RUTGERS
New Jersey Agricultural
Experiment Station

Impervious Cover Reduction Action Plan
for
Lebanon Township, Hunterdon County, New Jersey

Prepared for Lebanon Township by the
Rutgers Cooperative Extension Water Resources Program

March 23, 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 Lebanon Township. We would like to thank the New Jersey Highlands Water Protection and Planning Council, the New Jersey Agricultural Experiment Station, and Lebanon Township for their input and support in creating this document.

RUTGERS
New Jersey Agricultural Experiment Station

Highlands Council
New Jersey

Table of Contents

Introduction

Located in Hunterdon County, New Jersey, Lebanon Township covers approximately 31.70 square miles. Figures 1 and 2 illustrate that Lebanon Township is dominated by forest land use. A total of 19.9% of the municipality's land use is classified as urban. Of the urban land in Lebanon Township, 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 Lebanon Township 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 Lebanon Township. Based upon the 2015 NJDEP land use/land cover data, approximately 2.9% of Lebanon Township has impervious cover. This level of impervious cover suggests that the streams in Lebanon Township are likely sensitive streams. [1]

Methodology

Lebanon Township contains portions of six subwatersheds (Figure 4). For this impervious cover reduction action plan, projects have been identified in three 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.

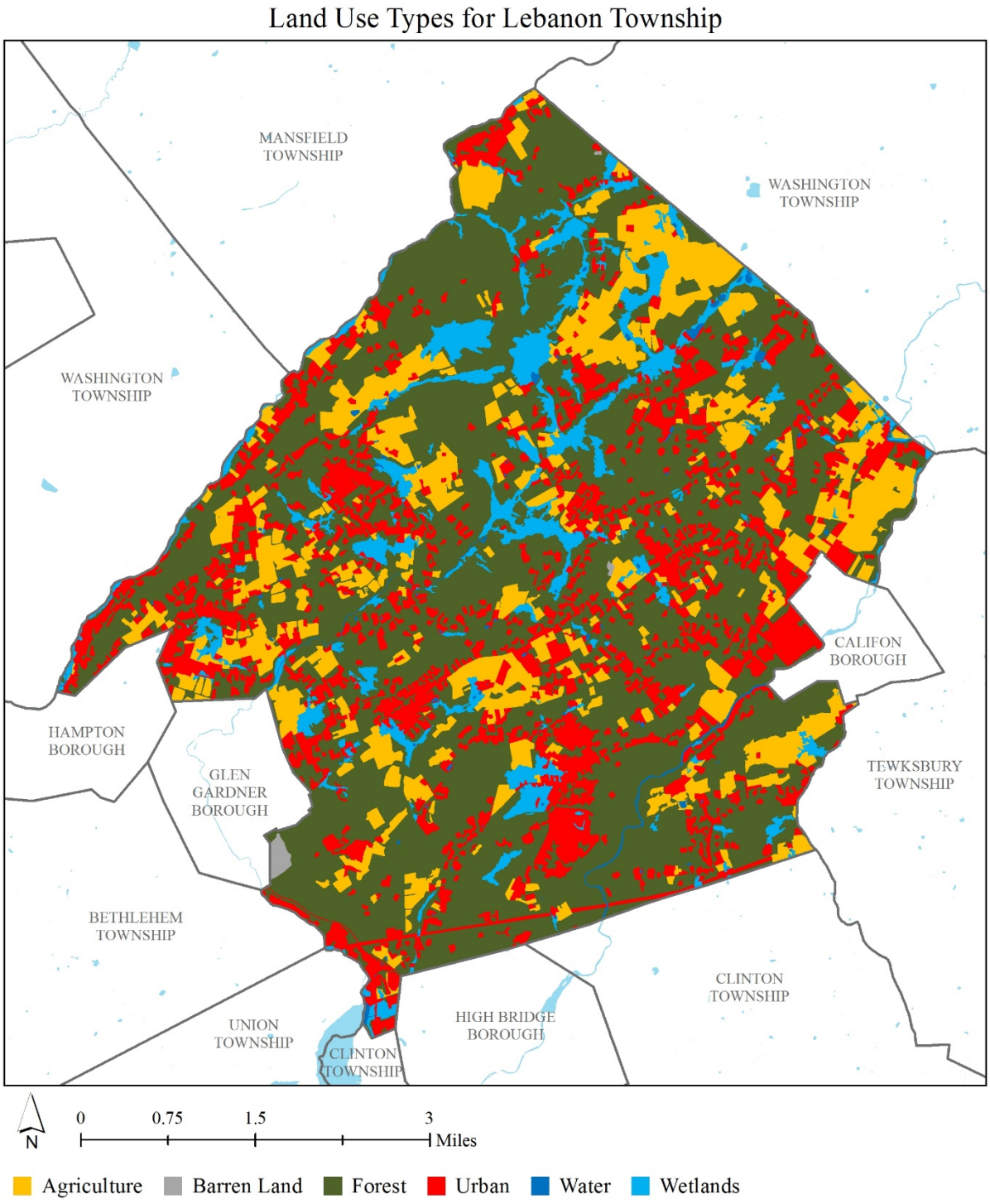


Figure 1: Map illustrating the land use in Lebanon Township

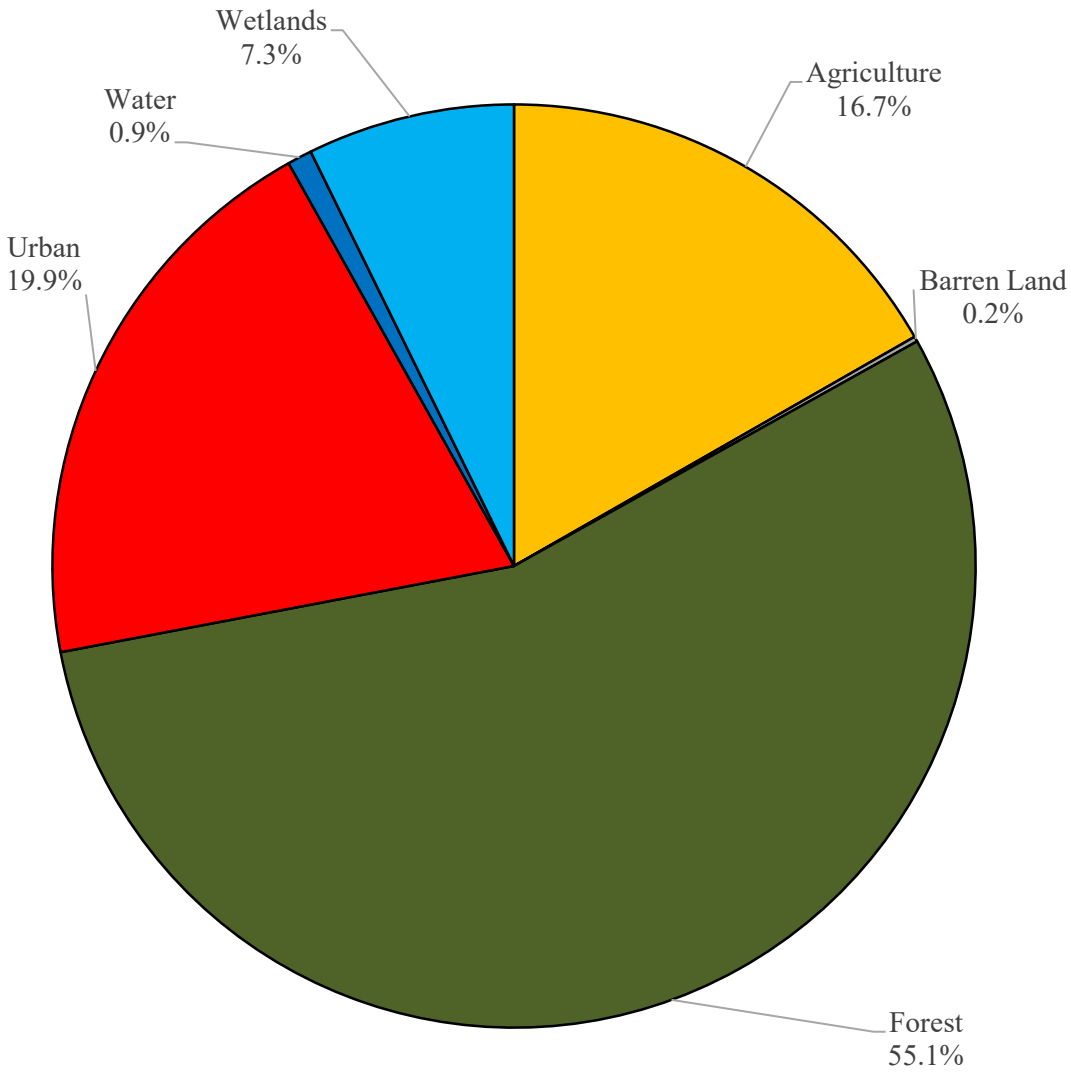


Figure 2: Pie chart illustrating the land use in Lebanon Township

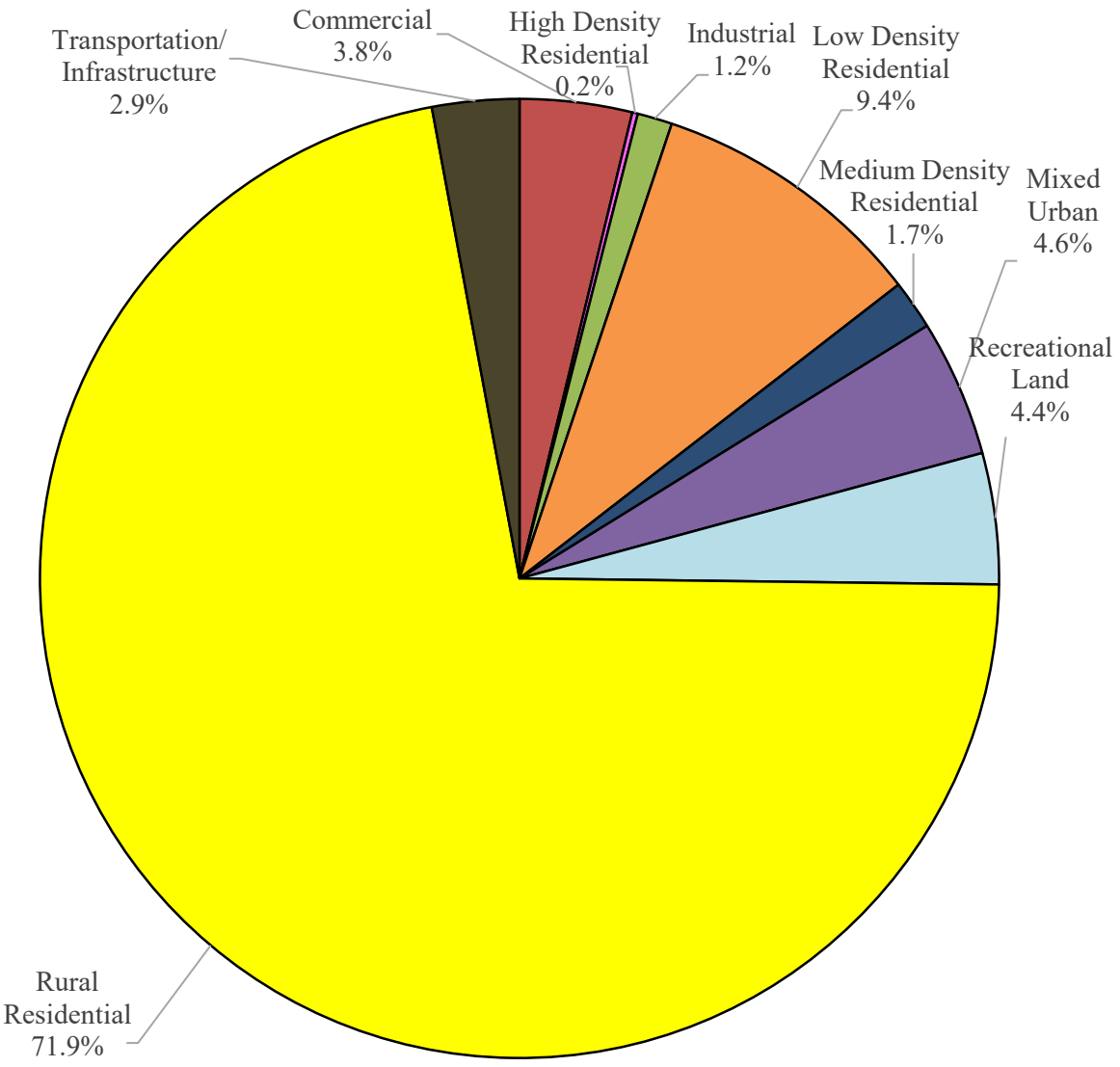


Figure 3: Pie chart illustrating the various types of urban land use in Lebanon Township

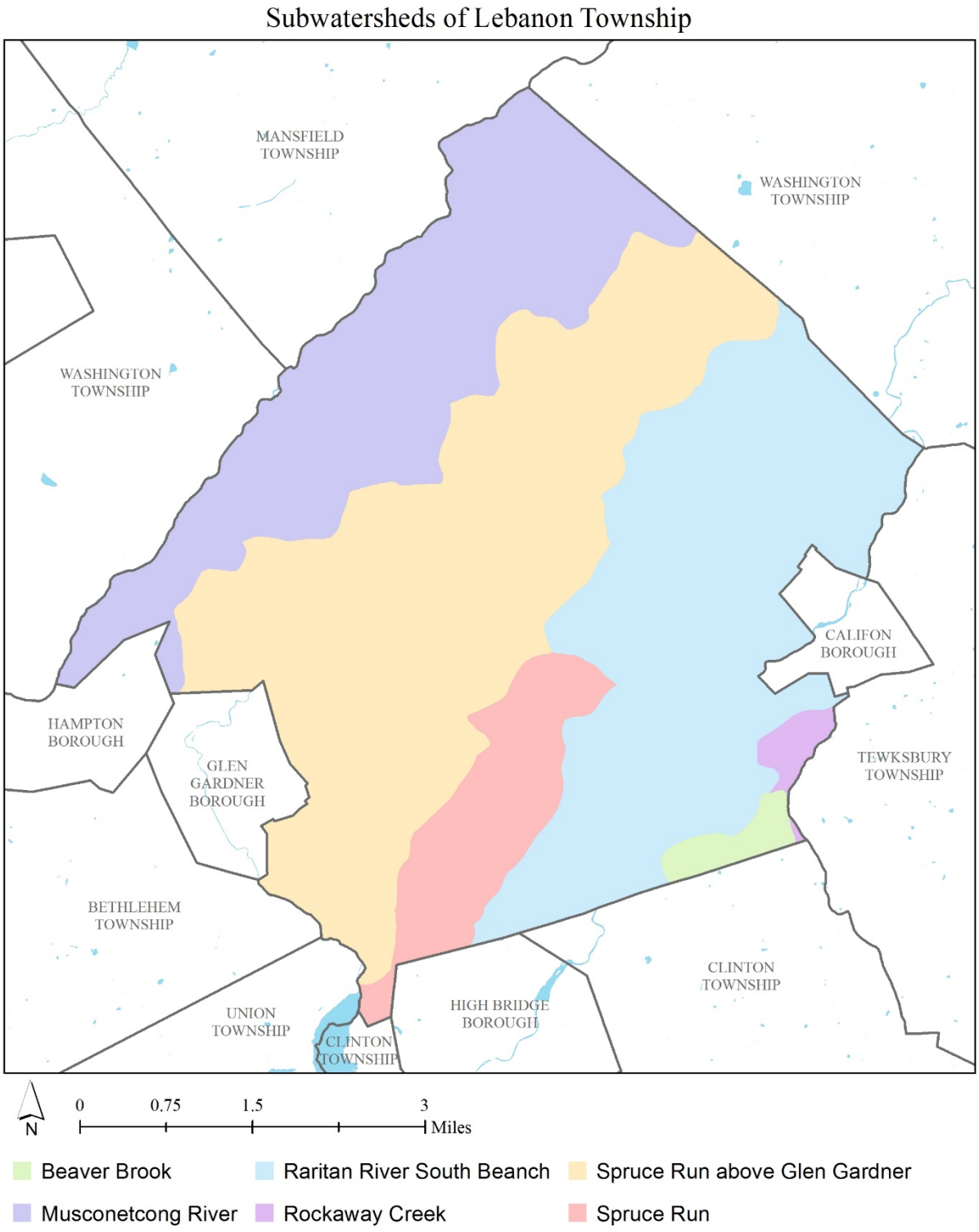


Figure 4: Map of the subwatersheds in Lebanon Township

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 Lebanon Township 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 Lebanon Township. 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.

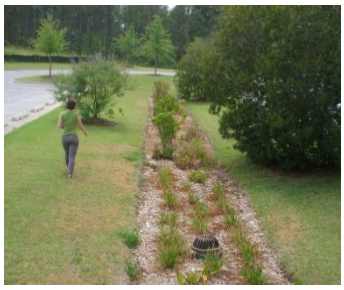
Downspout planter boxes

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

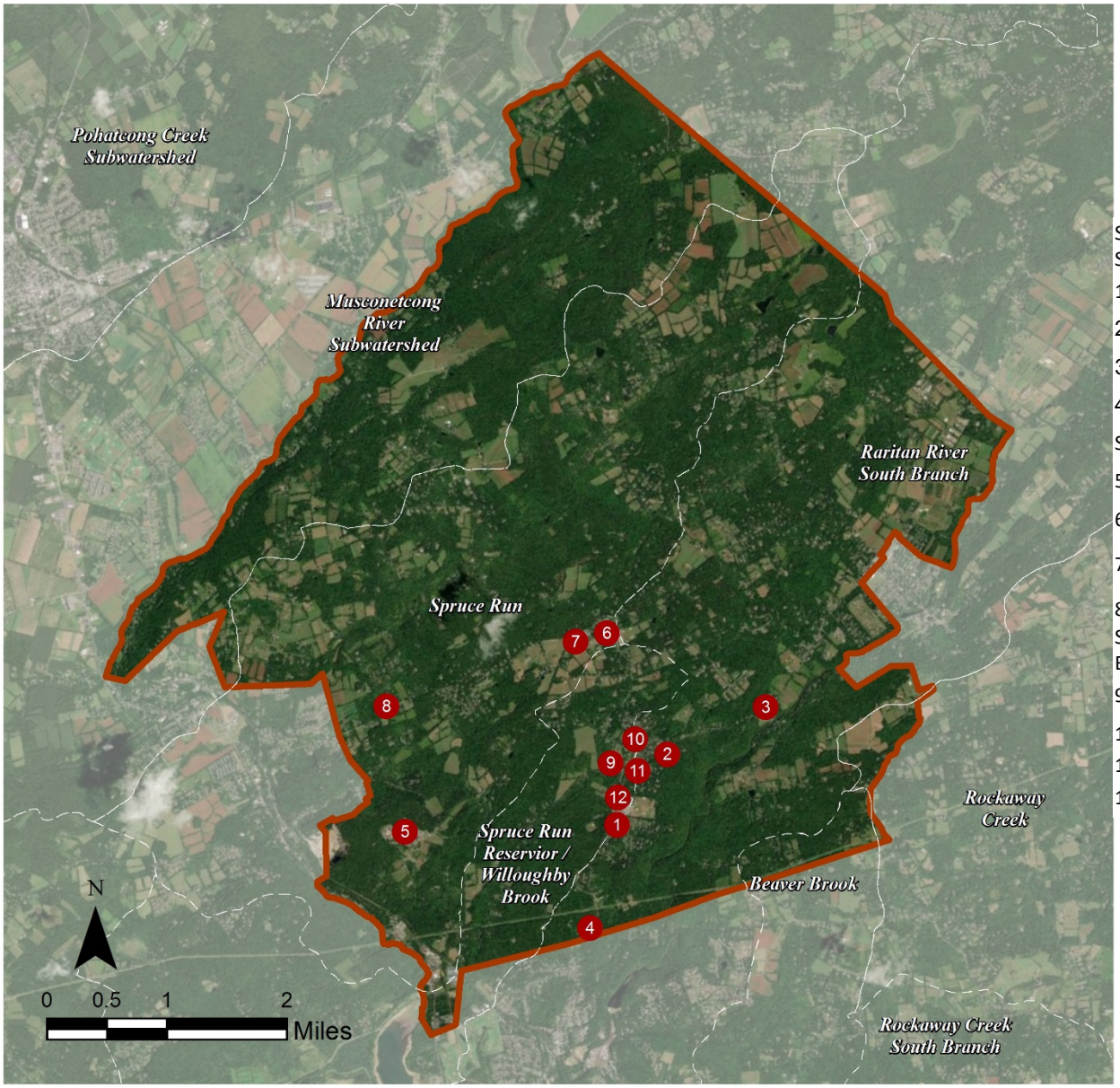
This impervious cover reduction action plan is meant to provide the municipality with a blueprint for implementing green infrastructure practices that will reduce the impact of stormwater runoff from impervious surfaces. These projects can be implemented by a wide variety of people such as boy scouts,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

LEBANON TOWNSHIP: GREEN INFRASTRUCTURE SITES



SITES WITHIN THE RARITAN RIVER SOUTH BRANCH SUBWATERSHED

1. Body of Christ Ministries
2. Groendyke Associates
3. Oldwick Village Auto Body
4. Voorhees Residential Community Home

SITES WITHIN THE SPRUCE RUN SUBWATERSHED

5. Freedom House
6. Lebanon Township Municipal Building
7. Lebanon Township Volunteer Fire Department – Station 3
8. Spruce Run Lutheran Church

SITES WITHIN THE SPRUCE RUN RESERVOIR / WILLOUGHBY BROOK SUBWATERSHED

9. Bunnvale Assembly of God
10. Bunnvale Library
11. Ono Rosa Restaurant
12. Voorhees High School

b. Proposed Green Infrastructure Concepts

BODY OF CHRIST MINISTRIES

Subwatershed: Raritan River South Branch

Site Area: 205,769 sq. ft.

Address: 101 Voorhees Road
Glen Gardner, NJ 08826

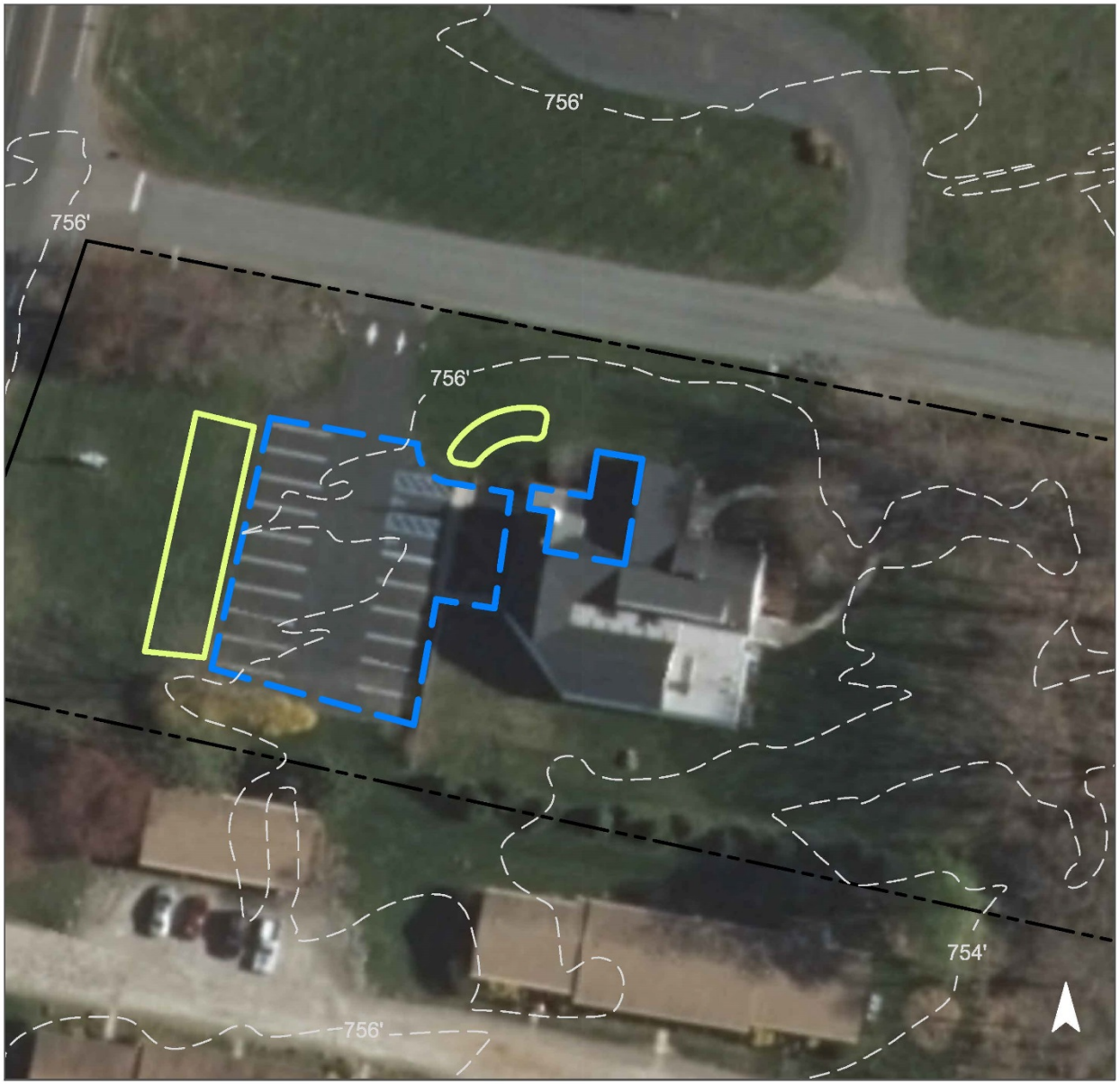
Block and Lot: Block 12, Lot 15

Two bioretention systems are proposed to infiltrate the water from the sloped lawn and a disconnected downspout. 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"
49	101,155	4.9	51.1	464.4	0.079	2.77

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	0.187	31	13,730	0.52	1,800	$9,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Body of Christ Ministries

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

0 25' 50'

GROENDYKE ASSOCIATES

Subwatershed: Raritan River South Branch

Site Area: 26,175 sq. ft.

Address: 295 County Road 513
Califon, NJ 07830

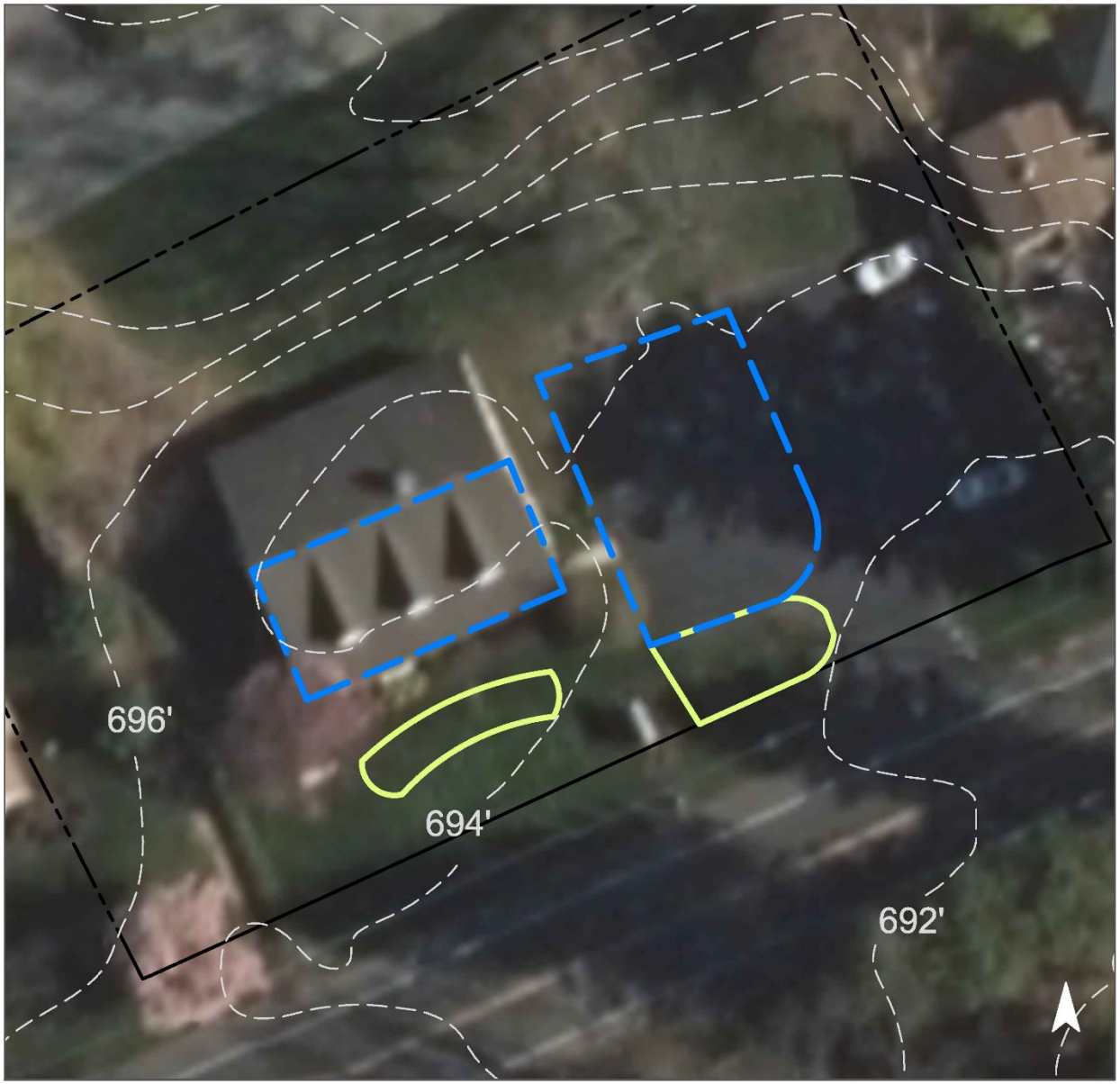
Block and Lot: Block 25, Lot 9

Two bioretention systems are proposed in the front of the building to infiltrate the water from the roof as well as the downspouts. 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"
57	15,042	0.7	7.6	69.1	0.012	0.41

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	0.093	16	6,800	0.26	890	$4,450

GREEN INFRASTRUCTURE RECOMMENDATIONS



Groendyke Associates

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

0 25' 50'

OLDWICK VILLAGE AUTO BODY

Subwatershed: Raritan River South Branch

Site Area: 167,230 sq. ft.

Address: 363 County Road 513
Califon, NJ 07830

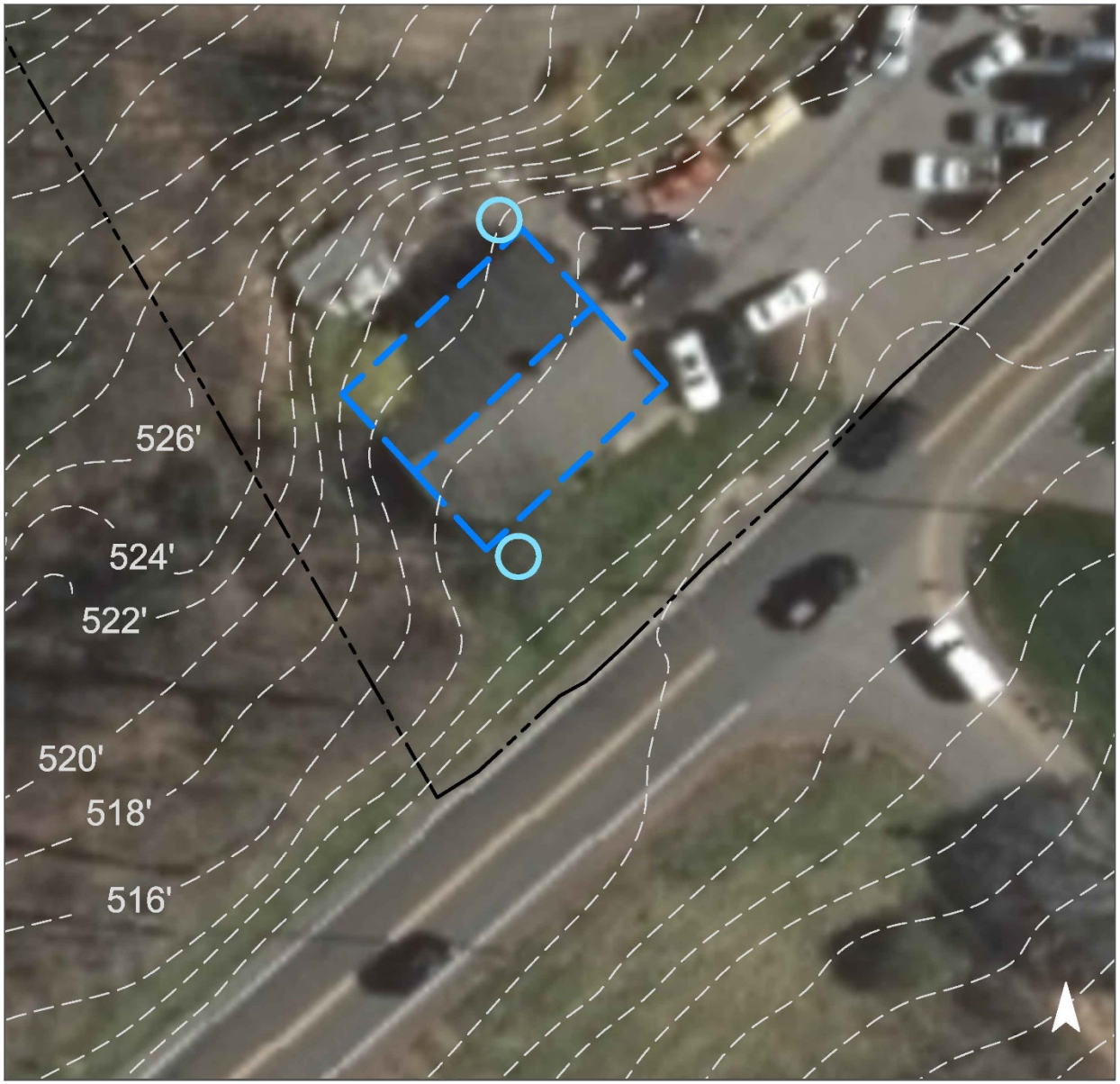
Block and Lot: Block 24, Lot 20

Two rainwater harvesting cisterns are proposed on opposite corners of the building to capture stormwater runoff from the roof. The water can be used for washing vehicles, watering plants, or other non-potable purposes. 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"
7	12,467	0.6	6.3	57.2	0.010	0.34

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
Rainwater harvesting	0.052	9	1,000	0.04	1,000 (gal)	$2,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Oldwick Village Auto Body

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

0 25' 50'

VOORHEES RESIDENTIAL COMMUNITY HOME

Subwatershed: Raritan River South Branch

Site Area: 18,782,281 sq. ft.

Address: 201 County Road 513
Glen Gardner, NJ 08826

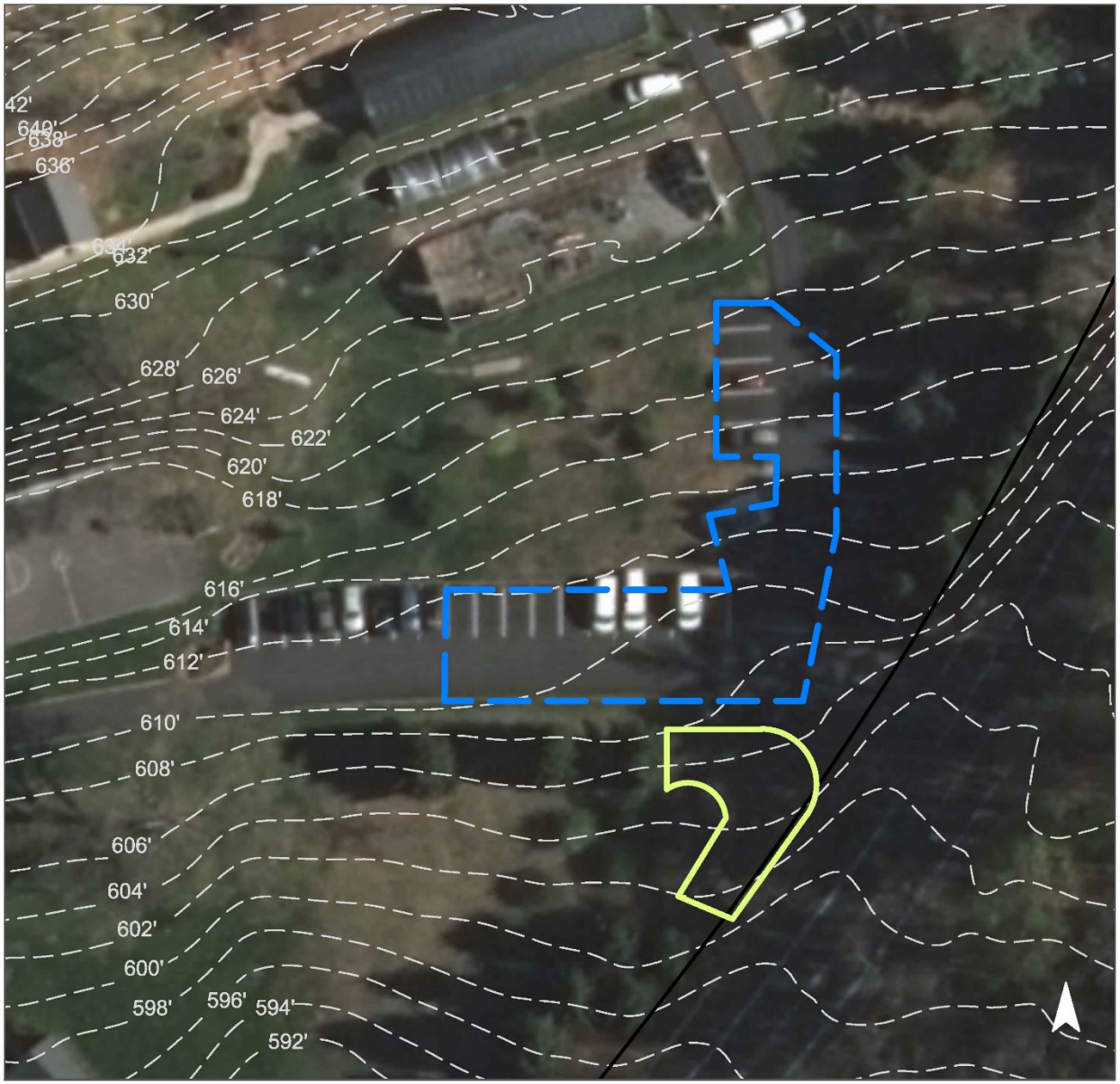
Block and Lot: Block 11, Lot 37

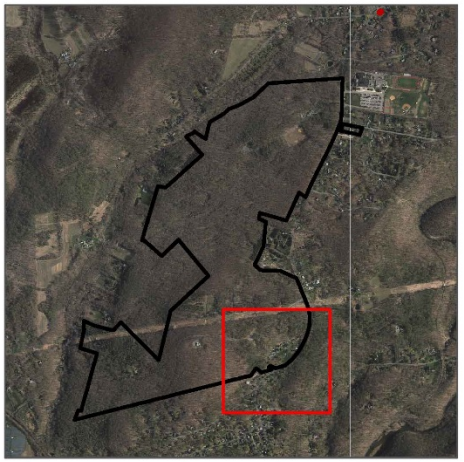
A bioretention system is proposed at the entrance of the property to reduce erosion and infiltrate the stormwater runoff from the parking area. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

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"
3	626,716	30.2	316.5	2,877.5	0.488	17.19

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	0.195	33	14,300	0.54	1,830	$9,150

GREEN INFRASTRUCTURE RECOMMENDATIONS





Voorhees Residential Community Home

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

0 25' 50'

FREEDOM HOUSE

Subwatershed: Spruce Run

Site Area: 10,391,842 sq. ft.

Address: 3 Pavilion Road
Glen Gardner, NJ 08826

Block and Lot: Block 9, Lot 7

A bioretention system is proposed on the south side of the building to infiltrate the water from the downspouts of the building and to prevent erosion and flooding at the bottom of the hill. A rainwater harvesting cistern is proposed at the north side of the building to capture stormwater runoff from the roof. This water can be reused for non-potable purposes. 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"
9	957,328	46.2	483.5	4,395.4	0.746	26.26

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	0.020	3	1,480	0.06	195	$975
Rainwater harvesting	0.026	4	1,000	0.04	1,000 (gal)	$2,000

GREEN INFRASTRUCTURE RECOMMENDATIONS

Freedom House

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

0 25' 50'

LEBANON TOWNSHIP MUNICIPAL BUILDING

Subwatershed: Spruce Run

Site Area: 223,388 sq. ft.

Address: 530 West Hill Road
Glen Gardner, NJ 08826

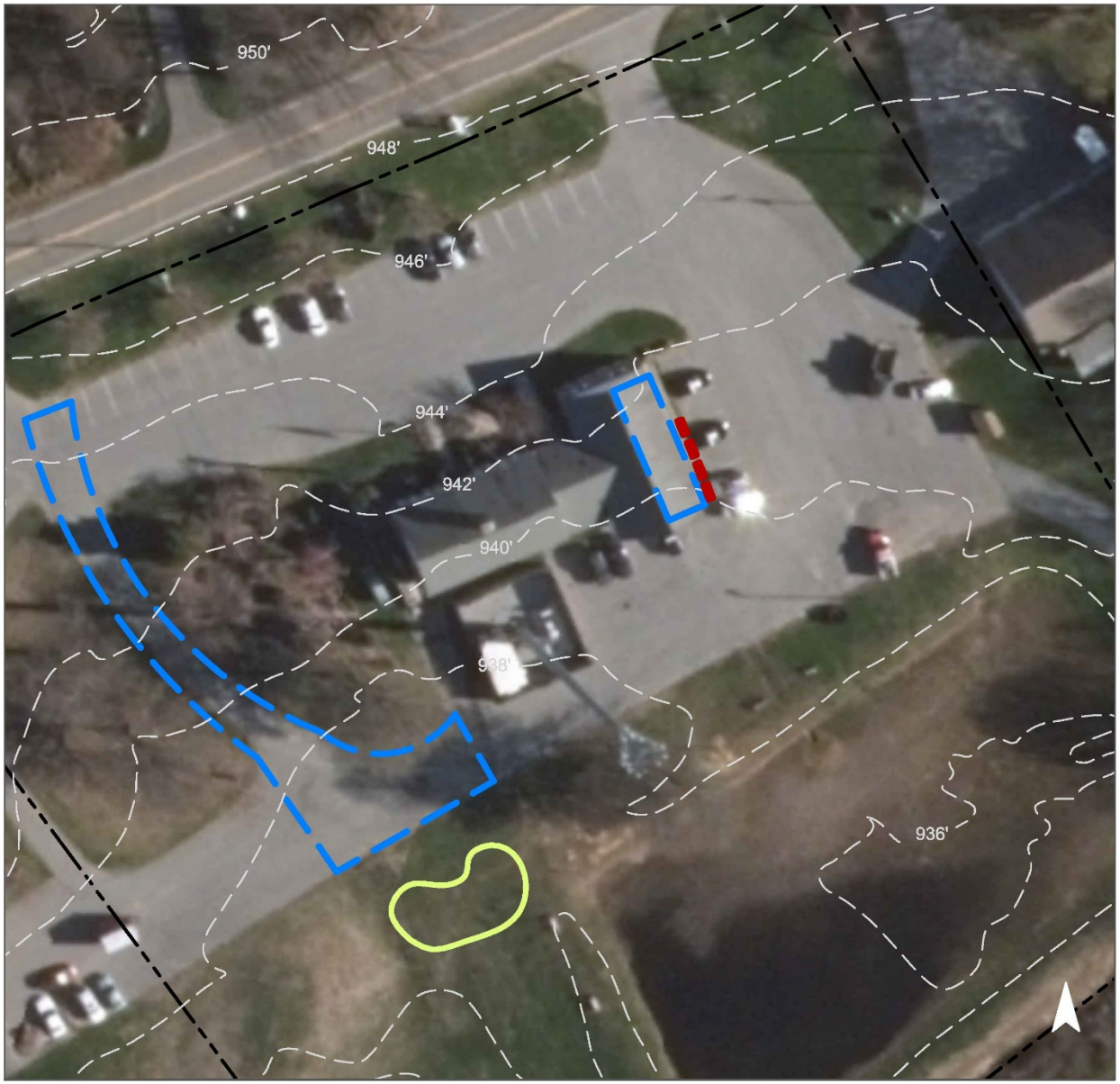
Block and Lot: Block 29, Lot 32.01

A bioretention system is proposed in the turfgrass area to treat the stormwater runoff from a section of the parking lot. Downspout planter boxes are proposed to capture runoff from the roof of the building and enhance the aesthetic of the building. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
31	68,517	3.3	34.6	314.6	0.053	1.88

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention system	0.144	24	10,570	0.40	1,380	$6,900
Planter boxes	n/a	3	n/a	n/a	4 (boxes)	$4,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Lebanon Township Municipal Building

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

0 25' 50'

LEBANON TOWNSHIP VOLUNTEER FIRE DEPARTMENT – STATION 3

Subwatershed: Spruce Run

Site Area: 36,735 sq. ft.

Address: 528 West Hill Road
Glen Gardner, NJ 08826

Block and Lot: Block 29, Lot 32.05

Two cisterns are proposed on the front of the firehouse to recycle rainwater. In addition, a bioretention system can be installed to treat the runoff from the parking lot. 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"
47	17,132	0.8	8.7	78.7	0.013	0.47

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	0.098	16	7,230	0.27	945	$4,725
Rainwater harvesting	0.044	7	1,320	0.05	1,320 (gal)	$2,640

GREEN INFRASTRUCTURE RECOMMENDATIONS

Lebanon Township Volunteer Fire Department - Station 3

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

0 25' 50'

SPRUCE RUN LUTHERAN CHURCH

Subwatershed: Spruce Run

Site Area: 89,927 sq. ft.

Address: 442 West Hill Road
Glen Gardner, NJ 08826

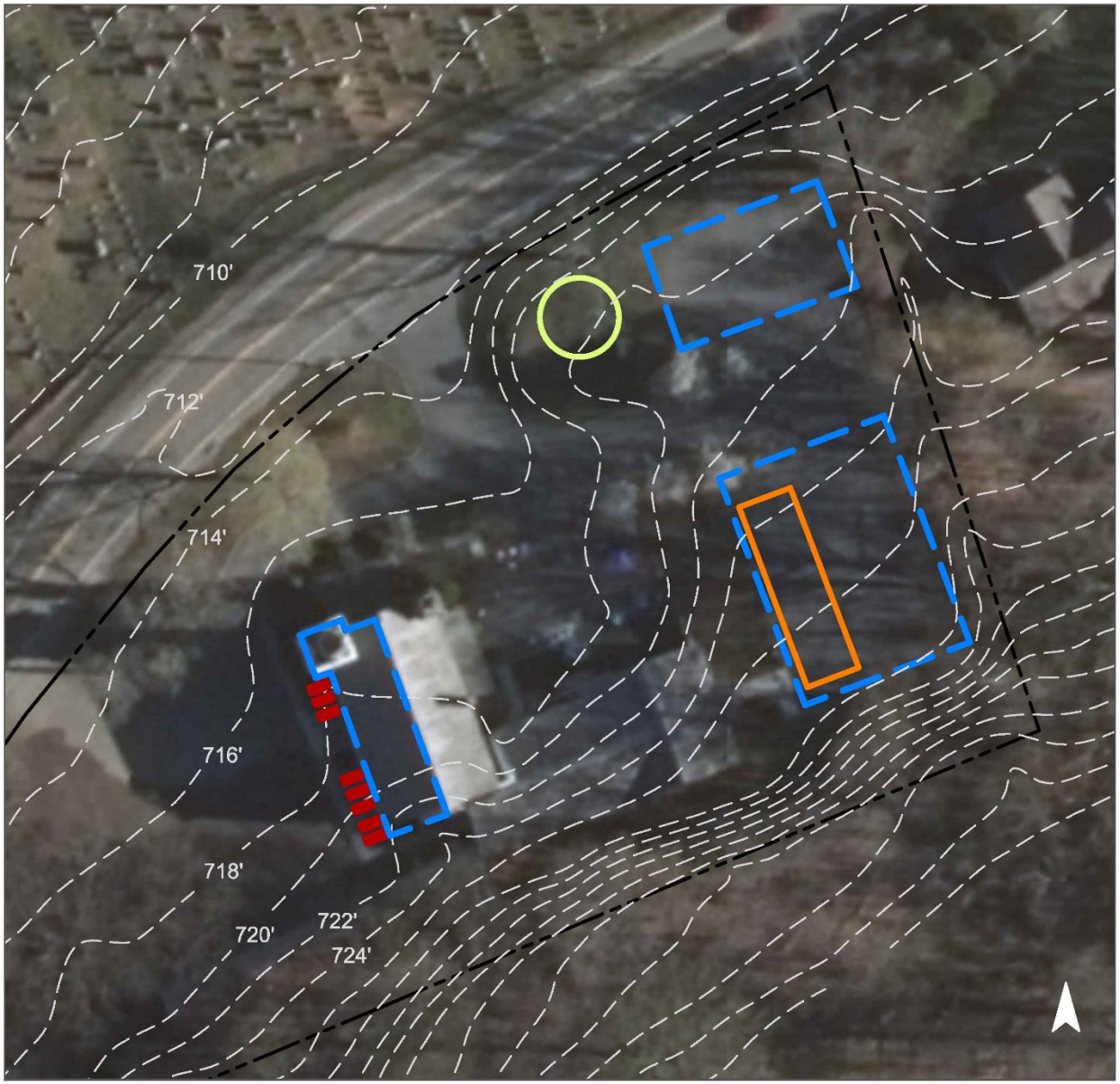
Block and Lot: Block 34, Lot 5

A bioretention system can be installed to capture, treat, and infiltrate stormwater runoff from the northeastern section of the parking lot. Additionally, pervious pavement is suggested to capture and infiltrate stormwater runoff from the other section of the parking lot. Planter boxes can be installed on the southwest corner of the building to treat the rooftop 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"
13	11,353	0.5	5.7	52.1	0.009	0.31

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	0.059	10	4,300	0.16	550	$2,750
Pervious pavement	0.119	20	8,760	0.33	1,130	$28,250
Planter boxes	n/a	6	n/a	n/a	8 (boxes)	$8,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Spruce Run Lutheran Church

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

0 25' 50'

BUNNVALE ASSEMBLY OF GOD

Subwatershed: Spruce Run Reservoir / Willoughby Brook

Site Area: 203,876 sq. ft.

Address: 285 County Road 513 #1 Glen Gardner, NJ 08826

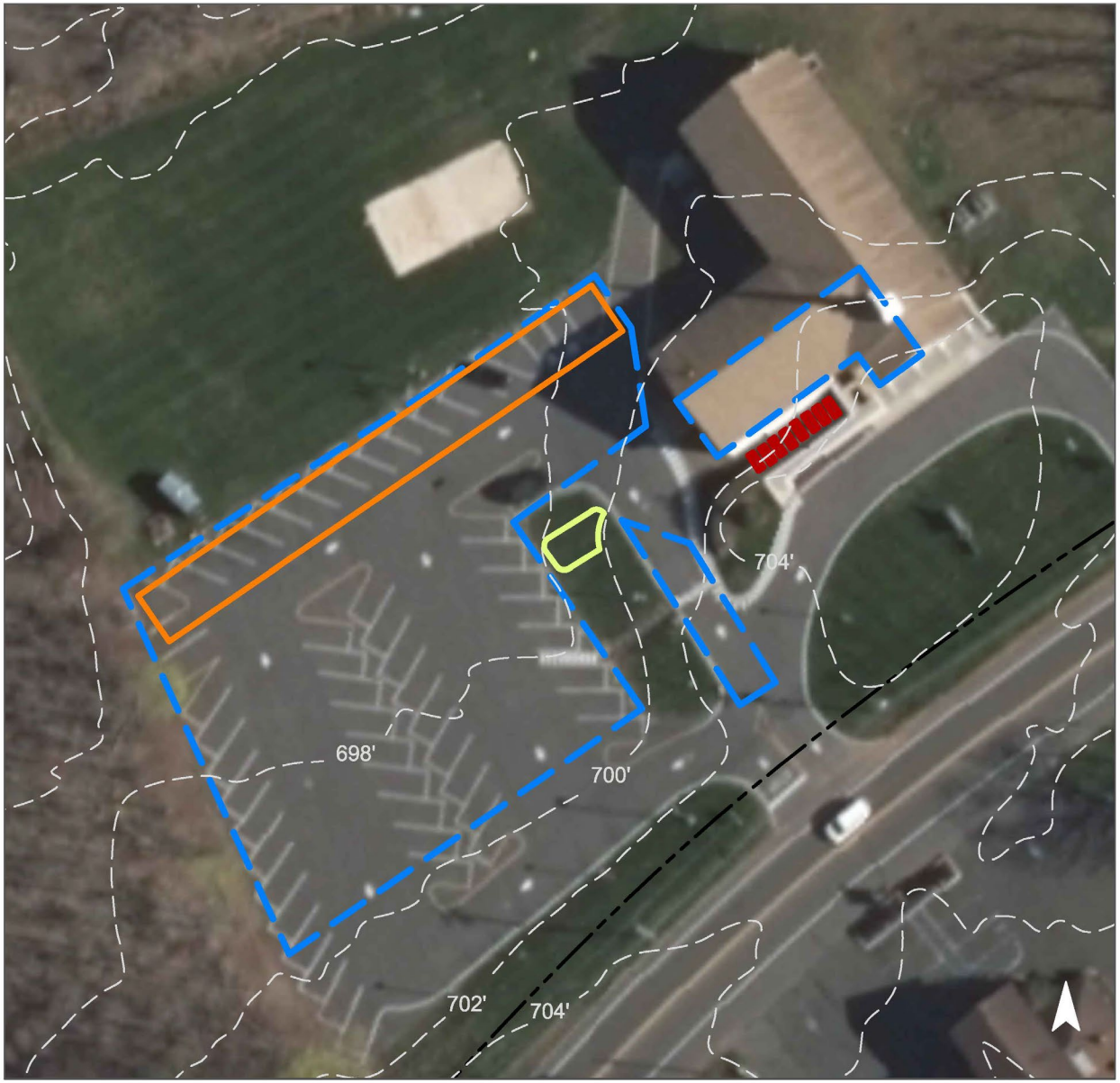
Block and Lot: Block 10, Lot 30

Pervious pavement can be installed in the northern section parking spaces to capture and infiltrate the runoff from the parking lot. A rain garden can be installed in the center island to capture, treat, and infiltrate stormwater runoff from the driveway. Planter boxes can be installed on the building to treat the rooftop drainage area. 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	50,570	2.4	25.5	232.2	0.039	1.39

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 system	0.023	4	1,680	0.06	220	$1,100
Pervious pavement	0.473	79	34,690	1.30	3,240	$81,000
Planter boxes	n/a	6	n/a	n/a	8 (boxes)	$8,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Bunnvale Assembly of God

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

0 25' 50'

BUNNVALE LIBRARY

Subwatershed: Spruce Run Reservoir / Willoughby Brook

Site Area: 43,965 sq. ft.

Address: 7 Bunnvale Road
Califon, NJ 07830

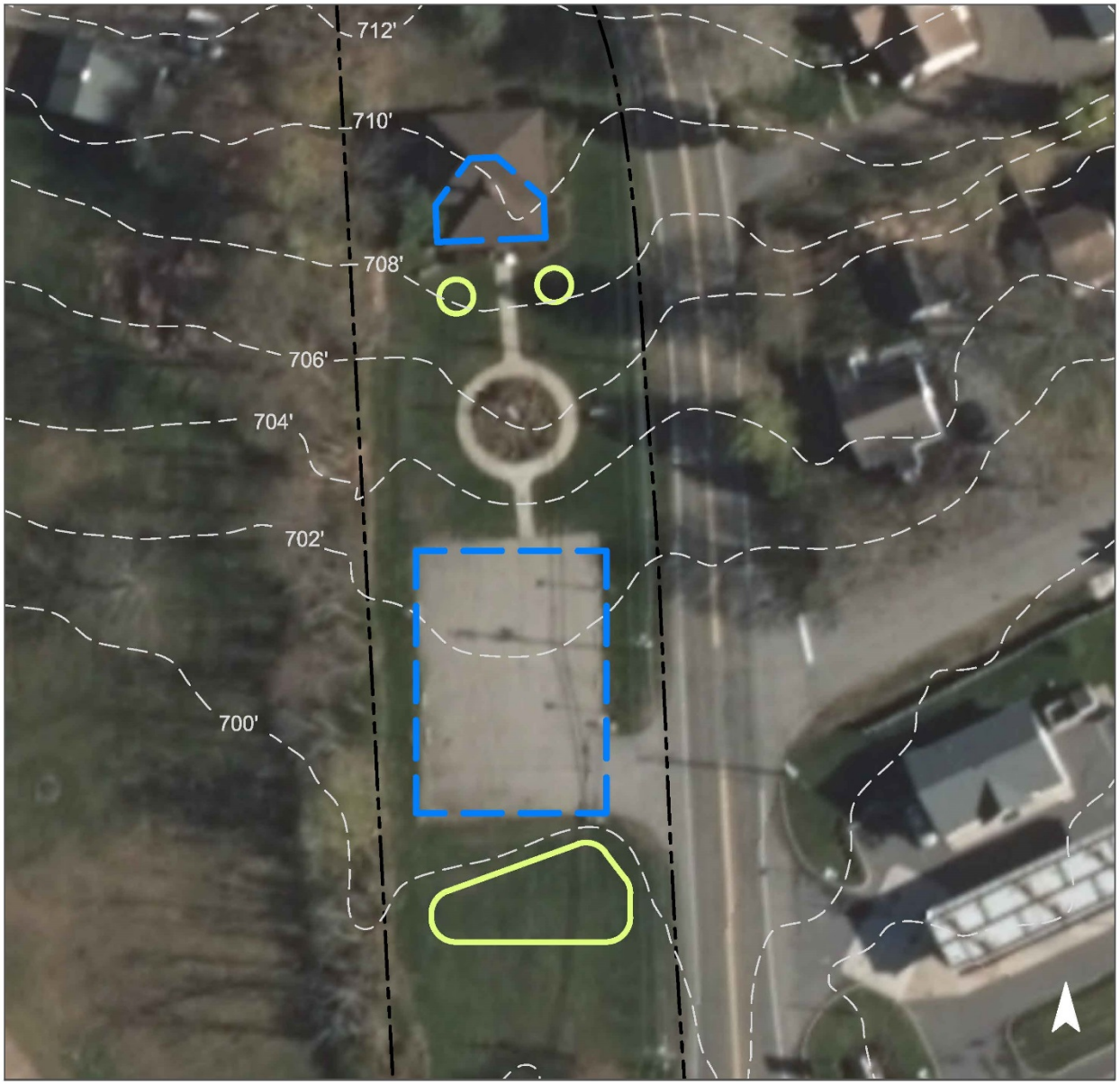
Block and Lot: Block 10, Lot 31

Two identical bioretention systems can be installed on either side of the dividing sidewalk to infiltrate the water from the downspouts on either corner of the front side of the library. Another rain garden can be installed to capture, treat, and infiltrate stormwater runoff from the parking lot. 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"
40	17,744	0.9	9.0	81.5	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	0.159	27	11,690	0.44	1,530	$7,650

GREEN INFRASTRUCTURE RECOMMENDATIONS



Bunnvale Library

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

0 25' 50'

ONO ROSA RESTAURANT

Subwatershed: Spruce Run Reservoir / Willoughby Brook

Site Area: 36,744 sq. ft.

Address: 282 County Road 513
Glen Gardner, NJ 08826

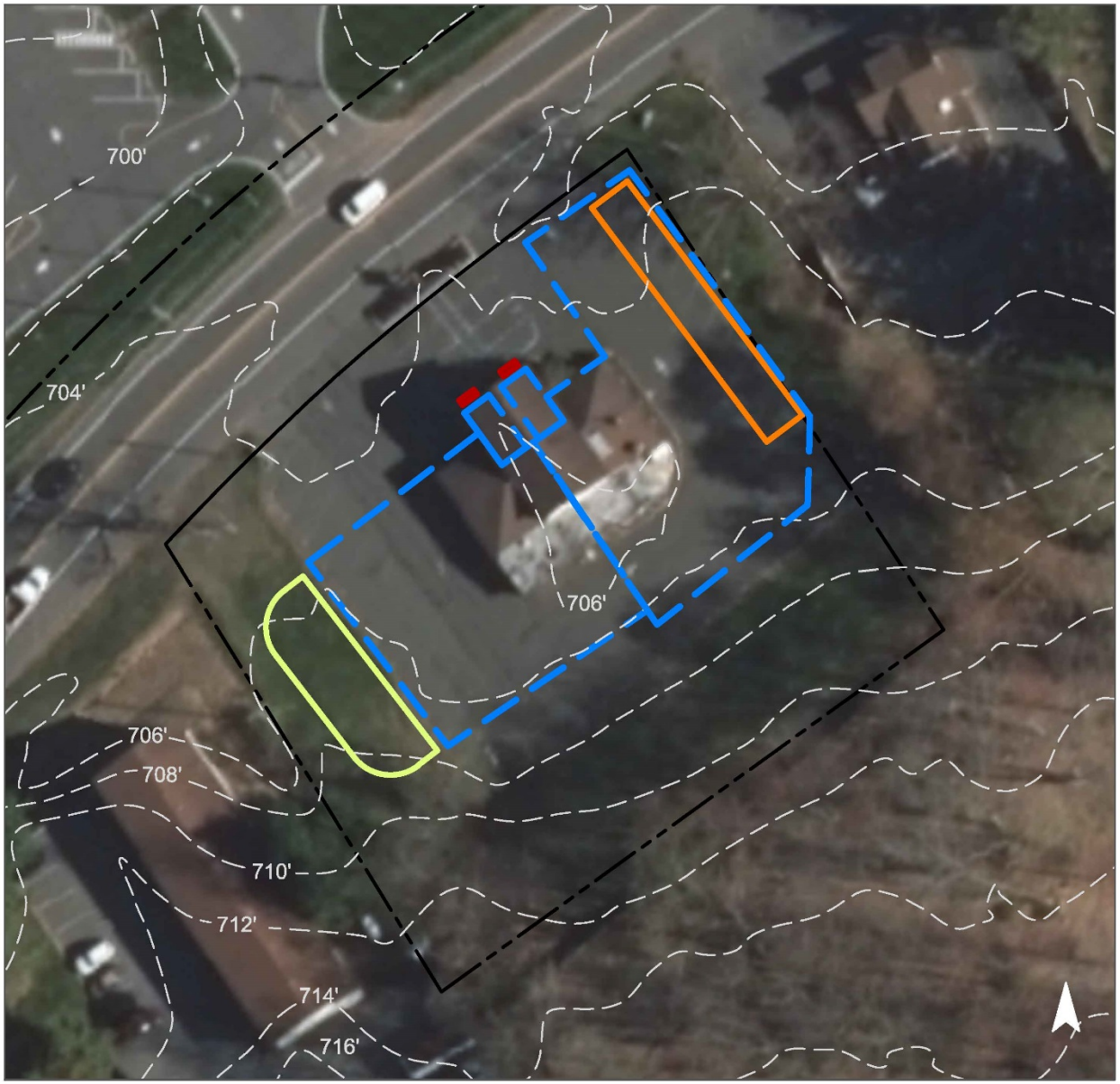
Block and Lot: Block 12, Lot 46

A bioretention system is proposed in the turfgrass to capture, treat, and infiltrate the west side of the parking lot and rooftop. Parking spaces on the east side of the parking lot can be converted to porous pavement to capture and infiltrate stormwater from the parking lot and rooftop. Planter boxes can be added to both entrances to capture runoff from the downspouts. 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"
69	25,259	1.2	12.8	116.0	0.020	0.69

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	0.159	27	11,700	0.44	1,530	$7,650
Pervious pavement	0.204	34	14,990	0.56	1,400	$35,000
Planter boxes	n/a	2	n/a	n/a	2 (boxes)	$2,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Ono Rosa Restaurant

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

0 25' 50'

VOORHEES HIGH SCHOOL

Subwatershed: Spruce Run Reservoir / Willoughby Brook

Site Area: 2,417,193 sq. ft.

Address: 256 County Road 513 Glen Gardner, 08826

Block and Lot: Block 12, Lot 44

Two mowed detention basins at the east entrance can be retrofitted with rain gardens to capture, treat, and infiltrate stormwater runoff from the driveway and enhance pollinator habitat. Two sections of parking spaces can be converted to porous pavement to capture and infiltrate runoff from the parking lot. 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"
25	596,442	28.8	301.2	2,738.5	0.465	16.36

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 systems	0.366	61	26,890	1.01	3,515	$17,575
Pervious pavement	1.811	303	132,870	4.99	12,140	$303,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

Voorhees High School

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

0 100' 200'

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.)	Annual (cu.ft.)	Runoff Volumes from I.C. Water Quality Storm (1.25" over 2-hours) (Mgal)	Annual (Mgal)
	RARITAN RIVER SOUTH BRANCH SITES	**9.16**	**399,175**				**2.95**	**128,664**	**6.2**	**65.0**	**590.7**	**13,402**	**471,768**	**0.100**	**3.53**
1	**Body of Christ Ministries**														
	Total Site Info	4.72	205,769	12	15	49	2.32	101,155	4.9	51.1	464.4	10,537	370,902	0.079	2.77
2	**Groendyke Associates**														
	Total Site Info	0.60	26,175	25	9	57	0.35	15,042	0.7	7.6	69.1	1,567	55,155	0.012	0.41
3	**Oldwick Village Auto Body**														
	Total Site Info	3.84	167,230	24	20	7	0.29	12,467	0.6	6.3	57.2	1,299	45,711	0.010	0.34
4	**Voorhees Residential Community Home**														
	Total Site Info	431.18	18,782,281	11	37	3	14.39	626,716	30.2	316.5	2,877.5	65,283	2,297,959	0.488	17.19
	SPRUCE RUN SITES	**246.60**	**10,741,892**				**24.20**	**1,054,332**	**50.8**	**532.5**	**4,840.8**	**109,826**	**3,865,883**	**0.822**	**28.92**
5	**Freedom House**														
	Total Site Info	238.56	10,391,842	9	7	9	21.98	957,328	46.2	483.5	4,395.4	99,722	3,510,204	0.746	26.26
6	**Lebanon Township Municipal Building**														
	Total Site Info	5.13	223,388	29	32.01	31	1.57	68,517	3.3	34.6	314.6	7,137	251,230	0.053	1.88
7	**Lebanon Township Volunteer Fire Department - Station 3**														
	Total Site Info	0.84	36,735	29	32.05	47	0.39	17,132	0.8	8.7	78.7	1,785	62,819	0.013	0.47
8	**Spruce Run Lutheran Church**														
	Total Site Info	2.06	89,927	34	5	13	0.26	11,353	0.5	5.7	52.1	1,183	41,629	0.009	0.31
	SPRUCE RUN RESERVOIR / WILLOUGHBY BROOK	**62.02**	**2,701,777**				**15.84**	**690,015**	**33.3**	**348.5**	**3,168.1**	**71,877**	**2,530,055**	**0.538**	**18.92**
9	**Bunnvale Assembly of God**														
	Total Site Info	4.68	203,876	10	30	25	1.16	50,570	2.4	25.5	232.2	5,268	185,425	0.039	1.39
10	**Bunnvale Library**														
	Total Site Info	1.01	43,965	10	31	40	0.41	17,744	0.9	9.0	81.5	1,848	65,061	0.014	0.49
11	**Ono Rosa Restaurant**														
	Total Site Info	0.84	36,744	12	46	69	0.58	25,259	1.2	12.8	116.0	2,631	92,616	0.020	0.69
12	**Voorhees High School**														
	Total Site Info	55.49	2,417,193	12	44	25	13.69	596,442	28.8	301.2	2,738.5	62,129	2,186,953	0.465	16.36

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	Unit Cost ($/unit)	Unit	Total Cost ($)	I.C. Treated %
	RARITAN RIVER SOUTH BRANCH SITES	**12,740**	**0.29**	**0.332**	**56**	**21,530**	**0.82**				**$15,450**	**9.9%**
1	**Body of Christ Ministries**											
	Bioretention systems	7,185	0.16	0.187	31	13,730	0.52	1,800	$5	SF	$9,000	7.1%
	Total Site Info	**7,185**	**0.16**	**0.187**	**31**	**13,730**	**0.52**				**$9,000**	**7.1%**
2	**Groendyke Associates**											
	Bioretention systems	3,555	0.08	0.093	16	6,800	0.26	890	$5	SF	$4,450	23.6%
	Total Site Info	**3,555**	**0.08**	**0.093**	**16**	**6,800**	**0.26**				**$4,450**	**23.6%**
3	**Oldwick Village Auto Body**											
	Rainwater harvesting	2,000	0.05	0.052	9	1,000	0.04	1,000	$2	gal	$2,000	16.0%
	Total Site Info	**2,000**	**0.05**	**0.052**	**9**	**1,000**	**0.04**				**$2,000**	**16.0%**
4	**Voorhees Residential Community Home**											
	Bioretention system	7,480	0.17	0.195	33	14,300	0.54	1,830	$5	SF	$9,150	1.2%
	Total Site Info	**7,480**	**0.17**	**0.195**	**33**	**14,300**	**0.54**				**$9,150**	**1.2%**
	SPRUCE RUN SITES	**22,185**	**0.51**	**0.511**	**95**	**34,660**	**1.31**	**0**			**$60,240**	**2.1%**
5	**Freedom House**											
	Bioretention system	775	0.02	0.020	3	1,480	0.06	195	$5	SF	$975	0.1%
	Rainwater harvesting	1,000	0.02	0.026	4	1,000	0.04	1,000	$2	gal	$2,000	0.1%
	Total Site Info	**1,775**	**0.04**	**0.046**	**8**	**2,480**	**0.10**				**$2,975**	**0.2%**
6	**Lebanon Township Municipal Building**											
	Bioretention system	5,530	0.13	0.144	24	10,570	0.40	1,380	$5	SF	$6,900	8.1%
	Planter boxes	860	0.02	n/a	3	n/a	n/a	4	$1,000	box	$4,000	1.3%
	Total Site Info	**6,390**	**0.15**	**0.144**	**27**	**10,570**	**0.40**				**$10,900**	**9.3%**
7	**Lebanon Township Volunteer Fire Department-Station 3**											
	Bioretention system	3,780	0.09	0.098	16	7,230	0.27	945	$5	SF	$4,725	22.1%
	Rainwater harvesting	1,690	0.04	0.044	7	1,320	0.05	1,320	$2	gal	$2,640	9.9%
	Total Site Info	**5,470**	**0.13**	**0.143**	**24**	**8,550**	**0.32**				**$7,365**	**31.9%**
8	**Spruce Run Lutheran Church**											
	Bioretention system	2,250	0.05	0.059	10	4,300	0.16	550	$5	SF	$2,750	19.8%

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	Unit Cost ($/unit)	Unit	Total Cost ($)	I.C. Treated %
	Pervious pavement	4,580	0.11	0.119	20	8,760	0.33	1,130	$25	SF	$28,250	40.3%
	Planter boxes	1,720	0.04	n/a	6	n/a	n/a	8	$1,000	box	$8,000	15.1%
	Total Site Info	**8,550**	**0.20**	**0.178**	**36**	**13,060**	**0.49**				**$39,000**	**75.3%**
	SPRUCE RUN RESERVOIR / WILLOUGHBY BROOK	**123,930**	**2.85**	**3.173**	**539**	**232,830**	**8.74**				**$397,575**	**18.0%**
9	**Bunnvale Assembly of God**											
	Bioretention system	18,145	0.42	0.473	79	34,690	1.30	3,240	$5	SF	$16,200	35.9%
	Planter boxes	1,720	0.04	n/a	6	n/a	n/a	8	$1,000	box	$8,000	3.4%
	Total Site Info	**19,865**	**0.46**	**0.473**	**85**	**34,690**	**1.30**				**$24,200**	**39.3%**
10	**Bunnvale Library**											
	Bioretention systems	6,115	0.14	0.159	27	11,690	0.44	1,530	$5	SF	$7,650	34.5%
	Total Site Info	**6,115**	**0.14**	**0.159**	**27**	**11,690**	**0.44**				**$7,650**	**34.5%**
11	**Ono Rosa Restaurant**											
	Bioretention system	6,120	0.14	0.159	27	11,700	0.44	1,530	$5	SF	$7,650	24.2%
	Pervious pavement	7,840	0.18	0.204	34	14,990	0.56	1,400	$25	SF	$35,000	31.0%
	Planter boxes	430	0.01	n/a	2	n/a	n/a	2	$1,000	box	$2,000	1.7%
	Total Site Info	**14,390**	**0.33**	**0.364**	**62**	**26,690**	**1.00**				**$44,650**	**57.0%**
12	**Voorhees High School**											
	Bioretention systems	14,065	0.32	0.366	61	26,890	1.01	3,515	$5	SF	$17,575	2.4%
	Pervious pavement	69,495	1.60	1.811	303	132,870	4.99	12,140	$25	SF	$303,500	11.7%
	Total Site Info	**83,560**	**1.92**	**2.177**	**364**	**159,760**	**6.00**				**$321,075**	**14.0%**