RUTGERS
New Jersey Agricultural
Experiment Station

Green Infrastructure Strategic Plan for Madison, New Jersey

October 1, 2024 (Virtual)

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Green Infrastructure in New Jersey

Green infrastructure is ...

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

Green infrastructure projects:

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

stormwater to restore the natural water cycle.

Green Infrastructure Practices

<u>Bioretention Systems</u>
- Rain Gardens
- Bioswales
- Stormwater Planters
- Curb Extensions
- Tree Filter Boxes

<u>Permeable Pavements</u>

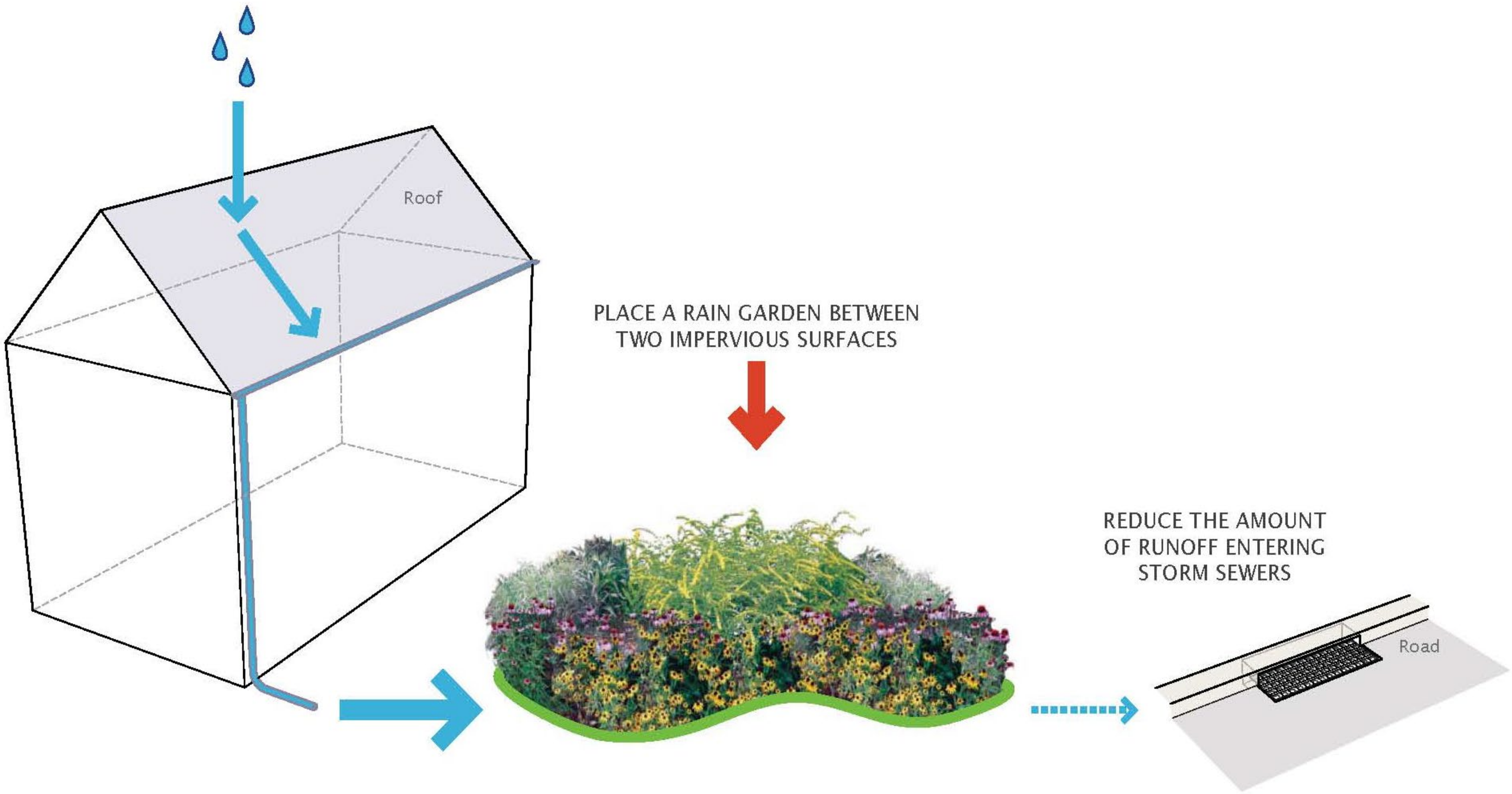
<u>Rainwater Harvesting</u>
- Rain Barrels
- Cisterns

<u>Dry Wells</u>

<u>Rooftop Systems</u>
- Green Roofs
- Blue Roofs

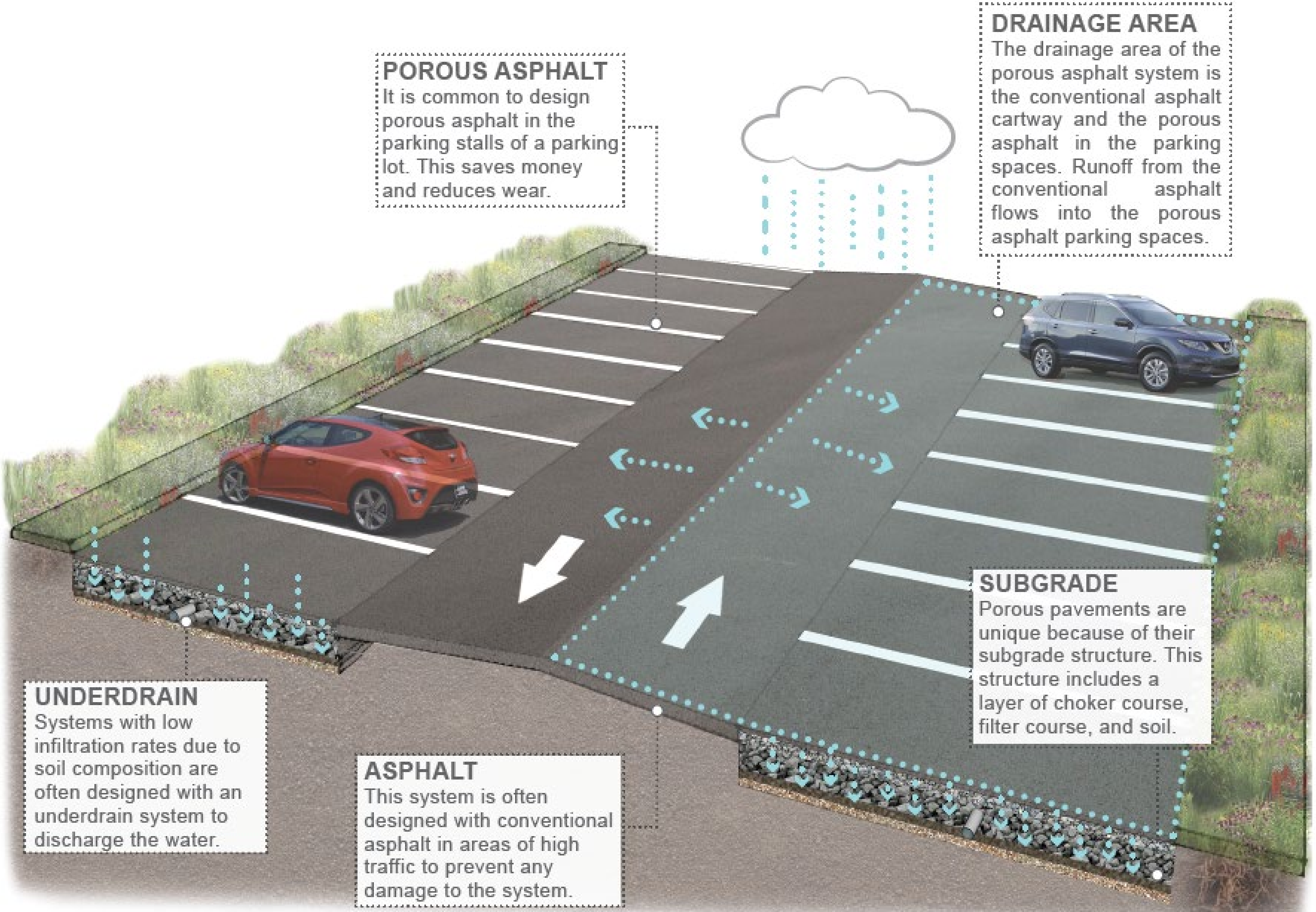
Parker Urban Greenscapes. 2009.

Rain Gardens are the most economical option



Lots of Rain Gardens

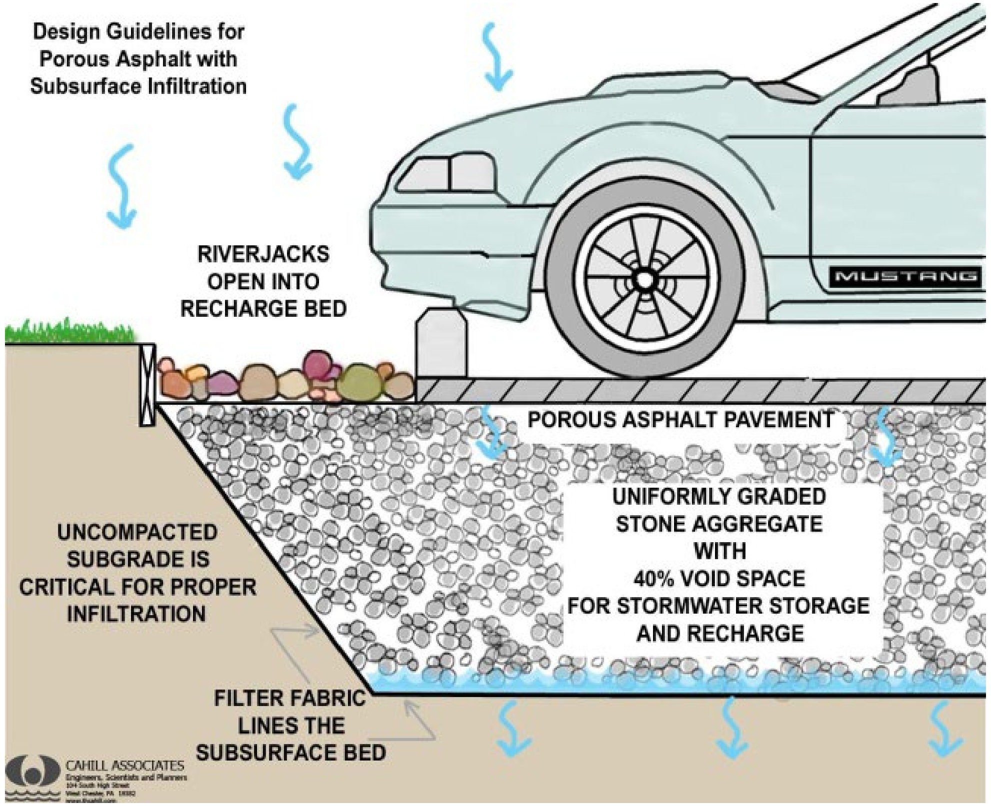
Permeable Pavement is very effect but more costly



ADVANTAGES

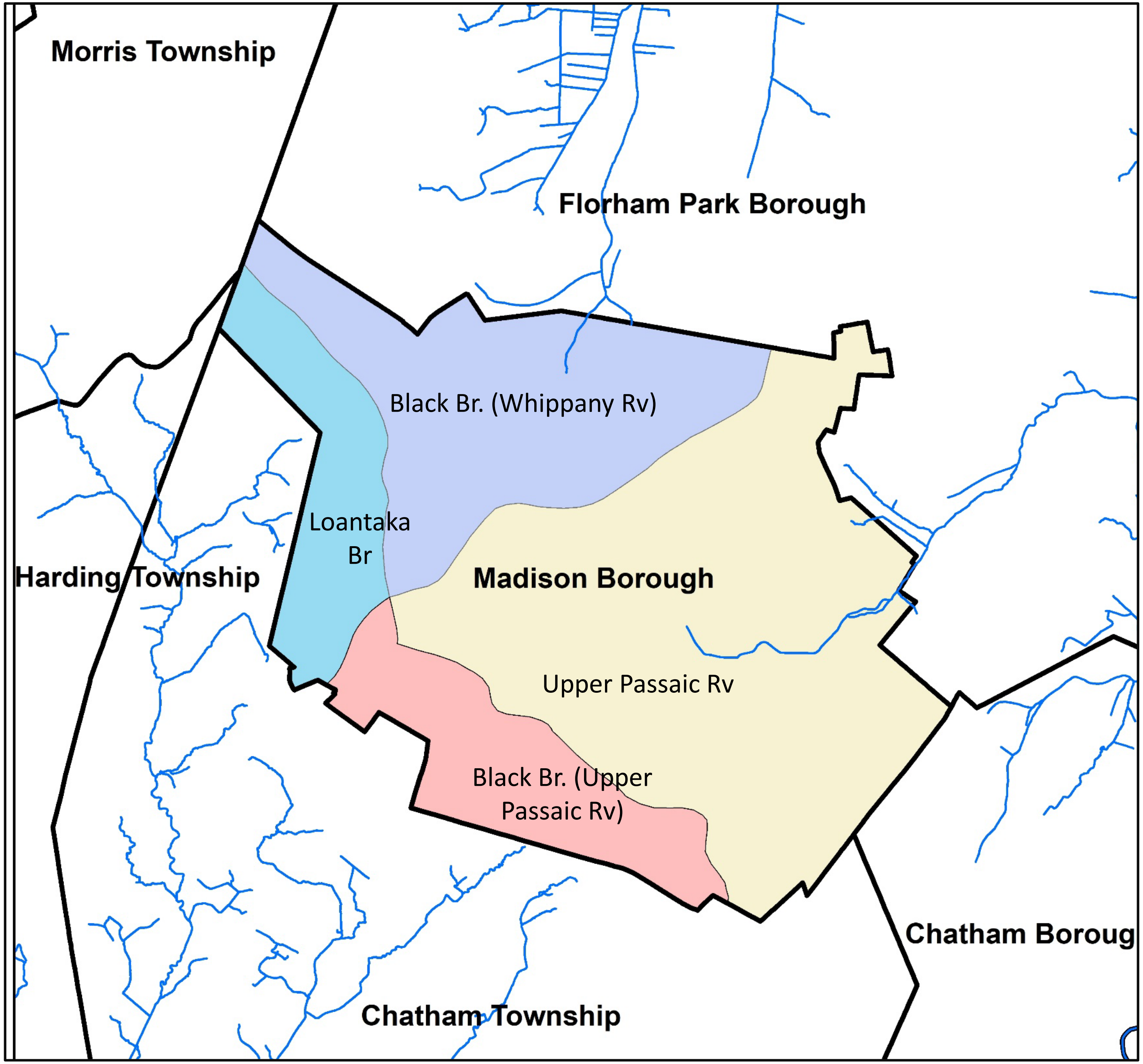
- Manage stormwater runoff
- Minimize site disturbance
- Promote groundwater recharge
- Low life cycle costs, alternative to costly traditional stormwater management methods
- Mitigation of urban heat island effect
- Contaminant removal as water moves through layers of system

COMPONENTS



Porous Asphalt

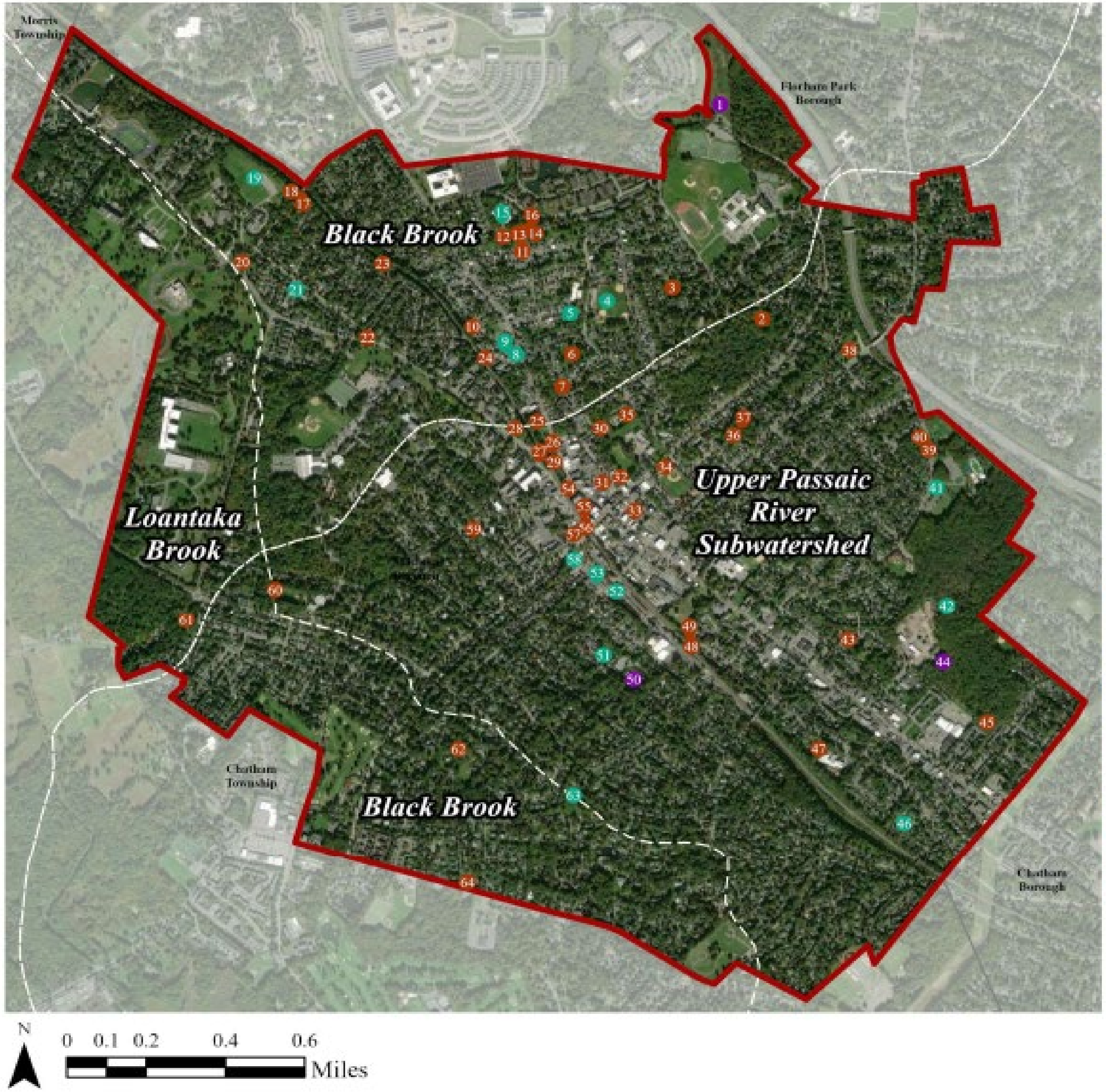
Grass Pavers


Morris Township
Florham Park Borough
Black Br. (Whippany Rv)
Loantaka Br
Harding Township
Madison Borough
Upper Passaic Rv
Black Br. (Upper Passaic Rv)
Chatham Boroug
Chatham Township

Watershed	Total Area (ac)	Impervious Cover (ac)	%
Loantaka Brook (Upper Passaic Rv)	279.2	47.6	17.05%
Black Brook (Upper Passaic Rv)	355.9	106.7	29.98%
Upper Passaic River	1,401.60	536.1	38.25%
Black Brook (Whippany Rv)	668.6	255.6	38.23%
Total	2,705.3	946	34.97%

Subwatershed	NJ Water Quality Storm 1.25" (MGal)	Annual Rainfall of 50" (MGal)	2-Year Design Storm (4.35") (MGal)	10-Year Design Storm (6.71") (MGal)	100-Year Design Storm (12.19") (MGal)
Loantaka Brook (Upper Passaic Rv)	0.22	8.64	0.75	1.16	2.11
Black Brook (Upper Passaic Rv)	0.48	19.37	1.68	2.60	4.72
Upper Passaic River	2.43	97.30	8.47	13.06	23.72
Black Brook (Whippany Rv)	1.16	46.39	4.04	6.23	11.31
Total	**4.29**	**171.70**	**14.94**	**23.04**	**41.86**

SUSTAINABLE MADISON POTENTIAL GREEN INFRASTRUCTURE SITES



Action Plan Sites:

Site 1: Madison Recreation Complex
Site 44: Madison Department of Public Works
Site 50: Madison Public Library

Other Selected Target Sites:

Site 4: Lucy D Field
Site 5: Utility Building
Site 8: Apartment Complex (72 Park Avenue)
Site 9: Apartment Complex (80 Park Avenue)
Site 15: Rexford S. Tucker Apartments
Site 19: Danforth Park
Site 21: Baumgartner Drive Park
Site 41: Madison Community Pool Corporation
Site 42: Delbarton Field
Site 46: Fen Court Park
Site 51: Public Housing (Belmont Avenue)
Site 52: Madison Public Safety Complex
Site 53: Parking Lot (10 Maple Avenue)
Site 58: Madison Recreation Department
Site 63: Niles Park

Unused Analyzed Sites: (Site: Block, Lot)

2: 1001, 73	20: 211, 1	33: 1802, 14	49: 2601, 26
3: 504, 23	22: 209, 21	34: 1701, 2	54: 1504, 2
6: 1102, 24	23: 208, 18	35: 1601, 42	55: 2701, 17
7: 1101, 37	24: 1302, 1	36: 1002, 8	56: 2701, 18
10: 1203, 7	25: 1402, 9	37: 1003, 15	57: 2801, 6
11: 404, 20	26: 1503, 1	38: 1004, 19	59: 2901, 3
12: 404, 48	27: 1505, 1	39: 903, 3	60: 3404, 56
13: 404, 47	28: 1401, 3	40: 903, 3.01	61: 4303, 1
14: 404, 46	29: 1504, 1	43: 2207, 1	62: 4402, 6
16: 402, 1.02	30: 1601, 23	45: 2301, 1	64: 4503, 7
17: 208, 1	31: 1502, 25	47: 3901, 11	
18: 201, 2	32: 1601, 12	48: 3801, 1.01	

Madison Recreation Complex

Subwatershed: Black Brook
Site Area: 2,157,847 sq. ft.
Address: 184 Ridgedale Avenue
Madison, NJ 07940
Block and Lot: Block 601, Lot 1.01

Two rain gardens can be installed in the turfgrass area near the entrance of the parking lot to capture, treat, and infiltrate stormwater runoff from the road.

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 50"
15	329,965	15.9	166.6	1,515.0	0.257	10.28

Recommended Green Infrastructure Practices	Drainage Area (sq. ft)	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	11,980	0.355	53	24,990	0.90	2,995	$29,950

GREEN INFRASTRUCTURE RECOMMENDATIONS

MADISON RECREATION COMPLEX

- bioretention system
- captured drainage area
- property line
- 2020 Aerial: NJOIT, OGIS

0 50' 100'

BEFORE:

AFTER:

Madison Department of Public Works

Subwatershed: Passaic River

Site Area: 1,464,936 sq. ft.

Address: 10 John Avenue
Madison, NJ, 07940

Block and Lot: Block 2208, Lot 19

Two rain gardens can be installed in the turfgrass area alongside the northwest and south side of the building to capture, treat, and infiltrate stormwater runoff from the road. A cistern can be installed alongside the north side of the small building on the intersection of John Avenue and Station Road to harvest rainwater for watering plants throughout the town.

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 50"
12	171,591	8.3	86.7	787.8	0.134	5.35

Recommended Green Infrastructure Practices	Drainage Area (sq. ft)	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	4,770	0.141	21	9,950	0.36	1,195	$11,950
Rainwater harvesting	740	0.022	4	575	0.06	575	$1,150

GREEN INFRASTRUCTURE STRATEGIC PLAN

MADISON BOROUGH

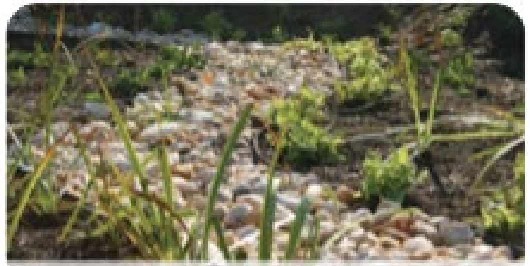
JULY 1, 2024

WHAT IS GREEN INFRASTRUCTURE?

Green infrastructure is 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 to treat runoff as a resource. As a general principle, green infrastructure practices use soil and vegetation to recycle stormwater runoff through infiltration and evapotranspiration. When used as components of a stormwater management system, green infrastructure practices such as bioretention, green roofs, porous pavement, rain gardens, and vegetated swales can produce a variety of environmental benefits. In addition to effectively retaining and infiltrating rainfall, these technologies can simultaneously help filter air pollutants, reduce energy demands, mitigate urban heat islands, and sequester carbon while also providing communities with aesthetic and natural resource benefits (USEPA, 2013).

A community garden that harvests and recycles rainwater

Rain barrel workshop participants



A rain garden after planting

WHAT IS STORMWATER?

When rainfall hits the ground, it can soak into the ground or flow across the surface. When rainfall flows across a surface, it is called "stormwater" runoff. Pervious surfaces allow stormwater to readily soak into the soil and recharge groundwater. An impervious surface can be any material that has been placed over soil that prevents water from soaking into the ground. Impervious surfaces include paved roadways, parking lots, sidewalks, and rooftops. As impervious areas increase, so does the amount of stormwater runoff. New Jersey has many problems due to stormwater runoff from impervious surfaces, including:

- POLLUTION: According to the 2010 New Jersey Water Quality Assessment Report, 90% of the assessed waters in New Jersey are impaired. Urban-related stormwater runoff is listed as the most probable source of impairment (USEPA, 2013). As stormwater flows over the ground, it picks up pollutants, including animal waste, excess fertilizers, pesticides, and other toxic substances. These pollutants are carried to waterways.
- FLOODING: Over the past decade, the state has seen an increase in flooding. Communities around the state have been affected by these floods. The amount of damage caused has increased greatly with this trend, costing billions of dollars over this time span.
- EROSION: Increased stormwater runoff causes an increase in stream velocity. The increased velocity after storm events erodes stream banks and shorelines, degrading water quality. This erosion can damage local roads and bridges and cause harm to wildlife.

Stormwater catch basin

Purple cone flower

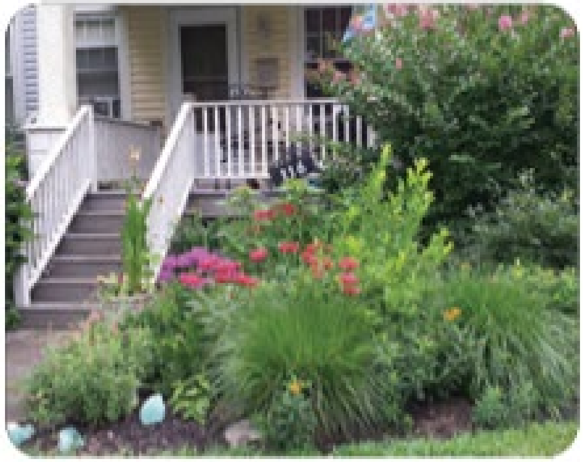
Pervious pavers

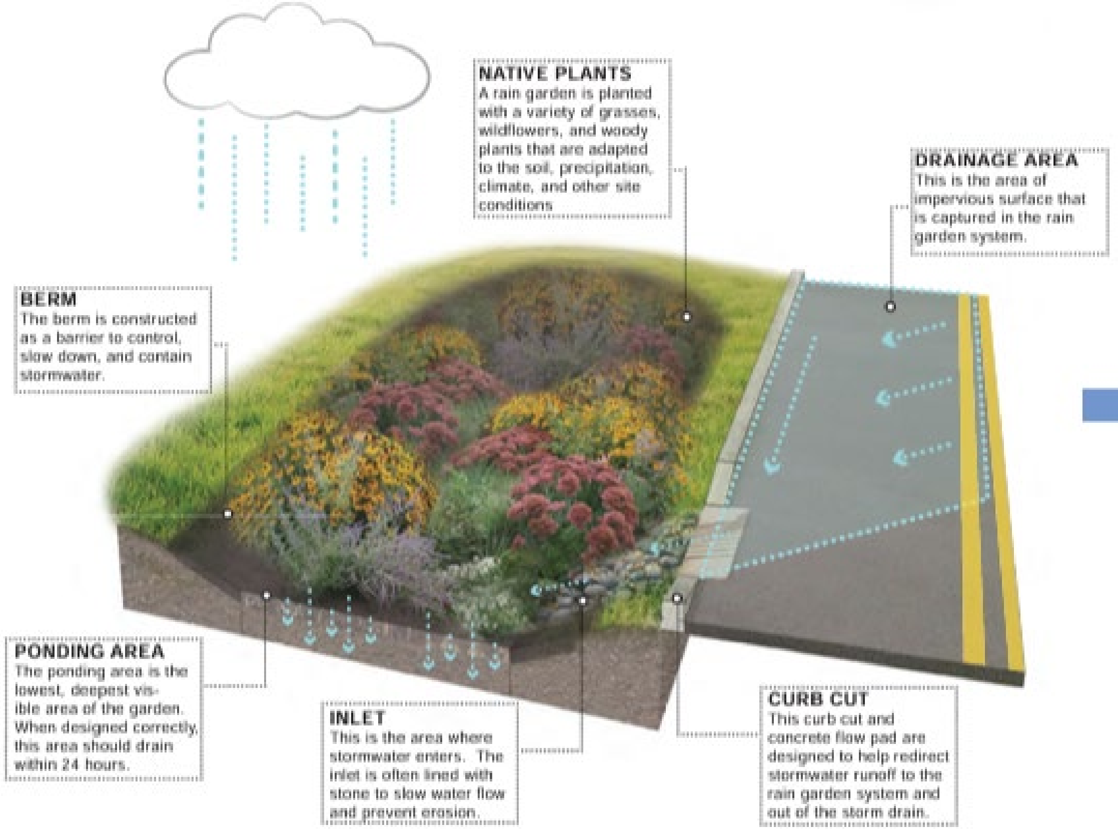
To protect and repair our waterways, reduce flooding, and stop erosion, stormwater runoff has to be better managed. Impervious surfaces need to be disconnected with green infrastructure to prevent stormwater runoff from flowing directly into New Jersey's waterways. Disconnection redirects runoff from paving and rooftops to pervious areas in the landscape.

BIORETENTION SYSTEMS

A rain garden, or bioretention system, is a landscaped, shallow depression that captures, filters, and infiltrates stormwater runoff. The rain garden removes nonpoint source pollutants from stormwater runoff while recharging groundwater. A rain garden serves as a functional system to capture, filter, and infiltrate stormwater runoff at the source while being aesthetically pleasing. Rain gardens are an important tool for communities and neighborhoods to create diverse, attractive landscapes while protecting the health of the natural environment. By incorporating an underdrain system, rain gardens can also be installed in areas that do not infiltrate.

Rain gardens can be implemented throughout communities to begin the process of re-establishing the natural function of the land. Rain gardens offer one of the quickest and easiest methods to reduce runoff and help protect our water resources. Beyond the aesthetic and ecological benefits, rain gardens encourage environmental stewardship and community pride.

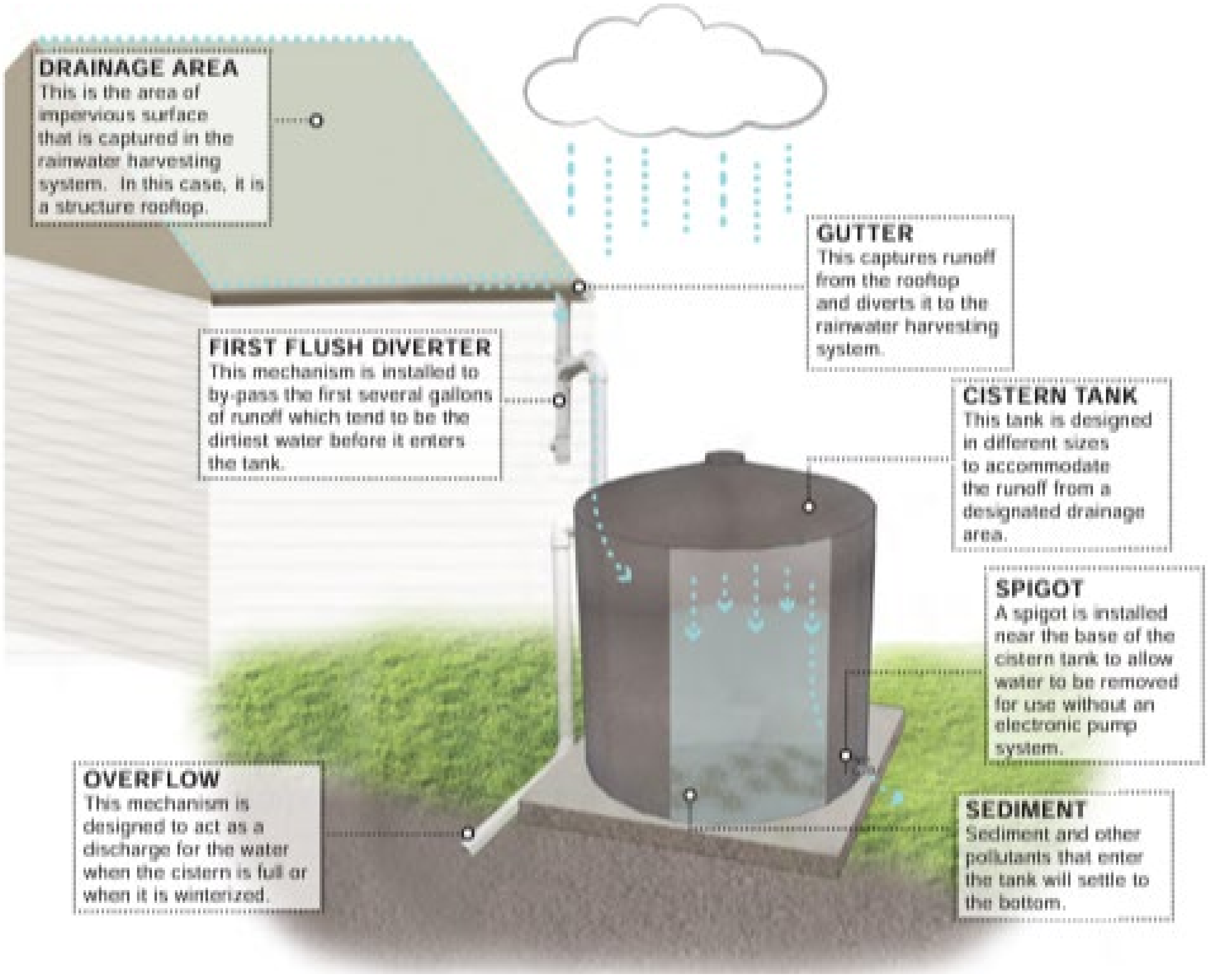




RAINWATER HARVESTING SYSTEMS

These systems capture rainwater, mainly from rooftops, in cisterns or rain barrels. The water can then be used for watering gardens, washing vehicles, or for other non-potable uses.

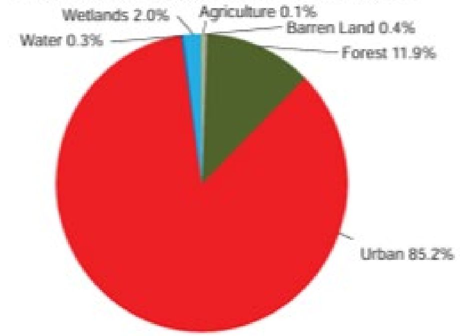
Rainwater harvesting systems come in all shapes and sizes. These systems are good for harvesting rainwater in the spring, summer, and fall but must be winterized during the colder months. Cisterns are winterized, and then their water source is redirected from the cistern back to the original discharge area.



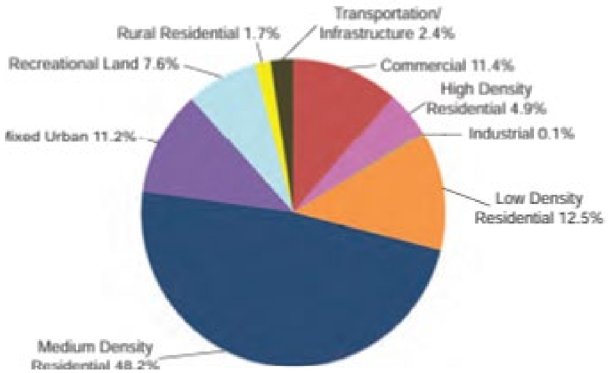
LAND USE IN MADISON BOROUGH

Madison Borough is dominated by urban land uses. A total of 85.2% of the municipality's land use is classified as urban. Of the urban land in Madison Borough, medium density residential is the dominant land use. Urban land uses tend to have a high percentage of impervious surfaces.

MADISON BOROUGH LAND USE



MADISON BOROUGH URBAN LAND USE



MADISON BOROUGH LAND USE

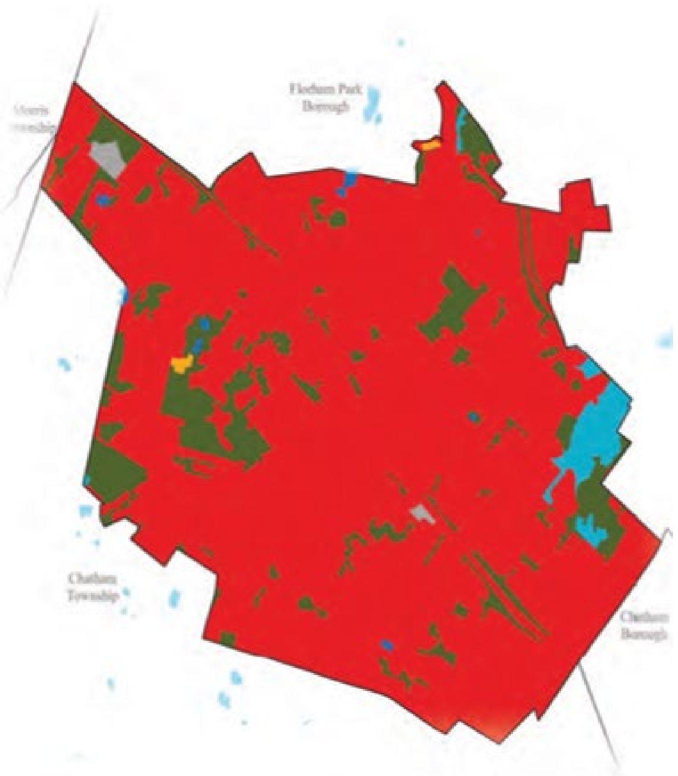
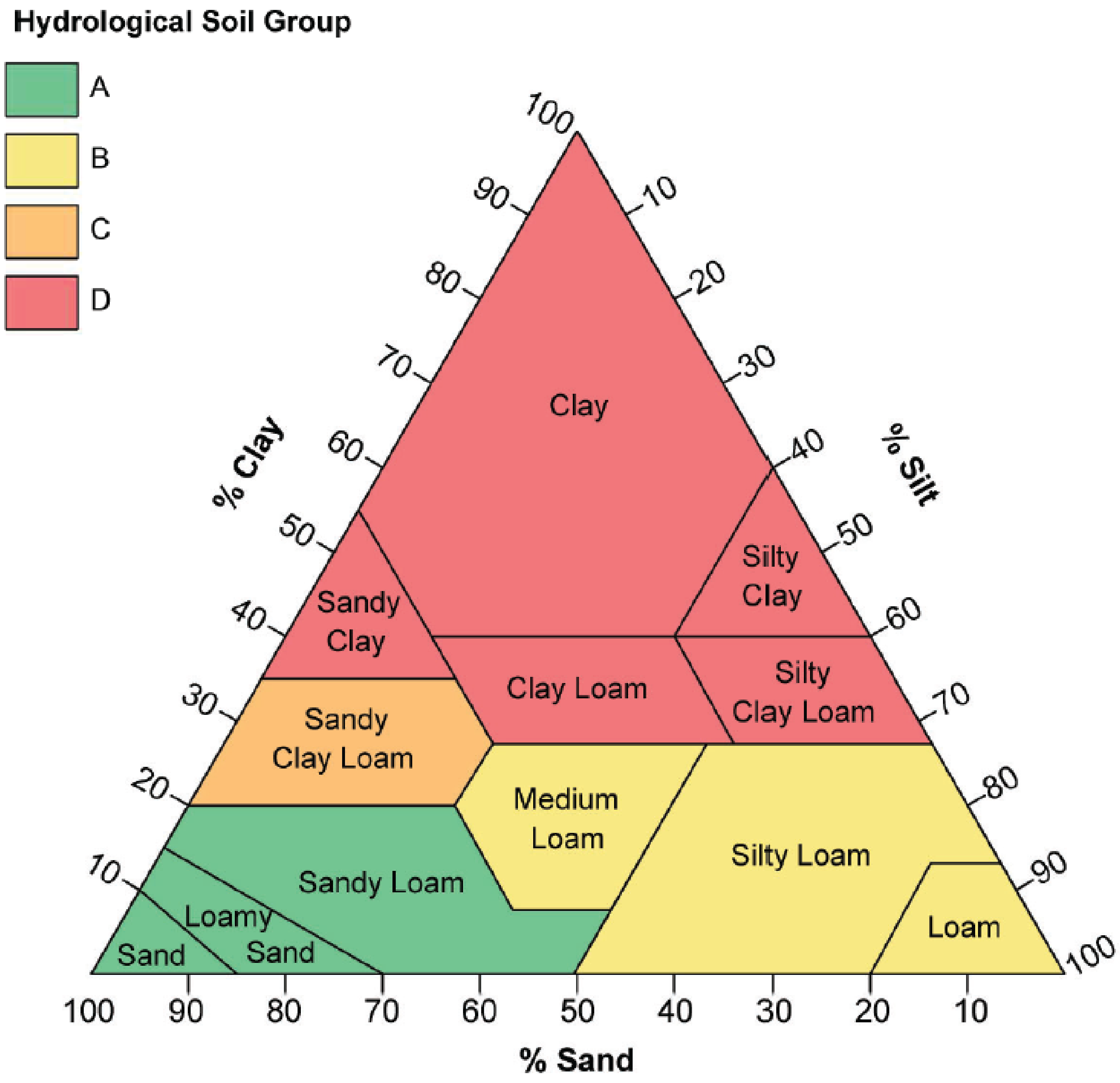


TABLE 1. IMPERVIOUS COVER ANALYSIS BY SUBWATERSHED FOR MADISON BOROUGH

Subwatershed	Total Area	Land Use Area	Water Area	Impervious Cover	
	(ac)	(ac)	(ac)	(ac)	(%)
Black Brook (Great Swamp)	355.9	355.0	0.9	106.7	30.1%
Black Brook (Hanover)	730.7	726.0	4.7	265.3	36.5%
Loantaka Brook	279.2	277.2	2.0	47.6	17.2%
Upper Passaic River	1,401.6	1,401.2	0.4	536.1	38.3%
Total	**2,767.4**	**2,759.34**	**8.0**	**955.69**	**34.6%**

TABLE 2. STORMWATER RUNOFF VOLUMES FROM IMPERVIOUS SURFACES BY SUBWATERSHED IN MADISON BOROUGH

Subwatershed	Total Runoff Volume for the 1.25" NJ Water Quality Storm (Mgal)	Total Runoff Volume for the NJ Annual Rainfall of 50" (Mgal)	Total Runoff Volume for the 2-year Design Storm (3.58") (Mgal)	Total Runoff Volume for the 10-year Design Storm (5.40") (Mgal)	Total Runoff Volume for the 100 Year Design Storm(8.85") (Mgal)
Black Brook (Great Swamp)	3.6	144.9	10.4	15.6	25.6
Black Brook (Hanover)	9.0	360.1	25.8	38.9	63.7
Loantaka Brook	1.6	64.7	4.6	7.0	11.4
Upper Passaic River	18.2	727.8	52.1	78.6	128.8
Total	**32.4**	**1,297.5**	**92.9**	**140.1**	**229.7**

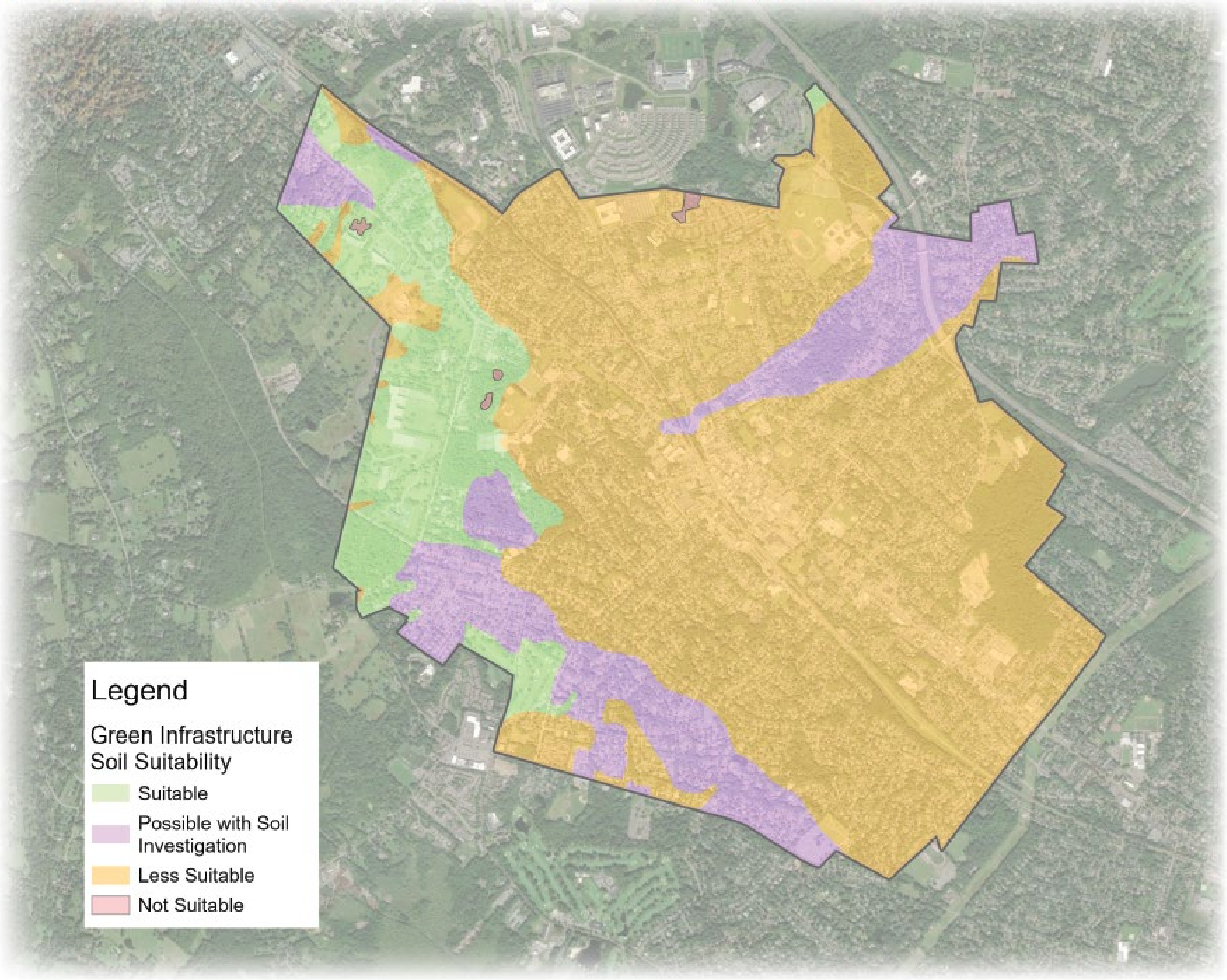


Hydrological Soil Group
A
B
C
D
% Clay
% Silt
% Sand
Clay
Silty Clay
Sandy Clay
Clay Loam
Silty Clay Loam
Sandy Clay Loam
Medium Loam
Silty Loam
Sandy Loam
Loamy Sand
Sand
Loam
100 90 80 70 60 50 40 30 20 10
10 20 30 40 50 60 70 80 90 100

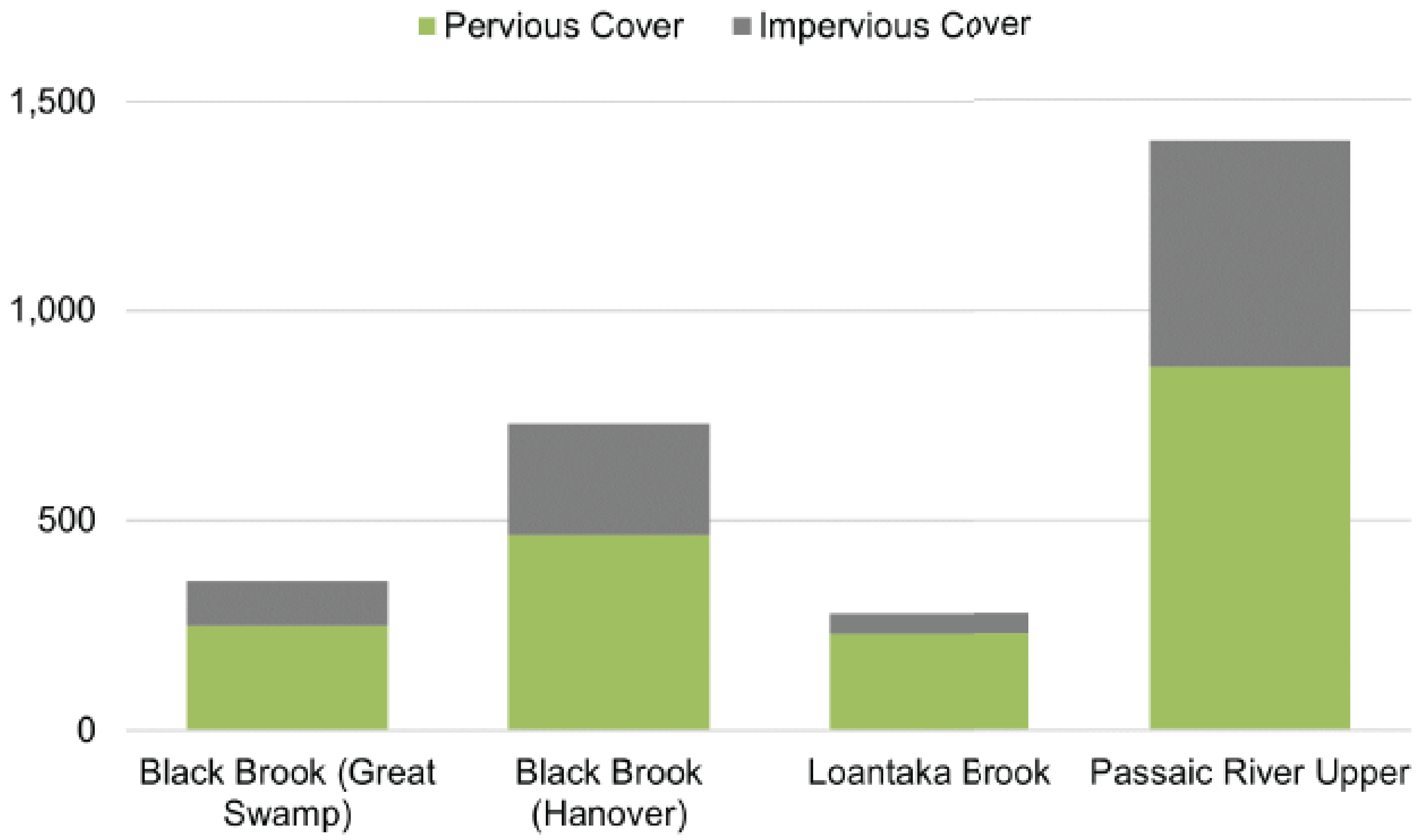
Green infrastructure suitability is defined using the following parameters:

		Depth to Water Table or Bedrock			
		0"	0"-24"	24"-36"	>36"
Hydrologic Soil Group	Unknown	Not suitable	Less Suitable	Possible with investigation	Possible with investigation
	A	Not suitable	Less Suitable	Possible with investigation	Suitable
	B	Not suitable	Less Suitable	Possible with investigation	Suitable
	C	Not suitable	Less Suitable	Possible, underdrained	Suitable, underdrained
	D	Not suitable	Less Suitable	Possible, underdrained	Suitable, underdrained

MADISON BOROUGH
GREEN INFRASTRUCTURE SUITABILITY

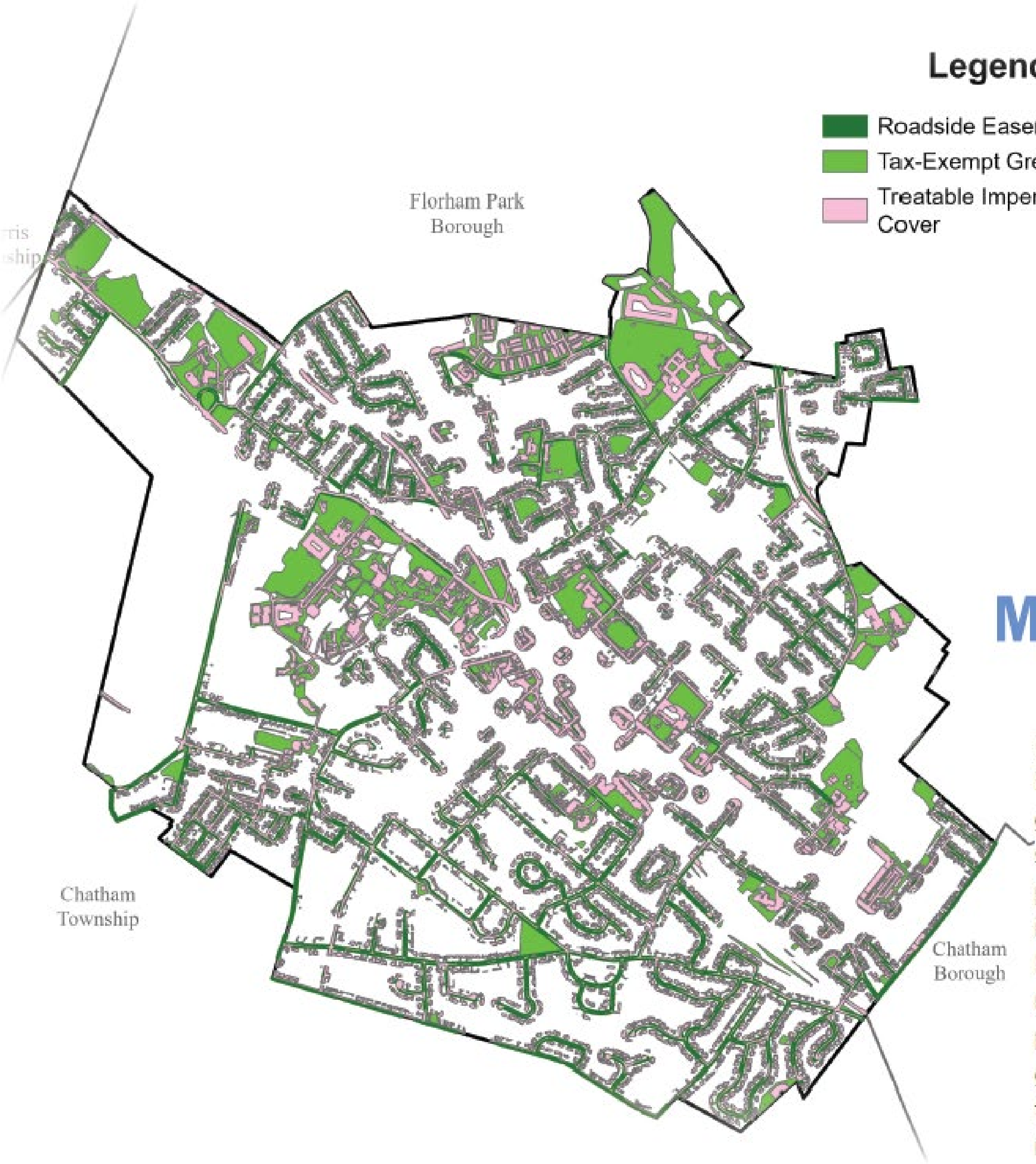


PERVIOUS AND IMPERVIOUS COVER IN ACRES BY SUBWATERSHED



MADISON BOROUGH IMPERVIOUS COVER

MADISON BOROUGH TAX-EXEMPT PARCELS AND ROADSIDE EASEMENTS



MADISON BOROUGH
GREEN SPACE

From the 134 parcels throughout Madison Borough with tax-exempt property classes, green spaces were isolated as potential sites for bioretention systems or stormwater planters that were close enough to nearby impervious surfaces (within 100 feet). Municipally owned green spaces alongside roadways are also included as potential project sites. A total of 309 acres of viable green space were isolated: 248 acres within tax-exempt parcels and 62 acres within roadside easements.

TABLE 4: MADISON BOROUGH EXISTING CONDITIONS

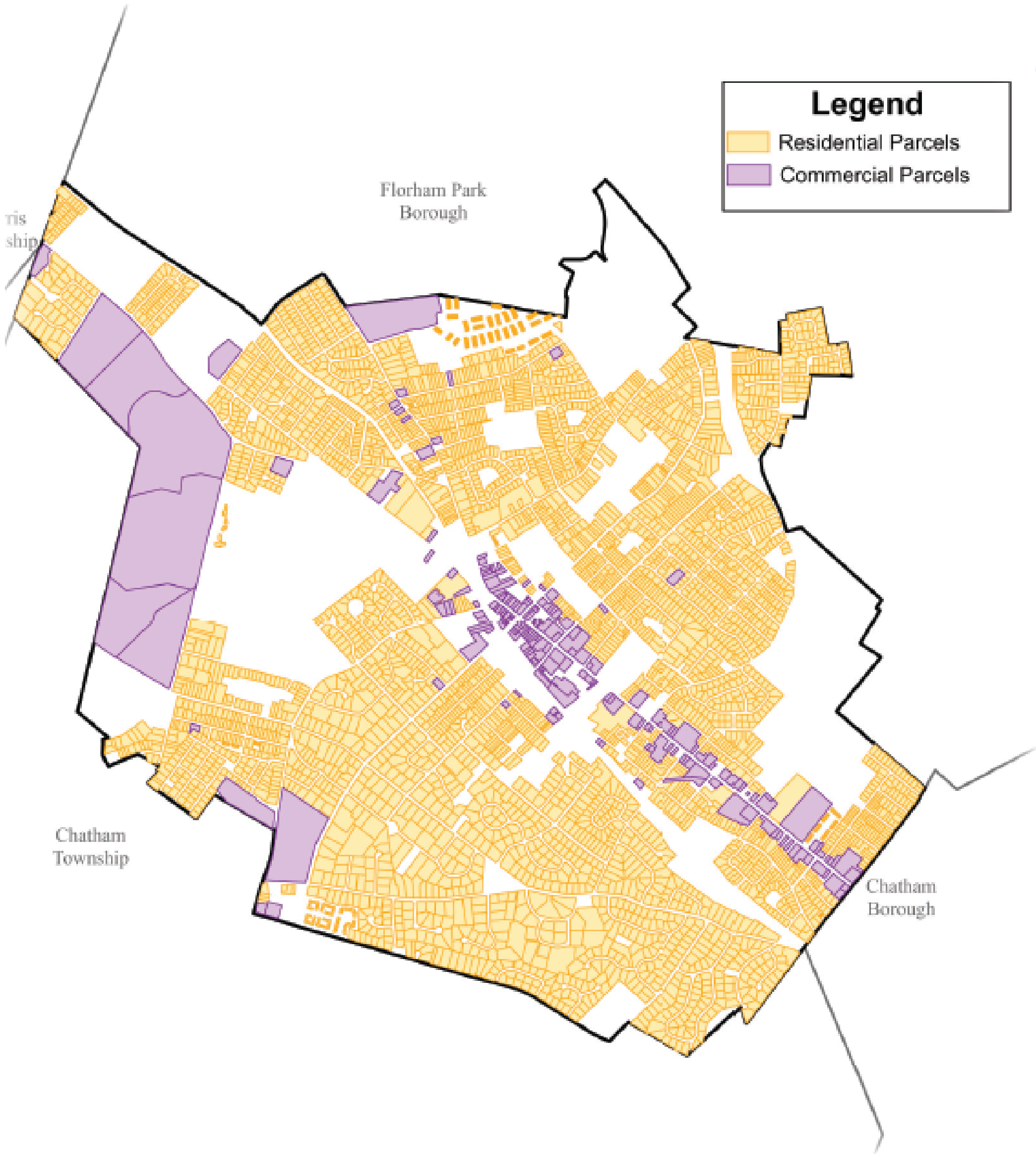
Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	acres	TP	TN	TSS	From the 1.25" Water Quality Storm	For an Annual Rainfall of 50"
34.6	2,759	2,007.6	21,032.1	191,200.8	32.447	1,297.89

TABLE 5: MADISON BOROUGH MANAGEMENT GOALS

Potential Management Area (acres)	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (Mgal/storm)	Peak Discharge Reduction Potential for 2-year storm (3.58") (cu. ft./second)	Estimated Size (acres)	Estimated Cost
Short-Term Management Goal						
20	25.795	3,800	1.817	68.29	5	$2,178,009
Long-Term Management Goal						
80	103.180	15,200	7.269	273.14	20	$8,712,035

MADISON BOROUGH

ADDITIONAL SITES



Residential and commercial areas present additional opportunities to integrate rain gardens to help mitigate flooding, reduce pollution, and promote groundwater recharge. In commercial areas such as office complexes, shopping centers, and industrial parks, rain gardens can be strategically placed to complement existing landscaping and infrastructure. They can be incorporated into entrance landscaping, parking lot islands, and along the perimeters of buildings. Larger commercial developments present opportunities to include rain gardens in public spaces such as plazas, courtyards, and pedestrian walkways. Some areas may already contain stormwater management practices (detention basins, underground infiltration, etc.). These areas should be deprioritized in site selection.

In residential neighborhoods, rain gardens can be scaled to fit individual properties or implemented as a part of community-wide initiatives. They can be integrated into existing landscaping and replace traditional lawns or flower beds, or in underutilized spaces such as side yards between properties, or in multi-family residential developments as community gardens.

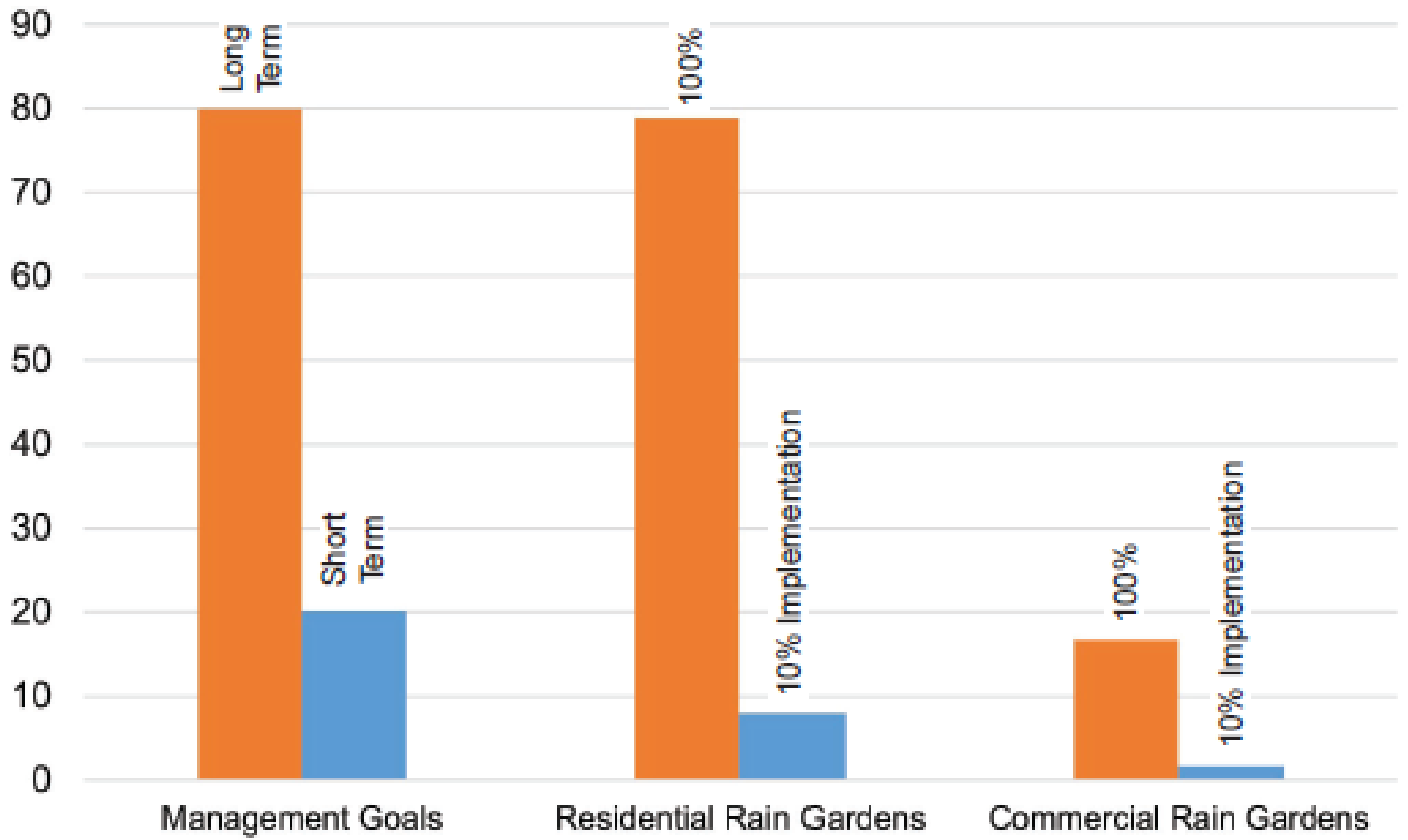
Quantitative analysis of implementing rain gardens in residential and commercial areas represents the implementation of 200-square foot bioretention systems for each residential parcel and treatment of 15% of impervious cover on commercial parcels.

ADDITIONAL GREEN INFRASTRUCTURE SITES

TABLE 6: MADISON BOROUGH ADDITIONAL SITES

Potential Management Area (acres)	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential for 2-year storm (3.58") (cu. ft./second)	Estimated Size (acres)	Estimated Cost
100% Implementation of 200-sq ft Rain Gardens per Residential Parcel						
78.86	101.711	14,983	7,165,200	269.25	19.72	$8,588,000
10% Implementation of 200-sq ft Rain Gardens per Residential Parcel						
7.88	10.162	1,497	715,850	26.90	1.97	$858,000
100% Implementation of Rain Gardens Targeting 15% of Impervious Cover on Every Commercial Parcel						
16.74	21.591	3,181	1,521,010	57.16	4.19	$1,823,048
10% Implementation of Rain Gardens Targeting 15% of Impervious Cover on Every Commmercial Parcel						
1.67	2.159	317	152,100	5.72	0.42	$182,305

IMPERVIOUS COVER TREATMENT GOALS AND POTENTIAL



SITE ASSESSMENT AND IMPLEMENTATION FACTORS

BUILT ELEMENTS

Circulation and Transportation
Observe movement through, in, and around the site

Structures and Utilities
Examine existing infrastructure within the area of the site

Integration
Incorporate new infrastructure into the existing surroundings

NATURAL ELEMENTS

Water Flow
Delineate impervious cover management based on drainage

Existing Vegetation
Take note of existing trees or invasive species that may conflict

Soil Suitability
Test existing soils for infiltration and assess need for underdrains

IMPLEMENTATION

Users and Maintenance
Gather information on who will be using and maintaning the space

Funding and Available Space
Consider the scale and limitations of the site and budget

Project Oversight
Ensure installation of green infrastructure is overseen by qualified individuals

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Questions?

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