RUTGERS
New Jersey Agricultural
Experiment Station

Draft

Impervious Cover Reduction Action Plan
for
Spotswood Borough, Middlesex County, New Jersey

Prepared for Spotswood Borough by the
Rutgers Cooperative Extension Water Resources Program

September 5, 2015

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Introduction

Located in Middlesex County in central New Jersey, Spotswood Borough covers approximately 2.4 square miles. Figures 1 and 2 illustrate that Spotswood Borough is dominated by urban land uses. A total of 72.6% of the municipality's land use is classified as urban. Of the urban land in Spotswood Borough, medium density residential is the dominant land use (Figure 2).

The New Jersey Department of Environmental Protection's (NJDEP) 2007 land use/land cover geographical information system (GIS) data layer categorizes Spotswood Borough into many unique land use areas, assigning a percent impervious cover for each delineated area. These impervious cover values were used to estimate the impervious coverage for Spotswood Borough. Based upon the 2007 NJDEP land use/land cover data, approximately 31.2% of Spotswood Borough has impervious cover. This level of impervious cover suggests that the streams in Spotswood Borough are likely non-supporting streams.[1]

Methodology

Spotswood Borough contains portions of three subwatersheds (Figure 4). For this impervious cover reduction action plan, projects have been identified in each of these watersheds. Initially, aerial imagery was used to identify potential project sites that contain extensive impervious cover. Field visits were then conducted at each of these potential project sites to determine if a viable option exists to reduce impervious cover or to disconnect impervious surfaces from draining directly to the local waterway or storm sewer system. During the site visit, appropriate green infrastructure practices for the site were determined. Sites that already had stormwater management practices in place were not considered.

[1] Caraco, D., R. Claytor, P. Hinkle, H. Kwon, T. Schueler, C. Swann, S. Vysotsky, and J. Zielinski. 1998. Rapid Watershed Planning Handbook. A Comprehensive Guide for Managing Urbanizing Watersheds. Prepared by Center For Watershed Protection, Ellicott City, MD. Prepared for U.S. Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds and Region V. October 1998

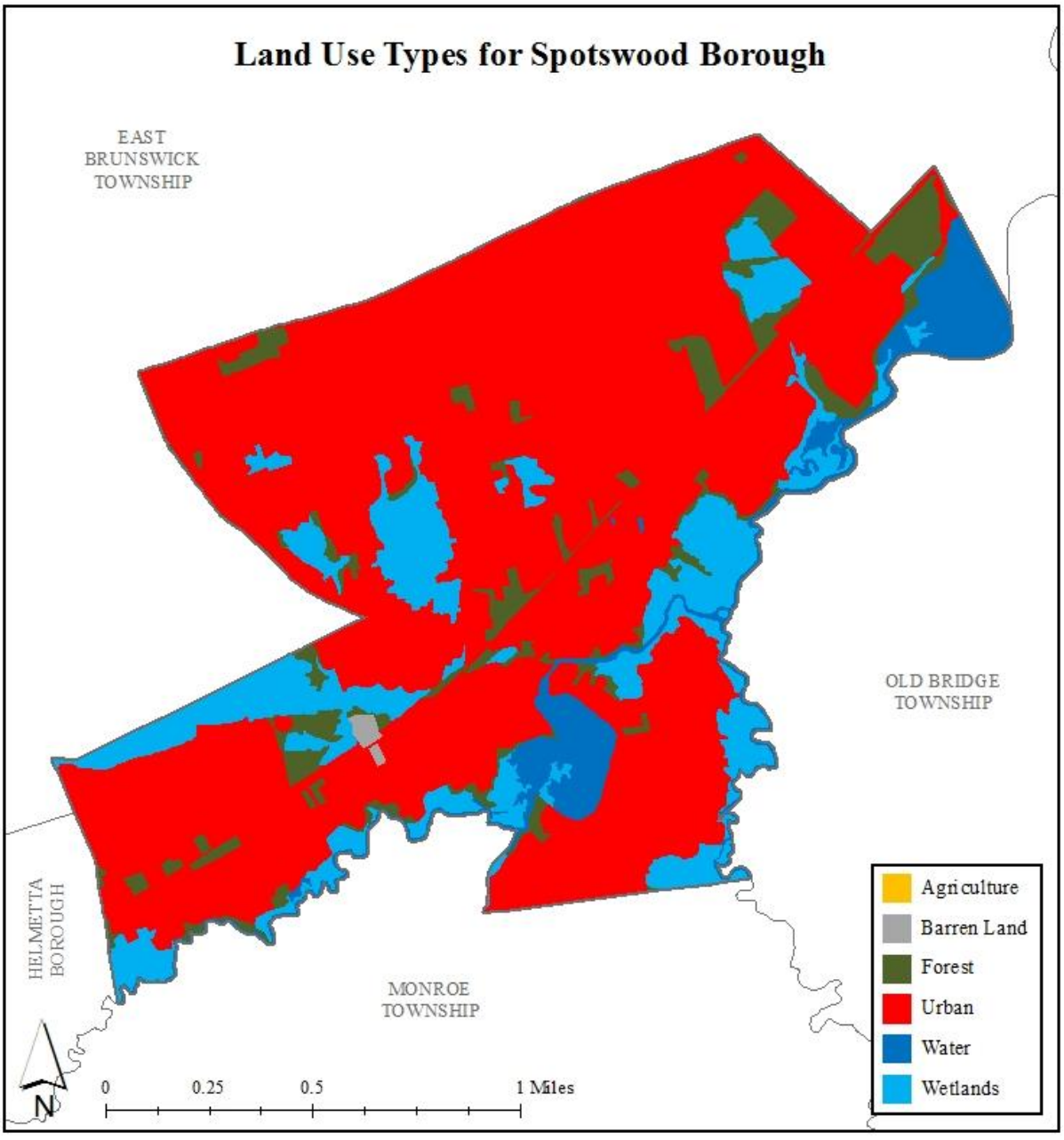


Figure 1: Map illustrating the land use in Spotswood Borough

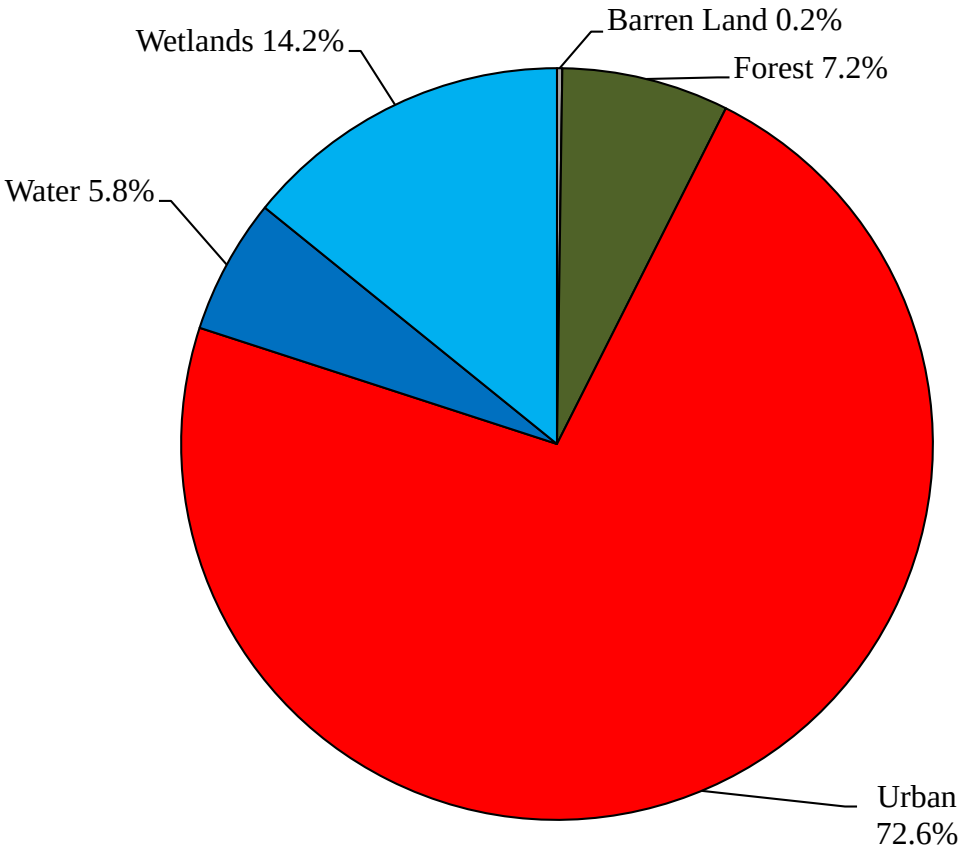


Figure 2: Pie chart illustrating the land use in Spotswood Borough

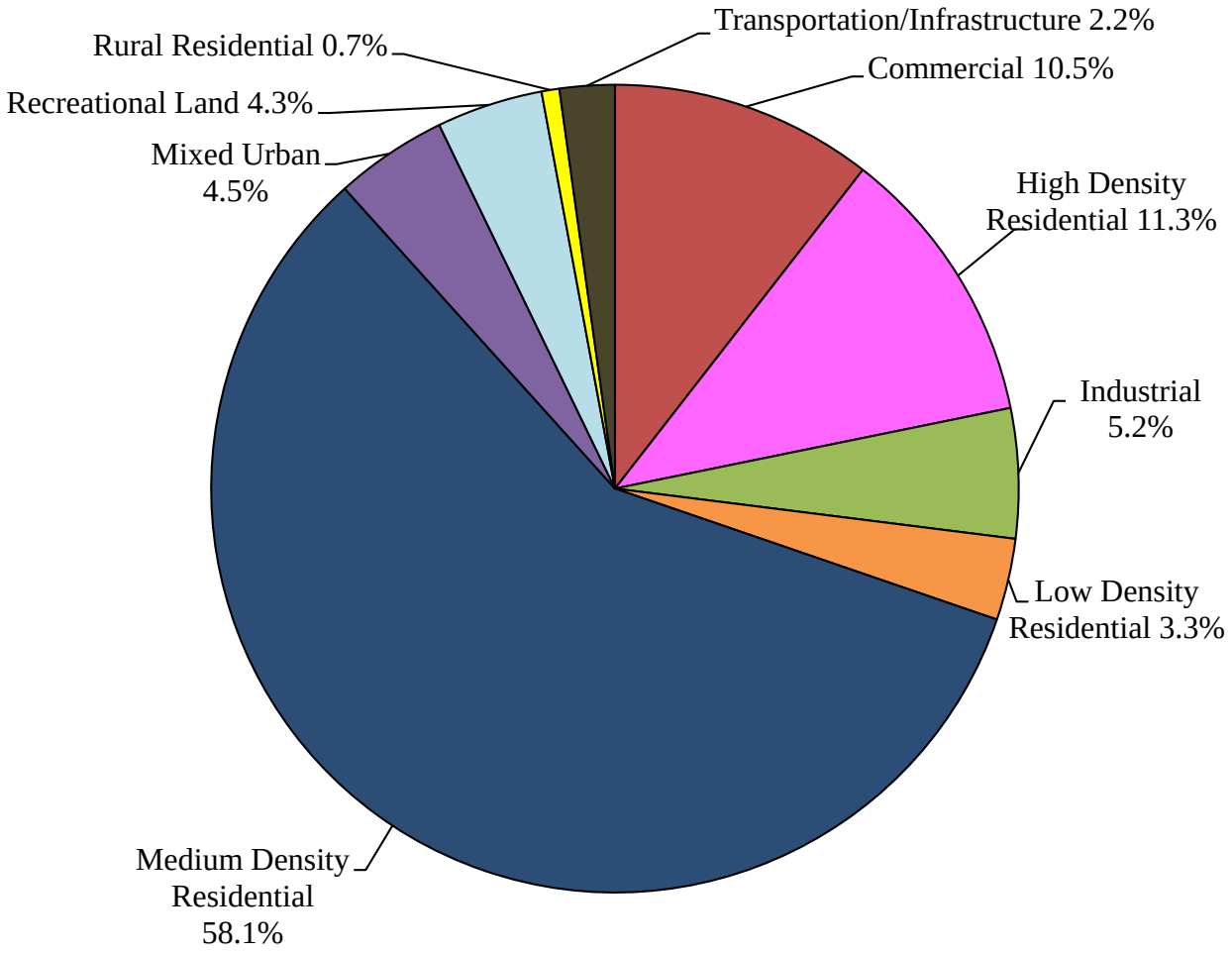


Figure 3: Pie chart illustrating the various types of urban land use in Spotswood Borough

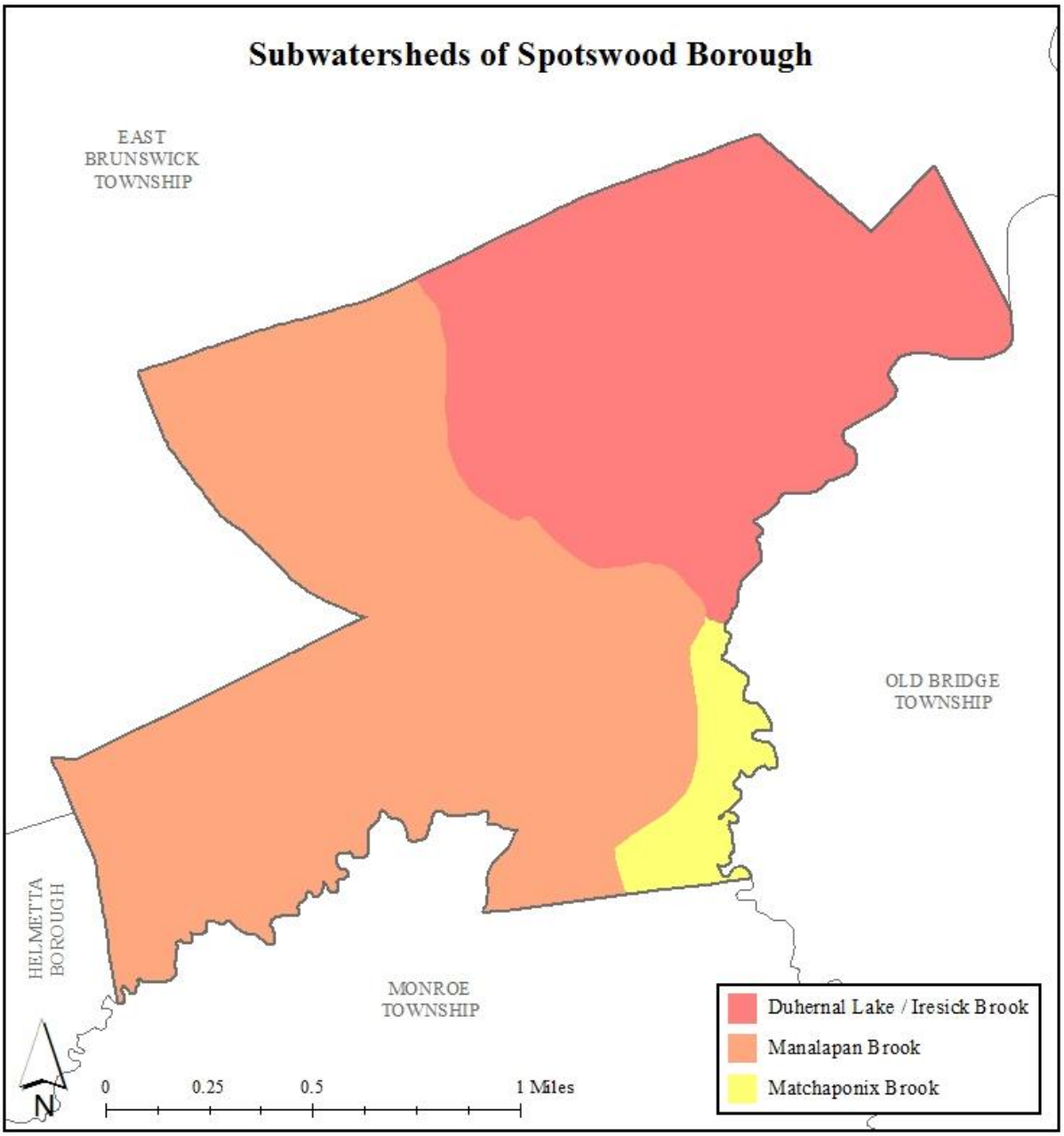


Figure 4: Map of the subwatersheds in Spotswood Borough

For each potential project site, specific aerial loading coefficients for commercial land use were used to determine the annual runoff loads for total phosphorus (TP), total nitrogen (TN), and total suspended solids (TSS) from impervious surfaces (Table 1). These are the same aerial loading coefficients that NJDEP uses in developing total maximum daily loads (TMDLs) for impaired waterways of the state. The percentage of impervious cover for each site was extracted from the 2007 NJDEP land use/land cover database. For impervious areas, runoff volumes were determined for the water quality design storm (1.25 inches of rain over two-hours) and for the annual rainfall total of 44 inches.

Preliminary soil assessments were conducted for each potential project site identified in Spotswood Borough using the United States Department of Agriculture Natural Resources Conservation Service Web Soil Survey, which utilizes regional and statewide soil data to predict soil types in an area. Several key soil parameters were examined (e.g., natural drainage class, saturated hydraulic conductivity of the most limiting soil layer (K_{sat}), depth to water table, and hydrologic soil group) to evaluate the suitability of each site's soil for green infrastructure practices. In cases where multiple soil types were encountered, the key soil parameters were examined for each soil type expected at a site.

For each potential project site, drainage areas were determined for each of the green infrastructure practices proposed at the site. These green infrastructure practices were designed to manage the 2-year design storm, enabling these practices to capture 95% of the annual rainfall. Runoff volumes were calculated for each proposed green infrastructure practice. The reduction in TSS loading was calculated for each drainage area for each proposed green infrastructure practice using the aerial loading coefficients in Table 1. The maximum volume reduction in stormwater runoff for each green infrastructure practice for a storm was determined by calculating the volume of runoff captured from the 2-year design storm. For each green infrastructure practice, peak discharge reduction potential was determined through hydrologic modeling in HydroCAD. For each green infrastructure practice, a cost estimate is provided. These costs are based upon the square footage of the green infrastructure practice and the real cost of green infrastructure practice implementation in New Jersey.

Table 1: Aerial Loading Coefficients[2]

Land Cover	TP load (lbs/acre/yr)	TN load (lbs/acre/yr)	TSS load (lbs/acre/yr)
High, Medium Density Residential	1.4	15	140
Low Density, Rural Residential	0.6	5	100
Commercial	2.1	22	200
Industrial	1.5	16	200
Urban, Mixed Urban, Other Urban	1.0	10	120
Agriculture	1.3	10	300
Forest, Water, Wetlands	0.1	3	40
Barrenland/Transitional Area	0.5	5	60

[2] New Jersey Department of Environmental Protection (NJDEP), Stormwater Best Management Practice Manual, 2004.

Green Infrastructure Practices

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 principal, 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 practices 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[3]. A wide range of green infrastructure practices have been evaluated for the potential project sites in Spotswood Borough. Each practice is discussed below.

Disconnected downspouts

This is often referred to as simple disconnection. A downspout is simply disconnected, prevented from draining directly to the roadway or storm sewer system, and directed to discharge water to a pervious area (i.e., lawn).

Pervious pavements

There are several types of permeable pavement systems including porous asphalt, pervious concrete, permeable pavers, and grass pavers. These surfaces are hard and support vehicle traffic but also allow water to infiltrate through the surface. They have an underlying stone layer to store stormwater runoff and allow it to slowly seep into the ground.




[3] United States Environmental Protection Agency (USEPA), 2013. Watershed Assessment, Tracking, and Environmental Results, New Jersey Water Quality Assessment Report. http://ofmpub.epa.gov/waters10/attains_state.control?p_state=NJ

Bioretention systems/rain gardens

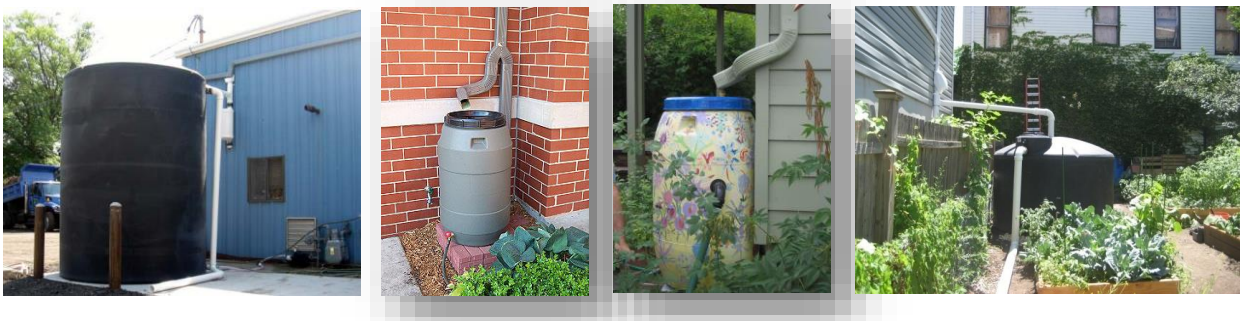
These are landscaped features that are designed to capture, treat, and infiltrate stormwater runoff. These systems can easily be incorporated into existing landscapes, improving aesthetics and creating a wildlife habitat while managing stormwater runoff. Bioretention systems also can be used in soils that do not quickly infiltrate by incorporating an underdrain into the system.

Downspout planter boxes

These are wooden boxes with plants installed at the base of a downspout that provide an opportunity to beneficially reuse rooftop runoff.

Rainwater harvesting systems (cistern or rain barrel)

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.



Bioswale

Bioswales are landscape features that convey stormwater from one location to another while removing pollutants and providing water an opportunity to infiltrate.

Stormwater planters

Stormwater planters are vegetated structures that are built into the sidewalk to intercept stormwater runoff from the roadway or sidewalk. Many of these planters are designed to allow the water to infiltrate into the ground while others are designed simply to filter the water and convey it back into the stormwater sewer system.

Tree filter boxes

These are pre-manufactured concrete boxes that contain a special soil mix and are planted with a tree or shrub. They filter stormwater runoff but provide little storage capacity. They are typically designed to quickly filter stormwater and then discharge it to the local sewer system.

Potential Project Sites

Attachment 1 contains information on potential project sites where green infrastructure practices could be installed. The recommended green infrastructure practice and the drainage area that the green infrastructure practice can treat are identified for each potential project site. For each practice, the recharge potential, TSS removal potential, maximum volume reduction potential per storm, and the peak reduction potential are provided. This information is also provided so that proposed development projects that cannot satisfy the New Jersey stormwater management requirements for major development can use one of the identified projects to offset a stormwater management deficit. [4]

[4] New Jersey Administrative Code, N.J.A.C. 7:8, Stormwater Management, Statutory Authority: N.J.S.A. 12:5-3, 13:1D-1 et seq., 13:9A-1 et seq., 13:19-1 et seq., 40:55D-93 to 99, 58:4-1 et seq., 58:10A-1 et seq., 58:11A-1 et seq. and 58:16A-50 et seq., *Date last amended: April 19, 2010*.

Conclusion

This impervious cover reduction action plan is meant to provide the municipality with a blueprint for implementing green infrastructure practices that will reduce the impact of stormwater runoff from impervious surfaces. These projects can be implemented by a wide variety of people such as boy scouts, girl scouts, school groups, faith-based groups, social groups, watershed groups, and other community groups.

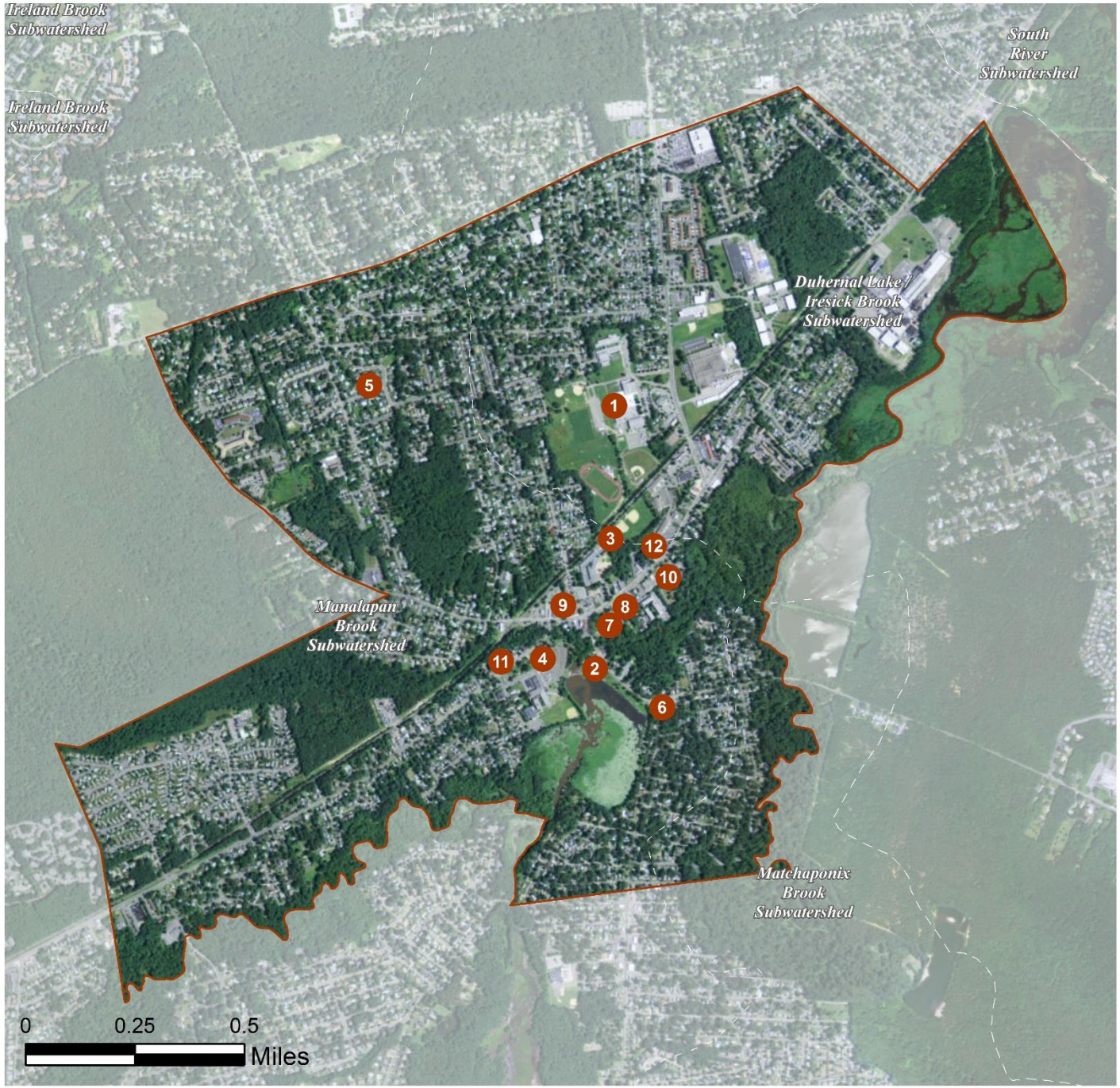
Additionally, development projects that are in need of providing off-site compensation for stormwater impacts can use the projects in this plan as a starting point. The municipality can quickly convert this impervious cover reduction action plan into a stormwater mitigation plan and incorporate it into the municipal stormwater control ordinance.

a. Overview Map of the Project

SPOTSWOOD BOROUGH: CLIMATE RESILIENT GREEN INFRASTRUCTURE FOR THE RARITAN BASIN

b. Green Infrastructure Sites

SPOTSWOOD BOROUGH: GREEN INFRASTRUCTURE SITES



SITES WITHIN THEDUHERNAL LAKE/IRESICK BROOK SUBWATERSHED:

1. Spotswood High School, Middle School & Municipal Building

SITES WITHIN THE MANALAPAN BROOK SUBWATERSHED:

2. American Legion
3. Applyby School
4. Immaculate Conception Church
5. Michael Road Play Area
6. Mundy Avenue Park
7. Saint Peter's Episcopal Church
8. Spotswood Fire Department
9. Spotswood Library
10. Spotswood Reformed Church
11. Trinity Methodist Church
12. US Post Office

c. Proposed Green Infrastructure Concepts

SPOTSWOOD HIGH SCHOOL, MIDDLE SCHOOL, & MUNICIPAL BUILDING

Subwatershed: Duhernal Lake/ Iresick Brook

Site Area: 2,438,021 sq. ft.

Address: 105 Summerhill Road Spotswood, NJ 08884

Block and Lot: Block 87.1, Lot 1.03

The high school has several locations where rain gardens can be installed to capture, treat, and infiltrate roof runoff. Parking spaces can also be converted into pervious pavement to capture stormwater. The middle school also has several suitable areas to build rain gardens to manage runoff from the roof and parking lot, as well as an opportunity for pervious pavement in their parking lot. Additionally, both rain gardens and pervious pavement can be installed at the municipal building. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability 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"
27	657,187	31.7	331.9	3,017.4	0.512	18.02

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	0.988	165	72,489	2.73	9,797	$48,985
Pervious pavements	2.476	415	181,697	6.83	12,688	$317,200

GREEN INFRASTRUCTURE RECOMMENDATIONS

Spotswood High School, Middle School & Municipal Building

- disconnected downspouts
- pervious pavements
- bioretention / rain gardens
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 110' 220'

AMERICAN LEGION

Subwatershed: Manalapan Brook

Site Area: 140,057 sq. ft.

Address: 60 De Voe Avenue
Spotswood, NJ 08884

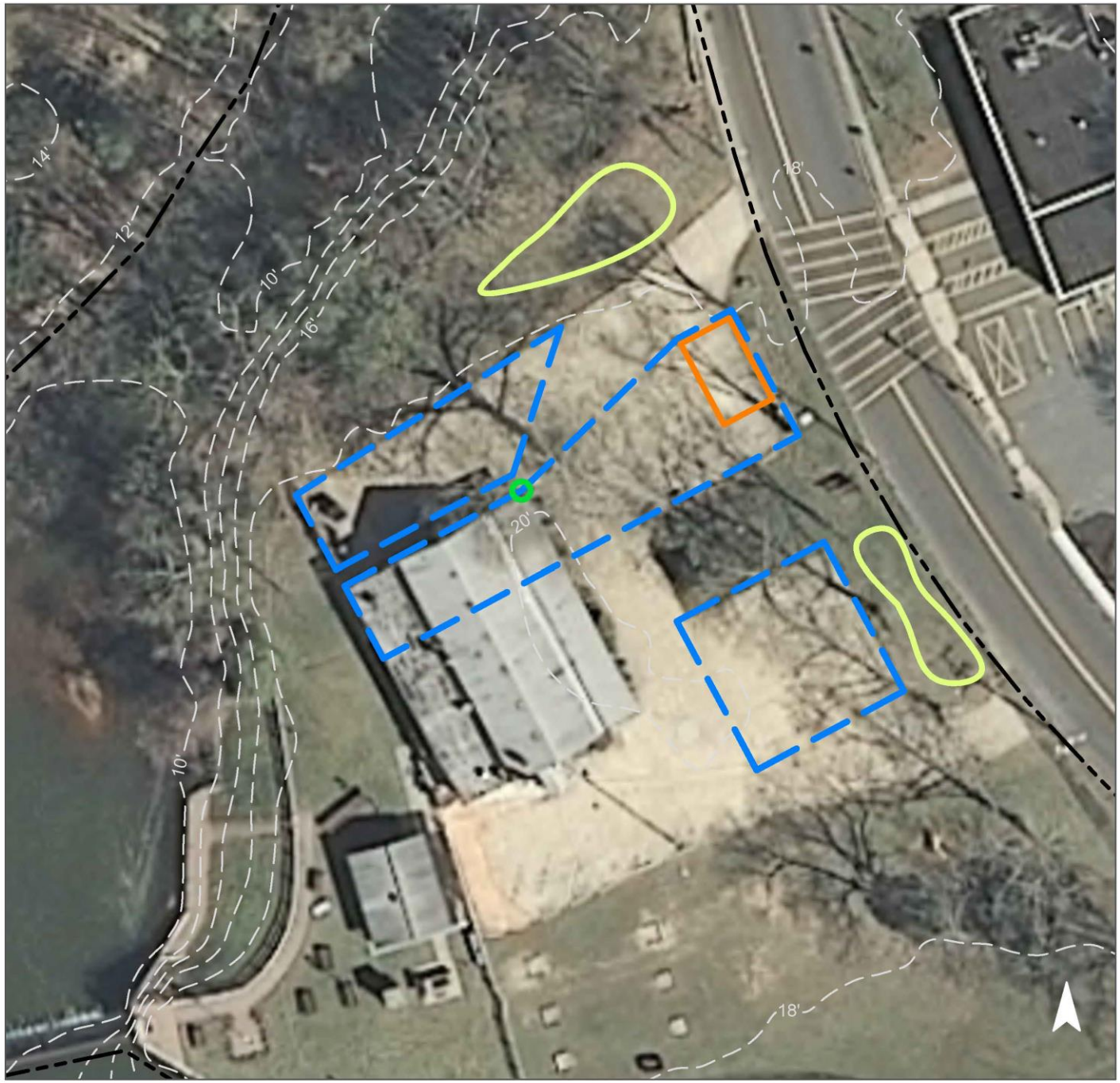
Block and Lot: Block 112, Lot 1

The American Legion parking lot and driveway are paved with concrete. The building has connected downspouts. Rain gardens can capture, treat, and infiltrate parking lot runoff. Additional runoff can be treated by replacing parking spaces with pervious pavement. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability 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"
23	31,929	1.5	16.1	146.6	0.025	0.88

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	0.146	24	10,726	0.40	1,991	$9,955
Pervious pavements	0.137	23	10,023	0.38	555	$13,875

GREEN INFRASTRUCTURE RECOMMENDATIONS



American Legion

- disconnected downspouts
- pervious pavements
- bioretention / rain gardens
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 25' 50'

APPLYBY SCHOOL

Subwatershed: **Manalapan Brook**

Site Area: **429,622 sq. ft.**

Address: **23 Vliet Street**
Spotswood, NJ 08884

Block and Lot: **Block 107, Lot 21.01**

Most of the school's downspouts are directly connected, except for a pair of disconnected downspouts at the south end. The parking lot flows in the direction of the baseball field. Parking lot runoff can be managed replacing parking spaces with pervious pavement. A rain garden can also capture, treat, and infiltrate rooftop runoff. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability 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"
31	133,161	6.4	67.3	611.4	0.104	3.65

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	0.040	7	2,910	0.11	404	$2,020
Pervious pavements	0.926	155	67,971	2.56	4,800	$120,000

GREEN INFRASTRUCTURE RECOMMENDATIONS

Applyby School

- pervious pavements
- bioretention / rain gardens
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 50' 100'

IMMACULATE CONCEPTION CHURCH

Subwatershed: **Manalapan Brook**

Site Area: **833,119 sq. ft.**

Address: **23 Manalapan Road**
Spotswood, NJ 08884

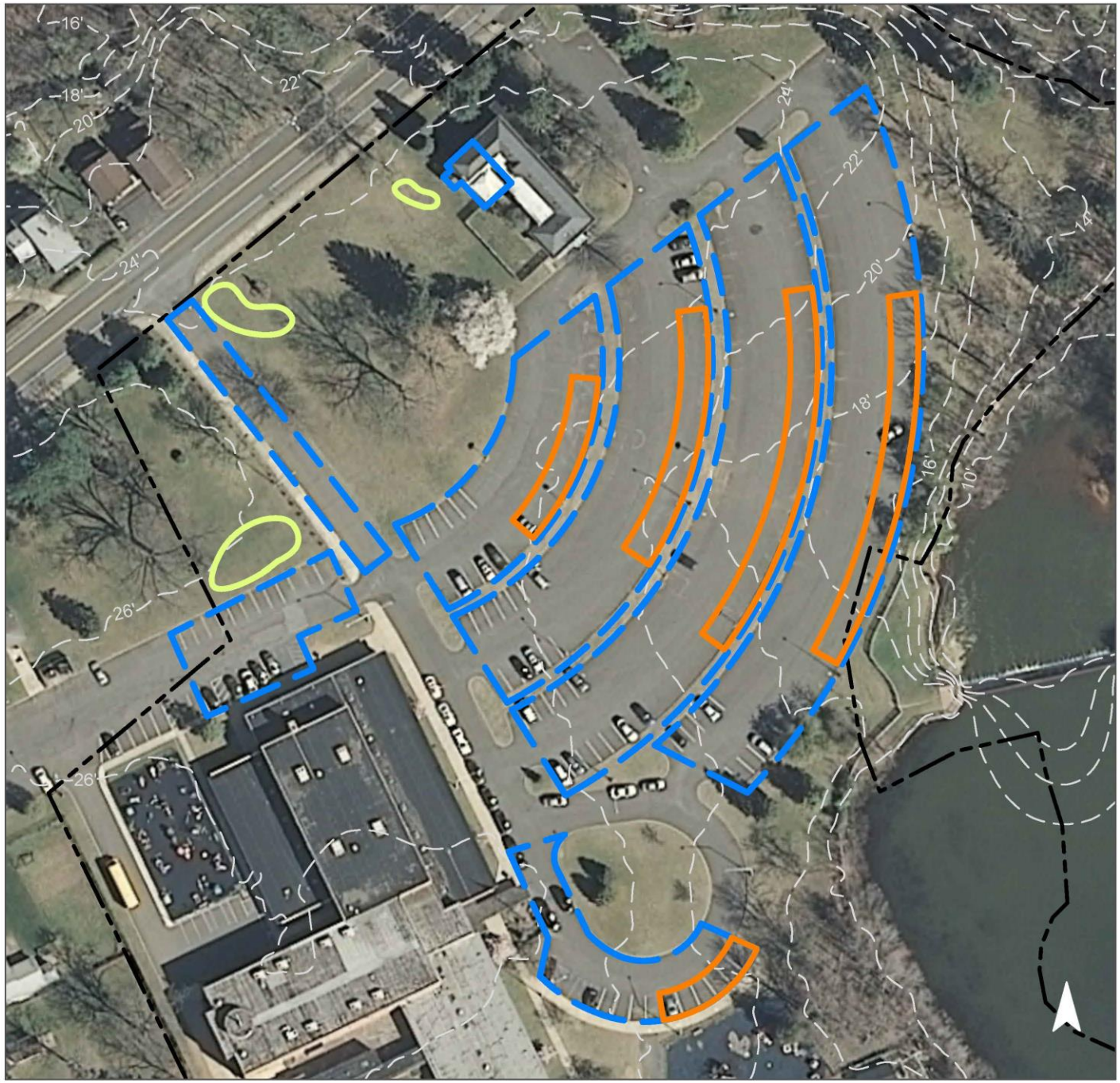
Block and Lot: **Block 13, Lot 1.03**

The main building has internal drainage, and the smaller building has downspouts which can be rerouted into a rain garden to capture, treat, and infiltrate runoff. Rain gardens can also be constructed near the driveway entrance and the western parking lot. Multiple rows of parking spaces can be replaced with pervious pavement to infiltrate parking lot runoff. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability 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"
30	254,048	12.2	128.3	1,166.4	0.198	6.97

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	0.302	51	22,178	0.83	2,950	$14,750
Pervious pavements	2.452	410	179,924	6.76	15,114	$377,850

GREEN INFRASTRUCTURE RECOMMENDATIONS



Immaculate Conception Church

- pervious pavements
- bioretention / rain gardens
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 50' 100'

MICHAEL ROAD PLAY AREA

Subwatershed: Manalapan Brook

Site Area: 41,841 sq. ft.

Address: 1 Leonard Avenue
Spotswood, NJ 08884

Block and Lot: Block 50, Lot 15

This play area contains two paved areas, a blacktop and a basketball court, which drain to the surrounding grass and roadway. The runoff from the basketball court primarily flows toward the northeast corner where a rain garden can be installed to capture, treat, and infiltrate stormwater. The blacktop can also be redone with pervious pavement to infiltrate runoff. 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"
83	34,592	1.7	17.5	158.8	0.027	0.95

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	0.060	10	4,368	0.16	570	$2,850
Pervious pavements	0.238	40	17,466	0.66	9,000	$225,000

GREEN INFRASTRUCTURE RECOMMENDATIONS

Michael Road Play Area

- pervious pavements
- bioretention / rain gardens
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 25' 50'

MUNDY AVENUE PARK

Subwatershed: Manalapan Brook

Site Area: 64,449 sq. ft.

Address: 1 Mundy Avenue
Spotswood, NJ 08884

Block and Lot: Block 110.1, Lot 1

This site is primarily green space. Runoff is generated by the parking lot, basketball court, and sidewalks. The parking lot runoff flows into the street. Half of the basketball court drains toward the parking lot, and the other half drains in the direction of the wooded area. The parking lot runoff can be managed by installing porous asphalt along the north edge. The basketball court can be redone with pervious pavement to capture and infiltrate stormwater. 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"
16	10,441	0.5	5.3	47.9	0.008	0.29

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
Pervious pavements	0.261	44	19,119	0.72	7,372	$184,300

GREEN INFRASTRUCTURE RECOMMENDATIONS

Mundy Avenue Park

- pervious pavements
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 20' 40'

SAINT PETER'S EPISCOPAL CHURCH

Subwatershed: **Manalapan Brook**

Site Area: **128,188 sq. ft.**

Address: **505 Main Street**
Spotswood, NJ 08884

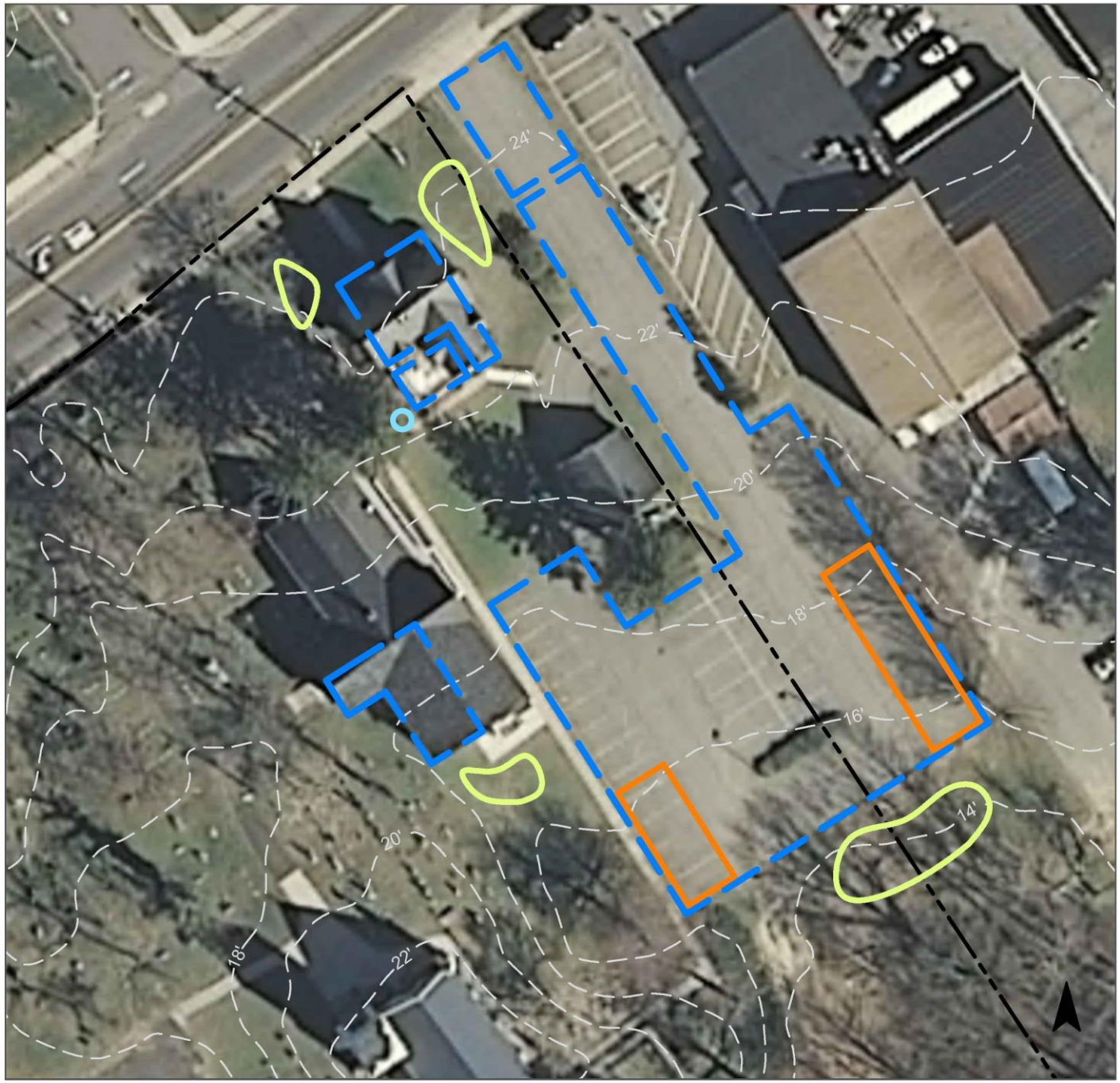
Block and Lot: **Block 108.01, Lot 20**

Buildings have disconnected downspouts that flow onto the grass or pavement. The parking lot drains southeast into the grass where it is causing erosion, and eventually flows into a neighboring stream. There are several locations where rain gardens can be installed to capture, treat, and infiltrate roof runoff by rerouting downspouts. Parking lot runoff can be managed by replacing parking spaces with pervious pavement, and by installing a rain garden where the lot drains. Additionally, a rain barrel can be set up to harvest rainwater to water an existing garden. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability 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"
33	42,688	2.1	21.6	196.0	0.033	1.17

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	0.192	32	14,070	0.53	1,888	$9,440
Pervious pavements	0.264	44	19,358	0.73	2,000	$50,000
Rainwater harvesting systems	0.007	1	250	0.02	250 (gal)	$500

GREEN INFRASTRUCTURE RECOMMENDATIONS



Saint Peter's Episcopal Church

- pervious pavements
- bioretention / rain gardens
- rainwater harvesting
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 25' 50'

SPOTSWOOD FIRE DEPARTMENT

Subwatershed: Manalapan Brook

Site Area: 38,724 sq. ft.

Address: 495 Main Street
Spotswood, NJ 08884

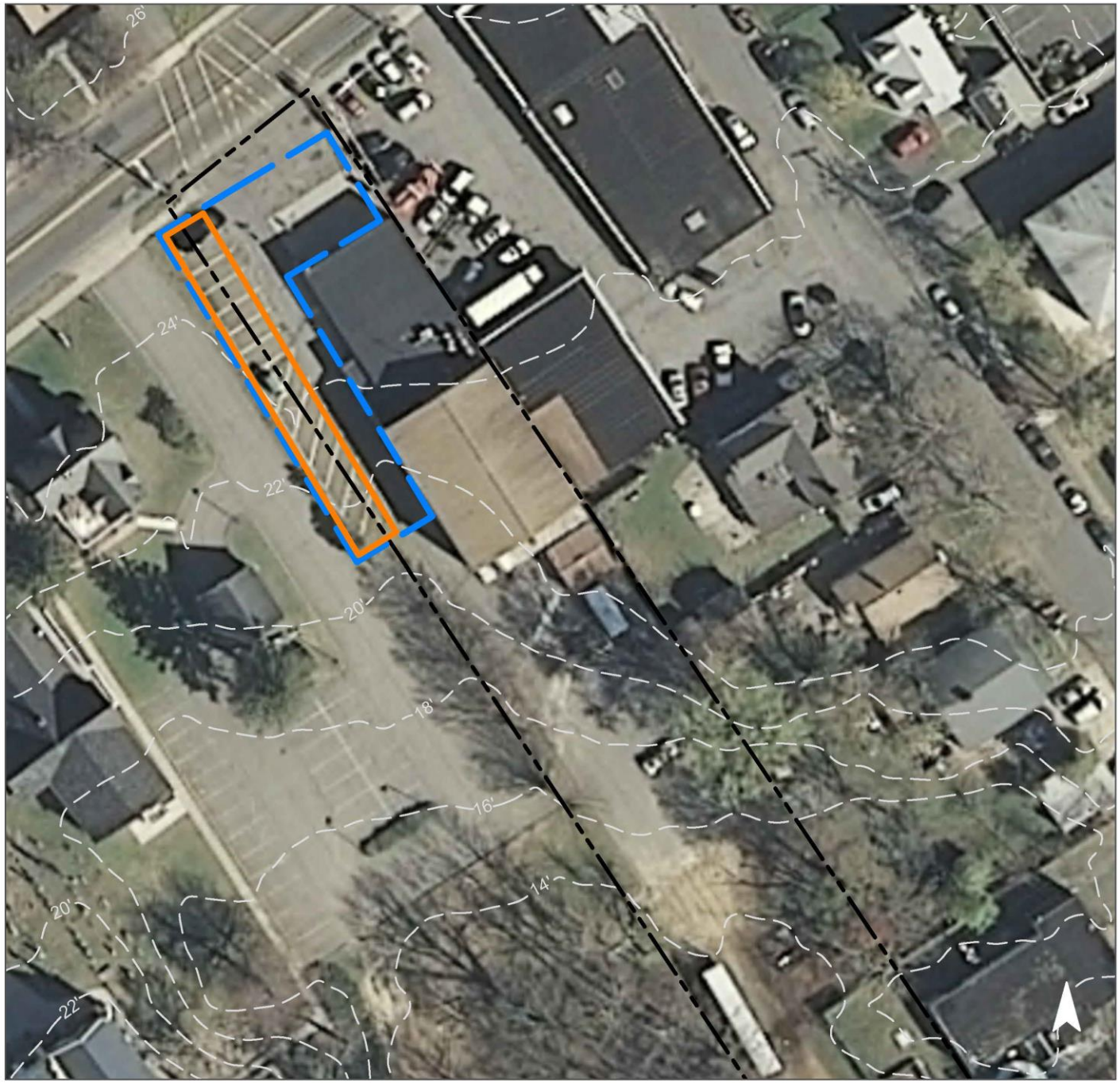
Block and Lot: Block 108.01, Lot 18

The fire department's runoff drains into directly connected downspouts. Parking lot runoff flows into the grass area to the southeast. Parking spaces can be replaced with pervious pavement to capture and infiltrate stormwater. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability 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"
77	29,922	1.4	15.1	137.4	0.023	0.82

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
Pervious pavements	0.170	28	12,484	0.47	2,544	$63,600

GREEN INFRASTRUCTURE RECOMMENDATIONS



Spotswood Fire Department

- pervious pavements
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 30' 60'

SPOTSWOOD LIBRARY

Subwatershed: **Manalapan Brook**

Site Area: **38,673 sq. ft.**

Address: **548 Main Street**
Spotswood, NJ 08884

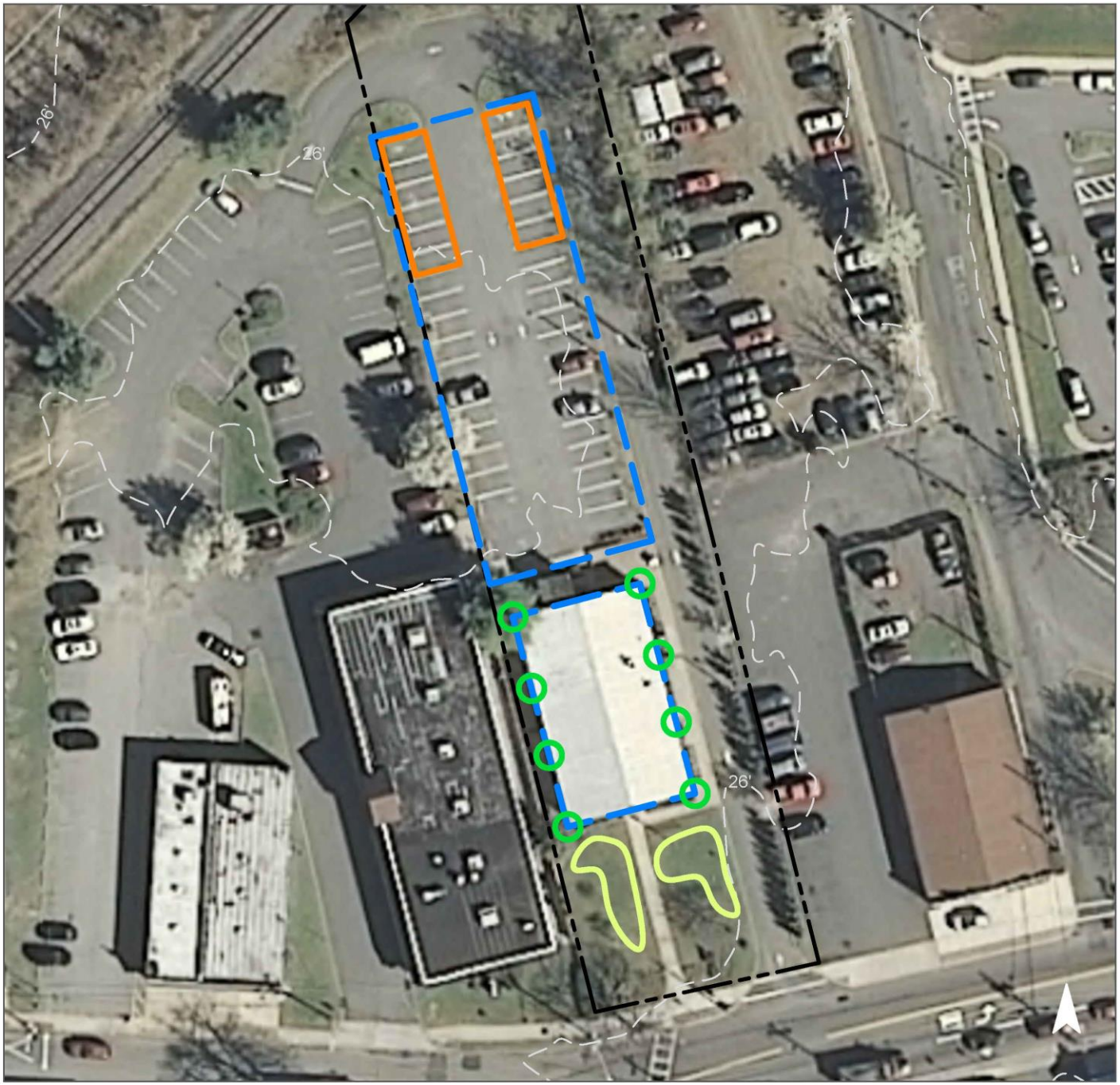
Block and Lot: **Block 15, Lot 2**

Rooftop runoff can be captured, treated, and infiltrated by installing two rain gardens in front of the building by redirecting downspouts into them. Parking spaces can also be replaced with pervious pavement to capture and infiltrate stormwater. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability 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"
85	32,877	1.6	16.6	151.0	0.026	0.90

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	0.113	19	8,295	0.31	1,100	$5,500
Pervious pavements	0.311	52	22,814	0.86	1,900	$47,500

GREEN INFRASTRUCTURE RECOMMENDATIONS



Spotswood Library

- disconnected downspouts
- pervious pavements
- bioretention / rain gardens
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 30' 60'

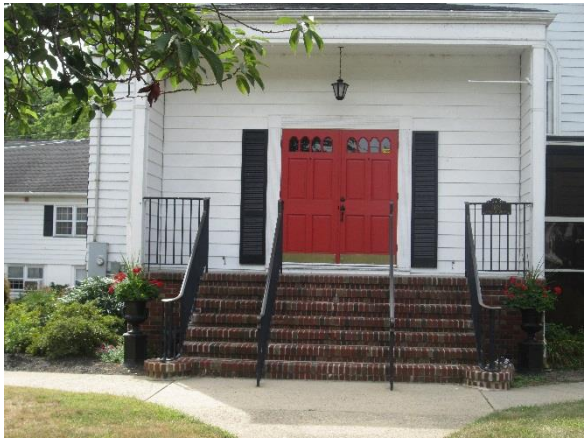
SPOTSWOOD REFORMED CHURCH

Subwatershed: Manalapan Brook

Site Area: 180,363 sq. ft.

Address: 429 Main Street
Spotswood, NJ 08884

Block and Lot: Block 108, Lot 9

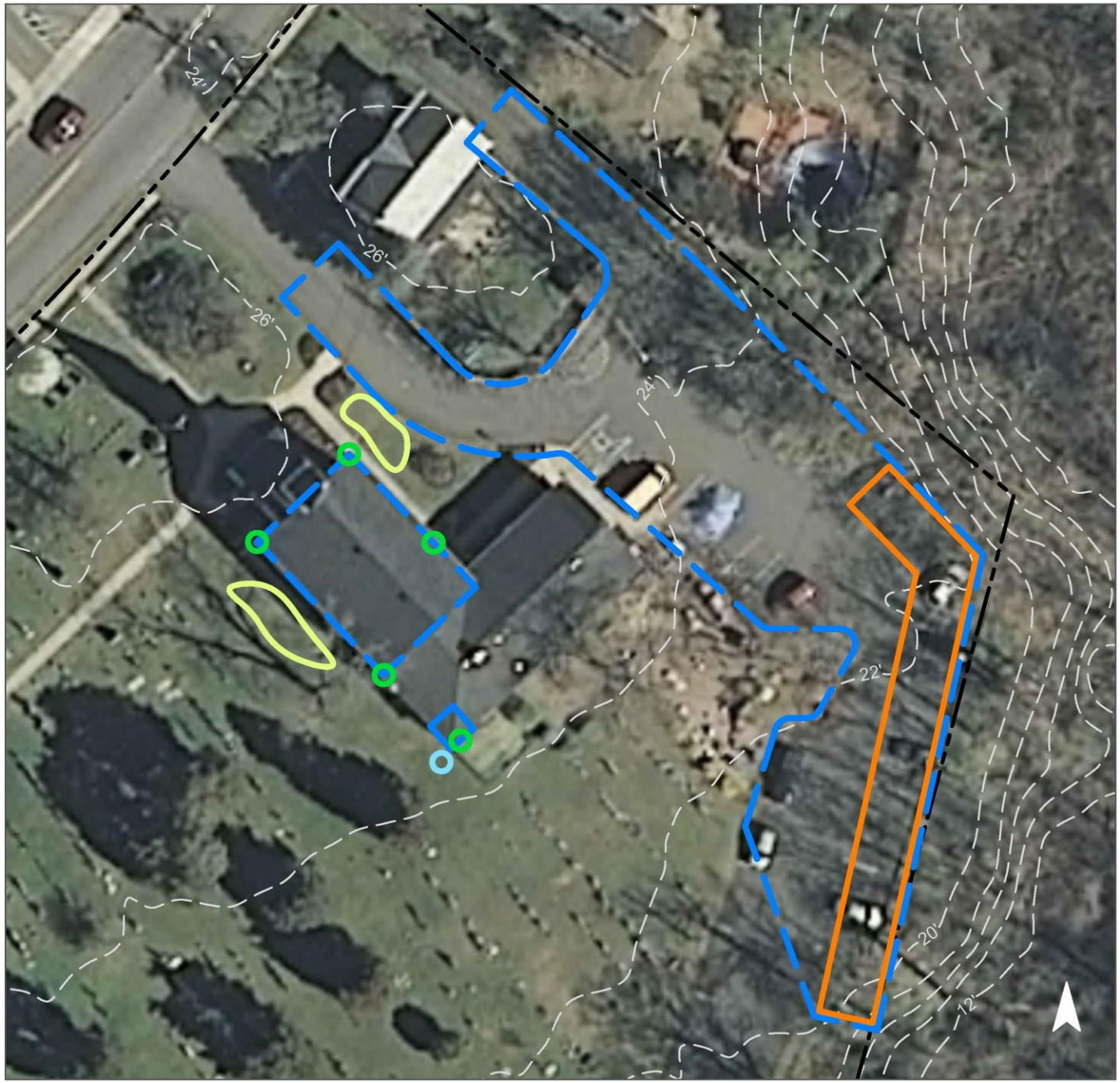


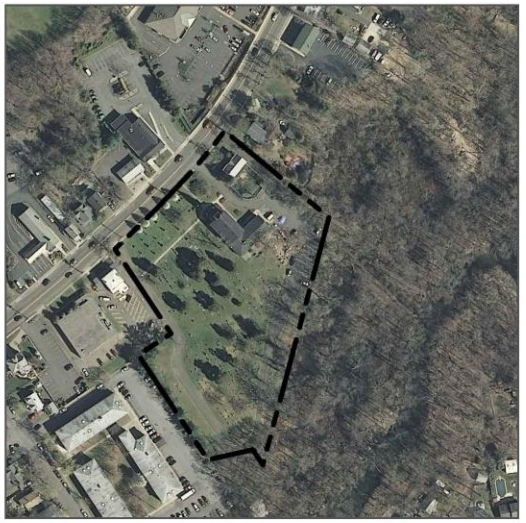
The parking lot runoff drains to the east, and overflows into a nearby creek. Rain gardens can be installed to capture, treat and infiltrate rooftop runoff. A rain barrel can also be set up to harvest rainwater for us in an existing garden. Parking spaces can be replaced with pervious pavement to capture and infiltrate stormwater. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability 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"
32	58,068	2.8	29.3	266.6	0.045	1.59

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	0.065	11	4,802	0.18	630	$3,150
Pervious pavements	0.489	82	35,867	1.35	3,350	$83,750
Rainwater harvesting systems	0.003	0	100	0.01	100 (gal)	$200

GREEN INFRASTRUCTURE RECOMMENDATIONS





Spotswood Reformed Church

- disconnected downspouts
- pervious pavements
- bioretention / rain gardens
- rainwater harvesting
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 25' 50'

TRINITY METHODIST CHURCH

Subwatershed: Manalapan Brook

Site Area: 27,510 sq. ft.

Address: 70 Manalapan Road
Spotswood, NJ 08884

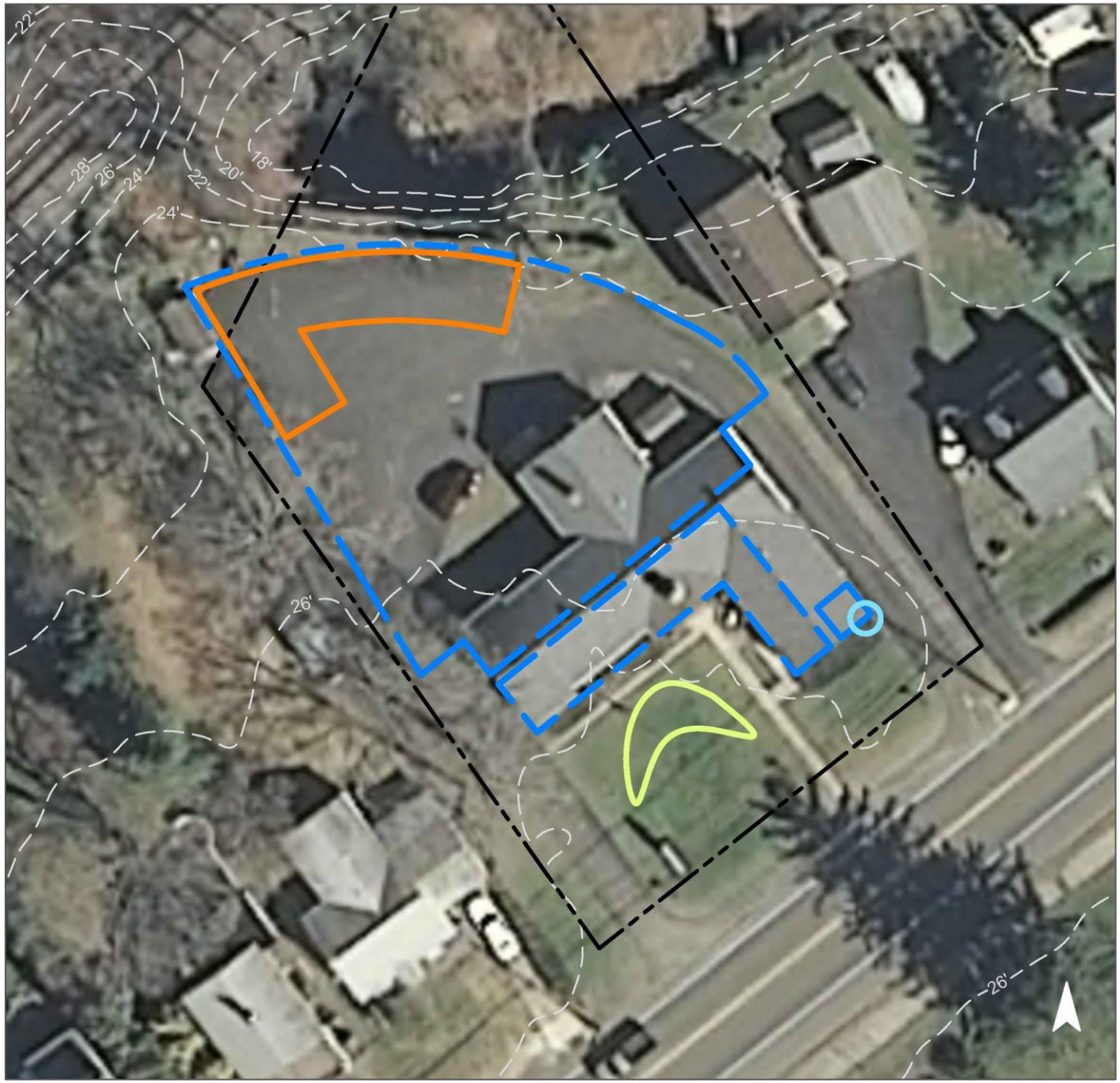
Block and Lot: Block 17, Lot 50

This church has disconnected downspouts that flow onto the surrounding grass and the pavement in the back. Parking lot runoff flows into a forested area to the north. A rain garden can be constructed in front of the building to capture, treat, and infiltrate rooftop runoff. Pervious pavement can also be installed to infiltrate parking lot and roof runoff. Additionally, a rain barrel can be installed to harvest rainwater for watering an existing garden. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability 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"
73	19,967	1.0	10.1	91.7	0.016	0.55

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	0.042	7	3,119	0.12	400	$2,000
Pervious pavements	0.261	44	19,119	0.72	1,800	$45,000
Rainwater harvesting systems	0.003	0	100	0.01	100 (gal)	$200

GREEN INFRASTRUCTURE RECOMMENDATIONS



Trinity Methodist Church

- pervious pavements
- bioretention / rain gardens
- rainwater harvesting
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 20' 40'

US POST OFFICE

Subwatershed: Manalapan Brook

Site Area: 48,234 sq. ft.

Address: 436 Main Street
Spotswood, NJ 08884

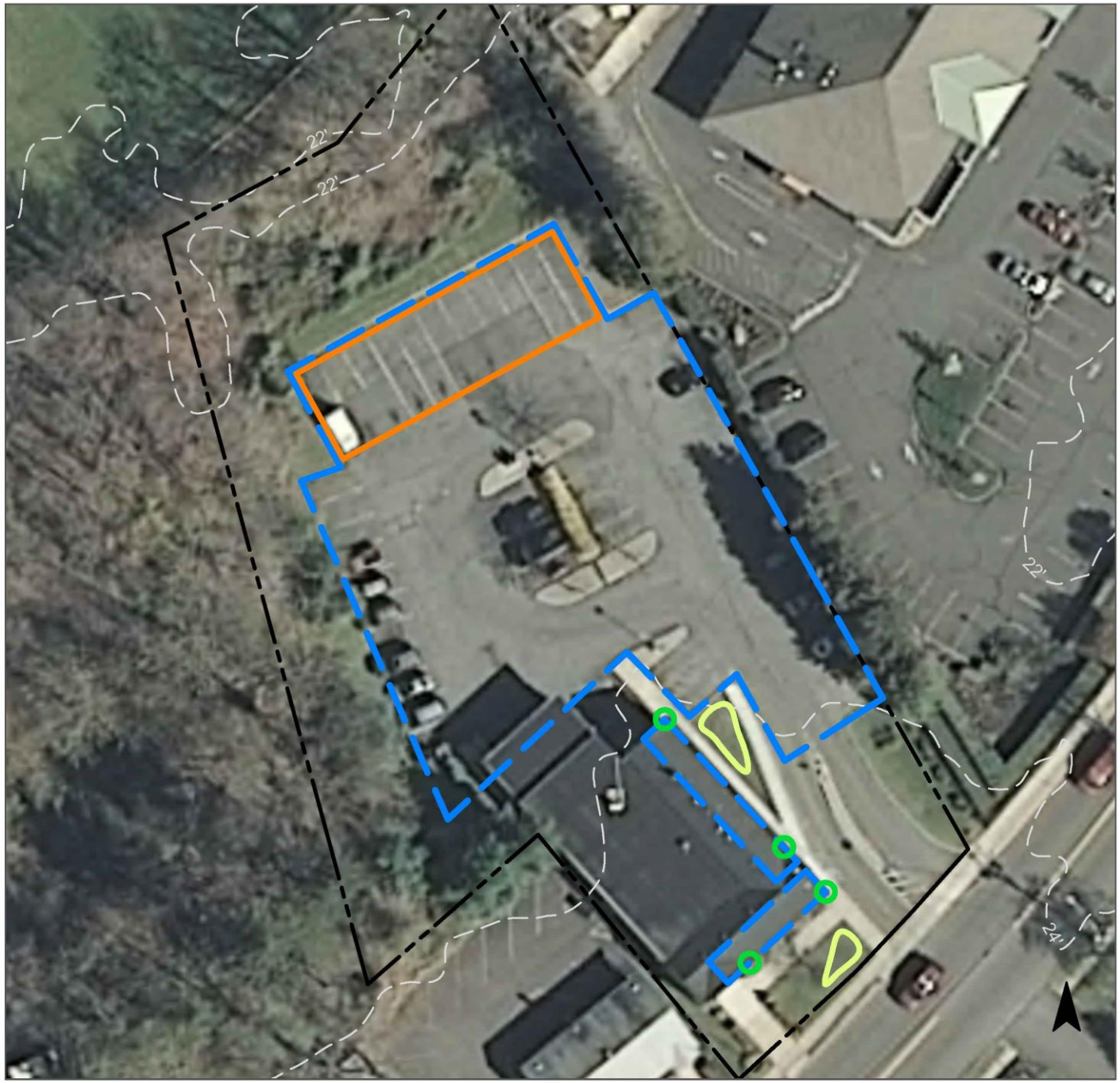
Block and Lot: Block 107, Lot 9.01

Some of the building's downspouts can be disconnected into rain gardens to capture, treat, and infiltrate rooftop runoff. Parking spaces in the northern section of the lot can be replaced with pervious pavement to capture and infiltrate stormwater. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability 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"
73	35,026	1.7	17.7	160.8	0.027	0.96

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	0.028	5	2,035	0.08	1,286	$6,430
Pervious pavements	0.273	46	20,024	0.75	3,072	$76,800

GREEN INFRASTRUCTURE RECOMMENDATIONS



US Post Office

- disconnected downspouts
- pervious pavements
- bioretention / rain gardens
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 25' 50'

d. Summary of Existing Conditions

Summary of Existing Site Conditions

Subwatershed/Site Name/Total Site Info/GI Practice	Area (ac)	Area (SF)	Block	Lot	Existing Annual Loads TP (lb/yr)	Existing Annual Loads TN (lb/yr)	Existing Annual Loads TSS (lb/yr)	I.C. %	I.C. Area (ac)	I.C. Area (SF)	Runoff Volumes from I.C. Water Quality Storm (1.25" over 2-hours) (Mgal)	Runoff Volumes from I.C. Annual (Mgal)
DUHERNAL LAKE/IRESICK BROOK SUBWATERSHED	**55.97**	**2,438,021**			**31.7**	**331.9**	**3,017.4**		**15.09**	**657,187**	**0.512**	**18.02**
Spotswood High School, Middle School, & Municipal Buildings												
Total Site Info	55.97	2,438,021	87.1	1.03	31.7	331.9	3,017.4	27	15.09	657,187	0.512	18.02
MANALAPAN BROOK SUBWATERSHED	**45.24**	**1,970,779**			**32.9**	**344.8**	**3,134.6**		**15.67**	**682,719**	**0.532**	**18.72**
American Legion												
Total Site Info	3.22	140,057	112	1	1.5	16.1	146.6	23	0.73	31,929	0.025	0.88
Applyby School												
Total Site Info	9.86	429,622	107	21.01	6.4	67.3	611.4	31	3.06	133,161	0.104	3.65
Immaculate Conception Church												
Total Site Info	19.13	833,119	13	1.03	12.2	128.3	1,166.4	30	5.83	254,048	0.198	6.97
Michael Road Play Area												
Total Site Info	0.96	41,841	50	15	1.7	17.5	158.8	83	0.79	34,592	0.027	0.95
Mundy Avenue Park												
Total Site Info	1.48	64,449	110.01	1	0.5	5.3	47.9	16	0.24	10,441	0.008	0.29
Saint Peter's Episcopal Church												
Total Site Info	2.94	128,188	108.01	20	2.1	21.6	196.0	33	0.98	42,688	0.033	1.17
Spotswood Fire Department												
Total Site Info	0.89	38,724	108.01	18	1.4	15.1	137.4	77	0.69	29,922	0.023	0.82
Spotswood Library												
Total Site Info	0.89	38,673	15	2	1.6	16.6	151.0	85	0.75	32,877	0.026	0.90
Spotswood Reformed Church												
Total Site Info	4.14	180,363	108	9	2.8	29.3	266.6	32	1.33	58,068	0.045	1.59

Summary of Existing Site Conditions

Subwatershed/Site Name/Total Site Info/GI Practice	Area (ac)	Area (SF)	Block	Lot	Existing Annual Loads TP (lb/yr)	Existing Annual Loads TN (lb/yr)	Existing Annual Loads TSS (lb/yr)	I.C. %	I.C. Area (ac)	I.C. Area (SF)	Runoff Volumes from I.C. Water Quality Storm (1.25" over 2-hours) (Mgal)	Runoff Volumes from I.C. Annual (Mgal)
Trinity Methodist Church												
Total Site Info	0.63	27,510	17	50	1.0	10.1	91.7	73	0.46	19,967	0.016	0.55
US Post Office												
Total Site Info	1.11	48,234	107	9.01	1.7	17.7	160.8	73	0.80	35,026	0.027	0.96

e. Summary of Proposed Green Infrastructure Practices

Summary of Proposed Green Infrastructure Practices

	Subwatershed/Site Name/Total Site Info/GI Practice	Potential Management Area: Area (SF)	Potential Management Area: Area (ac)	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Max Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cfs)	Size of BMP (SF)	Unit Cost ($)	Unit	Total Cost ($)	I.C. Treated %
	DUHERNAL LAKE/IRESICK BROOK SUBWATERSHED	**132,955**	**3.05**	**3.464**	**580**	**254,186**	**9.56**	**22,485**			**$366,185**	**20.2%**
1	**Spotswood High School, Middle School, & Municipal Buildings**											
	Bioretention systems/rain gardens	37,916	0.87	0.988	165	72,489	2.73	9,797	5	SF	$48,985	5.8%
	Pervious pavements	95,039	2.18	2.476	415	181,697	6.83	12,688	25	SF	$317,200	14.5%
	Total Site Info	**132,955**	**3.05**	**3.464**	**580**	**254,186**	**9.56**	**22,485**			**$366,185**	**20.2%**
	MANALAPAN BROOK SUBWATERSHED	**260,253**	**5.97**	**6.781**	**1,135**	**497,122**	**18.72**	**63,176**			**$1,344,670**	**38.1%**
2	**American Legion**											
	Bioretention systems/rain gardens	5,612	0.13	0.146	24	10,726	0.40	1,991	5	SF	$9,955	17.6%
	Pervious pavements	5,243	0.12	0.137	23	10,023	0.38	555	25	SF	$13,875	16.4%
	Total Site Info	**10,855**	**0.25**	**0.283**	**47**	**20,749**	**0.78**	**2,546**			**$23,830**	**34.0%**
3	**Applyby School**											
	Bioretention systems/rain gardens	1,520	0.03	0.040	7	2,910	0.11	404	5	SF	$2,020	1.1%
	Pervious pavements	35,551	0.82	0.926	155	67,971	2.56	4,800	25	SF	$120,000	26.7%
	Total Site Info	**37,071**	**0.85**	**0.966**	**162**	**70,881**	**2.67**	**5,204**			**$122,020**	**27.8%**
4	**Immaculate Conception Church**											
	Bioretention systems/rain gardens	11,600	0.27	0.302	51	22,178	0.83	2,950	5	SF	$14,750	4.6%
	Pervious pavements	94,111	2.16	2.452	410	179,924	6.76	15,114	25	SF	$377,850	37.0%
	Total Site Info	**105,711**	**2.43**	**2.754**	**461**	**202,102**	**7.59**	**18,064**			**$392,600**	**41.6%**
5	**Michael Road Play Area**											
	Bioretention systems/rain gardens	2,285	0.05	0.060	10	4,368	0.16	570	5	SF	$2,850	6.6%
	Pervious pavements	9,135	0.21	0.238	40	17,466	0.66	9,000	25	SF	$225,000	26.4%
	Total Site Info	**11,420**	**0.26**	**0.298**	**50**	**21,834**	**0.82**	**9,570**			**$227,850**	**33.0%**
6	**Mundy Avenue Park**											
	Pervious pavements	10,000	0.23	0.261	44	19,119	0.72	7,372	25	SF	$184,300	95.8%
	Total Site Info	**10,000**	**0.23**	**0.261**	**44**	**19,119**	**0.72**	**7,372**			**$184,300**	**95.8%**

Summary of Proposed Green Infrastructure Practices

	Subwatershed/Site Name/Total Site Info/GI Practice	Potential Management Area		Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Max Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cfs)	Size of BMP (SF)	Unit Cost ($)	Unit	Total Cost ($)	I.C. Treated %
		Area (SF)	Area (ac)									
7	**Saint Peter's Episcopal Church**											
	Bioretention systems/rain gardens	7,361	0.17	0.192	32	14,070	0.53	1,888	5	SF	$9,440	17.2%
	Pervious pavements	10,125	0.23	0.264	44	19,358	0.73	2,000	25	SF	$50,000	23.7%
	Rainwater harvesting systems	266	0.01	0.007	1	250	0.02	250	2	gal	$500	0.6%
	Total Site Info	**17,752**	**0.41**	**0.463**	**77**	**33,678**	**1.28**	**4,138**			**$59,940**	**41.6%**
8	**Spotswood Fire Department**											
	Pervious pavements	6,530	0.15	0.170	28	12,484	0.47	2,544	25	SF	$63,600	21.8%
	Total Site Info	**6,530**	**0.15**	**0.170**	**28**	**12,484**	**0.47**	**2,544**			**$63,600**	**21.8%**
9	**Spotswood Library**											
	Bioretention systems/rain gardens	4,340	0.10	0.113	19	8,295	0.31	1,100	5	SF	$5,500	13.2%
	Pervious pavements	11,934	0.27	0.311	52	22,814	0.86	1,900	25	SF	$47,500	36.3%
	Total Site Info	**16,274**	**0.37**	**0.424**	**71**	**31,109**	**1.17**	**3,000**			**$53,000**	**49.5%**
10	**Spotswood Reformed Church**											
	Bioretention systems/rain gardens	2,510	0.06	0.065	11	4,802	0.18	630	5	SF	$3,150	4.3%
	Pervious pavements	18,760	0.43	0.489	82	35,867	1.35	3,350	25	SF	$83,750	32.3%
	Rainwater harvesting systems	100	0.00	0.003	0	100	0.01	100	2	gal	$200	0.2%
	Total Site Info	**21,370**	**0.49**	**0.557**	**93**	**40,769**	**1.54**	**4,080**			**$87,100**	**36.8%**
11	**Trinity Methodist Church**											
	Bioretention systems/rain gardens	1,630	0.04	0.042	7	3,119	0.12	400	5	SF	$2,000	8.2%
	Pervious pavements	10,000	0.23	0.261	44	19,119	0.72	1,800	25	SF	$45,000	50.1%
	Rainwater harvesting systems	100	0.00	0.003	0	100	0.01	100	2	gal	$200	0.5%
	Total Site Info	**11,730**	**0.27**	**0.306**	**51**	**22,338**	**0.85**	**2,300**			**$47,200**	**58.7%**
12	**US Post Office**											
	Bioretention systems/rain gardens	1,065	0.02	0.028	5	2,035	0.08	1,286	5	SF	$6,430	3.0%
	Pervious pavements	10,475	0.24	0.273	46	20,024	0.75	3,072	25	SF	$76,800	29.9%
	Total Site Info	**11,540**	**0.26**	**0.301**	**50**	**22,059**	**0.83**	**4,358**			**$83,230**	**32.9%**