RUTGERS
New Jersey Agricultural
Experiment Station

Impervious Cover Reduction Action Plan
for
Washington Borough, Warren County, New Jersey

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

August 10, 2016

WILLIAM PENN
FOUNDATION

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Introduction

Located in Warren County in northern New Jersey, Washington Borough covers approximately 1.97 square miles. Figures 1 and 2 illustrate that Washington Borough is dominated by urban land uses. A total of 77.4% of the municipality's land use is classified as ubran. Of the urban land in Washington Borough, medium density residential is the dominant land use (Figure 3).

The New Jersey Department of Environmental Protection's (NJDEP) 2012 land use/land cover geographical information system (GIS) data layer categorizes Washington 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 Washington Borough. Based upon the 2012 NJDEP land use/land cover data, approximately 29.2% of Washington Borough has impervious cover. This level of impervious cover suggests that the streams in Washington Borough are likely non-supporting streams.[1]

Methodology

Washington Borough contains portions of two 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

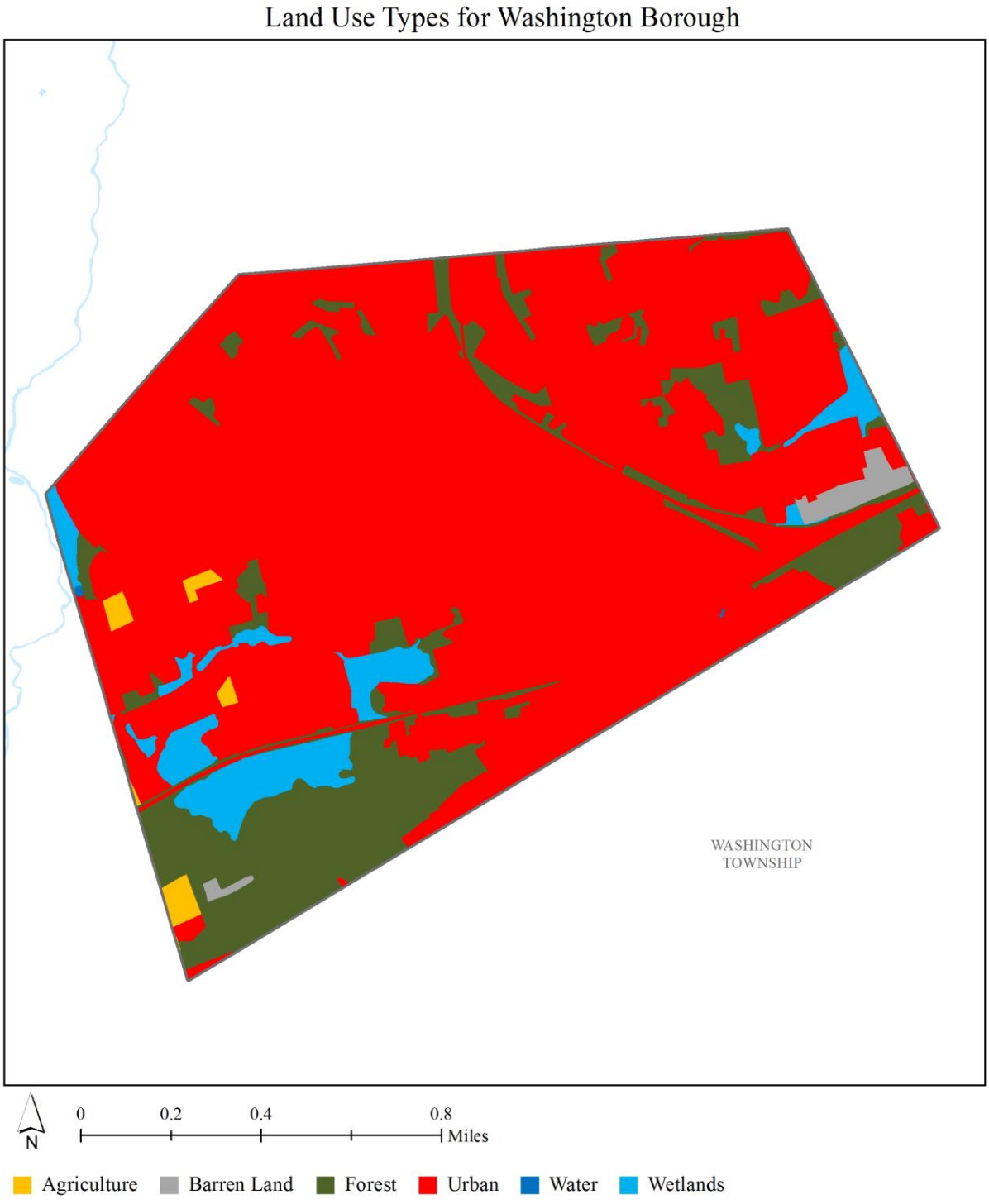


Figure 1: Map illustrating the land use in Washington Borough

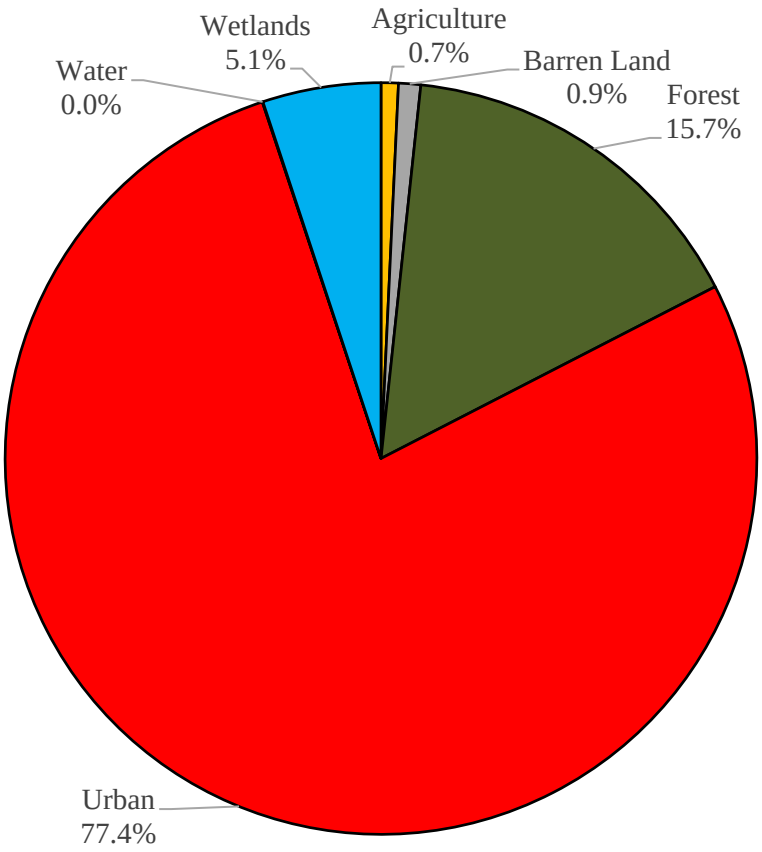


Figure 2: Pie chart illustrating the land use in Washington Borough

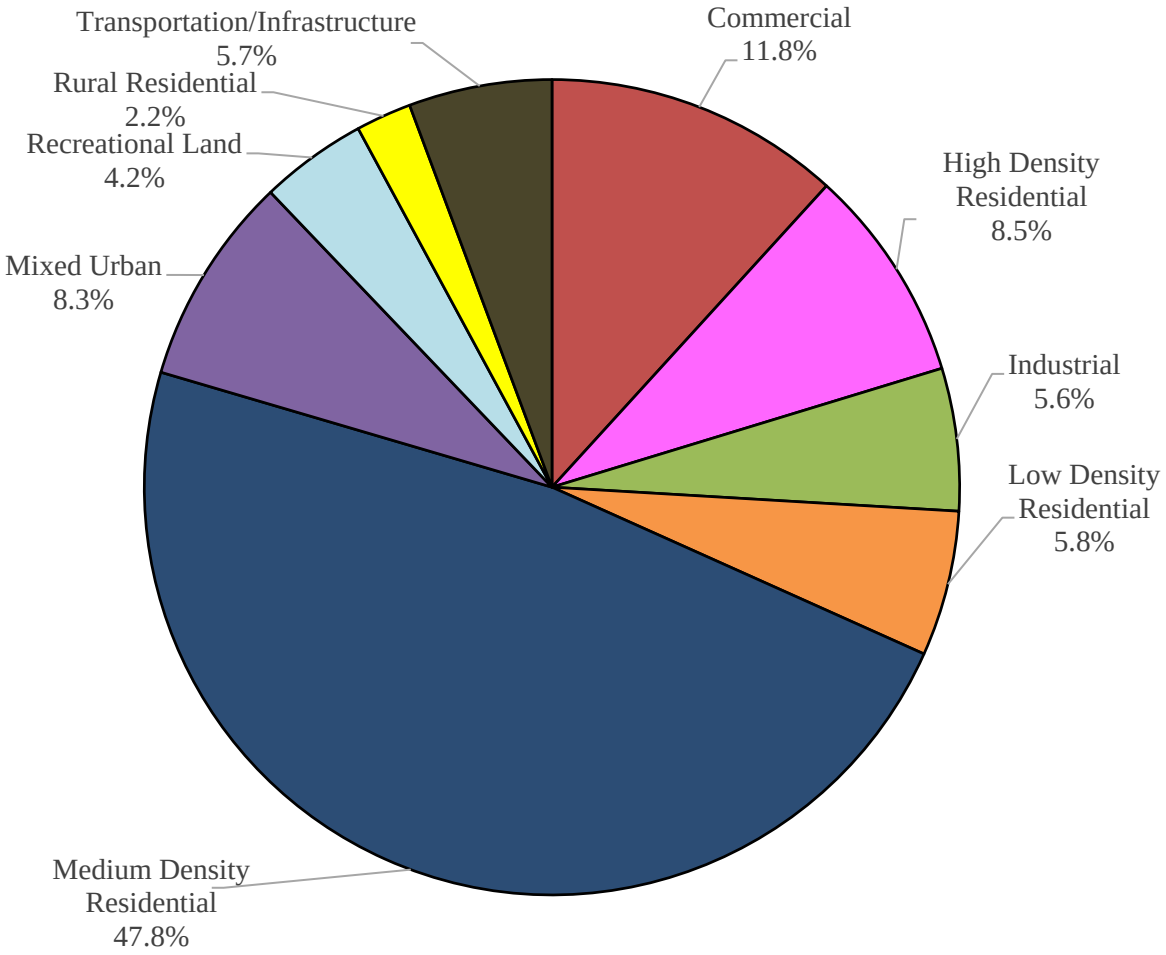


Figure 3: Pie chart illustrating the various types of urban land use in Washington Borough

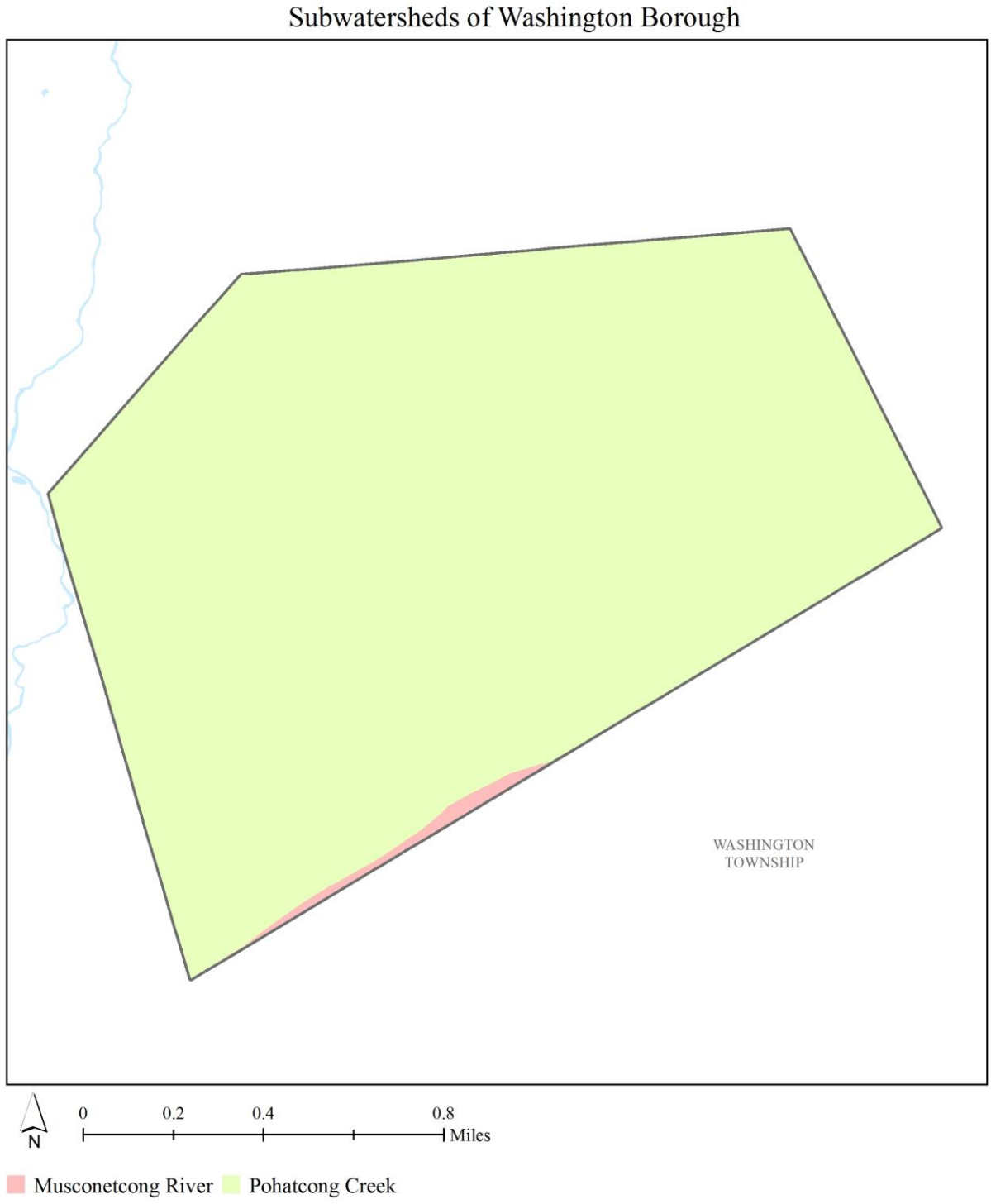


Figure 4: Map of the subwatersheds in Washington Borough

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 2012 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 Washington 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 Washington 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

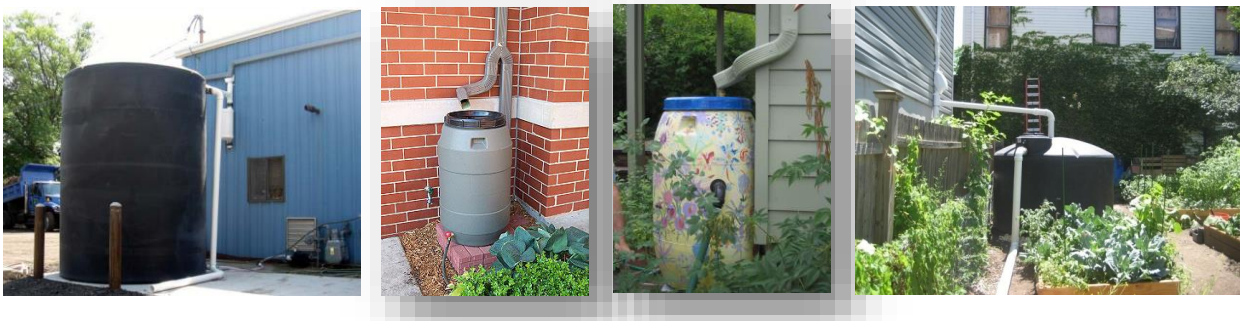
These are landscaped features that are designed to capture, treat, and infiltrate stormwater runoff. These systems can easily be incorporated into existing landscapes, improving aesthetics and creating wildlife habitat while managing stormwater runoff. Bioretention systems also can be used in soils that 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*.

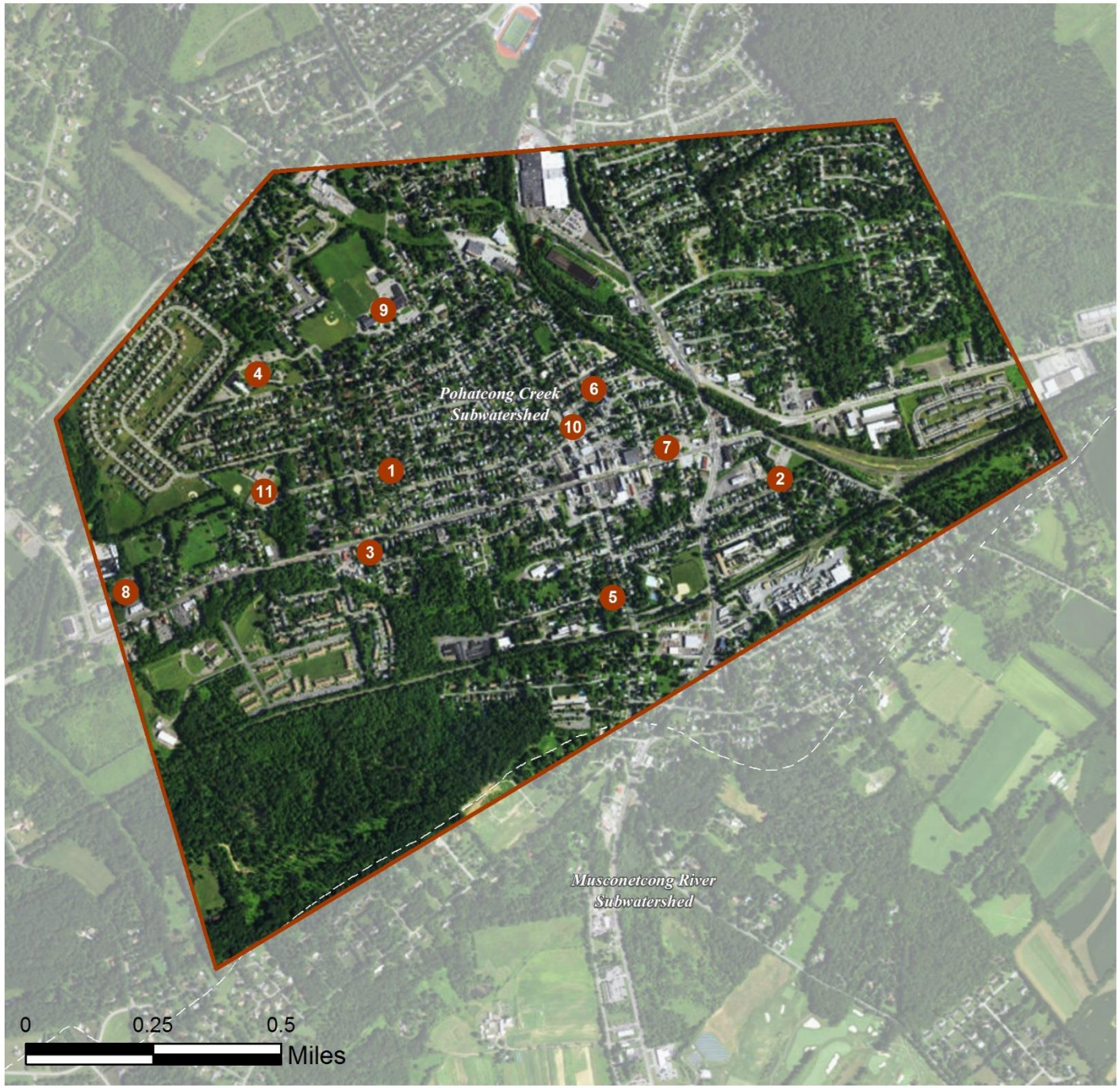
Conclusion

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. Green Infrastructure Sites

WASHINGTON BOROUGH: GREEN INFRASTRUCTURE SITES



SITES WITHIN THE POHATCONG RIVER SUBWATERSHED:

1. Church of Christ
2. Jewish Center of Northwest Jersey
3. Muheisen Bakery
4. St. Joseph Catholic Church
5. St. Peter's Episcopal Church
6. Taylor Street Elementary School
7. United Methodist Church
8. Warren County Convention and Visitors Bureau
9. Warren Hills Middle School
10. Washington Borough Fire Department
11. Washington Memorial Elementary School

b. Proposed Green Infrastructure Concepts

CHURCH OF CHRIST

Subwatershed: Pohatcong Creek

Site Area: 8,901 sq. ft.

Address: 27 Grand Avenue
Washington, NJ 07882

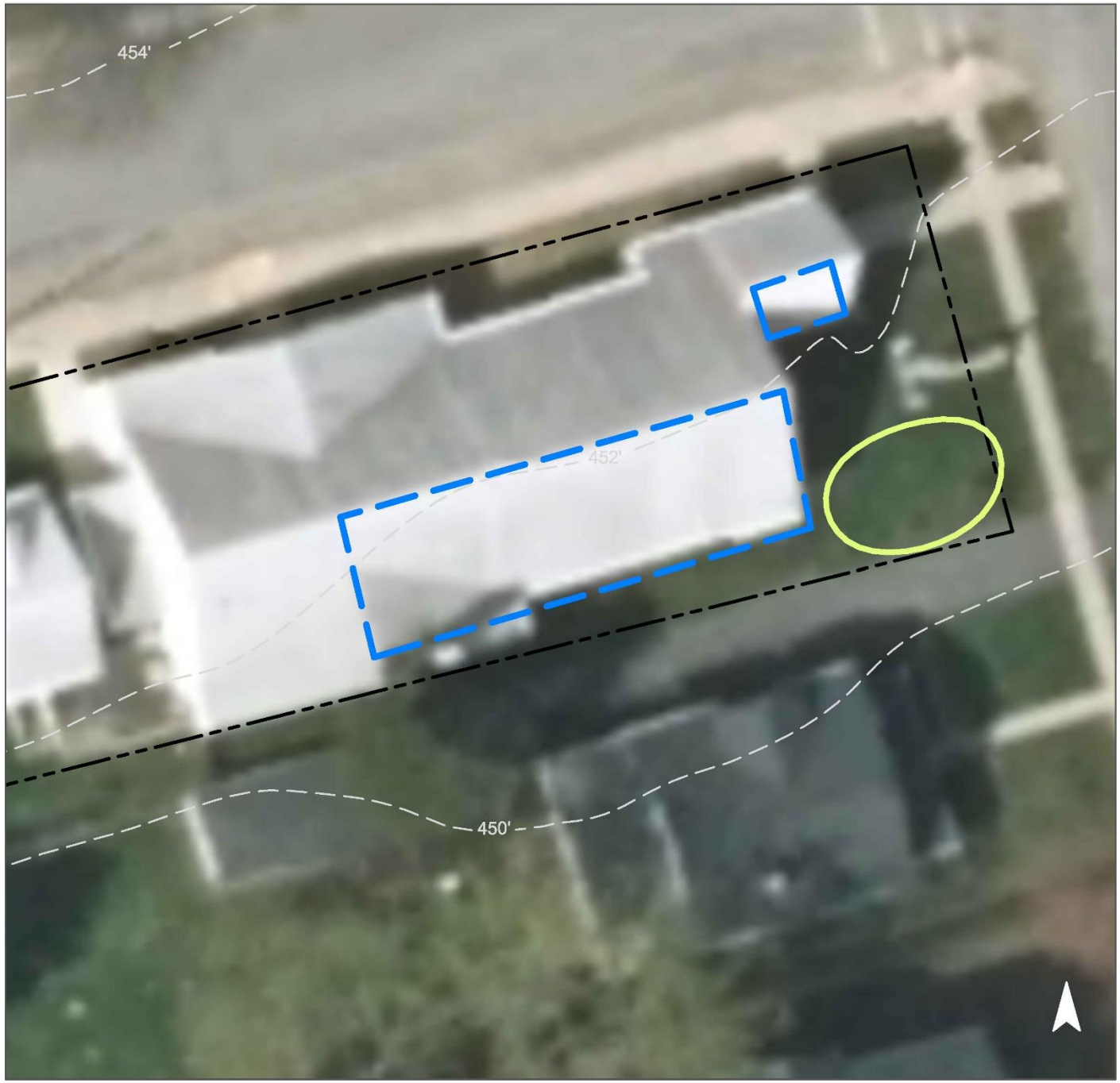
Block and Lot: Block 9.02, Lot 1,1.01

Existing downspouts from the roof can be disconnected and rerouted to a rain garden near the front of the church, which will capture, treat, and infiltrate roof 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"
35	3,115	0.2	1.6	14.3	0.002	0.09

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 system	0.031	5	2,266	0.09	300	$1,500

GREEN INFRASTRUCTURE RECOMMENDATIONS



Church of Christ

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

0 10' 20'

JEWISH CENTER OF NORTHWEST JERSEY

Subwatershed: Pohatcong Creek

Site Area: 13,721 sq. ft.

Address: 115 Youmans Avenue
Washington, NJ 07882

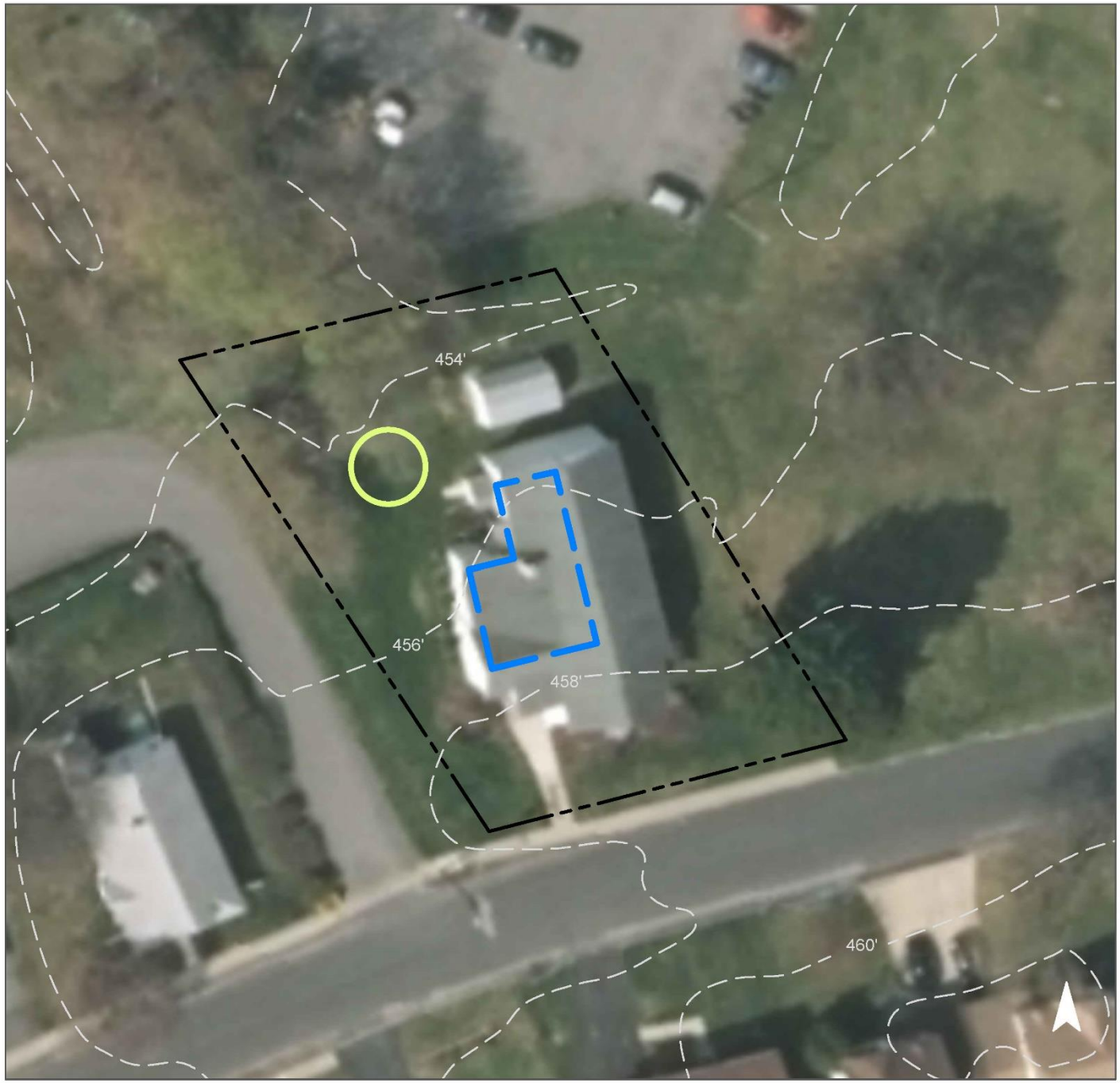
Block and Lot: Block 80, Lot 14

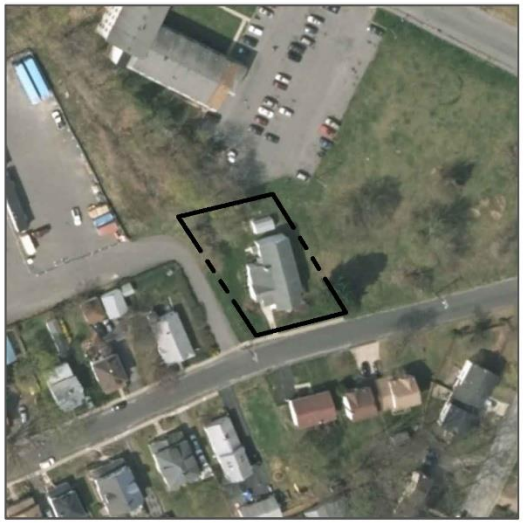
A rain garden adjacent to the building in the northwest corner can capture, treat, and infiltrate roof runoff. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

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"
32	4,414	0.2	2.2	20.3	0.003	0.12

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 system	0.028	5	2,035	0.08	275	$1,375

GREEN INFRASTRUCTURE RECOMMENDATIONS





Jewish Center of Northwest Jersey

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

0 20' 40'

MUHEISEN BAKERY

Subwatershed: Pohatcong Creek
Site Area: 27,314 sq. ft.
Address: 217 West Washington Avenue
Washington, NJ 07882

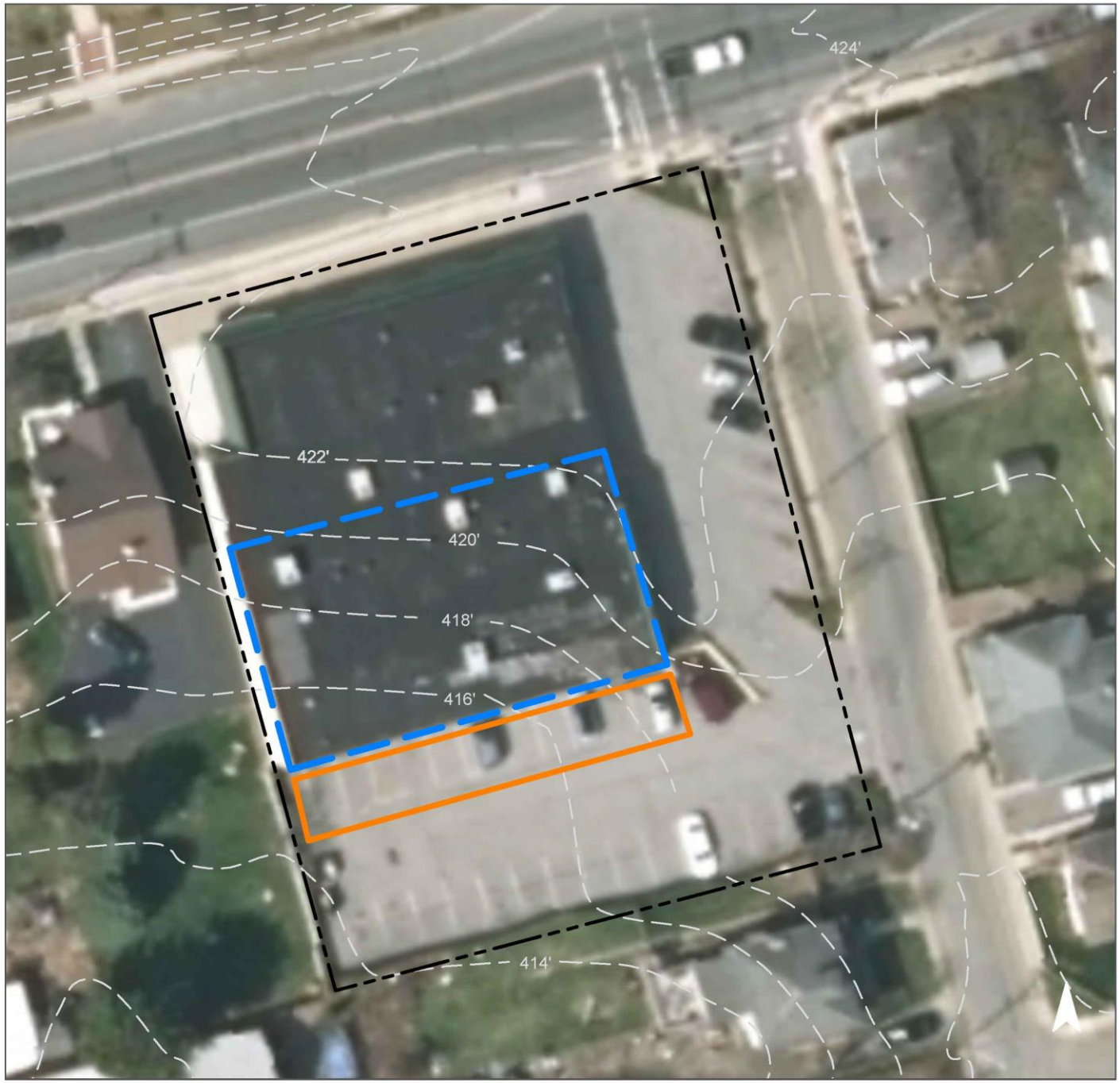
Block and Lot: Block 101, Lot 18

Parking spaces adjacent to the building can be replaced with porous asphalt to intercept stormwater runoff from the roof. 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"
79	21,650	1.0	10.9	99.4	0.017	0.59

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
Pervious pavement	0.157	26	11,527	0.43	1,700	$42,500

GREEN INFRASTRUCTURE RECOMMENDATIONS



Muheisen Bakery

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

0 20' 40'

ST. JOSEPH CATHOLIC CHURCH

Subwatershed: Pohatcong Creek

Site Area: 430,807 sq. ft.

Address: 200 Carlton Avenue
Washington, NJ 07882

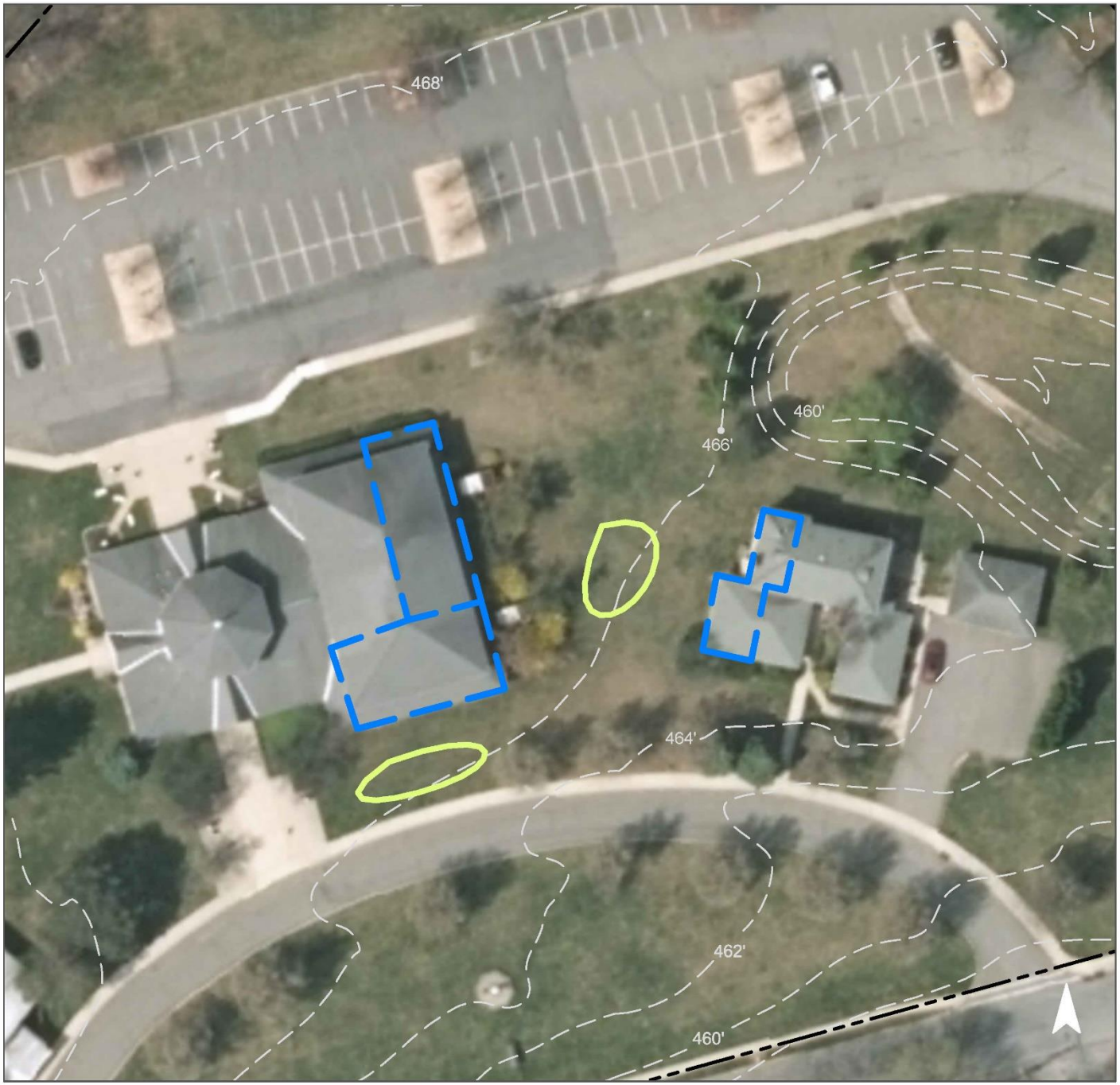
Block and Lot: Block 2.06, Lot 17

Downspouts originating from the roofs of the two buildings can be disconnected and rerouted to two rain gardens to capture, treat, and infiltrate roof 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"
47	200,346	9.7	101.2	919.9	0.156	5.49

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	0.144	24	10,547	0.40	1,385	$6,925

GREEN INFRASTRUCTURE RECOMMENDATIONS



St. Joseph Catholic Church

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

0 30' 60'

ST. PETER'S EPISCOPAL CHURCH

Subwatershed: Pohatcong Creek

Site Area: 27,058 sq. ft.

Address: 127 Broad Street
Washington, NJ 07882

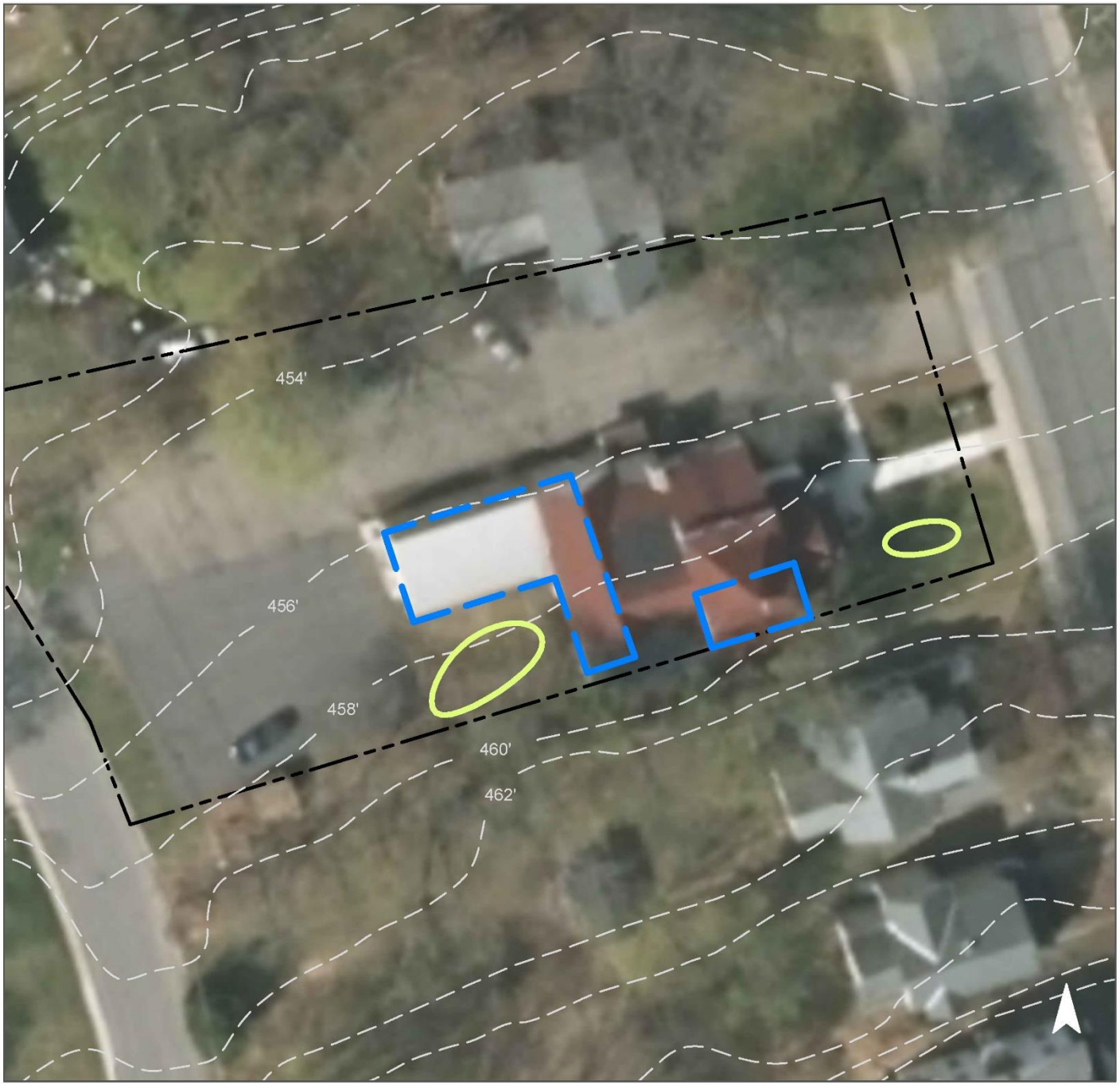
Block and Lot: Block 95.01, Lot 16

Rain gardens adjacent to the buildings can capture, treat, and infiltrate roof runoff. Existing downspouts on the western building can be disconnected and rerouted to the rain garden. The downspout on the eastern building is already disconnected. 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"
66	17,728	0.9	9.0	81.4	0.014	0.49

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	0.052	9	3,822	0.14	400	$2,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



St. Peter's Episcopal Church

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

0 20' 40'

TAYLOR STREET ELEMENTARY SCHOOL

Subwatershed: Pohatcong Creek

Site Area: 43,204 sq. ft.

Address: 16 Taylor Street # 24
Washington, NJ 07882

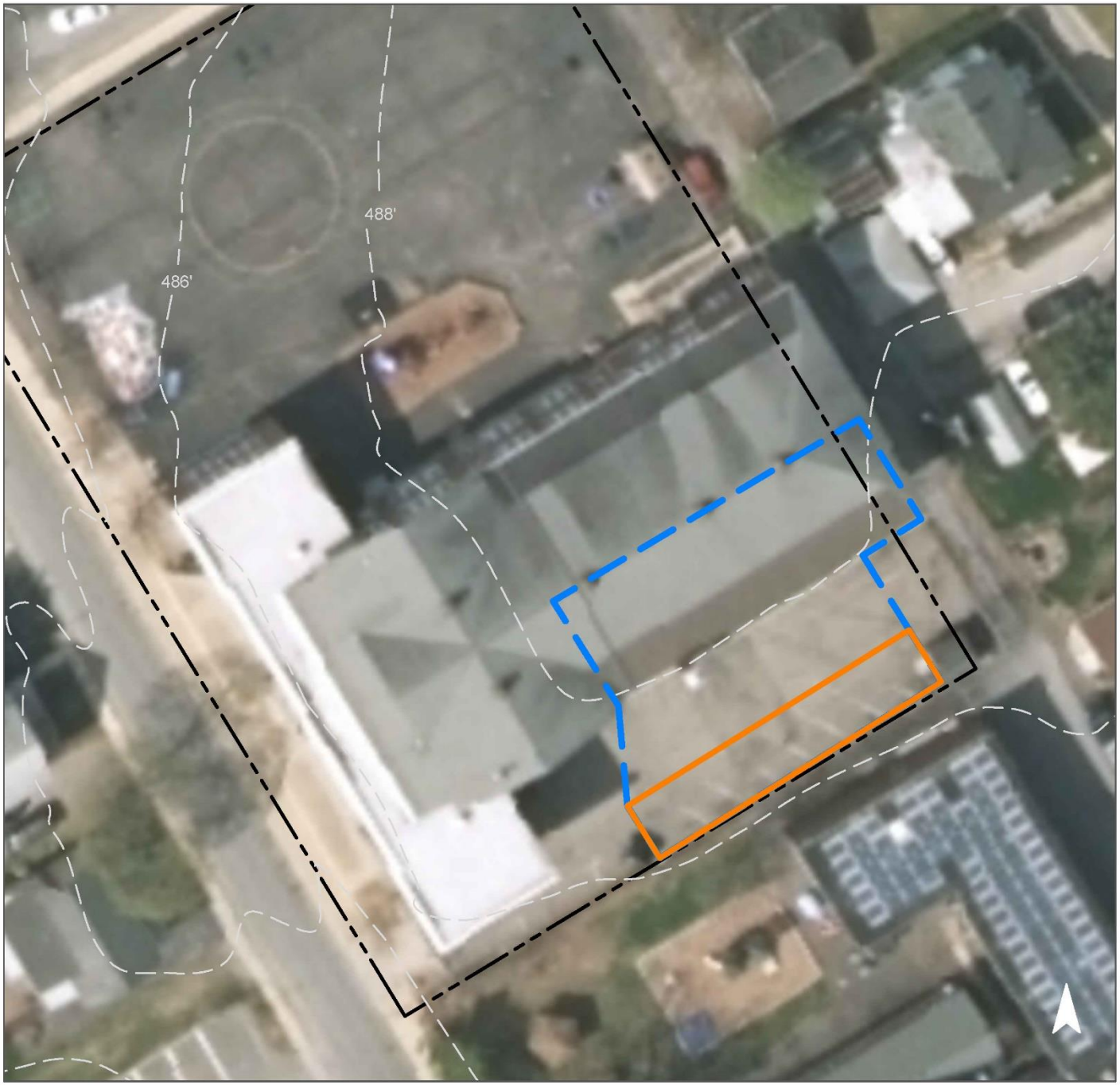
Block and Lot: Block 28, Lot 1, 2

Erosion is evident in the asphalt of the courtyard. The parking spaces can be replaced with porous pavement to capture, treat, and infiltrate roof and pavement 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"
95	41,044	2.0	20.7	188.4	0.032	1.13

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 pavement	0.162	27	11,886	0.45	1,400	$35,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Taylor Street Elementary School

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

0 20' 40'

UNITED METHODIST CHURCH

Subwatershed: Pohatcong Creek

Site Area: 51,669 sq. ft.

Address: 116 E Washington Avenue
Washington, NJ 07882

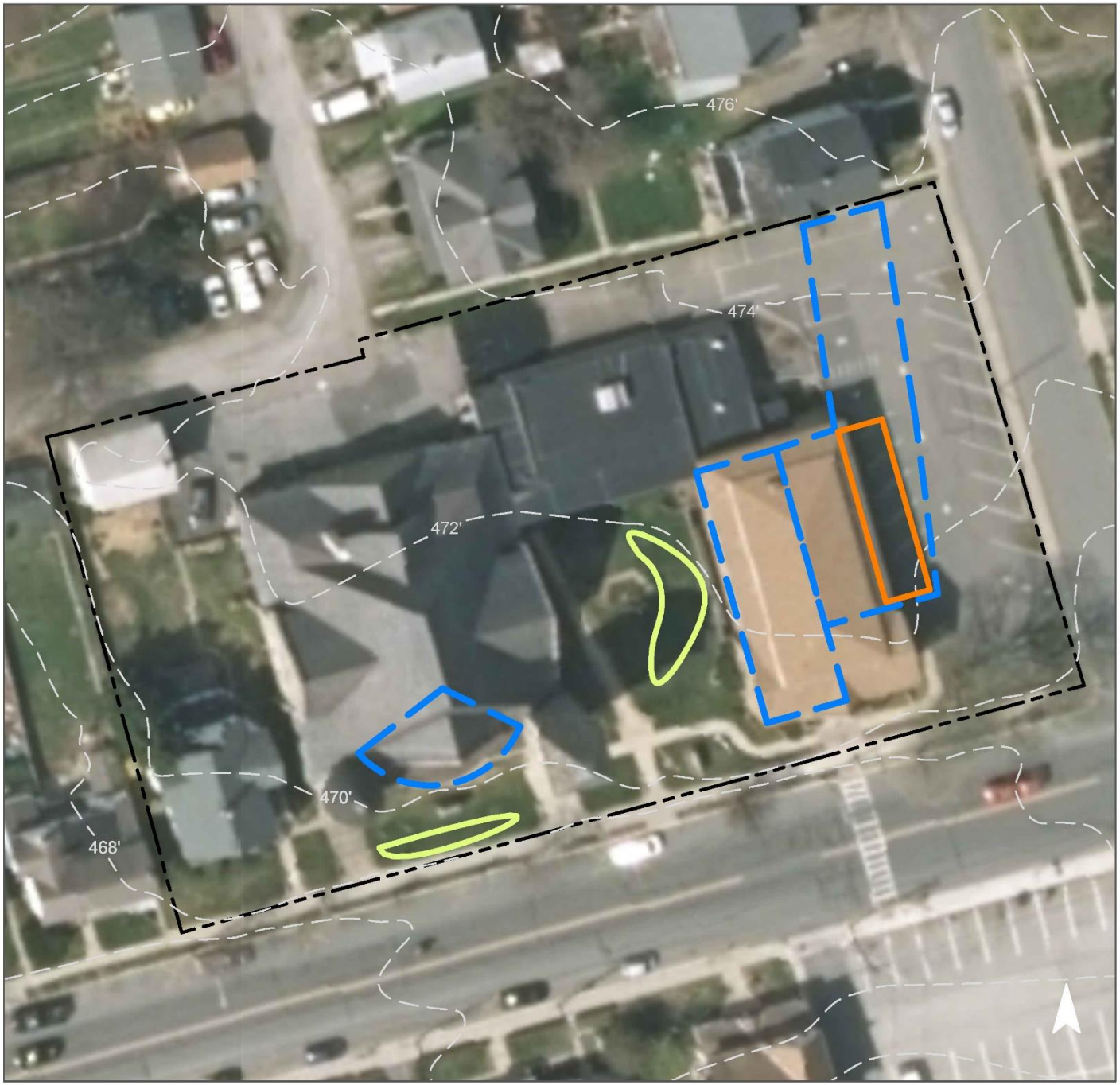
Block and Lot: Block 25.01, Lot 6

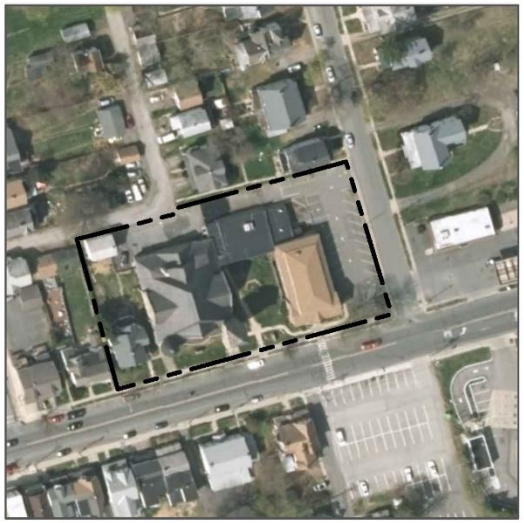
Rain gardens adjacent to the building can capture, treat, and infiltrate runoff from the roof when their respective downspouts are disconnected. A section of the parking lot along the property where flooding is an issue can be replaced with porous asphalt to capture runoff. A preliminary soil assessment 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"
85	44,014	2.1	22.2	202.1	0.034	1.21

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	0.086	14	6,306	0.24	825	$4,125
Pervious pavement	0.114	19	8,355	0.31	870	$21,750

GREEN INFRASTRUCTURE RECOMMENDATIONS





United Methodist Church

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

0 25' 50'

WARREN COUNTY CONVENTION AND VISITORS BUREAU

Subwatershed: Pohatcong Creek

Site Area: 115,594 sq. ft.

Address: 10 Brass Castle Road
Washington, NJ 07882

Block and Lot: Block 2.05,23, Lot 6,12.01

A rain garden installed in the northwest section of the property can capture, treat, and infiltrate roof runoff. A second rain garden in the center grass area can help to prevent erosion of the lawn. Parking spaces can be redone with porous pavement to intercept rainwater. 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"
39	44,775	2.2	22.6	205.6	0.035	1.23

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	0.071	12	5,236	0.20	685	$3,425
Pervious pavement	0.326	55	23,899	0.90	3,540	$88,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

Warren County Convention and Visitors Bureau

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

0 30' 60'

WARREN HILLS MIDDLE SCHOOL

Subwatershed: Pohatcong Creek

Site Area: 940,994 sq. ft.

Address: 64 Carlton Avenue
Washington, NJ 07882

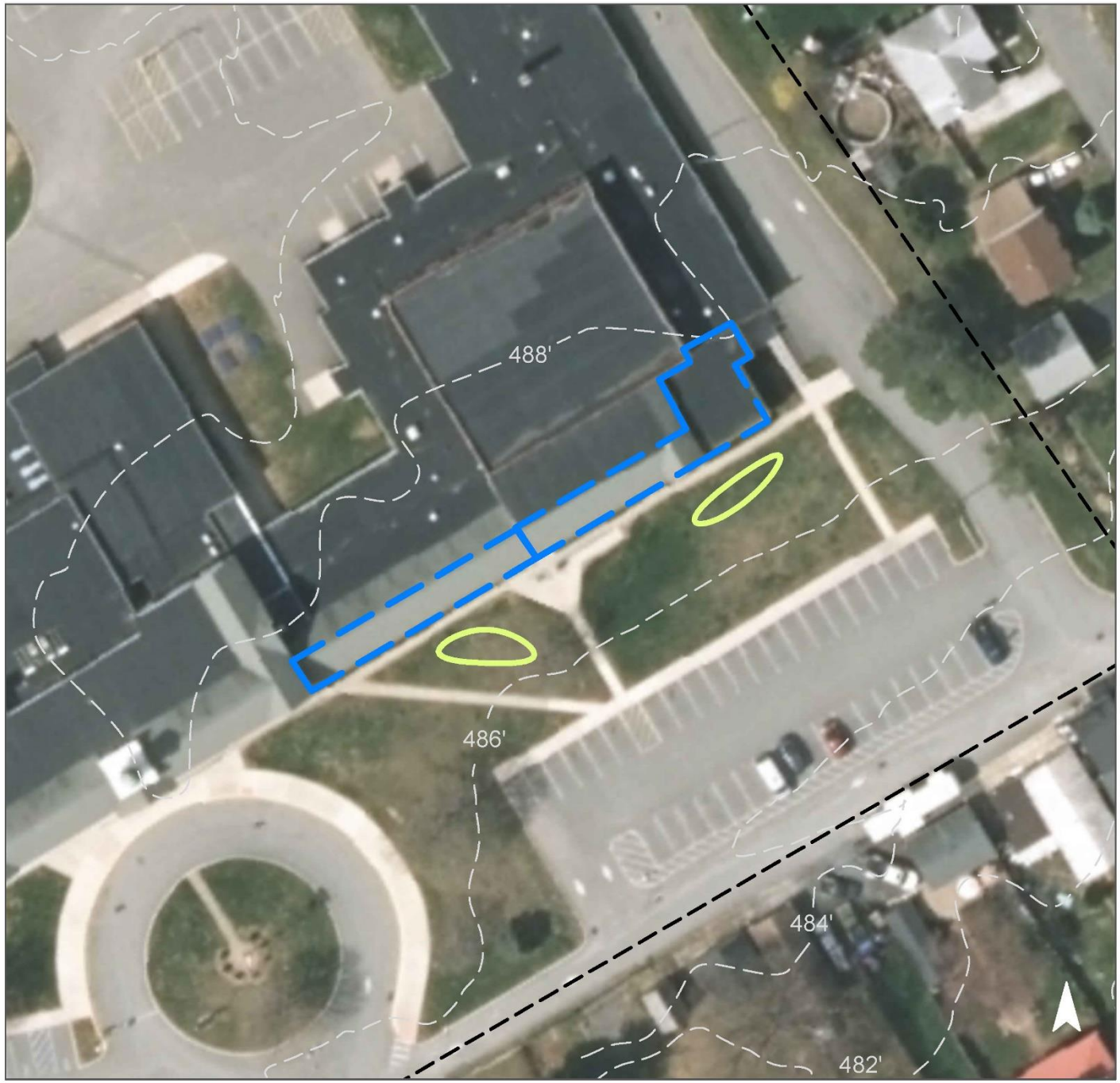
Block and Lot: Block 6, Lot 22

Multiple downspouts along the southern side of the building can be disconnected to redirect rainwater to two rain gardens. Rain gardens can be used to capture, treat, and infiltrate roof 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"
25	234,908	11.3	118.6	1,078.6	0.183	6.44

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	0.066	11	4,825	0.18	630	$3,150

GREEN INFRASTRUCTURE RECOMMENDATIONS



Warren Hills Middle School

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

0 30' 60'

WASHINGTON BOROUGH FIRE DEPARTMENT

Subwatershed: Pohatcong Creek

Site Area: 77,729 sq. ft.

Address: 100 Belvidere Avenue
Washington, NJ 07882

Block and Lot: Block 29, Lot 11,12

Rainwater harvesting systems such as cisterns can collect rainfall from rooftops and be repurposed for washing vehicles. Parking spaces along the parking lot edge can be replaced with porous pavement to capture, treat, and infiltrate rainwater. 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"
94	73,141	3.5	36.9	335.8	0.057	2.01

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 pavement	0.263	44	19,306	0.73	2,080	$52,000
Rainwater harvesting	0.078	13	5,737	0.22	6,000 (gal)	$12,000

GREEN INFRASTRUCTURE RECOMMENDATIONS

Washington Borough Fire Department

- pervious pavement
- rainwater harvesting
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 30' 60'

WASHINGTON MEMORIAL ELEMENTARY SCHOOL

Subwatershed: Pohatcong Creek

Site Area: 427,792 sq. ft.

Address: 300 W Stewart Street
Washington, NJ 07882

Block and Lot: Block 2.03, Lot 1

Rain gardens adjacent to the building can capture, treat, and infiltrate roof runoff. A water harvesting system such as a cistern can collect rainfall from rooftops as well and be put to other uses. The basketball court can be replaced with porous pavement to intercept and infiltrate rainwater from the rooftop as well as its surface. 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"
30	129,350	6.2	65.3	593.9	0.101	3.55

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	0.397	67	29,157	1.10	3,800	$19,000
Pervious pavement	0.168	28	12,335	0.46	2,630	$65,750
Rainwater harvesting	0.009	2	666	0.03	700 (gal)	$1,400

GREEN INFRASTRUCTURE RECOMMENDATIONS

Washington Memorial Elementary School

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

0 35' 70'

c. 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)
POHATCONG CREEK SUBWATERSHED	**49.70**	**2,164,783**			**39.3**	**411.4**	**3,739.6**		**18.70**	**814,485**	**0.635**	**22.34**
Church of Christ												
Total Site Info	0.20	8,901	9.02	1,1.01	0.2	1.6	14.3	35	0.07	3,115	0.002	0.09
Jewish Center of Northwest Jersey												
Total Site Info	0.31	13,721	80	14	0.2	2.2	20.3	32	0.10	4,414	0.003	0.12
Muheisen Bakery												
Total Site Info	0.63	27,314	101	18	1.0	10.9	99.4	79	0.50	21,650	0.017	0.59
St. Joseph Catholic Church												
Total Site Info	9.89	430,807	2.06	17	9.7	101.2	919.9	47	4.60	200,346	0.156	5.49
St. Peter's Episcopal Church												
Total Site Info	0.62	27,058	95.01	16	0.9	9.0	81.4	66	0.41	17,728	0.014	0.49
Taylor Street Elementary School												
Total Site Info	0.99	43,204	28	1,2	2.0	20.7	188.4	95	0.94	41,044	0.032	1.13
United Methodist Church												
Total Site Info	1.19	51,669	25.01	6	2.1	22.2	202.1	85	1.01	44,014	0.034	1.21
Warren County Convention and Visitors Bureau												
Total Site Info	2.65	115,594	2.05;23	6;12.01	2.2	22.6	205.6	39	1.03	44,775	0.035	1.23
Warren Hills Middle School												
Total Site Info	21.60	940,994	6	22	11.3	118.6	1,078.6	25	5.39	234,908	0.183	6.44
Washington Borough Fire Department												
Total Site Info	1.78	77,729	29	11,12	3.5	36.9	335.8	94	1.68	73,141	0.057	2.01
Washington Memorial Elementary School												
Total Site Info	9.82	427,792	2.03	1	6.2	65.3	593.9	30	2.97	129,350	0.101	3.55

d. Summary of Proposed Green Infrastructure Practices

Summary of Proposed Green Infrastructure Practices

	Subwatershed/Site Name/Total Site Info/GI Practice	Potential Management Area		Recharge Potential	TSS Removal Potential	Max Volume Reduction Potential	Peak Discharge Reduction Potential	Size of BMP	Unit Cost	Unit	Total Cost	I.C. Treated
		Area (SF)	Area (ac)	(Mgal/yr)	(lbs/yr)	(gal/storm)	(cfs)	(SF)	($)		($)	%
	POHATCONG CREEK SUBWATERSHED	**78,225**	**1.80**	**2.038**	**341**	**82,901**	**5.96**	**20,350**			**$338,650**	**3.6%**
1	**Church of Christ**											
	Bioretention system	1,185	0.03	0.031	5	2,266	0.09	300	5	SF	$1,500	38.0%
	Total Site Info	**1,185**	**0.03**	**0.031**	**5**	**2,266**	**0.09**	**300**			**$1,500**	**38.0%**
2	**Jewish Center of Northwest Jersey**											
	Bioretention system	1,065	0.02	0.028	5	2,035	0.08	275	5	SF	$1,375	24.1%
	Total Site Info	**1,065**	**0.02**	**0.028**	**5**	**2,035**	**0.08**	**275**			**$1,375**	**24.1%**
3	**Muheisen Bakery**											
	Pervious pavement	6,030	0.14	0.157	26	11,527	0.43	1,700	25	SF	$42,500	27.9%
	Total Site Info	**6,030**	**0.14**	**0.157**	**26**	**11,527**	**0.43**	**1,700**			**$42,500**	**27.9%**
4	**St. Joseph Catholic Church**											
	Bioretention systems	5,515	0.13	0.144	24	10,547	0.40	1,385	5	SF	$6,925	2.8%
	Total Site Info	**5,515**	**0.13**	**0.144**	**24**	**10,547**	**0.40**	**1,385**			**$6,925**	**2.8%**
5	**St. Peter's Episcopal Church**											
	Bioretention systems	2,000	0.05	0.052	9	3,822	0.14	400	5	SF	$2,000	11.3%
	Total Site Info	**2,000**	**0.05**	**0.052**	**9**	**3,822**	**0.14**	**400**			**$2,000**	**11.3%**
6	**Taylor Street Elementary School**											
	Pervious pavement	6,215	0.14	0.162	27	11,886	0.45	1,400	25	SF	$35,000	15.1%
	Total Site Info	**6,215**	**0.14**	**0.162**	**27**	**11,886**	**0.45**	**1,400**			**$35,000**	**15.1%**
7	**United Methodist Church**											
	Bioretention systems	3,300	0.08	0.086	14	6,306	0.24	825	5	SF	$4,125	7.5%
	Pervious pavement	4,370	0.10	0.114	19	8,355	0.31	870	25	SF	$21,750	9.9%
	Total Site Info	**3,300**	**0.08**	**0.086**	**14**	**14,661**	**0.55**	**825**			**$4,125**	**7.5%**
8	**Warren County Convention and Visitors Bureau**											
	Bioretention systems	2,740	0.06	0.071	12	5,236	0.20	685	5	SF	$3,425	6.1%
	Pervious pavement	12,500	0.29	0.326	55	23,899	0.90	3,540	25	SF	$88,500	27.9%
	Total Site Info	**15,240**	**0.35**	**0.397**	**66**	**29,135**	**1.10**	**4,225**			**$91,925**	**34.0%**

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 %
9	**Warren Hills Middle School**											
	Bioretention systems	2,525	0.06	0.066	11	4,825	0.18	630	5	SF	$3,150	1.1%
	Total Site Info	**2,525**	**0.06**	**0.066**	**11**	**4,825**	**0.18**	**630**			**$3,150**	**1.1%**
10	**Washington Borough Fire Department**											
	Pervious pavement	10,100	0.23	0.263	44	19,306	0.73	2,080	25	SF	$52,000	13.8%
	Rainwater harvesting	3,000	0.07	0.078	13	5,737	0.22	6,000	2	gal	$12,000	4.1%
	Total Site Info	**13,100**	**0.30**	**0.341**	**57**	**25,043**	**0.95**	**2,080**			**$64,000**	**17.9%**
11	**Washington Memorial Elementary School**											
	Bioretention systems	15,250	0.35	0.397	67	29,157	1.10	3,800	5	SF	$19,000	11.8%
	Pervious pavement	6,450	0.15	0.168	28	12,335	0.46	2,630	25	SF	$65,750	5.0%
	Rainwater harvesting	350	0.01	0.009	2	666	0.03	700	2	gal	$1,400	0.3%
	Total Site Info	**22,050**	**0.51**	**0.575**	**96**	**42,157**	**1.59**	**7,130**			**$86,150**	**17.0%**