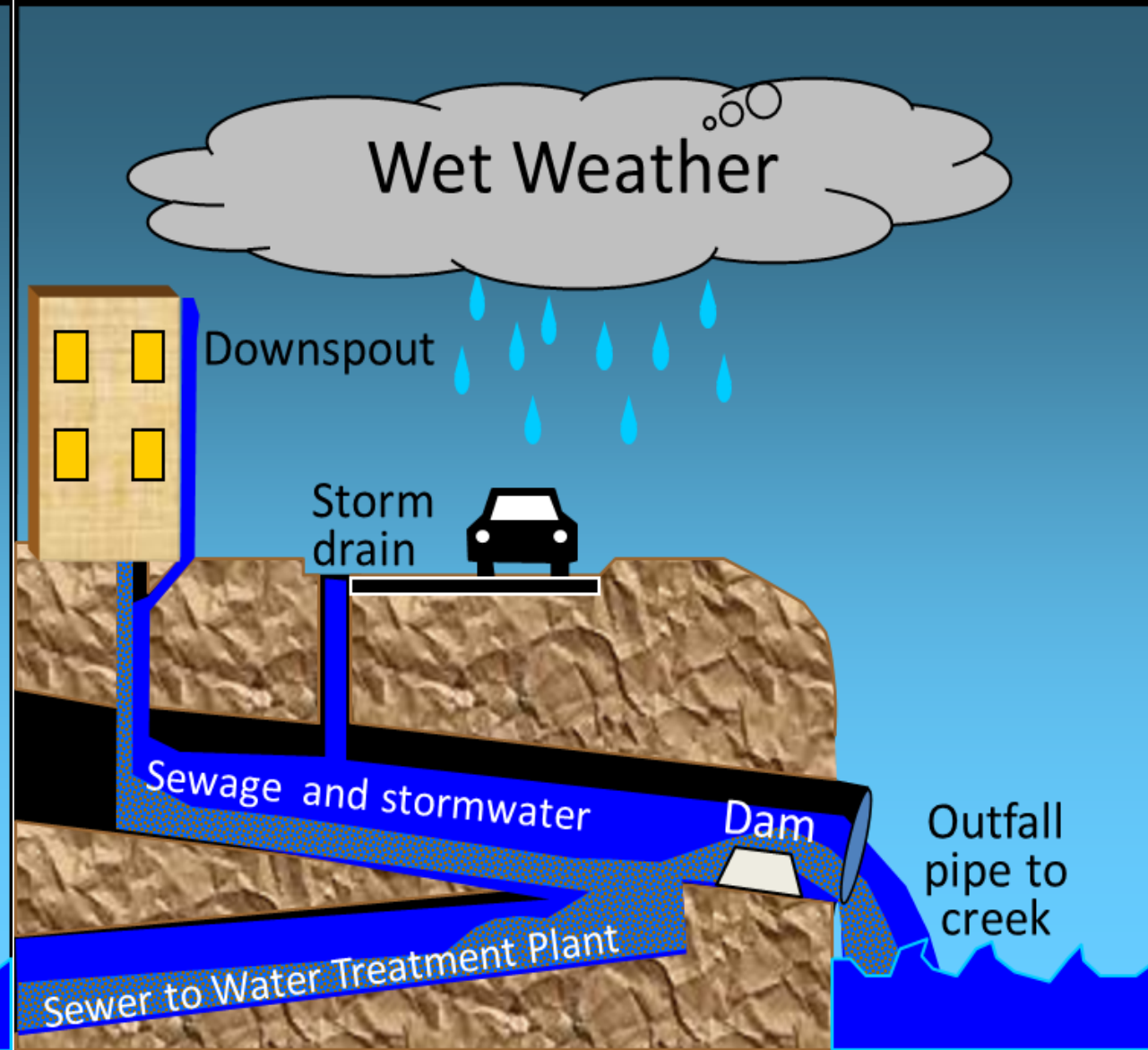


Municipality	Permit Holder Entity	County	# CSOs
Bayonne	Passaic Valley Sewerage Commission	Hudson	30
Camden City	Camden County Municipal Utilities Authority	Camden	28
CCMUA	Camden County Municipal Utilities Authority	Camden	1
East Newark	Passaic Valley Sewerage Commission	Hudson	1
Elizabeth	Joint Meeting of Essex & Union	Union	28
Fort Lee	Bergen County Utilities Authority	Bergen	2
Gloucester	Camden County Municipal Utilities Authority	Camden	7
Guttenberg	North Bergen Municipal Utilities Authority-Woodcliff	Hudson	1
Hackensack	Bergen County Utilities Authority	Bergen	2
Harrison	Passaic Valley Sewerage Commission	Hudson	7
Jersey City	Passaic Valley Sewerage Commission	Hudson	21
Kearny	Passaic Valley Sewerage Commission	Hudson	5
Newark	Passaic Valley Sewerage Commission	Essex	17
North Bergen	North Bergen Municipal Utilities Authority-Woodcliff	Hudson	1
North Bergen	Passaic Valley Sewerage Commission	Hudson	9
Paterson	Passaic Valley Sewerage Commission	Passaic	24
Perth Amboy	Middlesex County Utilities Authority	Middlesex	16
Ridgefield Park	Bergen County Utilities Authority	Bergen	6
Trenton	Trenton	Mercer	1
Union City	North Hudson Sewerage Authority-Adams	Hudson	8
West New York	North Hudson Sewerage Authority-West NY	Hudson	2
Total			217

Combined Sewer



Combined Sewer



Gray Infrastructure



Green Infrastructure



Green Infrastructure

...an approach to stormwater management that is cost-effective, sustainable, and environmentally friendly.

Green Infrastructure projects:

- capture,
- filter,
- absorb, and
- reuse

stormwater to maintain or mimic natural systems and treat runoff as a resource.



Green Infrastructure

Stormwater management practices that protect, restore, and mimic the native hydrologic condition by providing the following functions:

- Infiltration
- Filtration
- Storage
- Evaporation
- Transpiration



Green Infrastructure Practices

Bioretention Systems

- Rain Gardens
- Bioswales
- Stormwater Planters
- Curb Extensions
- Tree Filter Boxes

Permeable Pavements

Rainwater Harvesting

- Rain barrels
- Cisterns

Dry Wells

Rooftop Systems

- Green Roofs
- Blue Roofs

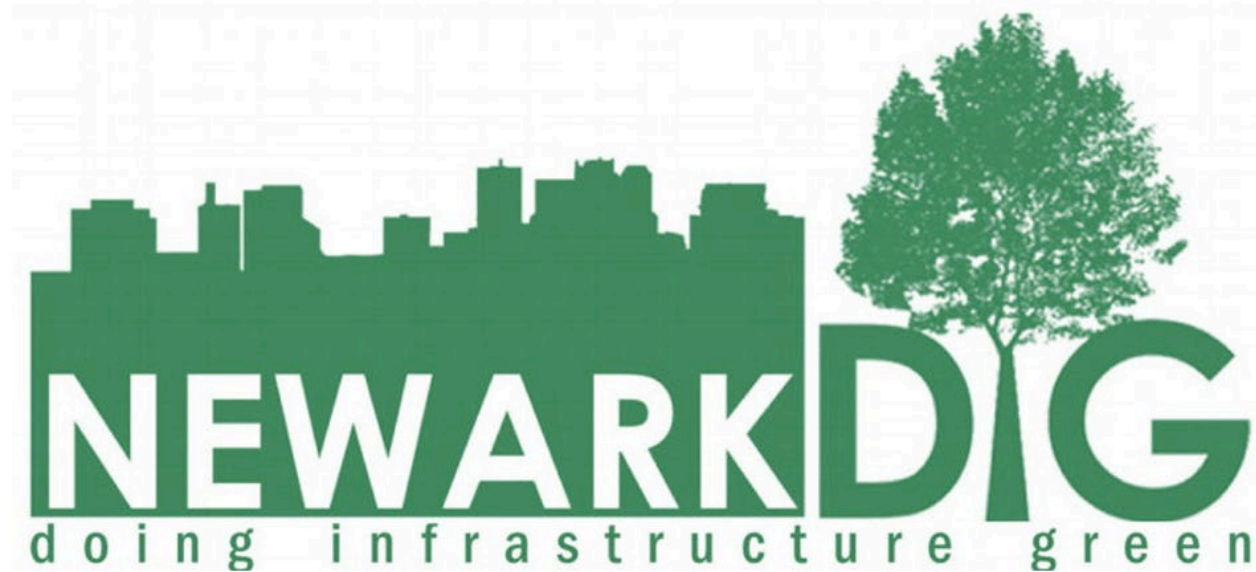


Parker Urban Greenscapes, 2009.

Green Infrastructure and Community Engagement

- Municipal Action Teams like:
 - Camden SMART
 - NewarkDIG
 - Perth Amboy SWIM
- Green Infrastructure Reformers
- Newark Greenworks





Newark DIG

est. 2013

Doing Infrastructure Green

www.newarkdig.org

Facebook @NewarkDIG

Twitter @NewarkNJ_DIG



Goodwin Ave Rain Garden



Miller Street Academy Rain Garden and Tree Planting



Sussex Ave Community Garden Cistern

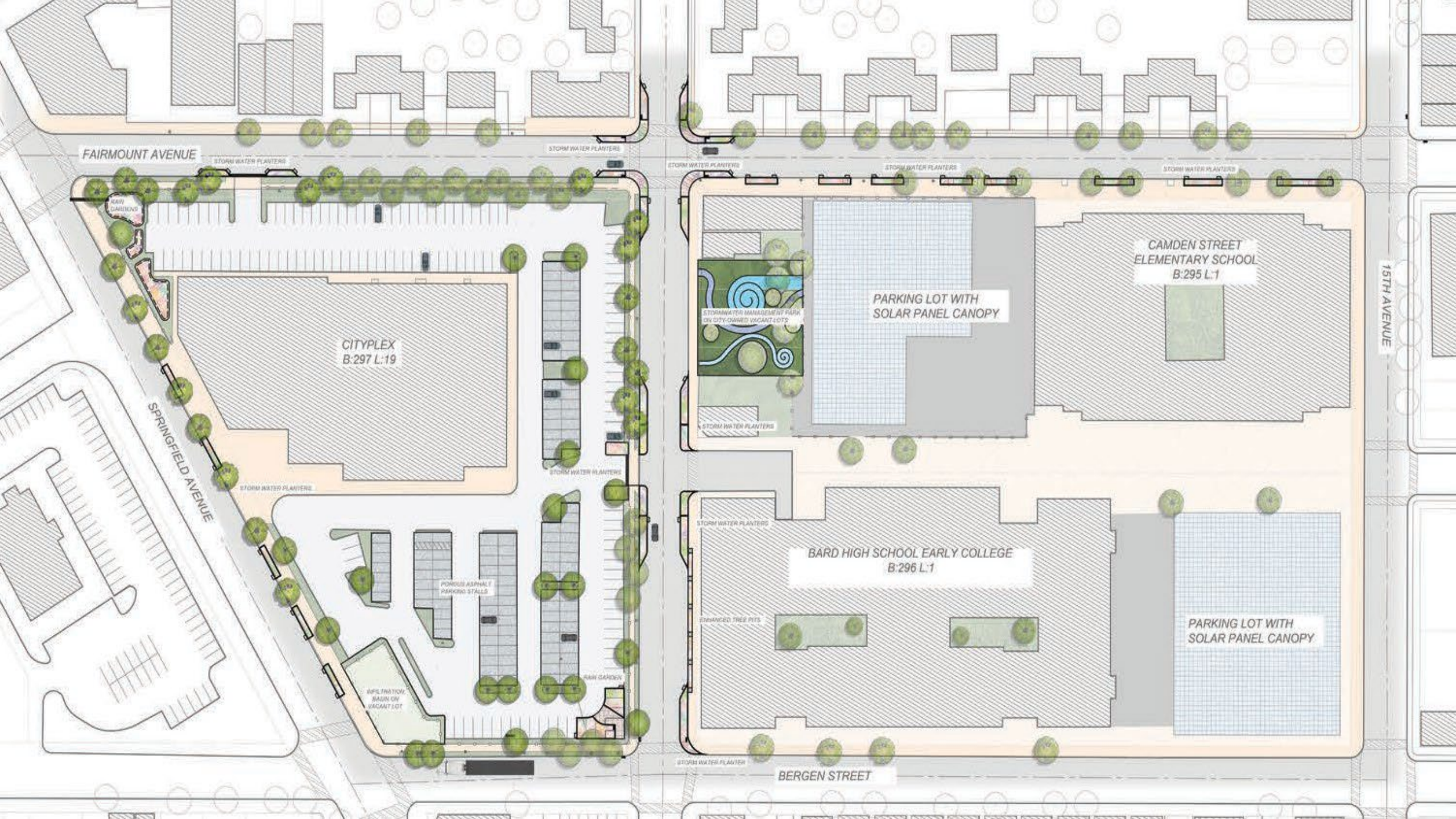


Vailsburg Park Rain Garden



Fairmount Avenue Green Streets Project

FAIRMOUNT AVENUE GREEN STREET CONCEPT PLAN
FAIRMOUNT AVENUE, 16TH AVENUE, SPRINGFIELD AVENUE,
CITYPLEX 12 NEWARK, ESSEX COUNTY, NEW JERSEY



FAIRMOUNT AVENUE

STORM WATER PLANTERS

STORM WATER PLANTERS

STORM WATER PLANTERS

STORM WATER PLANTERS

STORM WATER PLANTERS

15TH AVENUE

CITYPLEX
B:297 L:19

SPRINGFIELD AVENUE

STORM WATER PLANTERS

STORM WATER PLANTERS

STORM WATER PLANTERS

STORM WATER PLANTERS

BARD HIGH SCHOOL EARLY COLLEGE
B:296 L:1

ADVANCED TREE PITS

PARKING LOT WITH
SOLAR PANEL CANOPY

BERGEN STREET

STORM WATER PLANTERS

CAMDEN STREET
ELEMENTARY SCHOOL
B:295 L:1

PARKING LOT WITH
SOLAR PANEL CANOPY



STORMWATER MANAGEMENT PARK
ON CITY-OWNED VACANT LOTS

POROUS ASPHALT
PARKING STALLS

INFILTRATION
BASIN ON
VACANT LOT

RAIN GARDEN



CITYPLEX 12 RAIN GARDEN

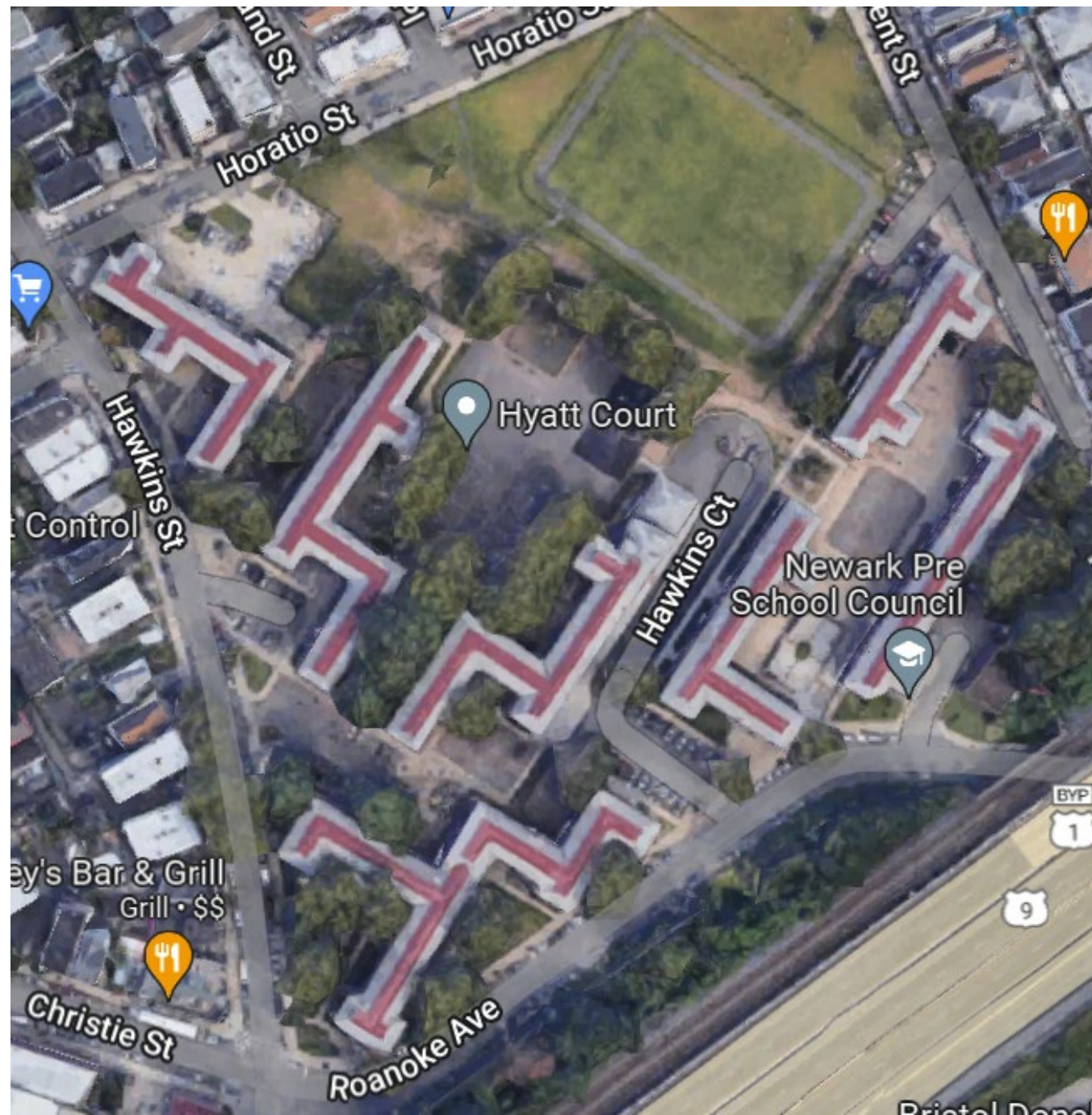
CITYPLEX 12, 16TH AVENUE, BERGEN STREET NEWARK,
ESSEX COUNTY, NEW JERSEY



16TH AVENUE STORMWATER PLANTERS

16TH AVENUE, CITYPLEX 12, BARD HIGH SCHOOL EARLY
COLLEGE NEWARK, ESSEX COUNTY, NEW JERSEY

Hyatt Court Housing Authority Green Infrastructure Project

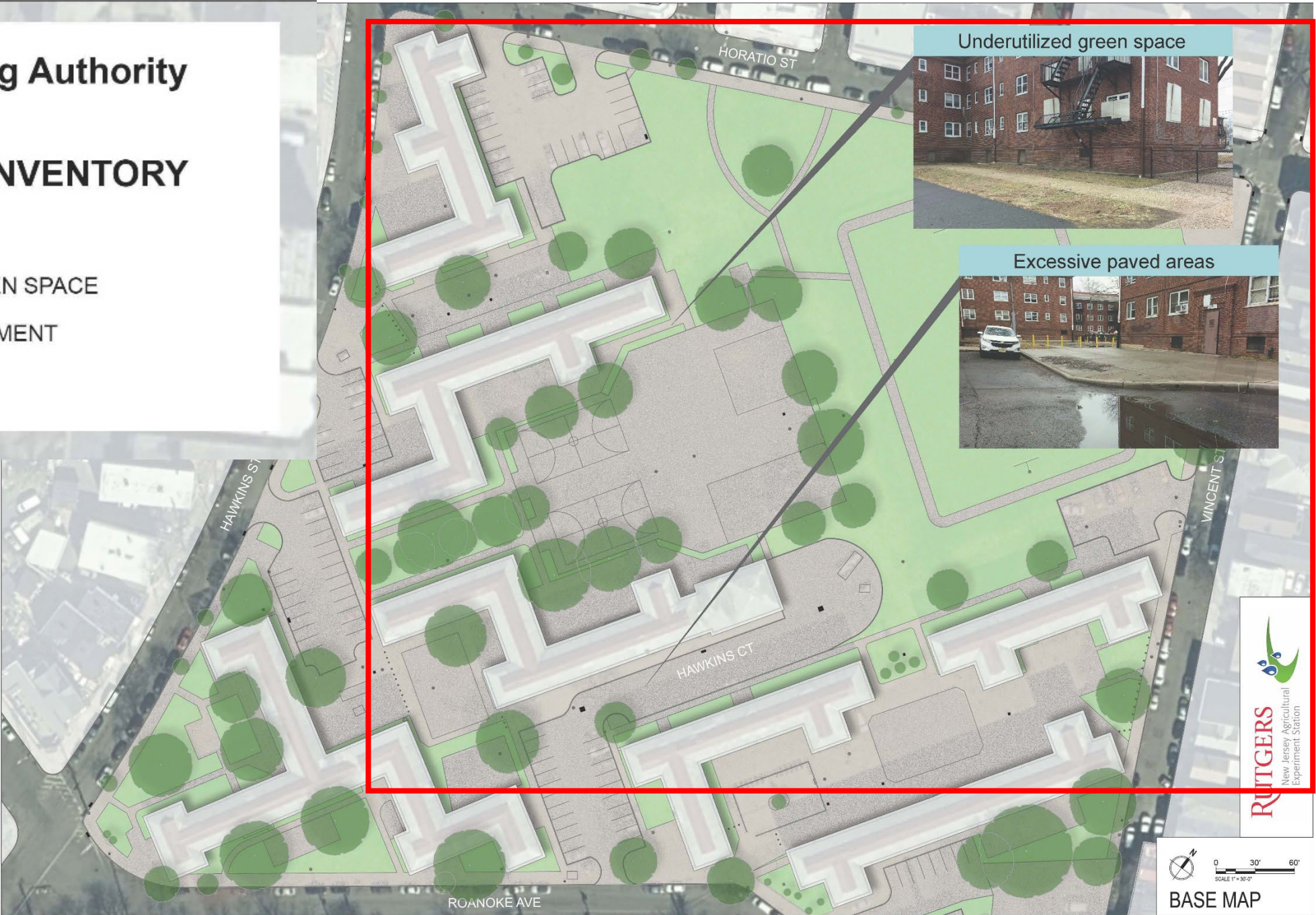


Newark Housing Authority Hyatt Court

OPEN SPACE INVENTORY

LEGEND

- EXISTING GREEN SPACE
- EXISTING PAVEMENT
- TREES



Concept 1 - Vegetation



- Convert grass to planted beds, rain gardens
- Capture rooftop runoff from downspouts
- Capture pavement runoff through curb cuts



Concept 2 - Plazas



- Convert pavement to plazas with rain gardens and permeable paving
- Capture rooftop runoff from downspouts
- Capture pavement runoff through curb cuts



Concept 3 - Parking Lots



- Porous asphalt in parking stalls
- Regrade parking lots to curb cuts
- Rain gardens, vegetated filter strips



More Hope for Newark

- Funding has been obtained for Fairmount Ave Project and Hyatt Court Project
- Over 200 more sites have been identified for green infrastructure
- Newark hired a green infrastructure coordinator (HDR)
- Ten designs have been completed and are ready to go out to bid
- NewarkDIG receive funding from the Harbor Estuary Program to complete three designs

Green Infrastructure



and Flooding





Questions?



Paterson Green Infrastructure Projects

Paterson, New Jersey





Paterson Public School #28



Paterson Public School #28

Paterson Public School #4



Paterson Public School #4



Fair Street Green Street Project

Paterson, New Jersey







More Hope for Paterson

- Funding has been obtained for Fair Street Project
- Over 100 more sites have been identified for green infrastructure by WSP and Rutgers
- Ten projects were designs by Lan Engineering and are ready to build

Green Infrastructure



and Flooding

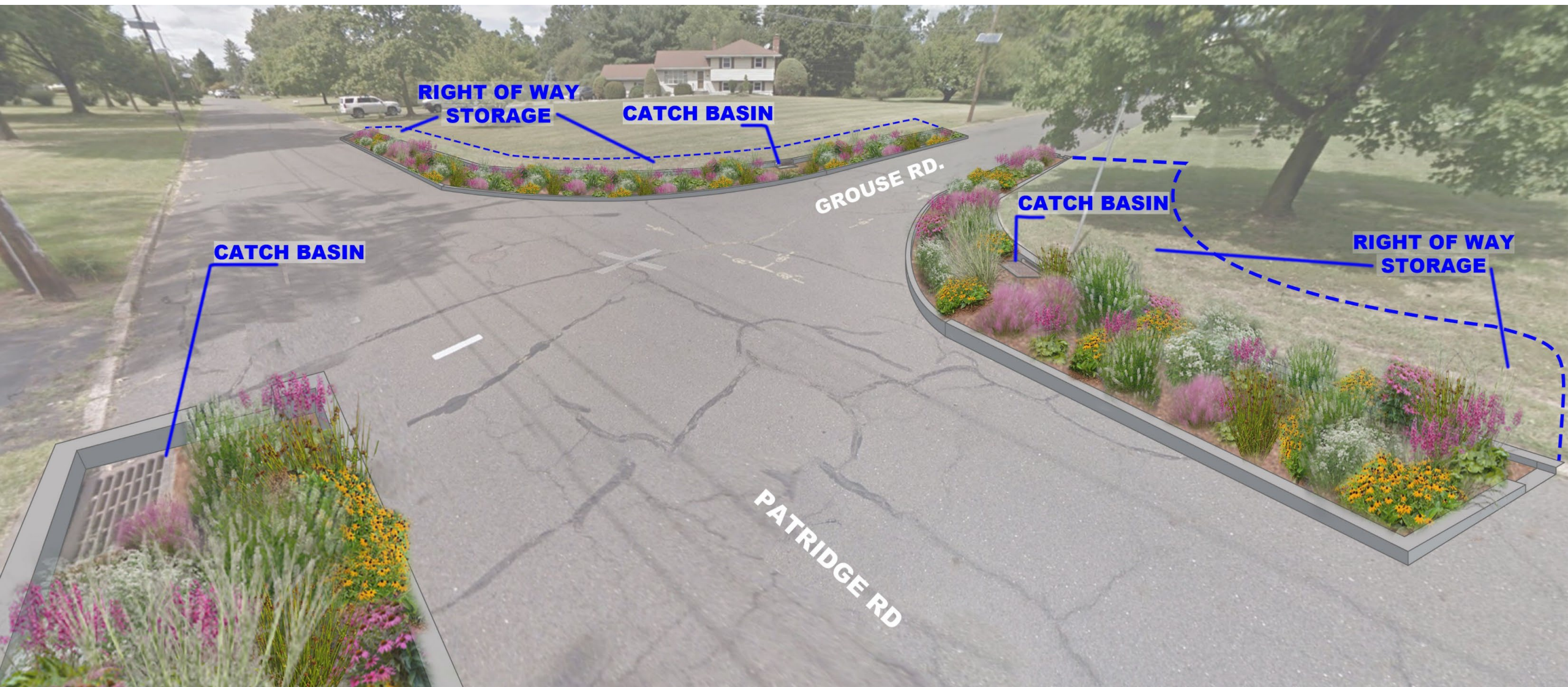




How can we hold the volume?

- Smaller distributed systems
 - Individual household rain gardens
 - Pervious pavement
 - Right-of-way stormwater planters





**RIGHT OF WAY
STORAGE**

CATCH BASIN

GROUSE RD.

CATCH BASIN

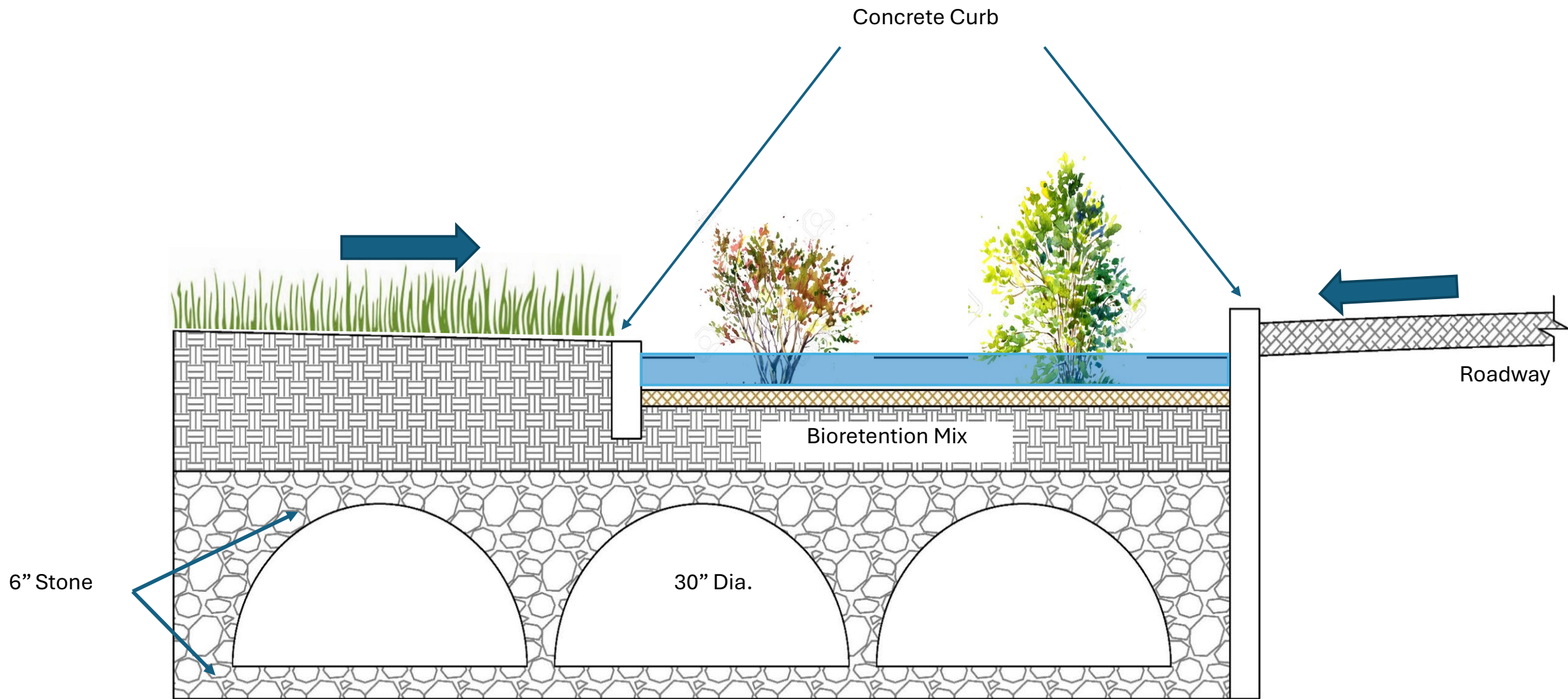
**RIGHT OF WAY
STORAGE**

CATCH BASIN

PATRIDGE RD



**PATRIDGE RD
CUL DE SAC**



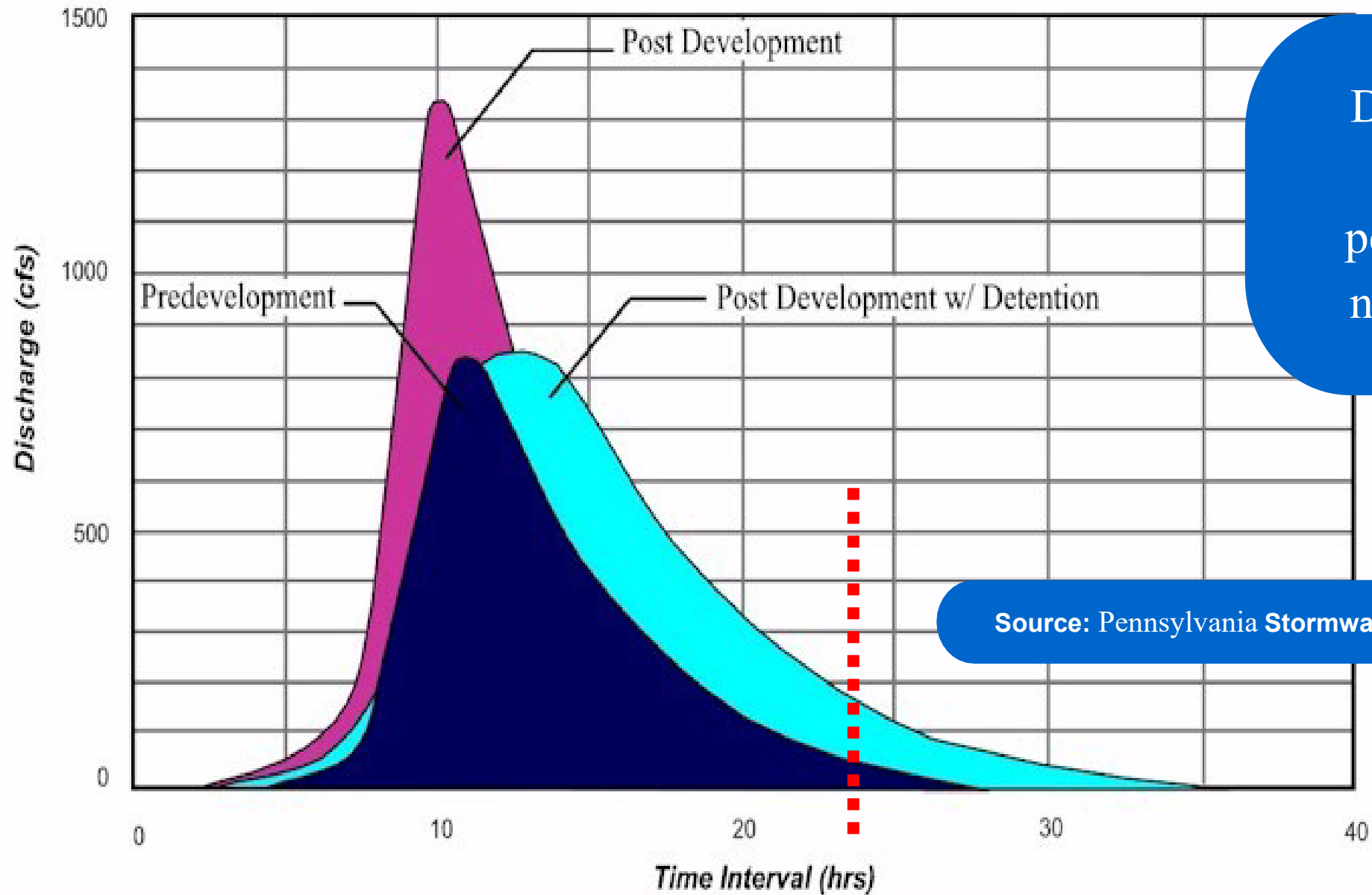
How can we hold even larger volumes of stormwater runoff?

- Large detention/ bioretention basins
 - Can provide largest volume storage to land area
- Underground detention systems
 - Can create systems under parking lots or parks like in Hoboken



Stormwater Runoff Hydrograph

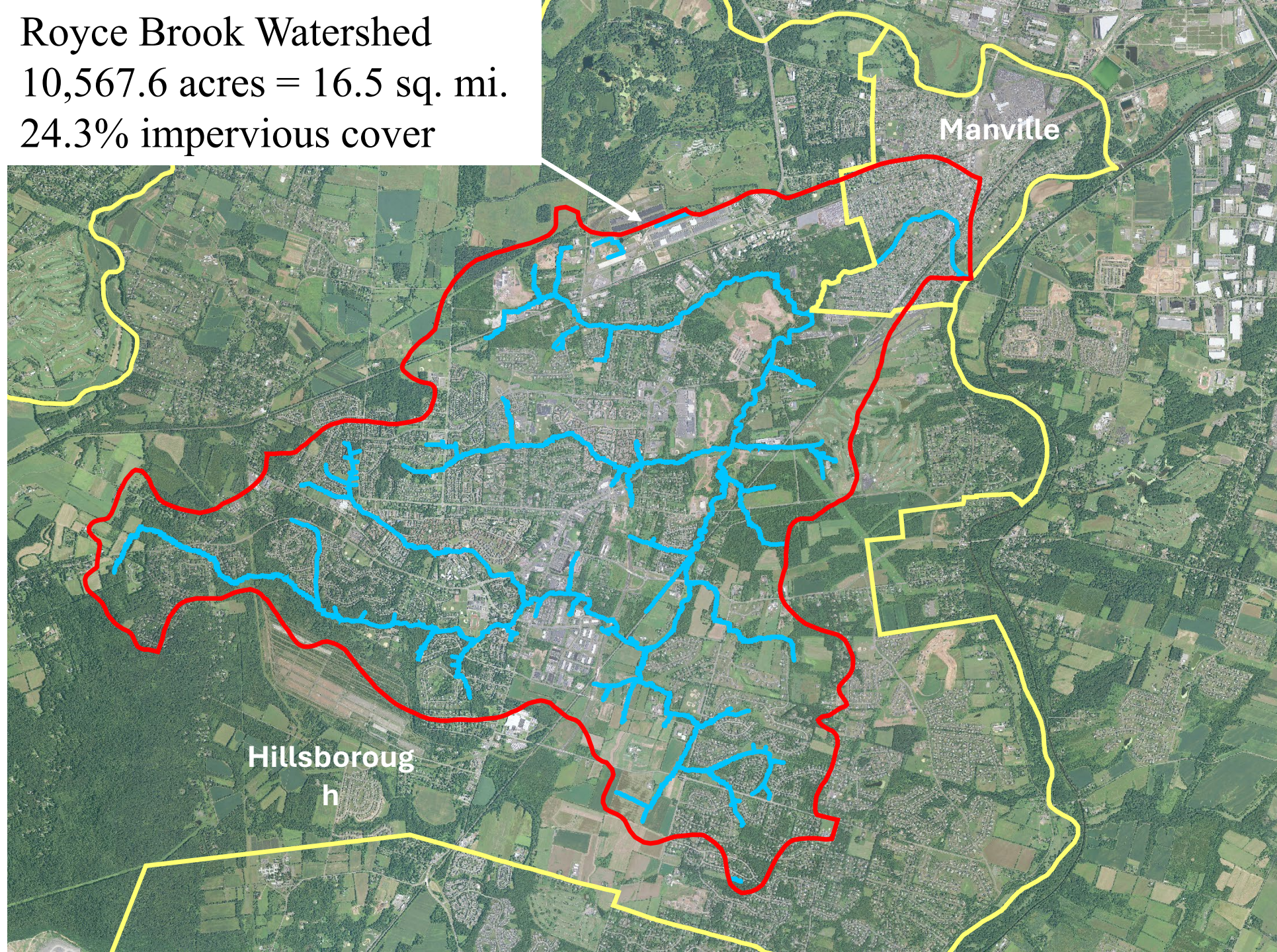
WITH DETENTION



Detention does
reduce
peak flow...but
not much more

Source: Pennsylvania Stormwater Management Manual

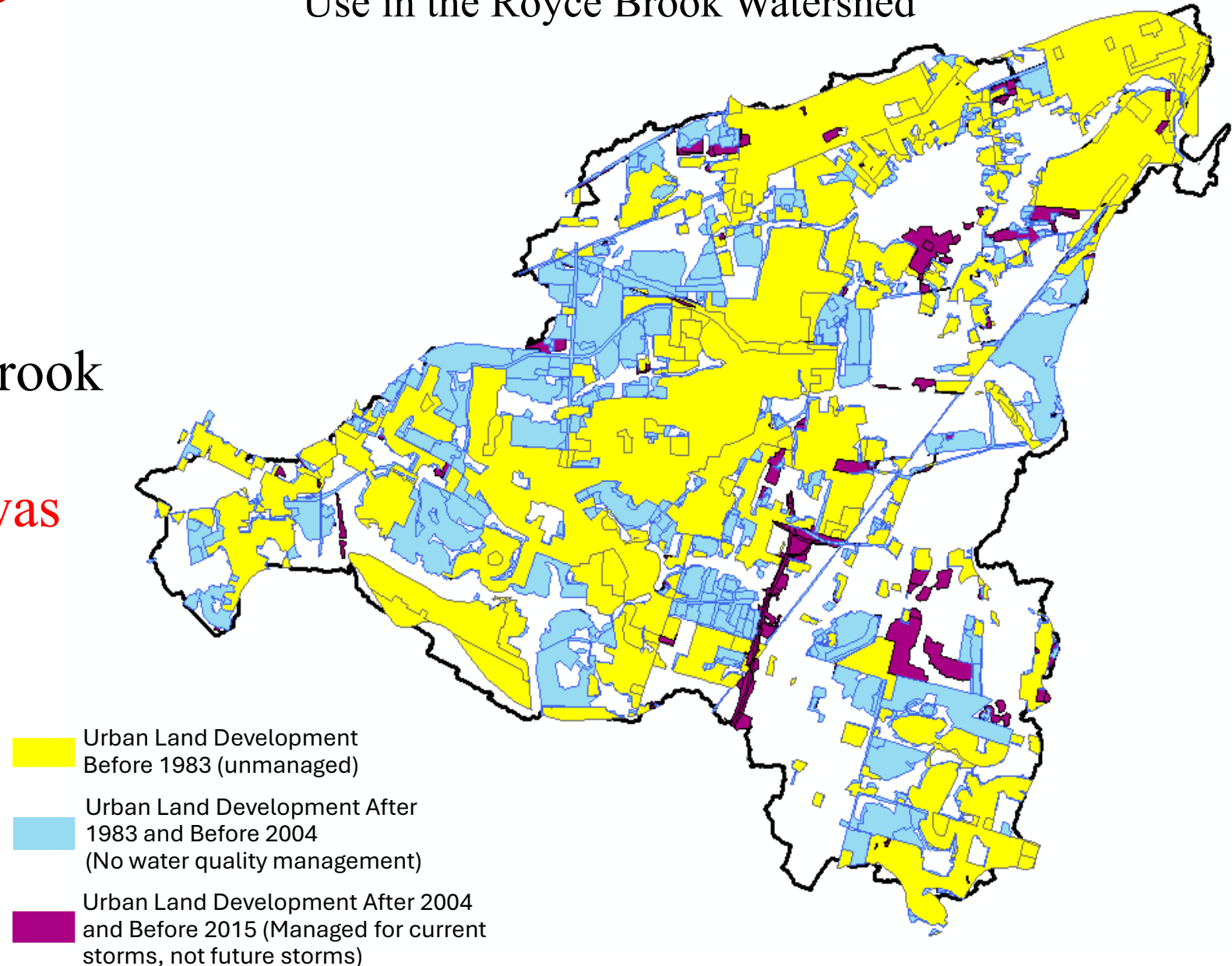
Royce Brook Watershed
10,567.6 acres = 16.5 sq. mi.
24.3% impervious cover



What land is being managed in the Royce Brook Watershed?

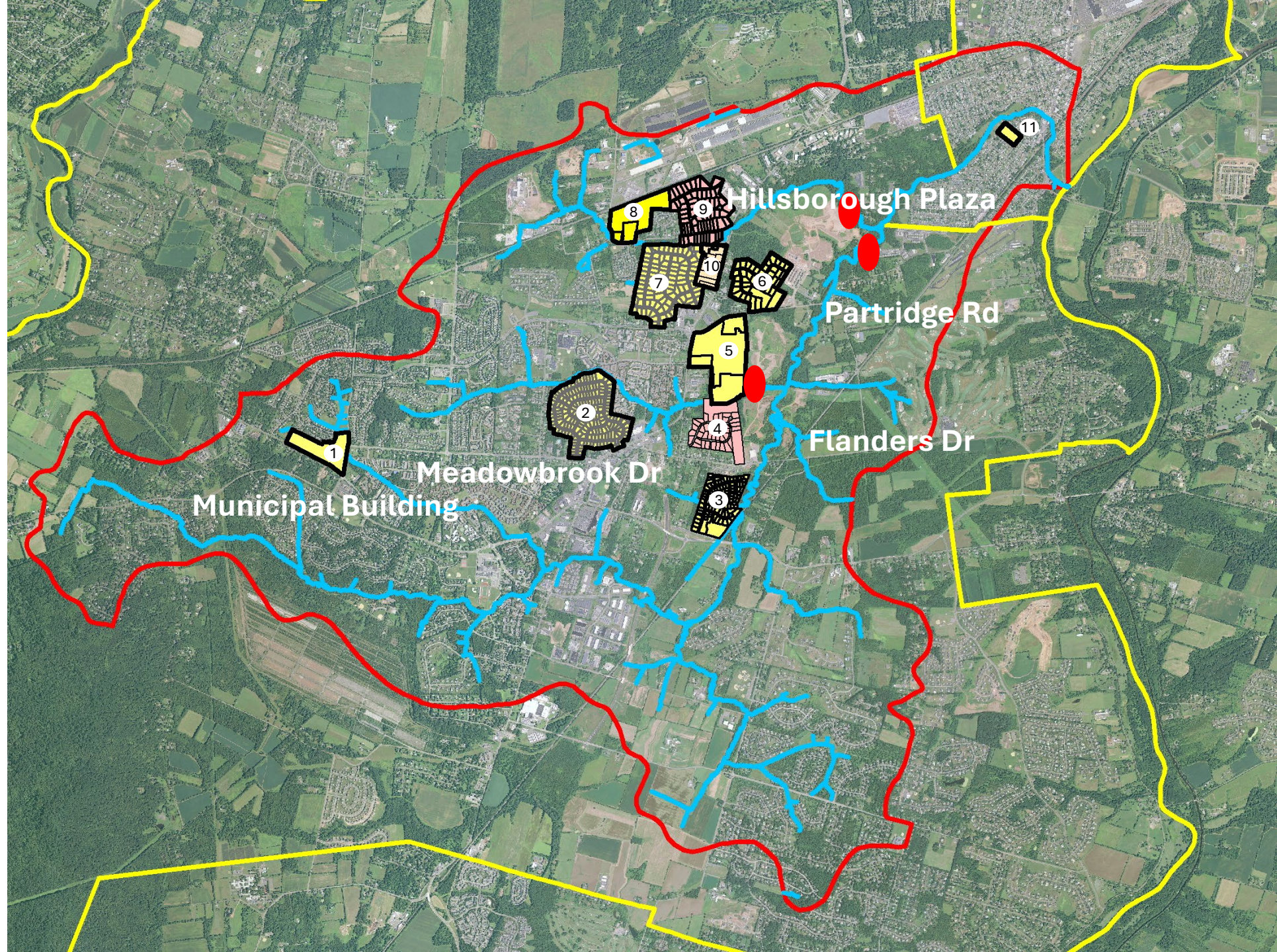
- Urban land in the Royce Brook Watershed
- Majority of development was created before 1983

Managed and Unmanaged Urban Land
Use in the Royce Brook Watershed



11 potential development sites for retrofitting

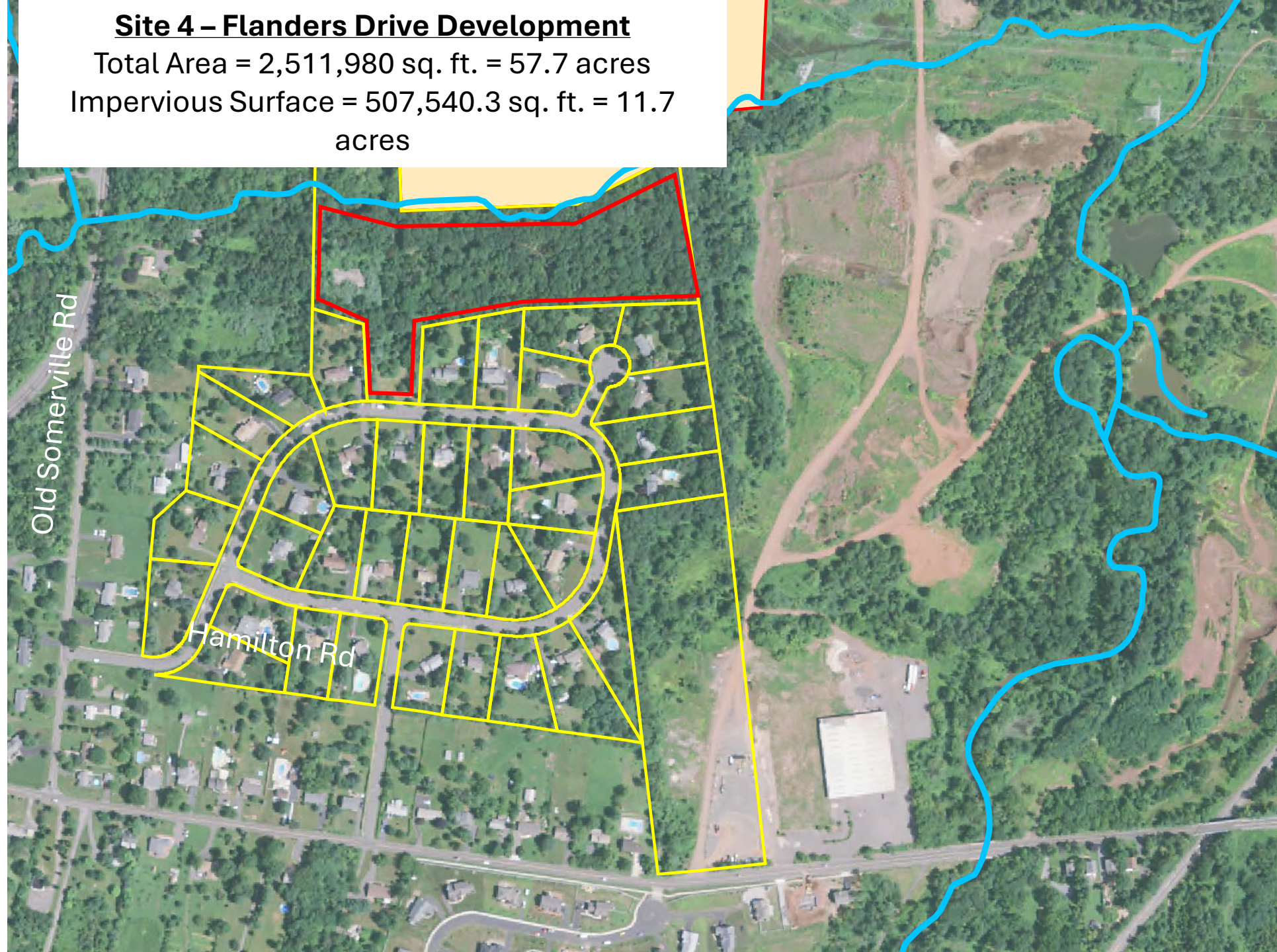
- 673.4 acres = 1.05 sq. mi.
- Six residential developments
- Three commercial sites (one with some stormwater management)
- One municipal site
- One public school
- Possible solutions
 - Constructed wetlands
 - Bioretention
 - Permeable pavement
 - Roadside rain gardens
 - Homeowner rain gardens



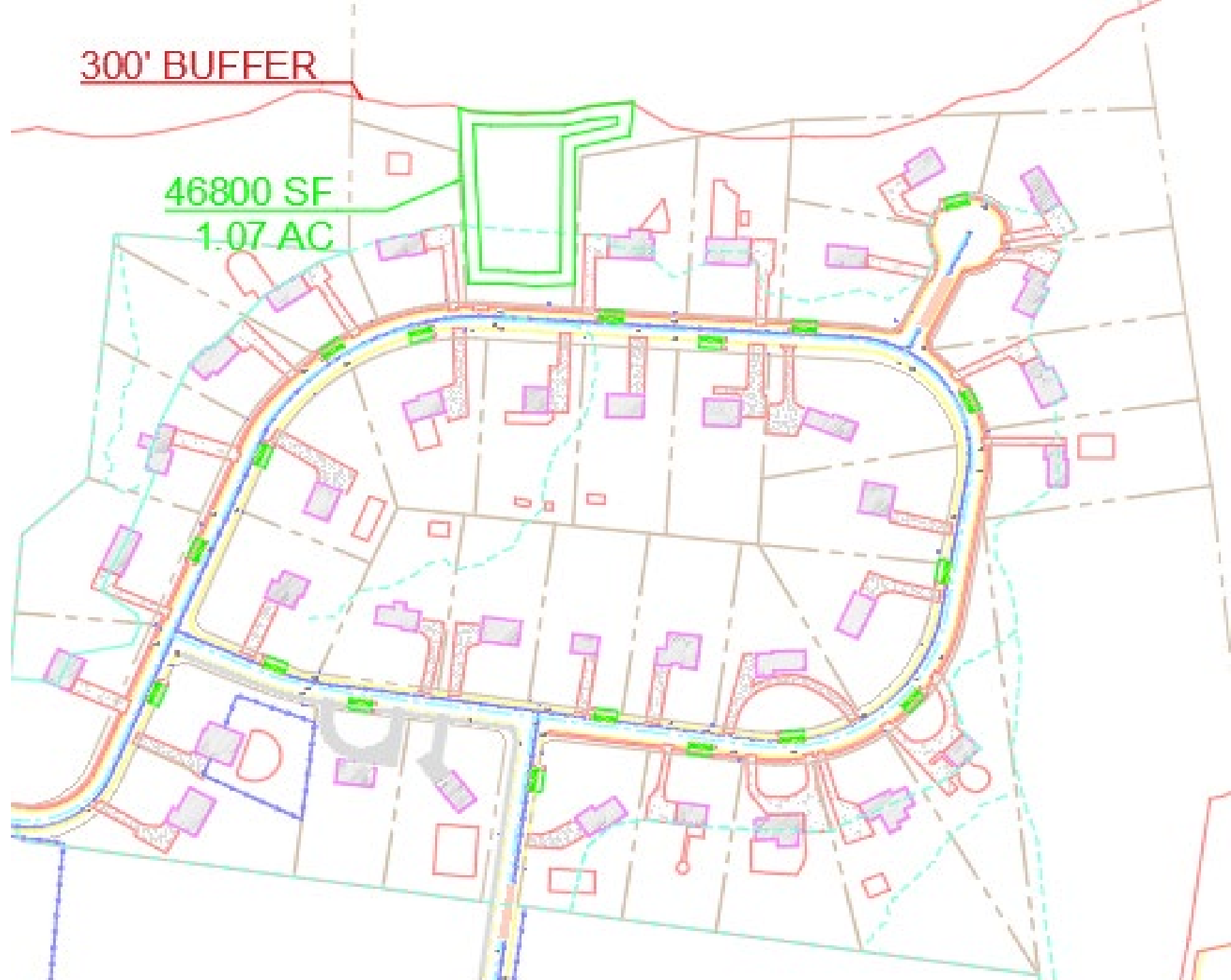
Site 4 – Flanders Drive Development

Total Area = 2,511,980 sq. ft. = 57.7 acres

Impervious Surface = 507,540.3 sq. ft. = 11.7
acres



Option #1: Municipal Land Only



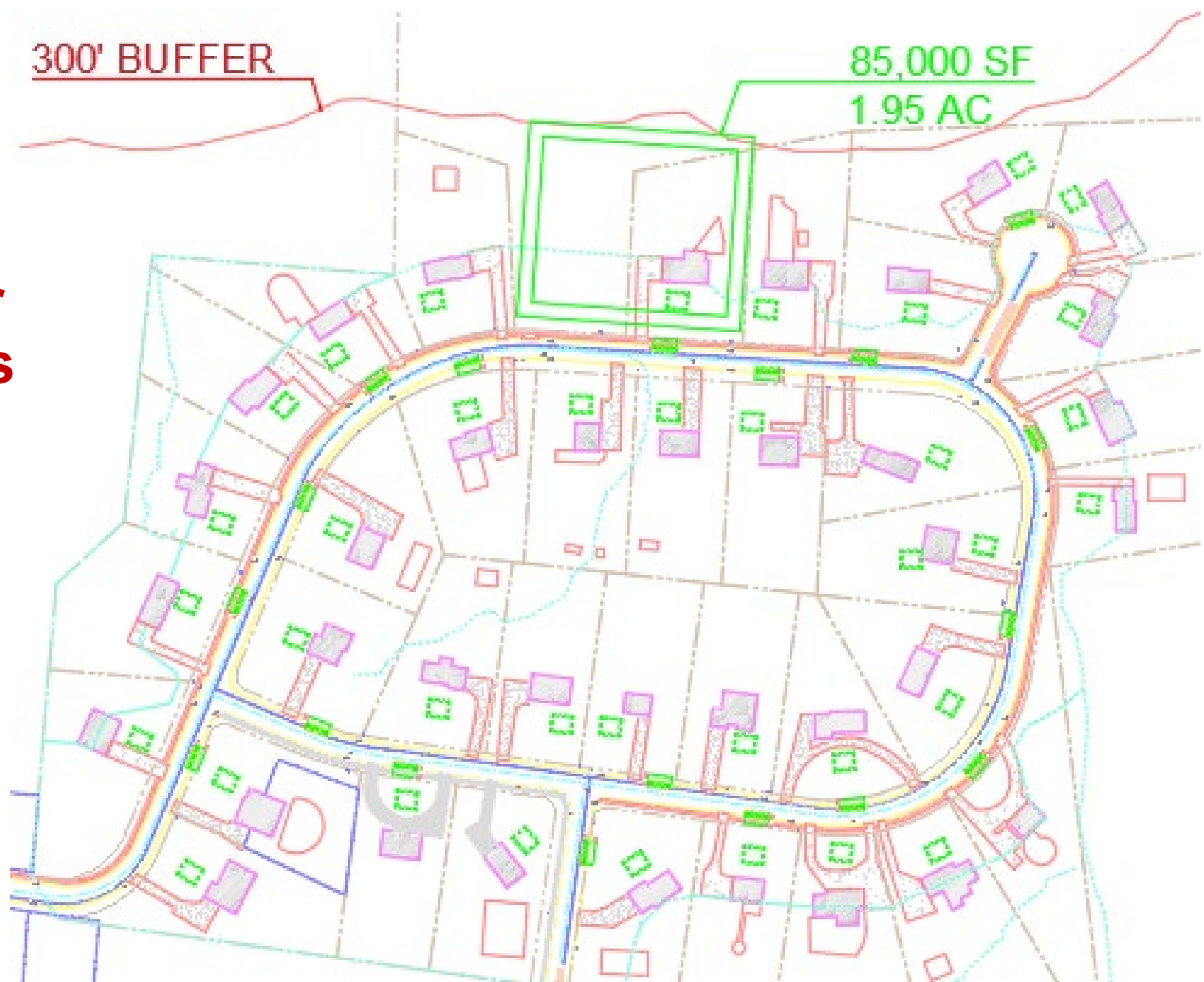
Municipal Land Only

- Reduces peak flow by 25%
- Space for one basin and distributed systems in ROW

	Storage Volume (cf)	% Contribution
Basin	187,528	88%
Rain Gardens - Road	25,464	12%
Total Storage Volume	212,992	cf
Peak Discharge	144	cfs
Peak Reduction	25%	% of inflow (191.3cfs)
Detention Time 75%	14.4	hrs
Basin Area	1.07	ac

Target Peak Flow = 154 cfs

**Option #2:
Buy a lot
and
homeowner
rain gardens**



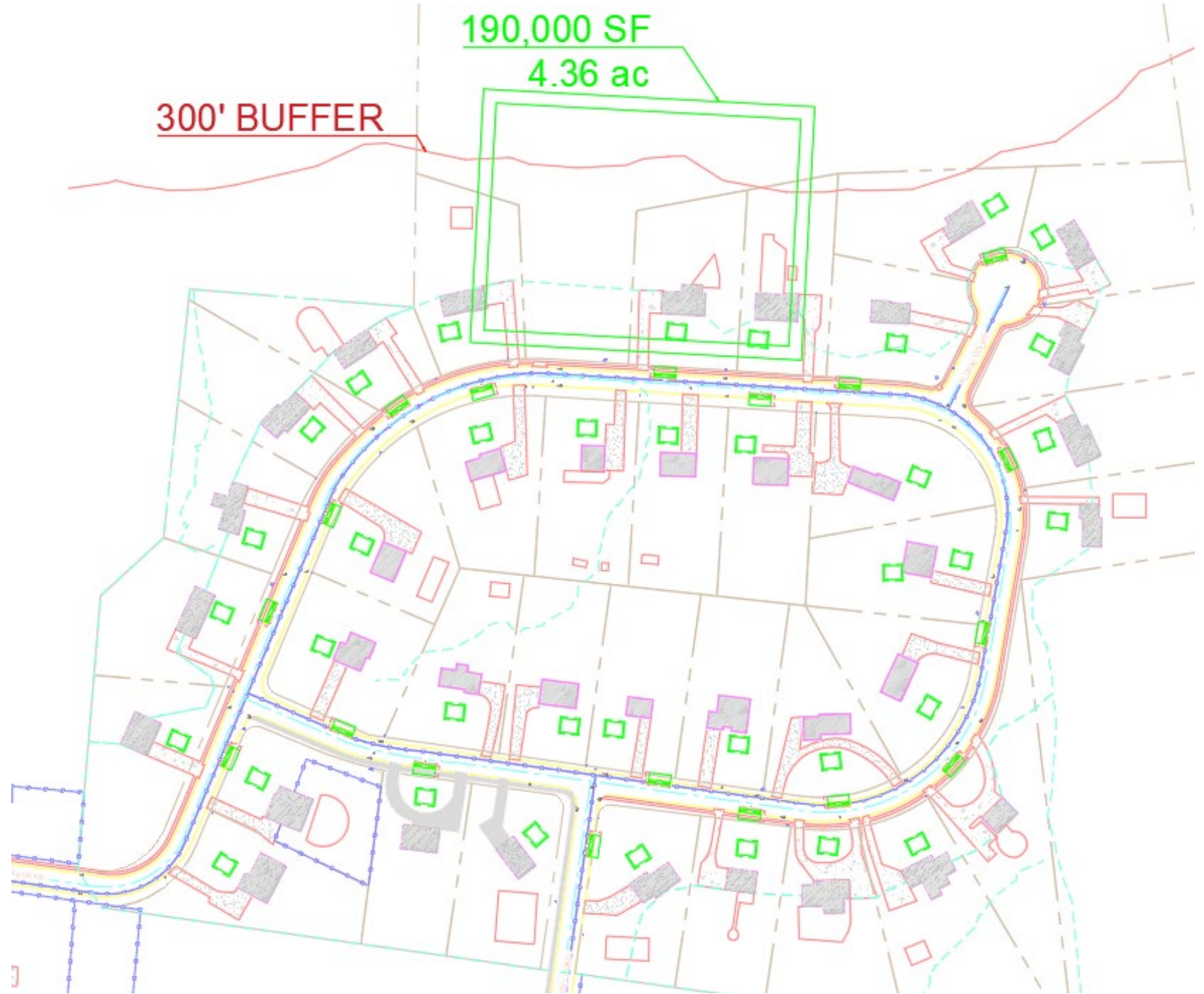
Current Regulations

- Reduce peak to 80% of pre-development peak (100-yr storm)

	Storage Volume (cf)	% Contribution
Basin	370,550	78%
Permeable Pavement	58,570	12%
Rain Gardens – Roof	20,276	4%
Rain Gardens - Road	25,464	5%
Total Storage Volume	474,860	cf
Peak Discharge	52.72	cfs
Peak Reduction	72%	% of Inflow (191.3cfs)
Detention Time 75%	17.0	hrs
Basin Area	1.95	ac

Target Peak Flow = 85.5 cfs

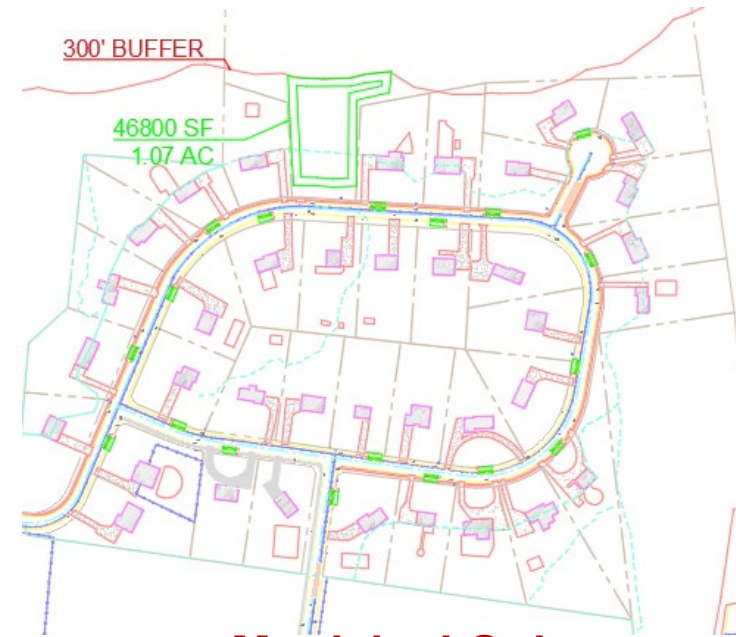
Option #3:
Capture
entire
volume for
100-yr
storm



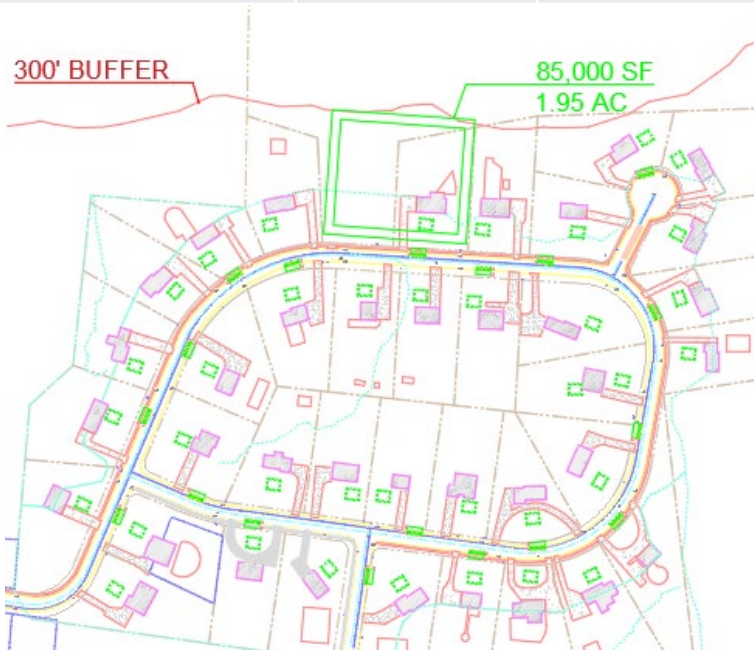
	Storage Volume (cf)	% Contribution
Basin	866,,000	89%
Porous Pavement	58,570	6%
Rain Gardens – Roof	20,276	2%
Rain Gardens - Road	25,464	3%
Total Storage Volume	970,310	cf
Peak Discharge	0	cfs
Peak Reduction	100%	% of Inflow (191.3cfs)
Basin Storage Peak	853,911	cf
Detention Time 75%	NA	hrs
Detention Time 100%	NA	hrs
Basin Area	4.36	ac

Case comparison

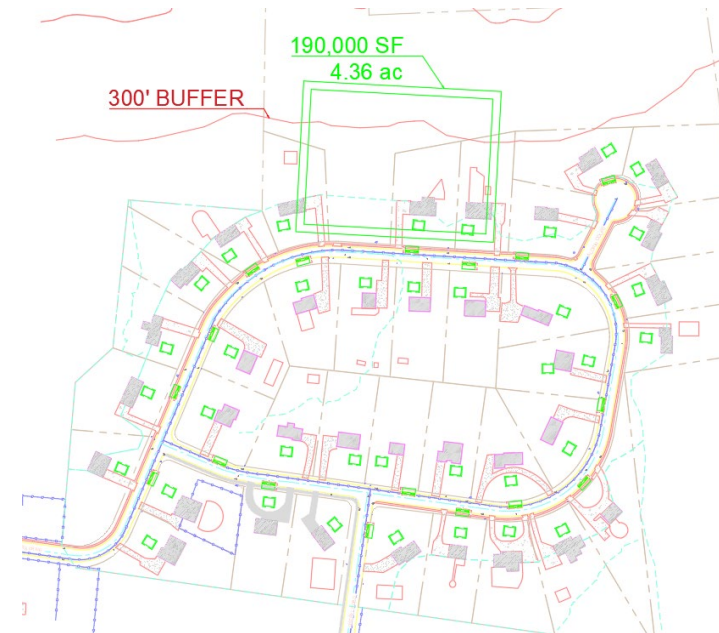
Parameter	Municipal	Current Reg	All Storage
Basin Size (acre)	1.07	1.95	4.36
Peak Red.	25%	72%	100%
Storage (CF)	212,992	474,860	970,310
Det. Time 75% (hr)	14.4	17.0	n/a



Municipal Only



Current Regulation



All Storage

Questions?

