Green Infrastructure Planning and Implementation in New Jersey

Presented to Municipalities Seeking Sustainable Jersey Points in Mountain Lakes
by Christopher C. Obropta, Ph.D., P.E.
on January 14, 2020

RUTGERS
New Jersey Agricultural Experiment Station

NEW JERSEY FUTURE

NEW JERSEY GREEN INFRASTRUCTURE MUNICIPAL TOOLKIT

PLAN. IMPLEMENT. SUSTAIN.

https://gitoolkit.njfuture.org/

- ✓ Language for municipal plans & ordinances
- ✓ Connect to Sustainable Jersey Green Infrastructure Actions
- ✓ Funding sources & strategies
- ✓ Design resources
- ✓ Education and training resources
- ✓ Maintenance information
- ✓ School programs

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Water Resources Program

SUSTAINABLE JERSEY • CERTIFIED • A Better Tomorrow, One Community at a Time

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

The Water Resources Program is one of many specialty programs under Rutgers Cooperative Extension.

Our Mission is to identify and address community water resources issues using sustainable and practical science-based solutions.

Green Infrastructure

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

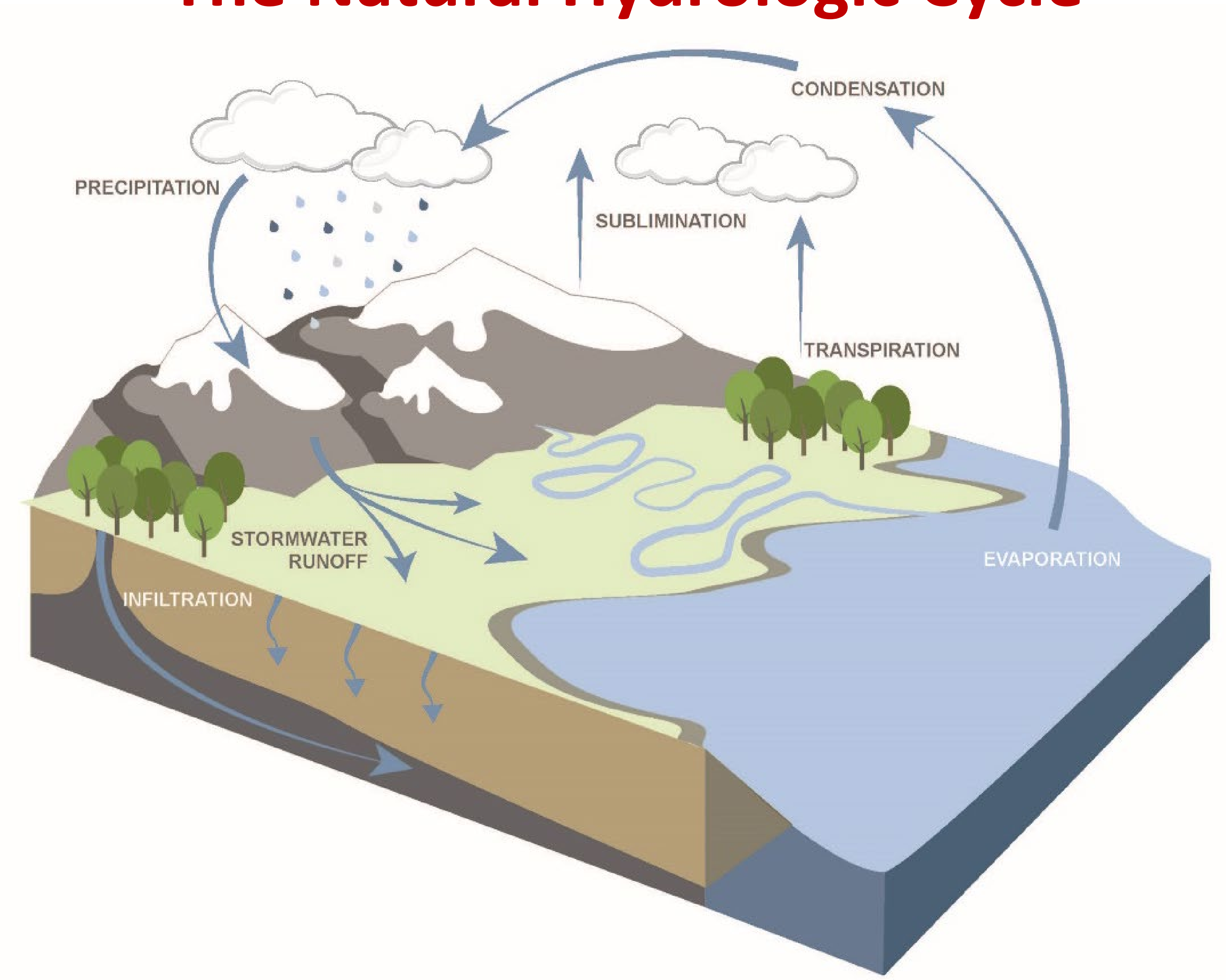
Green infrastructure projects:

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

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

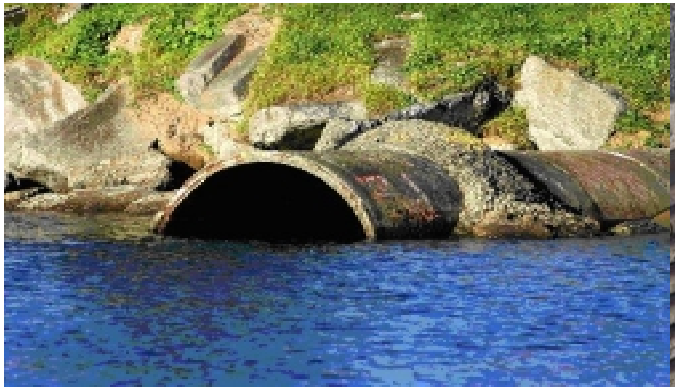
What is a green infrastructure plan (and why do we need one)?

The Natural Hydrologic Cycle

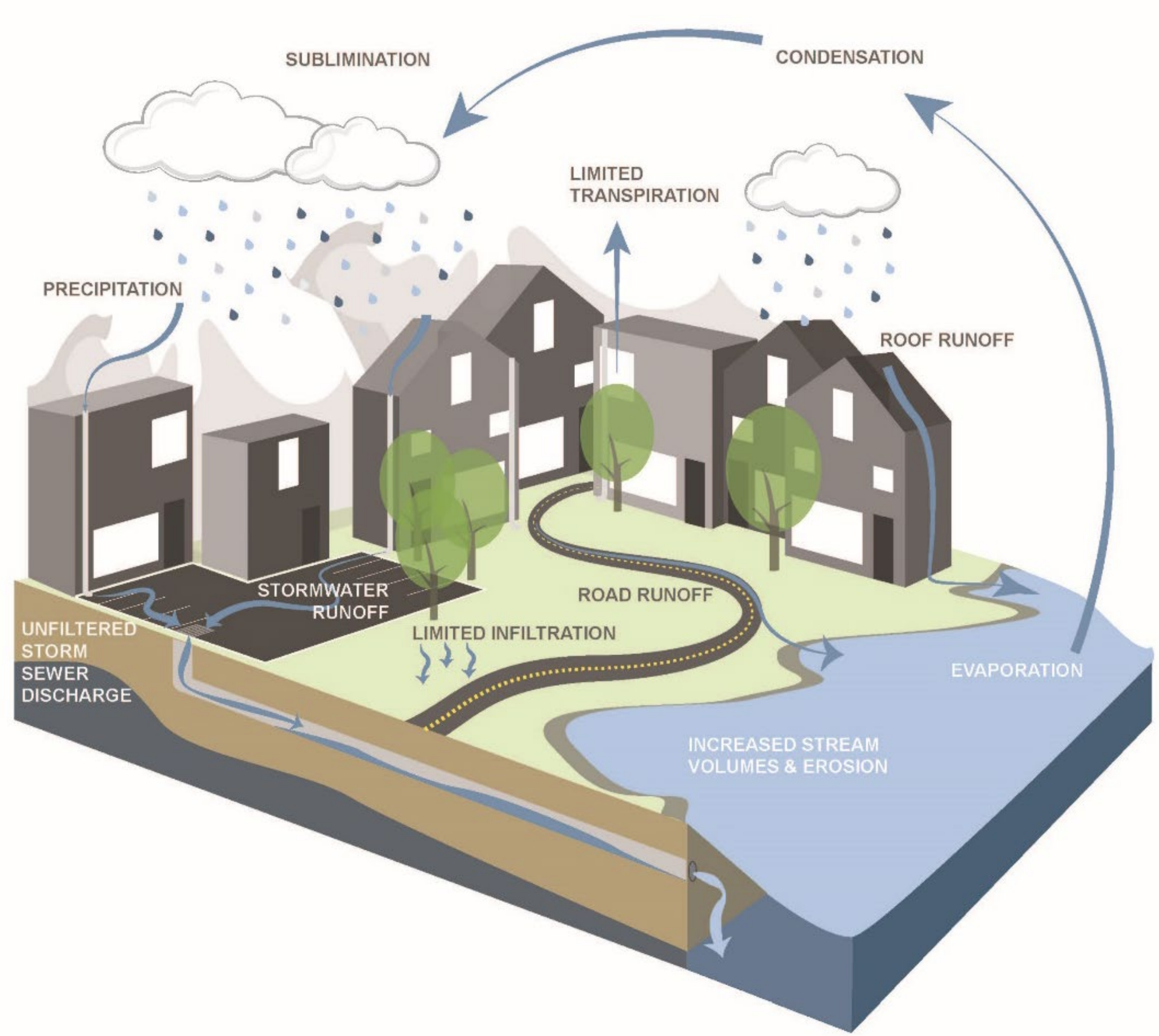


+ impervious surfaces =

More development → *More impervious surfaces* → *More stormwater runoff*



The Urban Hydrologic Cycle



+ green infrastructure =

- Green Roofs
- Rainwater Harvesting
- Tree Filter/Planter Boxes
- Rain Gardens/Bioretention Systems
- Permeable Pavements
- Vegetated Swales or Bioswales
- Natural Retention Basins
- Green Streets

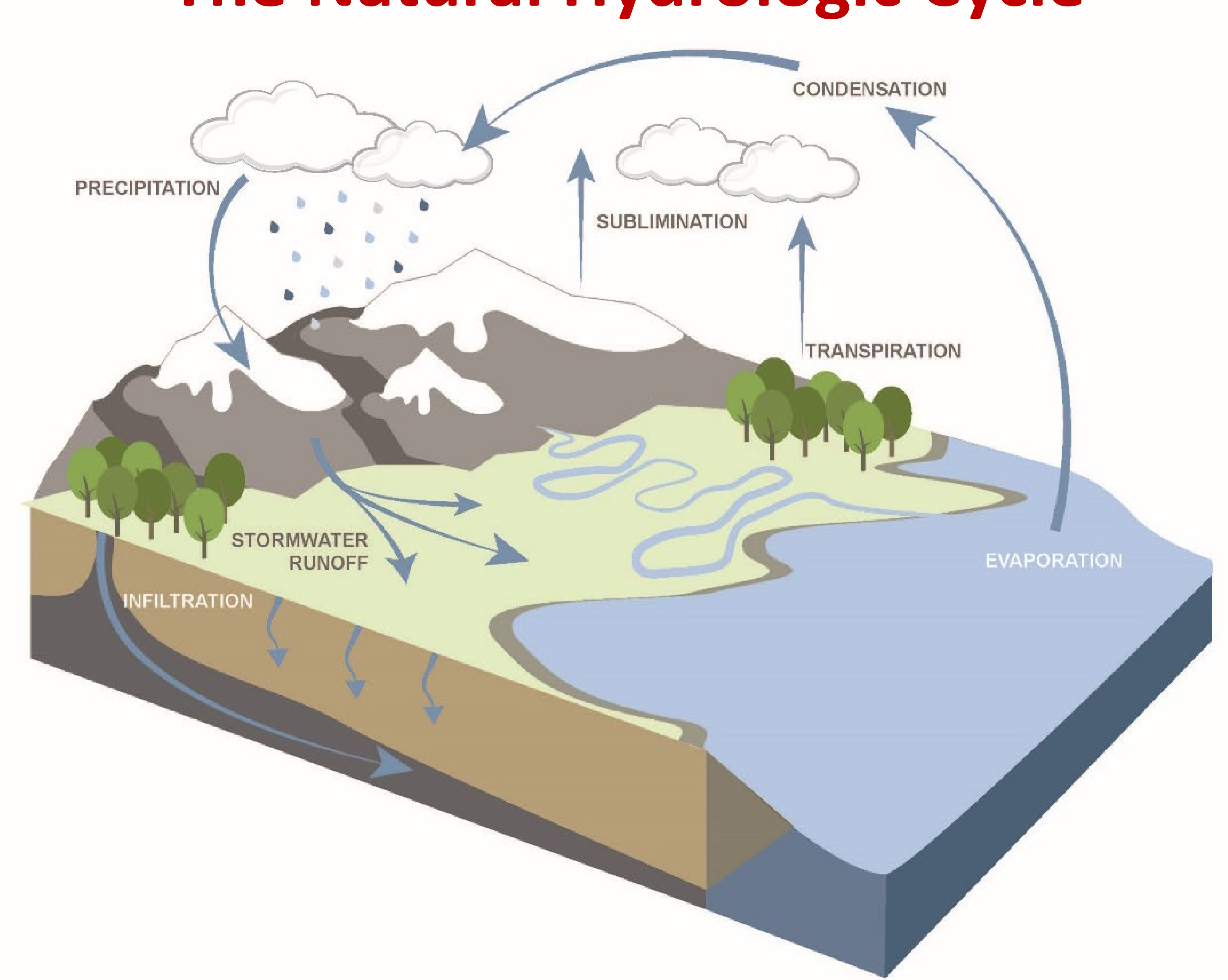







Parker Urban Greenscapes. 2009.

The Natural Hydrologic Cycle



Hydrologic Impacts of Urbanization

- Disruption of natural water balance
- Increased flood peaks
- Increased stormwater runoff
- More frequent flooding
- Increased bankfull flows
- Lower dry weather flows

Water Quality Impacts of Urbanization (increased nonpoint source pollution)

- Oil and grease from cars
- Fertilizers
- Animal waste
- Grass clippings
- Septic systems
- Sewage leaks
- Household cleaning products
- Litter
- Agriculture
- Sediment

Components of a Green Infrastructure Plan and How Do You Create Them

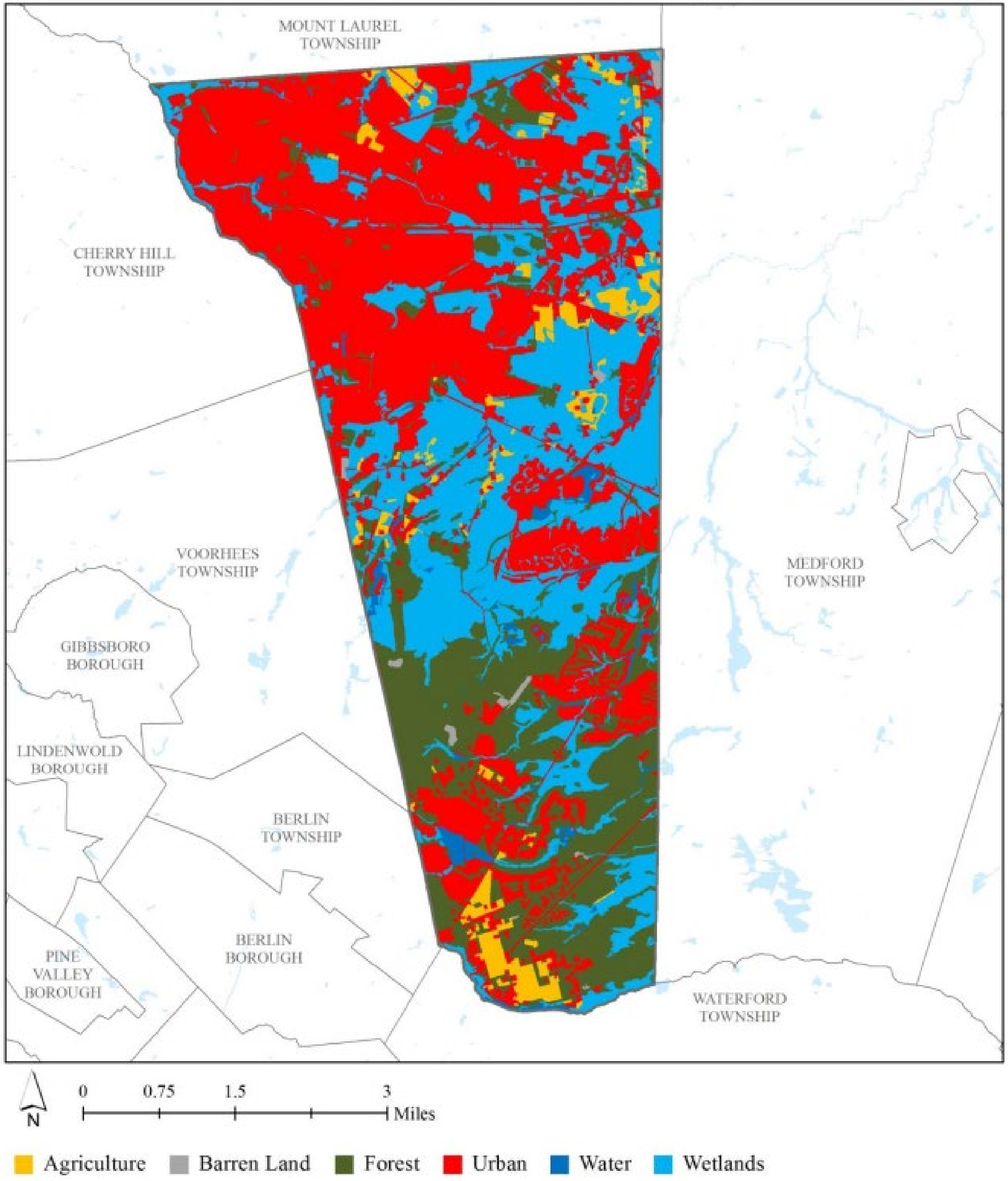
1. Impervious Cover Assessment (ICA)
2. Green Infrastructure Action Plan (a.k.a. Impervious Cover Reduction Action Plan or RAP)
3. Green Infrastructure Strategic Plan (a.k.a. Green Infrastructure Feasibility Study)

Impervious Cover Assessment (ICA)

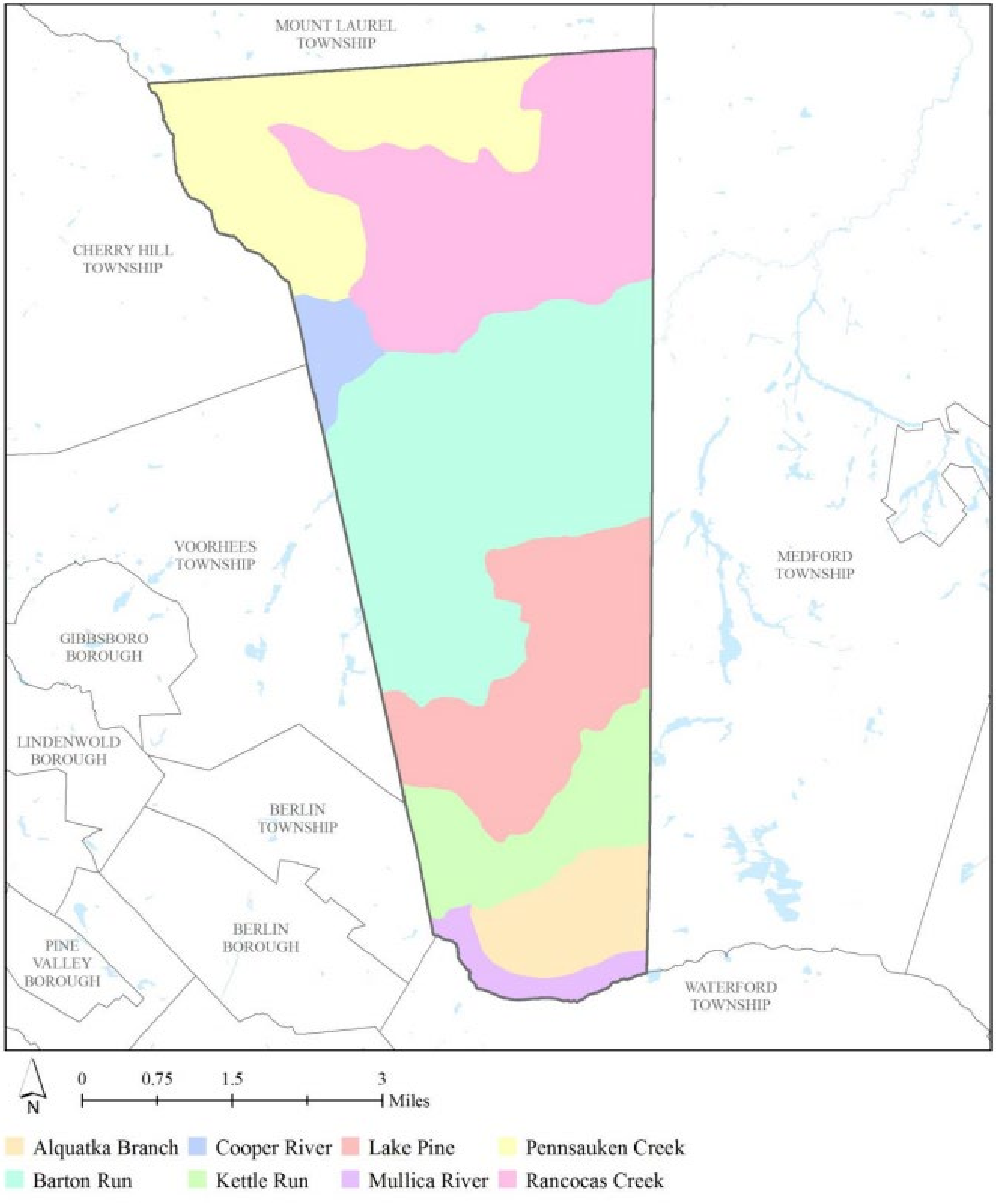
Impervious Cover Assessment

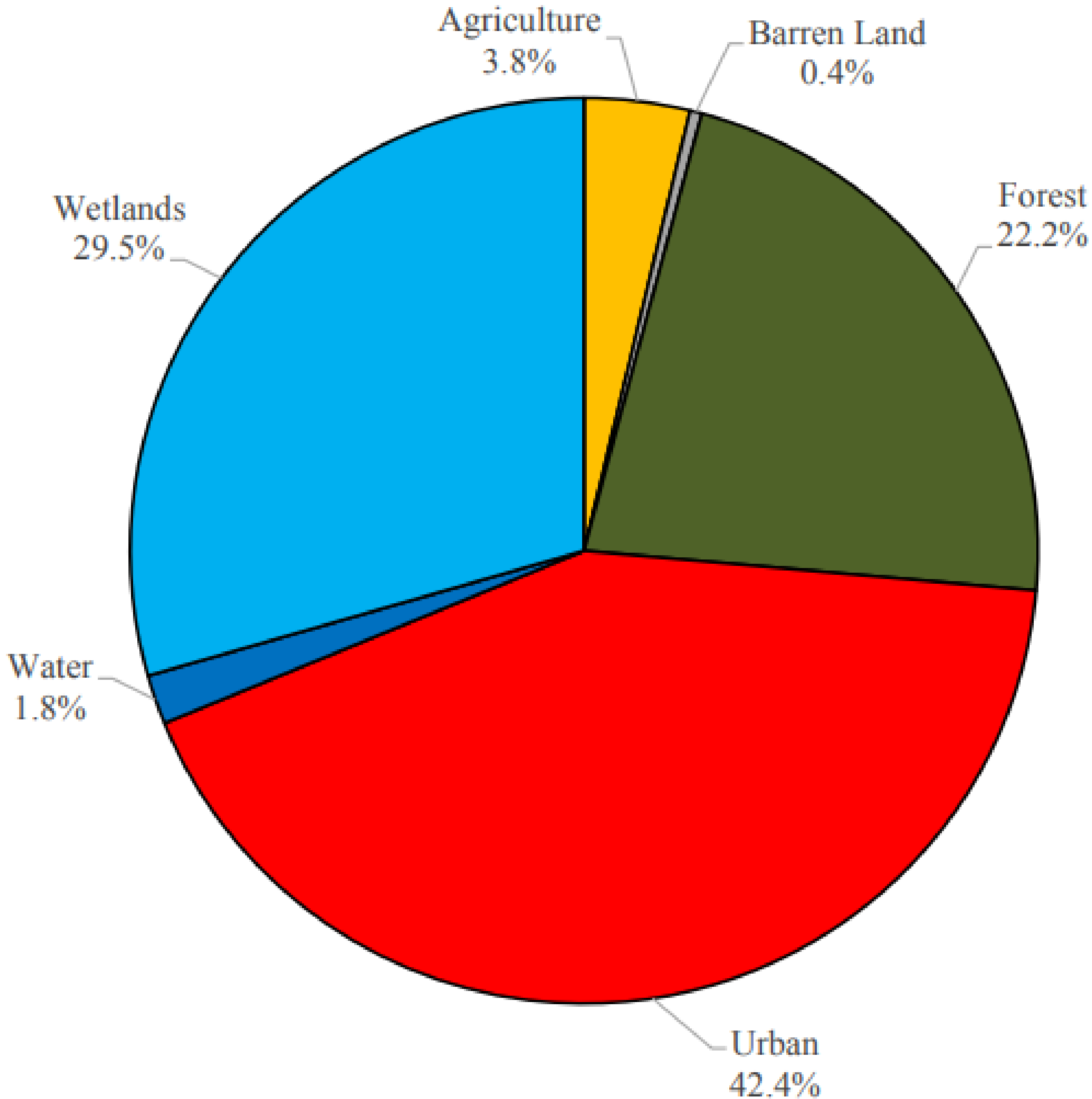
- Analysis completed by watershed and by municipality
- Use 2012 Land Use data to determine impervious cover
- Calculate runoff volumes for water quality, 2-, 10- and 100-year design storm and annual rainfall
- Contains three concept designs

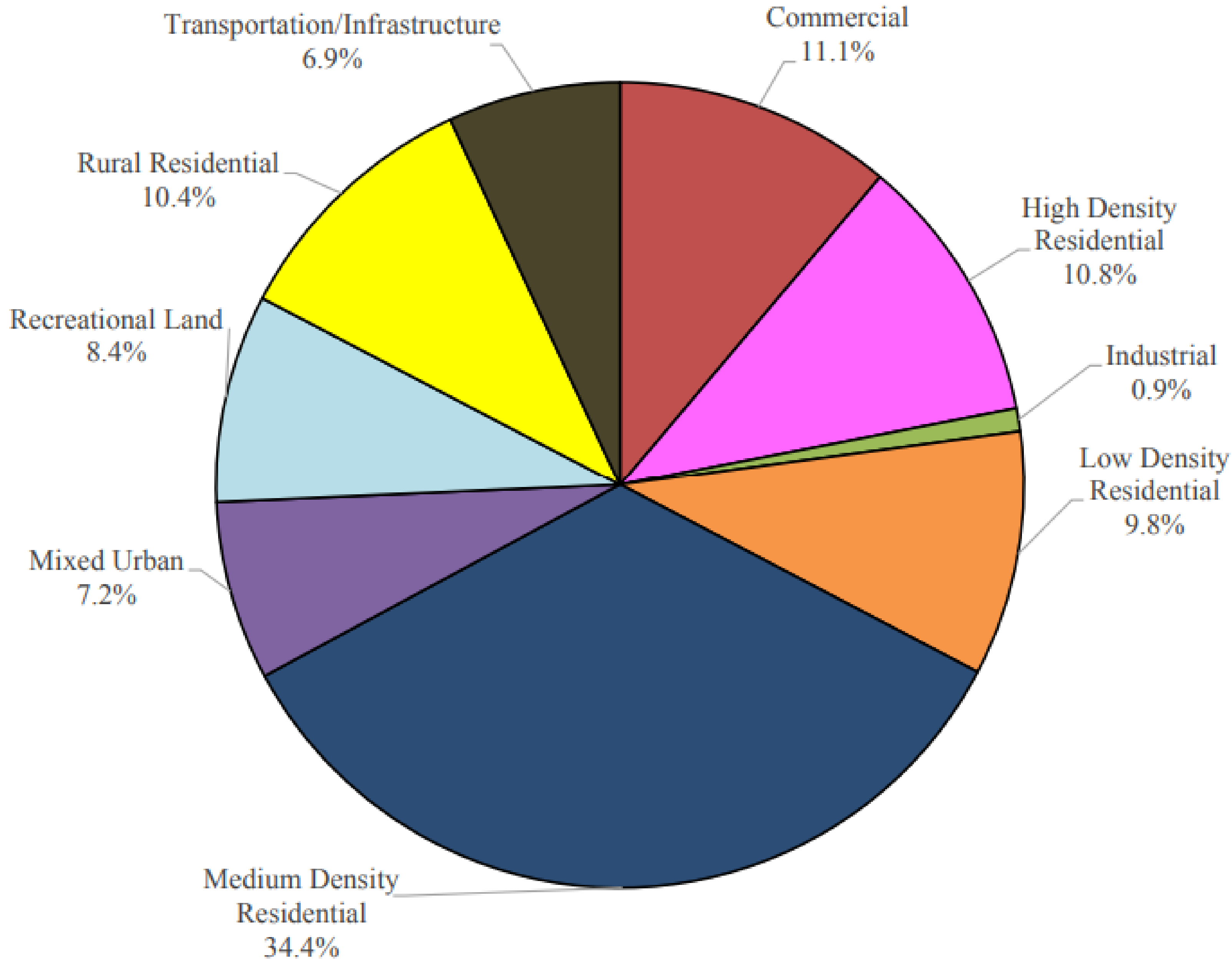
Subwatersheds of Evesham Township



Subwatersheds of Evesham Township




Agriculture
3.8%
Barren Land
0.4%
Forest
22.2%
Wetlands
29.5%
Water
1.8%
Urban
42.4%


Transportation/Infrastructure
6.9%
Commercial
11.1%
Rural Residential
10.4%
High Density
Residential
10.8%
Recreational Land
8.4%
Industrial
0.9%
Low Density
Residential
9.8%
Mixed Urban
7.2%
Medium Density
Residential
34.4%

Watershed	Total Area (ac)	Impervious Cover (ac)	%
Alquatka Branch	1,026.8	14.3	1.4%
Barton Run	5,669.5	515.6	9.3%
Cooper River	415.0	184.5	45.0%
Kettle Run	1,509.0	99.5	6.9%
Lake Pine	2,857.2	180.9	6.4%
Mullica River	383.2	16.8	4.5%
Pennsauken Creek	2,951.5	1,025.8	35.1%
Rancocas Creek	4,116.9	846.9	20.7%
Total	18,929.1	2,884.3	15.5%

Subwatershed	NJ Water Quality Storm (MGal)	Annual Rainfall of 44" (MGal)	2-Year Design Storm (3.3”) (MGal)	10-Year Design Storm (5.0”) (MGal)	100-Year Design Storm (8.2”) (MGal)
Alquatka Branch	0.5	17.0	1.4	2.0	3.2
Barton Run	17.5	616.0	49.0	72.8	116.2
Cooper River	6.3	220.4	17.5	26.1	41.6
Kettle Run	3.4	118.9	9.5	14.0	22.4
Lake Pine	6.1	216.1	17.2	25.5	40.8
Mullica River	0.6	20.1	1.6	2.4	3.8
Pennsauken Creek	34.8	1,225.5	97.5	144.8	231.2
Rancocas Creek	28.7	1,011.8	80.5	119.6	190.9
Total	97.9	3,445.9	274.1	407.2	650.0

Green Infrastructure Action Plan (a.k.a. Impervious Cover Reduction Action Plan or RAP)

Green Infrastructure Action Plan

ICA (Tier1) + the following:

- Community engagement
- Potential green infrastructure sites
- Site level analysis including concept plans, information sheets, and costs
- Short-term 5-year goal

Identify project sites, but what makes a good site?

- Sites with impervious surfaces that are directly connected
- Sites with a lawn area that can be converted to accept stormwater runoff
- Sites with highly visibility – good educational opportunities
- Sites in impaired watersheds
- Sites on municipal owned land/public land
- Sites that provide partnership opportunities

Let's get started! Download aerial photograph of "Look Here First Sites."

- Go to Google or Bing Maps
- Type in address
- Aerial or birds eye view
- "Snip It"
- Insert into PowerPoint
- "Crop It"

- Schools
- House of Worship
- Libraries
- Municipal Building
- Public Works
- Firehouses
- Post Offices
- Elks or Moose Lodge
- Parks/ Rec Fields

Let's Find a Site

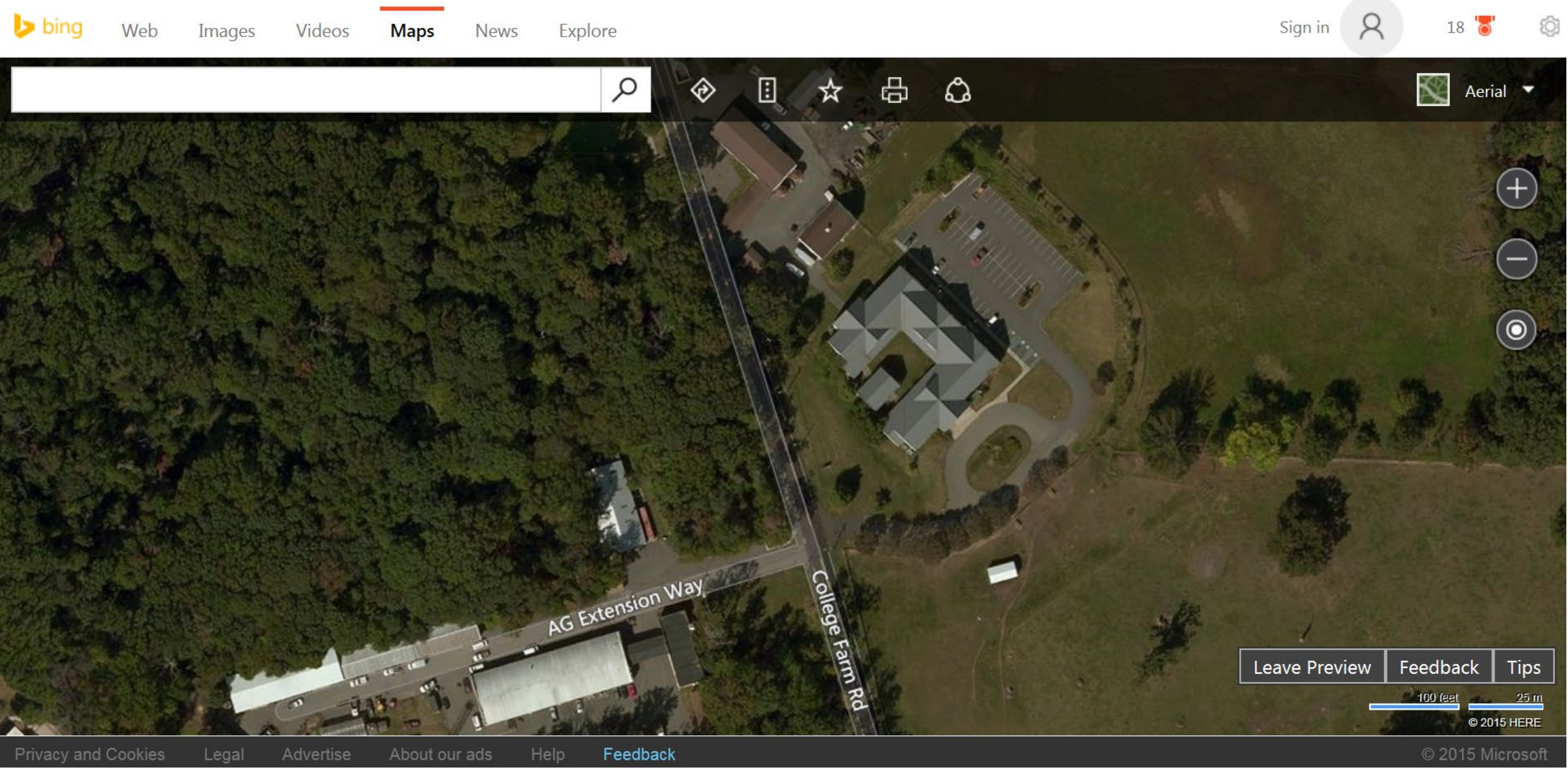
Here is one:

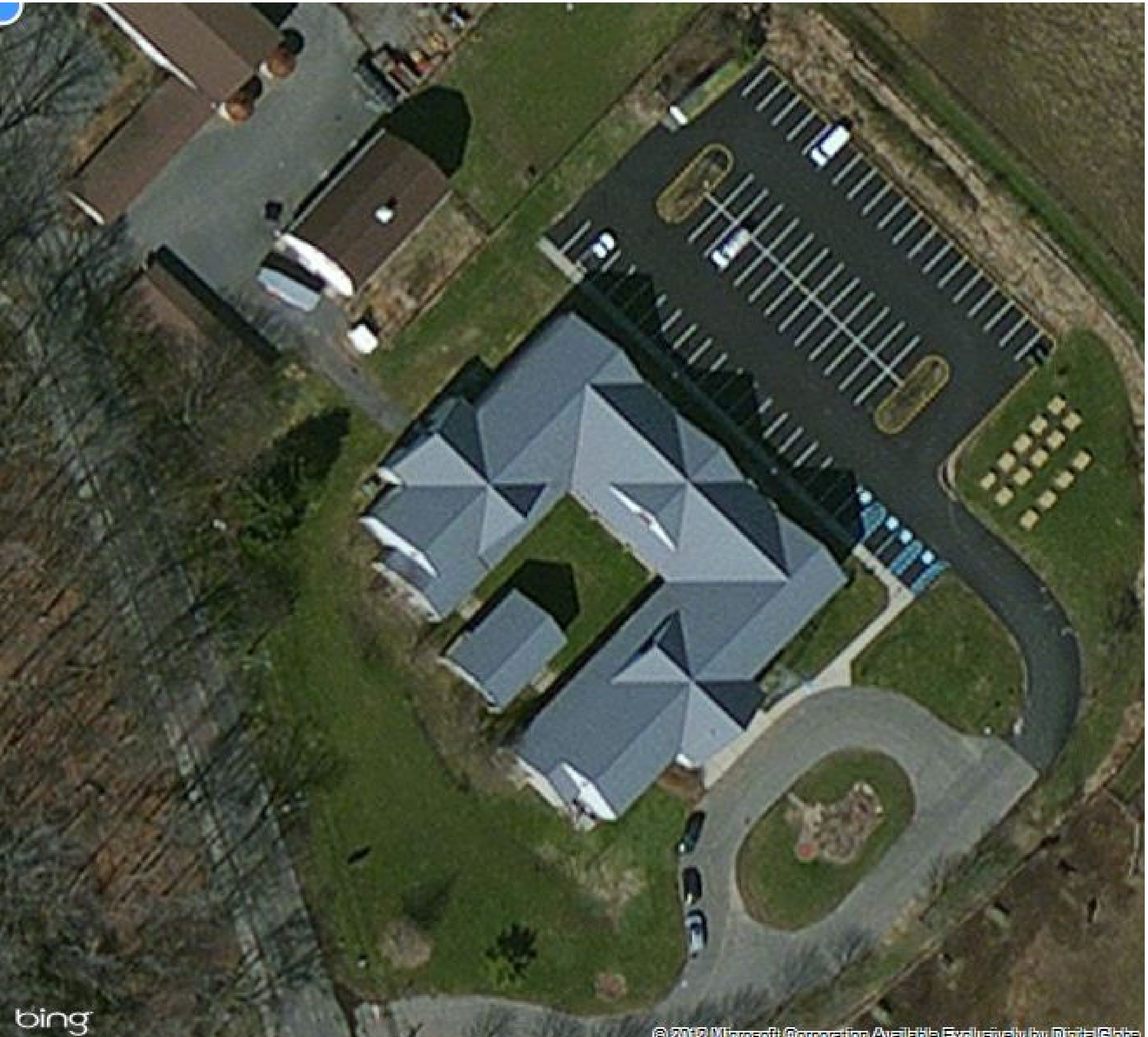
Former Agriculture Museum NJ

103 College Farm Road

New Brunswick, NJ 08901

From Bing Maps using the Snipping Tool





Observations:

- Lots of impervious cover
- No stormwater management
- Lots of open space for potential BMPs

Questions for site visit:

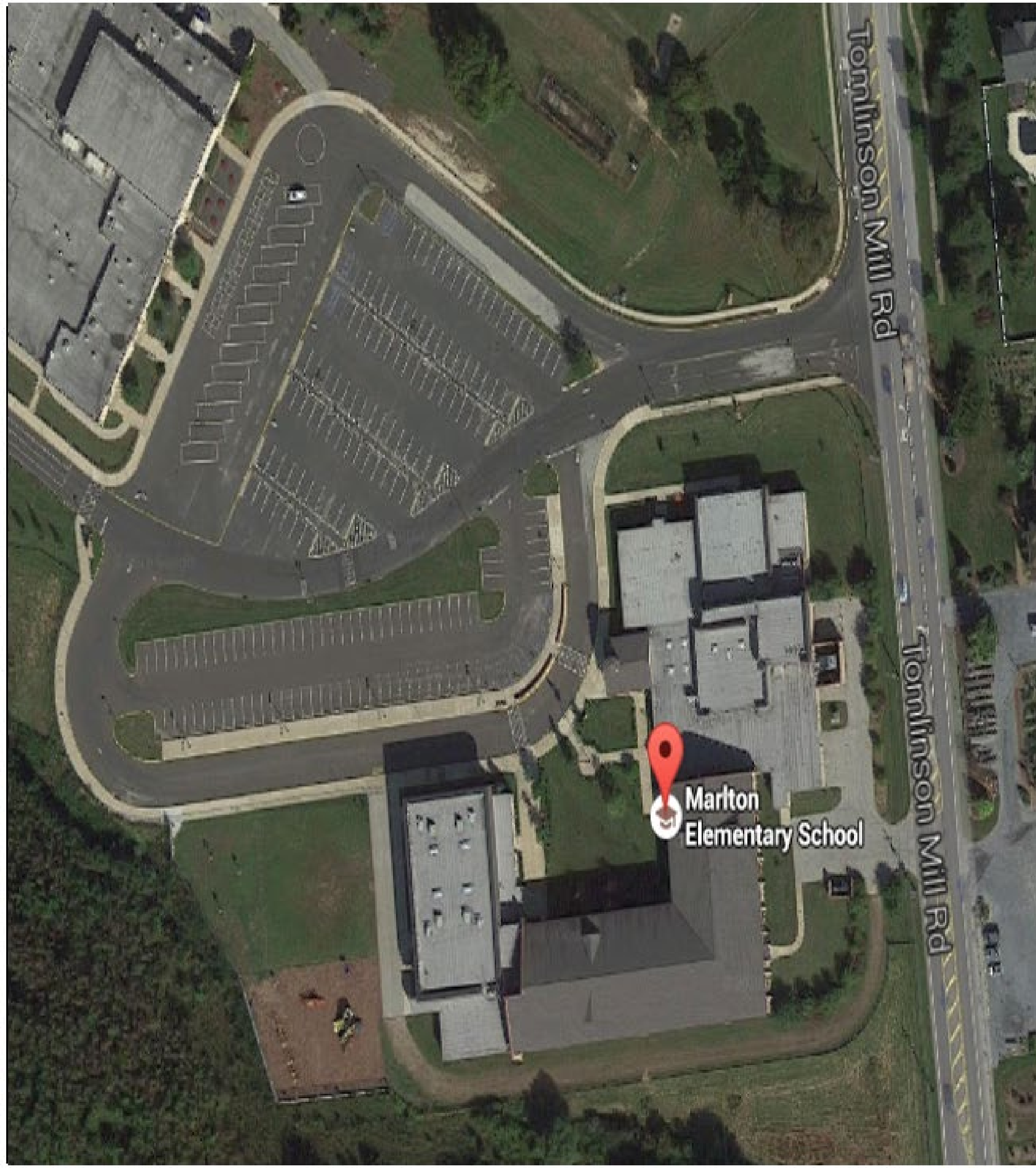
- Are there downspouts?
- Are they connected?
- Is there curb along the parking lot?
- Which way is the parking lot graded?
- What is the condition of the parking lot?

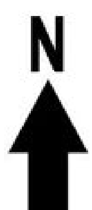
Other Questions

- Do the soils around the Ag Museum infiltrate?
- Who own the property? Will they be open to installing stormwater management measures?
- Are there potential partners to help with the project?
- Do we need permits for altering this site with stormwater best management practices?
- Does the building have a basement?
- Can we lose parking spaces?
- Who will maintain the BMPs?
- Is the project a high priority?

Marlton Elementary School

190 Tomlinson Mill Rd,
Evesham Township, NJ 08053





Marlton Elementary School

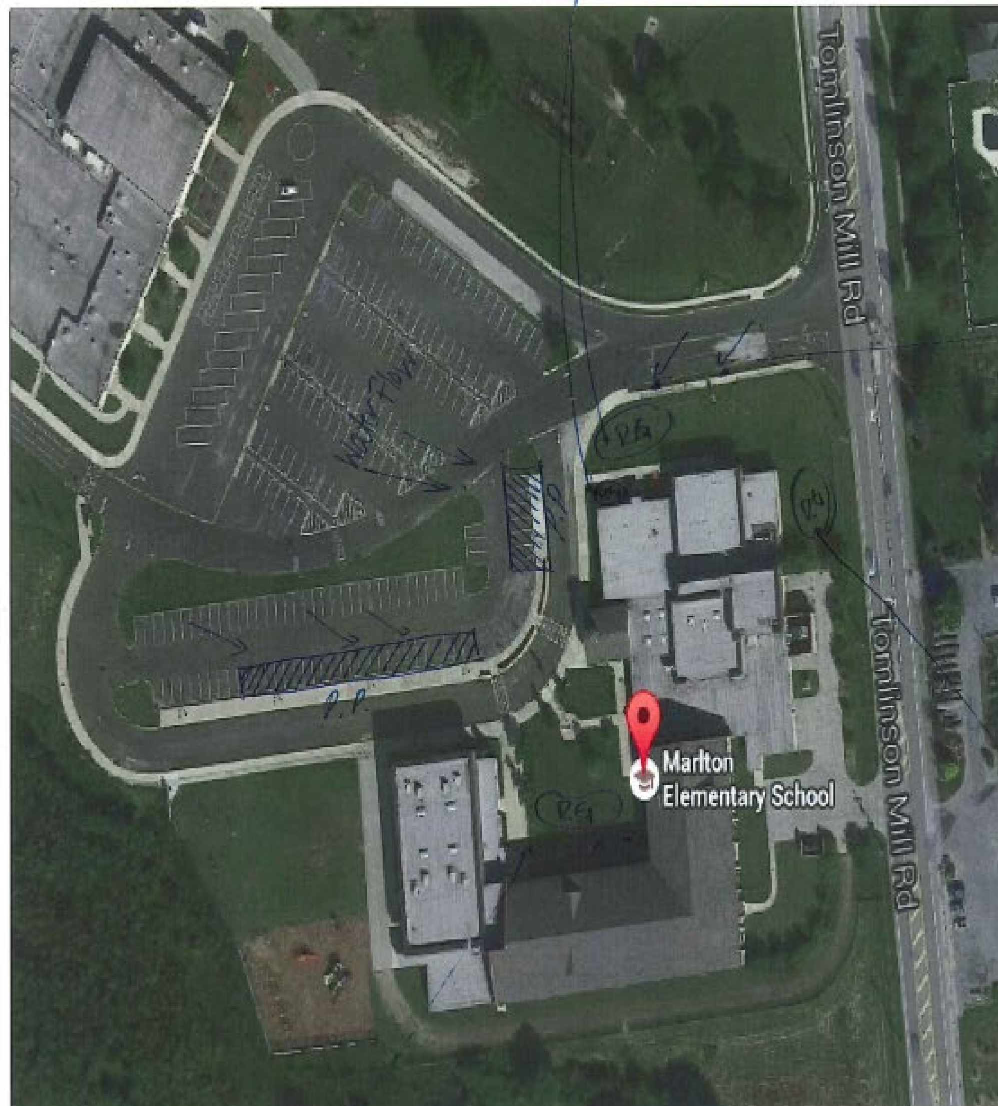
190 Tomlinson Mill Rd,
Evesham Township, NJ 08053

P.P.=Porous Pavement

RG. = Rain Garden

P.P. Look at Contours for parking lots to see flow of run off

2 inlets for overflow of rain Garden



N

Curb Cuts to allow flow to go into Rain Garden

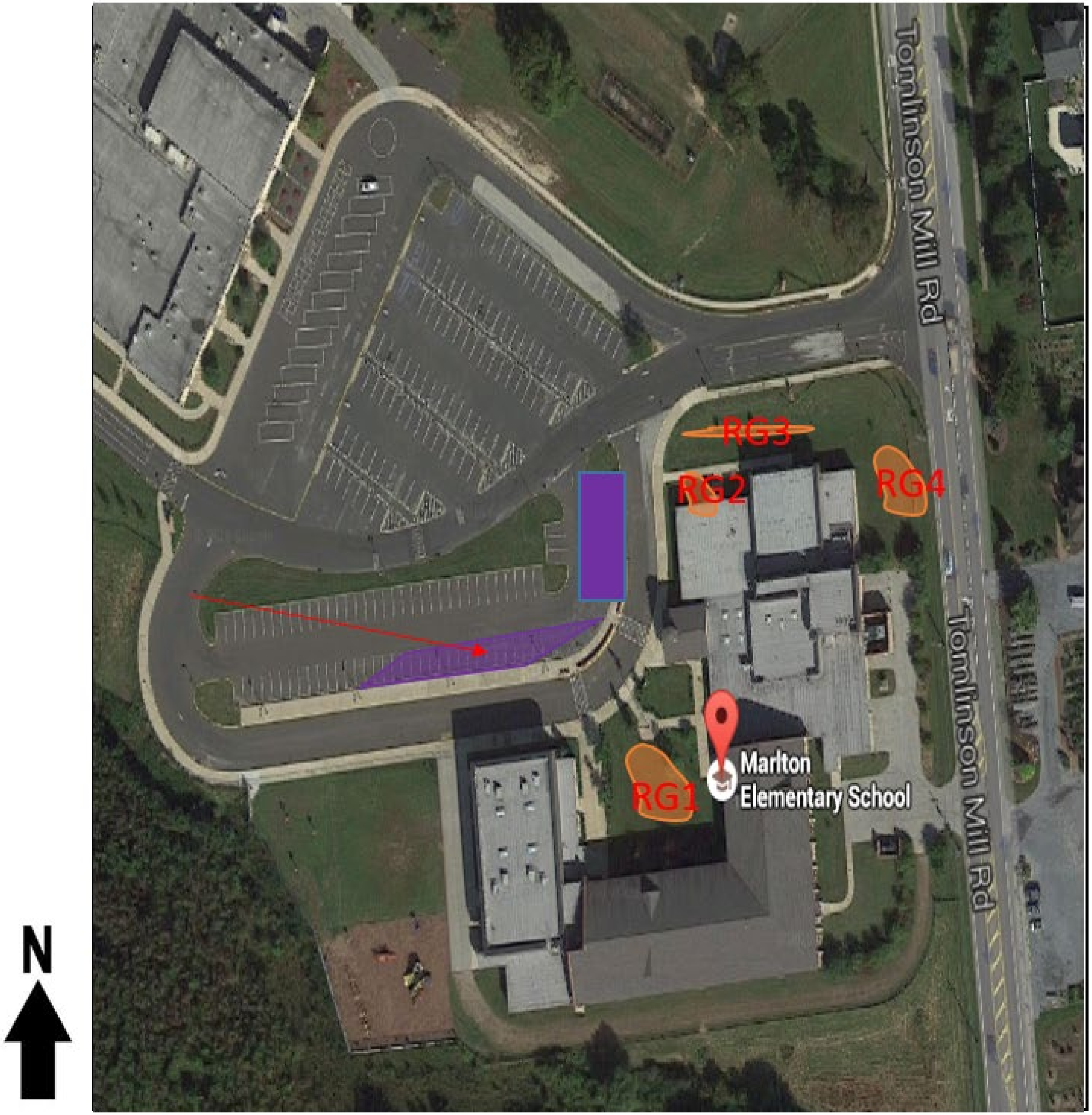
inlet for over flow

Disconnect downspouts to go into Rain Garden

Marlton Elementary School

190 Tomlinson Mill Rd,
Evesham Township, NJ 08053

1) Porous pavement?
2) Rain Gardens
3) Red arrow (Water Flow)



RG2

Rain Garden: disconnect downspouts and install rain garden

Next Step: Site Visit

What are we looking for during our site visit?

1. What are sources of stormwater and where does it flow?
2. What is the direction and relative slope of site?
3. Where are impervious surfaces on the site?
4. What is the condition of the paved areas?
5. Are impervious surfaces directly connected?
6. Are there opportunities to disconnect?
7. Are there stormwater catch basins?

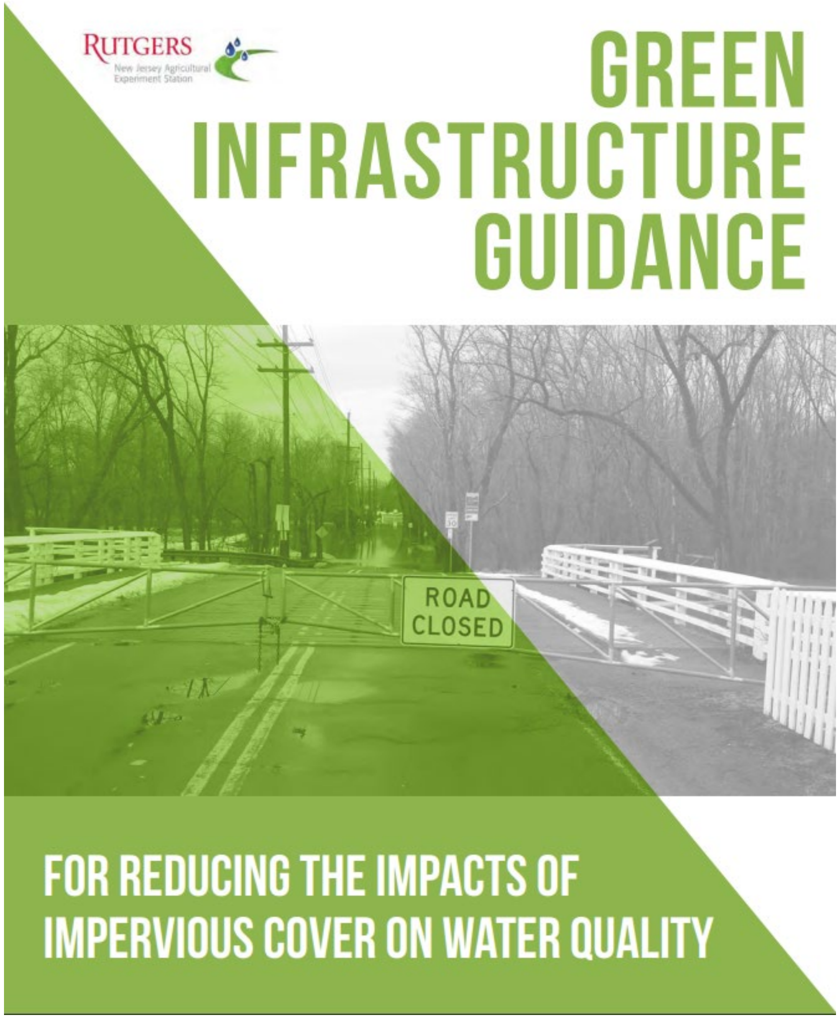
What are we looking for during our site visit (cont’d)?

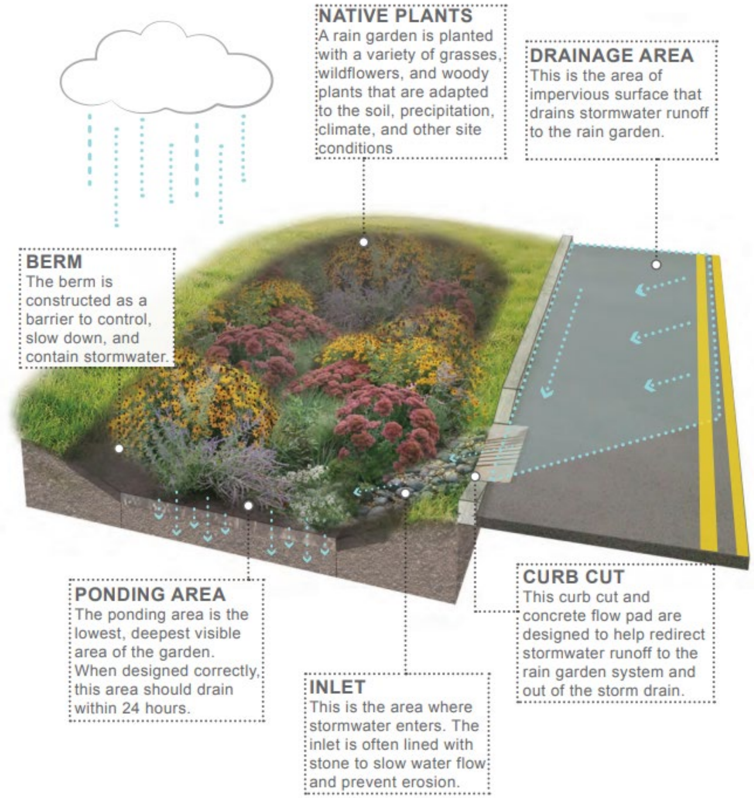
9. Is there evidence of ponding water on site?
10. Where are the utilities on the site?
11. Are there pedestrian safety issues?

Green Infrastructure Manual:
http://water.rutgers.edu/GreenInfrastructureGuidanceManual.html

Green Infrastructure Brochure:

http://water.rutgers.edu/Green_Infrastructure_Guidance_Manual/GI-Brochure_PRINT-FRIENDLY.pdf





Green Infrastructure CHECKLIST: http://water.rutgers.edu/GreenInfrastructureGuidanceManual.html

Also found on pages132-135 in the Manual

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Green Infrastructure Site Assessment Checklist

GENERAL INFORMATION		Site ID:
Name person(s) completing assessment:		Date:
Location Address and Cross Streets:	Neighborhood:	
Name of Nearest Waterway:	Property Owner / Tax Parcel ID/Street Segment:	
Contact Information:		
SITE DESCRIPTION		
Description of site and relative visibility to the public (public or private property, lot size, current use, streetscape, etc):		

OBSERVATIONS	NOTES/REMARKS
1) What is the source of stormwater runoff and where does it flow (on map or aerial photo indicate water flow direction and existing storm drains)? Is there a noticeable source or deposit of sediment?	
2) What is the direction and relative slope of the site and/or street? (indicate on map or aerial photo)	
3) Where on the site are impervious areas and estimate area in square feet (i.e. rooftops, parking lots, sidewalks)? For streetscapes, what is the building setback and/or sidewalk width?	
4) Do paved areas appear to be in poor condition (cracks, settling, vegetation growth, etc.) or do they appear newly paved or reconstructed?	
5) Does stormwater runoff from impervious areas flow directly to the sewer system (such as roof runoff directed into a storm drain)?	
6) Are there opportunities to redirect and disconnect runoff (downspouts, grassed areas, tree pits, curb extensions)?	
7) How many stormwater catch basins are visible? Note location on maps and general condition, i.e. clogged, functioning, shallow (< 3 ft), or deep (>3 ft)?	
8) Is there evidence of ponding water at the site or flooding in streets or intersections? (indicate reason; i.e. due to clogged drains, high water table, etc.)	
9) Are there mature trees/vegetation at the site? What types of plants would be appropriate at the site (sun or shade tolerant, height or site line restrictions)?	
10) Where are utilities on the site or in the right of way that could conflict with construction (sewer pipes, utility poles, water, gas, etc)?	
11) Does pedestrian safety need to be addressed? Will parking or bus stops be impacted by construction?	

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Green Infrastructure Site Assessment Checklist

Choose suggested BMPs or indicate other. Include site photos and a description of recommended BMP location.			
RAIN GARDENS	**YES**	**NO**	**COMMENTS**
1) Are there visible, exterior downspouts on any buildings?			
2) Are there unpaved areas suitable for landscaping?			
3) Is the site subject to ponding or flooding?			
RAIN WATER HARVESTING	**YES**	**NO**	**COMMENTS**
1) Are there nearby buildings with visible exterior downspouts?			
2) Is there a community garden nearby or other use for collected rainwater?			
TREE PITS, TRENCHES, AND STREETSCAPE STRATEGIES	**YES**	**NO**	**COMMENTS**
1) Does stormwater flow across sidewalks or along the curb?			
2) Are there existing trees, landscaping or tree pits near the street?			
2) Can water be directed from the street/curb into adjacent areas?			
POROUS PAVEMENT	**YES**	**NO**	**COMMENTS**
1) Are there large areas of pavement on the site and are any paved areas not heavily used (i.e. fire lane, overflow)?			
2) Are existing impervious areas in poor condition and in need of replacement?			
CURB EXTENSIONS AND STORMWATER PLANTERS	**YES**	**NO**	**COMMENTS**
1) Is this a heavily used pedestrian crossing? Are there pedestrian crosswalks that would be safer if shortened?			
2) Is the intersection or street at a location where stormwater can be collected before it enters a storm drain?			
OTHER STRATEGIES	**YES**	**NO**	**COMMENTS**

Concept Plans

Evesham Township
Impervious Cover Assessment
Kettle Run Fire Rescue, 498 Hopewell Road

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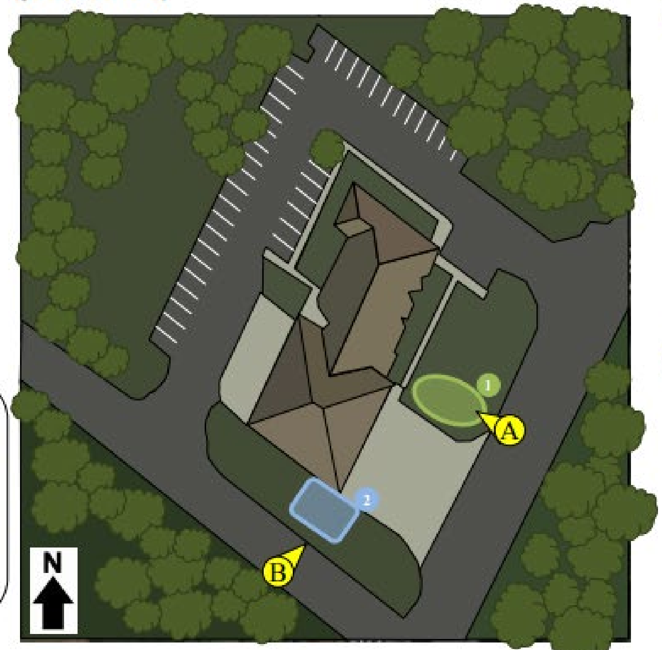
PROJECT LOCATION:

SITE PLAN:



A

B

1 **BIORETENTION SYSTEM:** A rain garden can be used to capture, treat, and infiltrate runoff from the roof of the building. These systems can easily be incorporated into existing landscapes, improving aesthetics and creating wildlife habitat while managing stormwater .

2 **RAINWATER HARVESTING SYSTEM:** A cistern can capture stormwater that drains from the building's rooftop. Connecting the downspouts to the cistern will allow the stormwater to be harvested and used for cleaning fire trucks.

1 BIORETENTION SYSTEM

2 RAINWATER HARVESTING SYSTEM

Evesham Township
Impervious Cover Assessment
Barton Run Swim Club, 100 Lakeside Drive

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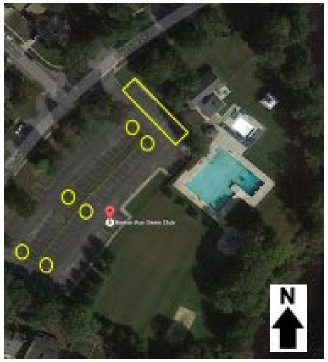
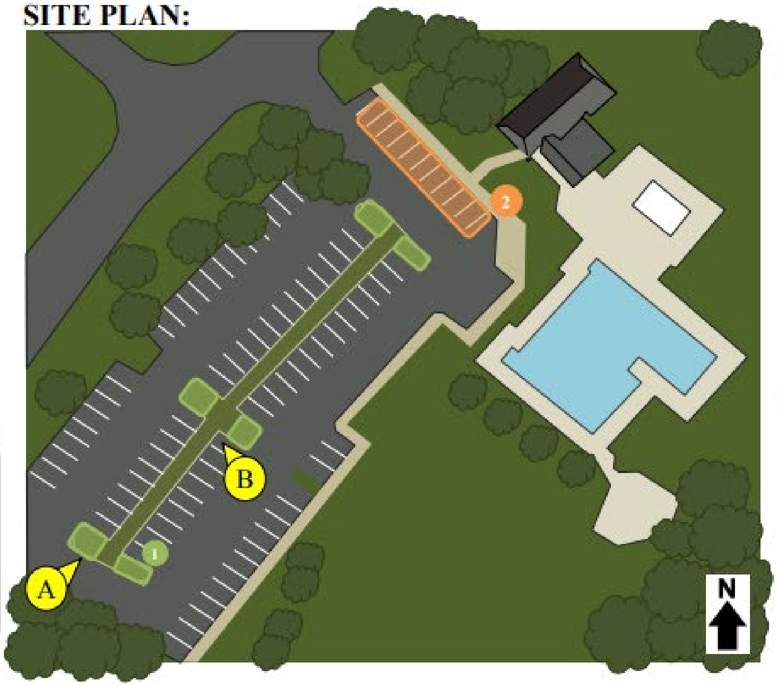
PROJECT LOCATION:



SITE PLAN:



A

B

1 **BIORETENTION SYSTEM:** On this property rain gardens can be used to reduce sediment and nutrient loading on local waterways by retrofitting the parking islands. The rain gardens will capture, treat, and infiltrate runoff from the parking lot.

2 **POROUS PAVEMENT:** Parking spaces close to the pool house can be converted to porous asphalt. Porous pavement promotes groundwater recharge and filters stormwater.

1 BIORETENTION SYSTEM

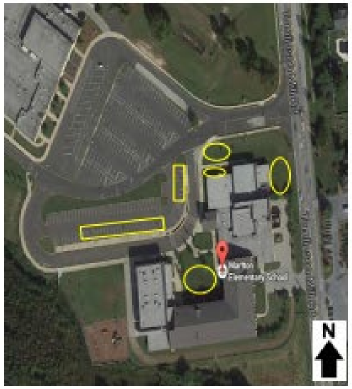
2 POROUS PAVEMENT

Evesham Township

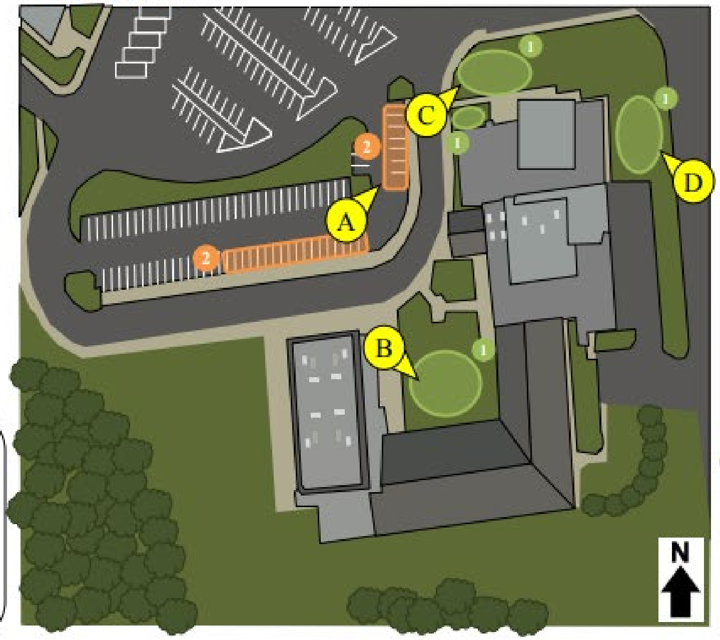
Impervious Cover Assessment

Marlton Elementary School, 190 Tomlinson Mill Road

PROJECT LOCATION:



SITE PLAN:



A

B

C

D

1 **BIORETENTION SYSTEM:** On this property rain gardens can be used to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge. There are opportunities to install rain gardens near entrances to the school.

2 **POROUS PAVEMENT:** Porous pavement promotes groundwater recharge and filters stormwater. The parking spots close to the school can be retrofitted with porous pavement.

1 BIORETENTION SYSTEM

2 POROUS PAVEMENT

Green Infrastructure Information Sheet

Marlton Elementary School
Green Infrastructure Information Sheet

Location: 190 Tomlinson Mill Road Evesham Township, NJ 08053	**Municipality:** Evesham Township **Subwatershed:** Barton Run
Green Infrastructure Description: bioretention system (rain garden) porous pavement	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (TP), total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes total suspended solids removal potential: yes	**Stormwater Captured and Treated Per Year:** bioretention system #1: 234,446 gal. bioretention system #2: 35,331 gal. bioretention system #3: 117,562 gal. bioretention system #4: 128,192 gal. porous pavement #1: 517,980 gal. porous pavement #2: 133,362 gal.

Existing Conditions and Issues:
Marlton Elementary School is surrounded by impervious surface such as asphalt and concrete. The downspouts on the building are connected directly to the sewer system. Bringing runoff from the roof and parking lots directly into the sewer systems leads to sediment and other solids being dumped into local waterways as nonpoint source pollution. High volumes of rain in the sewer system also contributes to flooding.

Proposed Solution(s):
Two areas of porous pavement have been proposed within the school parking lot near the catch basins so that the runoff can infiltrate into the ground, instead of going directly to local waterways via the catch basins. The porous pavement would be in parking spaces to avoid the strain of vehicular traffic.

Four potential rain garden sites were identified. The first garden could be located inside the lawn area at the school entrance. The downspouts from the three sides of the building surrounding the rain garden can be redirected so that the rainfall from the roof can be captured, treated, and filtered by the rain garden instead of flowing into the sewer system. The second rain garden can also treat runoff from the roof. The third rain garden could collect stormwater from the vehicle entrance via curb cuts and trench drains. The final rain garden proposal is on the northeastern side of the building and will also use downspouts to capture runoff from.

Anticipated Benefits:
Since the bioretention systems are designed to capture, treat, and infiltrate the entire 2-year design storm (3.4 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. Bioretention systems would also provide ancillary benefits, such as enhanced wildlife and aesthetic appeal to the local residents of Evesham Township.

Marlton Elementary School
Green Infrastructure Information Sheet

Porous pavement allows stormwater to infiltrate through to soil layers which will promote groundwater recharge as well as intercept and filter stormwater runoff. The porous pavement system will achieve the same level of pollutant load reduction for TN, TP and TSS as the bioretention system.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs
Municipality of Evesham Township
Local social and community groups

Partners/Stakeholders:
Evesham Township
Marlton Elementary School
local community groups
residents
students and parents
Rutgers Cooperative Extension

Estimated Cost:
Rain garden #1 would need to be approximately 2,250 square feet. At $5 per square foot, the estimated cost is $11,250.
Rain garden #2 would need to be approximately 339 square feet. At $5 per square foot, the estimated cost is $1,695.
Rain garden #3 would need to be approximately 1,128 square feet. At $5 per square foot, the estimated cost is $5,640.
Rain garden #4 would need to be approximately 1,230 square feet. At $5 per square foot, the estimated cost is $6,150.

The porous asphalt #1 would cover 3,550 square feet and have a 2-foot stone reservoir under the surface. At $25 per square foot, the cost of the porous asphalt system would be $88,750.
The porous asphalt #2 would cover 914 square feet and have a 2-foot stone reservoir under the surface. At $25 per square foot, the cost of the porous asphalt system would be $22,850.

The total cost of the project will thus be approximately $136,335.

SITES WITHIN THE BARTON RUN SUBWATERSHED:

EVESHAM TOWNSHIP: GREEN INFRASTRUCTURE SITES

1. Barton Run Swim Club
2. Cherokee High School
3. Evesham Fire/Rescue 223/227
4. Evesham Township Municipal Court
5. King's Grant Community Room
6. Marlton Elementary School
7. Memorial Park
8. Richard L. Rice Elementary School
9. Villa Royal Association

SITES WITHIN THE LAKE PINE SUBWATERSHED:

10. Kettle Run Fire/Rescue 225/228
11. Links Golf Course

SITES WITHIN THE PENNSAUKEN CREEK SUBWATERSHED:

12. Evesham Fire/Rescue 221/229

SITES WITHIN THE RANCOCAS CREEK SUBWATERSHED:

13. Christ Presbyterian Church
14. Frances S. DeMasi Elementary School
15. Marlton Assembly of God
16. Marlton Post Office
17. Robert B. Jaggard Elementary School
18. St. Joan of Arc Parish and School

MARLTON ELEMENTARY SCHOOL

Subwatershed: Barton Run

Site Area: 2,037,458 sq. ft.

Address: 190 Tomlinson Mill Road
Evesham, NJ 08053

Block and Lot: Block 39, Lot 1.01, 1.02

Stormwater is currently directed to existing catch basins. Parking spots by the north and west buildings can be replaced with porous asphalt to capture and infiltrate stormwater runoff from the parking lot. Rain gardens adjacent to the building can capture, treat, and infiltrate roof runoff before it reaches the existing catch basin. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
26	526,875	25.4	266.1	2,419.1	0.411	14.45

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention systems	0.516	86	39,068	1.47	4,950	$24,750
Pervious pavement	0.651	109	49,331	1.85	4,465	$111,625

GREEN INFRASTRUCTURE RECOMMENDATIONS

Marlton Elementary School

- bioretention system
- pervious pavement
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 50' 100'

Evesham

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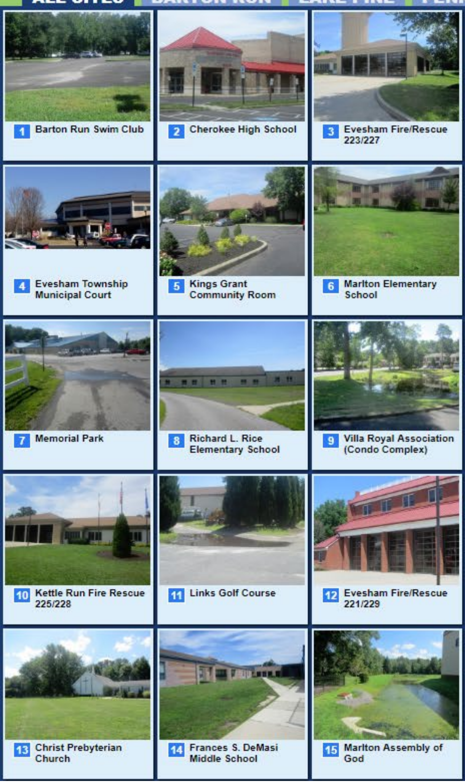
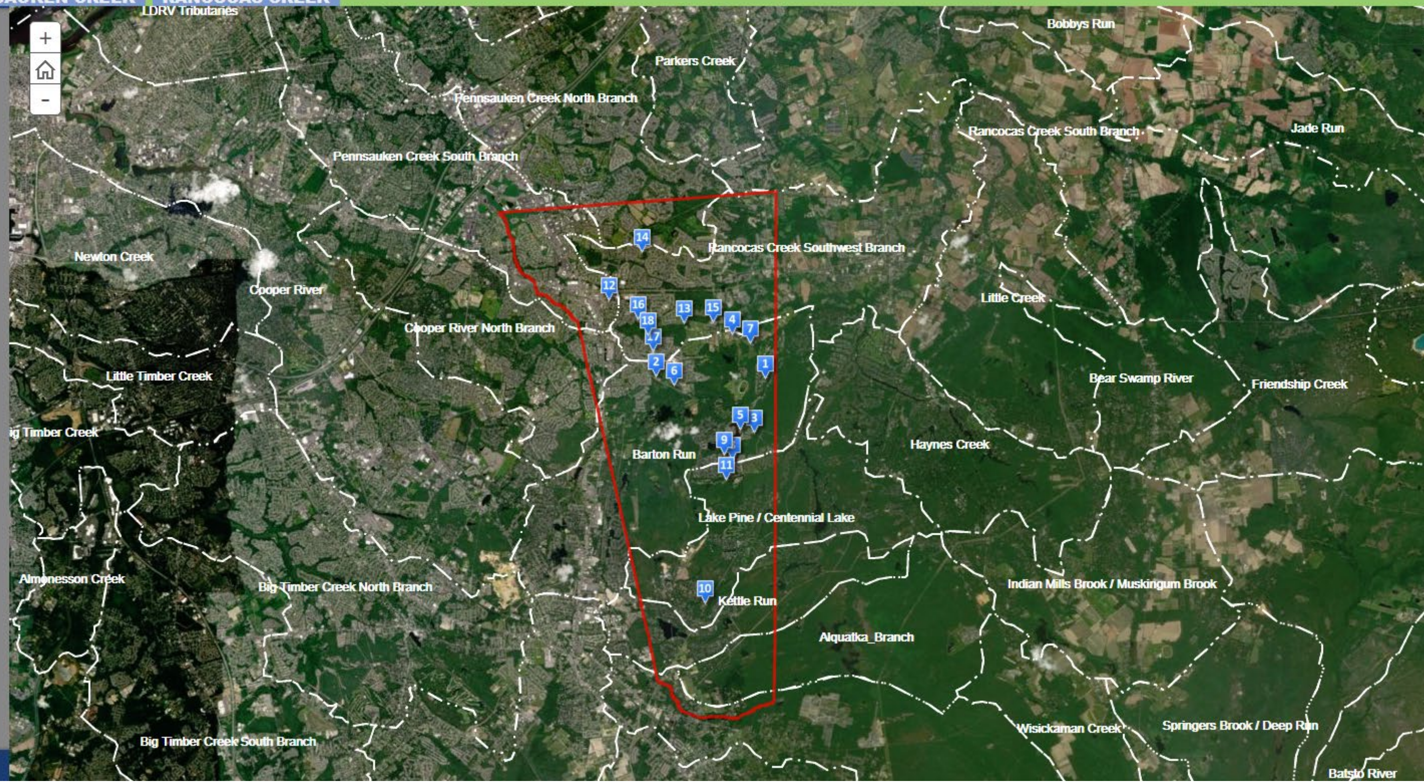
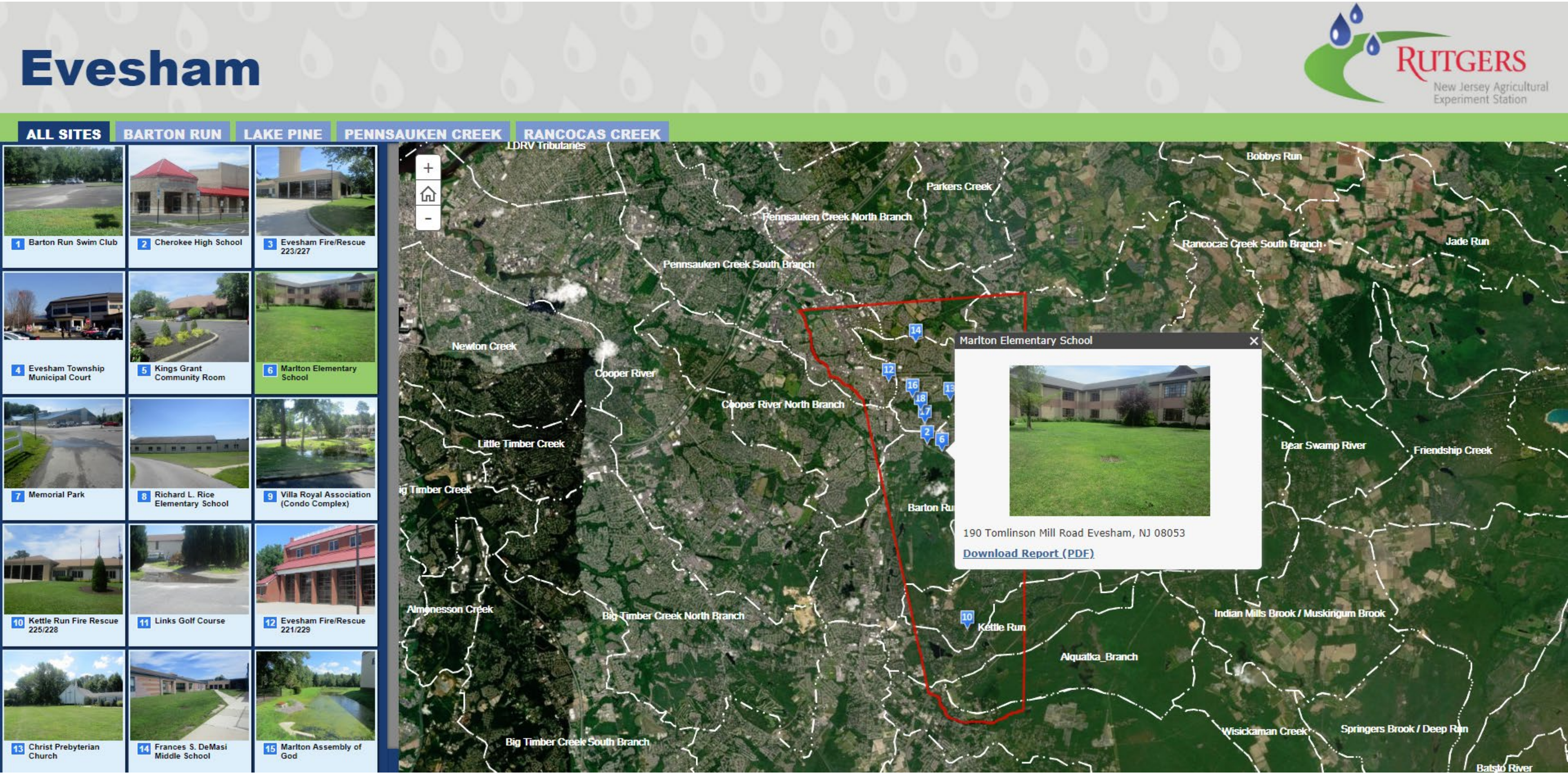
ALL SITES | BARTON RUN | LAKE PINE | PENNSAUKEN CREEK | RANCOCAS CREEK






Evesham
RUTGERS
New Jersey Agricultural Experiment Station
ALL SITES
BARTON RUN
LAKE PINE
PENNSAUKEN CREEK
RANCOCAS CREEK
1 Barton Run Swim Club
2 Cherokee High School
3 Evesham Fire/Rescue 223/227
4 Evesham Township Municipal Court
5 Kings Grant Community Room
6 Marlton Elementary School
7 Memorial Park
8 Richard L. Rice Elementary School
9 Villa Royal Association (Condo Complex)
10 Kettle Run Fire Rescue 225/228
11 Links Golf Course
12 Evesham Fire/Rescue 221/229
13 Christ Prebyterian Church
14 Frances S. DeMasi Middle School
15 Marlton Assembly of God
Marlton Elementary School
190 Tomlinson Mill Road Evesham, NJ 08053
Download Report (PDF)
LDRV Tributaries
Bobbys Run
Parkers Creek
Pennsauken Creek North Branch
Rancocas Creek South Branch
Jade Run
Pennsauken Creek South Branch
Newton Creek
Cooper River
Cooper River North Branch
Little Timber Creek
Bear Swamp River
Friendship Creek
Barton Ru
Almonesson Creek
Big Timber Creek North Branch
Indian Mills Brook / Muskingum Brook
Kettle Run
Alquatka_Branch
Big Timber Creek South Branch
Wisickaman Creek
Springers Brook / Deep Run
Batsto River

Short term (5 years) goal

Table 1. Recommended Short Term Impervious Cover Management Goals

Existing Municipal Impervious Cover	Recommended Short Term (less than 5 years) Impervious Cover Management Goal (%)	Recommended Impervious Cover Management Goal Area (acres)
0% to 10%	1%	10 acres
10.1% to 25%	2%	15 acres
>21.1%	5%	20 acres

Example of a “investment/funding strategy for green infrastructure projects” has been provided in your handouts. Let’s discuss it.

Green Infrastructure Strategic Plan (a.k.a. Green Infrastructure Feasibility Study)

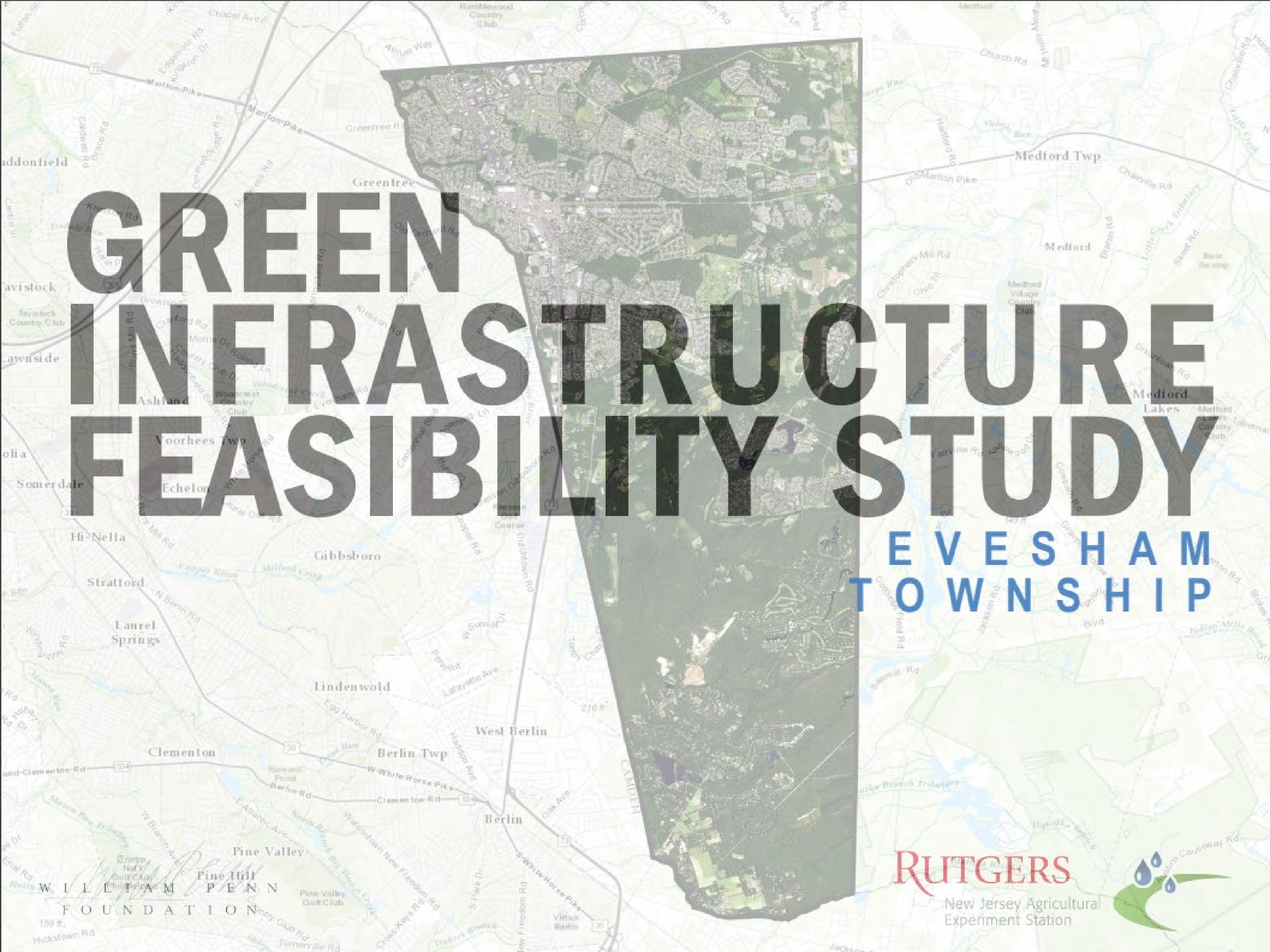
Green Infrastructure Strategic Plan

ICA (Tier 1) and GI Action Plan (Tier 2) + the following:

- Additional green infrastructure sites
- Policy recommendations
- Water quality and quantify benefits
- Implementation agenda
- Long-term 5-20 year goals

GREEN INFRASTRUCTURE FEASIBILITY STUDY

EVESHAM TOWNSHIP



WILLIAM PENN FOUNDATION

RUTGERS
New Jersey Agricultural Experiment Station

bioretention system

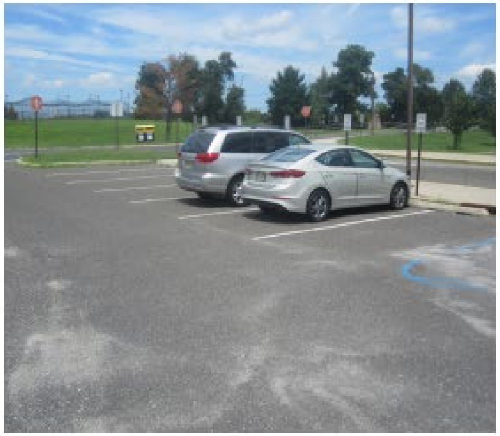
pervious pavement

drainage area

property line

2015 Aerial: NJOIT, OGIS

0' 50' 100'



Stormwater is currently directed to existing catch basins. Parking spots by the north and west buildings can be replaced with porous asphalt to capture and infiltrate stormwater runoff from the parking lot. Rain gardens adjacent to the building can capture, treat, and infiltrate roof runoff before it reaches the existing catch basin. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	From the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
26	526,875	25.4	266.1	2,419.1	0.411	14.45

Recommended Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention systems	0.516	86	39,068	1.47	4,950	$24,750
Pervious pavement	0.651	109	49,331	1.85	4,465	$111,625

CURRENT CONDITION

CONCEPT DESIGN

Policy Recommendations

- Update stormwater management plan and stormwater control ordinance to incorporate green infrastructure requirements
- Update municipal master plan
- Update zoning ordinance to eliminate barriers for green infrastructure
- Use Center for Watershed Protection "The Code and Ordinance Worksheet" to assess your local code/ordinances (https://owl.cwp.org/mdocs-posts/better-site-design-code-and-ordinance-cow-worksheet-2017-update/)

Long term (5-20 years) goal

Table 2. Recommended Long-Term Impervious Cover Management Goals and Green Infrastructure Goals

Existing Municipal Impervious Cover	Recommended Long Term (5-20 years) Impervious Cover Management Goal (%)	Recommended Impervious Cover Management Goal Area (acres)
0% to 10%	2%	25 acres
10.1% to 25%	5%	50 acres
>21.1%	10%	80 acres

Implementation Agenda

- Funding piece from Tier 2
- Maintenance and monitoring - NJDEP provides guidance on maintenance and monitoring of green infrastructure practices - Go to: https://www.njstormwater.org/maintenance_guidance.htm
- Responsible parties
- Timeframe

How does green infrastructure work?

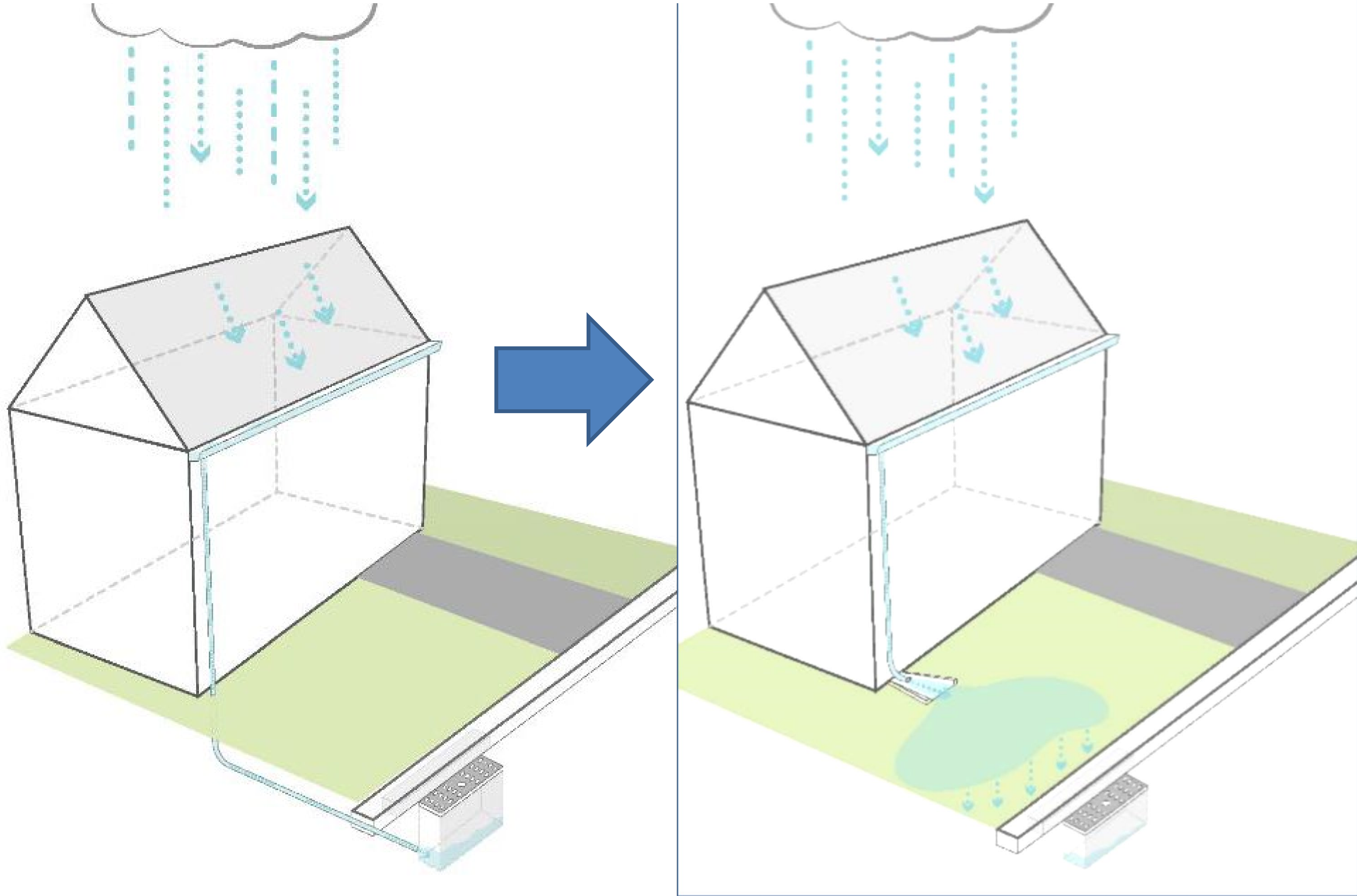
It is all about controlling runoff from impervious surfaces

Step 1: Depave

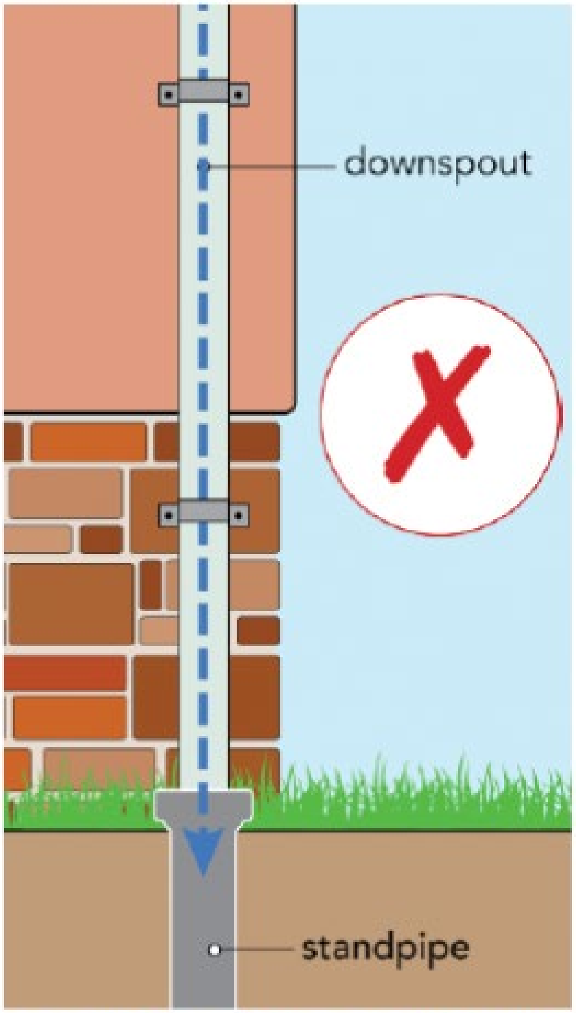




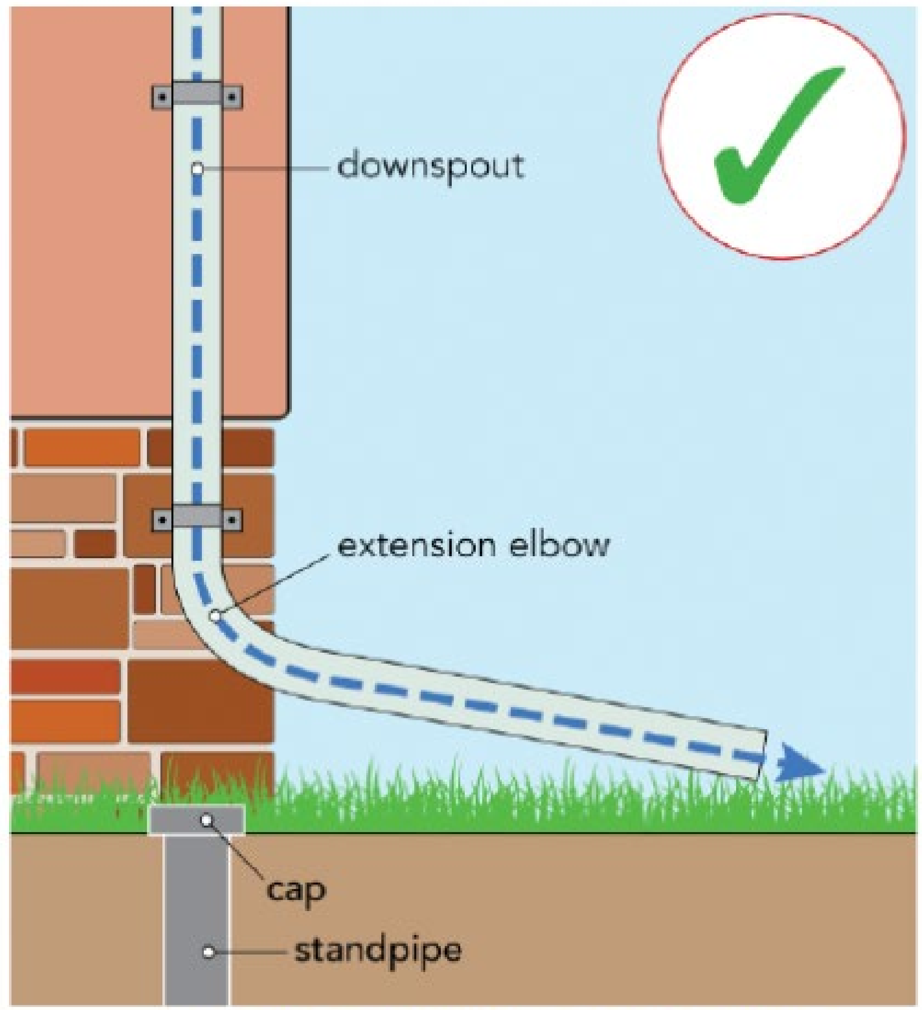

Step 2: Simple Disconnection



Downspout Disconnection

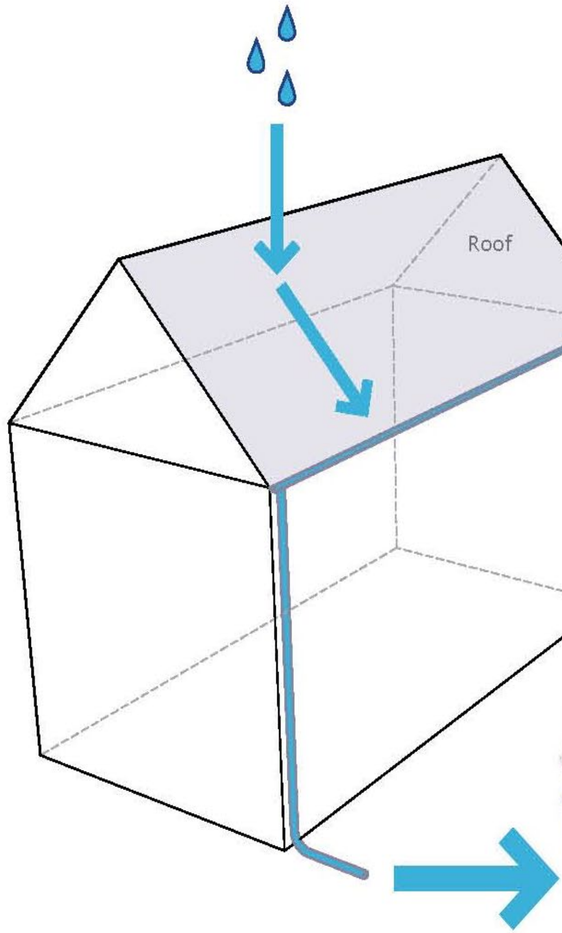


DOWNSPOUT CONNECTED TO SEWER SYSTEM



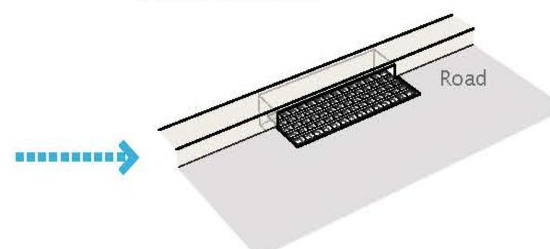
DOWNSPOUT DISCONNECTED FROM SEWER SYSTEM

Disconnect to a Rain Barrel or Cistern



Disconnect your downspout by installing a rain barrel

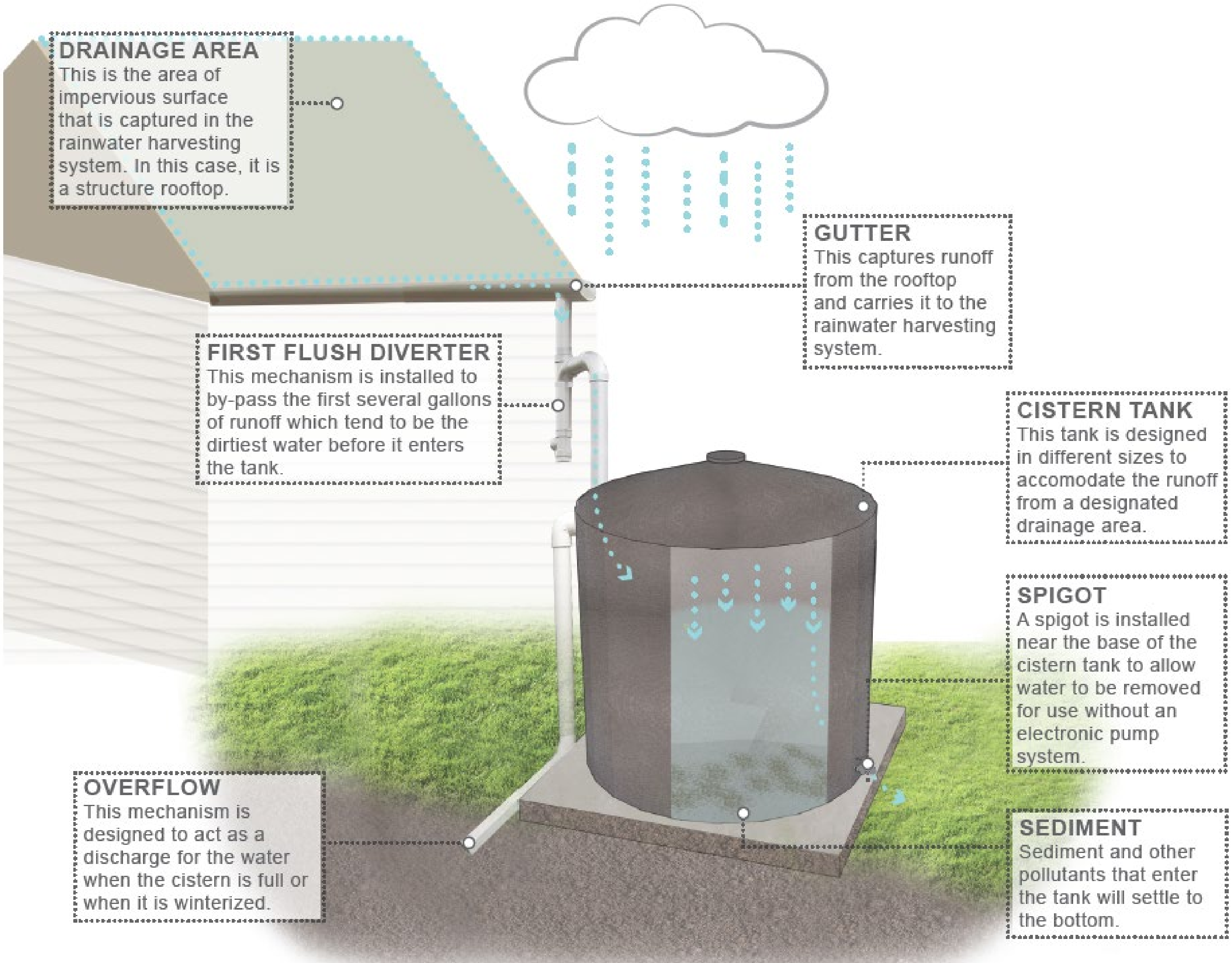
REDUCE THE AMOUNT OF RUNOFF ENTERING STORM SEWERS



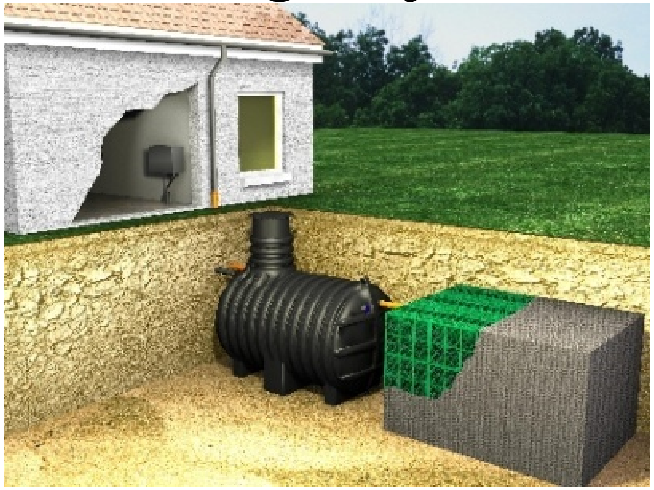
Impervious area is now ***"disconnected"*** from flowing directly into the storm sewer system

So Many Barrels to Choose From…

Rainwater Harvesting Systems

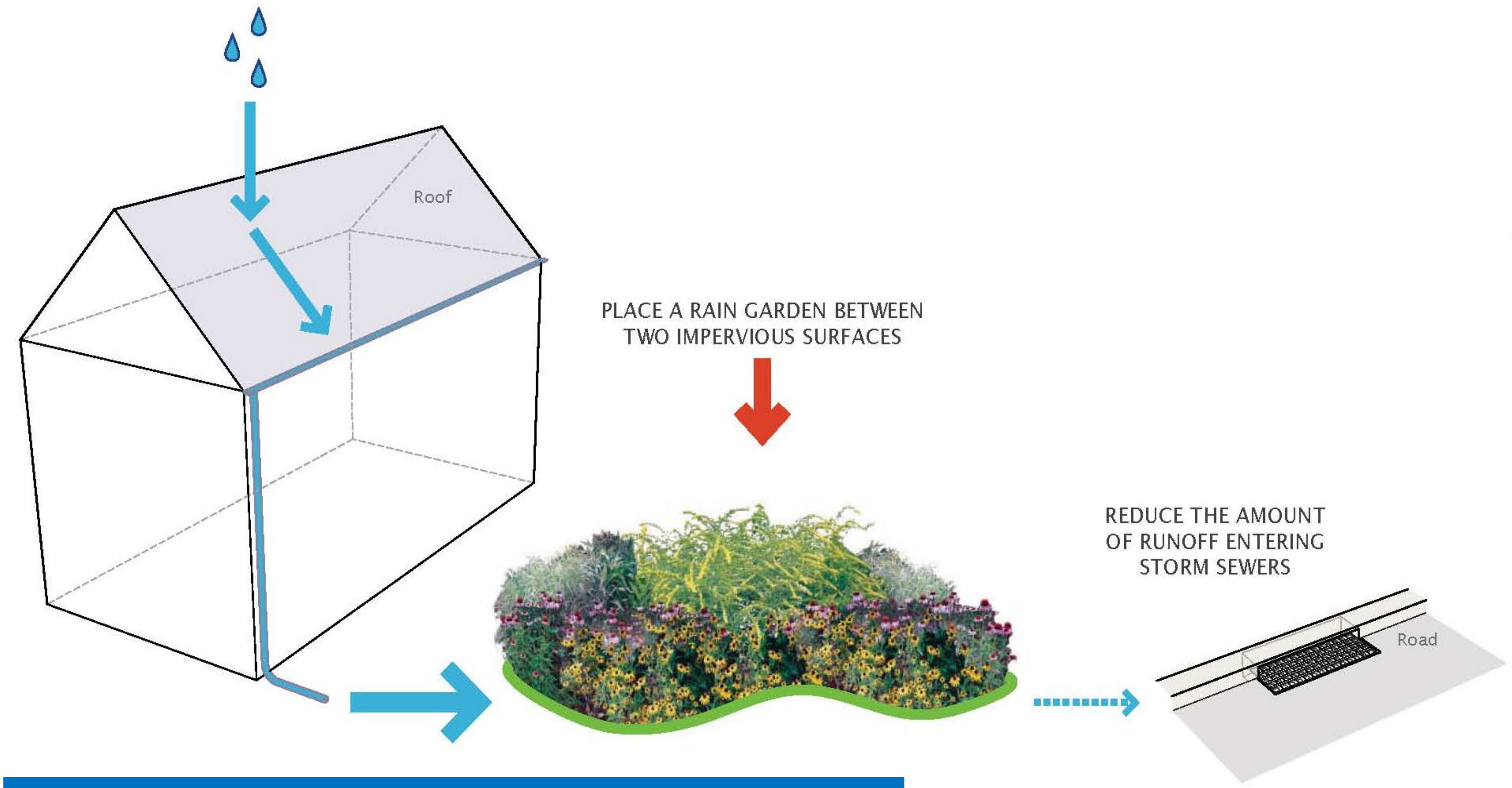


Or Larger Rainwater Harvesting Systems…



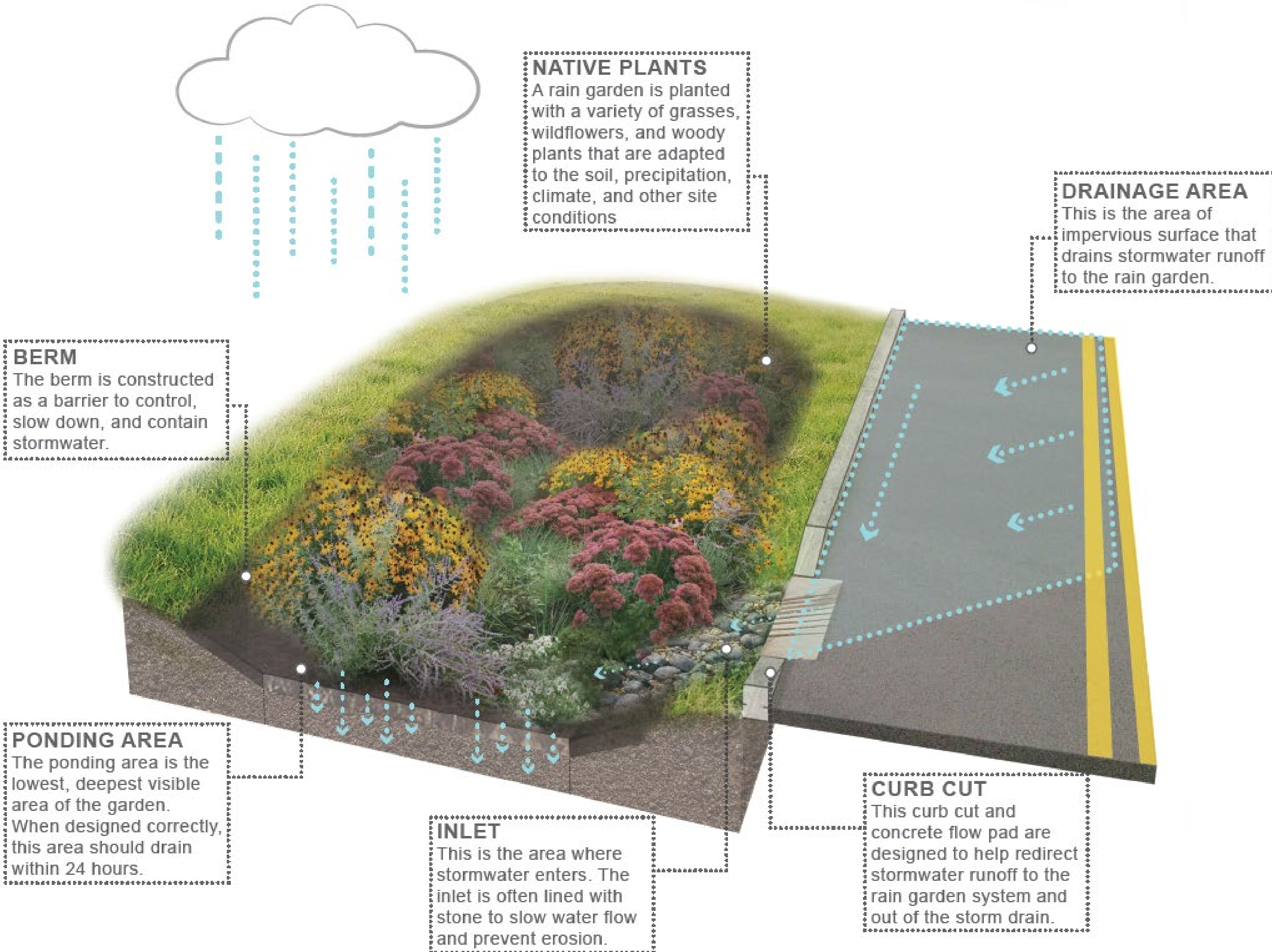

3M

Disconnect to a Rain Garden



Rooftop runoff is now ***"disconnected"*** from flowing directly into the storm sewer system

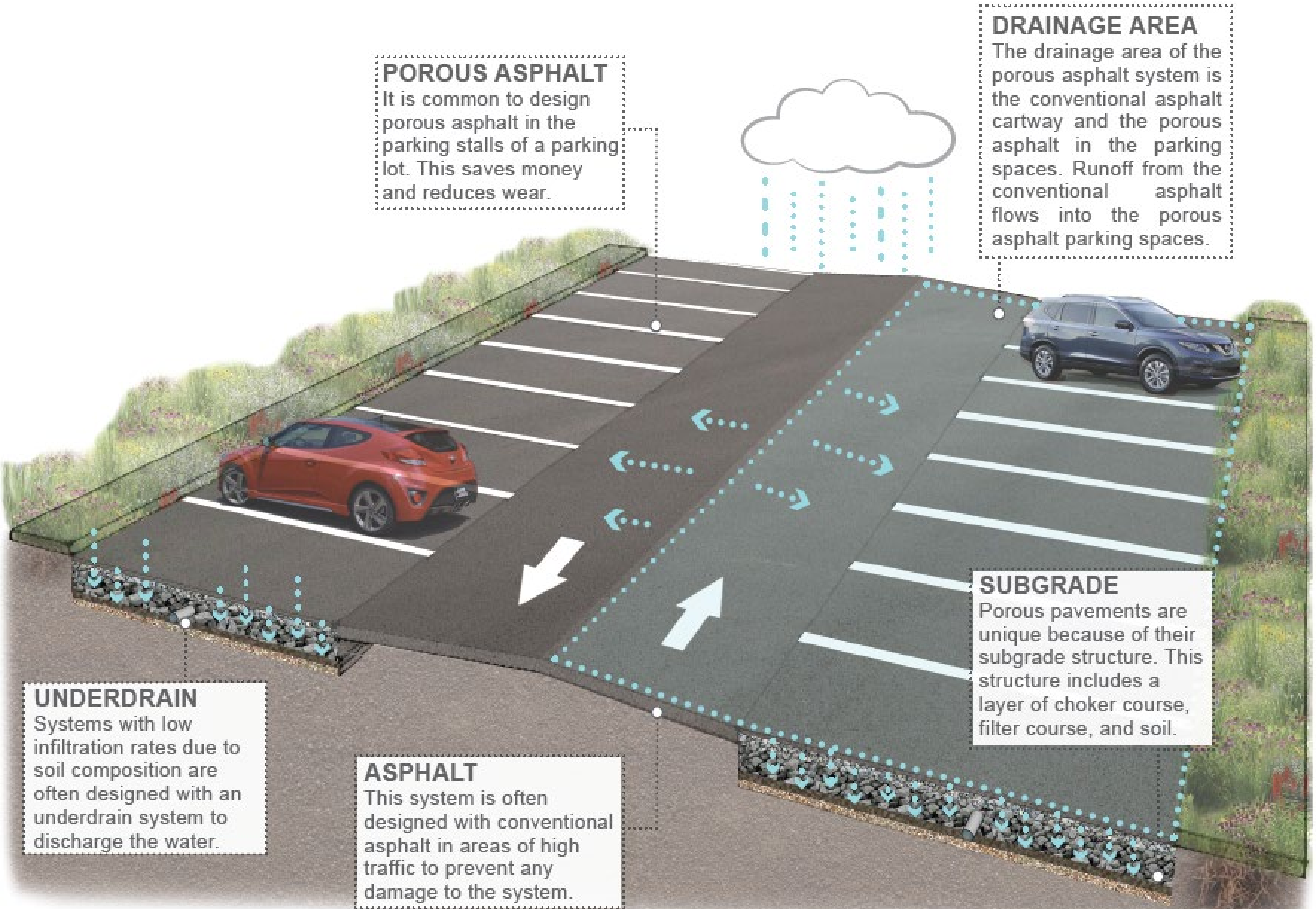
Bioretention Systems/Rain Gardens



Lots of Rain Gardens


116

Step 3: Convert to Permeable Pavement



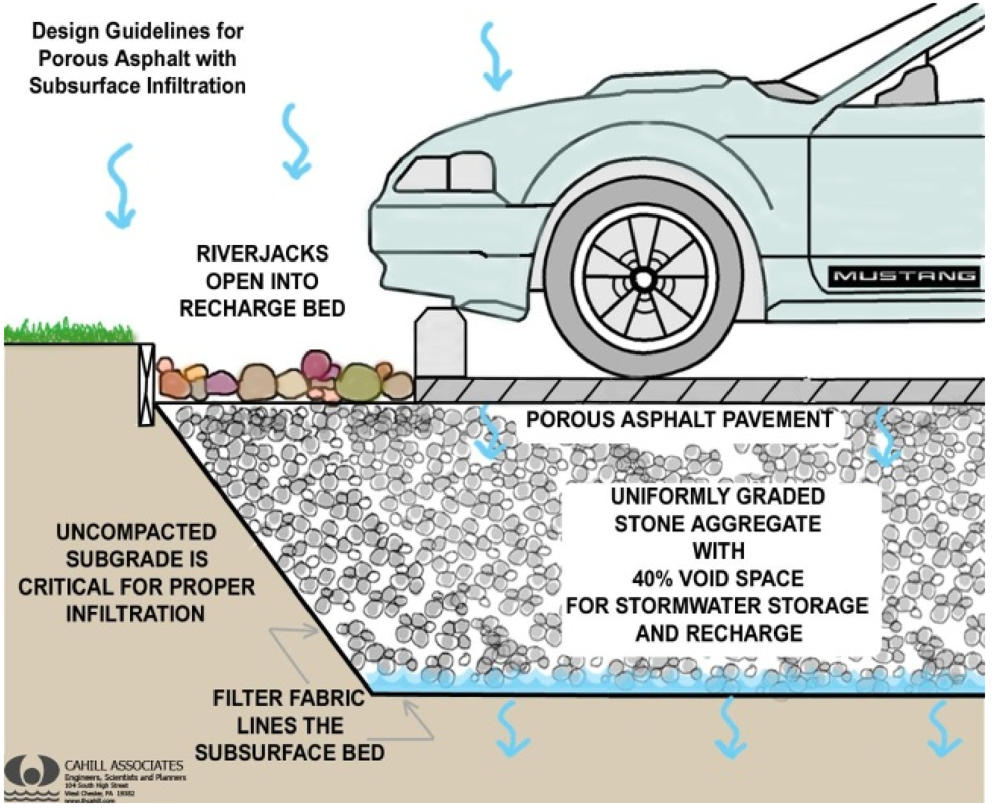
Permeable Pavements

- Underlying stone reservoir
- Porous asphalt and pervious concrete are manufactured without "fine" materials to allow infiltration
- Grass pavers are concrete interlocking blocks with open areas to allow grass to grow
- Ideal application for porous pavement is to treat a low traffic or overflow parking area

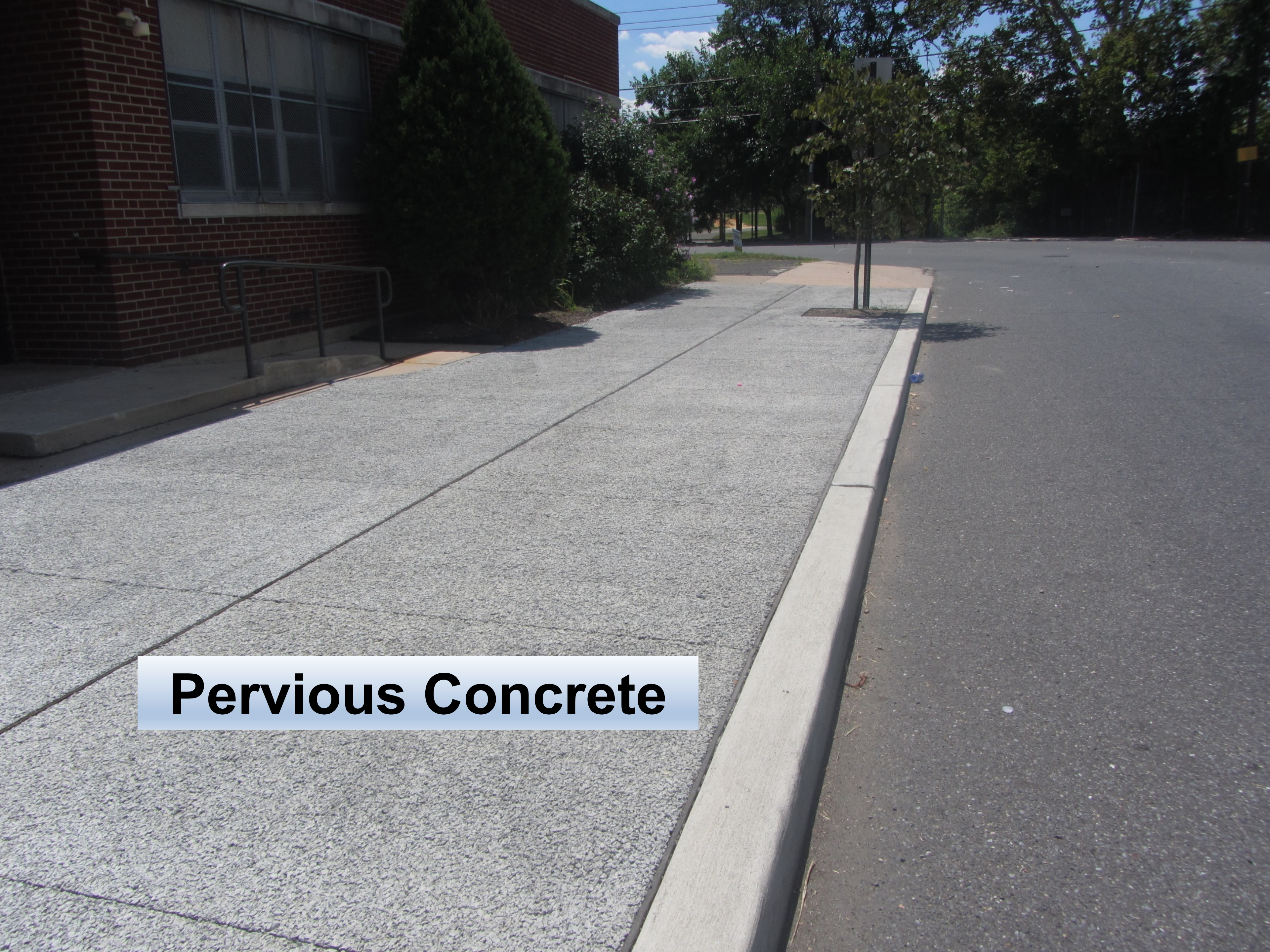
ADVANTAGES

- Manage stormwater runoff
- Minimize site disturbance
- Promote groundwater recharge
- Low life cycle costs, alternative to costly traditional stormwater management methods
- Mitigation of urban heat island effect
- Contaminant removal as water moves through layers of system

COMPONENTS



Porous Asphalt


Pervious Concrete

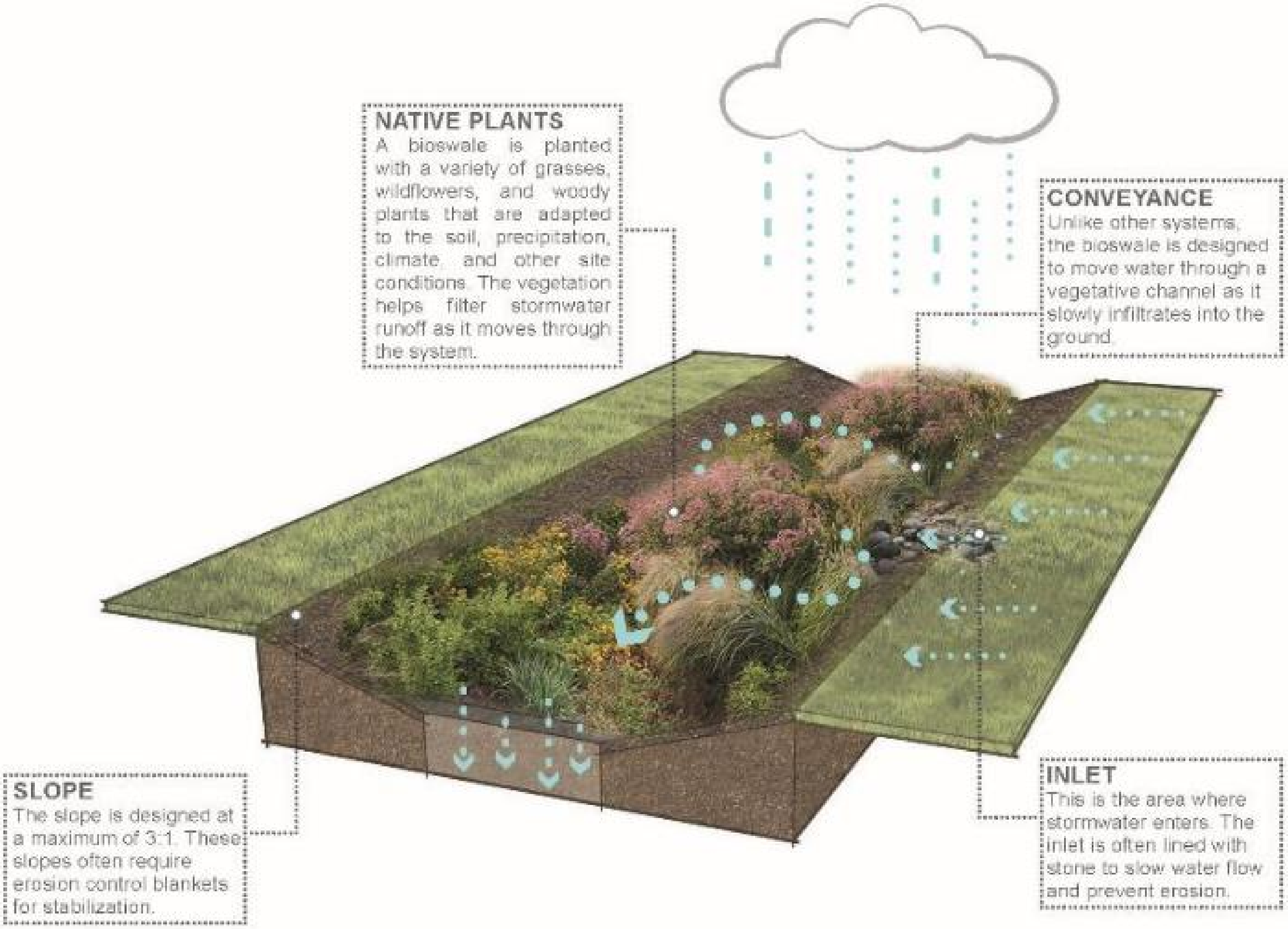

Permeable Pavers


Grass Pavers

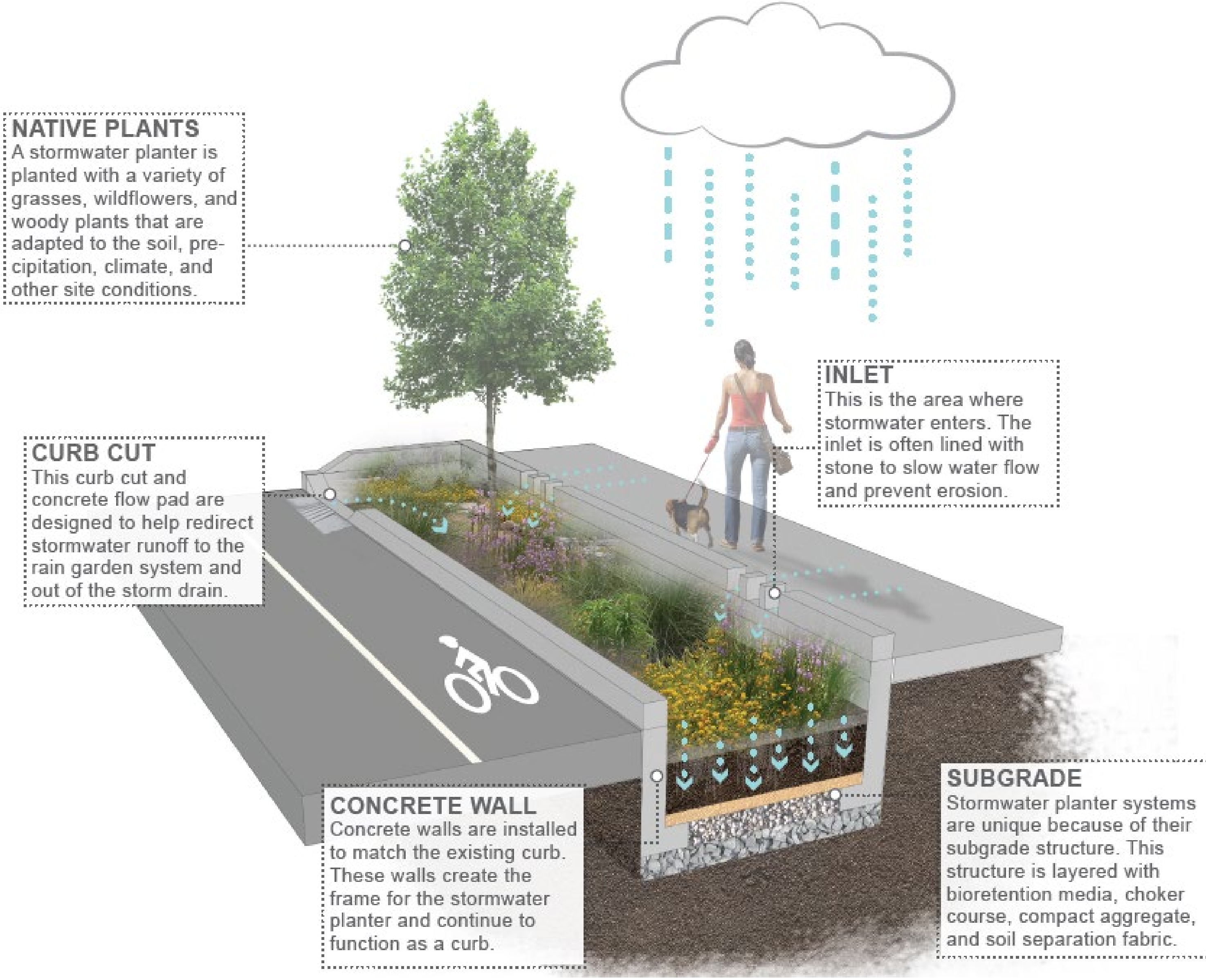
Other Green Infrastructure Practices

- Bioswale
- Stormwater Planters
- Green Roofs

BIOSWALE


NATIVE PLANTS
A bioswale is planted with a variety of grasses, wildflowers, and woody plants that are adapted to the soil, precipitation, climate, and other site conditions. The vegetation helps filter stormwater runoff as it moves through the system.
CONVEYANCE
Unlike other systems, the bioswale is designed to move water through a vegetative channel as it slowly infiltrates into the ground.
SLOPE
The slope is designed at a maximum of 3:1. These slopes often require erosion control blankets for stabilization.
INLET
This is the area where stormwater enters. The inlet is often lined with stone to slow water flow and prevent erosion.

STORMWATER PLANTERS

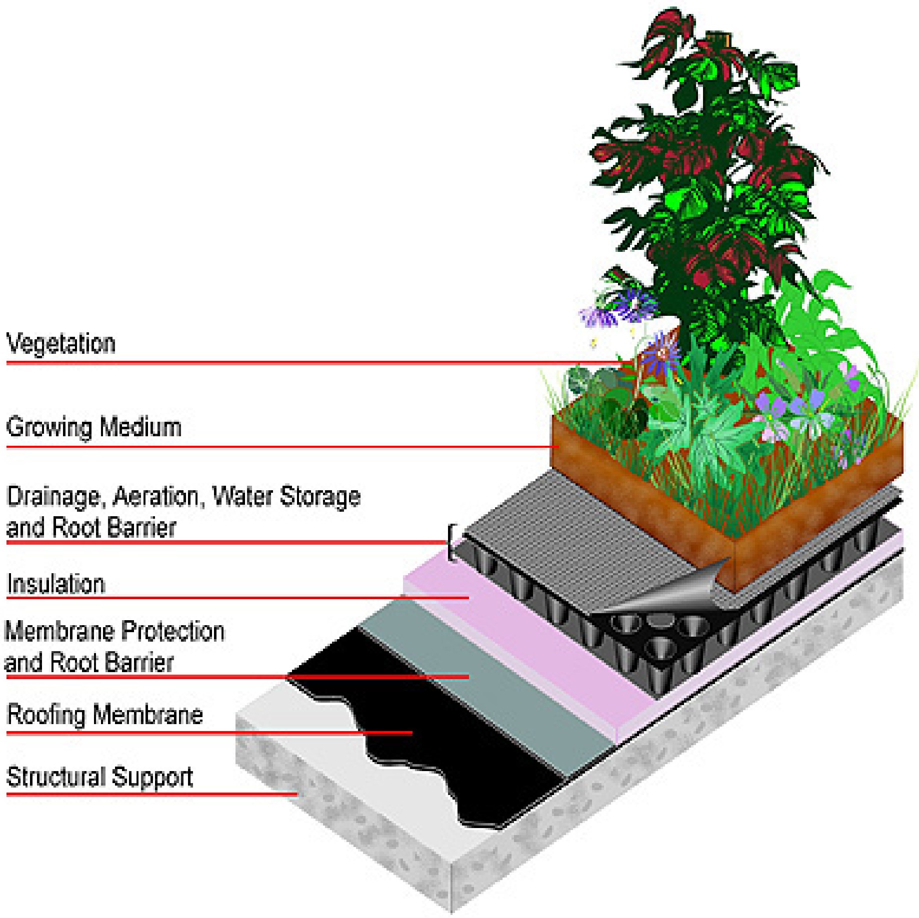


GREEN ROOFS

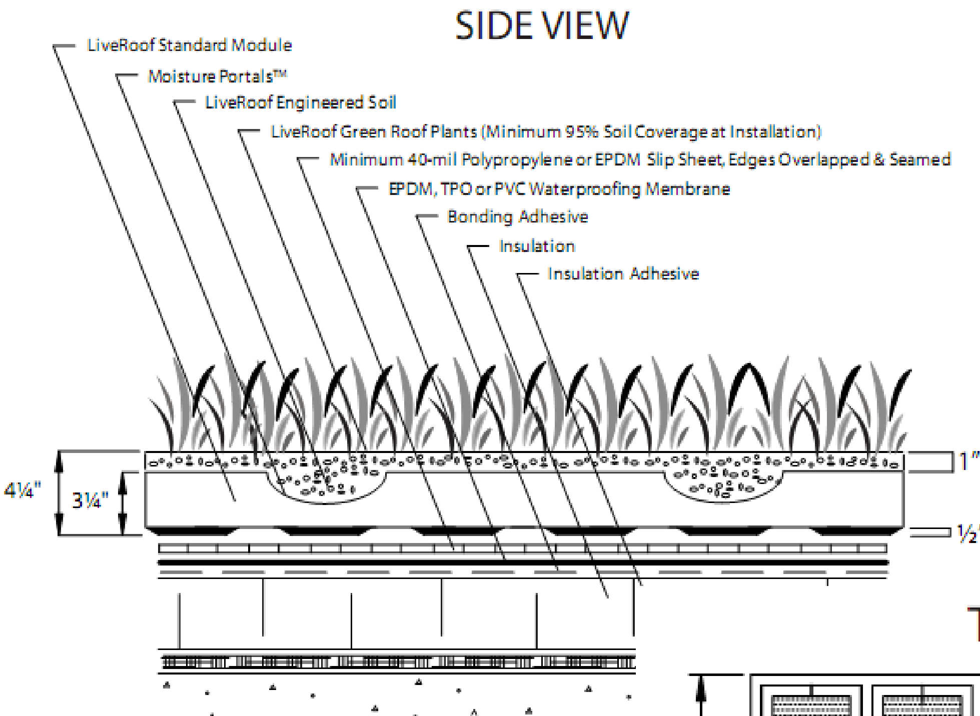
FUNCTIONS

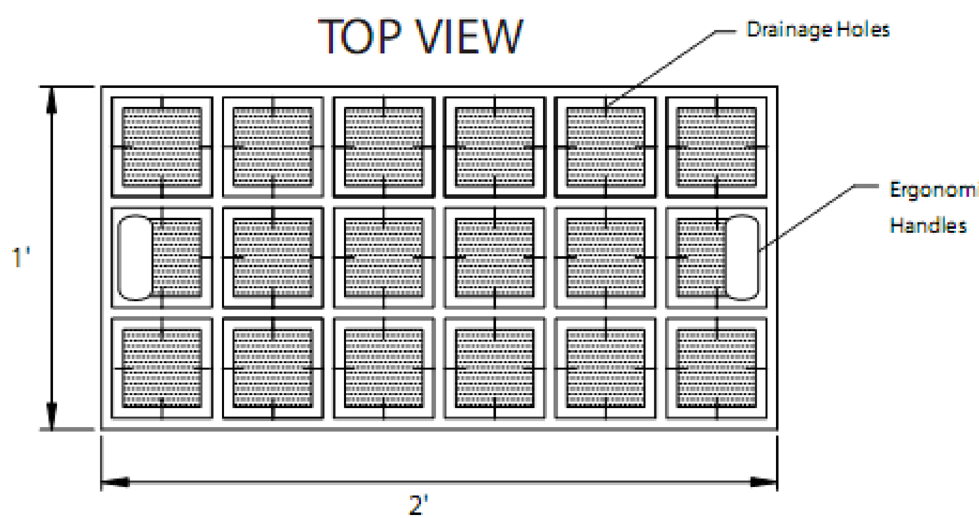
- Improves stormwater management
- Improves air quality
- Temperature regulation (moderation of Urban Heat Island Effect)
- Carbon dioxide/oxygen exchange
- Increased urban wildlife habitat
- Great for new construction

COMPONENTS



Modular System Specifications





How to use your green infrastructure plan

Impervious Cover Assessment

- Draws attention to problems
- Identifies impervious cover criteria (i.e., 2%, 10%, and 25%)
- Provides some concepts for green infrastructure opportunities
- Great conversation starter

Green Infrastructure Action Plan

- Identifies 10 to 20 projects on public or quasi-public lands
- Gives municipality examples of types of projects needed to fix problem
- Moves the conversation to project choice instead of willingness to do a project
- Sets realistic goals

BELLEVILLE ELEMENTARY SCHOOL #10

Address: 527 Belleville Avenue, Belleville, NJ 07109

property line   2015 Aerial: NJOIT, OGIS

1

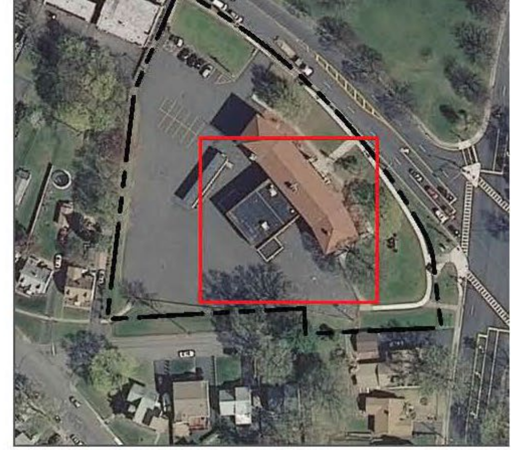
BELLEVILLE ELEMENTARY SCHOOL #10
(Front of School)

2

Directly Connected Downspouts

Directly Connected Downspouts

Belleville Elementary School #10



bioretention system

rainwater harvesting

drainage area

property line

2015 Aerial: NJOIT, OGIS

0' 20' 40'

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New Jersey Agricultural Experiment Station

527 Belleville Avenue,
Belleville, NJ 07109



The paved area adjacent to the building can be depaved and replaced with a rain garden to capture, treat, and infiltrate rooftop runoff. Rainwater can be harvested by installing cisterns around the building. The water can then be used for watering gardens, washing vehicles, or for other non-potable uses. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	From the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
66	66,110	3.2	33.4	303.5	0.052	1.81

Recommended Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention system	0.098	16	7,532	0.28	960	$4,800
Rainwater harvesting	0.060	10	4,600	0.17	5,000 (gal)	$10,000

"Protecting Public Health and the Environment"

RUTGERS
New Jersey Agricultural
Experiment Station

Funding Implementation

- Leverage existing projects
- Build partnerships
- Write grants

Who should I partner with?

Locally

- RCE Environmental County Agents
- Municipal Green Teams (Sustainable Jersey)
- Green Teams for Schools (Sustainable Jersey)
- Environmental Commissions
- Boy Scouts and Girl Scouts

Statewide

- The Nature Conservancy
- Association of Environmental Commissions
- Trust for Public Lands
- New Jersey Tree Foundation

Grant/Funding Opportunities

- Sustainable Jersey ($2k, $10k and $35k)
- ANJEC (Association of NJ Environmental Commissions)
- NJDEP
- NJ American Waters
- Home and School Associations

Resources for You!

RUTGERS New Jersey Agricultural Experiment Station

Water Resources Program

Search This Site Go

HOME PAGE
About the Program
Staff
Projects & Programs
Recent Presentations
Water Pages
Fact Sheets
E-learning Tools
Useful Links

Our green infrastructure initiative in urban centers focuses on capturing stormwater with cost-effective practices before it enters the combined sewer systems.

About Us

Rutgers Cooperative Extension
Water Resources Program

G.H. Cook Campus
14 College Farm Road
New Brunswick, NJ 08901

www.water.rutgers.edu

~Creating Solutions for
Water Resources Issues in New Jersey~

Our mission is to identify and address community water resources issues using sustainable and practical science-based solutions.

News

- In the News - October 3, 2017
- SEBS/NJAES Newsroom

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Projects & Programs

Agricultural Watershed Planning & Implementation	**Municipal/Community Training**
Green Infrastructure Program	**Rain Gardens & Rain Barrels**
Keep the Rain from the Drain ~ Impervious Cover Reduction Program	**Watershed Planning & Implementation**
Municipal Stormwater Management	

Agricultural Watershed Planning & Implementation

- Watershed Restoration & Protection Plan for Assiscunk Creek, Burlington County, NJ
- Assiscunk Creek Watershed Agricultural Mini-Grant Program
- Biofilter Wetland at Harrow Run, Water Quality Evaluation of Pollutant Removal Efficiency from a Tailwater Recovery System
- Watershed Restoration Plan for the Upper Cohansey River Watershed
- Upper Cohansey River Watershed Agricultural Mini-Grant Program
- Watershed Restoration Plan for the Upper Salem River Watershed
- Upper Salem River Watershed Agricultural Mini-Grant Program

Top of Page

Green Infrastructure Program

- Camden Green Infrastructure Initiative
- Fixing Flooding: One Community at a Time
  Innovative Solutions using Green Infrastructure Conference
- Green Infrastructure Education and Implementation Program
- Green Infrastructure Guidance Manual for New Jersey
- Green Infrastructure Solutions for New Jersey Conference

Keep the Rain from the Drain ~ Impervious Cover Reduction Program

- Impervious Cover Assessments and Impervious Cover Reduction Action Plans for Coastal Communities
- National Fish and Wildlife Foundation ~ Incorporating Green Infrastructure Resiliency in the Raritan River Basin
- Impervious Cover Assessments, Impervious Cover Reduction Action Plans, and Green Infrastructure Reduction Action Plans for New Jersey Future's Mainstreaming Green Infrastructure Program
- Salem County and Cumberland County, NJ ~ Impervious Cover Assessments and Impervious Cover Reduction Action Plans
- William Penn Foundation - Technical Support Program for Municipalities and Watershed Partners

HUNTERDON COUNTY	
Delaware Twp • *ICA* • *RAP* • *RAP web map*	**Franklin Twp** • *ICA* • *RAP* • *RAP web map*
East Amwell Twp • *ICA* • *RAP* • *RAP web map*	**Raritan Twp** • *ICA* • *RAP* • *RAP web map*
Flemington Boro • *ICA* • *RAP* • *RAP web map*	**Readington Twp** • *ICA* • *RAP* • *RAP web map*
MIDDLESEX COUNTY	
Dunellen Boro • *ICA* • *RAP* • *RAP web map*	**North Brunswick Twp** • *ICA* • *RAP* • *RAP web map*

NEW JERSEY HIGHLANDS WATERSHED CLUSTER	
Alpha • *ICA* • *RAP* • *RAP web map* • *Feasibility Study*	**Lopatcong** • *ICA* • *RAP* • *RAP web map* • *Feasibility Study*
Branchville • *ICA* • *RAP* • *RAP web map* • *Feasibility Study*	**Mount Arlington** • *ICA* • *RAP* • *RAP web map* • *Feasibility Study*
Greenwich • *ICA* • *RAP* • *RAP web map* • *Feasibility Study*	**Mount Olive** • *ICA* • *RAP* • *RAP web map* • *Feasibility Study*

E-learning Tools

- *Inventory and Assessment of Your Stormwater Infrastructure* (January, 2017)
- *Green Infrastructure Overview: Examples and Properties of a Variety of Stormwater Managment Solutions* (November, 2016)
- *Ideas and Resources for Implementing Green Infrastructure in Your Community - Planning documents, programs, and ordinances* (May, 2016)
- *Impervious Cover Assessment (ICA) and Impervious Cover Reduction Action Plan: The Answer to All Your Problems* (December, 2015)
- *Asking the Right Questions in Stormwater Review* (April, 2015)
- *Understanding Your Impervious Cover Assessment (ICA) Report* (March, 2015)

Connect With Us

E-learning Tools

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Quality of Life Issues

POLLUTION

- 90% of NJ waterways are considered 'impaired'
- primary source is urban-related stormwater runoff

FLOODING

EROSION

Staff to Contact

Hollie DiMuro, Program Associate, graduated in May 2015 from Rutgers, The State University of New Jersey with a B.S. in Environmental Planning and Design and a minor in Environmental Policy, Institutions, and Behaviors. Hollie interned with the Water Resources Program from May 2014 to July 2015. During her internship, Hollie assisted with rain barrel workshops, participated in the construction and maintenance of rain gardens, and she assisted with the design of stormwater best management practices and green infrastructure practices for municipalities within the Raritan River Basin. In her role as a Program Associate, Hollie will be providing technical support to the Water Resources Program by organizing and coordinating municipal action teams to promote green stormwater infrastructure in New Jersey's urban and suburban communities. She also will be assisting the Water Resources Program with grant management and project resource allocation.

Room 105, 848-932-6728, dimuro@envsci.rutgers.edu

Staff to Contact

Sara Mellor, Program Associate, graduated in May 2010 from Rutgers, The State University of New Jersey, with a B.S. in Environmental Policy, Institutions, and Behaviors. Sara interned with the Water Resources Program from May 2009 to May 2010 and has worked part time as a Program Coordinator with the Water Resources Program from May 2010 to May 2011. During the internship and tenure as a Program Coordinator, Sara has participated in water quality sampling, flow monitoring, and stream visual assessments for watershed restoration and protection plans, assisted in the coordination, construction, and maintenance of rain gardens, helped develop and run rain barrel workshops, organized the "One Barrel at a Time Co-op," created flyers, press releases, and other forms of promotional materials for the program, supported Water Resources Program staff in community educational outreach projects, supervised project volunteers, researched ways to inform the public about the importance of conserving water, and contributed to the development of evaluation tools to measure programmatic impact. As a Program Associate with the Rutgers Cooperative Extension Water Resources Program, Sara will be coordinating and presenting rain barrel workshops throughout New Jersey, designing, constructing, and coordinating the installation of rain gardens and natural landscaped systems throughout New Jersey, and participating in community and youth outreach projects pertaining to water resources.

Room 216, 848-932-6747, saramellor@envsci.rutgers.edu


QUESTIONS?

The great aim of education is not knowledge but action.

- Herbert Spencer