RUTGERS
New Jersey Agricultural
Experiment Station

Impervious Cover Reduction Action Plan
for
Hackettstown, Warren County, New Jersey

Prepared for Hackettstown by the
Rutgers Cooperative Extension Water Resources Program

August 10, 2016

WILLIAM PENN
FOUNDATION

Table of Contents

Introduction

Located in Warren County in northern New Jersey, Hackettstown covers approximately 3.71 square miles. Figures 1 and 2 illustrate that Hackettstown is dominated by urban land uses. A total of 64.8% of the municipality's land use is classified as urban. Of the urban land in Hackettstown, 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 Hackettstown 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 Hackettstown. Based upon the 2012 NJDEP land use/land cover data, approximately 26.5% of Hackettstown has impervious cover. This level of impervious cover suggests that the streams in Hackettstown are likely non-supporting streams. [1]

Methodology

Hackettstown contains portions of one subwatershed (Figure 4). For this impervious cover reduction action plan, projects have been identified in this subwatershed. 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

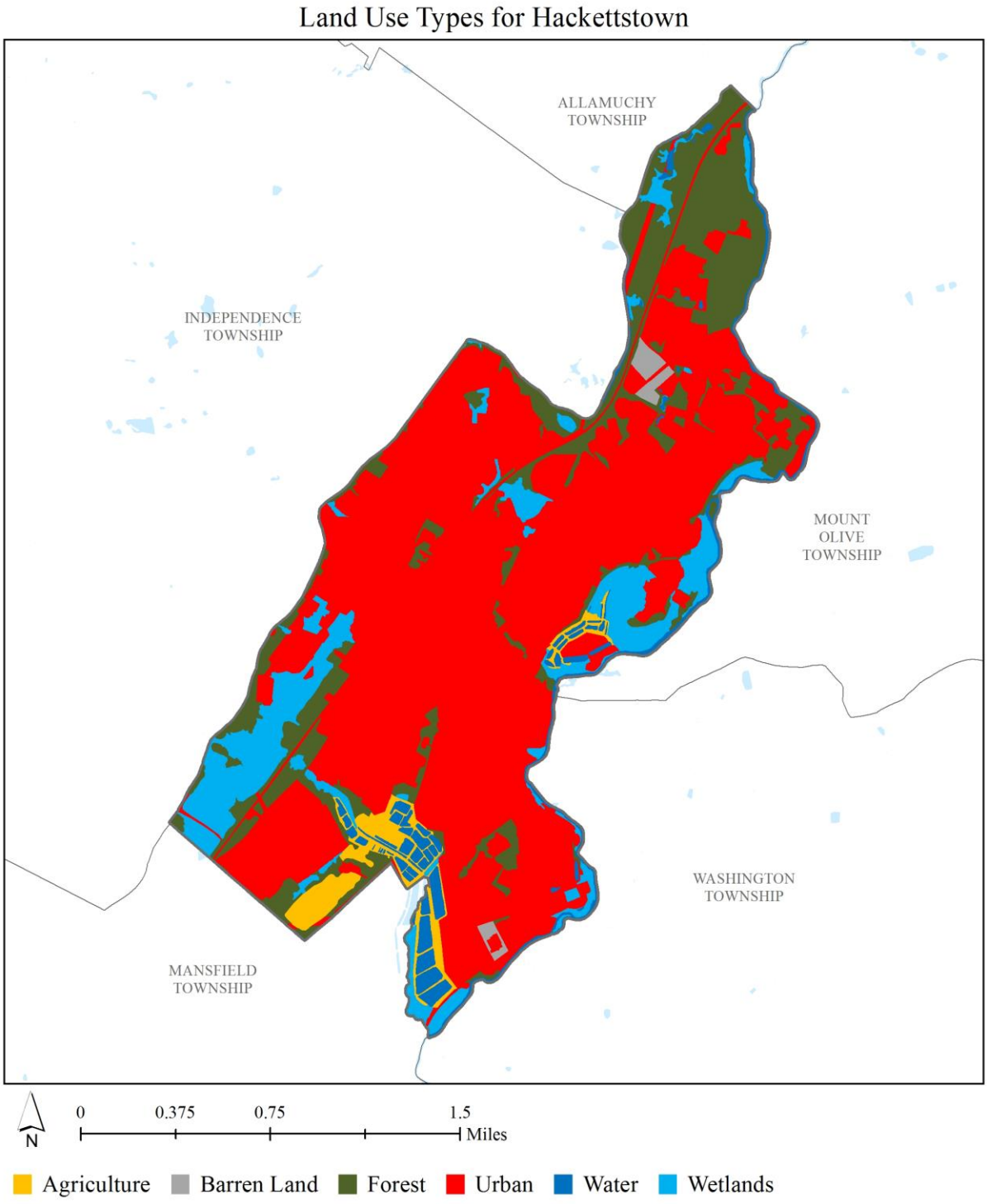


Figure 1: Map illustrating the land use in Hackettstown

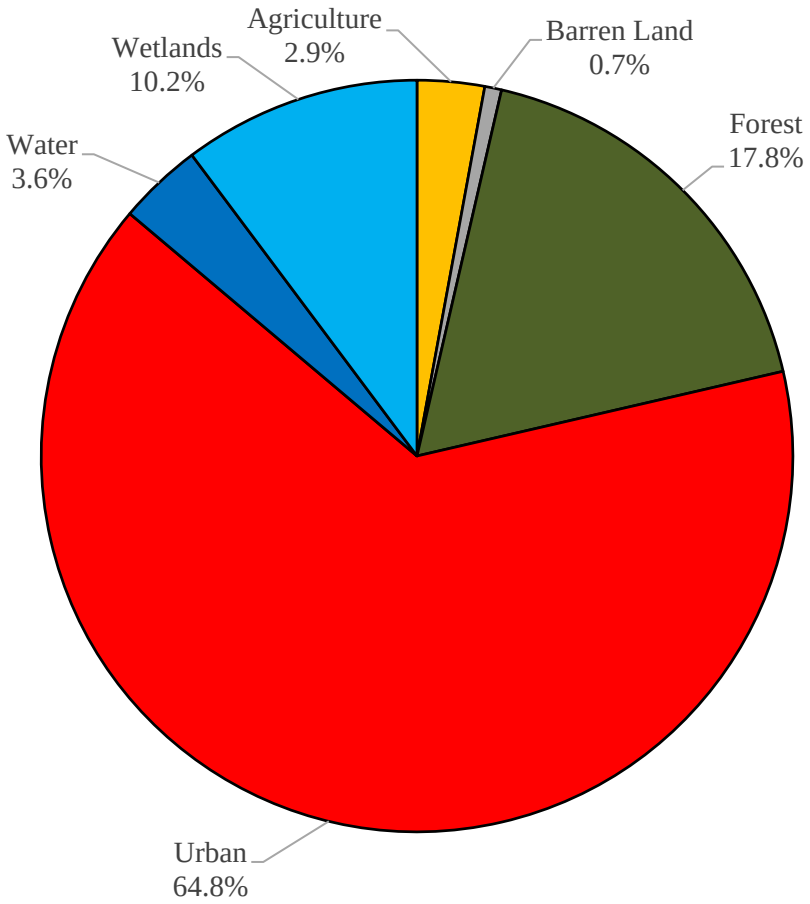


Figure 2: Pie chart illustrating the land use in Hackettstown

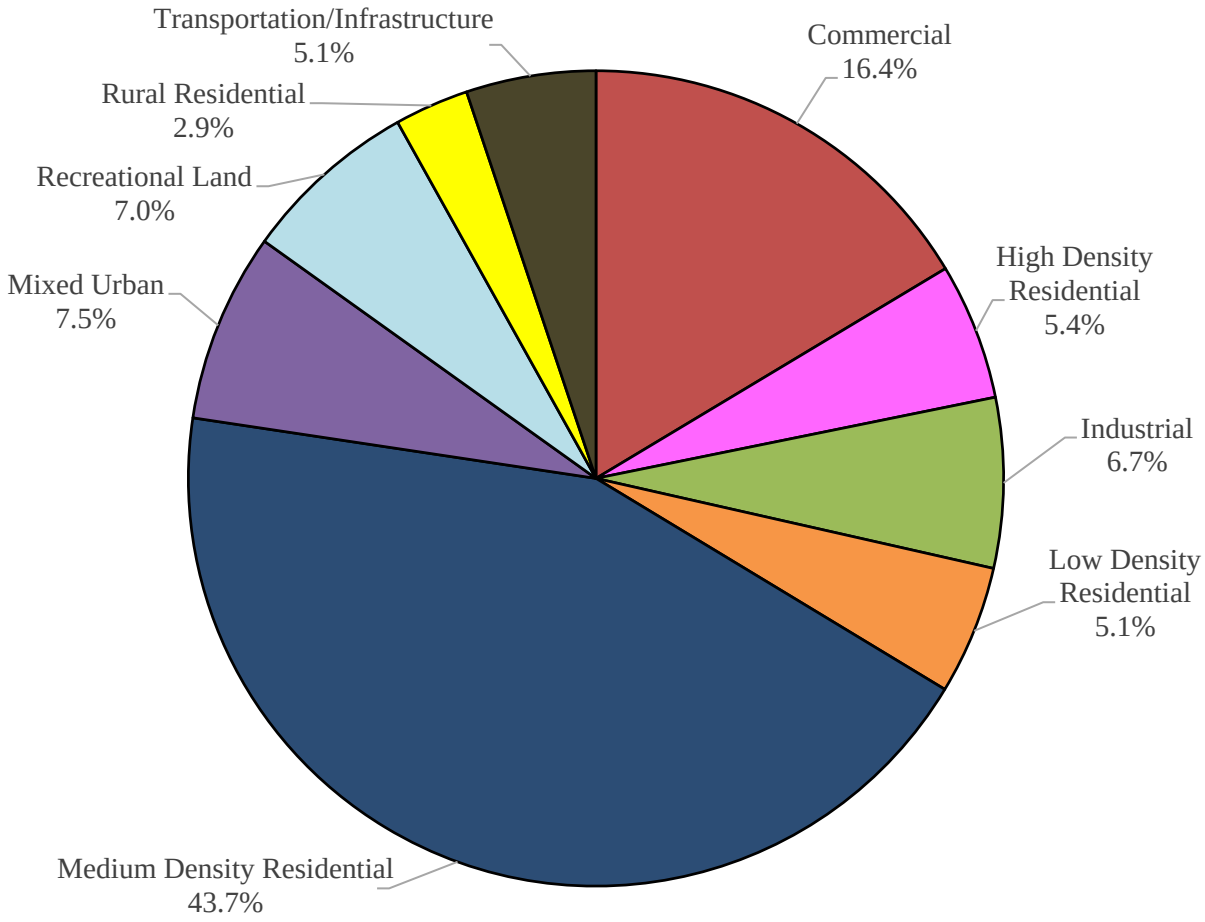


Figure 3: Pie chart illustrating the various types of urban land use in Hackettstown

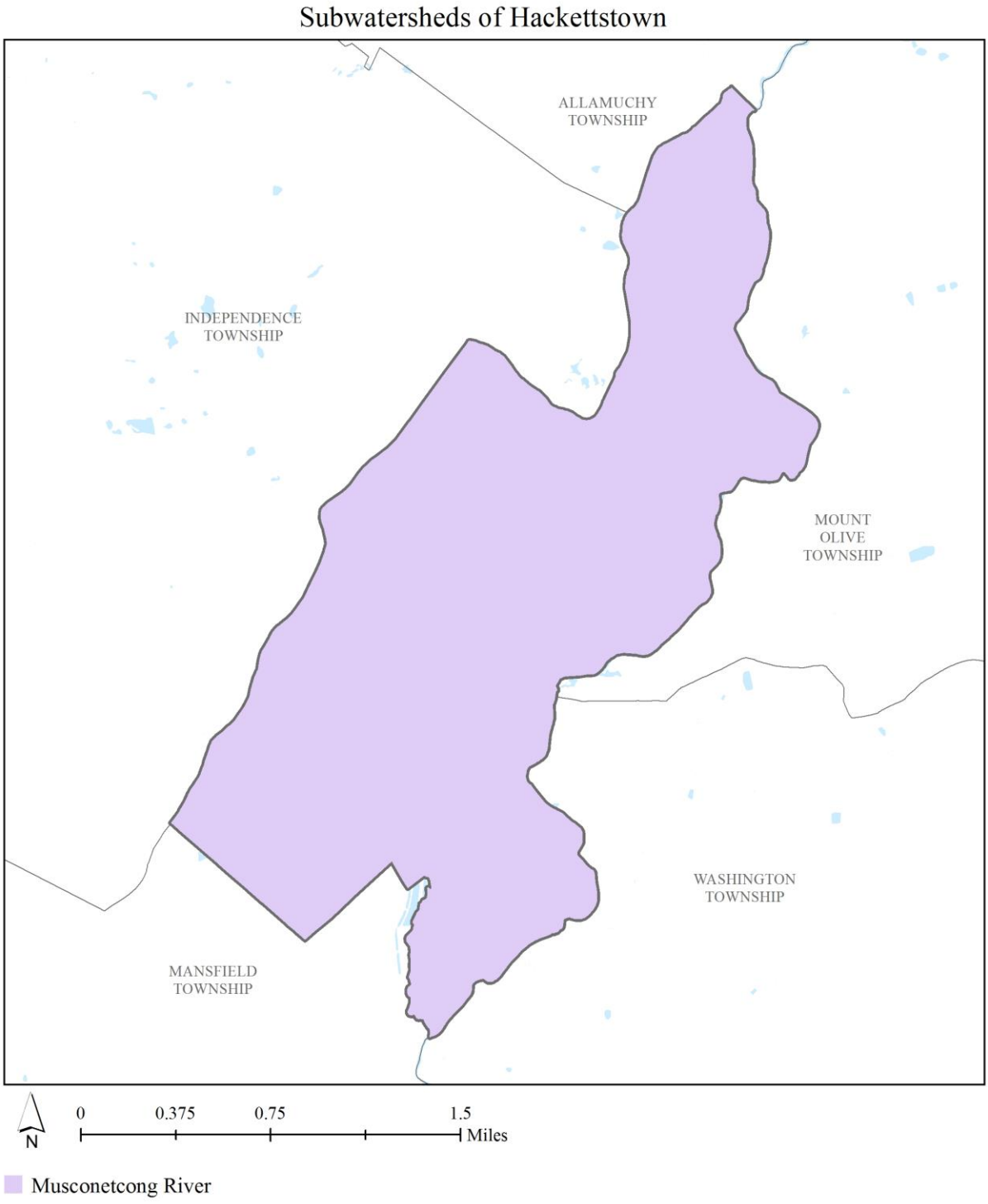


Figure 4: Map of the subwatersheds in Hackettstown

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 Hackettstown 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 Hackettstown. 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 practices 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*.

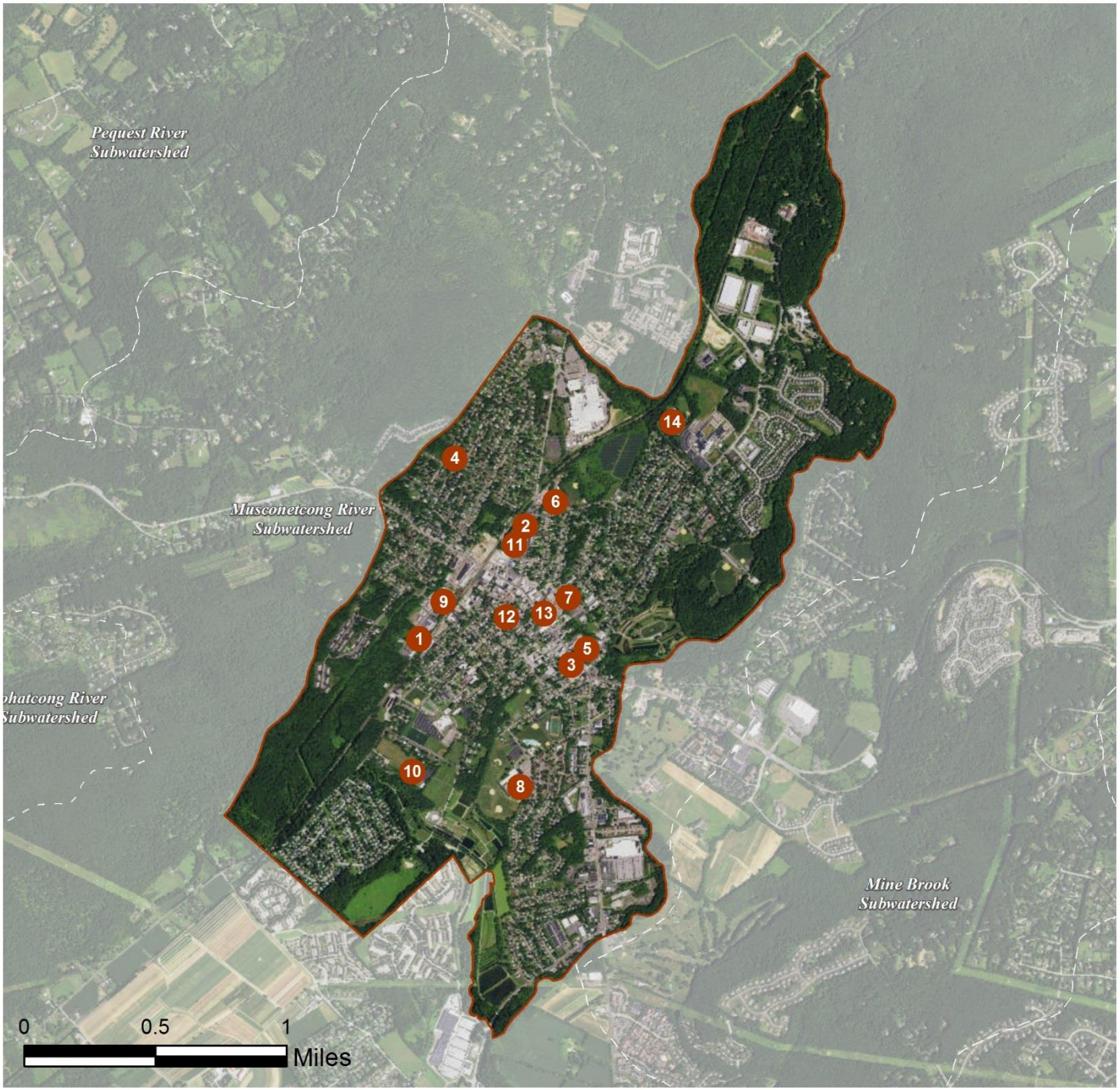
Conclusion

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

HACKETTSTOWN: GREEN INFRASTRUCTURE SITES



SITES WITHIN THE MUSCONETCONG RIVER SUBWATERSHED:

1. All Play Indoor Playground
2. Church of the Assumption
3. First Presbyterian Church
4. Gethsemane Lutheran Church
5. Hackettstown Community Center
6. Hackettstown Fire Department
7. Hackettstown First Aid and Rescue Headquarters
8. Hackettstown High School
9. Hackettstown Municipal Building
10. Hatchery Hill Elementary School
11. Knights of Columbus
12. Saint James Episcopal Church
13. Trinity United Methodist Church
14. Willow Grove Elementary School

b. Proposed Green Infrastructure Concepts

ALL PLAY INDOOR PLAYGROUND

Subwatershed: **Musconetcong River**

Site Area: **451,618 sq. ft.**

Address: **308 West Stiger Street**
Hackettstown, NJ 07840

Block and Lot: **Block 41, Lot 23**

A rain garden can be installed at the western corner of the parking lot to collect stormwater from the roof and prevent it from draining directly into local waterways. 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. Pervious pavement can also be utilized in the parking spaces to capture additional runoff in the northern lot area. 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	144,722	7.0	73.1	664.5	0.113	3.97

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 system	0.076	13	5,580	0.21	730	$3,650
Pervious pavement	0.527	88	38,634	1.45	3,890	$97,250

GREEN INFRASTRUCTURE RECOMMENDATIONS

All Play Indoor Playground

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

0 50' 100'

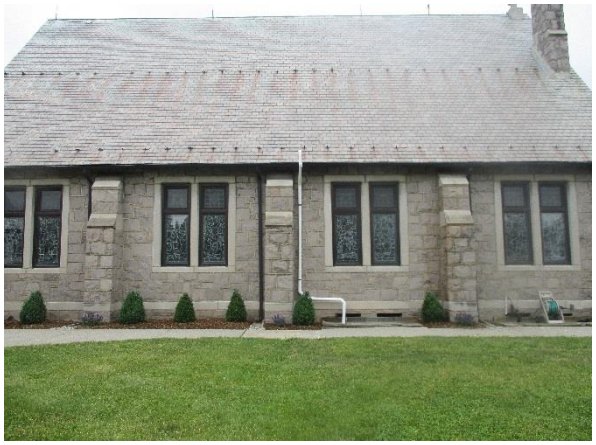
CHURCH OF THE ASSUMPTION

Subwatershed: **Musconetcong River**

Site Area: **65,023 sq. ft.**

Address: **302 High Street**
Hackettstown, NJ 07840

Block and Lot: **Block 50, Lot 4**

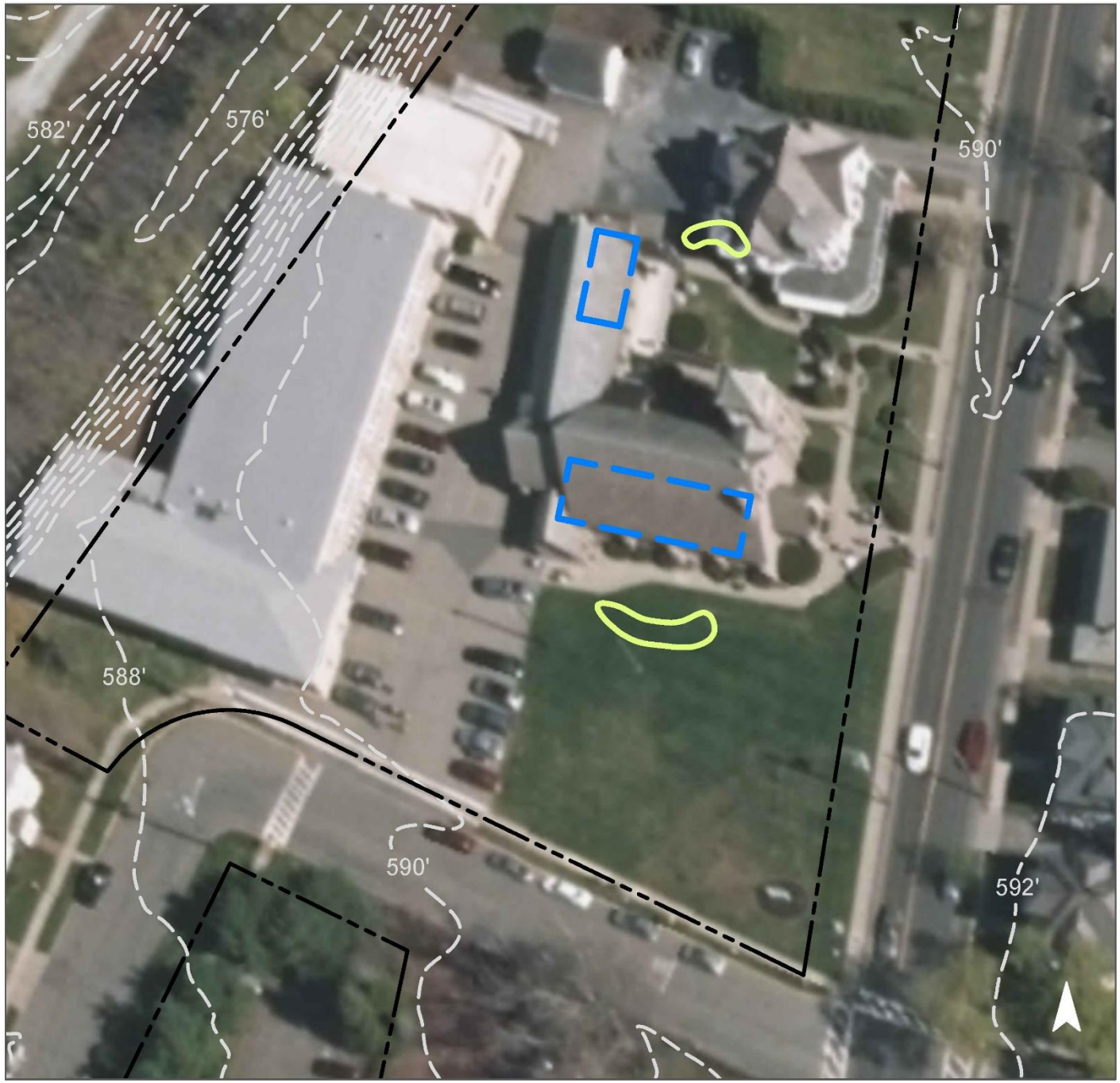


Two rain gardens can be installed along the north and south sides of the main church building to collect stormwater from the roof and prevent it from draining into local waterways. These are landscaped features that are designed to capture, treat, and infiltrate stormwater runoff. These systems can easily be incorporated into existing landscapes, improving aesthetics and creating wildlife habitat while managing stormwater runoff. 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"
65	42,265	2.0	21.3	194.1	0.033	1.16

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	3,059	0.11	400	$2,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Church of the Assumption

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

0 25' 50'

FIRST PRESBYTERIAN CHURCH

Subwatershed: **Musconetcong River**

Site Area: **66,233 sq. ft.**

Address: **298 Main Street**
Hackettstown, NJ 07840

Block and Lot: **Block 79, Lot 8**

A bioretention system can be implemented on the northwest side of the church to capture the rooftop runoff. Permeable pavement can be installed along the southeast side of the church and in the parking lot. There are several types of permeable pavement systems including porous asphalt, pervious concrete, permeable pavers, and grass pavers. These surfaces are hard and durable 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. 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"
75	49,753	2.4	25.1	228.4	0.039	1.36

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	0.102	17	7,450	0.28	975	$4,875
Pervious pavement	0.408	68	29,905	1.12	3,700	$92,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

First Presbyterian Church

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

0 25' 50'

GETHSEMANE LUTHERAN CHURCH

Subwatershed: Musconetcong River

Site Area: 230,577 sq. ft.

Address: 409 East Baldwin Street
Hackettstown, NJ 07840

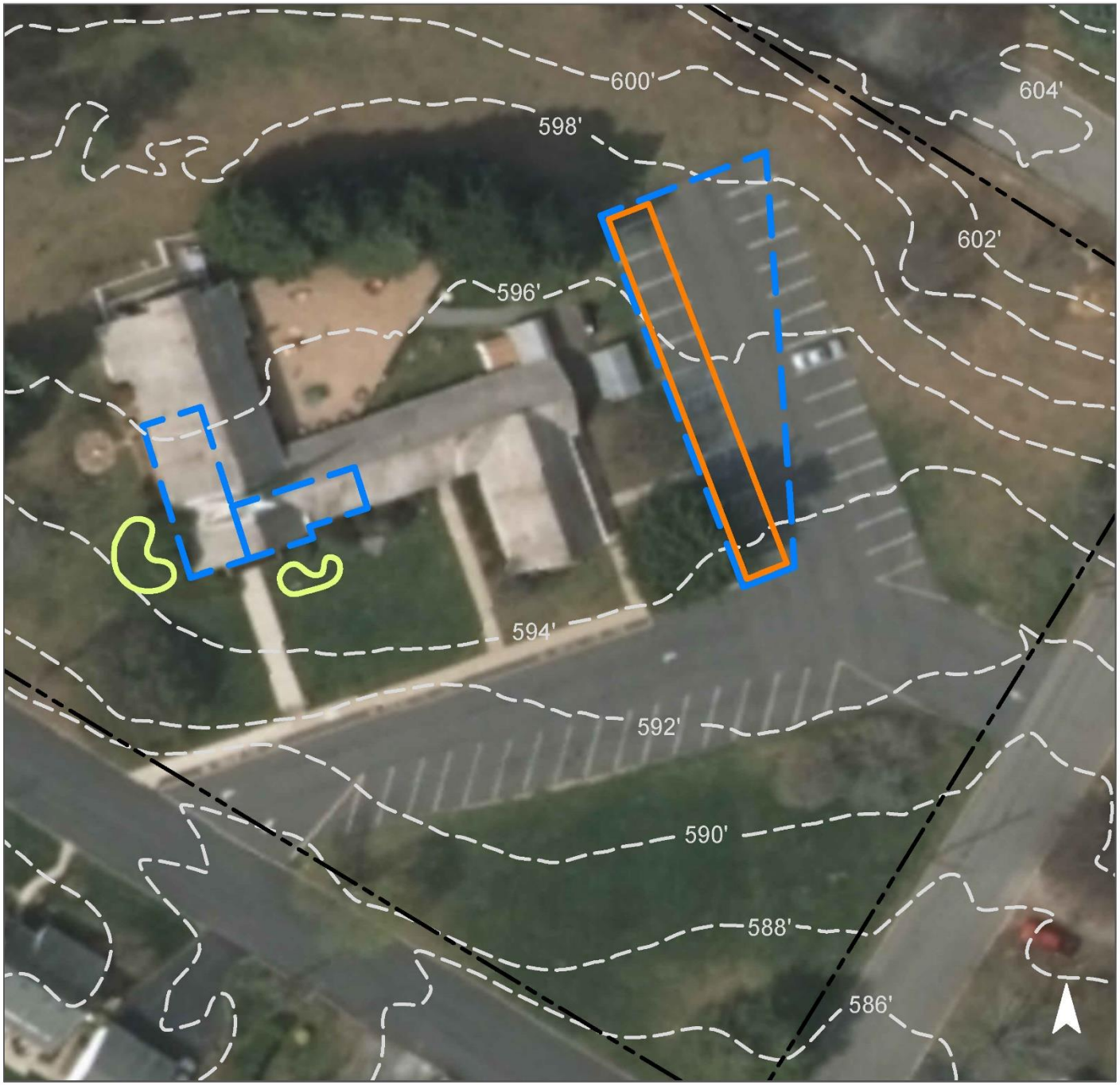
Block and Lot: Block 3.01, Lot 1

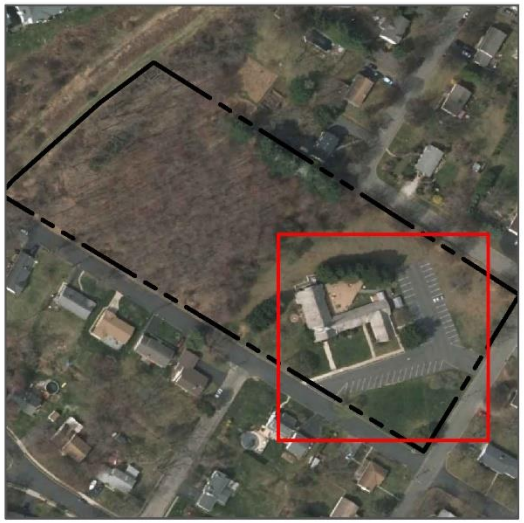
Two rain gardens can be installed around the southwestern corner of the church to collect stormwater from the roof and prevent it from draining into local waterways. These systems can easily be incorporated into existing landscapes, improving aesthetics and creating wildlife habitat while managing stormwater runoff. Permeable pavement can be installed in the parking lot east of the church. These surfaces are hard and support vehicle traffic but also allow water to infiltrate through the 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"
20	45,996	2.2	23.2	211.1	0.036	1.26

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	0.045	8	3,284	0.12	530	$2,650
Pervious pavement	0.129	22	9,440	0.36	2,340	$58,500

GREEN INFRASTRUCTURE RECOMMENDATIONS





Gethsemane Lutheran Church

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

0 25' 50'

HACKETTSTOWN COMMUNITY CENTER

Subwatershed: **Musconetcong River**

Site Area: **32,497 sq. ft.**

Address: **293 Main Street**
Hackettstown, NJ 07840

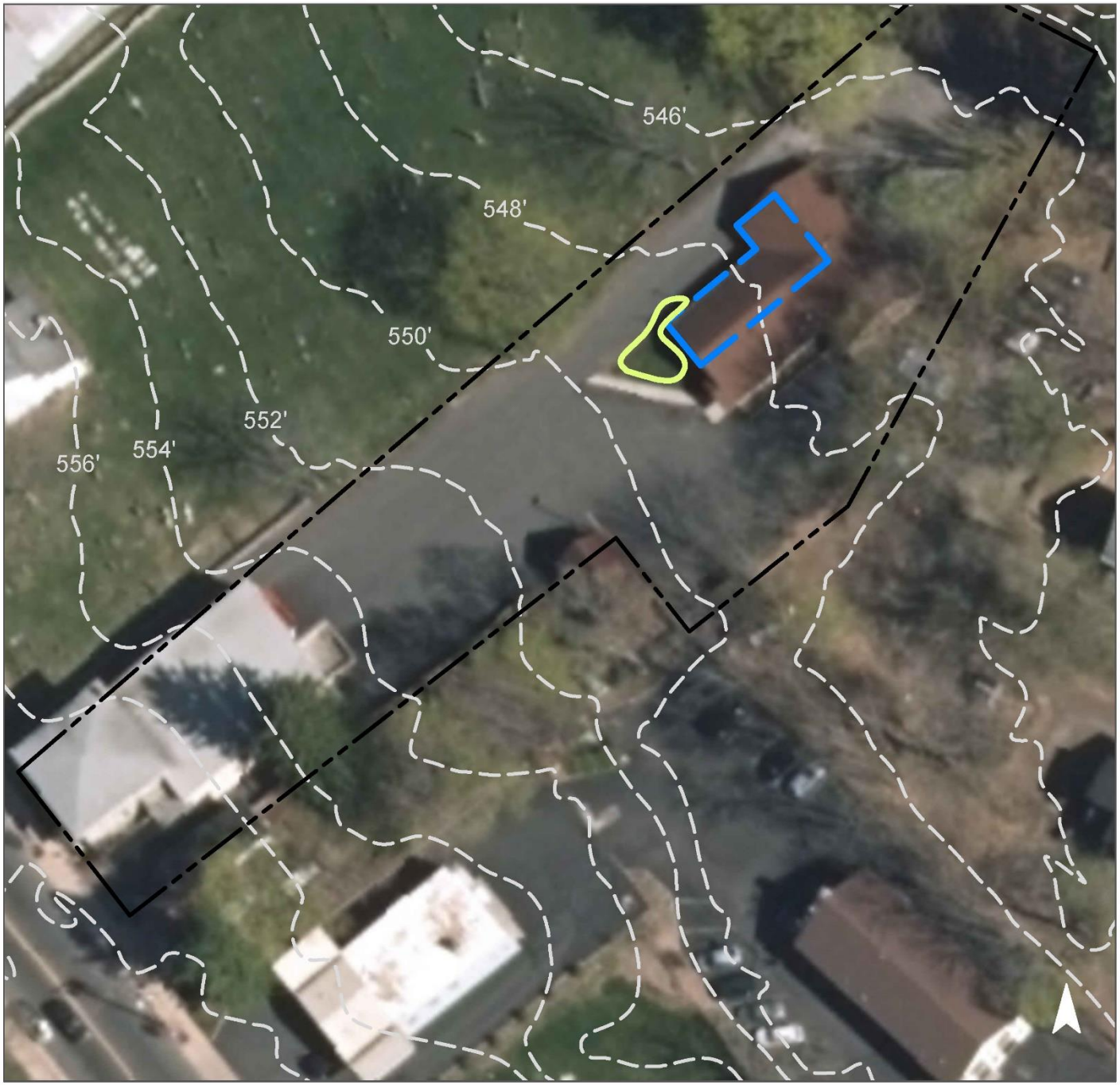
Block and Lot: **Block 72, Lot 13**

A rain garden can be installed at the northeast corner of the senior center to collect stormwater from the roof and prevent it from draining into local waterways. These systems can easily be incorporated into existing landscapes, improving aesthetics and creating wildlife habitat while managing stormwater 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"
81	26,287	1.3	13.3	120.7	0.020	0.72

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	0.029	5	2,162	0.08	285	$1,425

GREEN INFRASTRUCTURE RECOMMENDATIONS



Hackettstown Community Center

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

0 25' 50'

HACKETTSTOWN FIRE DEPARTMENT

Subwatershed: **Musconetcong River**

Site Area: **38,042 sq. ft.**

Address: **101 Miller Street**
Hackettstown, NJ 07840

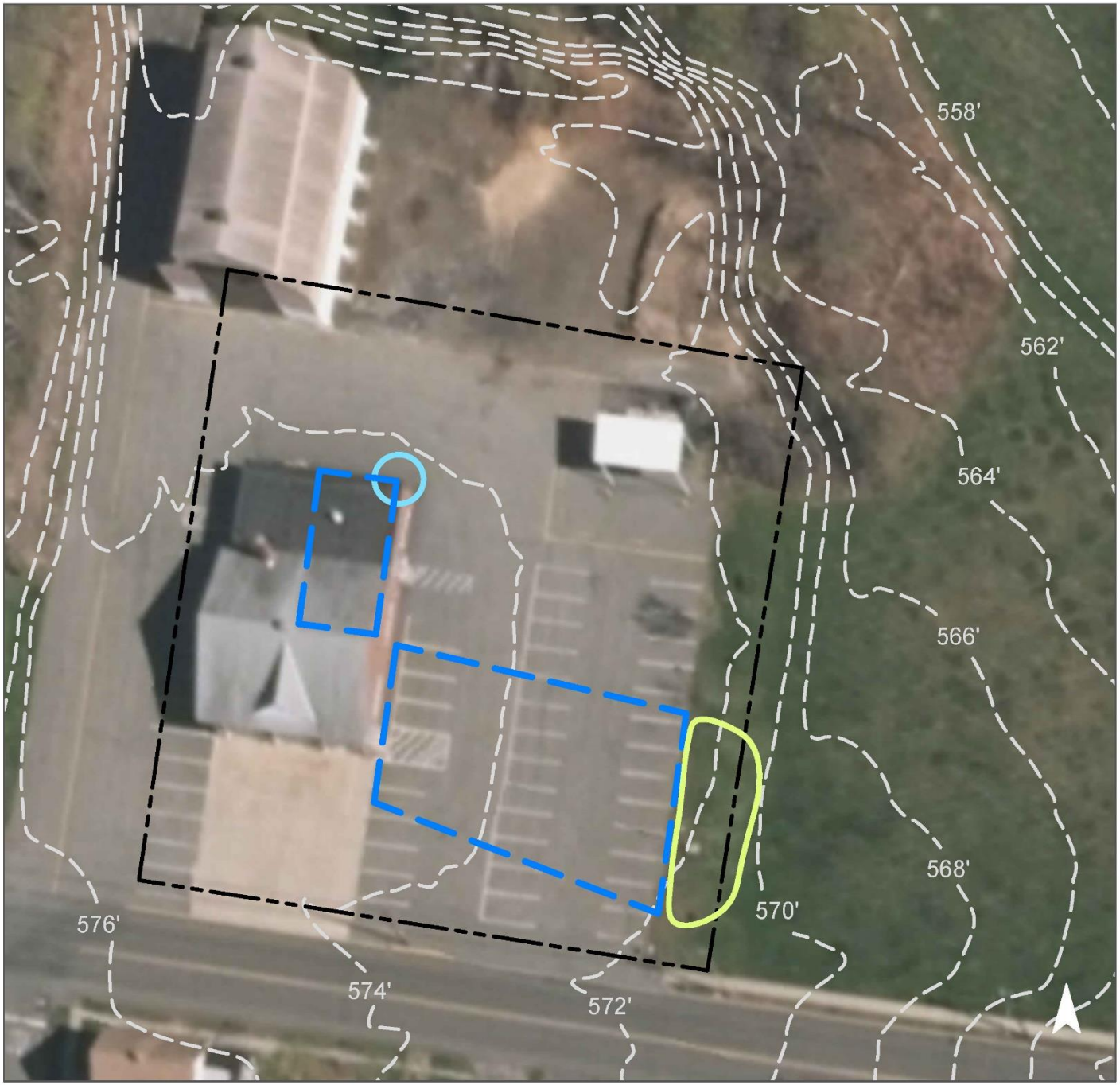
Block and Lot: **Block 45, Lot 7.01**

A rain garden can be installed east of the parking lot to collect stormwater from the parking lot and prevent it from draining into local waterways. 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. A cistern can additionally be installed by redirecting downspouts from the rooftop. The stormwater can be reused for washing vehicles. 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	29,394	1.4	14.8	135.0	0.023	0.81

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	0.149	25	10,958	0.41	1,435	$7,175
Rainwater harvesting	0.033	6	1,000	0.09	1,000 (gal)	$2,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Hackettstown Fire Department

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

0 25' 50'

HACKETTSTOWN FIRST AID AND RESCUE HEADQUARTERS

Subwatershed: Musconetcong River

Site Area: 78,733 sq. ft.

Address: 118 Maple Street
Hackettstown, NJ 07840

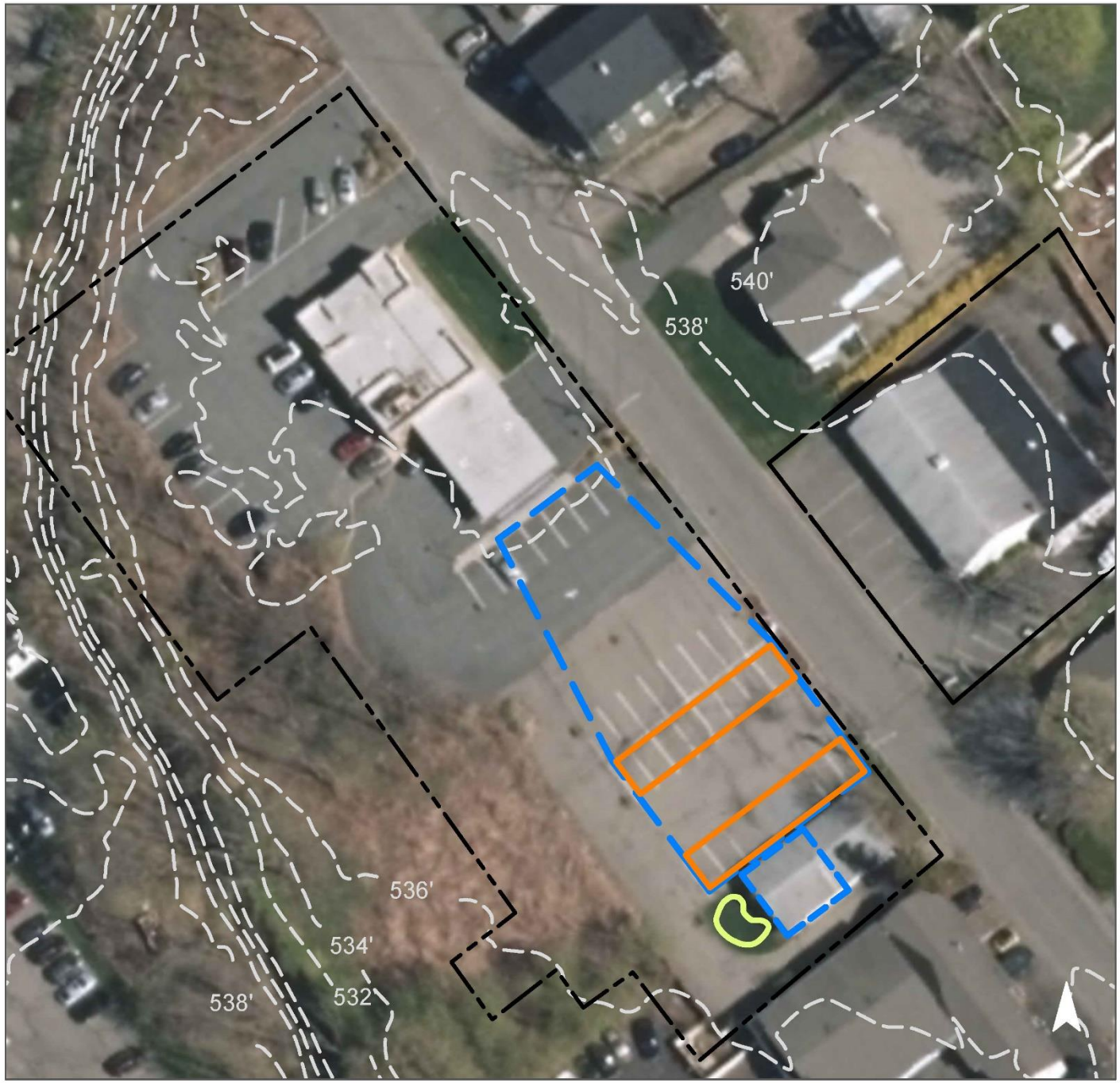
Block and Lot: Block 71, Lot 3

A rain garden can be installed at the southwest side of the southernmost building to collect stormwater from the roof and prevent it from draining into local waterways. These systems can easily be incorporated into existing landscapes, improving aesthetics and creating wildlife habitat while managing stormwater runoff. Permeable pavement can be installed in the parking lot. These surfaces are hard and durable but also allow water to infiltrate through the surface. 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"
78	61,660	3.0	31.1	283.1	0.048	1.69

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	0.023	4	1,720	0.06	225	$1,125
Pervious pavement	0.290	48	21,236	0.80	2,815	$70,375

GREEN INFRASTRUCTURE RECOMMENDATIONS



Hackettstown First Aid and Rescue Headquarters

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

0 30' 60'

HACKETTSTOWN HIGH SCHOOL

Subwatershed: **Musconetcong River**

Site Area: **1,452,596 sq. ft.**

Address: **701 Warren Street**
Hackettstown, NJ 07840

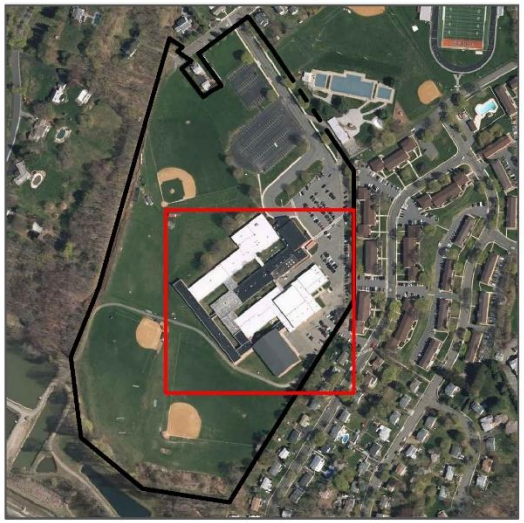
Block and Lot: **Block 107, Lot 20**

A total of seven rain gardens can be installed around the building to collect stormwater from the roof and prevent it from draining into local waterways. These systems can easily be incorporated into existing landscapes, improving aesthetics and creating wildlife habitat while managing stormwater runoff. Permeable pavement can be installed on the east side of the building. Permeable surfaces are hard and durable but also allow water to infiltrate through the surface. 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"
29	421,594	20.3	212.9	1,935.7	0.328	11.56

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	0.457	77	33,510	1.26	4,385	$21,925
Pervious pavement	0.276	46	20,256	0.76	3,925	$98,125

GREEN INFRASTRUCTURE RECOMMENDATIONS



Hackettstown High School

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

0 50' 100'

HACKETTSTOWN MUNICIPAL BUILDING

Subwatershed: Musconetcong River

Site Area: 45,317 sq. ft.

Address: 215 West Stiger Street
Hackettstown, NJ 07840

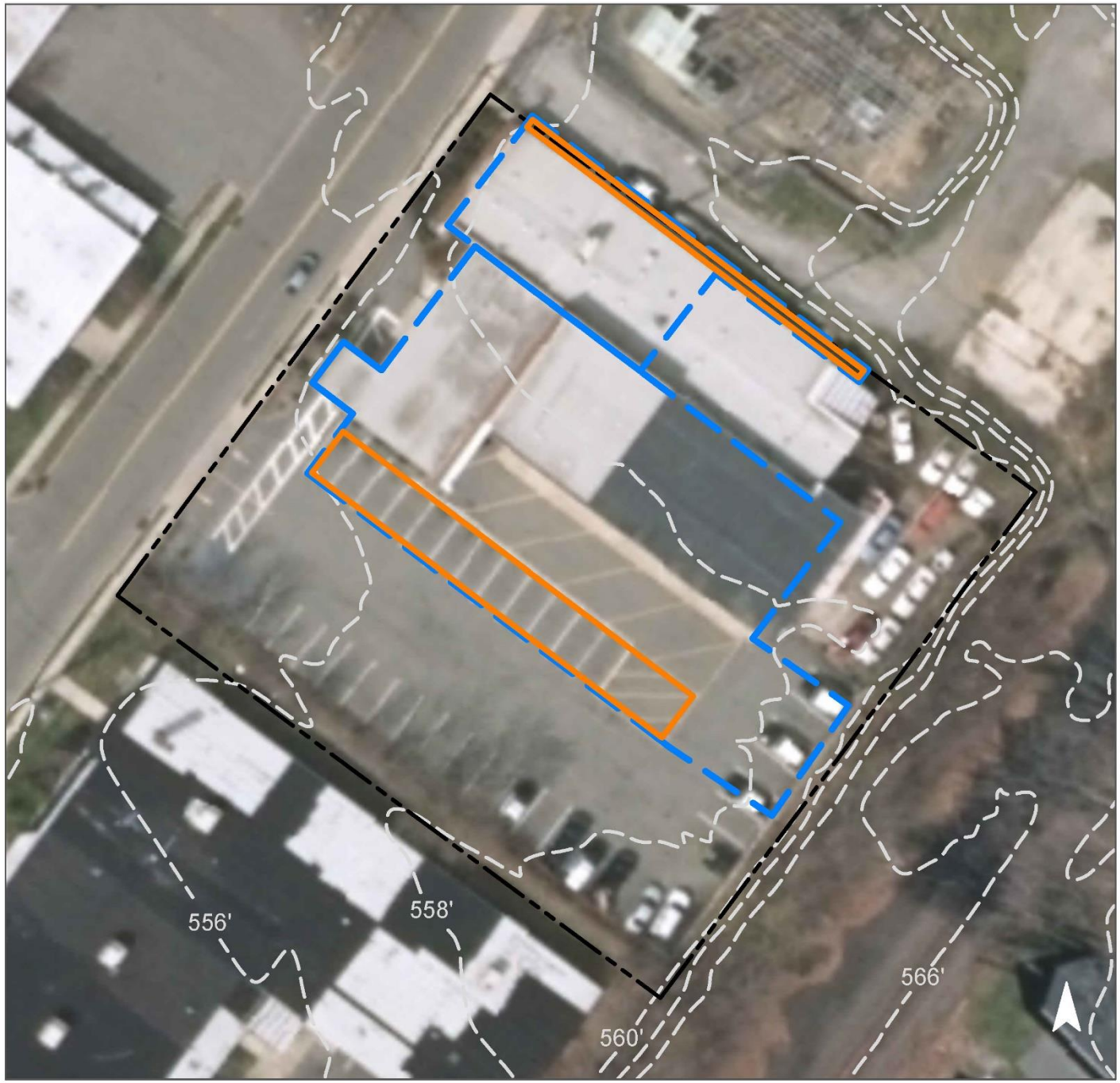
Block and Lot: Block 41.02, Lot 29.01

Permeable pavement can be installed in the parking lot in the parking spaces and along the northeast side of the building by replacing the sidewalk. There are several types of permeable pavement systems including porous asphalt, pervious concrete, permeable pavers, and grass pavers. These surfaces are hard and durable 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. 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	38,519	1.9	19.5	176.9	0.030	1.06

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	0.504	84	36,974	1.39	3,460	$86,500

GREEN INFRASTRUCTURE RECOMMENDATIONS



Hackettstown Municipal Building

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

0 25' 50'

HATCHERY HILL ELEMENTARY SCHOOL

Subwatershed: Musconetcong River

Site Area: 625,852 sq. ft.

Address: 398 5th Avenue
Hackettstown, NJ 07840

Block and Lot: Block 107, Lot 36

Six rain gardens can be installed around the school to collect stormwater from the roof and prevent it from draining into local waterways. These systems can easily be incorporated into existing landscapes, improving aesthetics and creating wildlife habitat while managing stormwater runoff. Permeable pavement can be installed at the northeast corner of the building in the blacktop area. Permeable surfaces are hard and durable but also allow water to infiltrate through the surface. 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"
22	140,596	6.8	71.0	645.5	0.110	3.86

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	22,126	0.83	2,900	$14,500
Pervious pavement	0.085	14	6,208	0.23	600	$15,000

GREEN INFRASTRUCTURE RECOMMENDATIONS

Hatchery Hill Elementary School

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

0 30' 60'

KNIGHTS OF COLUMBUS

Subwatershed: **Musconetcong River**

Site Area: **31,693 sq. ft.**

Address: **142 Liberty Street**
Hackettstown, NJ 07840

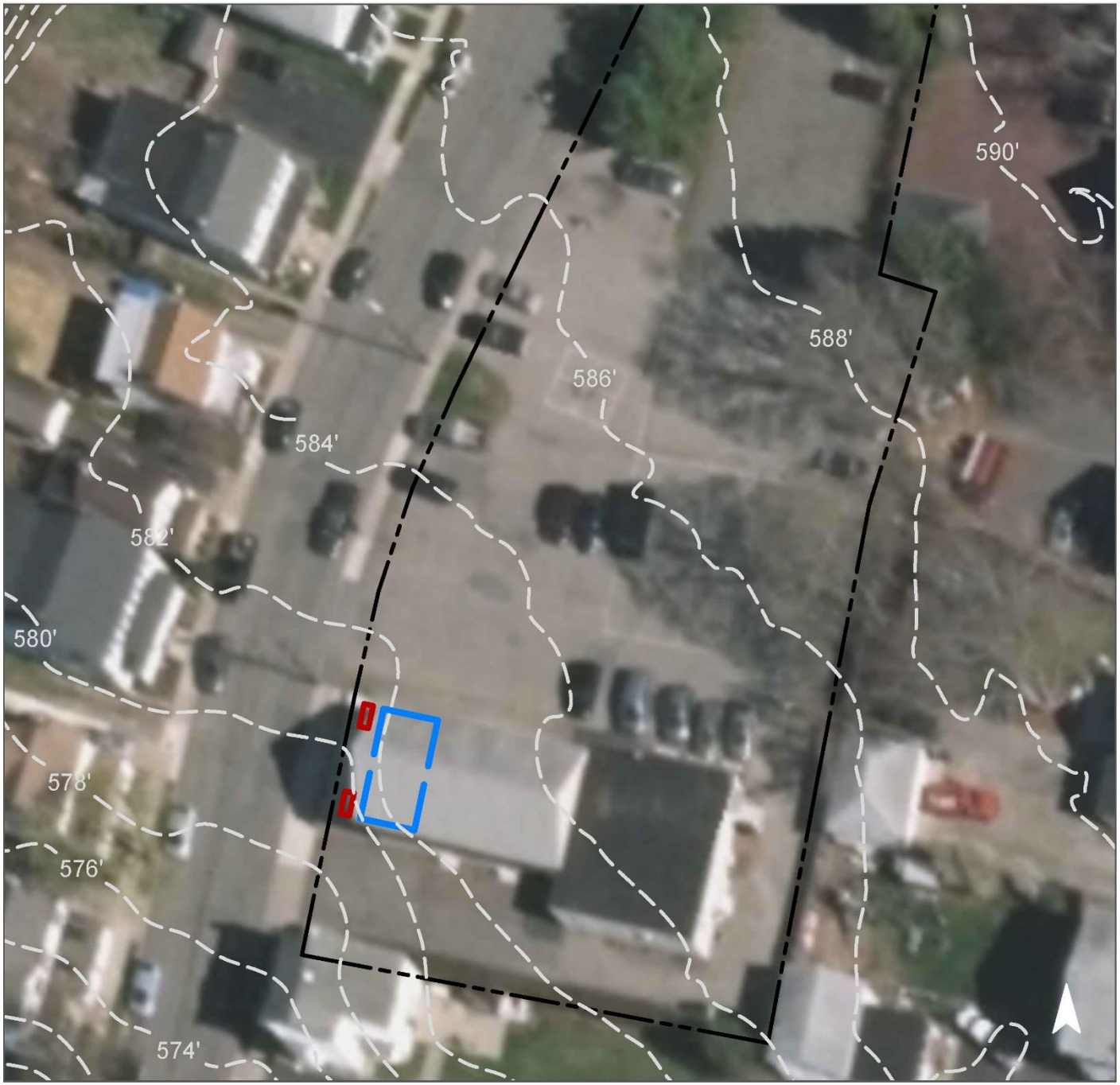
Block and Lot: **Block 60, Lot 14**

Two planter boxes can be installed on the west side of the building. These are wooden boxes with plants installed at the base of a downspout that provide an opportunity to beneficially reuse 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"
65	20,468	1.0	10.3	94.0	0.016	0.56

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
Planter boxes	0.011	2	823	0.03	24	$2,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Knights of Columbus

- planter box
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 20' 40'

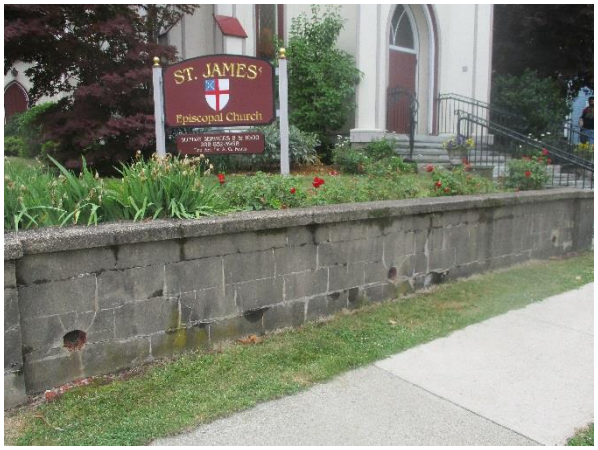
SAINT JAMES' EPISCOPAL CHURCH

Subwatershed: Musconetcong River

Site Area: 14,512 sq. ft.

Address: 214 Washington Street
Hackettstown, NJ 07840

Block and Lot: Block 81, Lot 4

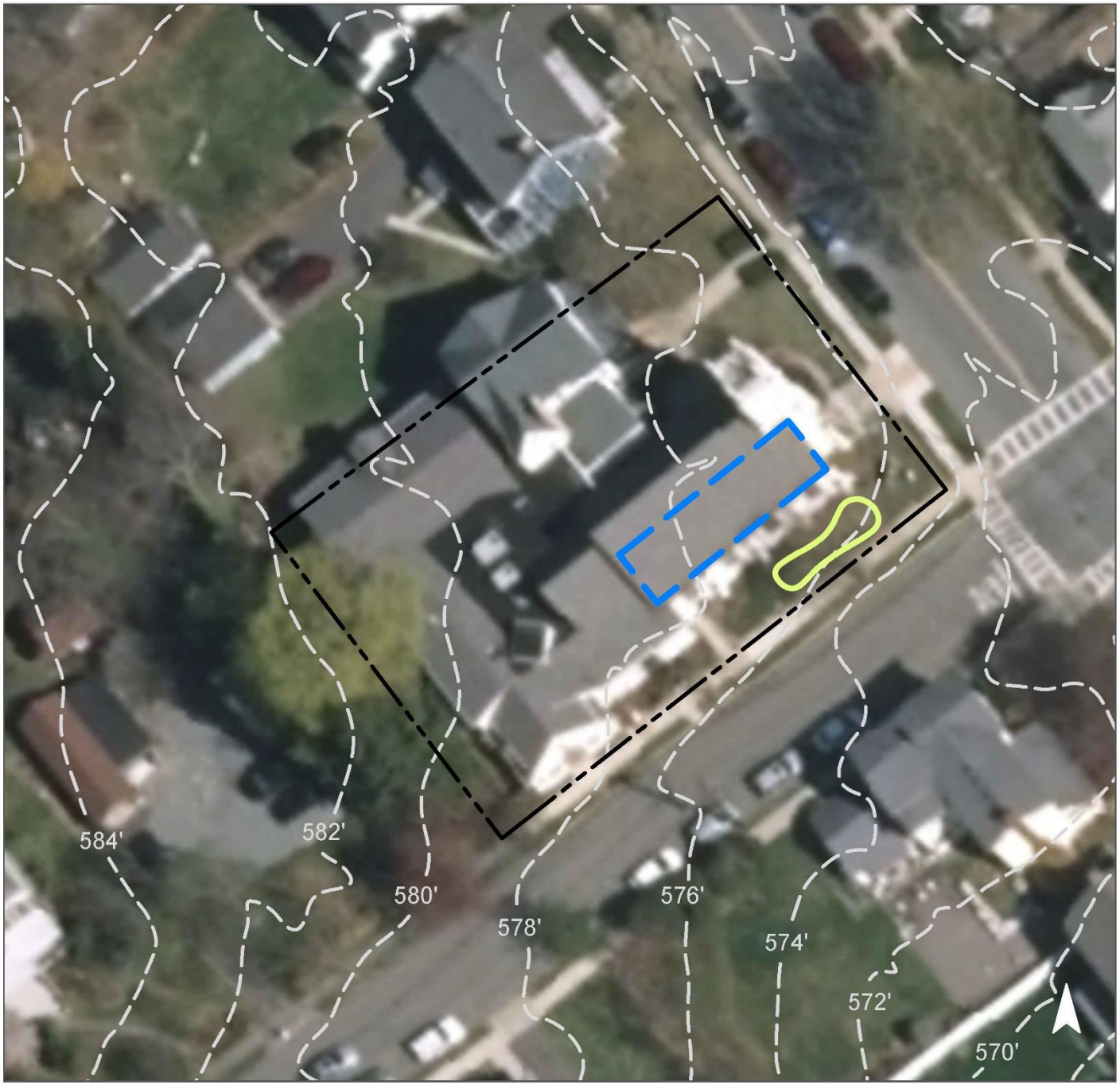


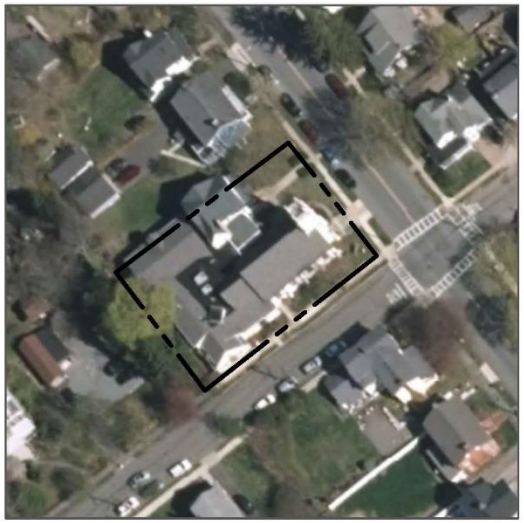
A rain garden can be installed along the southeast side to collect stormwater from the roof and prevent it from draining into local waterways. These are landscaped features that are designed to capture, treat, and infiltrate stormwater runoff. These systems can easily be incorporated into existing landscapes, improve aesthetics and create wildlife habitat while managing stormwater 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"
66	9,550	0.5	4.8	43.8	0.007	0.26

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	0.029	5	2,124	0.08	280	$1,400

GREEN INFRASTRUCTURE RECOMMENDATIONS





Saint James' Episcopal Church

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

0 20' 40'

TRINITY UNITED METHODIST CHURCH

Subwatershed: Musconetcong River

Site Area: 213,957 sq. ft.

Address: 213 Main Street
Hackettstown, NJ 07840

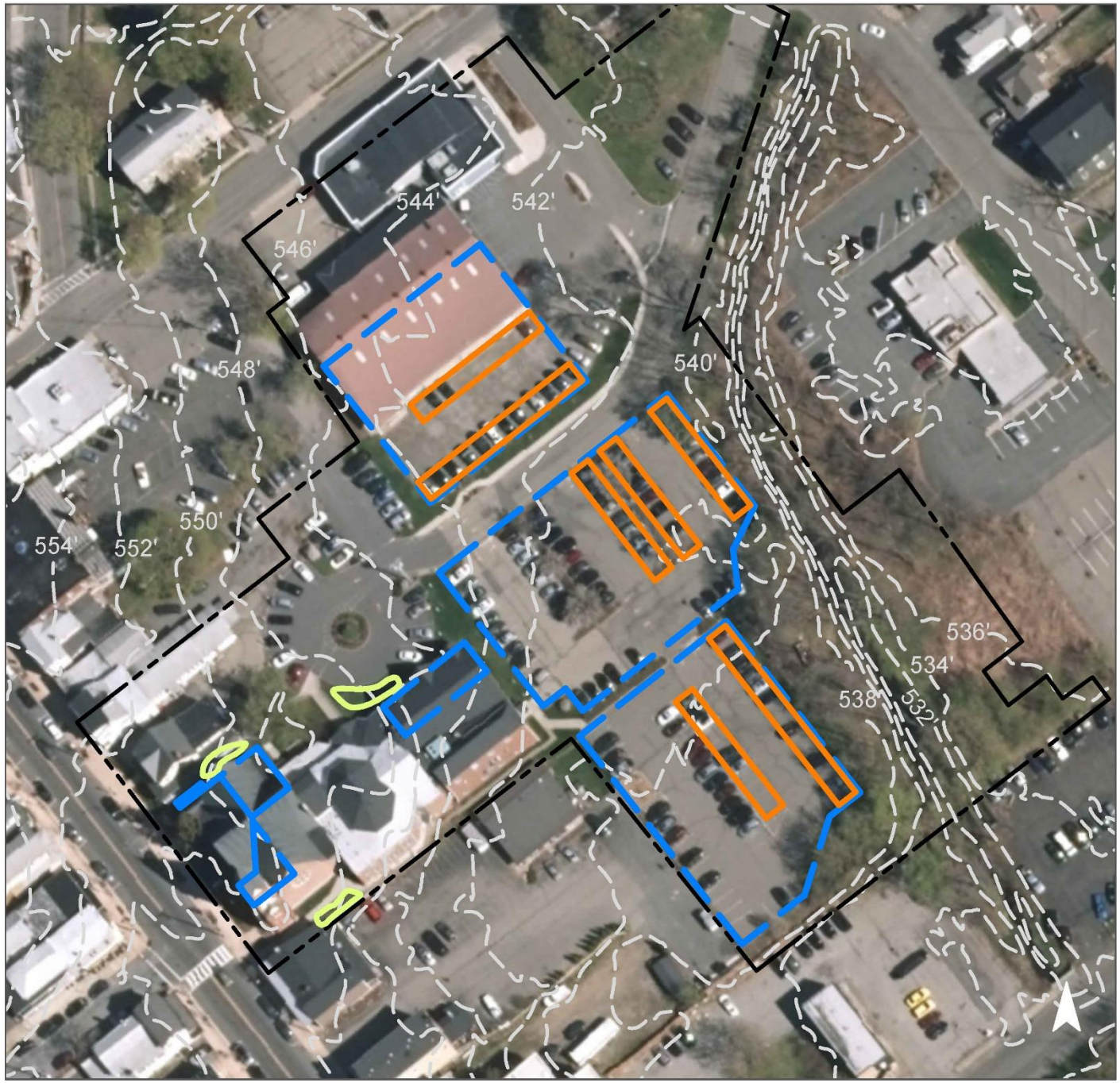
Block and Lot: Block 71, Lot 13

Three rain gardens can be installed to collect stormwater from the roof and prevent it from draining into local waterways. These systems can easily be incorporated into existing landscapes, improving aesthetics and creating wildlife habitat while managing stormwater runoff. Permeable pavement can be installed at several locations in the various parking lots to catch additional stormwater runoff. These surfaces are hard and durable but also allow water to infiltrate through the surface. 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"
75	160,241	7.7	80.9	735.7	0.125	4.39

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	0.092	15	6,784	0.26	890	$4,450
Pervious pavement	1.503	252	110,188	4.14	13,600	$340,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Trinity United Methodist Church

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

0 50' 100'

WILLOW GROVE ELEMENTARY SCHOOL

Subwatershed: **Musconetcong River**

Site Area: **640,120 sq. ft.**

Address: **601 Willow Grove Street**
Hackettstown, NJ 07840

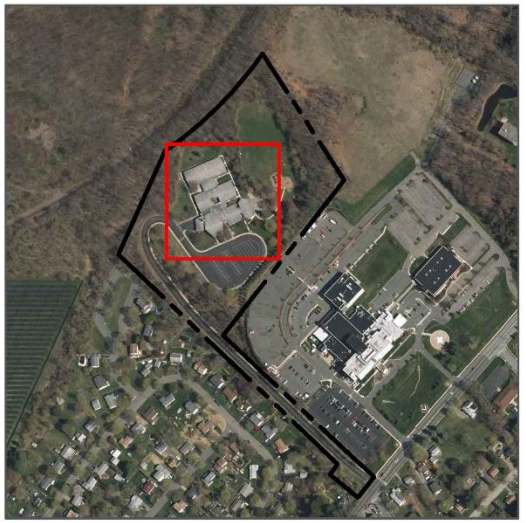
Block and Lot: **Block 45, Lot 6**

A rain garden can be installed along the south side of the school to collect stormwater from the roof and prevent it from draining into local waterways. 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. 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"
24	154,974	7.5	78.3	711.5	0.121	4.25

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	0.070	12	5,161	0.19	675	$3,375

GREEN INFRASTRUCTURE RECOMMENDATIONS



Willow Grove Elementary School

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

0 30' 60'

c. Summary of Existing Conditions

Summary of Proposed Green Infrastructure Practices

Subwatershed/Site Name/Total Site Info/GI Practice	Area (ac)	Area (SF)	Block	Lot	Existing Annual Loads			I.C. %	I.C. Area (ac)	I.C. Area (SF)	Runoff Volumes from I.C.	
					TP (lb/yr)	TN (lb/yr)	TSS (lb/yr)				Water Quality Storm (1.25" over 2-hours) (Mgal)	Annual (Mgal)
MUSCONETCONG RIVER SUBWATERSHED	**33.34**	**3,986,680**			**64.9**	**679.8**	**6,180.1**		**30.90**	**1,346,018**	**1.049**	**36.92**
All Play Indoor Playground												
Total Site Info	10.37	451,618	41	23	7.0	73.1	664.5	32	3.32	144,722	0.113	3.97
Church of the Assumption												
Total Site Info	1.49	65,023	50	4.01	2.0	21.3	194.1	65	0.97	42,265	0.033	1.16
First Presbyterian Church												
Total Site Info	1.52	66,233	79	8	2.4	25.1	228.4	75	1.14	49,753	0.039	1.36
Gethsemane Lutheran Church												
Total Site Info	5.29	230,577	3.01	1	2.2	23.2	211.2	20	1.06	45,996	0.036	1.26
Hackettstown Community Center												
Total Site Info	0.75	32,497	72	13	1.3	13.3	120.7	81	0.60	26,287	0.020	0.72
Hackettstown Fire Department												
Total Site Info	0.87	38,042	45	7.01	1.4	14.8	135.0	77	0.67	29,394	0.023	0.81
Hackettstown First Aid and Rescue Headquarters												
Total Site Info	1.81	78,733	71	3	3.0	31.1	283.1	78	1.42	61,660	0.048	1.69
Hackettstown High School												
Total Site Info	33.34	1,452,506	107	20	20.3	212.9	1,935.7	29	9.68	421,594	0.328	11.56
Hackettstown Municipal Building												
Total Site Info	1.04	45,317	41.02	29.01	1.9	19.5	176.9	85	0.88	38,519	0.030	1.06
Hatchery Hill Elementary School												
Total Site Info	14.37	625,852	107	36	6.8	71.0	645.5	22	3.23	140,596	0.110	3.86
Knights of Columbus												
Total Site Info	0.73	31,693	60	14	1.0	10.3	94.0	65	0.47	20,468	0.016	0.56
Saint James' Episcopal Church												
Total Site Info	0.33	14,512	81	4	0.5	4.8	43.8	66	0.22	9,550	0.007	0.26

Summary of Proposed Green Infrastructure Practices

Subwatershed/Site Name/Total Site Info/GI Practice	Area (ac)	Area (SF)	Block	Lot	Existing Annual Loads			I.C. %	I.C. Area (ac)	I.C. Area (SF)	Runoff Volumes from I.C.	
					TP (lb/yr)	TN (lb/yr)	TSS (lb/yr)				Water Quality Storm (1.25" over 2-hours) (Mgal)	Annual (Mgal)
Trinity United Methodist Church												
Total Site Info	4.91	213,957	71	13	7.7	80.9	735.7	75	3.68	160,241	0.125	4.39
Willow Grove Elementary School												
Total Site Info	14.70	640,120	45	6	7.5	78.3	711.5	24	3.56	154,974	0.121	4.25

d. 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 %
	MUSCONETCONG RIVER SUBWATERSHED	**198,895**	**4.57**	**5.182**	**868**	**378,583**	**14.26**	**49,064**			**$930,800**	**4.8%**
1	**All Play Indoor Playground**											
	Bioretention system	2,920	0.07	0.076	13	5,580	0.21	730	5	SF	$3,650	2.0%
	Pervious pavement	20,220	0.46	0.527	88	38,634	1.45	3,890	25	SF	$97,250	14.0%
	Total Site Info	**23,140**	**0.53**	**0.603**	**101**	**44,214**	**1.66**	**4,620**			**$100,900**	**16.0%**
2	**Church of the Assumption**											
	Bioretention systems	1,600	0.04	0.042	7	3,059	0.11	400	5	SF	$2,000	3.8%
	Total Site Info	**1,600**	**0.04**	**0.042**	**7**	**3,059**	**0.11**	**400**			**$2,000**	**3.8%**
3	**First Presbyterian Church**											
	Bioretention system	3,900	0.09	0.102	17	7,450	0.28	975	5	SF	$4,875	8.5%
	Pervious pavement	15,650	0.36	0.408	68	29,905	1.12	3,700	25	SF	$92,500	34.0%
	Total Site Info	**19,550**	**0.45**	**0.509**	**85**	**37,355**	**1.40**	**4,675**			**$97,375**	**42.5%**
4	**Gethsemane Lutheran Church**											
	Bioretention systems	1,720	0.04	0.045	8	3,284	0.12	530	5	SF	$2,650	3.7%
	Pervious pavement	4,940	0.11	0.129	22	9,440	0.36	2,340	25	SF	$58,500	10.7%
	Total Site Info	**6,660**	**0.15**	**0.174**	**29**	**12,723**	**0.48**	**2,870**			**$61,150**	**14.5%**
5	**Hackettstown Community Center**											
	Bioretention system	1,130	0.03	0.029	5	2,162	0.08	285	5	SF	$1,425	4.3%
	Total Site Info	**1,130**	**0.03**	**0.029**	**5**	**2,162**	**0.08**	**285**			**$1,425**	**4.3%**
6	**Hackettstown Fire Department**											
	Bioretention system	5,735	0.13	0.149	25	10,958	0.41	1,435	5	SF	$7,175	19.5%
	Rainwater harvesting	1,285	0.03	0.033	6	1,000	0.09	1,000	2	gal	$2,000	4.4%
	Total Site Info	**7,020**	**0.16**	**0.183**	**31**	**11,958**	**0.50**	**2,435**			**$9,175**	**23.9%**
7	**Hackettstown First Aid and Rescue Headquarters**											
	Bioretention system	900	0.02	0.023	4	1,720	0.06	225	5	SF	$1,125	1.5%
	Pervious pavement	11,115	0.26	0.290	48	21,236	0.80	2,815	25	SF	$70,375	18.0%
	Total Site Info	**12,015**	**0.28**	**0.313**	**52**	**22,956**	**0.86**	**3,040**			**$71,500**	**19.5%**

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 %
8	**Hackettstown High School**											
	Bioretention systems	17,540	0.40	0.457	77	33,510	1.26	4,385	5	SF	$21,925	4.2%
	Pervious pavement	10,600	0.24	0.276	46	20,256	0.76	3,925	25	SF	$98,125	2.5%
	Total Site Info	**28,140**	**0.65**	**0.733**	**123**	**53,766**	**2.02**	**8,310**			**$120,050**	**6.7%**
9	**Hackettstown Municipal Building**											
	Pervious pavement	19,350	0.44	0.504	84	36,974	1.39	3,460	25	SF	$86,500	50.2%
	Total Site Info	**19,350**	**0.44**	**0.504**	**84**	**36,974**	**1.39**	**3,460**			**$86,500**	**50.2%**
10	**Hatchery Hill Elementary School**											
	Bioretention systems	11,580	0.27	0.302	51	22,126	0.83	2,900	5	SF	$14,500	8.2%
	Pervious pavement	3,250	0.07	0.085	14	6,208	0.23	600	25	SF	$15,000	2.3%
	Total Site Info	**14,830**	**0.34**	**0.386**	**65**	**28,334**	**1.06**	**3,500**			**$29,500**	**10.5%**
11	**Knights of Columbus**											
	Planter boxes	430	0.01	0.011	2	823	0.03	24	1,000	box	$2,000	2.1%
	Total Site Info	**430**	**0.01**	**0.011**	**2**	**823**	**0.03**	**24**			**$2,000**	**2.1%**
12	**Saint James' Episcopal Church**											
	Bioretention system	1,110	0.03	0.029	5	2,124	0.08	280	5	SF	$1,400	11.6%
	Total Site Info	**1,110**	**0.03**	**0.029**	**5**	**2,124**	**0.08**	**280**			**$1,400**	**11.6%**
13	**Trinity United Methodist Church**											
	Bioretention systems	3,550	0.08	0.092	15	6,784	0.26	890	5	SF	$4,450	2.2%
	Pervious pavement	57,670	1.32	1.503	252	110,188	4.14	13,600	25	SF	$340,000	36.0%
	Total Site Info	**61,220**	**1.41**	**1.595**	**267**	**116,972**	**4.40**	**14,490**			**$344,450**	**38.2%**
14	**Willow Grove Elementary School**											
	Bioretention system	2,700	0.06	0.070	12	5,161	0.19	675	5	SF	$3,375	1.7%
	Total Site Info	**2,700**	**0.06**	**0.070**	**12**	**5,161**	**0.19**	**675**			**$3,375**	**1.7%**