RUTGERS
New Jersey Agricultural
Experiment Station

Impervious Cover Reduction Action Plan
for
Bernardsville Borough, Somerset County, New Jersey

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

February 10, 2020

Highlands Council
New Jersey

ACKNOWLEDGEMENTS:

This document has been prepared by the Rutgers Cooperative Extension Water Resources Program, with funding and direction from the New Jersey Highlands Water Protection and Planning Council and the New Jersey Agricultural Experiment Station, to highlight green infrastructure opportunities within Bernardsville Borough. We would like to thank the New Jersey Highlands Water Protection and Planning Council, the New Jersey Agricultural Experiment Station, and Bernardsville Borough for their input and support in creating this document.

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New Jersey

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Introduction

Located in Somerset County, New Jersey, Bernardsville Borough covers approximately 12.9 square miles. Figures 1 and 2 illustrate that Bernardsville Borough is dominated by forest land use. A total of 43.7% of the municipality's land use is classified as urban. Of the urban land in Bernardsville Borough, rural residential is the dominant land use (Figure 3).

The New Jersey Department of Environmental Protection's (NJDEP) 2015 land use/land cover geographical information system (GIS) data layer categorizes Bernardsville 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 Bernardsville Borough. Based upon the 2015 NJDEP land use/land cover data, approximately 8.0% of Bernardsville Borough has impervious cover. This level of impervious cover suggests that the streams in Bernardsville Borough likely range from sensitive to impacted streams. [1]

Methodology

Bernardsville Borough contains portions of four subwatersheds (Figure 4). For this impervious cover reduction action plan, projects have been identified in two 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] Schuler, T.R., L. Fraley-McNeal, and K. Cappiella. 2009. Is Impervious Cover Still Important? Review of Recent Research. *Journal of Hydrologic Engineering* 14 (4): 309-315.

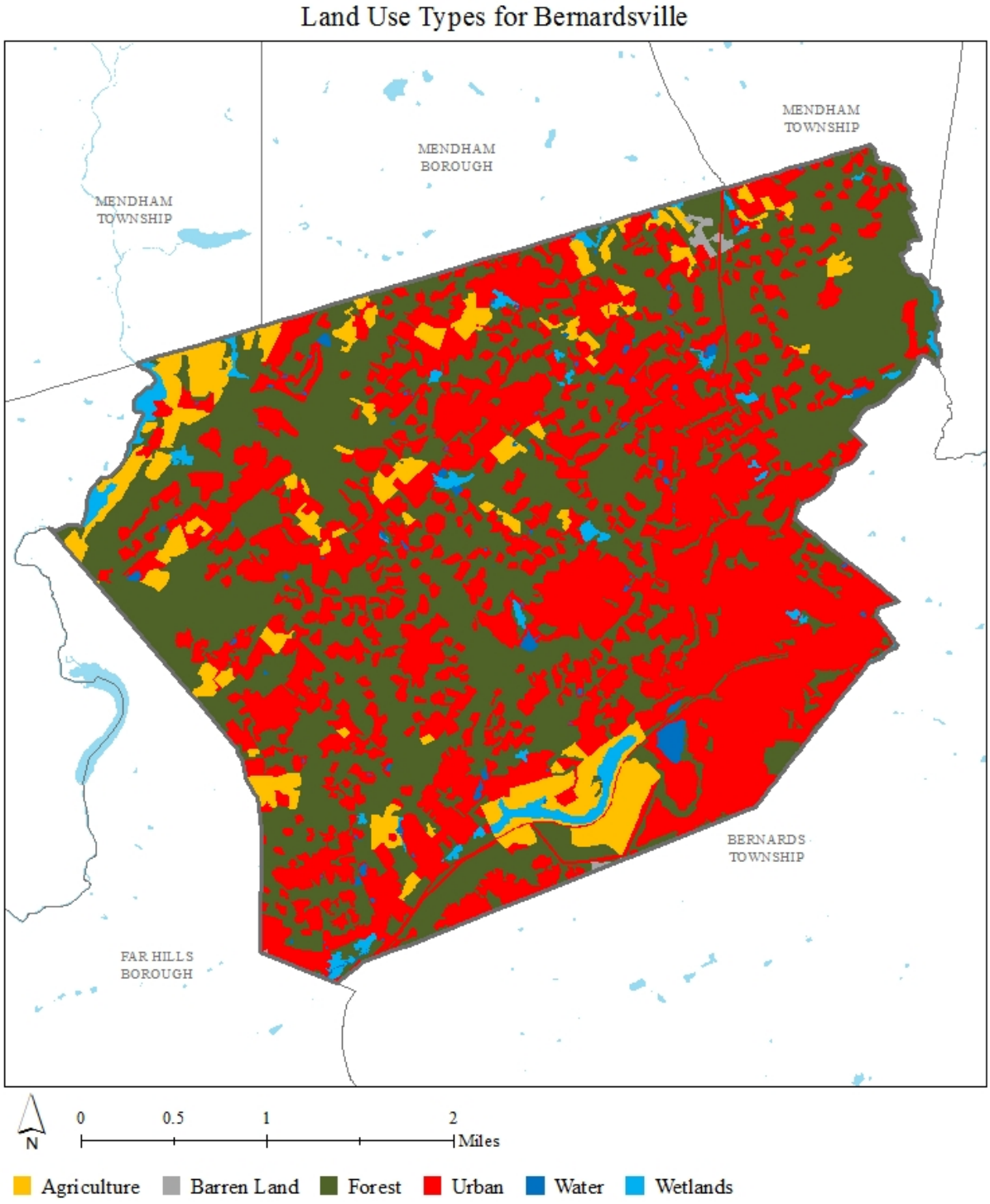


Figure 1: Map illustrating the land use in Bernardsville Borough

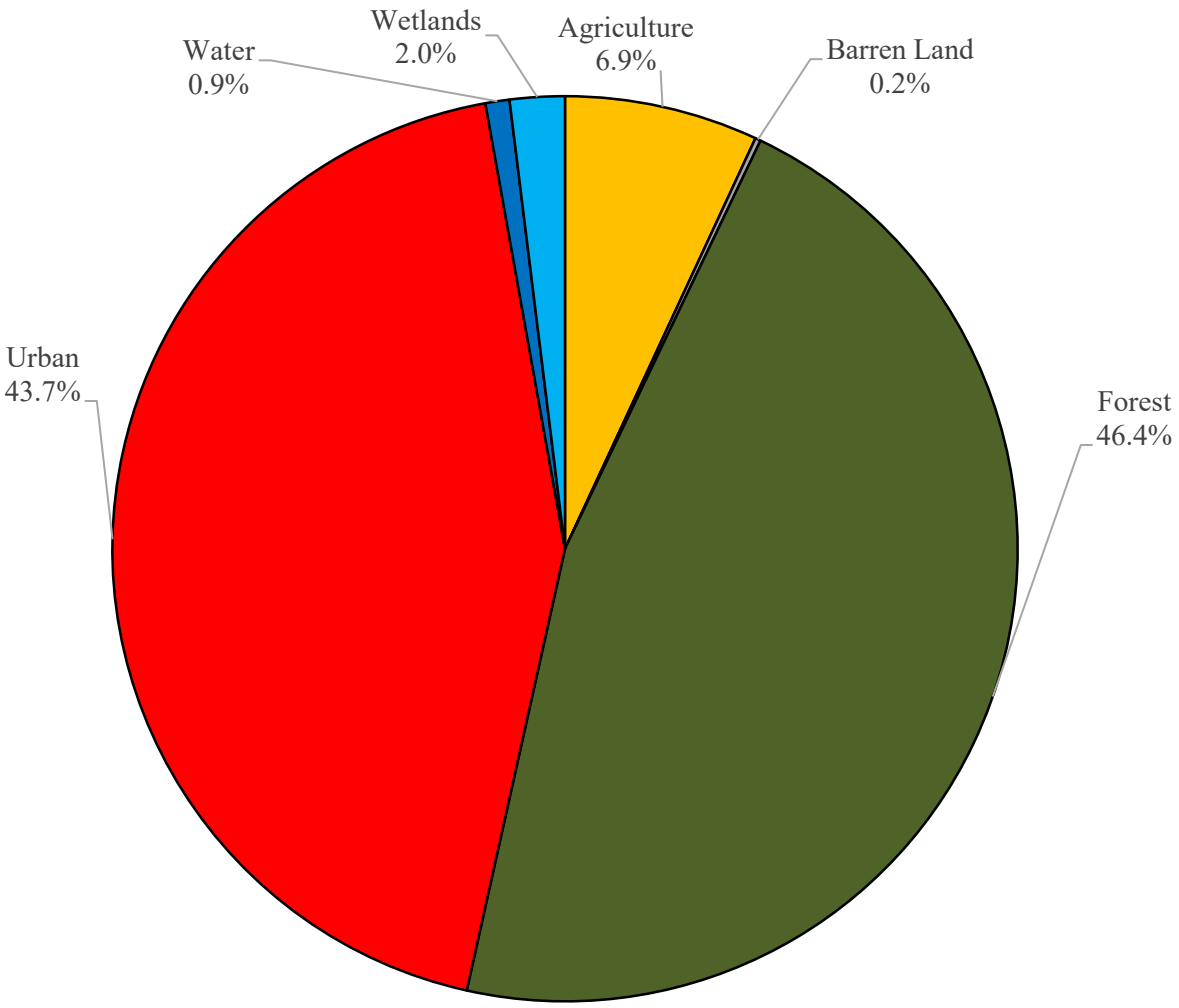


Figure 2: Pie chart illustrating the land use in Bernardsville Borough

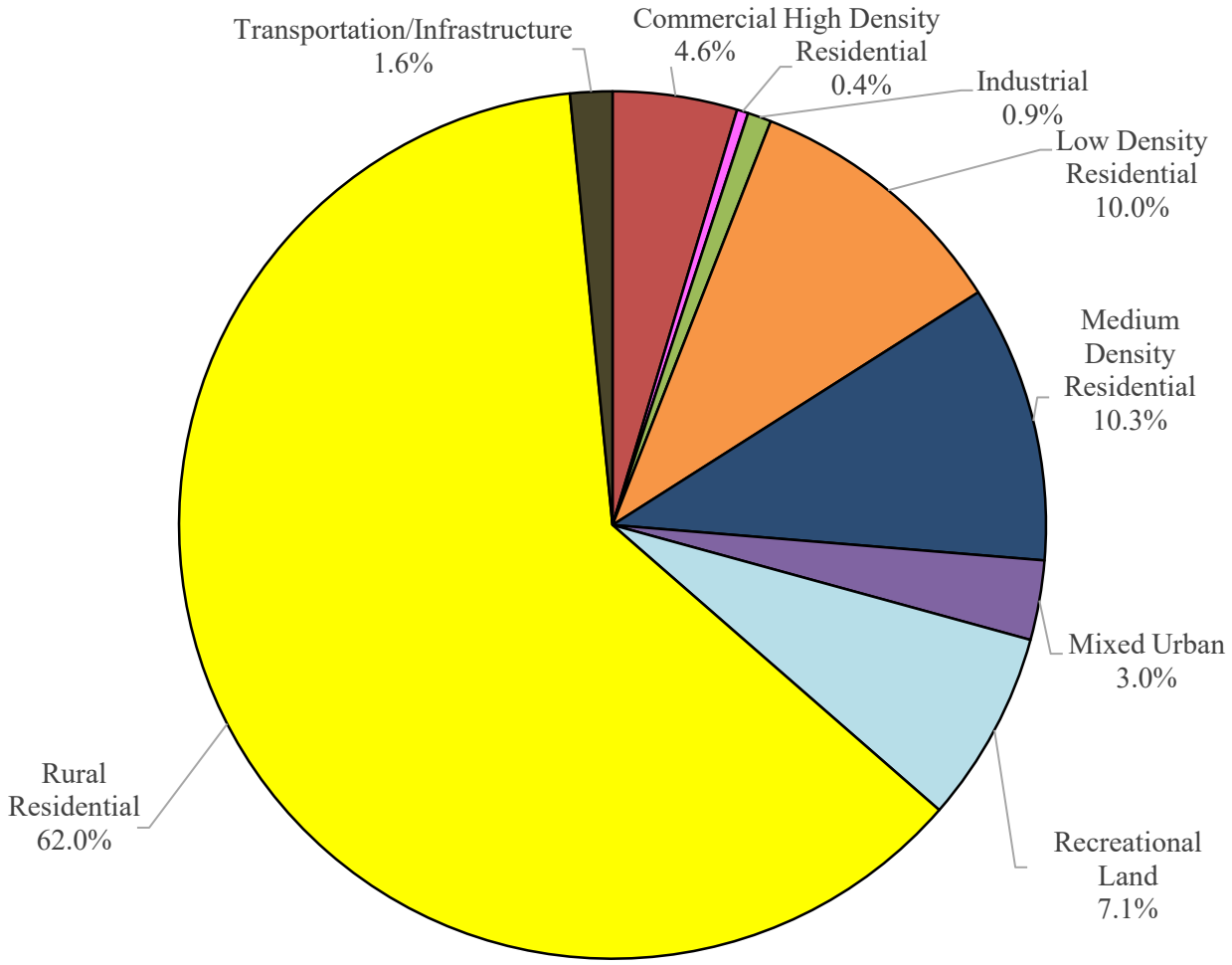


Figure 3: Pie chart illustrating the various types of urban land use in Bernardsville Borough

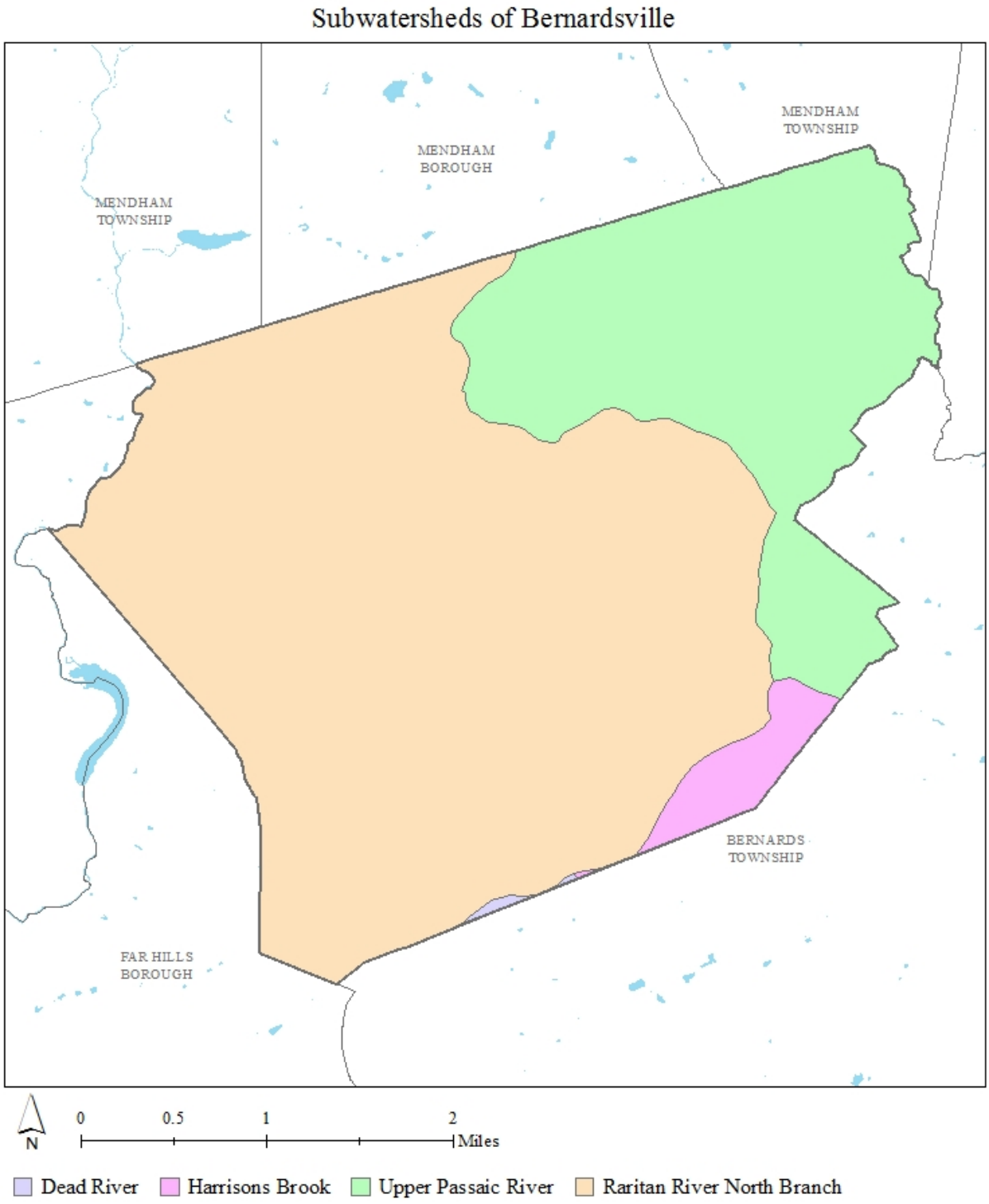


Figure 4: Map of the subwatersheds in Bernardsville Borough

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 2015 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 Bernardsville 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 principle, green infrastructure practices use soil and vegetation to recycle stormwater runoff through infiltration and evapotranspiration. When used as components of a stormwater management system, green infrastructure practices such as bioretention, green roofs, porous pavement, rain gardens, and vegetated swales can produce a variety of environmental benefits. In addition to effectively retaining and infiltrating rainfall, these 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 Bernardsville 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.

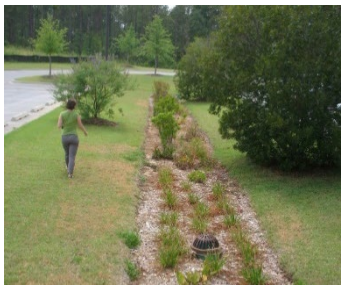
Downspout planter boxes

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

Appendix A contains information on potential project sites where green infrastructure practices could be installed as well as information on existing site conditions. The recommended green infrastructure practices and the drainage area that the green infrastructure practices can treat are identified for each potential project site. For each practice, the recharge potential, TSS removal potential, maximum volume reduction potential per storm, the peak reduction potential, and estimated costs 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

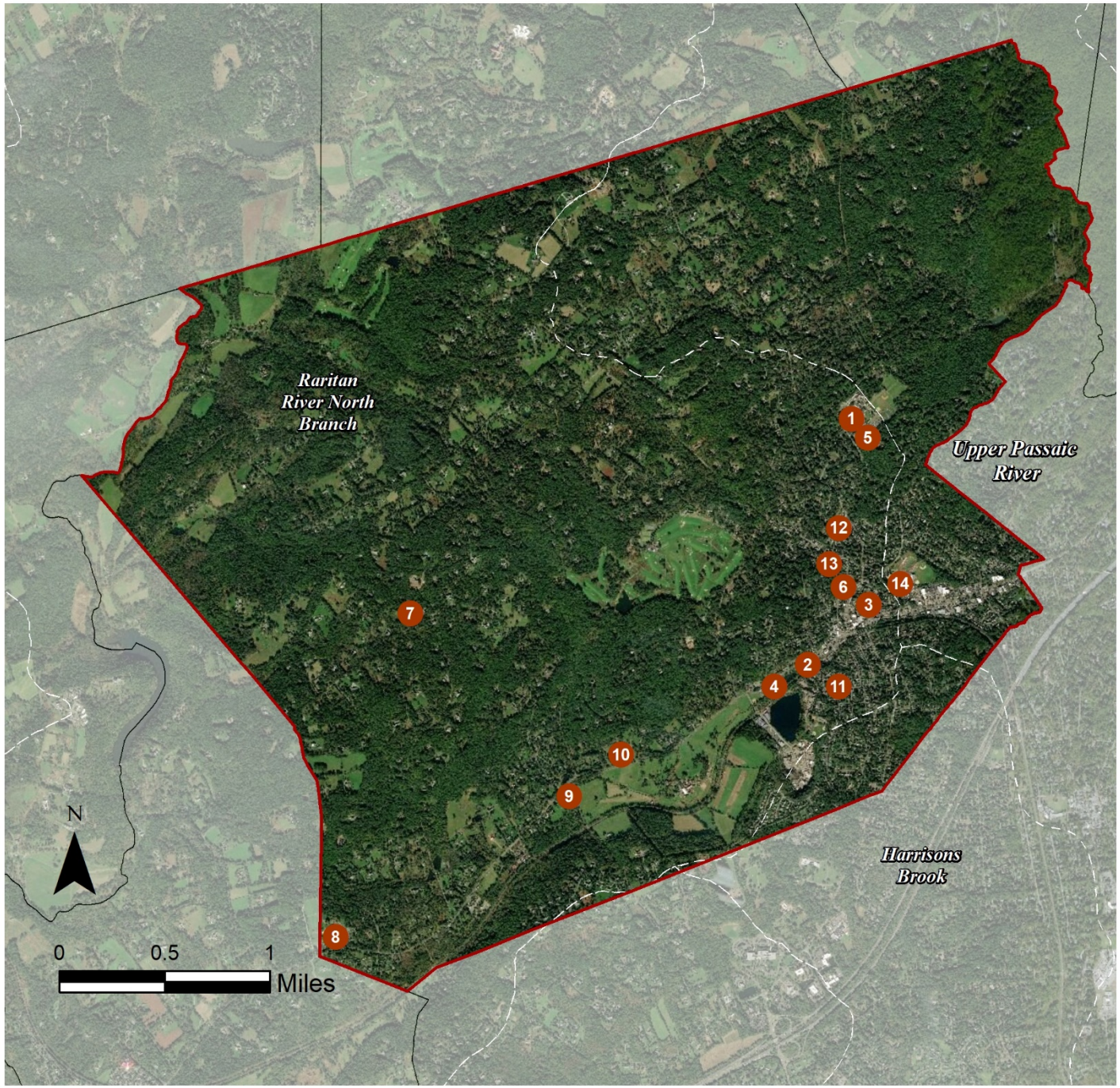
This impervious cover reduction action plan is meant to provide the municipality with a blueprint for implementing green infrastructure practices that will reduce the impact of stormwater runoff from impervious surfaces. These projects can be implemented by a wide variety of people such as boy scouts,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

Appendix A: Climate Resilient Green Infrastructure

a. Green Infrastructure Sites

BERNARDSVILLE BOROUGH: GREEN INFRASTRUCTURE SITES



SITES WITHIN THE RARITAN RIVER NORTH BRANCH SUBWATERSHED

1. Bedwell Elementary School
2. Bernardsville Fire Company
3. Bernardsville Library
4. Bernardsville Municipal Court & Nervine Park
5. Bernardsville Municipal Pool
6. Bernardsville School of Music
7. Church of Saint John of the Mountain
8. Far Hills Country Day School
9. First Church of Christ, Scientist
10. Good Shepherd Church
11. Sacred Heart Chapel
12. School of Saint Elizabeth
13. Saint Bernard's Church

SITES WITHIN THE UPPER PASSAIC RIVER SUBWATERSHED

14. Bernards High School & Somerset Hills School District

b. Proposed Green Infrastructure Concepts

BEDWELL ELEMENTARY SCHOOL

Subwatershed: Raritan River North Branch

Site Area: 684,276 sq. ft.

Address: 141 Seney Drive
Bernardsville, NJ 07924

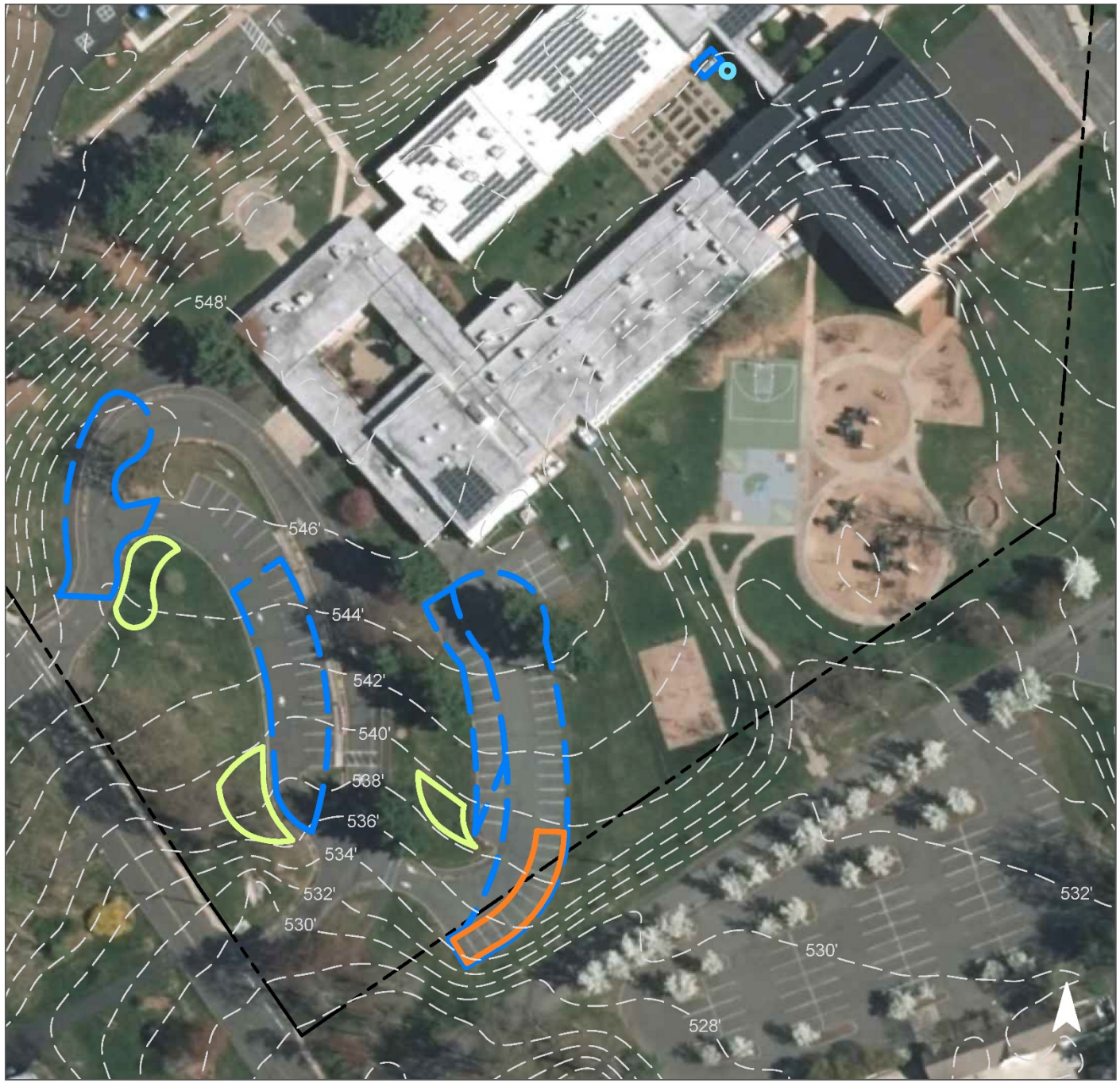
Block and Lot: Block 35, Lot 1

Rain gardens can be installed in parking lot islands to capture, treat, and infiltrate stormwater runoff from the parking lot. A section of parking spaces can be converted to porous asphalt to capture and infiltrate runoff from the parking lot as well. A rain barrel can be installed at the small greenhouse in the courtyard to capture runoff to be reused for watering the 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"
52	357,822	17.3	180.7	1,642.9	0.279	9.81

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 systems	0.351	59	25,750	0.97	3,370	$16,850
Pervious pavement	0.278	47	20,420	0.77	1,925	$48,125
Rainwater harvesting	0.004	1	115	0.00	115 (gal)	$230

GREEN INFRASTRUCTURE RECOMMENDATIONS



Bedwell Elementary School

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

0 50' 100'

BERNARDSVILLE FIRE COMPANY

Subwatershed: Raritan River North Branch

Site Area: 46,026 sq. ft.

Address: 118 Mine Brook Road
Bernardsville, NJ 07924

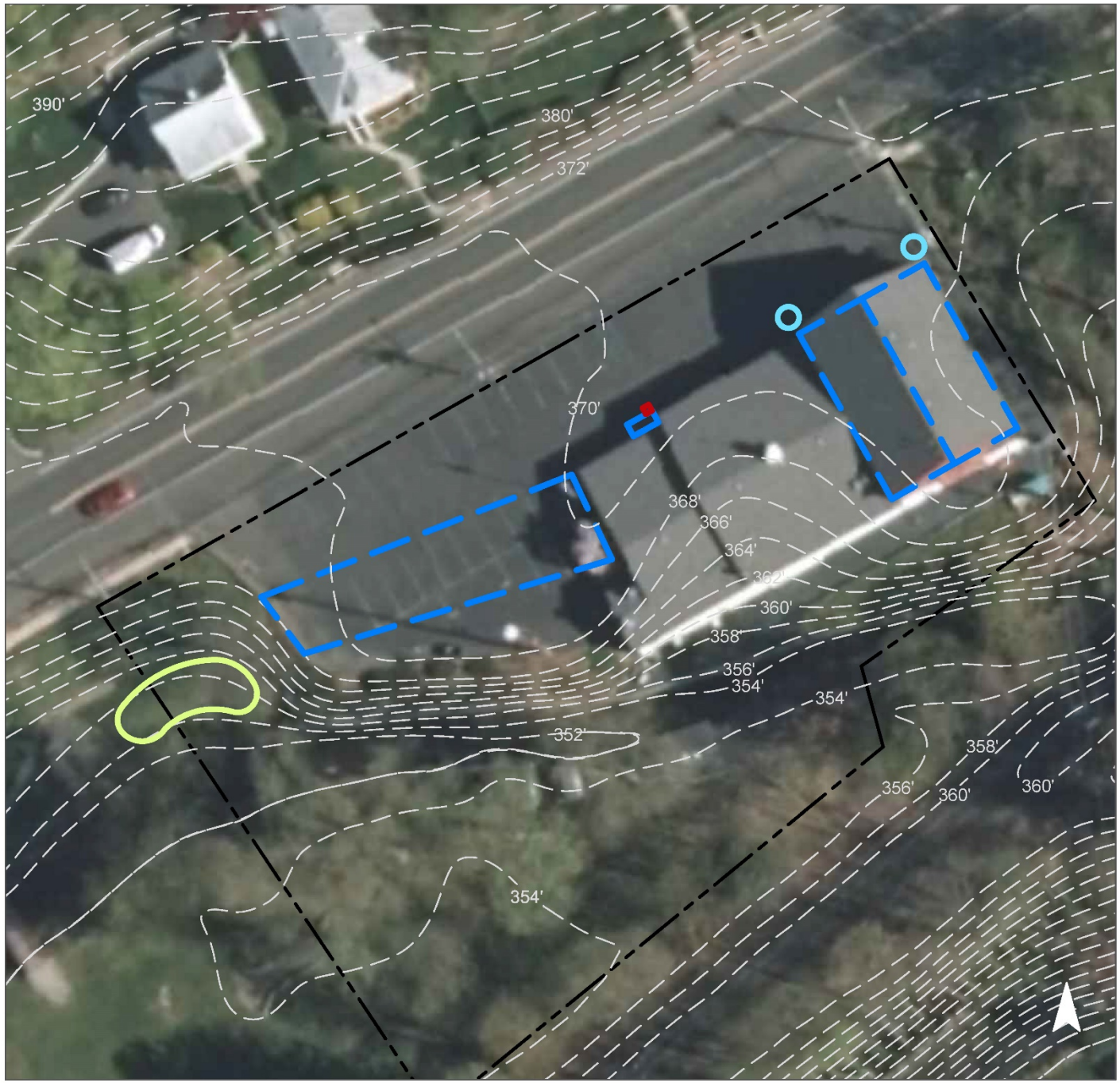
Block and Lot: Block 97, Lot 2

Cisterns can be installed at the northeast and west corners of the main building to capture and reuse stormwater. A downspout planter box can be installed next to the main entrance to capture and filter stormwater. A rain garden can be installed at the bottom of the hill to help manage stormwater causing erosion along the hill. Additional measures should be taken to stabilize the slope. 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"
60	27,463	1.3	13.9	126.1	0.021	0.75

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	0.073	12	5,360	0.20	700	$3,500
Planter box	n/a	0.1	n/a	n/a	1 (box)	$1,000
Rainwater harvesting	0.076	13	2,280	0.26	2,280 (gal)	$4,560

GREEN INFRASTRUCTURE RECOMMENDATIONS



Bernardsville Fire Company

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

0 25' 50'

BERNARDSVILLE LIBRARY

Subwatershed: Raritan River North Branch

Site Area: 131,851 sq. ft.

Address: 1 Anderson Hill Road
Bernardsville, NJ 07924

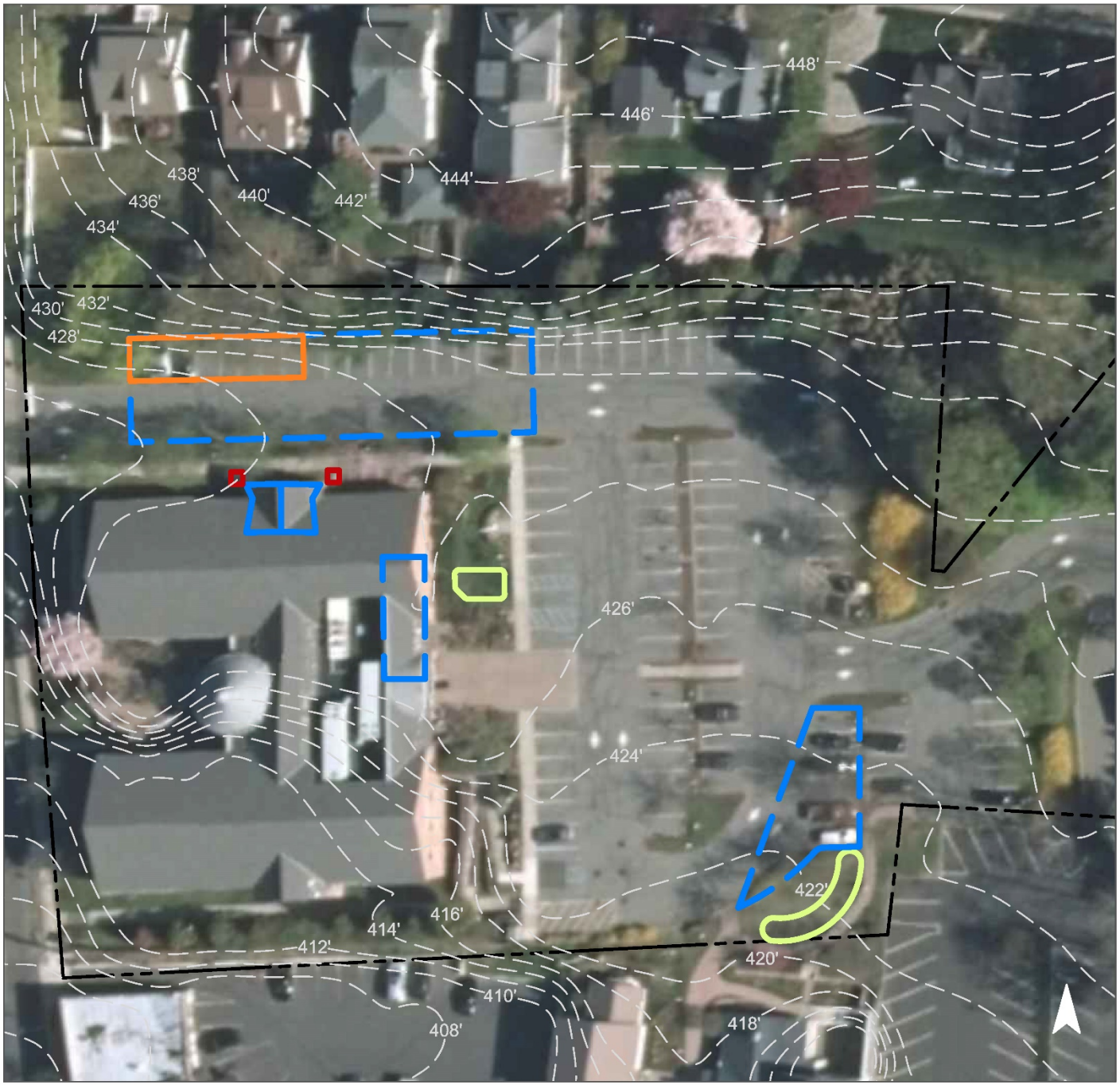
Block and Lot: Block 66, Lot 22

Downspout planter boxes can be installed alongside the northern side of the building to capture and filter stormwater. Pervious pavement can be installed in the parking spaces to the east to capture, treat, and infiltrate parking lot runoff. Rain gardens can be installed adjacent to parking spaces and downspouts to capture, treat, and infiltrate runoff from the parking lot and rooftop. 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"
81	106,775	5.1	53.9	490.2	0.083	2.93

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	4,810	0.18	680	$3,400
Pervious pavement	0.167	28	12,240	0.46	1,145	$28,625
Planter boxes	n/a	2	n/a	n/a	2 (boxes)	$2,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Bernardsville Library

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

0 30' 60'

BERNARDSVILLE MUNICIPAL COURT & NERVINE PARK

Subwatershed: Raritan River North Branch

Site Area: 465,036 sq. ft.

Address: 166 Mine Brook Road
Bernardsville, NJ 07924

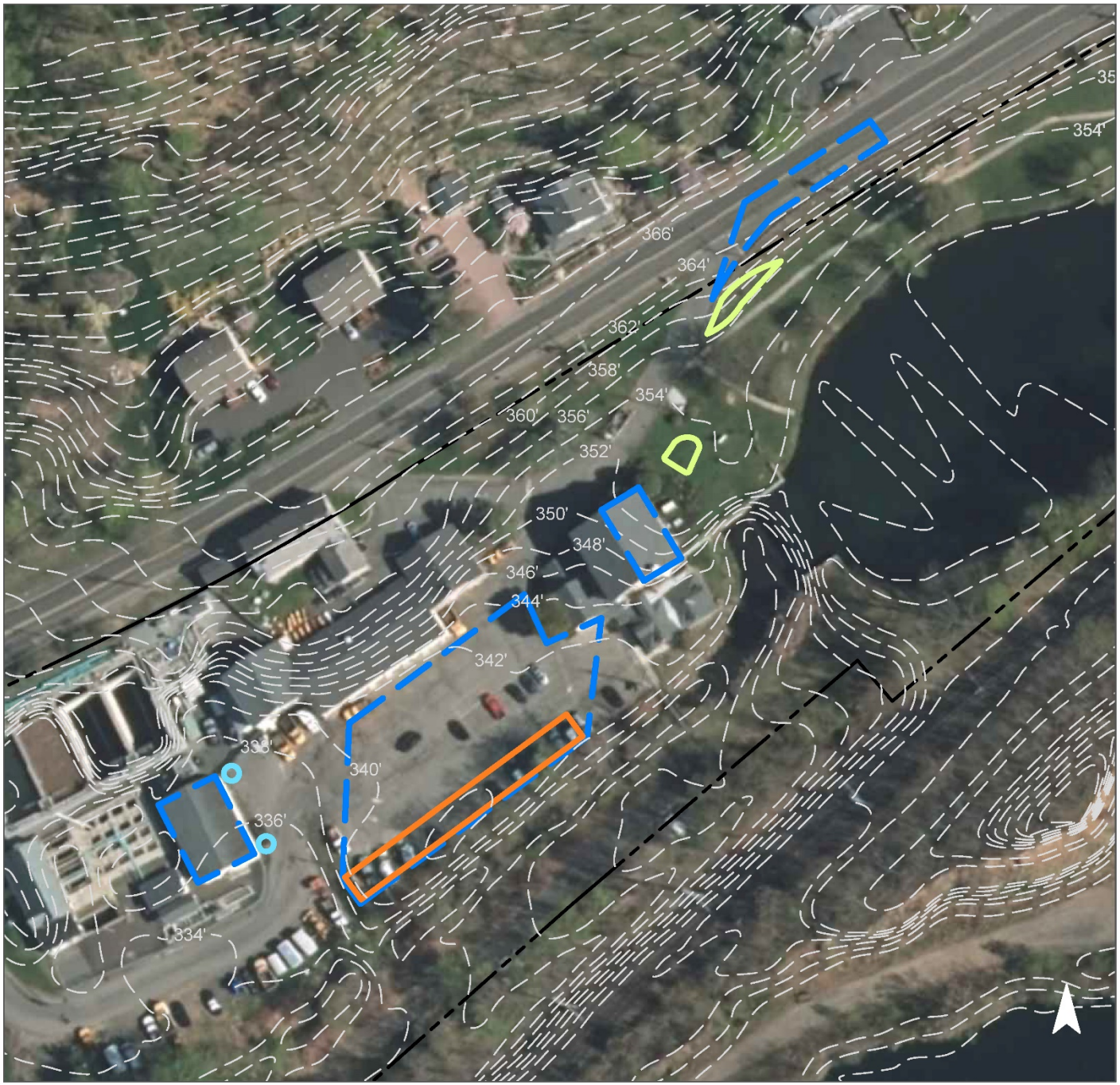
Block and Lot: Block 97, Lot 1

Pervious pavement can be installed in the parking lot to capture, treat, and infiltrate parking lot runoff. Two cisterns can be attached to the building to capture and filter stormwater runoff from the rooftop. Rain gardens can be installed adjacent to the roadways to capture, treat, and infiltrate runoff from the road. 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"
34	156,500	7.5	79.0	718.5	0.122	4.29

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
Bioretention systems	0.241	40	17,710	0.67	2,315	$11,575
Pervious pavement	0.473	79	34,690	1.30	3,240	$81,000
Rainwater harvesting	0.061	10	1,830	0.07	1,830 (gal)	$3,660

GREEN INFRASTRUCTURE RECOMMENDATIONS

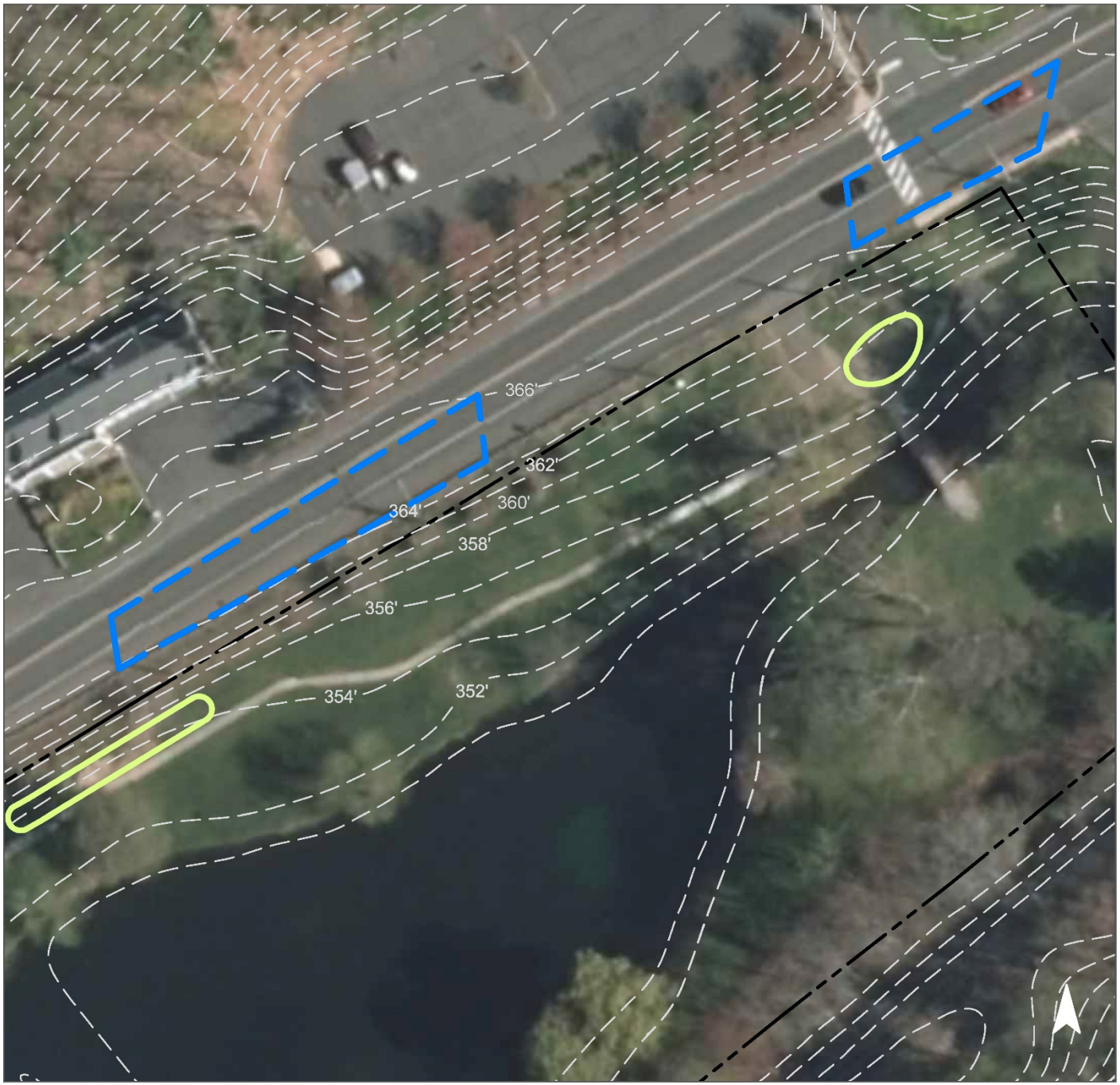


Bernardsville Municipal Court

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

0 50' 100'

GREEN INFRASTRUCTURE RECOMMENDATIONS



Nervine Park

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

0 30' 60'

BERNARDSVILLE MUNICIPAL POOL

Subwatershed: Raritan River North Branch

Site Area: 1,630,208 sq. ft.

Address: 141 Seney Drive
Bernardsville, NJ 07924

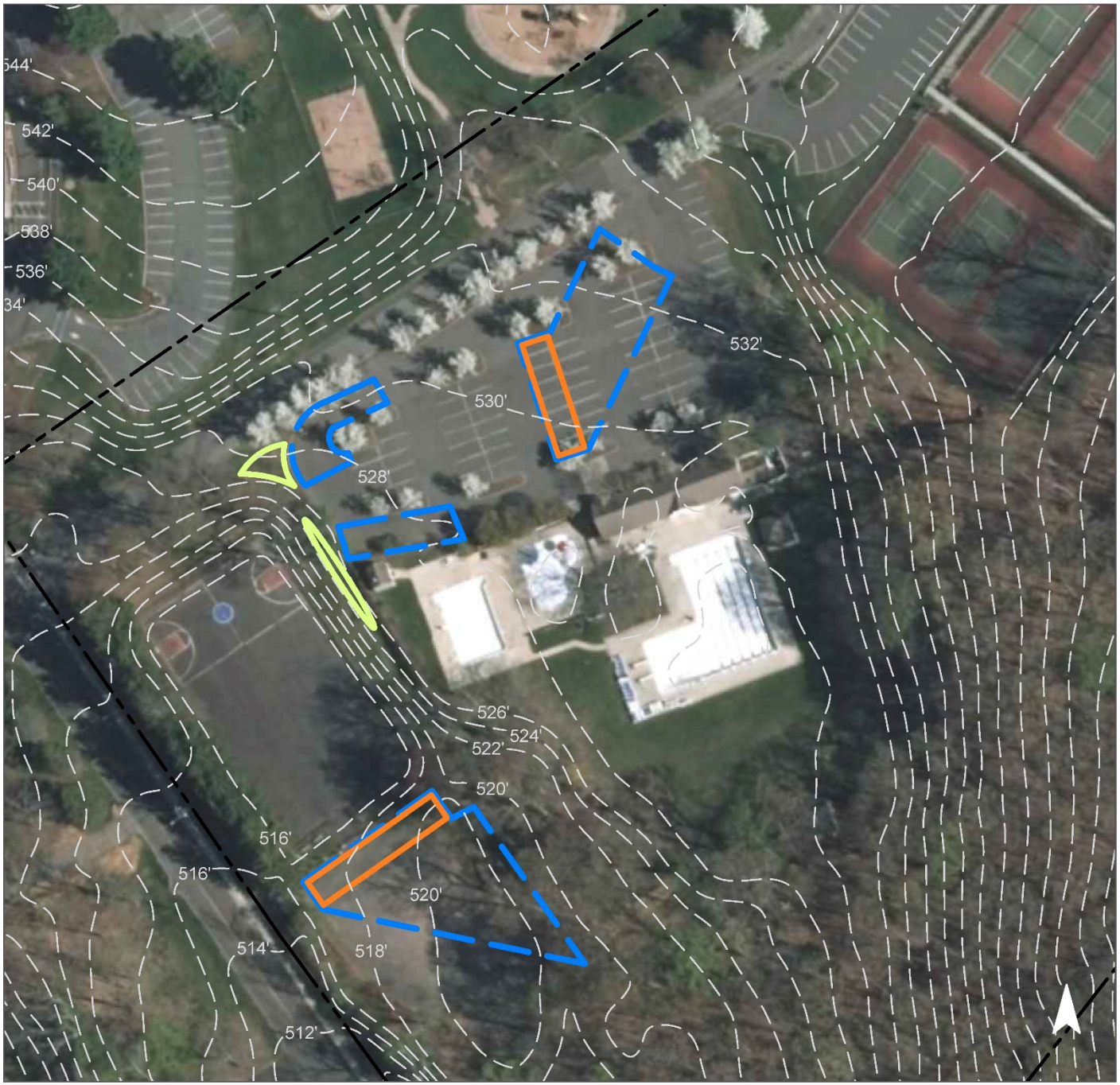
Block and Lot: Block 35, Lot 2, 6

Two sections of parking spaces can be converted to pervious pavement to capture and infiltrate parking lot runoff. Sections of turfgrass adjacent to the parking lot can be converted to rain gardens to capture, treat, and 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"
16	263,800	12.7	133.2	1,211.2	0.206	7.24

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	0.088	15	6,460	0.24	845	$4,225
Pervious pavement	0.460	77	33,760	1.27	3,150	$78,750

GREEN INFRASTRUCTURE RECOMMENDATIONS



Bernardsville Municipal Pool

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

0 50' 100'

BERNARDSVILLE SCHOOL OF MUSIC

Subwatershed: Raritan River North Branch

Site Area: 36,235 sq. ft.

Address: 75 Claremont Road #101
Bernardsville, NJ 07924

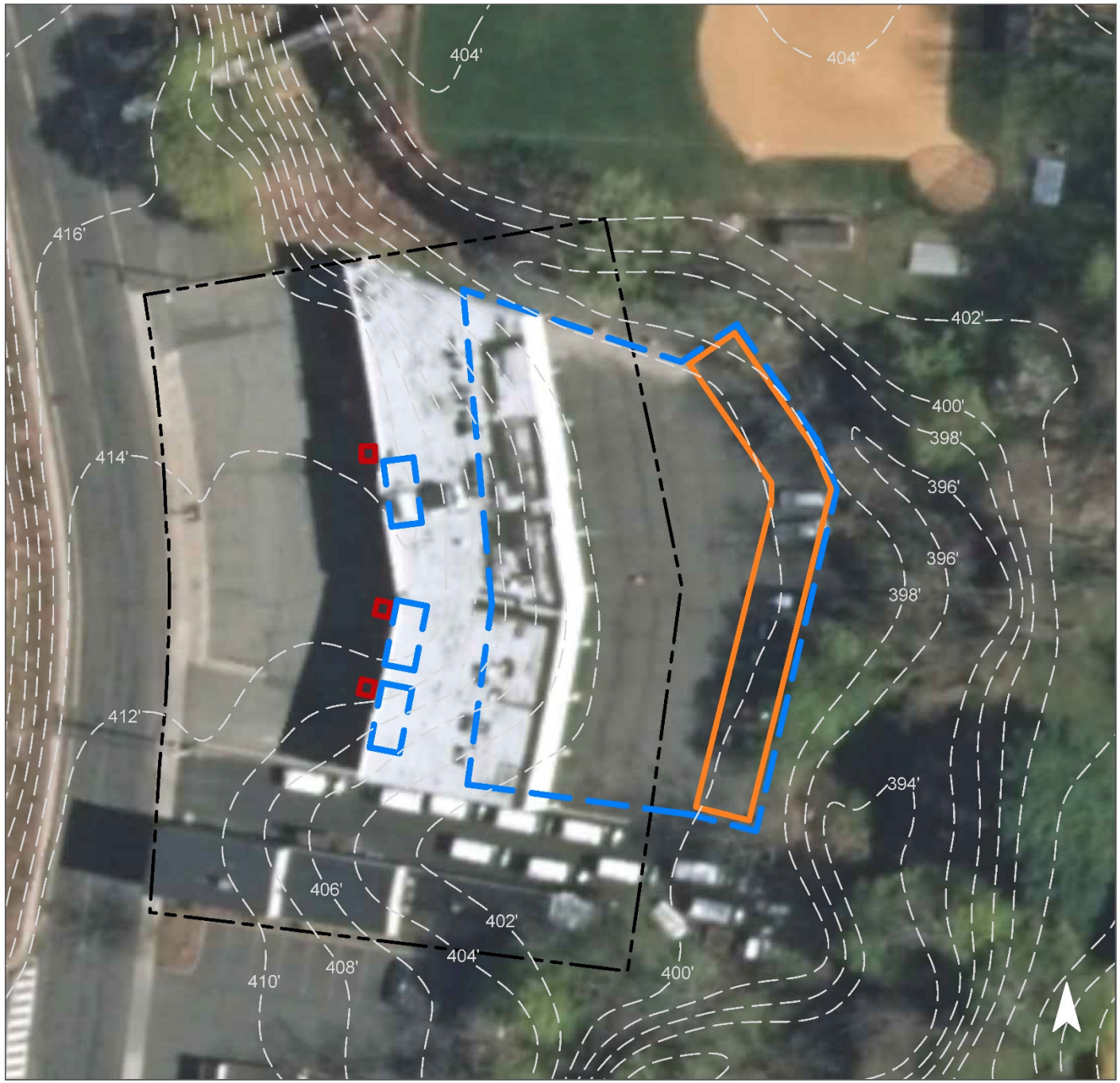
Block and Lot: Block 69, Lot 5, 6, 7

Pervious pavement can be installed in the back parking lot to capture, treat, and infiltrate parking lot runoff. Downspout planter boxes can be installed at the bases of the downspouts connected to the support beams at the southeast corner of the building to capture and filter 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"
81	29,441	1.4	14.9	135.2	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
Pervious pavement	0.423	71	31,050	1.17	2,900	$72,500
Planter boxes	n/a	2	n/a	n/a	3 (boxes)	$3,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Bernardsville School of Music

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

0 25' 50'

CHURCH OF SAINT JOHN OF THE MOUNTAIN

Subwatershed: Raritan River North Branch

Site Area: 124,250 sq. ft.

Address: 370 Mount Harmony Road
Bernardsville, NJ 07924

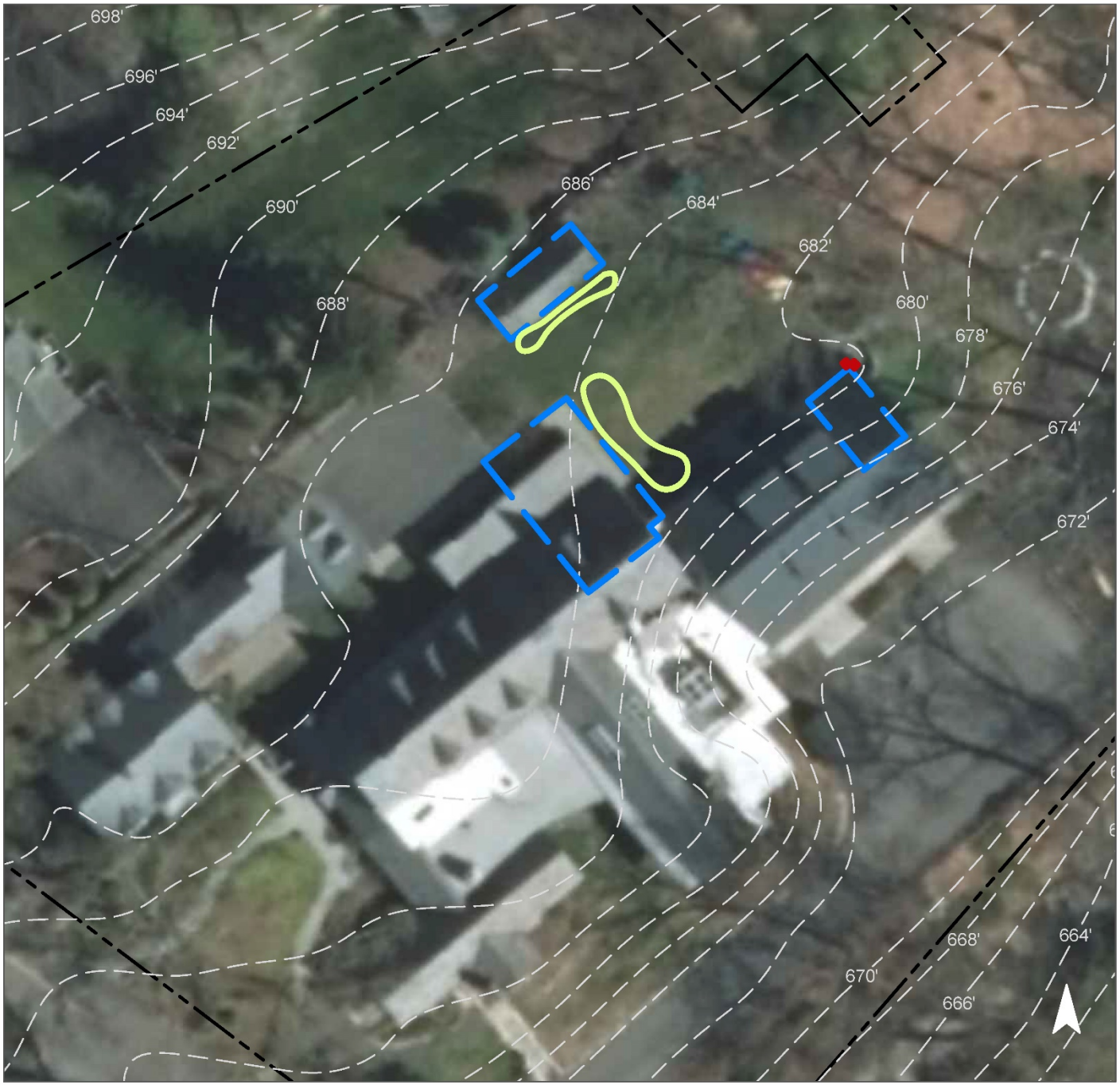
Block and Lot: Block 14, Lot 21

Rain gardens can be installed at the corner of the sidewalk and adjacent to the shed to the north of the church to capture, treat, and infiltrate rooftop runoff. Downspout planter boxes can be installed at the northeast corner of the building to capture and filter 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"
27	33,683	1.6	17.0	154.7	0.026	0.92

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	3,100	0.14	405	$2,025
Planter boxes	n/a	1	n/a	n/a	2 (boxes)	$2,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Church of Saint John of the Mountain

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

0 20' 40'

FAR HILLS COUNTRY DAY SCHOOL

Subwatershed: Raritan River North Branch

Site Area: 803,550 sq. ft.

Address: 697 US-202
Far Hills, NJ 07931

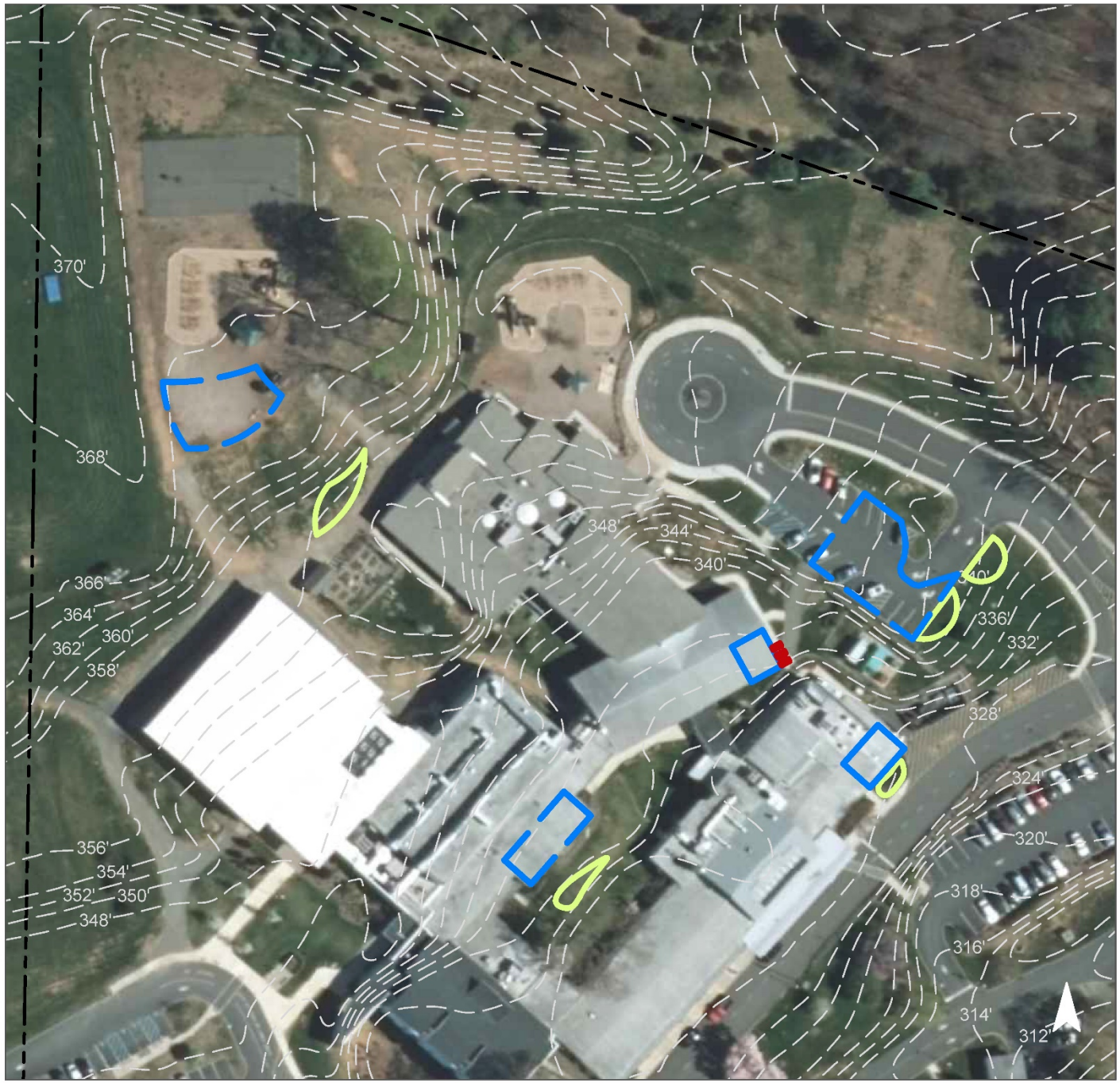
Block and Lot: Block 89, Lot 10

Rain gardens can be installed in the turfgrass to capture, treat, and infiltrate rooftop and parking lot runoff. Downspout planter boxes can be installed in the courtyard to capture and filter 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"
44	350,940	16.9	177.2	1,611.3	0.273	9.63

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	0.229	38	16,820	0.63	2,200	$11,000
Planter boxes	n/a	2	n/a	n/a	3 (boxes)	$3,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Far Hills Country Day School

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

0 50' 100'

FIRST CHURCH OF CHRIST, SCIENTIST

Subwatershed: Raritan River North Branch

Site Area: 101,910 sq. ft.

Address: 11 Meeker Road
Bernardsville, NJ 07924

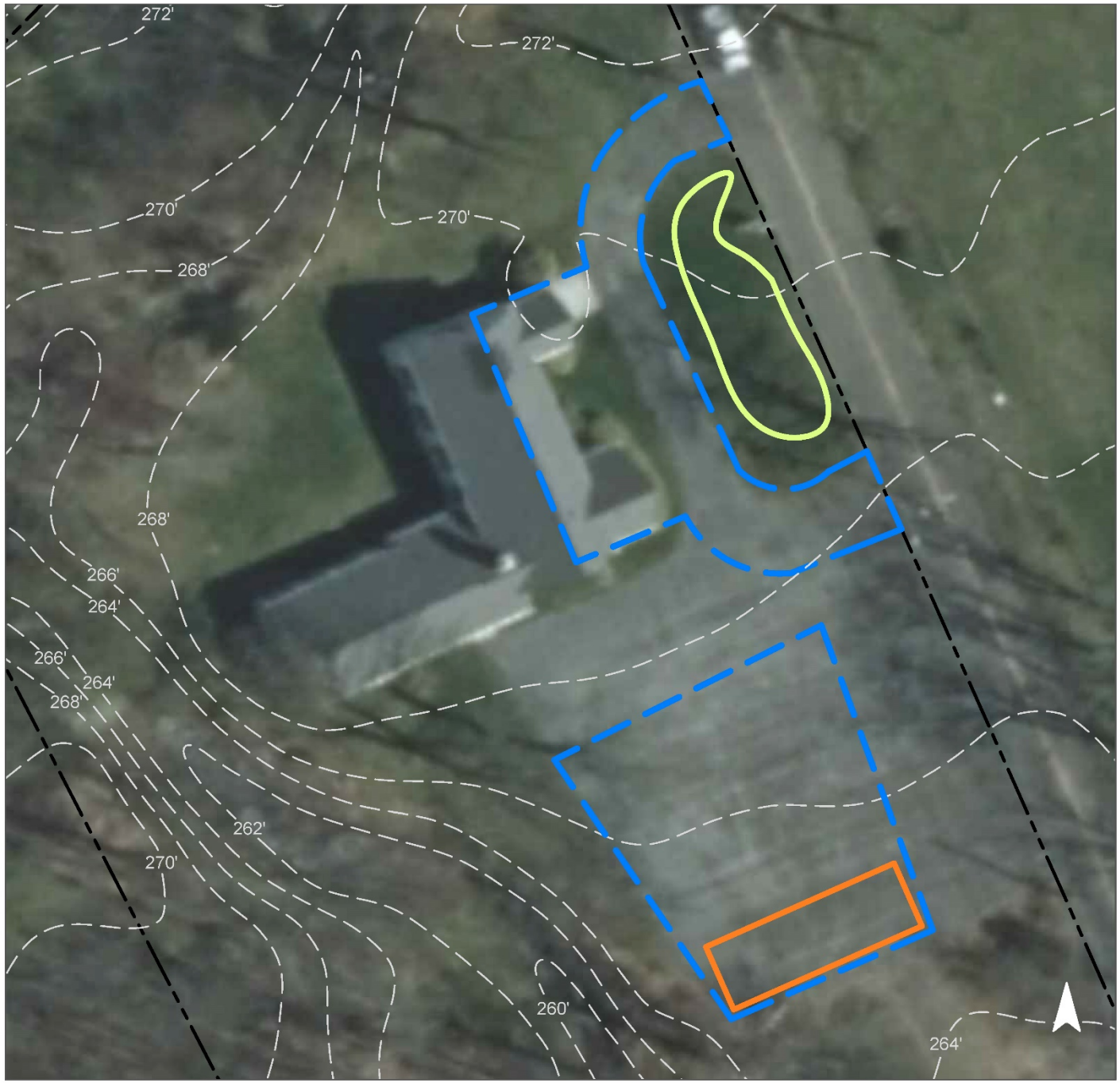
Block and Lot: Block 94, Lot 19

A rain garden can be installed in the turfgrass court to capture, treat, and infiltrate parking lot runoff. Pervious pavement can be installed in the parking spaces to capture, treat, and 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"
29	29,507	1.4	14.9	135.5	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	0.133	22	9,790	0.37	1,280	$6,400
Pervious pavement	0.141	24	10,380	0.39	970	$24,250

GREEN INFRASTRUCTURE RECOMMENDATIONS



First Church of Christ, Scientist

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

0 20' 40'

GOOD SHEPHERD CHURCH

Subwatershed: Raritan River North Branch

Site Area: 372,570 sq. ft.

Address: 321 Mine Brook Road
Bernardsville, NJ 07924

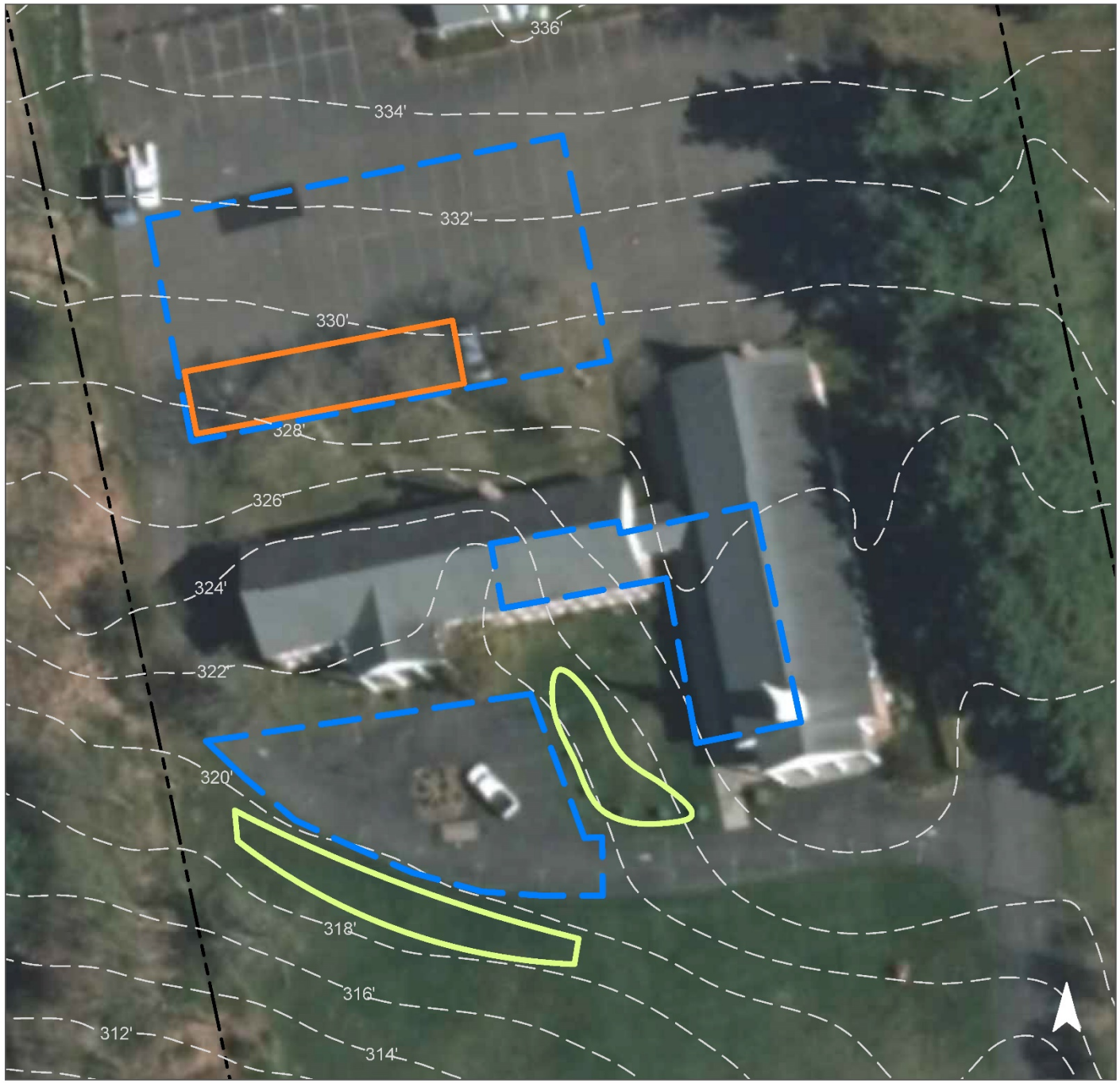
Block and Lot: Block 81, Lot 3

Rain gardens can be installed in the courtyard in the corner of the building and adjacent to the parking lot south of the building to capture, treat, and infiltrate rooftop and parking lot runoff. Pervious pavement can be installed in the small area of parking spaces in front and in the larger parking lot in the rear of the building to capture, treat, and 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"
19	71,293	3.4	36.0	327.3	0.056	1.96

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	0.231	39	16,920	0.64	2,215	$11,075
Pervious pavement	0.270	45	19,810	0.74	1,850	$46,250

GREEN INFRASTRUCTURE RECOMMENDATIONS



Good Shepherd Church

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

0 25' 50'

SACRED HEART CHAPEL

Subwatershed: Raritan River North Branch

Site Area: 15,409 sq. ft.

Address: 47 Bernards Avenue
Bernardsville, NJ 07924

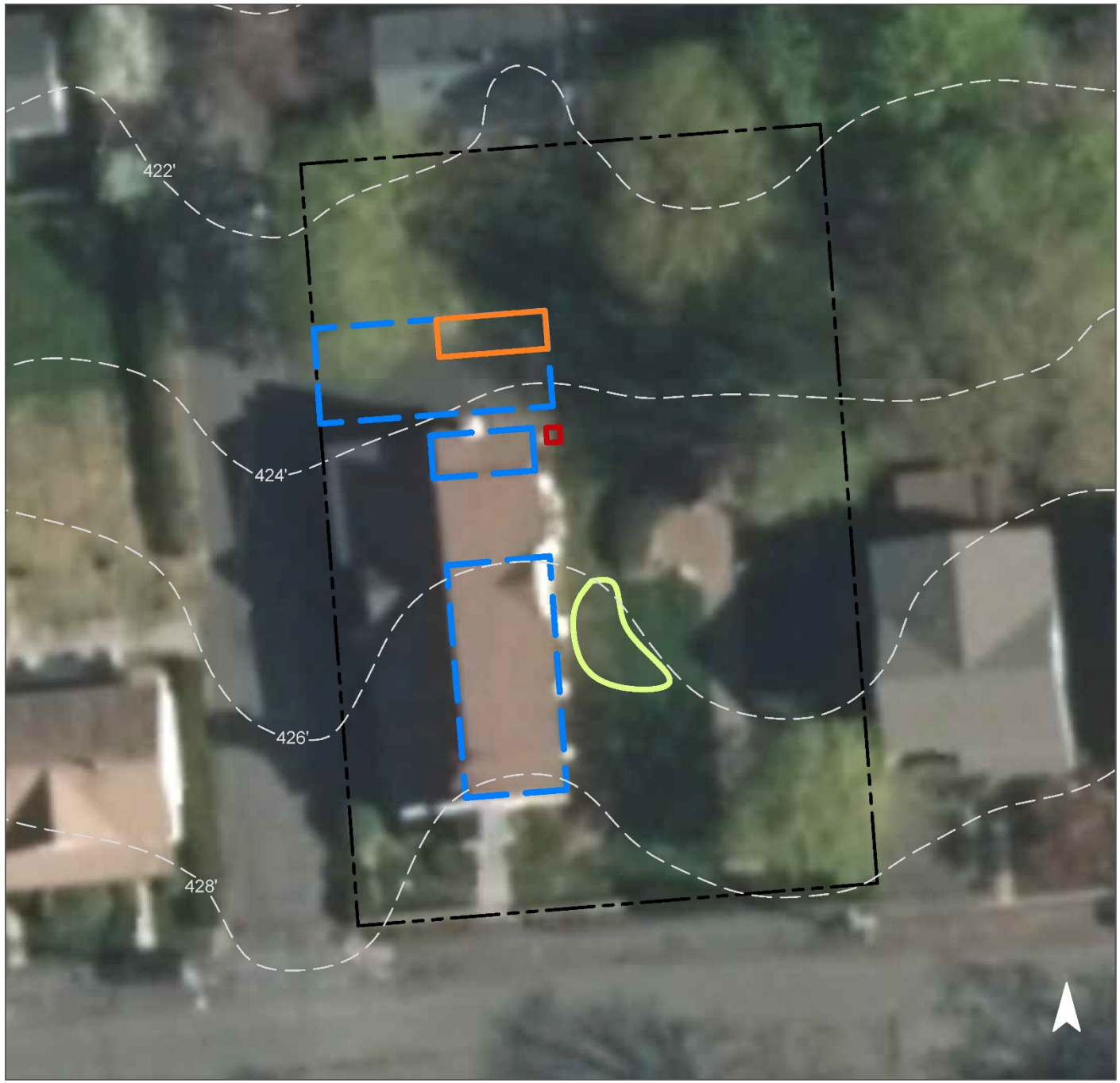
Block and Lot: Block 105, Lots 1,12

A rain garden can be installed on the eastern side of the church to capture, treat, and infiltrate rooftop runoff. A downspout planter box can be installed at the northeast corner of the church to capture and filter stormwater. Pervious pavement can be installed in the parking spaces north of the building to capture, treat, and 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"
50	7,656	0.4	3.9	35.2	0.006	0.21

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 system	0.024	4	1,770	0.07	230	$1,150
Pervious pavement	0.022	4	1,650	0.06	160	$4,000
Planter box	n/a	1	n/a	n/a	1 (box)	$1,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Sacred Heart Chapel

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

0 15' 30'

SCHOOL OF SAINT ELIZABETH

Subwatershed: Raritan River North Branch

Site Area: 263,055 sq. ft.

Address: 30 Seney Drive
Bernardsville, NJ 07924

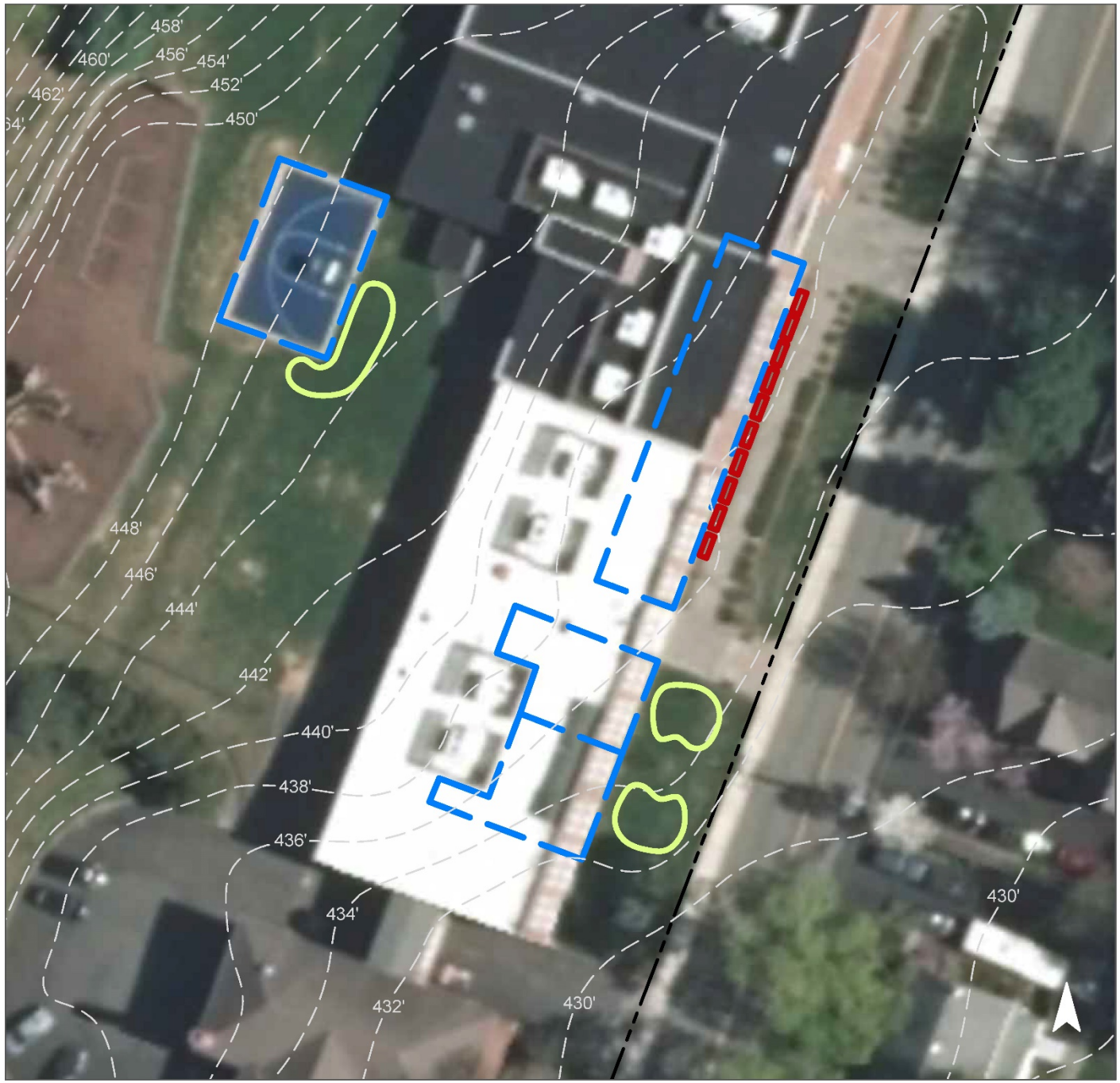
Block and Lot: Block 39, Lot 6

Rain gardens can be installed on either side of the red tree shown to the southeast of the school and along the southeast corner of the tennis court to capture, treat, and infiltrate rooftop and pavement runoff. Downspout planter boxes can be installed to the right of the main entrance to capture and filter 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"
42	110,897	5.3	56.0	509.2	0.086	3.04

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	0.083	14	6,120	0.23	815	$4,075
Planter boxes	n/a	8	n/a	n/a	10 (boxes)	$10,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



School of Saint Elizabeth

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

0 20' 40'

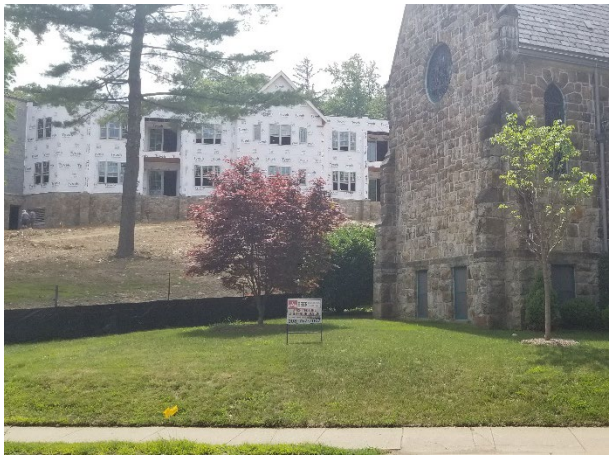
SAINT BERNARD'S CHURCH

Subwatershed: Raritan River North Branch

Site Area: 158,487 sq. ft.

Address: 88 Claremont Road
Bernardsville, NJ 07924

Block and Lot: Block 68, Lot 9



A rain garden can be installed along the southeast side of the church and at the bottom of a hill on the property to capture, treat, and infiltrate parking lot and 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"
50	78,635	3.8	39.7	361.0	0.061	2.16

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	0.056	9	4,130	0.16	540	$2,700

GREEN INFRASTRUCTURE RECOMMENDATIONS

Saint Bernard's Church

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

0 25' 50'

BERNARDS HIGH SCHOOL & SOMERSET HILLS SCHOOL DISTRICT

Subwatershed: Upper Passaic River

Site Area: 1,107,539 sq. ft.

Address: 25 Olcott Avenue
Bernardsville, NJ 07924

Block and Lot: Block 64, Lot 1

Rain gardens can be installed in the front of the School District building to capture, treat, and infiltrate runoff from connected downspouts. A section of parking spaces in the high school parking lot can be converted to porous asphalt, which will then overflow to a rain garden to capture, treat, and infiltrate runoff from the parking lot. A turfgrass area can be converted to a rain garden to capture runoff from the roadway in front of the high school. 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"
50	554,590	26.7	280.1	2,546.3	0.432	15.21

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	0.422	71	30,980	1.16	3,560	$17,800
Pervious pavement	0.473	79	34,740	1.31	3,245	$81,125

GREEN INFRASTRUCTURE RECOMMENDATIONS

Somerset Hills School District

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

c. Summary of Existing Conditions

Summary of Existing Conditions

	Subwatershed/Site Name/Total Site Info/GI Practice	Area (ac)	Area (SF)	Block	Lot	I.C. %	I.C. Area (ac)	I.C. Area (SF)	Existing Annual Loads (Commercial) TP (lb/yr)	TN (lb/yr)	TSS (lb/yr)	Runoff Volumes from I.C. Water Quality Storm (1.25" over 2-hours) (cu.ft.)	Runoff Volumes from I.C. Annual (cu.ft.)	Runoff Volumes from I.C. Water Quality Storm (1.25" over 2-hours) (Mgal)	Runoff Volumes from I.C. Annual (Mgal)
	RARITAN RIVER NORTH BRANCH	**110.95**	**4,832,864**				**37.29**	**1,624,413**	**78.3**	**820.4**	**7,458.3**	**169,210**	**5,956,179**	**1.266**	**44.55**
1	**Bedwell Elementary School**														
	Total Site Info	15.71	684,276	35	1	52	8.21	357,822	17.3	180.7	1,642.9	37,273	1,312,016	0.279	9.81
2	**Bernardsville Fire Company**														
	Total Site Info	1.06	46,026	97	2	60	0.63	27,463	1.3	13.9	126.1	2,861	100,699	0.021	0.75
3	**Bernardsville Library**														
	Total Site Info	3.03	131,851	66	22	81	2.45	106,775	5.1	53.9	490.2	11,122	391,507	0.083	2.93
4	**Bernardsville Municipal Court & Nervine Park**														
	Total Site Info	10.68	465,036	97	1	34	3.59	156,500	7.5	79.0	718.5	16,302	573,833	0.122	4.29
5	**Bernardsville Municipal Pool**														
	Total Site Info	37.42	1,630,208	35	2, 6	16	6.06	263,800	12.7	133.2	1,211.2	27,479	967,267	0.206	7.24
6	**Bernardsville School of Music**														
	Total Site Info	0.83	36,235	69	5, 6, 7	81	0.68	29,441	1.4	14.9	135.2	3,067	107,952	0.023	0.81
7	**Church of Saint John of the Mountain**														
	Total Site Info	2.85	124,250	14	21	27	0.77	33,683	1.6	17.0	154.7	3,509	123,505	0.026	0.92
8	**Far Hills Country Day School**														
	Total Site Info	18.45	803,550	89	10	44	8.06	350,940	16.9	177.2	1,611.3	36,556	1,286,779	0.273	9.63
9	**First Church of Christ, Scientist**														
	Total Site Info	2.34	101,910	94	19	29	0.68	29,507	1.4	14.9	135.5	3,074	108,193	0.023	0.81
10	**Good Shepherd Church**														
	Total Site Info	8.55	372,570	81	3	19	1.64	71,293	3.4	36.0	327.3	7,426	261,409	0.056	1.96
11	**Sacred Heart Chapel**														
	Total Site Info	0.35	15,409	105	1, 12	50	0.18	7,656	0.4	3.9	35.2	797	28,072	0.006	0.21
12	**School of Saint Elizabeth Alumni**														
	Total Site Info	6.04	263,055	39	6	42	2.55	110,897	5.3	56.0	509.2	11,552	406,621	0.086	3.04
13	**Saint Bernard's Church**														
	Total Site Info	3.64	158,487	68	9	50	1.81	78,635	3.8	39.7	361.0	8,191	288,328	0.061	2.16
	UPPER PASSAIC RIVER	**25.43**	**1,107,539**				**12.73**	**554,590**	**26.7**	**280.1**	**2,546.3**	**57,770**	**2,033,496**	**0.432**	**15.21**
14	**Bernardsville High School & Somerset Hills School District**														
	Total Site Info	25.43	1,107,539	64	1	50	12.73	554,590	26.7	280.1	2,546.3	57,770	2,033,496	0.432	15.21

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)		($/unit)		($)	%
	RARITAN RIVER NORTH BRANCH	**154,440**	**3.55**	**3.929**	**671**	**282,155**	**10.79**				**$485,525**	**9.5%**
1	**Bedwell Elementary School**											
	Bioretention systems	13,470	0.31	0.351	59	25,750	0.97	3,370	$5	SF	$16,850	3.8%
	Pervious pavement	10,680	0.25	0.278	47	20,420	0.77	1,925	$25	SF	$48,125	3.0%
	Rainwater harvesting	150	0.00	0.004	1	115	0.00	115	$2	gal	$230	0.0%
	Total Site Info	**24,300**	**0.56**	**0.633**	**106**	**46,285**	**1.74**				**$65,205**	**6.8%**
2	**Bernardsville Fire Company**											
	Bioretention system	2,800	0.06	0.073	12	5,360	0.20	700	$5	SF	$3,500	10.2%
	Planter box	40	0.00	n/a	0.1	n/a	n/a	1	$1,000	box	$1,000	0.1%
	Rainwater harvesting	2,920	0.07	0.076	13	2,280	0.26	2,280	$2	gal	$4,560	10.6%
	Total Site Info	**5,760**	**0.13**	**0.149**	**25**	**7,640**	**0.46**				**$9,060**	**21.0%**
3	**Bernardsville Library**											
	Bioretention systems	2,515	0.06	0.066	11	4,810	0.18	680	$5	SF	$3,400	2.4%
	Pervious pavement	6,400	0.15	0.167	28	12,240	0.46	1,145	$25	SF	$28,625	6.0%
	Planter boxes	430	0.01	n/a	2	n/a	n/a	2	$1,000	box	$2,000	0.4%
	Total Site Info	**6,830**	**0.16**	**0.167**	**29**	**12,240**	**0.46**				**$30,625**	**8.8%**
4	**Bernardsville Municipal Court & Nervine Park**											
	Bioretention systems	9,260	0.21	0.241	40	17,710	0.67	2,315	$5	SF	$11,575	5.9%
	Pervious pavement	18,145	0.42	0.473	79	34,690	1.30	3,240	$25	SF	$81,000	11.6%
	Rainwater harvesting	2,350	0.05	0.061	10	1,830	0.07	1,830	$2	gal	$3,660	1.5%
	Total Site Info	**29,755**	**0.68**	**0.775**	**130**	**54,230**	**2.04**				**$96,235**	**19.0%**
5	**Bernardsville Municipal Pool**											
	Bioretention systems	3,380	0.08	0.088	15	6,460	0.24	845	$5	SF	$4,225	1.3%
	Pervious pavement	17,660	0.41	0.460	77	33,760	1.27	3,150	$25	SF	$78,750	6.7%
	Total Site Info	**21,040**	**0.48**	**0.548**	**92**	**40,220**	**1.51**				**$82,975**	**8.0%**
6	**Bernardsville School of Music**											
	Pervious pavement	16,240	0.37	0.423	71	31,050	1.17	2,900	$25	SF	$72,500	55.2%
	Planter boxes	645	0.01	n/a	2	n/a	n/a	3	$1,000	box	$3,000	2.2%
	Total Site Info	**16,240**	**0.37**	**0.423**	**71**	**31,050**	**1.17**				**$72,500**	**57.4%**
7	**Church of Saint John of the Mountain**											
	Bioretention systems	1,620	0.04	0.042	7	3,100	0.12	405	$5	SF	$2,025	4.8%
	Planter boxes	320	0.01	n/a	1	n/a	n/a	2	$1,000	box	$2,000	1.0%
	Total Site Info	**1,940**	**0.04**	**0.042**	**8**	**3,100**	**0.12**				**$4,025**	**5.8%**
8	**Far Hills Country Day School**											

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)		($/unit)		($)	%
	Bioretention systems	8,800	0.20	0.229	38	16,820	0.63	2,200	$5	SF	$11,000	2.5%
	Planter boxes	600	0.01	n/a	2	n/a	n/a	3	$1,000	box	$3,000	0.2%
	Total Site Info	**9,400**	**0.22**	**0.229**	**41**	**16,820**	**0.63**				**$14,000**	**2.7%**
9	**First Church of Christ, Scientist**											
	Bioretention system	5,120	0.12	0.133	22	9,790	0.37	1,280	$5	SF	$6,400	17.4%
	Pervious pavement	5,430	0.12	0.141	24	10,380	0.39	970	$25	SF	$24,250	18.4%
	Total Site Info	**10,550**	**0.24**	**0.275**	**46**	**20,170**	**0.76**				**$30,650**	**35.8%**
10	**Good Shepherd Church**											
	Bioretention systems	8,850	0.20	0.231	39	16,920	0.64	2,215	$5	SF	$11,075	12.4%
	Pervious pavement	10,360	0.24	0.270	45	19,810	0.74	1,850	$25	SF	$46,250	14.5%
	Total Site Info	**19,210**	**0.44**	**0.501**	**84**	**36,730**	**1.38**				**$57,325**	**26.9%**
11	**Sacred Heart Chapel**											
	Bioretention system	925	0.02	0.024	4	1,770	0.07	230	$5	SF	$1,150	12.1%
	Pervious pavement	860	0.02	0.022	4	1,650	0.06	160	$25	SF	$4,000	11.2%
	Planter box	170	0.00	n/a	1	n/a	n/a	1	$1,000	box	$1,000	2.2%
	Total Site Info	**1,955**	**0.04**	**0.047**	**8**	**3,420**	**0.13**				**$6,150**	**25.5%**
12	**School of Saint Elizabeth Alumni**											
	Bioretention systems	3,200	0.07	0.083	14	6,120	0.23	815	$5	SF	$4,075	2.9%
	Planter boxes	2,100	0.05	n/a	8	n/a	n/a	10	$1,000	box	$10,000	1.9%
	Total Site Info	**5,300**	**0.12**	**0.083**	**22**	**6,120**	**0.23**				**$14,075**	**4.8%**
13	**Saint Bernard's Church**											
	Bioretention systems	2,160	0.05	0.056	9	4,130	0.16	540	$5	SF	$2,700	2.7%
	Total Site Info	**2,160**	**0.05**	**0.056**	**9**	**4,130**	**0.16**				**$2,700**	**2.7%**
	UPPER PASSAIC RIVER	**34,375**	**0.79**	**0.896**	**150**	**65,720**	**2.47**				**$98,925**	**6.2%**
14	**Bernardsville High School & Somerset Hills School District**											
	Bioretention systems	16,205	0.37	0.422	71	30,980	1.16	3,560	$5	SF	$17,800	2.9%
	Pervious pavement	18,170	0.42	0.473	79	34,740	1.31	3,245	$25	SF	$81,125	3.3%
	Total Site Info	**34,375**	**0.79**	**0.896**	**150**	**65,720**	**2.47**				**$98,925**	**6.2%**