RUTGERS
New Jersey Agricultural
Experiment Station

Impervious Cover Reduction Action Plan
for
Red Bank Borough, Monmouth County, New Jersey

Prepared for Red Bank Borough by the
Rutgers Cooperative Extension Water Resources Program

December 13, 2017

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Introduction

Located in Monmouth County in central New Jersey, Red Bank Borough covers approximately 2.2 square miles. Figures 1 and 2 illustrate that Red Bank Borough is dominated by urban land uses. A total of 76.1% of the municipality's land use is classified as urban. Of the urban land in Red Bank Borough, high 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 Red Bank 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 Red Bank Borough. Based upon the 2012 NJDEP land use/land cover data, approximately 52.4% of Red Bank Borough has impervious cover. This level of impervious cover suggests that the streams in Red Bank Borough are likely non-supporting streams. [1]

Methodology

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

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

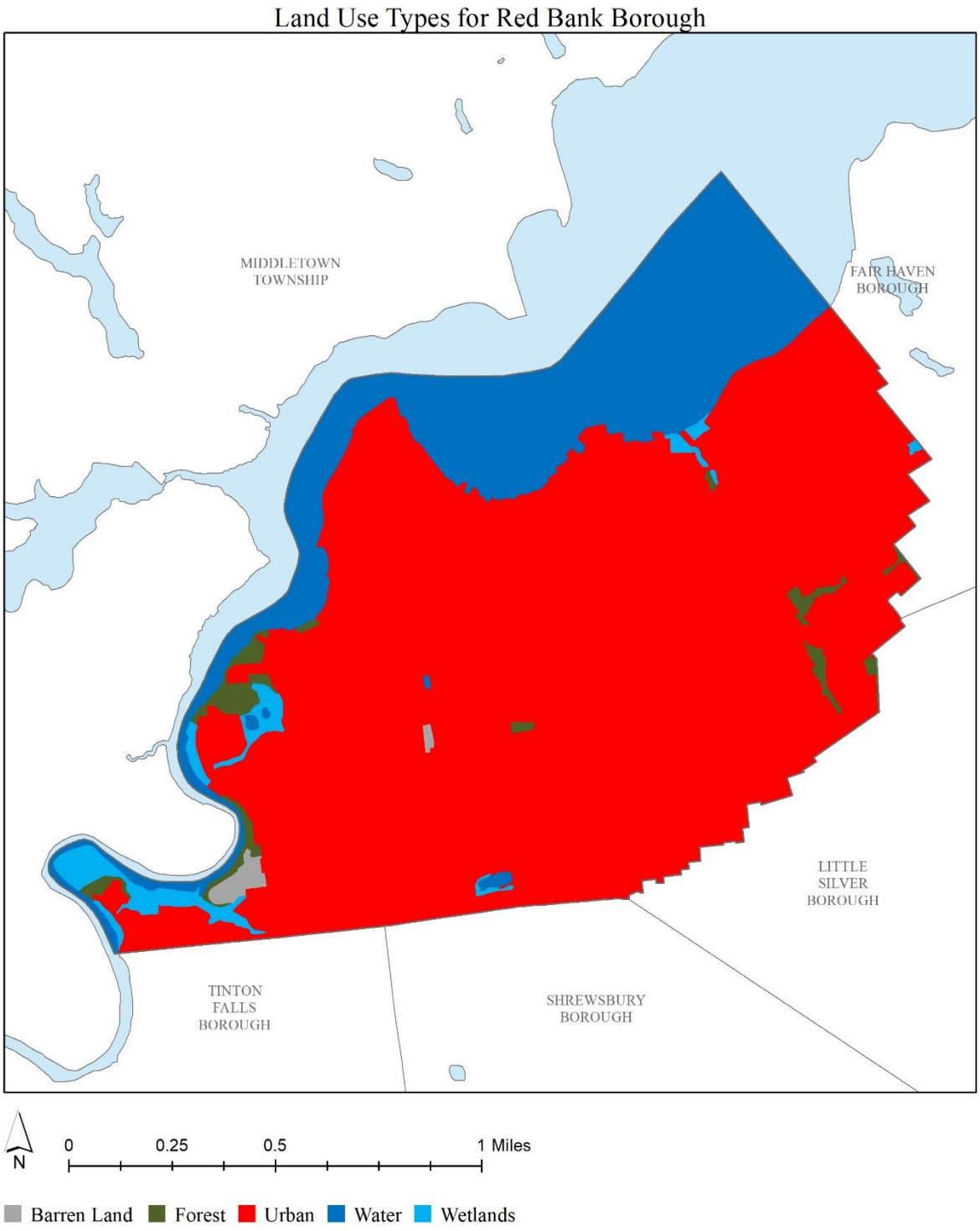


Figure 1: Map illustrating the land use in Red Bank Borough

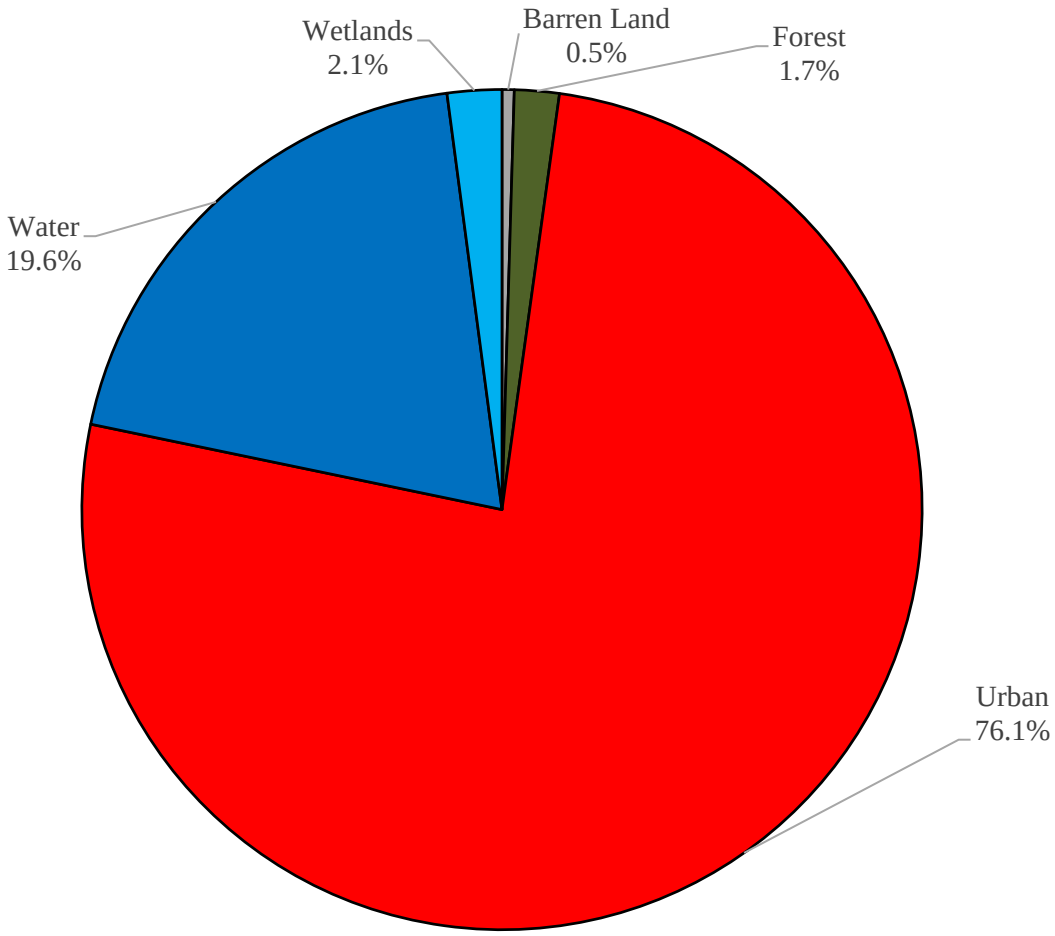


Figure 2: Pie chart illustrating the land use in Red Bank Borough

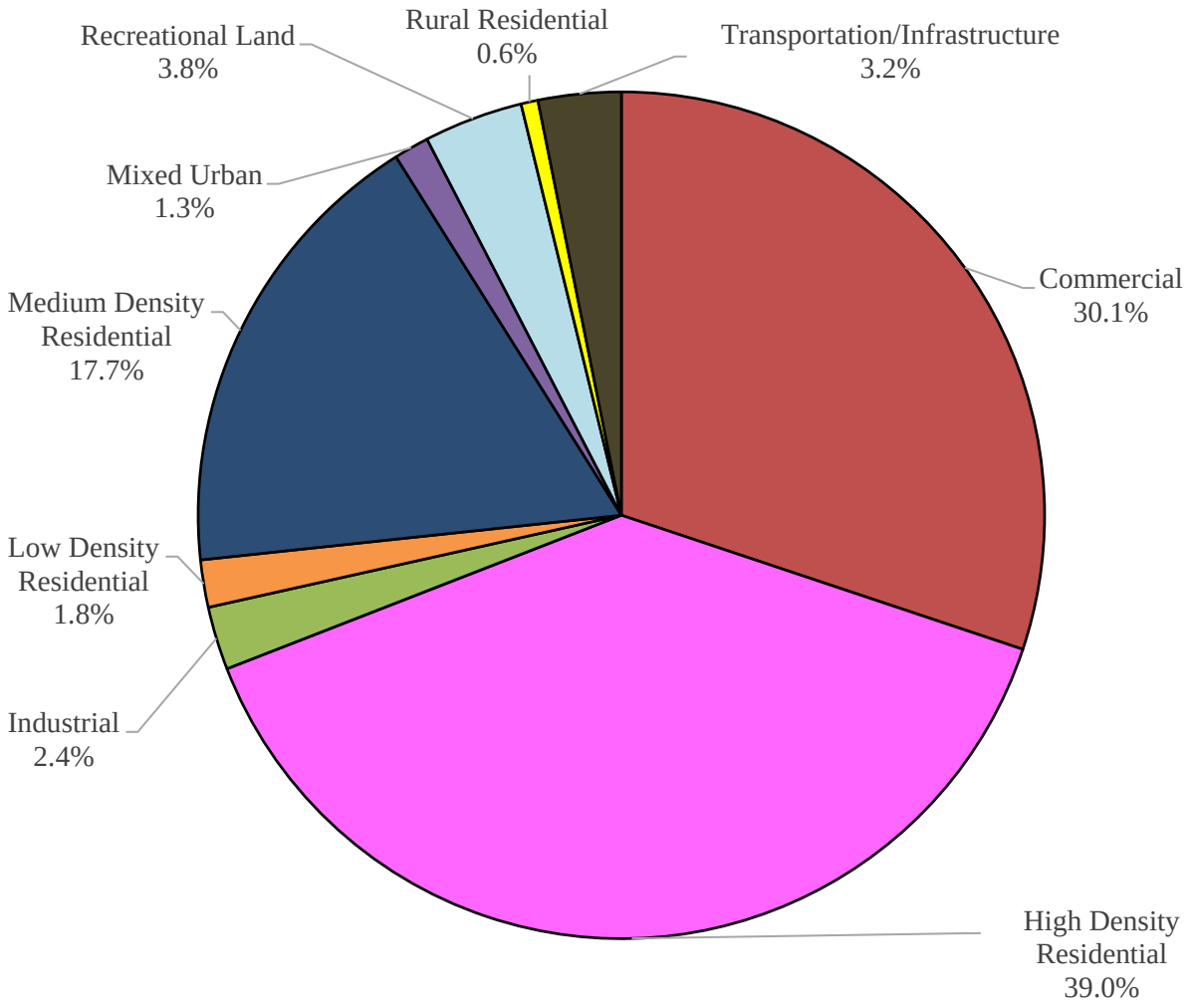


Figure 3: Pie chart illustrating the various types of urban land use in Red Bank Borough

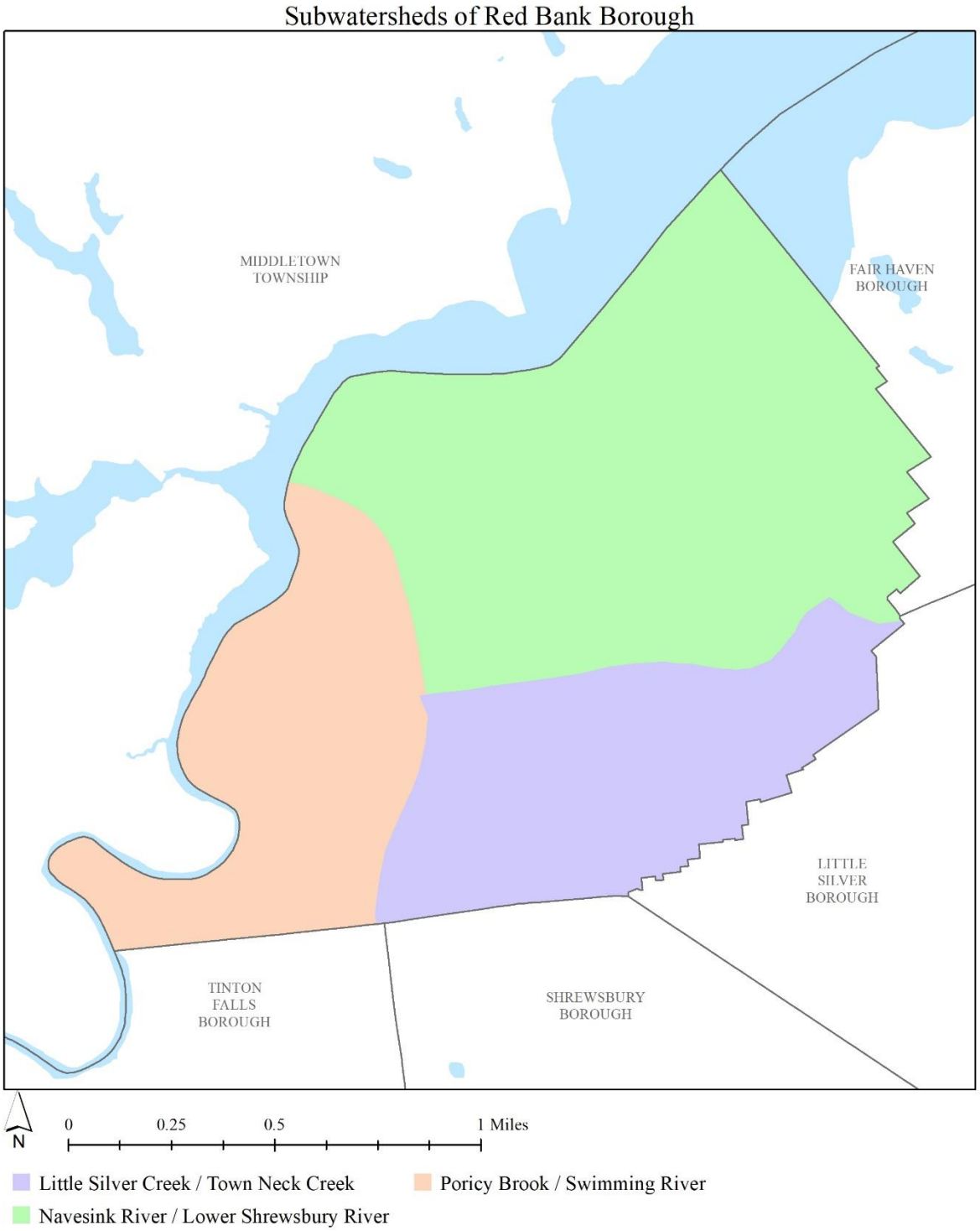


Figure 4: Map of the subwatersheds in Red Bank Borough

For each potential project site, specific aerial loading coefficients for commercial land use were used to determine the annual runoff loads for total phosphorus (TP), total nitrogen (TN), and total suspended solids (TSS) from impervious surfaces (Table 1). These are the same aerial loading coefficients that NJDEP uses in developing total maximum daily loads (TMDLs) for impaired waterways of the state. The percentage of impervious cover for each site was extracted from the 2012 NJDEP land use/land cover database. For impervious areas, runoff volumes were determined for the water quality design storm (1.25 inches of rain over two-hours) and for the annual rainfall total of 44 inches.

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

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

Table 1: Aerial Loading Coefficients[2]

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

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

Green Infrastructure Practices

Green infrastructure is an approach to stormwater management that is cost-effective, sustainable, and environmentally friendly. Green infrastructure projects capture, filter, absorb, and reuse stormwater to maintain or mimic natural systems and to treat runoff as a resource. As a general principal, green infrastructure practices use soil and vegetation to recycle stormwater runoff through infiltration and evapotranspiration. When used as components of a stormwater management system, green infrastructure practices such as bioretention, green roofs, porous pavement, rain gardens, and vegetated swales can produce a variety of environmental benefits. In addition to effectively retaining and infiltrating rainfall, these practices can simultaneously help filter air pollutants, reduce energy demands, mitigate urban heat islands, and sequester carbon while also providing communities with aesthetic and natural resource benefits[3]. A wide range of green infrastructure practices have been evaluated for the potential project sites in Red Bank 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

RED BANK TOWNSHIP: GREEN INFRASTRUCTURE SITES

SITES WITHIN THE LITTLE SILVER CREEK SUBWATERSHED:

1. Count Basie Park
2. Red Bank Board of Education

SITES WITHIN THE NAVESINK RIVER SUBWATERSHED:

3. English Plaza Parking Lot
4. Gold Street Parking Lot
5. Marine Park
6. Mechanic-Wallace Parking Lot
7. Phoenix Productions
8. Red Bank Catholic Fine & Performing Arts + Relief Engine
9. Red Bank First Aid & Rescue Squad
10. Red Bank Middle School
11. Red Bank Public Library
12. Wallace-Linden Parking Lot

SITES WITHIN THE PORICY BROOK SUBWATERSHED:

13. Calvary Baptist Church
14. Red Bank Primary School
15. Red Bank Senior Center
16. Saint Anthony of Padua Church
17. Union Hose Fire Station

b. Proposed Green Infrastructure Concepts

Count Basie Park

Subwatershed: Little Silver Creek

Site Area: 202,020 sq. ft.

Address: Henry Street
Red Bank, NJ 07701

Block and Lot: Block 97
Lot 38

Parking spots to the west of the park can be replaced with porous asphalt to capture and infiltrate stormwater. Installing a rain garden along the street can capture, treat, and infiltrate road runoff. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
25	50,096	2.4	25.3	230.0	0.039	1.37

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	0.052	9	3,950	0.15	500	$2,500
Pervious pavement	0.616	103	46,680	1.75	6,300	$157,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

Count Basie Park

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

0 50' 100'

Red Bank Board of Education

Subwatershed: Little Silver Creek

Site Area: 16,669 sq. ft.

Address: 76 Branch Avenue
Red Bank, NJ 07701

Block and Lot: Block 108
Lot 1.01

Parking spots to the north of the building can be replaced with porous asphalt to capture and infiltrate stormwater. Installing a rain garden adjacent to the building can capture, treat, and infiltrate roof runoff. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
80	13,335	0.6	6.7	61.2	0.010	0.37

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	2,170	0.08	275	$1,375
Pervious pavement	0.099	17	7,500	0.28	870	$21,750

GREEN INFRASTRUCTURE RECOMMENDATIONS

Red Bank
Board of Education

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

0 20' 40'

English Plaza Parking Lot

Subwatershed: Navesink River

Site Area: 48,976 sq. ft.

Address: English Plaza
Red Bank, NJ 07701

Block and Lot: Block 30.01
Lot 37, 39, 40, 41

Parking spots along the street can be replaced with porous asphalt to capture and infiltrate stormwater. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
95	46,528	2.2	23.5	213.6	0.036	1.28

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	0.404	68	30,590	1.15	4,700	$117,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

English Plaza Parking Lot

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

0 30' 60'

Gold Street Parking Lot

Subwatershed: Navesink River

Site Area: 31,767 sq. ft.

Address: Gold Street
Red Bank, NJ 07701

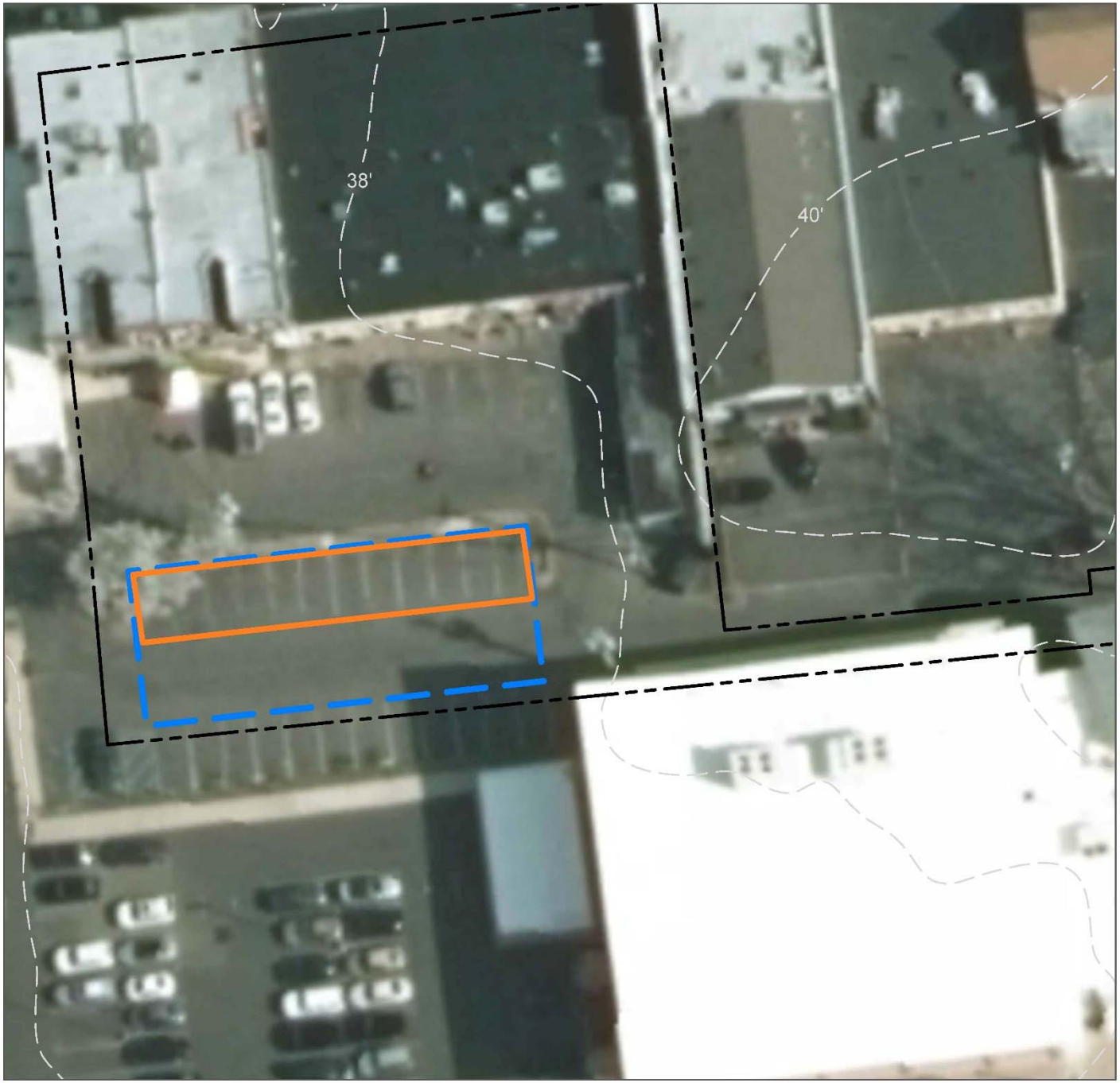
Block and Lot: Block 46
Lot 3, 36.01, 36.02, 4

Parking spots along the street can be replaced with porous asphalt to capture and infiltrate stormwater. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
95	30,178	1.5	15.2	138.6	0.024	0.83

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	0.112	19	8,490	0.32	1,850	$46,250

GREEN INFRASTRUCTURE RECOMMENDATIONS



Gold Street Parking Lot

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

0 20' 40'

Marine Park

Subwatershed: Navesink River

Site Area: 190,025 sq. ft.

Address: 1 Marine Park
Red Bank, NJ 07701

Block and Lot: Block 9
Lot 5, 5.04

Parking spots to the north end can be replaced with porous asphalt to capture and infiltrate stormwater. Installing rain gardens in the eroded areas around the park can capture, treat, and infiltrate runoff from the parking lot and walkways. 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"
49	93,703	4.5	47.3	430.2	0.073	2.57

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	0.189	32	14,310	0.54	1,800	$9,000
Pervious pavement	0.237	40	17,960	0.67	2,300	$57,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

Marine Park

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

0 50' 100'

Mechanic-Wallace Parking Lot

Subwatershed: Navesink River

Site Area: 63,208 sq. ft.

Address: Mechanic Street
Red Bank, NJ 07701

Block and Lot: Block 29
Lot 9, 20, 22.01

Parking spots can be replaced with porous asphalt to capture and infiltrate stormwater. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
95	60,027	2.9	30.3	275.6	0.047	1.65

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Pervious pavement	0.165	28	12,540	0.47	2,950	$73,750

GREEN INFRASTRUCTURE RECOMMENDATIONS

Mechanic-Wallace Parking Lot

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

0 30' 60'

Phoenix Productions

Subwatershed: Navesink River

Site Area: 66,151 sq. ft.

Address: 59 Chestnut Street
Red Bank, NJ 07701

Block and Lot: Block 75.02
Lot 169

Parking spots can be replaced with porous asphalt to capture and infiltrate stormwater from the parking lot and rooftop by directing downspouts into it. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
95	62,767	3.0	31.7	288.2	0.049	1.72

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
Pervious pavement	0.539	90	40,860	1.53	8,300	$207,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

Phoenix Productions

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

0 30' 60'

Red Bank Catholic Fine & Performing Arts + Relief Engine Co.

Subwatershed: Navesink River

Site Area: 14,916 sq. ft.

Address: 51 Monmouth Street
Red Bank, NJ 07701

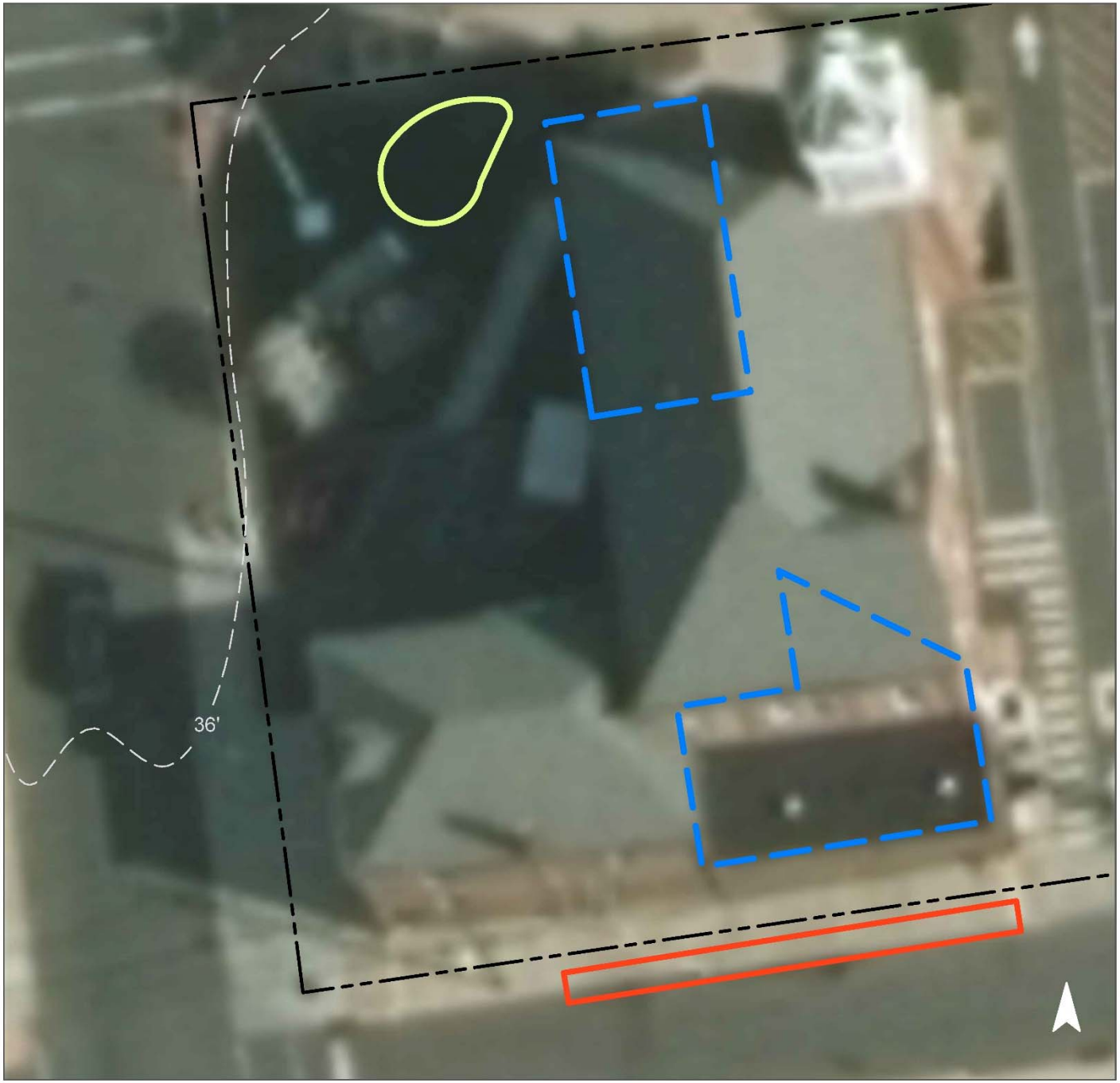
Block and Lot: Block 46
Lot 1

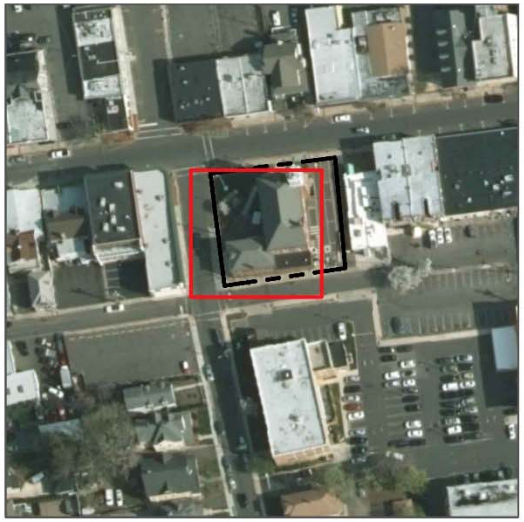
Installing a rain garden adjacent to the building can capture, treat, and infiltrate roof runoff. A stormwater planter can be constructed to the south of the building by directing the downspout that is already routed under the sidewalk into the planter. A preliminary soil assessment suggests that more 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"
95	14,170	0.7	7.2	65.1	0.011	0.39

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	0.021	3	1,580	0.06	200	$1,000
Stormwater planter	0.034	6	2,570	0.10	240	$90,000

GREEN INFRASTRUCTURE RECOMMENDATIONS





Red Bank Catholic Fine & Performing Arts + Relief Engine Co.

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

0 10' 20'

Red Bank First Aid & Rescue Squad

Subwatershed: Navesink River

Site Area: 22,871 sq. ft.

Address: 151 Spring Street
Red Bank, NJ 07701

Block and Lot: Block 52.03
Lot 1

Roof runoff can be harvested by installing a cistern at the northeast corner of the building. The water can then be used for watering gardens, washing vehicles, or for other non-potable uses. Installing a rain garden in front of the building can capture, treat, and infiltrate roof runoff. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
60	13,687	0.7	6.9	62.8	0.011	0.38

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	0.018	3	1,380	0.05	175	$875
Rainwater harvesting	0.029	5	2,170	0.08	600 (gal)	$1,200

GREEN INFRASTRUCTURE RECOMMENDATIONS

Red Bank First Aid & Rescue Squad

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

0 20' 40'

Red Bank Middle School

Subwatershed: Navesink River

Site Area: 295,329 sq. ft.

Address: 101 Harding Road
Red Bank, NJ 07701

Block and Lot: Block 108
Lot 1, 2

Installing two rain gardens near the outdoor seating area can capture, treat, and infiltrate runoff from the surrounding pavement. A portion of the parking spaces can be repaved with porous asphalt to capture a large volume of 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"
58	171,219	8.3	86.5	786.1	0.133	4.70

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	0.172	29	13,030	0.49	1,650	$8,250
Pervious pavement	0.625	105	47,380	1.78	4,300	$107,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

Red Bank Middle School

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

0 50' 100'

Red Bank Public Library

Subwatershed: Navesink River

Site Area: 49,895 sq. ft.

Address: 84 West Front Street
Red Bank, NJ 07701

Block and Lot: Block 8
Lot 4, 5

Installing a rain garden at the front of the building can capture, treat, and infiltrate roof runoff. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
55	27,393	1.3	13.8	125.8	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	0.023	4	1,780	0.07	225	$1,125

GREEN INFRASTRUCTURE RECOMMENDATIONS

Red Bank Public Library

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

0 20' 40'

Wallace-Linden Parking Lot

Subwatershed: Navesink River

Site Area: 29,973 sq. ft.

Address: Linden Place
Red Bank, NJ 07701

Block and Lot: Block 48
Lot 7.01

Parking spaces can be replaced with porous asphalt to capture and infiltrate stormwater. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
94	28,263	1.4	14.3	129.8	0.022	0.78

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	0.623	104	47,180	1.77	7,300	$182,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

Wallace-Linden Parking Lot

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

0 30' 60'

Calvary Baptist Church

Subwatershed: **Poricy Brook**

Site Area: **51,740 sq. ft.**

Address: **23 River Street**
Red Bank, NJ 07701

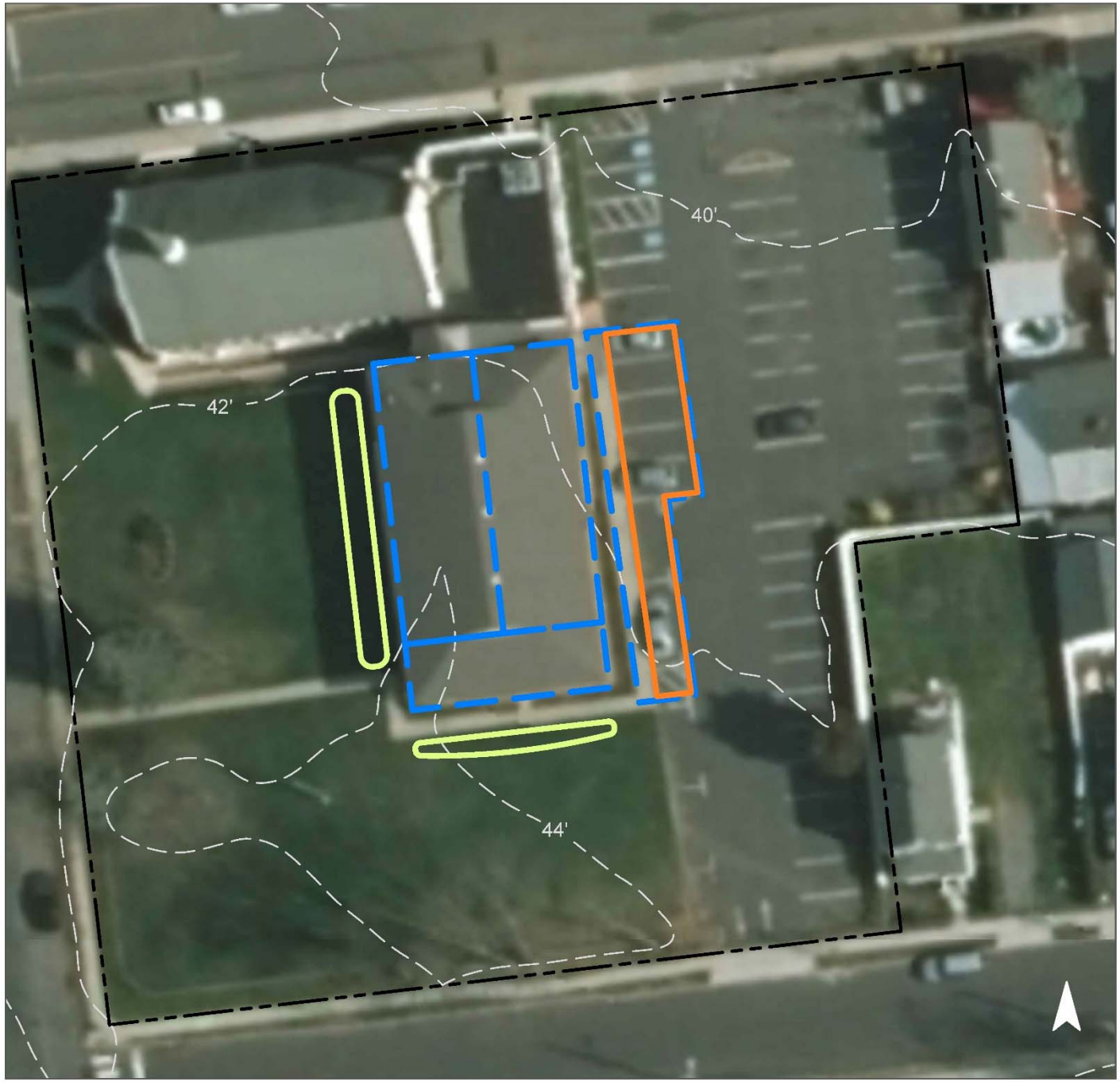
Block and Lot: **Block 75.03**
Lot 60, 61, 62, 63, 73, 74, 75

Parking spots to the east of the building can be replaced with porous asphalt to capture and infiltrate stormwater from downspouts already discharging to them. Installing rain gardens adjacent to the building can capture, treat, and infiltrate roof runoff. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
64	33,329	1.6	16.8	153.0	0.026	0.91

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	0.074	12	5,580	0.21	725	$3,625
Pervious pavement	0.099	17	7,500	0.28	1,250	$31,250

GREEN INFRASTRUCTURE RECOMMENDATIONS



Calvary Baptist Church

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

0 20' 40'

Red Bank Primary School

Subwatershed: Poricy Brook

Site Area: 945,425 sq. ft.

Address: 222 River Street
Red Bank, NJ 07701

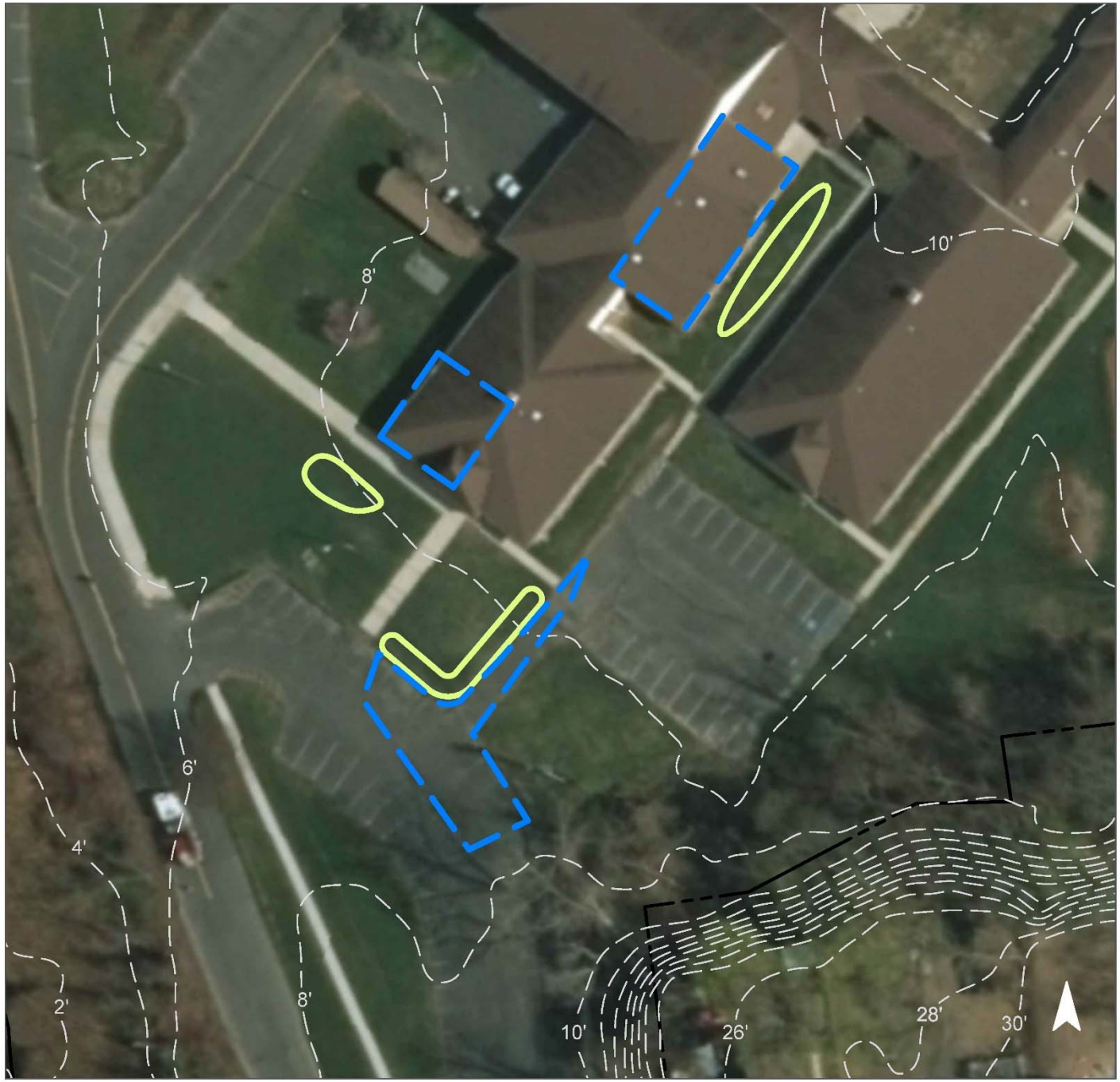
Block and Lot: Block 71
Lot 5

Installing rain gardens adjacent to the building and by the parking lot can capture, treat, and infiltrate roof runoff. A rain garden near the parking lot can help remediate some of the erosion occurring and capture 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"
21	198,655	9.6	100.3	912.1	0.155	5.45

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	0.175	29	13,220	0.50	1,675	$8,375

GREEN INFRASTRUCTURE RECOMMENDATIONS



Red Bank Primary School

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

0 30' 60'

Red Bank Senior Center

Subwatershed: **Poricy Brook**

Site Area: **64,448 sq. ft.**

Address: **80 Shrewsbury Avenue**
Red Bank, NJ 07701

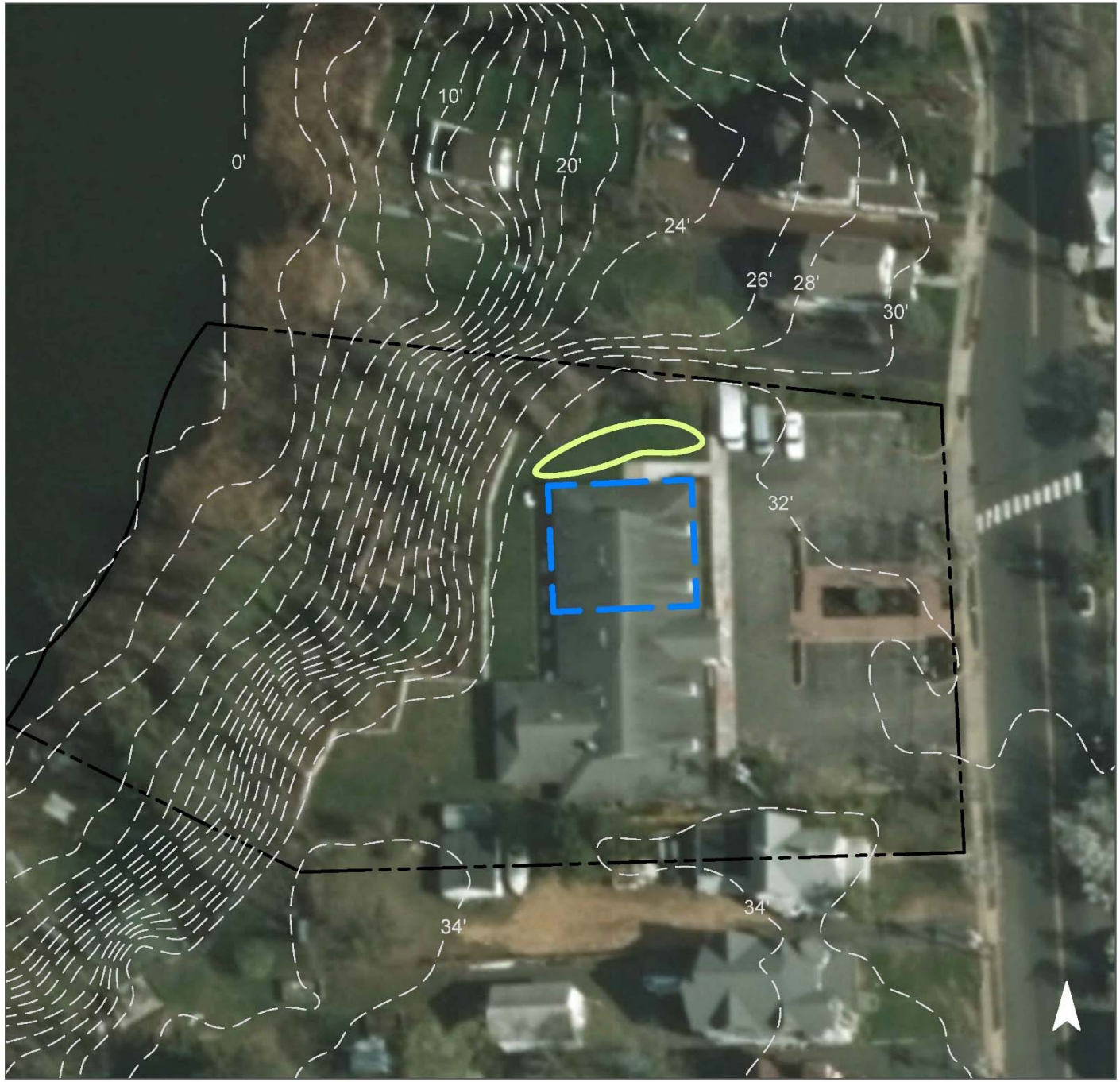
Block and Lot: **Block 39**
Lot 23, 24

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

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
52	33,453	1.6	16.9	153.6	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 system	0.073	12	5,530	0.21	700	$3,500

GREEN INFRASTRUCTURE RECOMMENDATIONS



Red Bank Senior Center

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

0 30' 60'

Saint Anthony of Padua Church

Subwatershed: Poricy Brook

Site Area: 30,459 sq. ft.

Address: 121 Bridge Avenue
Red Bank, NJ 07701

Block and Lot: Block 75.05; 75.06
Lot 14.01; 1.01

Roof runoff can be harvested by installing a cistern at the back of the building near the existing community garden raised beds. The water can then be used for watering the garden. Installing a rain garden adjacent to each of the building can capture, treat, and infiltrate roof runoff. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
94	28,519	1.4	14.4	130.9	0.022	0.78

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	0.069	12	5,230	0.20	675	$3,375
Rainwater harvesting	0.026	4	800	0.02	800 (gal)	$1,600

GREEN INFRASTRUCTURE RECOMMENDATIONS

Saint Anthony of Padua Church

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

0 25' 50'

Union Hose Fire Station

Subwatershed: Poricy Brook

Site Area: 5,043 sq. ft.

Address: 161 Shrewsbury Avenue
Red Bank, NJ 07701

Block and Lot: Block 68
Lot 10

Roof runoff can be harvested by installing a cistern adjacent to the garage. The water can then be used for washing vehicles or for other non-potable uses. 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"
90	4,539	0.2	2.3	20.8	0.004	0.12

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Rainwater harvesting	0.029	5	900	0.03	900 (gal)	$1,800

GREEN INFRASTRUCTURE RECOMMENDATIONS

Union Hose Fire Station

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

0 10' 20'

c. Summary of Existing Conditions

Summary of Existing Site 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)			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)
LITTLE SILVER CREEK SUBWATERSHED	**5.02**	**218,689**				**1.46**	**63,432**	**3.1**	**32.0**	**291.2**	**0.049**	**1.74**
Count Basie Park												
Total Site Info	4.64	202,020	97	38	25	1.15	50,096	2.4	25.3	230.0	0.039	1.37
Red Bank Board of Education												
Total Site Info	0.38	16,669	108	1.01	80	0.31	13,335	0.6	6.7	61.2	0.010	0.37
NAVESINK RIVER SUBWATERSHED	**18.67**	**813,111**				**12.58**	**547,933**	**26.4**	**276.7**	**2,515.8**	**0.427**	**15.03**
English Plaza Parking Lot												
Total Site Info	1.12	48,976	30.01	37, 39, 40, 41	95	1.07	46,528	2.2	23.5	213.6	0.036	1.28
Gold Street Parking Lot												
Total Site Info	0.73	31,767	46	3, 36.01, 36.02, 4	95	0.69	30,178	1.5	15.2	138.6	0.024	0.83
Marine Park												
Total Site Info	4.36	190,025	9	5, 5.04	49	2.15	93,703	4.5	47.3	430.2	0.073	2.57
Mechanic-Wallace Parking Lot												
Total Site Info	1.45	63,208	29	9, 20, 22.01	95	1.38	60,027	2.9	30.3	275.6	0.047	1.65
Phoenix Productions												
Total Site Info	1.52	66,151	75.02	169	95	1.44	62,767	3.0	31.7	288.2	0.049	1.72
Red Bank Catholic Fine & Performing Arts + Relief Engine Co.												
Total Site Info	0.34	14,916	46	1	95	0.33	14,170	0.7	7.2	65.1	0.011	0.39
Red Bank First Aid & Rescue Squad												
Total Site Info	0.53	22,871	52.03	1	60	0.31	13,687	0.7	6.9	62.8	0.011	0.38
Red Bank Middle School												
Total Site Info	6.78	295,329	108	1, 2	58	3.93	171,219	8.3	86.5	786.1	0.133	4.70

Summary of Existing Site 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)			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)
Red Bank Public Library												
Total Site Info	1.15	49,895	8	4, 5	55	0.63	27,393	1.3	13.8	125.8	0.021	0.75
Wallace-Linden Parking Lot												
Total Site Info	0.69	29,973	48	7.01	94	0.65	28,263	1.4	14.3	129.8	0.022	0.78
PORICY BROOK SUBWATERSHED	**27.61**	**1,202,899**				**8.84**	**385,072**	**18.6**	**194.5**	**1,768.0**	**0.300**	**10.56**
Calvary Baptist Church												
Total Site Info	1.19	51,740	75.03	60-63,73-75	64	0.77	33,329	1.6	16.8	153.0	0.026	0.91
Red Bank Primary School												
Total Site Info	21.70	945,425	71	5	21	4.56	198,655	9.6	100.3	912.1	0.155	5.45
Red Bank Senior Center												
Total Site Info	1.48	64,448	39	23, 24	52	0.77	33,453	1.6	16.9	153.6	0.026	0.92
Saint Anthony of Padua Church												
Total Site Info	1.61	70,092	75.05; 75.06	14.01; 1.01	75	1.20	52,330	2.5	26.4	240.3	0.041	1.44
Union Hose Fire Station												
Total Site Info	0.12	5,043	68	10	90	0.10	4,539	0.2	2.3	20.8	0.004	0.12

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)		($/unit)		($)	%
	LITTLE SILVER CREEK SUBWATERSHED	**30,550**	**0.70**	**0.796**	**133**	**60,300**	**2.26**				**$183,125**	**48.2%**
1	**Count Basie Park**											
	Bioretention system	2,000	0.05	0.052	9	3,950	0.15	500	$5	SF	$2,500	4.0%
	Pervious pavement	23,650	0.54	0.616	103	46,680	1.75	6,300	$25	SF	$157,500	47.2%
	Total Site Info	**25,650**	**0.59**	**0.668**	**112**	**50,630**	**1.90**				**$160,000**	**51.2%**
2	**Red Bank Board of Education**											
	Bioretention system	1,100	0.03	0.029	5	2,170	0.08	275	$5	SF	$1,375	8.2%
	Pervious pavement	3,800	0.09	0.099	17	7,500	0.28	870	$25	SF	$21,750	28.5%
	Total Site Info	**4,900**	**0.11**	**0.128**	**21**	**9,670**	**0.36**				**$23,125**	**36.7%**
	NAVESINK RIVER SUBWATERSHED	**122,500**	**2.81**	**3.192**	**534**	**241,820**	**9.08**				**$796,450**	**22.4%**
3	**English Plaza Parking Lot**											
	Pervious pavement	15,500	0.36	0.404	68	30,590	1.15	4,700	$25	SF	$117,500	33.3%
	Total Site Info	**15,500**	**0.36**	**0.404**	**68**	**30,590**	**1.15**				**$117,500**	**33.3%**
4	**Gold Street Parking Lot**											
	Pervious pavement	4,300	0.10	0.112	19	8,490	0.32	1,850	$25	SF	$46,250	14.2%
	Total Site Info	**4,300**	**0.10**	**0.112**	**19**	**8,490**	**0.32**				**$46,250**	**14.2%**
5	**Marine Park**											
	Bioretention systems	7,250	0.17	0.189	32	14,310	0.54	1,800	$5	SF	$9,000	7.7%
	Pervious pavement	9,100	0.21	0.237	40	17,960	0.67	2,300	$25	SF	$57,500	9.7%
	Total Site Info	**16,350**	**0.38**	**0.426**	**71**	**32,270**	**1.21**				**$66,500**	**17.4%**
6	**Mechanic-Wallace Parking Lot**											
	Pervious pavement	6,350	0.15	0.165	28	12,540	0.47	2,950	$25	SF	$73,750	10.6%
	Total Site Info	**6,350**	**0.15**	**0.165**	**28**	**12,540**	**0.47**				**$73,750**	**10.6%**
7	**Phoenix Productions**											
	Pervious pavement	20,700	0.48	0.539	90	40,860	1.53	8,300	$25	SF	$207,500	33.0%
	Total Site Info	**20,700**	**0.48**	**0.539**	**90**	**40,860**	**1.53**				**$207,500**	**33.0%**

Summary of Proposed Green Infrastructure Practices

	Subwatershed/Site Name/Total Site Info/GI Practice	Potential Management Area Area (SF)	Potential Management Area Area (ac)	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Max Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cfs)	Size of BMP	Unit Cost ($/unit)	Unit	Total Cost ($)	I.C. Treated %
8	**Red Bank Catholic Fine & Performing Arts + Relief Engine Co.**											
	Bioretention system	800	0.02	0.021	3	1,580	0.06	200	$5	SF	$1,000	5.6%
	Stormwater planter	1,300	0.03	0.034	6	2,570	0.10	240	$375	SF	$90,000	9.2%
	Total Site Info	**2,100**	**0.05**	**0.055**	**9**	**4,150**	**0.16**				**$91,000**	**14.8%**
9	**Red Bank First Aid & Rescue Squad**											
	Bioretention system	700	0.02	0.018	3	1,380	0.05	175	$5	SF	$875	5.1%
	Rainwater harvesting	1,100	0.03	0.029	5	2,170	0.08	600	$2	gal	$1,200	8.0%
	Total Site Info	**1,800**	**0.04**	**0.047**	**8**	**3,550**	**0.13**				**$2,075**	**13.2%**
10	**Red Bank Middle School**											
	Bioretention systems	6,600	0.15	0.172	29	13,030	0.49	1,650	$5	SF	$8,250	3.9%
	Pervious pavement	24,000	0.55	0.625	105	47,380	1.78	4,300	$25	SF	$107,500	14.0%
	Total Site Info	**30,600**	**0.70**	**0.797**	**133**	**60,410**	**2.27**				**$8,250**	**3.9%**
11	**Red Bank Public Library**											
	Bioretention system	900	0.02	0.023	4	1,780	0.07	225	$5	SF	$1,125	3.3%
	Total Site Info	**900**	**0.02**	**0.023**	**4**	**1,780**	**0.07**				**$1,125**	**3.3%**
12	**Wallace-Linden Parking Lot**											
	Pervious pavement	23,900	0.55	0.623	104	47,180	1.77	7,300	$25	SF	$182,500	84.6%
	Total Site Info	**23,900**	**0.55**	**0.623**	**104**	**47,180**	**1.77**				**$182,500**	**84.6%**
	PORICY BROOK SUBWATERSHED	**41,575**	**0.95**	**1.083**	**181**	**79,620**	**2.98**				**$261,025**	**10.8%**
13	**Calvary Baptist Church**											
	Bioretention systems	2,825	0.06	0.074	12	5,580	0.21	725	$5	SF	$3,625	8.5%
	Pervious pavement	3,800	0.09	0.099	17	7,500	0.28	1,250	$25	SF	$31,250	11.4%
	Total Site Info	**6,625**	**0.15**	**0.173**	**29**	**13,080**	**0.49**				**$34,875**	**19.9%**
14	**Red Bank Primary School**											
	Bioretention systems	6,700	0.15	0.175	29	13,220	0.50	1,675	$5	SF	$8,375	3.4%
	Total Site Info	**6,700**	**0.15**	**0.175**	**29**	**13,220**	**0.50**				**$8,375**	**3.4%**
15	**Red Bank Senior Center**											
	Bioretention system	2,800	0.06	0.073	12	5,530	0.21	700	$5	SF	$3,500	8.4%
	Total Site Info	**2,800**	**0.06**	**0.073**	**12**	**5,530**	**0.21**				**$3,500**	**8.4%**

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)		($/unit)		($)	%
16 **Saint Anthony of Padua Church**											
Bioretention systems	2,650	0.06	0.069	12	5,230	0.20	675	$5	SF	$3,375	5.1%
Rainwater harvesting	1,000	0.02	0.026	4	800	0.02	800	$2	gal	$1,600	1.9%
Total Site Info	**3,650**	**0.08**	**0.095**	**16**	**6,030**	**0.22**				**$4,975**	**7.0%**
17 **Union Hose Fire Station**											
Rainwater harvesting	1,100	0.03	0.029	5	900	0.03	900	$2	gal	$1,800	24.2%
Total Site Info	**1,100**	**0.03**	**0.029**	**5**	**900**	**0.03**				**$1,800**	**24.2%**