RUTGERS
New Jersey Agricultural
Experiment Station

**Draft**

# Impervious Cover Reduction Action Plan
# for
# Holmdel Township, Monmouth County, New Jersey

*Prepared for Holmdel Township by the*
*Rutgers Cooperative Extension Water Resources Program*

January 12, 2021

Sea Grant
NJ Sea Grant Consortium

ACKNOWLEDGEMENTS:

This document has been prepared by the Rutgers Cooperative Extension Water Resources Program, with funding and direction from the New Jersey Sea Grant Consortium and the New Jersey Agricultural Experiment Station, to highlight green infrastructure opportunities within Holmdel Township. We would like to thank the New Jersey Sea Grant Consortium, the New Jersey Agricultural Experiment Station, and Holmdel Township for their input and support in creating this document.

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NJ Sea Grant Consortium

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## Introduction

Located in Monmouth County, New Jersey, Holmdel Township covers approximately 18.05 square miles. Figures 1 and 2 illustrate that Holmdel Township is dominated by urban land use. A total of 56.6% of the municipality's land use is classified as urban. Of the urban land in Holmdel 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 Holmdel 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 Holmdel Township. Based upon the 2015 NJDEP land use/land cover data, approximately 14.3% of Holmdel Township has impervious cover. This level of impervious cover suggests that the streams in Holmdel Township are likely impacted streams. [1]

## Methodology

Holmdel Township contains portions of seven 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.

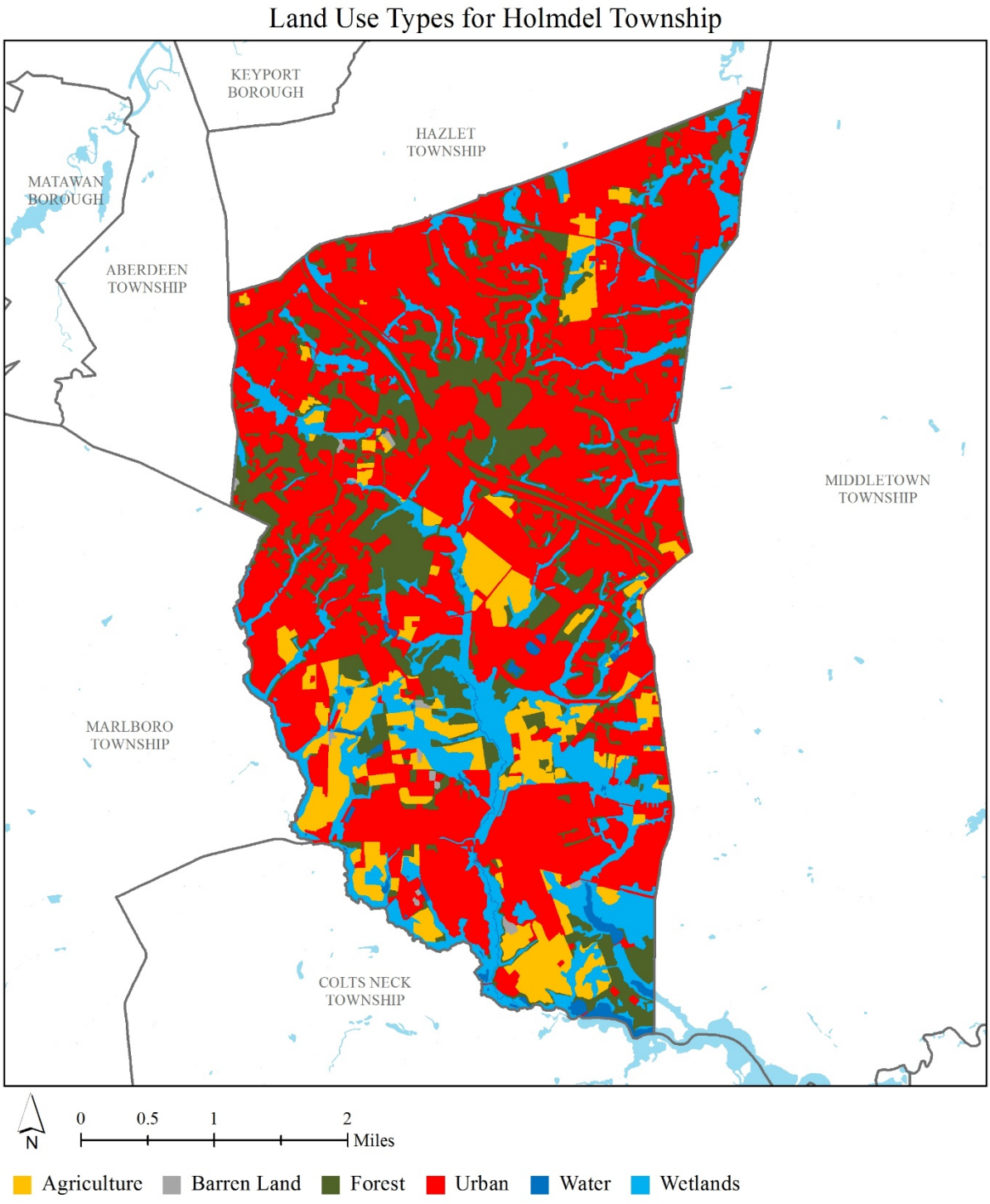



Figure 1: Map illustrating the land use in Holmdel Township

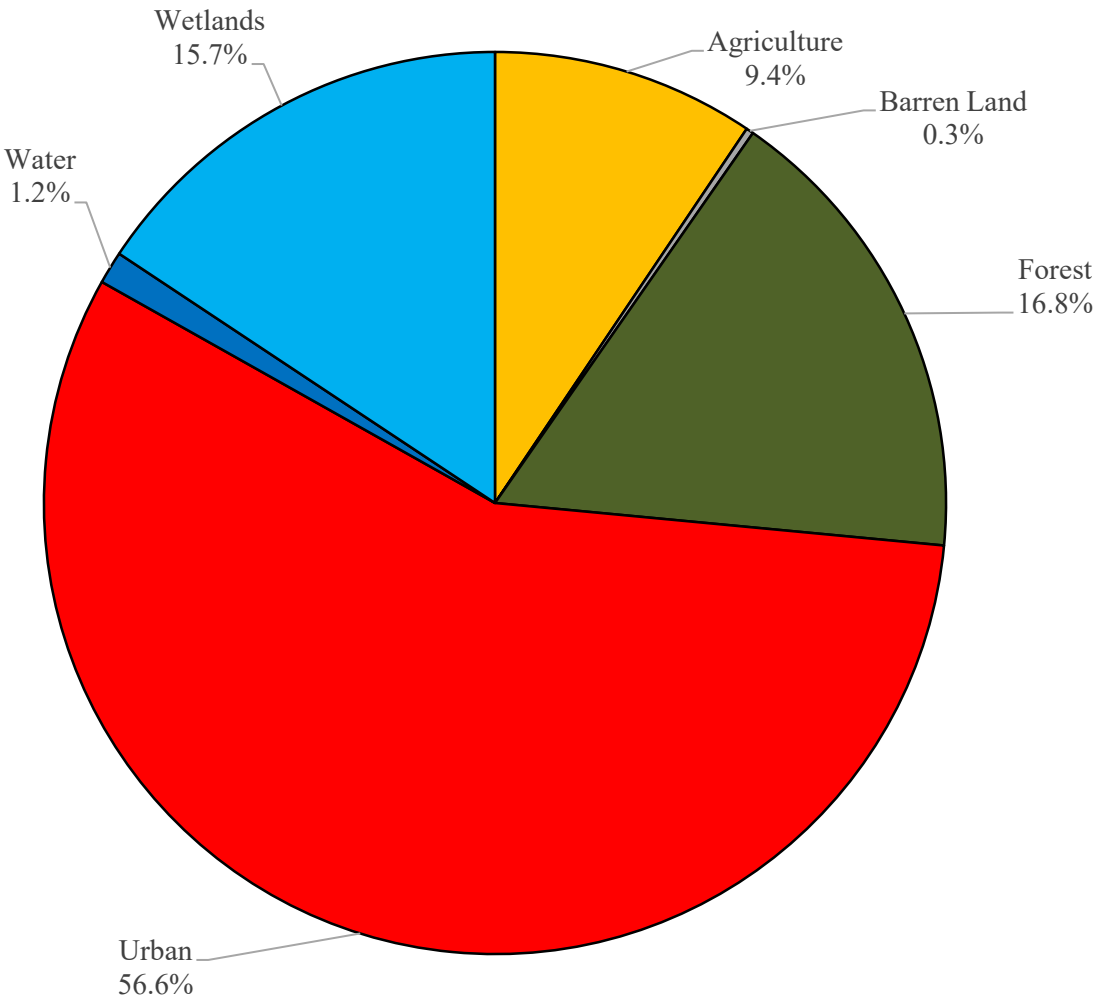



Figure 2: Pie chart illustrating the land use in Holmdel Township

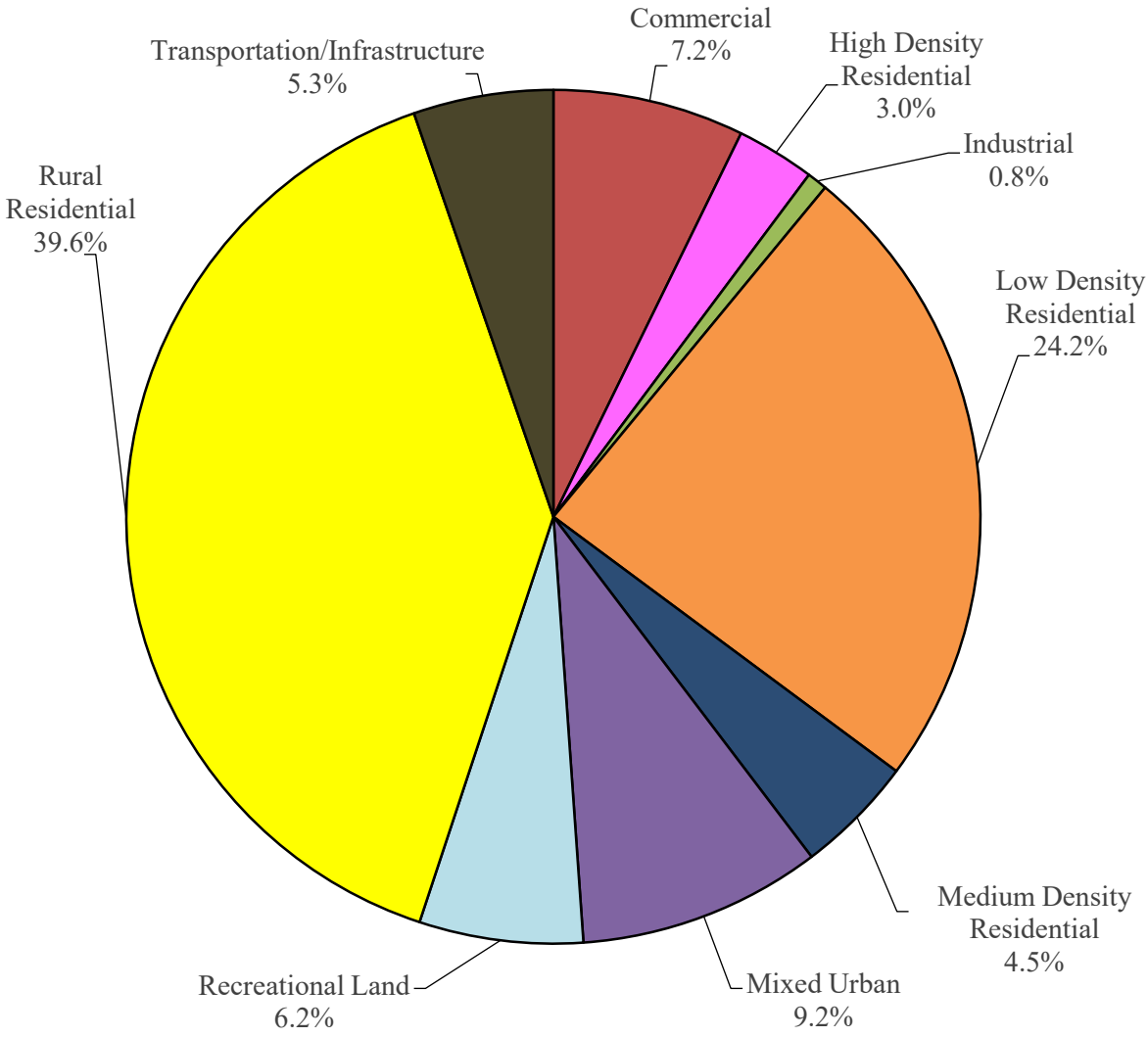



Figure 3: Pie chart illustrating the various types of urban land use in Holmdel Township

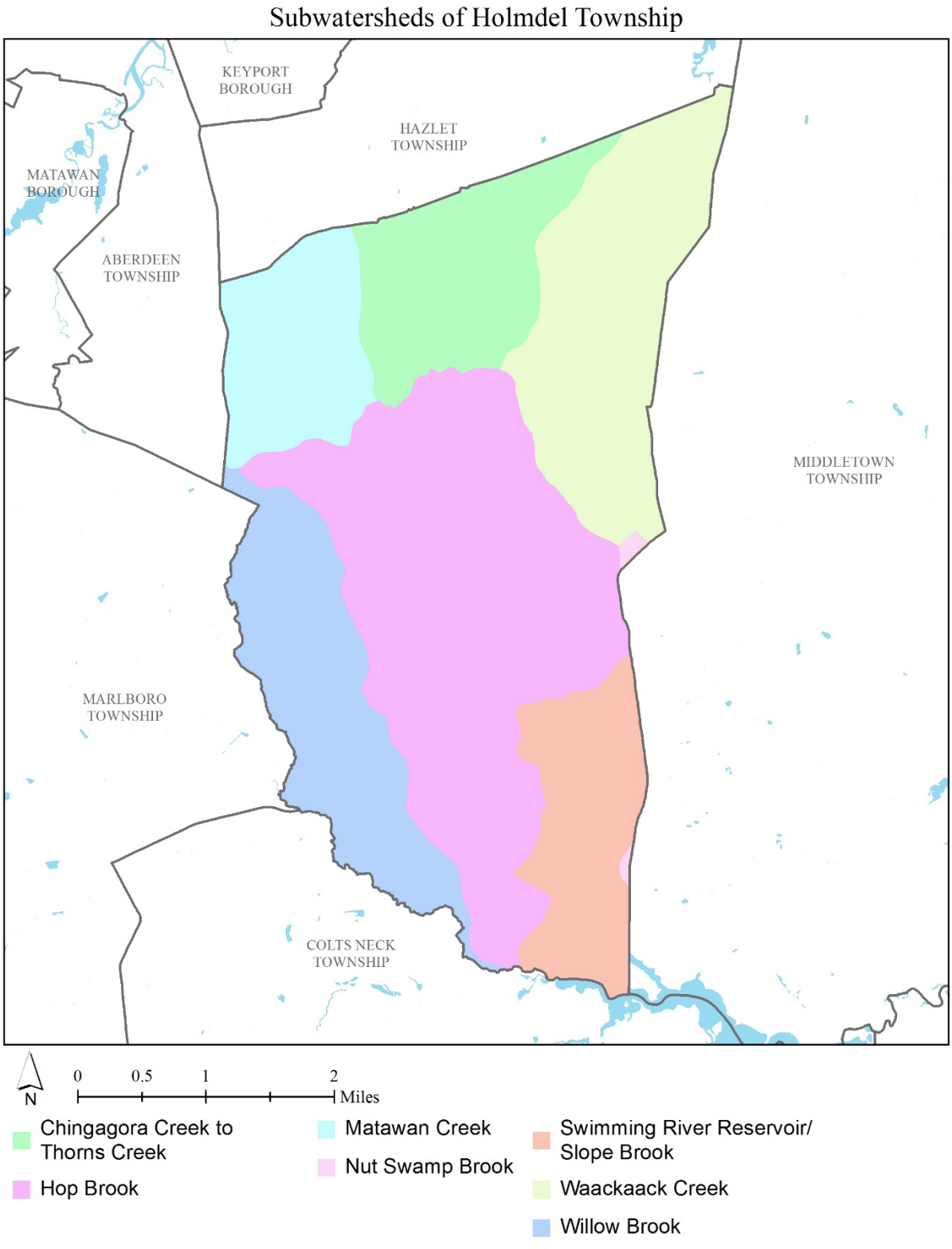



Figure 4: Map of the subwatersheds in Holmdel Township

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 Holmdel 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 Holmdel 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.

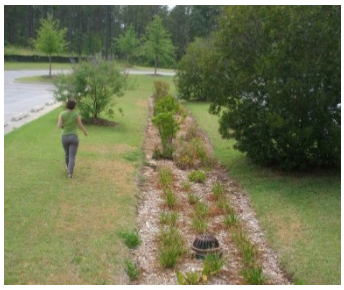
***Downspout planter boxes***

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

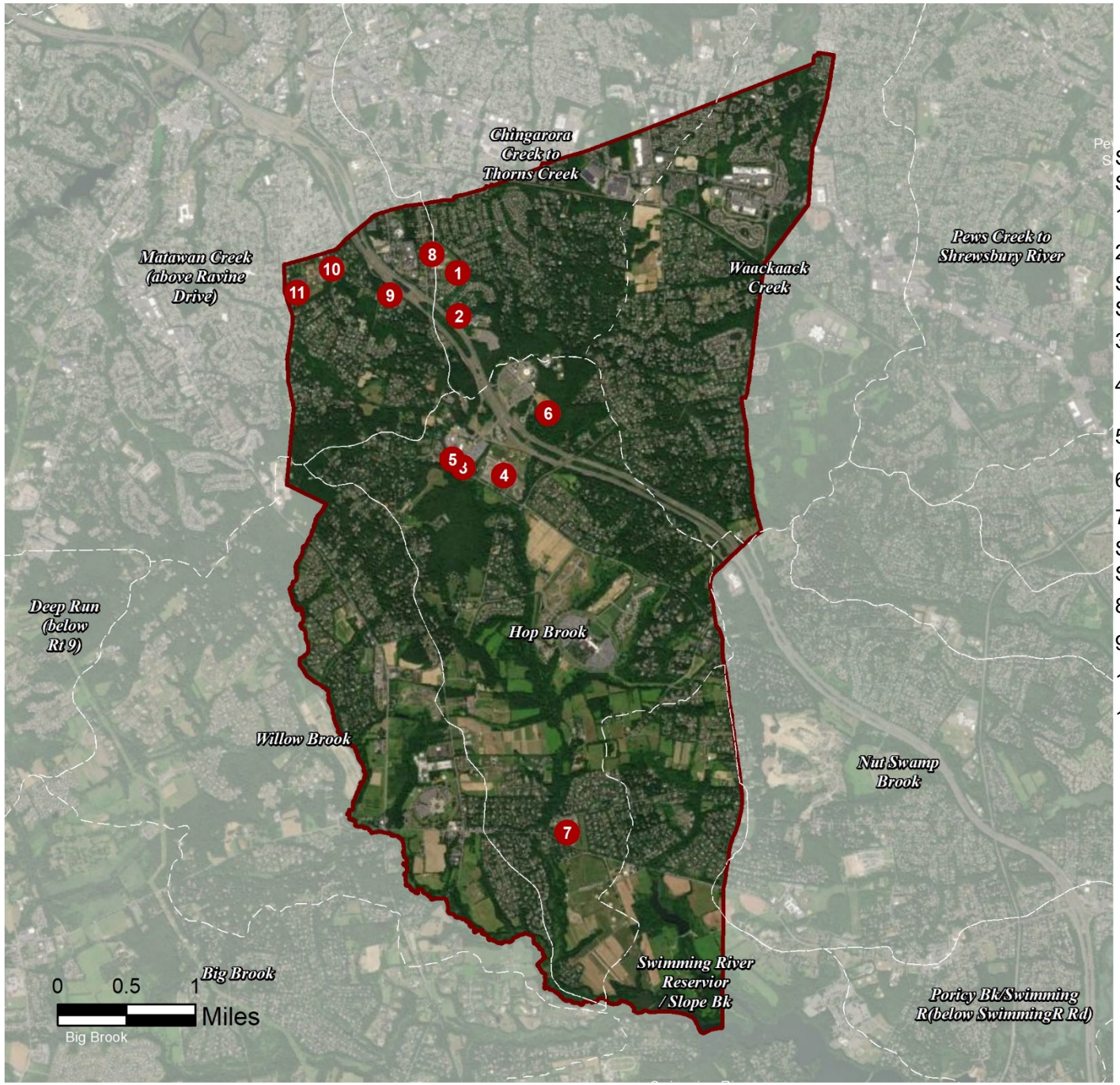
This impervious cover reduction action plan is meant to provide the municipality with a blueprint for implementing green infrastructure practices that will reduce the impact of stormwater runoff from impervious surfaces. These projects can be implemented by a wide variety of people such as boy scouts,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

# HOLMDEL: GREEN INFRASTRUCTURE SITES




SITES WITHIN THE CHINGARORA CREEK SUBWATERSHED

1. Ackerson Park
2. Holmdel Swim Club

SITES WITHIN THE HOP BROOK SUBWATERSHED

3. Holmdel First Aid Squad
4. Holmdel High School & William R. Satz Middle School
5. Holmdel Municipal Court & Gateway Church of Christ
6. Vietnam Era Museum and Education Center
7. Village Elementary School

SITES WITHIN THE MATAWAN CREEK SUBWATERSHED

8. Indian Hill School
9. Kimisis Tis Theotokou Church
10. Saint Benedict School and Church
11. Saint John Vianney High School

## b. Proposed Green Infrastructure Concepts

# ACKERSON PARK

**Subwatershed:** Chingarora Creek

**Site Area:** 550,557 sq. ft.

**Address:** 17 Crape Myrtle Drive
Holmdel, NJ 07733

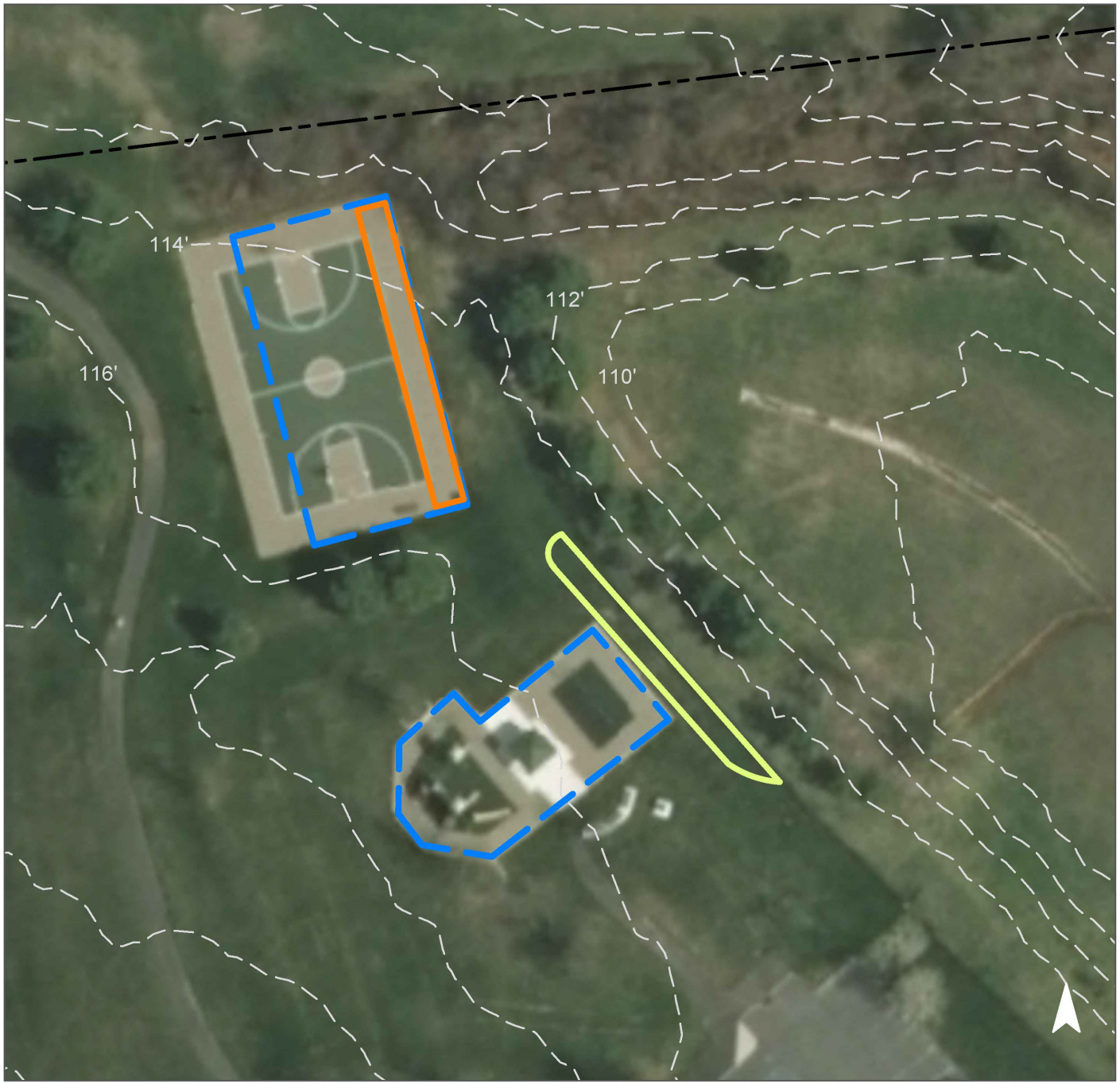
**Block and Lot:** Block 46, Lot 64.09

A rain garden can be installed near the playground area to capture, treat, and infiltrate stormwater runoff and also serve as an educational demonstration. Pervious pavement can be installed to treat the drainage area of the basketball court and also improve the structure of the existing cracked pavement. 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" |
| 11 | 58,326 | 2.8 | 29.5 | 267.8 | 0.045 | 1.60 |

| 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 | 0.091 | 15 | 6,680 | 0.25 | 1,656 | $8,280 |
| Pervious pavement | 0.140 | 23 | 10,280 | 0.39 | 960 | $24,000 |

# GREEN INFRASTRUCTURE RECOMMENDATIONS




## Ackerson Park

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

0 25' 50'

# HOLMDEL SWIM CLUB

**Subwatershed:** Chingarora Creek

**Site Area:** 1,236,055 sq. ft.

**Address:** 36 Crawfords Corner Road
Holmdel, NJ 07733

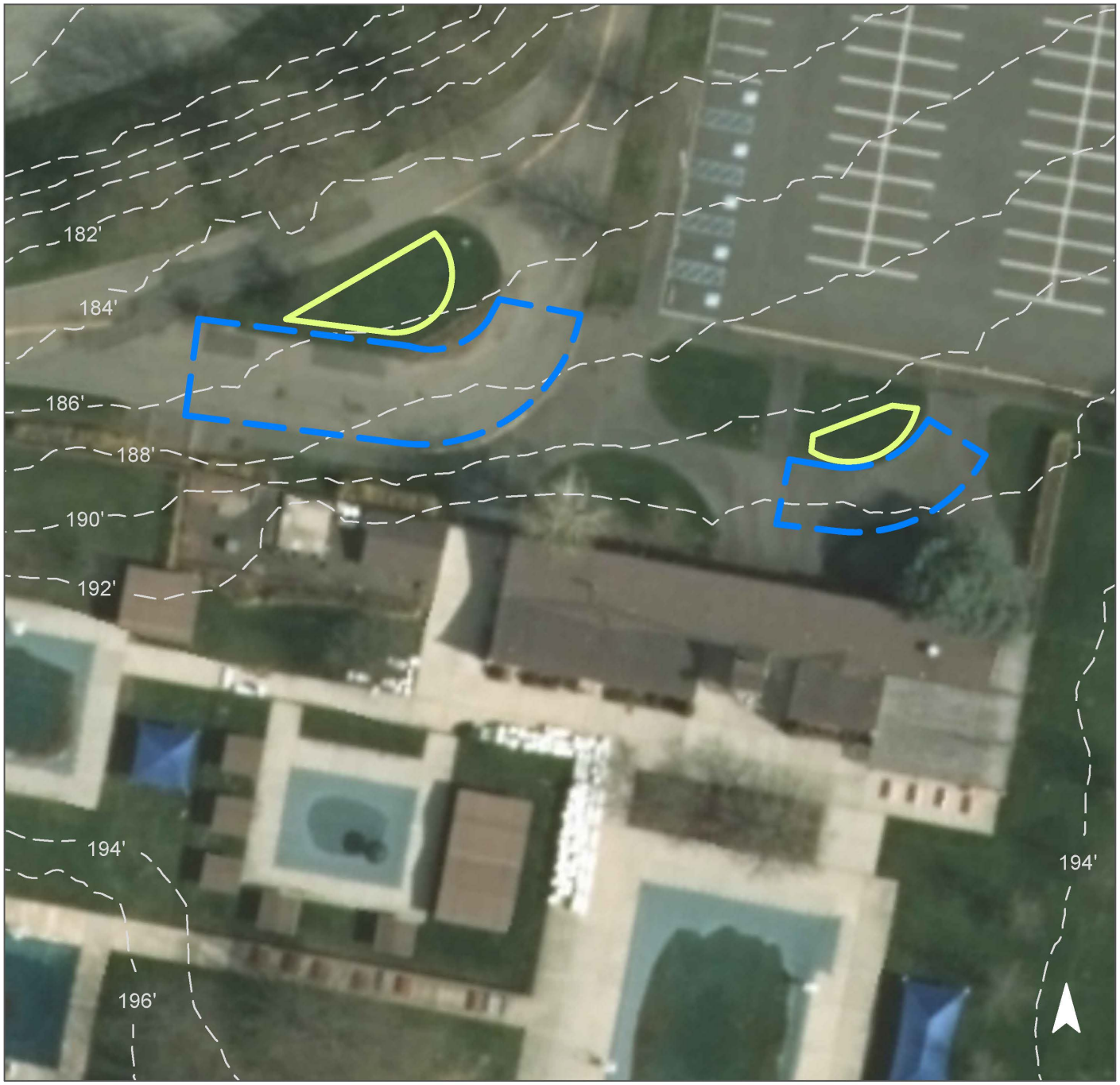
**Block and Lot:** Block 46, Lot 79

Two bioretention systems can be installed in the front of the building to capture, treat, and infiltrate runoff from the surrounding driveways. 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 | 306,098 | 14.8 | 154.6 | 1,405.4 | 0.239 | 8.40 |

| 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 | 0.139 | 23 | 10,230 | 0.38 | 1,656 | $8,280 |

# GREEN INFRASTRUCTURE RECOMMENDATIONS




## Holmdel Swim Club

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

0 25' 50'

# HOLMDEL FIRST AID SQUAD

**Subwatershed:** Hop Brook

**Site Area:** 159,518 sq. ft.

**Address:** 20 Crawfords Corner Road
Holmdel, NJ 07733

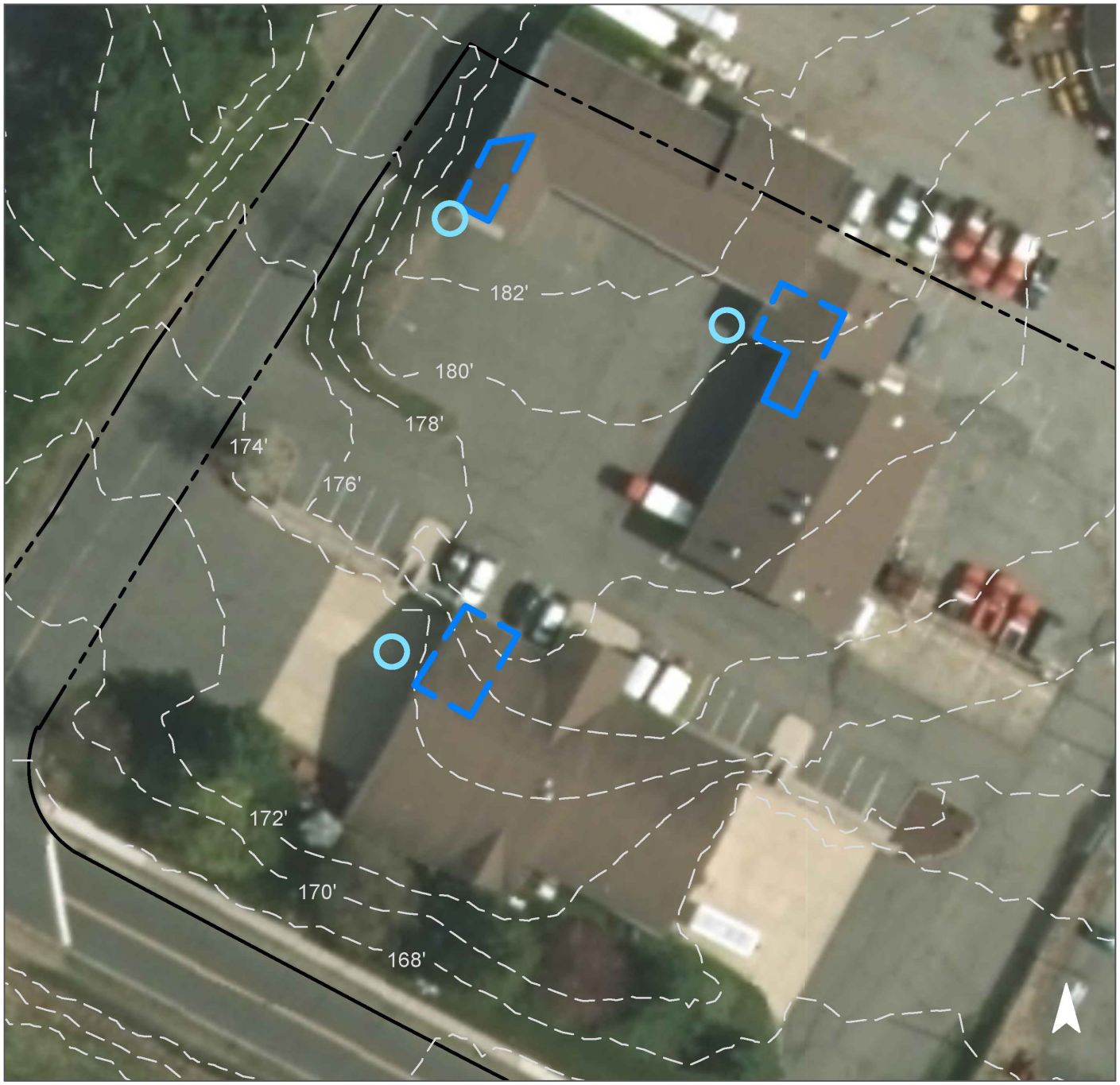
**Block and Lot:** Block 26, Lot 2

Three cisterns can be installed to capture runoff from the rooftops. The water can then be reused to provide a source of non-potable water for the first aid squad to wash vehicles. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability for green infrastructure.

| Impervious Cover | | Existing Loads from Impervious Cover (lbs/yr) | | | Runoff Volume from Impervious Cover (Mgal) | |
|---|---|---|---|---|---|---|
| % | sq. ft. | TP | TN | TSS | For the 1.25" Water Quality Storm | For an Annual Rainfall of 44" |
| 85 | 135,943 | 6.6 | 68.7 | 624.2 | 0.106 | 3.73 |

| 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 | 0.042 | 7 | 1,250 | 0.04 | 1,250 (gal) | $2,500 |

# GREEN INFRASTRUCTURE RECOMMENDATIONS




## Holmdel First Aid Squad

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

0 25' 50'

# HOLMDEL HIGH SCHOOL & WILLIAM R. SATZ MIDDLE SCHOOL

**Subwatershed:** Hop Brook

**Site Area:** 2,856,767 sq. ft.

**Address:** 36 Crawfords Corner Road
Holmdel, NJ 07733

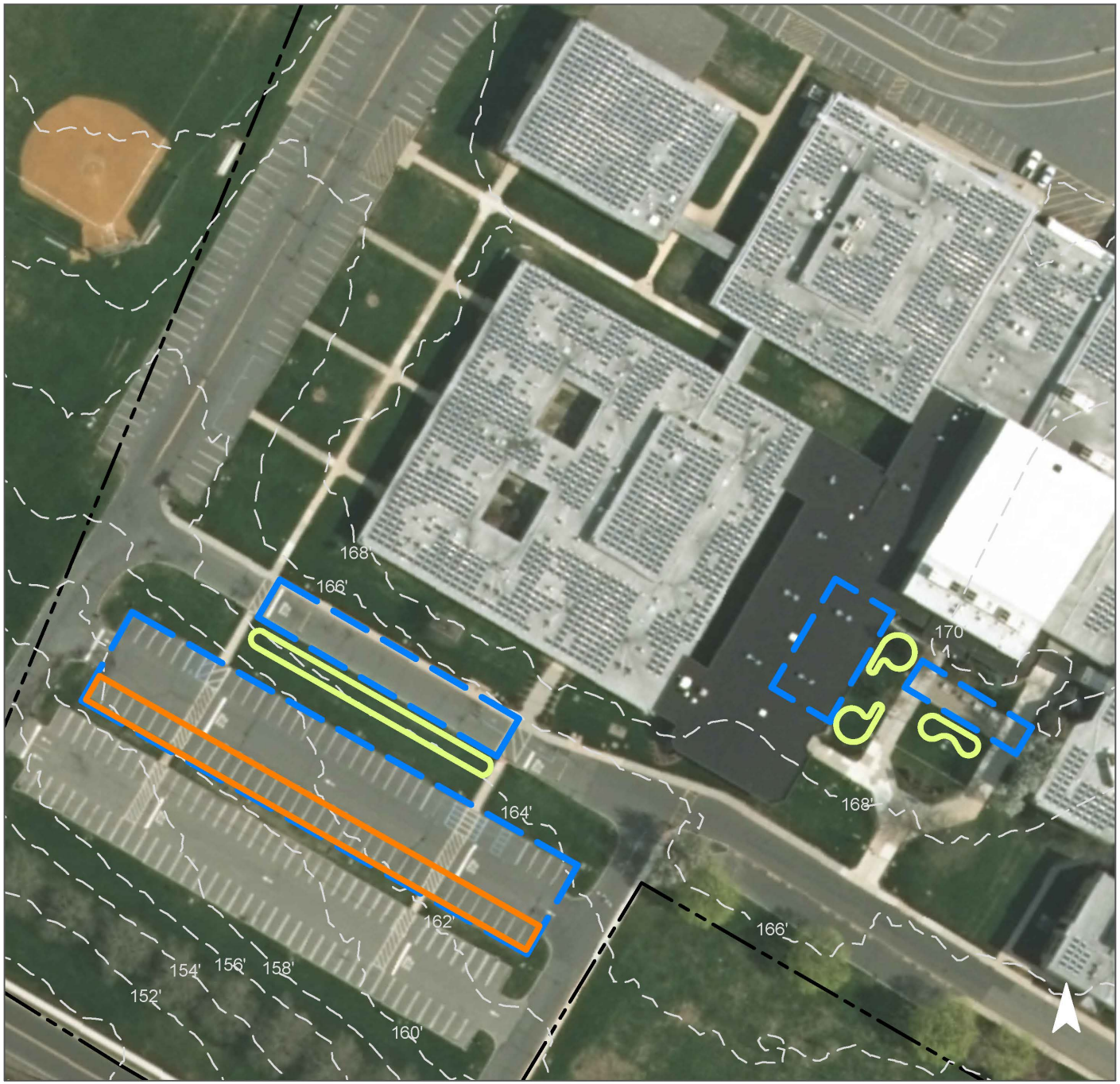
**Block and Lot:** Block 26, Lot 5.01

Two bioretention systems can be installed to treat the rooftop drainage area, and an additional one can be installed to capture, treat, and infiltrate runoff from a portion of the driveway. A section of parking spaces can be converted to porous pavement to capture and infiltrate 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" |
| 33 | 934,927 | 45.1 | 472.2 | 4,292.6 | 0.728 | 25.64 |

| 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 | 0.274 | 46 | 20,080 | 0.75 | 2,625 | $13,125 |
| Pervious pavement | 0.586 | 98 | 42,980 | 1.62 | 5,970 | $149,250 |

# GREEN INFRASTRUCTURE RECOMMENDATIONS




**Holmdel High School & William R. Satz Middle School**

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

0 50' 100'

# HOLMDEL MUNICIPAL COURT & GATEWAY CHURCH OF CHRIST

**Subwatershed:** Hop Brook

**Site Area:** 573,985 sq. ft.

**Address:** 4 Crawfords Corner Road
Holmdel, NJ 07733

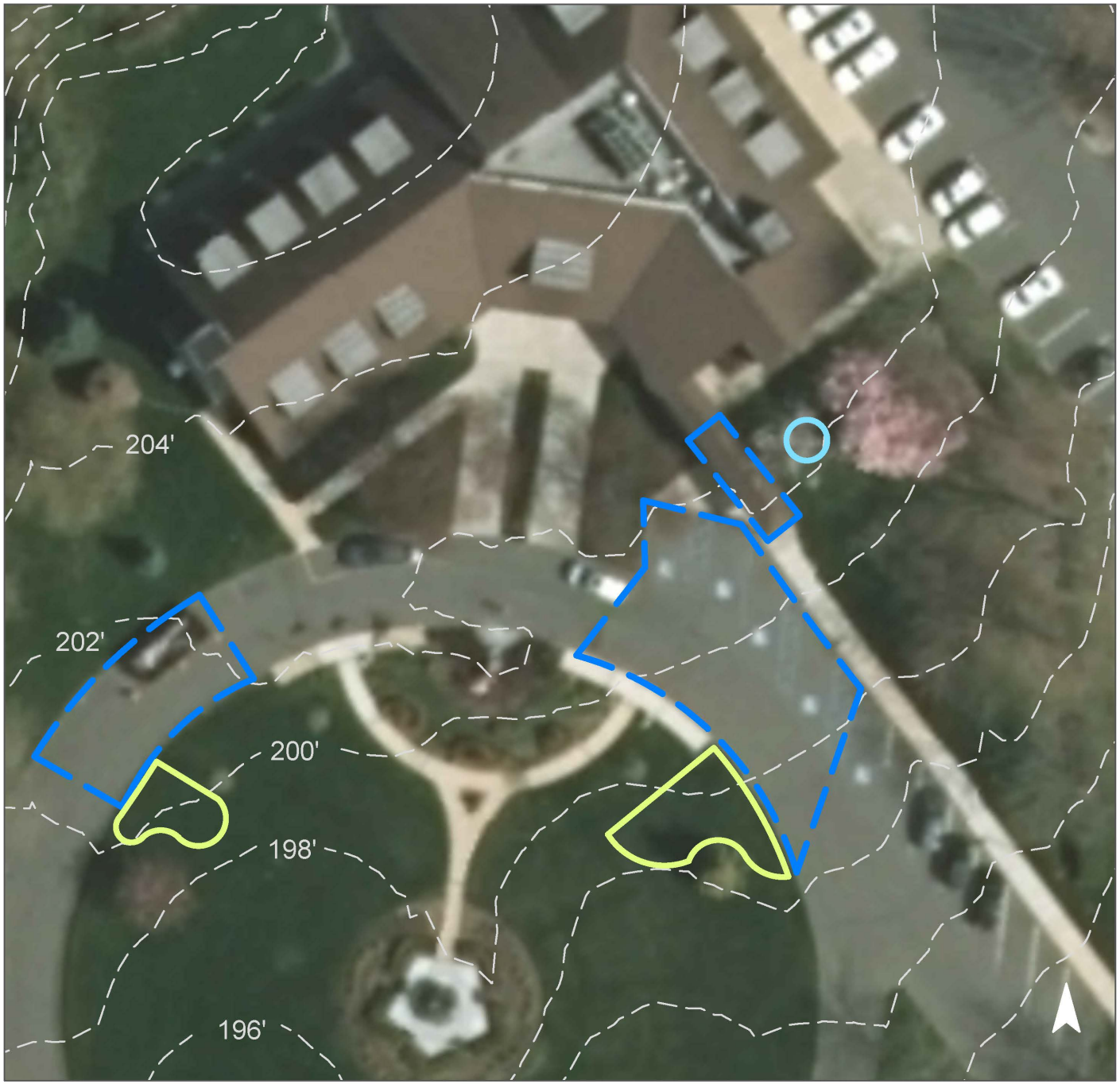
**Block and Lot:** Block 27, Lot 10

At the municipal court, two identical rain gardens can be installed on either side of the central turfgrass area in the front of the building to treat the parking lot drainage area on both sides. A small rainwater harvesting cistern can be installed near the entrance to capture runoff from the roof. The water can be reused to water the lawn or for other non-potable purposes. At the rear entrance to the church, two rain gardens can be installed to capture, treat, and infiltrate runoff from the 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" |
| 44 | 258,596 | 12.5 | 130.6 | 1,187.3 | 0.201 | 7.09 |

| Recommended Green Infrastructure Practices | Recharge Potential (Mgal/yr) | TSS Removal Potential (lbs/yr) | Maximum Volume Reduction Potential (gal/storm) | Peak Discharge Reduction Potential (cu. ft./second) | Estimated Size (sq. ft.) | Estimated Cost |
|---|---|---|---|---|---|---|
| Bioretention systems | 0.179 | 30 | 13,150 | 0.49 | 1,140 | $5,700 |
| Rainwater harvesting | 0.009 | 2 | 280 | 0.01 | 280 (gal) | $560 |

# GREEN INFRASTRUCTURE RECOMMENDATIONS




**Holmdel Municipal Court**

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

0 20' 40'

# GREEN INFRASTRUCTURE RECOMMENDATIONS


## Gateway Church of Christ

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

0 25' 50'

# VIETNAM ERA MUSEUM AND EDUCATION CENTER

**Subwatershed:** Hop Brook

**Site Area:** 863,936 sq. ft.

**Address:** 1 Memorial Lane
Holmdel, NJ 07733

**Block and Lot:** Block 47, Lot 2.01

Two bioretention systems can be installed to capture, treat, and infiltrate both the rooftop drainage area and runoff from the road. 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" |
| 8 | 65,763 | 3.2 | 33.2 | 301.9 | 0.051 | 1.80 |

| 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 | 0.075 | 13 | 5,510 | 0.21 | 725 | $3,625 |

# GREEN INFRASTRUCTURE RECOMMENDATIONS


**Vietnam Era Museum and Education Center**

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

0 25' 50'

# VILLAGE ELEMENTARY SCHOOL

**Subwatershed:** Hop Brook

**Site Area:** 1,095,449 sq. ft.

**Address:** 67 McCampbell Road
Holmdel, NJ 07733

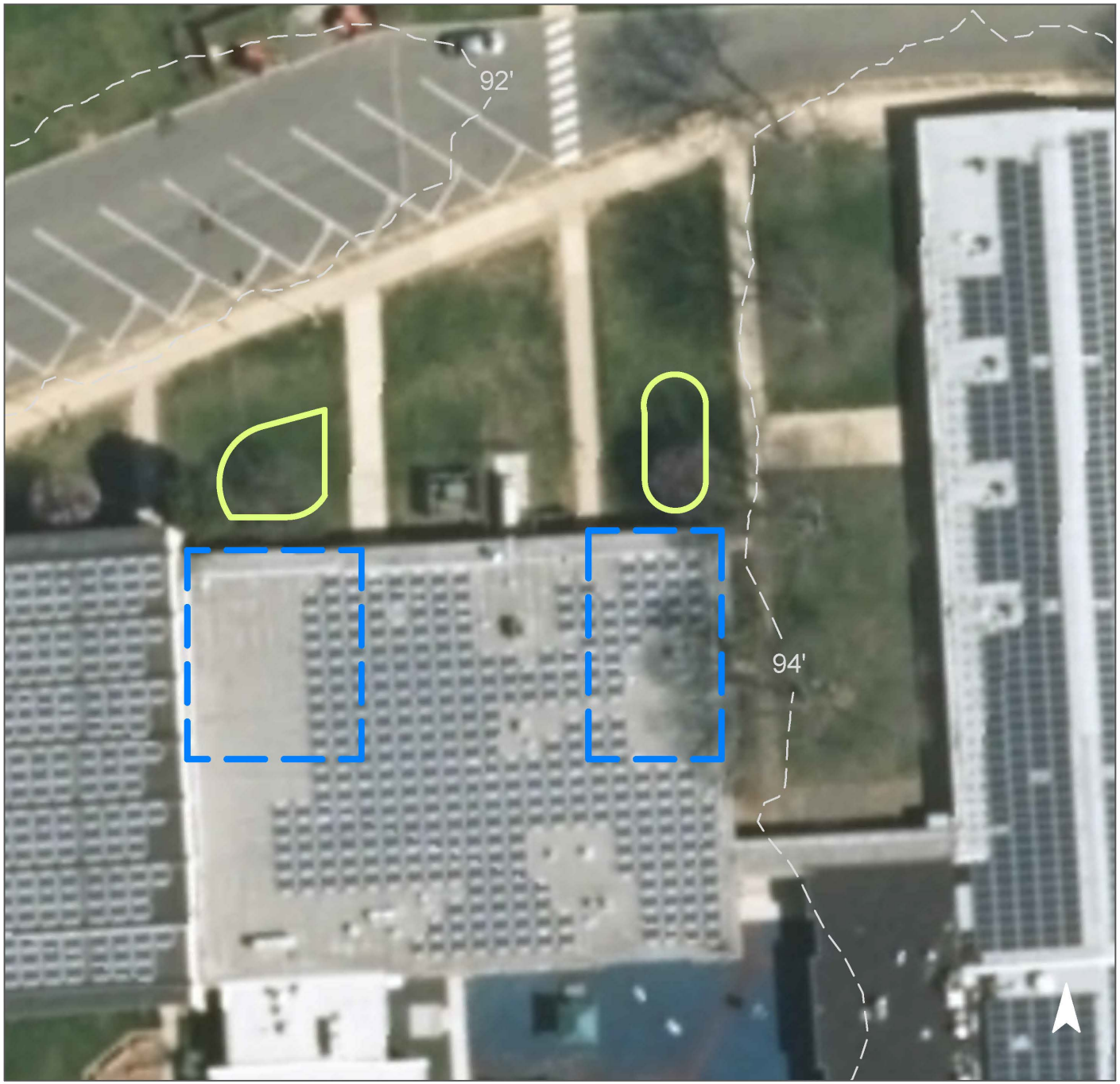
**Block and Lot:** Block 8, Lot 3

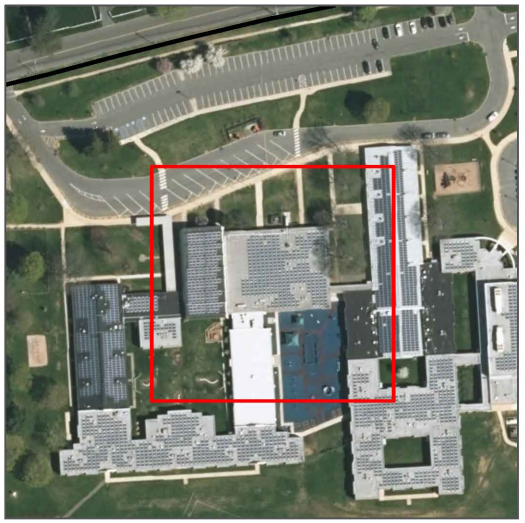

Two bioretention systems can be installed to capture, treat, and infiltrate runoff from the rooftop drainage area and serve as educational demonstration projects. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability for green infrastructure.

| Impervious Cover | | Existing Loads from Impervious Cover (lbs/yr) | | | Runoff Volume from Impervious Cover (Mgal) | |
|---|---|---|---|---|---|---|
| % | sq. ft. | TP | TN | TSS | For the 1.25" Water Quality Storm | For an Annual Rainfall of 44" |
| 32 | 353,159 | 17.0 | 178.4 | 1,621.5 | 0.275 | 9.69 |

| 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 systems | 0.120 | 20 | 8,770 | 0.33 | 1,150 | $5,750 |

# GREEN INFRASTRUCTURE RECOMMENDATIONS



## Village Elementary School

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

0 20' 40'

# INDIAN HILL SCHOOL

**Subwatershed:** Matawan Creek

**Site Area:** 435,962 sq. ft.

**Address:** 735 Holmdel Road
Holmdel, NJ 07733

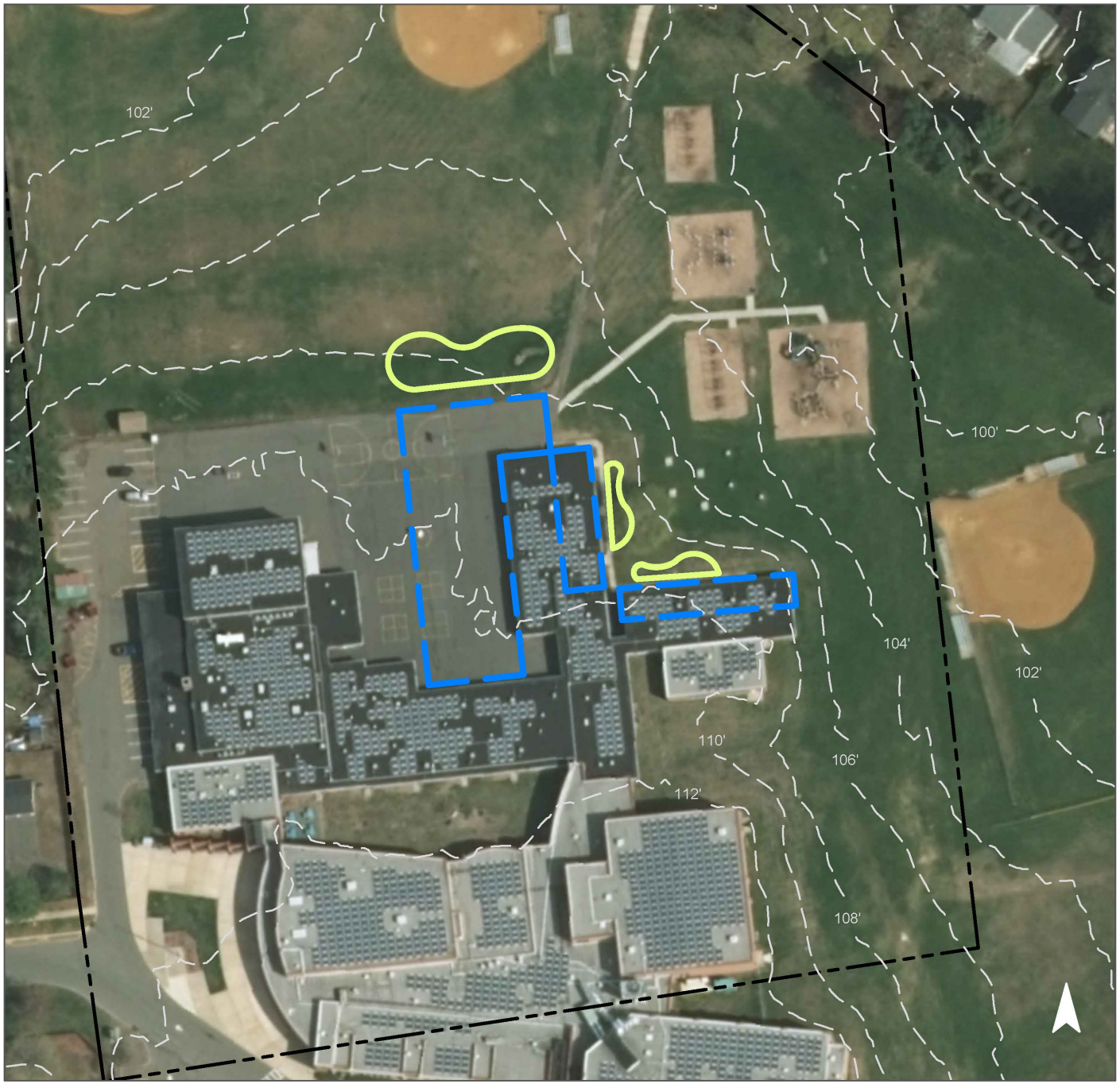
**Block and Lot:** Block 46, Lot 53

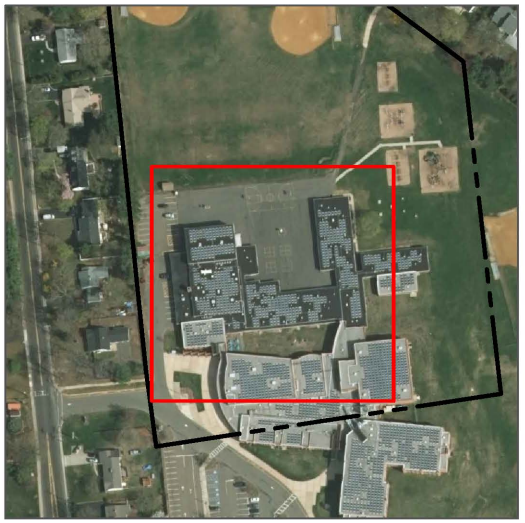
A rain garden can be installed adjacent to the northeast corner of the parking lot to capture, treat, and infiltrate runoff from the parking lot. Additionally, two raingardens can be installed to treat the rooftops of the adjacent buildings. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

| Impervious Cover | | Existing Loads from Impervious Cover (lbs/yr) | | | Runoff Volume from Impervious Cover (Mgal) | |
|---|---|---|---|---|---|---|
| % | sq. ft. | TP | TN | TSS | For the 1.25" Water Quality Storm | For an Annual Rainfall of 44" |
| 35 | 152,480 | 7.4 | 77.0 | 700.1 | 0.119 | 4.18 |

| 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 | 0.447 | 75 | 32,780 | 1.23 | 4,285 | $21,425 |

# GREEN INFRASTRUCTURE RECOMMENDATIONS



## Indian Hill School

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

0 50' 100'

# KIMISIS TIS THEOTOKOU CHURCH

**Subwatershed:** Matawan Creek

**Site Area:** 275,133 sq. ft.

**Address:** 20 Hillcrest Road
Holmdel, NJ 07733

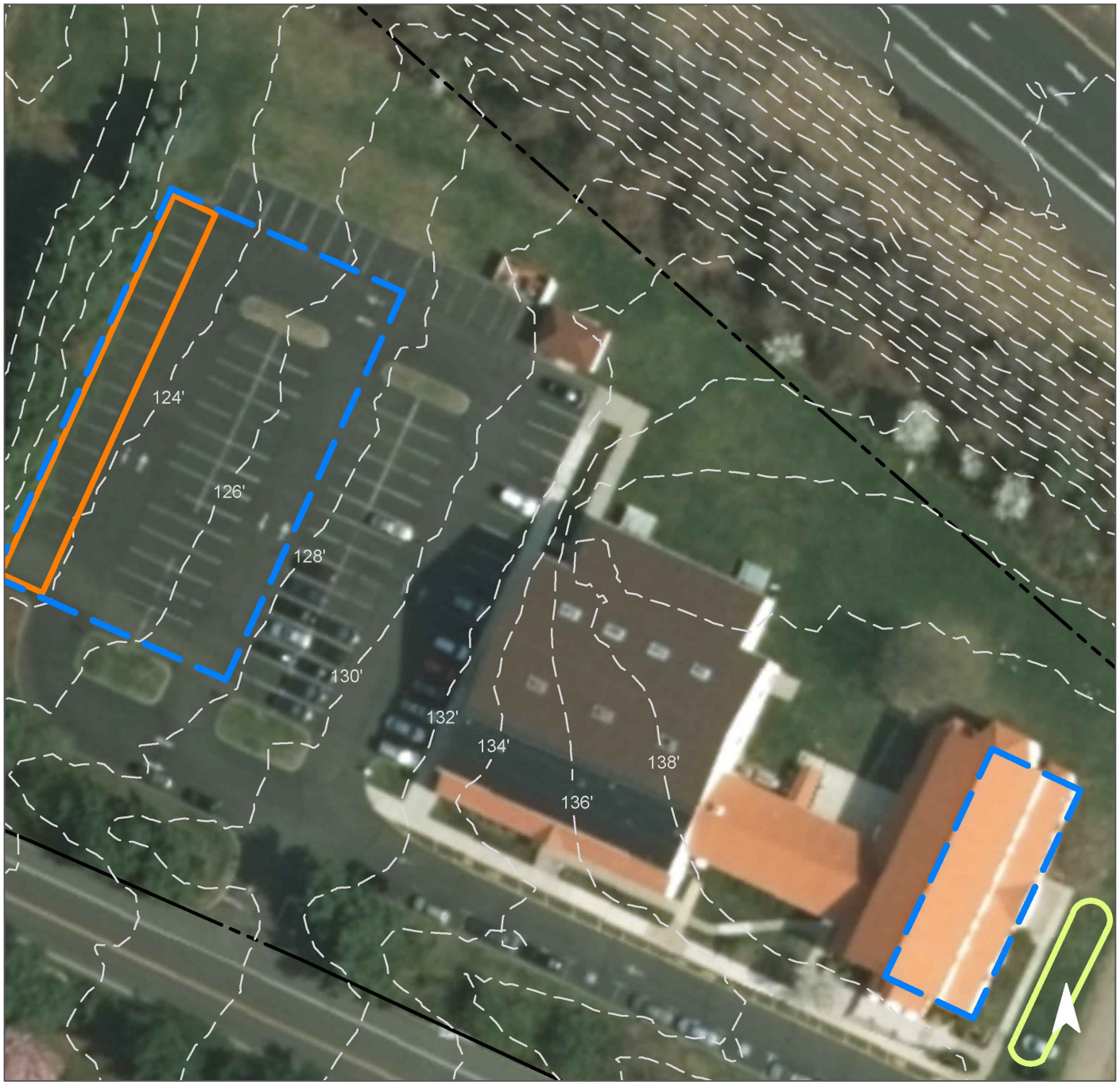
**Block and Lot:** Block 32, Lot 1

A rain garden can be installed east of the building to capture, treat, and infiltrate runoff from the rooftop. A section of parking spaces can be converted to porous pavement to capture and infiltrate 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" |
| 36 | 99,717 | 4.8 | 50.4 | 457.8 | 0.078 | 2.73 |

| 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 | 0.099 | 17 | 7,260 | 0.27 | 950 | $4,750 |
| Pervious pavement | 0.429 | 72 | 31,480 | 1.18 | 2,940 | $73,500 |

# GREEN INFRASTRUCTURE RECOMMENDATIONS




## Kimisis Tis Theotokou Church

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

0 30' 60'

# SAINT BENEDICT SCHOOL AND CHURCH

**Subwatershed:** Matawan Creek

**Site Area:** 985,133 sq. ft.

**Address:** 165 Bethany Road
Holmdel, NJ 07733

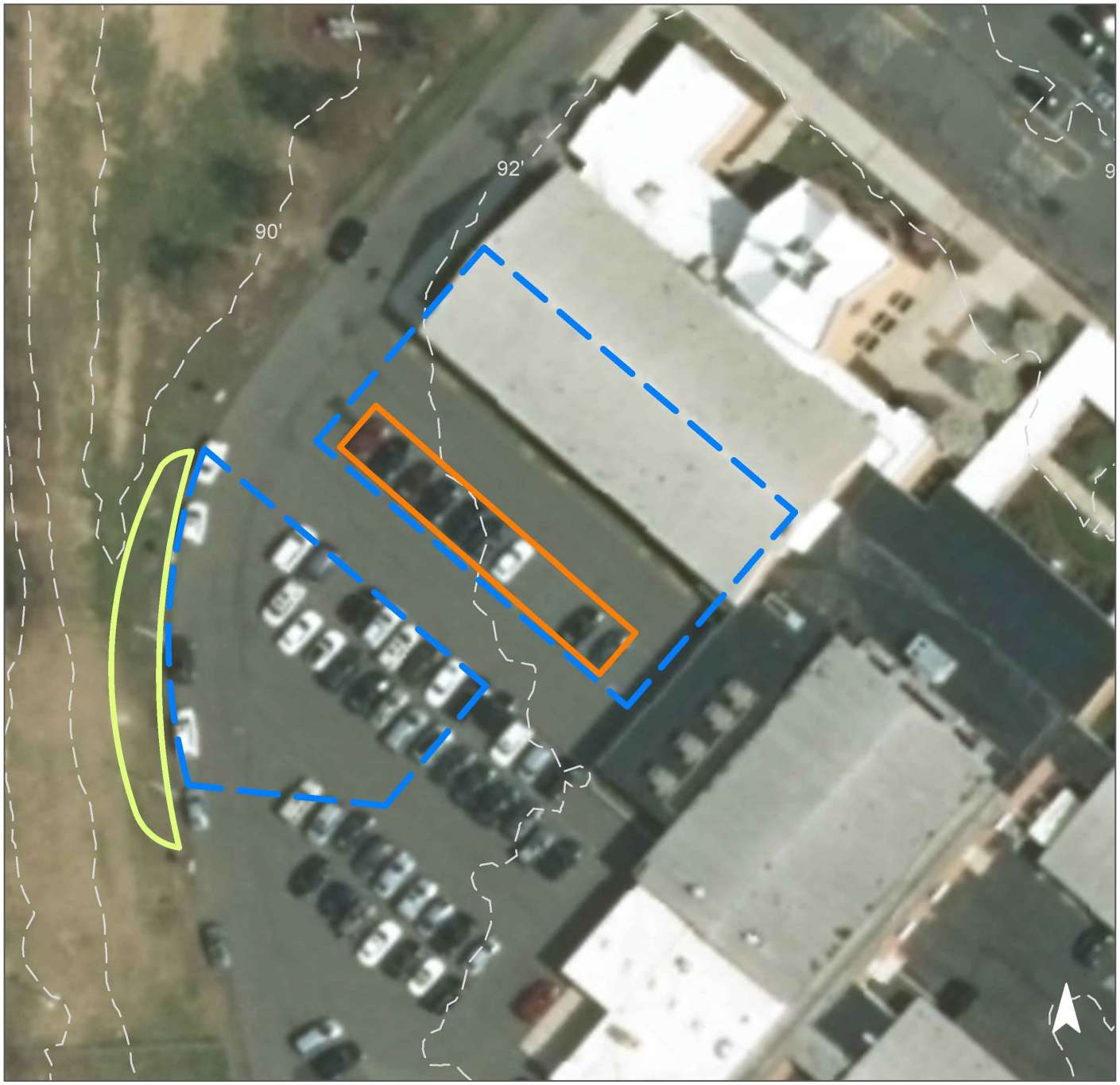
**Block and Lot:** Block 30.09, Lot 6.01

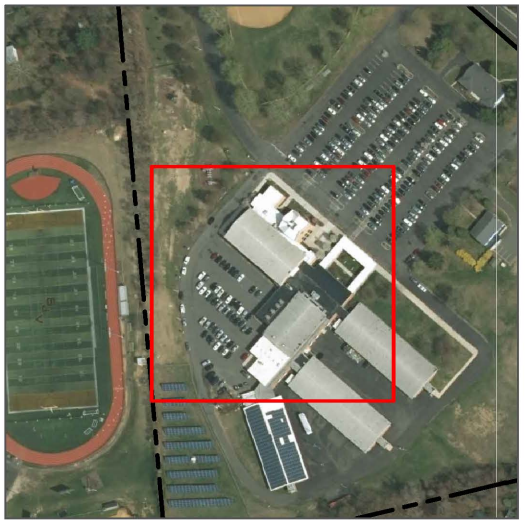
A section of parking spaces can be converted to porous pavement to capture and infiltrate runoff from the rooftop and parking lot. A rain garden can be installed in the turfgrass adjacent to the parking lot to capture, treat, and infiltrate runoff from the parking lot. A preliminary soil assessment suggests 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 | 395,887 | 19.1 | 199.9 | 1,817.7 | 0.308 | 10.86 |

| Recommended Green Infrastructure Practices | Recharge Potential (Mgal/yr) | TSS Removal Potential (lbs/yr) | Maximum Volume Reduction Potential (gal/storm) | Peak Discharge Reduction Potential (cu. ft./second) | Estimated Size (sq. ft.) | Estimated Cost |
|---|---|---|---|---|---|---|
| Bioretention system | 0.190 | 32 | 13,960 | 0.52 | 1,825 | $9,125 |
| Pervious pavement | 0.296 | 50 | 21,740 | 0.82 | 2,030 | $50,750 |

# GREEN INFRASTRUCTURE RECOMMENDATIONS



## St. Benedict School and Church

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

0 25' 50'

# SAINT JOHN VIANNEY HIGH SCHOOL

**Subwatershed:** Matawan Creek

**Site Area:** 637,033 sq. ft.

**Address:** 540A Line Road
Holmdel, NJ 07733

**Block and Lot:** Block 30.09, Lot 33


A rain garden can be installed north of the building to capture, treat, and infiltrate runoff from the rooftop drainage area. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability for green infrastructure.

| Impervious Cover | | Existing Loads from Impervious Cover (lbs/yr) | | | Runoff Volume from Impervious Cover (Mgal) | |
|---|---|---|---|---|---|---|
| % | sq. ft. | TP | TN | TSS | For the 1.25" Water Quality Storm | For an Annual Rainfall of 44" |
| 43 | 275,694 | 13.3 | 139.2 | 1,265.8 | 0.215 | 7.56 |

| Recommended Green Infrastructure Practices | Recharge Potential (Mgal/yr) | TSS Removal Potential (lbs/yr) | Maximum Volume Reduction Potential (gal/storm) | Peak Discharge Reduction Potential (cu. ft./second) | Estimated Size (sq. ft.) | Estimated Cost |
|---|---|---|---|---|---|---|
| Bioretention system | 0.060 | 10 | 4,380 | 0.16 | 575 | $2,875 |

# GREEN INFRASTRUCTURE RECOMMENDATIONS


**Saint John Vianney High School**

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

0 25' 50'

# 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **CHINGARORA CREEK SITES** | **41.01** | **1,786,612** | | | | **8.37** | **364,425** | **17.6** | **184.1** | **1,673.2** | **37,961** | **1,336,224** | **0.284** | **9.99** |
| 1 | **Ackerson Park** | | | | | | | | | | | | | | |
| | **Total Site Info** | 12.64 | 550,557 | 46 | 64.09 | 11 | 1.34 | 58,326 | 2.8 | 29.5 | 267.8 | 6,076 | 213,864 | 0.045 | 1.60 |
| 2 | **Holmdel Swim Club** | | | | | | | | | | | | | | |
| | **Total Site Info** | 28.38 | 1,236,055 | 46 | 79 | 25 | 7.03 | 306,098 | 14.8 | 154.6 | 1,405.4 | 31,885 | 1,122,361 | 0.239 | 8.40 |
| | **HOP BROOK SITES** | **127.40** | **5,549,656** | | | | **40.14** | **1,748,388** | **84.3** | **883.0** | **8,027.5** | **182,124** | **6,410,758** | **1.362** | **47.95** |
| 3 | **Holmdel First Aid Squad** | | | | | | | | | | | | | | |
| | **Total Site Info** | 3.66 | 159,518 | 26 | 2 | 85 | 3.12 | 135,943 | 6.6 | 68.7 | 624.2 | 14,161 | 498,459 | 0.106 | 3.73 |
| 4 | **Holmdel High School & William R. Satz Middle School** | | | | | | | | | | | | | | |
| | **Total Site Info** | 65.58 | 2,856,767 | 26 | 5.01 | 33 | 21.46 | 934,927 | 45.1 | 472.2 | 4,292.6 | 97,388 | 3,428,066 | 0.728 | 25.64 |
| 5 | **Holmdel Municipal Court & Gateway Church of Christ** | | | | | | | | | | | | | | |
| | **Total Site Info** | 13.18 | 573,985 | 27 | 10 | 44 | 5.94 | 258,596 | 12.5 | 130.6 | 1,187.3 | 26,937 | 948,185 | 0.201 | 7.09 |
| 6 | **Vietnam Era Museum & Education Center** | | | | | | | | | | | | | | |
| | **Total Site Info** | 19.83 | 863,936 | 47 | 2.01 | 8 | 1.51 | 65,763 | 3.2 | 33.2 | 301.9 | 6,850 | 241,132 | 0.051 | 1.80 |
| 7 | **Village Elementary School** | | | | | | | | | | | | | | |
| | **Total Site Info** | 25.15 | 1,095,449 | 8.14 | 3 | 32 | 8.11 | 353,159 | 17.0 | 178.4 | 1,621.5 | 36,787 | 1,294,916 | 0.275 | 9.69 |
| | **MATAWAN CREEK SITES** | **53.56** | **2,333,261** | | | | **21.21** | **923,778** | **44.5** | **466.6** | **4,241.4** | **96,227** | **3,387,187** | **0.720** | **25.34** |
| 8 | **Indian Hill School** | | | | | | | | | | | | | | |
| | **Total Site Info** | 10.01 | 435,962 | 46 | 53 | 35 | 3.50 | 152,480 | 7.4 | 77.0 | 700.1 | 15,883 | 559,092 | 0.119 | 4.18 |
| 9 | **Kimisis Tis Theotokou Church** | | | | | | | | | | | | | | |
| | **Total Site Info** | 6.32 | 275,133 | 32 | 1 | 36 | 2.29 | 99,717 | 4.8 | 50.4 | 457.8 | 10,387 | 365,629 | 0.078 | 2.73 |
| 10 | **Saint Benedict School & Church** | | | | | | | | | | | | | | |
| | **Total Site Info** | 22.62 | 985,133 | 30.09 | 6.01 | 40 | 9.09 | 395,887 | 19.1 | 199.9 | 1,817.7 | 41,238 | 1,451,587 | 0.308 | 10.86 |
| 11 | **Saint John Vianney High School** | | | | | | | | | | | | | | |
| | **Total Site Info** | 14.62 | 637,033 | 30.09 | 33 | 43 | 6.33 | 275,694 | 13.3 | 139.2 | 1,265.8 | 28,718 | 1,010,879 | 0.215 | 7.56 |

# 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 % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **CHINGARORA CREEK SITES** | **10,727** | **0.25** | **0.279** | **47** | **20,510** | **0.77** | | | | **$32,280** | **2.9%** |
| 1 | **Ackerson Park** | | | | | | | | | | | |
| | Bioretention system | 3,495 | 0.08 | 0.091 | 15 | 6,680 | 0.25 | 1,656 | $5 | SF | $8,280 | 6.0% |
| | Pervious pavement | 5,375 | 0.12 | 0.140 | 23 | 10,280 | 0.39 | 960 | $25 | SF | $24,000 | 9.2% |
| | **Total Site Info** | **5,375** | **0.12** | **0.140** | **23** | **10,280** | **0.39** | | | | **$24,000** | **9.2%** |
| 2 | **Holmdel Swim Club** | | | | | | | | | | | |
| | Bioretention systems | 5,352 | 0.12 | 0.139 | 23 | 10,230 | 0.38 | 1,656 | $5 | SF | $8,280 | 1.7% |
| | **Total Site Info** | **5,352** | **0.12** | **0.139** | **23** | **10,230** | **0.38** | | | | **$8,280** | **1.7%** |
| | **HOP BROOK SITES** | **49,295** | **1.13** | **1.284** | **215** | **92,020** | **3.45** | **0** | | | **$180,510** | **2.8%** |
| 3 | **Holmdel First Aid Squad** | | | | | | | | | | | |
| | Rainwater harvesting | 1,600 | 0.04 | 0.042 | 7 | 1,250 | 0.04 | 1,250 | $2 | gal | $2,500 | 1.2% |
| | **Total Site Info** | **1,600** | **0.04** | **0.042** | **7** | **1,250** | **0.04** | | | | **$2,500** | **1.2%** |
| 4 | **Holmdel High School & William R. Satz Middle School** | | | | | | | | | | | |
| | Bioretention systems | 10,500 | 0.24 | 0.274 | 46 | 20,080 | 0.75 | 2,625 | $5 | SF | $13,125 | 1.1% |
| | Pervious pavement | 22,480 | 0.52 | 0.586 | 98 | 42,980 | 1.62 | 5,970 | $25 | SF | $149,250 | 2.4% |
| | **Total Site Info** | **32,980** | **0.76** | **0.859** | **144** | **63,060** | **2.37** | | | | **$162,375** | **3.5%** |
| 5 | **Holmdel Municipal Court & Gateway Church of Christ** | | | | | | | | | | | |
| | Bioretention systems | 6,880 | 0.16 | 0.179 | 30 | 13,150 | 0.49 | 1,140 | $5 | SF | $5,700 | 2.7% |
| | Rainwater harvesting | 360 | 0.01 | 0.009 | 2 | 280 | 0.01 | 280 | $2 | gal | $560 | 0.1% |
| | **Total Site Info** | **7,240** | **0.17** | **0.189** | **32** | **13,430** | **0.50** | | | | **$6,260** | **2.8%** |
| 6 | **Vietnam Era Museum and Education Center** | | | | | | | | | | | |
| | Bioretention systems | 2,885 | 0.07 | 0.075 | 13 | 5,510 | 0.21 | 725 | $5 | SF | $3,625 | 4.4% |
| | **Total Site Info** | **2,885** | **0.07** | **0.075** | **13** | **5,510** | **0.21** | | | | **$3,625** | **4.4%** |
| 7 | **Village Elementary School** | | | | | | | | | | | |
| | Bioretention systems | 4,590 | 0.11 | 0.120 | 20 | 8,770 | 0.33 | 1,150 | $5 | SF | $5,750 | 1.3% |
| | **Total Site Info** | **4,590** | **0.11** | **0.120** | **20** | **8,770** | **0.33** | | | | **$5,750** | **1.3%** |

**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 % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **MATAWAN CREEK SITES** | **58,370** | **1.34** | **1.521** | **255** | **111,600** | **4.18** | | | | **$162,425** | **6.3%** |
| 8 | **Indian Hill School** | | | | | | | | | | | |
| | Bioretention systems | 17,150 | 0.39 | 0.447 | 75 | 32,780 | 1.23 | 4,285 | $5 | SF | $21,425 | 11.2% |
| | **Total Site Info** | **17,150** | **0.39** | **0.447** | **75** | **32,780** | **1.23** | | | | **$21,425** | **11.2%** |
| 9 | **Kimisis Tis Theotokou Church** | | | | | | | | | | | |
| | Bioretention system | 3,795 | 0.09 | 0.099 | 17 | 7,260 | 0.27 | 950 | $5 | SF | $4,750 | 3.8% |
| | Pervious pavement | 16,465 | 0.38 | 0.429 | 72 | 31,480 | 1.18 | 2,940 | $25 | SF | $73,500 | 16.5% |
| | **Total Site Info** | **20,260** | **0.47** | **0.528** | **88** | **38,740** | **1.45** | | | | **$78,250** | **20.3%** |
| 10 | **Saint Benedict School and Church** | | | | | | | | | | | |
| | Bioretention system | 7,300 | 0.17 | 0.190 | 32 | 13,960 | 0.52 | 1,825 | $5 | SF | $9,125 | 1.8% |
| | Pervious pavement | 11,370 | 0.26 | 0.296 | 50 | 21,740 | 0.82 | 2,030 | $25 | SF | $50,750 | 2.9% |
| | **Total Site Info** | **18,670** | **0.43** | **0.486** | **81** | **35,700** | **1.34** | | | | **$59,875** | **4.7%** |
| 11 | **Saint John Vianney High School** | | | | | | | | | | | |
| | Bioretention system | 2,290 | 0.05 | 0.060 | 10 | 4,380 | 0.16 | 575 | $5 | SF | $2,875 | 0.8% |
| | **Total Site Info** | **2,290** | **0.05** | **0.060** | **10** | **4,380** | **0.16** | | | | **$2,875** | **0.8%** |