RUTGERS
New Jersey Agricultural
Experiment Station

# Impervious Cover Assessment
# for
# Washington Borough, Warren County, New Jersey

*Prepared for Washington Borough by the*
*Rutgers Cooperative Extension Water Resources Program*

August 10, 2016

WILLIAM PENN
FOUNDATION

## Introduction

Pervious and impervious are terms that are used to describe the ability or inability of water to flow through a surface. When rainfall hits a surface, it can soak into the surface or flow off the surface. Pervious surfaces are those which allow stormwater to readily soak into the soil and recharge groundwater. When rainfall drains from a surface, it is called "stormwater" runoff (Figure 1). An impervious surface can be any material that has been placed over soil that prevents water from soaking into the ground. Impervious surfaces include paved roadways, parking lots, sidewalks, and rooftops. As impervious areas increase, so does the volume of stormwater runoff.

Figure 1: Stormwater draining from a parking lot

New Jersey has many problems due to stormwater runoff, including:

- Pollution: According to the 2010 New Jersey Water Quality Assessment Report, 90% of the assessed waters in New Jersey are impaired, with urban-related stormwater runoff listed as the most probable source of impairment (USEPA, 2013). As stormwater flows over the ground, it picks up pollutants including animal waste, excess fertilizers, pesticides, and other toxic substances. These pollutants are then able to enter waterways.

- Flooding: Over the past decade, the state has seen an increase in flooding. Communities around the state have been affected by these floods. The amount of damage caused has also increased greatly with this trend, costing billions of dollars over this time span.

- Erosion: Increased stormwater runoff causes an increase in the velocity of flows in our waterways. The increased velocity after storm events erodes stream banks and shorelines, degrading water quality. This erosion can damage local roads and bridges and cause harm to wildlife.

The primary cause of the pollution, flooding, and erosion problems is the quantity of impervious surfaces draining directly to local waterways. New Jersey is one of the most developed states in the country. Currently, the state has the highest percent of impervious cover in the country at 12.1% of its total area (Nowak & Greenfield, 2012). Many of these impervious surfaces are directly connected to local waterways (i.e., every drop of rain that lands on these impervious surfaces ends up in a local river, lake, or bay without any chance of being treated or soaking into the ground). To repair our waterways, reduce flooding, and stop erosion, stormwater runoff from impervious surfaces has to be better managed. Surfaces need to be disconnected with green infrastructure to prevent stormwater runoff from flowing directly into New Jersey's waterways. Disconnection redirects runoff from paving and rooftops to pervious areas in the landscape.

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 technologies 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 (USEPA, 2013).

The first step to reducing the impacts from impervious surfaces is to conduct an impervious cover assessment. This assessment can be completed on different scales: individual lot, municipality, or watershed. Impervious surfaces need to be identified for stormwater management. Once impervious surfaces have been identified, there are three steps to better manage these surfaces.

1. ***Eliminate surfaces that are not necessary.*** For example, a paved courtyard at a public school could be converted to a grassed area.

2. ***Reduce or convert impervious surfaces.*** There may be surfaces that are required to be hardened, such as roadways or parking lots, but could be made smaller and still be functional. A parking lot that has two-way car ways could be converted to one-way car ways. There also are permeable paving materials such as porous asphalt, pervious concrete, or permeable paving stones that could be substituted for impermeable paving materials (Figure 2).

3. ***Disconnect impervious surfaces from flowing directly to local waterways.*** There are many ways to capture, treat, and infiltrate stormwater runoff from impervious surfaces. Opportunities may exist to reuse this captured water.

Figure 2: Rapid infiltration of water through porous pavement is demonstrated at the USEPA Edison New Jersey test site

## Washington Borough Impervious Cover Analysis

Located in Warren County in northern New Jersey, Washington Borough covers approximately 1.97 square miles north of Hampton Borough. Figures 3 and 4 illustrate that Washington Borough is dominated by urban land uses. A total of 77.4% of the municipality's land use is classified as ubran. Of the urban land in Washington Borough, medium density residential is the dominant land use (Figure 5).

The literature suggests a link between impervious cover and stream ecosystem impairment starting at approximately 10% impervious surface cover (Schueler, 1994; Arnold and Gibbons, 1996; May et al., 1997). Impervious cover may be linked to the quality of lakes, reservoirs, estuaries, and aquifers (Caraco et al., 1998), and the amount of impervious cover in a watershed can be used to project the current and future quality of streams. Based on the scientific literature, Caraco et al. (1998) classified urbanizing streams into the following three categories: sensitive streams, impacted streams, and non-supporting streams. Sensitive steams typically have a watershed impervious surface cover from 0 – 10%. Impacted streams have a watershed impervious cover ranging from 11-25% and typically show clear signs of degradation from urbanization. Non-supporting streams have a watershed impervious cover of greater than 25%; at this high level of impervious cover, streams are simply conduits for stormwater flow and no longer support a diverse stream community.

The New Jersey Department of Environmental Protection's (NJDEP) 2012 land use/land cover geographical information system (GIS) data layer categorizes Washington 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 Washington Borough. Based upon the 2012 NJDEP land use/land cover data, approximately 29.2% of Washington Borough has impervious cover. This level of impervious cover suggests that the streams in Washington Borough are likely non-supporting streams.

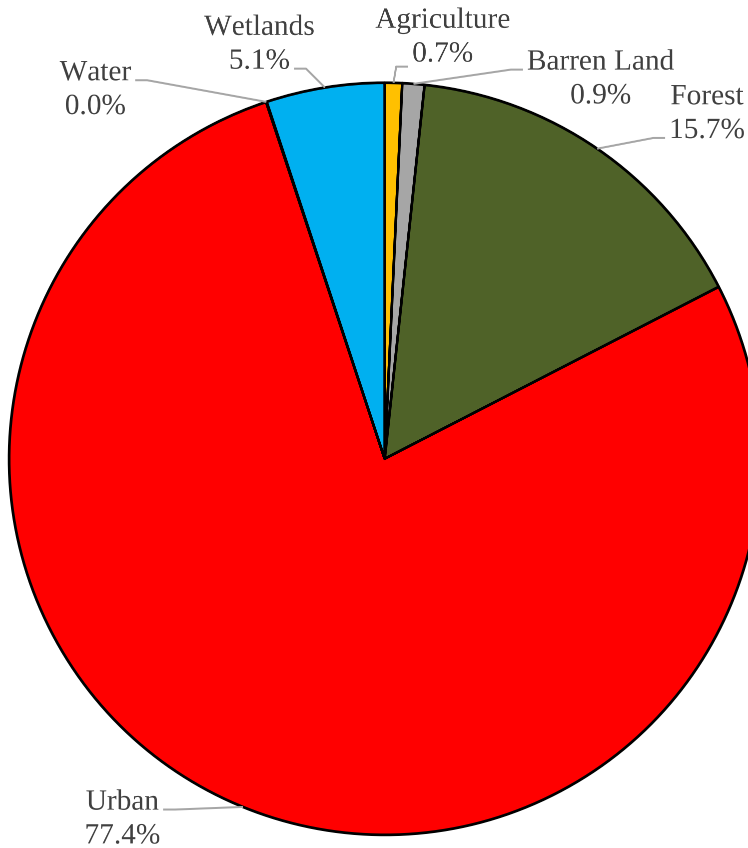



Figure 3:  Pie chart illustrating the land use in Washington Borough

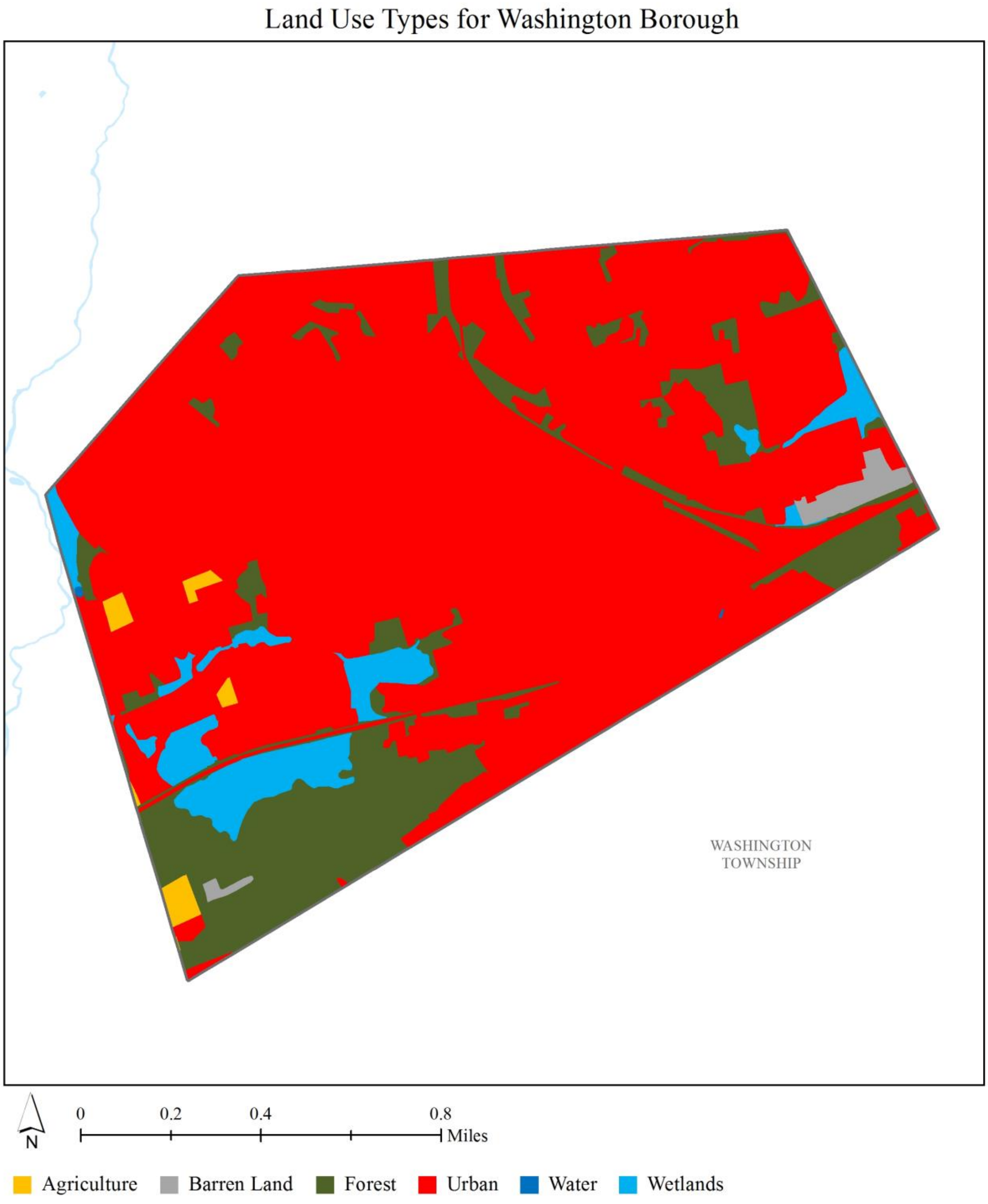



Figure 4: Map illustrating the land use in Washington Borough

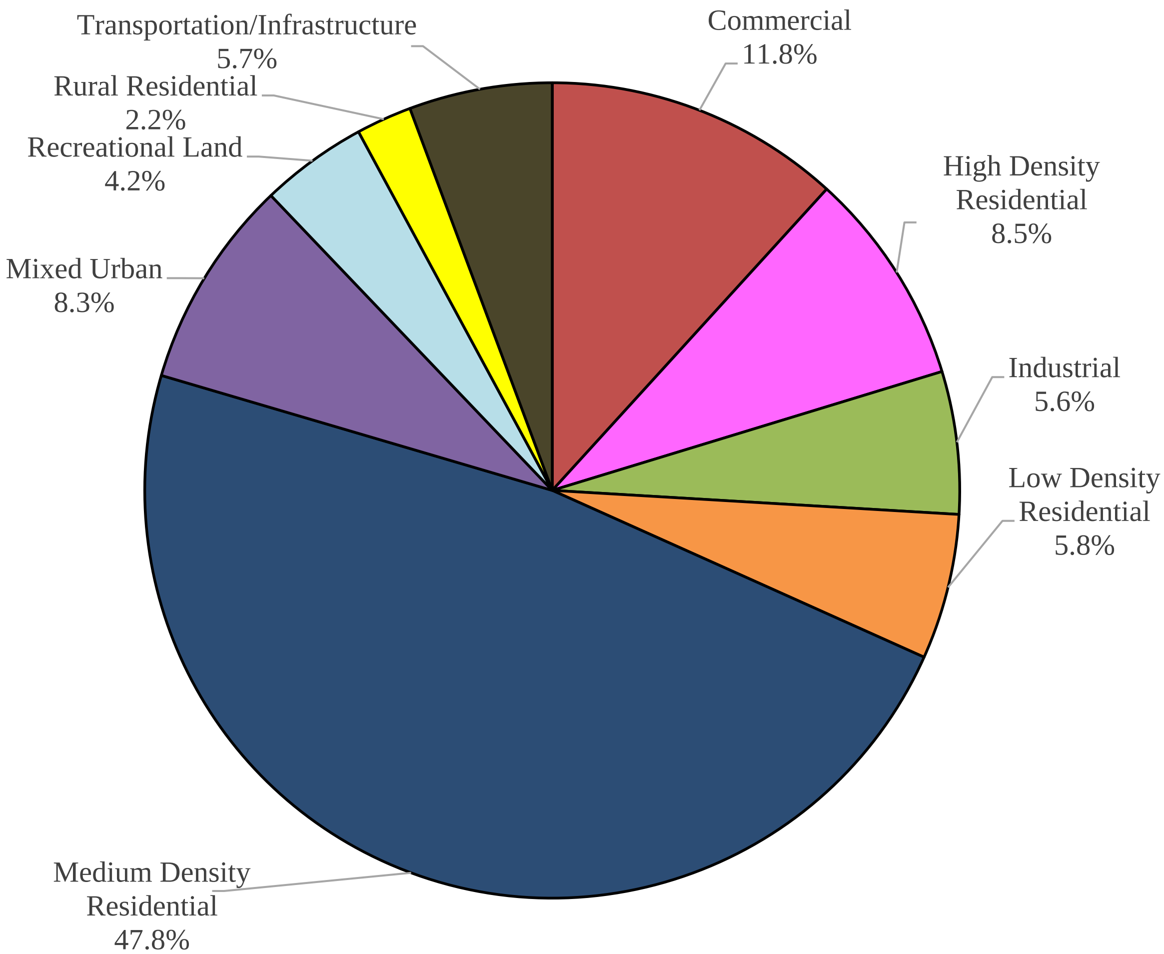



Figure 5: Pie chart illustrating the various types of urban land use in Washington Borough

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each subwatershed within Washington Borough (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 4.3% in the Musconetcong River subwatershed to 29.4% in the Pohatcong Creek subwatershed. Evaluating impervious cover on a subwatershed basis allows the municipality to focus impervious cover reduction or disconnection efforts in the subwatersheds where frequent flooding occurs.

In developed landscapes, stormwater runoff from parking lots, driveways, sidewalks, and rooftops flows to drainage pipes that feed the sewer system. The cumulative effect of these impervious surfaces and thousands of connected downspouts reduces the amount of water that can infiltrate into soils and greatly increases the volume and rate of runoff that flows to waterways. Stormwater runoff volumes (specific to Washington Borough, Warren County) associated with impervious surfaces were calculated for the following storms: the New Jersey water quality design storm of 1.25 inches of rain, an annual rainfall of 44 inches, the 2-year design storm (3.3 inches of rain), the 10-year design storm (4.9 inches of rain), and the 100-year design storm (7.8 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater drains from impervious surfaces in Washington Borough. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Pohatcong Creek subwatershed was harvested and purified, it could supply water to 114 homes for one year[1].

[1] Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for Washington Borough

| Subwatershed | Total Area | | Land Use Area | | Water Area | | Impervious Cover | | |
|---|---|---|---|---|---|---|---|---|---|
| | (ac) | ($mi^2$) | (ac) | ($mi^2$) | (ac) | ($mi^2$) | (ac) | ($mi^2$) | (%) |
| Musconetcong River | 9.0 | 0.01 | 9.0 | 0.01 | 0.0 | 0.00 | 0.4 | 0.00 | 4.3% |
| Pohatcong Creek | 1,249.6 | 1.95 | 1,249.3 | 1.95 | 0.3 | 0.00 | 367.3 | 0.57 | 29.4% |
| Total | 1,258.6 | 1.97 | 1,258.3 | 1.97 | 0.3 | 0.00 | 367.7 | 0.57 | 29.2% |

Subwatersheds of Washington Borough

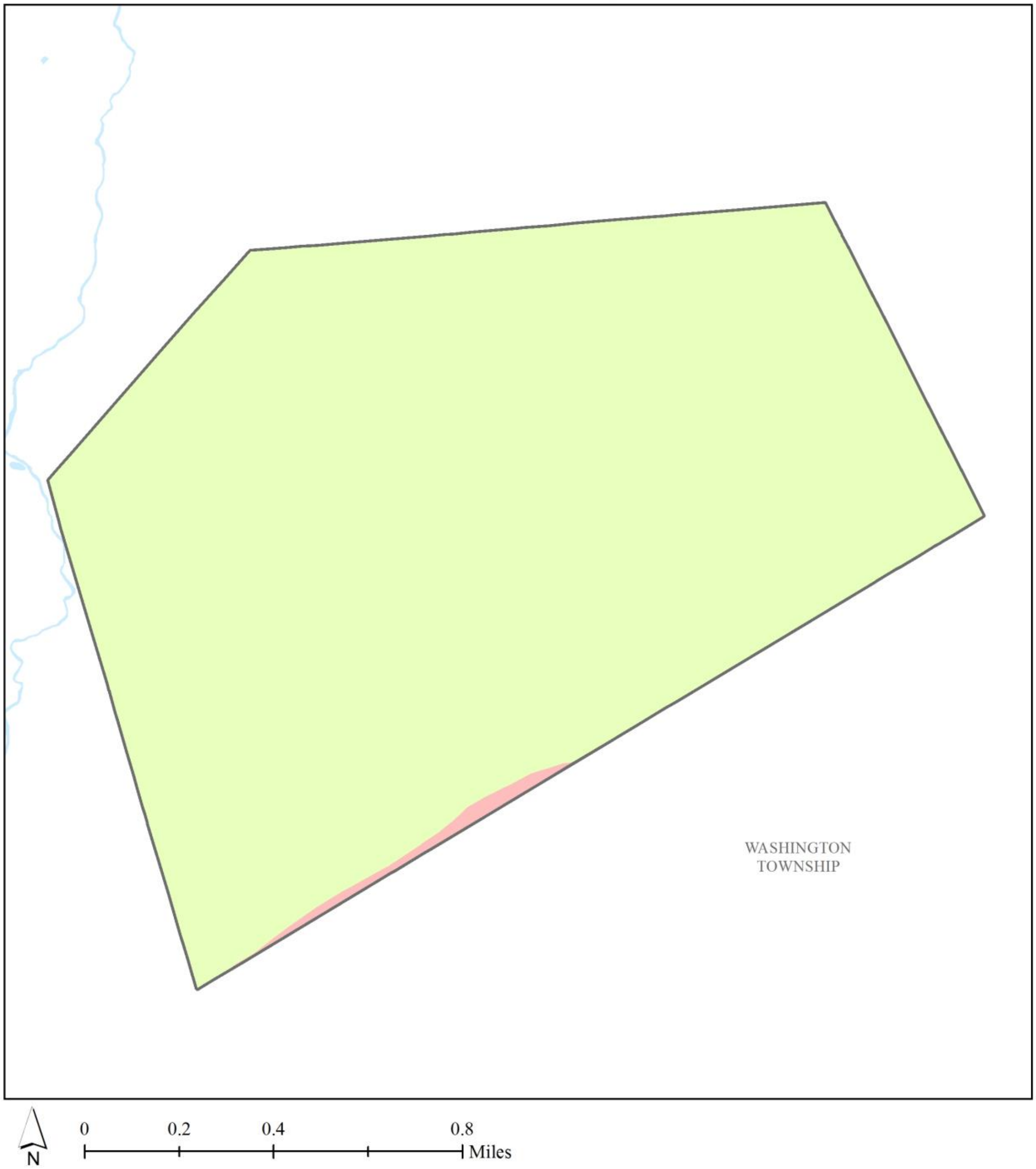



Figure 6: Map of the subwatersheds in Washington Borough

Table 2: Stormwater runoff volumes from impervious surfaces by subwatershed in Washington Borough

| Subwatershed | Total Runoff Volume for the 1.25" NJ Water Quality Storm (MGal) | Total Runoff Volume for the NJ Annual Rainfall of 44" (MGal) | Total Runoff Volume for the 2-Year Design Storm (3.3") (MGal) | Total Runoff Volume for the 10-Year Design Storm (4.9") (MGal) | Total Runoff Volume for the 100-Year Design Storm (7.8") (MGal) |
|---|---|---|---|---|---|
| Musconetcong River | 0.0 | 0.5 | 0.0 | 0.1 | 0.1 |
| Pohatcong Creek | 12.5 | 438.8 | 34.9 | 51.9 | 82.8 |
| Total | 12.5 | 439.3 | 34.9 | 51.9 | 82.9 |

The next step is to set a reduction goal for impervious area in each subwatershed. Based upon the Rutgers Cooperative Extension (RCE) Water Resources Program's experience, a 10% reduction would be a reasonably achievable reduction for these subwatersheds in Washington Borough. While it may be difficult to eliminate paved areas or replace paved areas with permeable pavement, it is relatively easy to identify impervious surfaces that can be disconnected using green infrastructure practices. For all practical purposes, disconnecting an impervious surface from a storm sewer system or a water body is an "impervious area reduction." The RCE Water Resources Program recommends that all green infrastructure practices that are installed to disconnect impervious surfaces should be designed for the 2-year design storm (3.3 inches of rain over 24-hours). Although this results in management practices that are slightly over-designed by NJDEP standards, which require systems to be designed for the New Jersey water quality storm (1.25 inches of rain over 2-hours), these systems will be able to handle the increase in storm intensities that are expected to occur due to climate change. By designing these management practices for the 2-year design storm, these practices will be able to manage 95% of the annual rainfall volume. The recommended annual reductions in runoff volumes are shown in Table 3.

As previously mentioned, once impervious surfaces have been identified, the next steps for managing impervious surfaces are to 1) eliminate surfaces that are not necessary, 2) reduce or convert impervious surfaces to pervious surfaces, and 3) disconnect impervious surfaces from flowing directly to local waterways.

## Elimination of Impervious Surfaces

One method to reduce impervious cover is to "depave." Depaving is the act of removing paved impervious surfaces and replacing them with pervious soil and vegetation that will allow for the infiltration of rainwater. Depaving leads to the re-creation of natural space that will help reduce flooding, increase wildlife habitat, and positively enhance water quality as well as beautify neighborhoods. Depaving also can bring communities together around a shared vision to work together to reconnect their neighborhood to the natural environment.

Table 3: Impervious cover reductions by subwatershed in Washington Borough

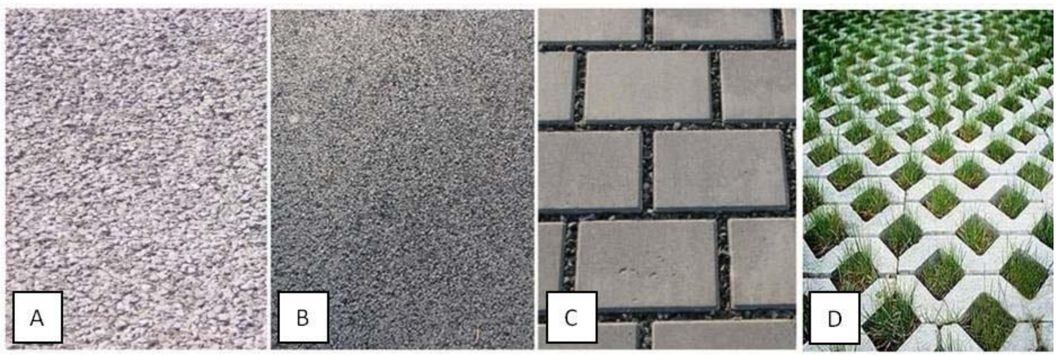
| Subwatershed | Recommended Impervious Area Reduction (10%) (ac) | Annual Runoff Volume Reduction[2] (Mgal) |
|---|---|---|
| Musconetcong River | 0.0 | 0.0 |
| Pohatcong Creek | 36.7 | 41.7 |
| Total | 36.8 | 41.7 |

[2] Annual Runoff Volume Reduction =
Acres of IC x 43,560 $ft^2$/ac x 44 in x (1 ft/12 in) x 0.95 x (7.48 gal/$ft^3$) x (1 MGal/1,000,000 gal)
All BMPs should be designed to capture the first 3.3 inches of rain from each storm. This would allow the BMP to capture 95% of the annual rainfall of 44 inches.

**Pervious Pavement**

There are four different types of permeable pavement systems that are commonly being used throughout the country to reduce the environmental impacts from impervious surfaces. These surfaces include pervious concrete, porous asphalt, interlocking concrete pavers, and grid pavers.

> "*Permeable pavement is a stormwater drainage system that allows rainwater and runoff to move through the pavement's surface to a storage layer below, with the water eventually seeping into the underlying soil. Permeable pavement is beneficial to the environment because it can reduce stormwater volume, treat stormwater water quality, replenish the groundwater supply, and lower air temperatures on hot days (Rowe, 2012).*"




*Permeable surfaces: (A) pervious concrete, (B) porous asphalt, (C) interlocking concrete pavers, (D) grid pavers (Rowe, 2012)*

Pervious concrete and porous asphalt are the most common of the permeable surfaces. They are similar to regular concrete and asphalt but without the fine materials. This allows water to quickly pass through the material into an underlying layered system of stone that holds the water, allowing it to infiltrate into the underlying uncompacted soil.

**Impervious Cover Disconnection Practices**

By redirecting runoff from paving and rooftops to pervious areas in the landscape, the amount of directly connected impervious area in a drainage area can be greatly reduced. There are many cost-effective ways to disconnect impervious surfaces from local waterways.

- Simple Disconnection: This is the easiest and least costly method to reduce stormwater runoff for smaller storm events. Instead of piping rooftop runoff to the street where it enters the catch basin and is piped to the river, the rooftop runoff is released onto a grassed area to allow the water to be filtered by the grass and soak into the ground. A healthy lawn typically can absorb the first one to two inches of stormwater runoff from a rooftop. Simple disconnection also can be used to manage stormwater runoff from paved areas. Designing a parking lot or driveway to drain onto a grassed area, instead of the street, can dramatically reduce pollution and runoff volumes.

- Rain Gardens: Stormwater can be diverted into shallow landscaped depressed areas (i.e., rain gardens) where the vegetation filters the water, and it is allowed to soak into the ground. Rain gardens, also known as bioretention systems, come in all shapes and sizes and can be designed to disconnect a variety of impervious surfaces (Figure 7).

Figure 7: Rain garden outside the RCE of Gloucester County office which was designed to disconnect rooftop runoff from the local storm sewer system

- Rainwater Harvesting: Rainwater harvesting includes the use of rain barrels and cisterns (Figures 8a and 8b). These can be placed below downspouts to collect rooftop runoff. The collected water has a variety of uses including watering plants and washing cars. This practice also helps cut down on the use of potable water for nondrinking purposes. It is important to divert the overflow from the rainwater harvesting system to a pervious area.

Figure 8a: Rain barrel used to disconnect a downspout with the overflow going to a flower bed

Figure 8b: A 5,000 gallon cistern used to disconnect the rooftop of the Department of Public Works in Clark Township to harvest rainwater for nonprofit car wash events

## Examples of Opportunities in Washington Borough

To address the impact of stormwater runoff from impervious surfaces, the next step is to identify opportunities in the municipality for eliminating, reducing, or disconnecting directly connected impervious surfaces. To accomplish this task, an impervious cover reduction action plan should be prepared. Aerial photographs are used to identify sites with impervious surfaces in the municipality that may be suitable for inclusion in the action plan. After sites are identified, site visits are conducted to photo-document all opportunities and evaluate the feasibility of eliminating, reducing, or disconnecting directly connected impervious surfaces. A brief description of each site discussing the existing conditions and recommendations for treatment of the impervious surfaces is developed. After a number of sites have been selected for inclusion in the action plan, concept plans and detailed green infrastructure information sheets are prepared for a selection of representative sites.

For Washington Borough, three sites have been included in this assessment. Examples of concept plans and detailed green infrastructure information sheets are provided in Appendix A. The detailed green infrastructure information sheets describe existing conditions and issues, proposed solutions, anticipated benefits, possible funding sources, potential partners and stakeholders, and estimated costs. Additionally, each project has been classified as a mitigation opportunity for recharge potential, total suspended solids removal, and stormwater peak reduction. Finally, these detailed green infrastructure information sheets provide an estimate of gallons of stormwater captured and treated per year by each proposed green infrastructure practice. The concept plans provide an aerial photograph of the site and details of the proposed green infrastructure practices.

## Conclusions

Washington Borough can reduce flooding and improve its waterways by better managing stormwater runoff from impervious surfaces. This impervious cover assessment is the first step toward better managing stormwater runoff. The next step is to develop an action plan to eliminate, reduce, or disconnect impervious surfaces where possible and practical. Many of the highly effective disconnection practices are inexpensive. The entire community can be engaged in implementing these disconnection practices.

**References**

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# Appendix A

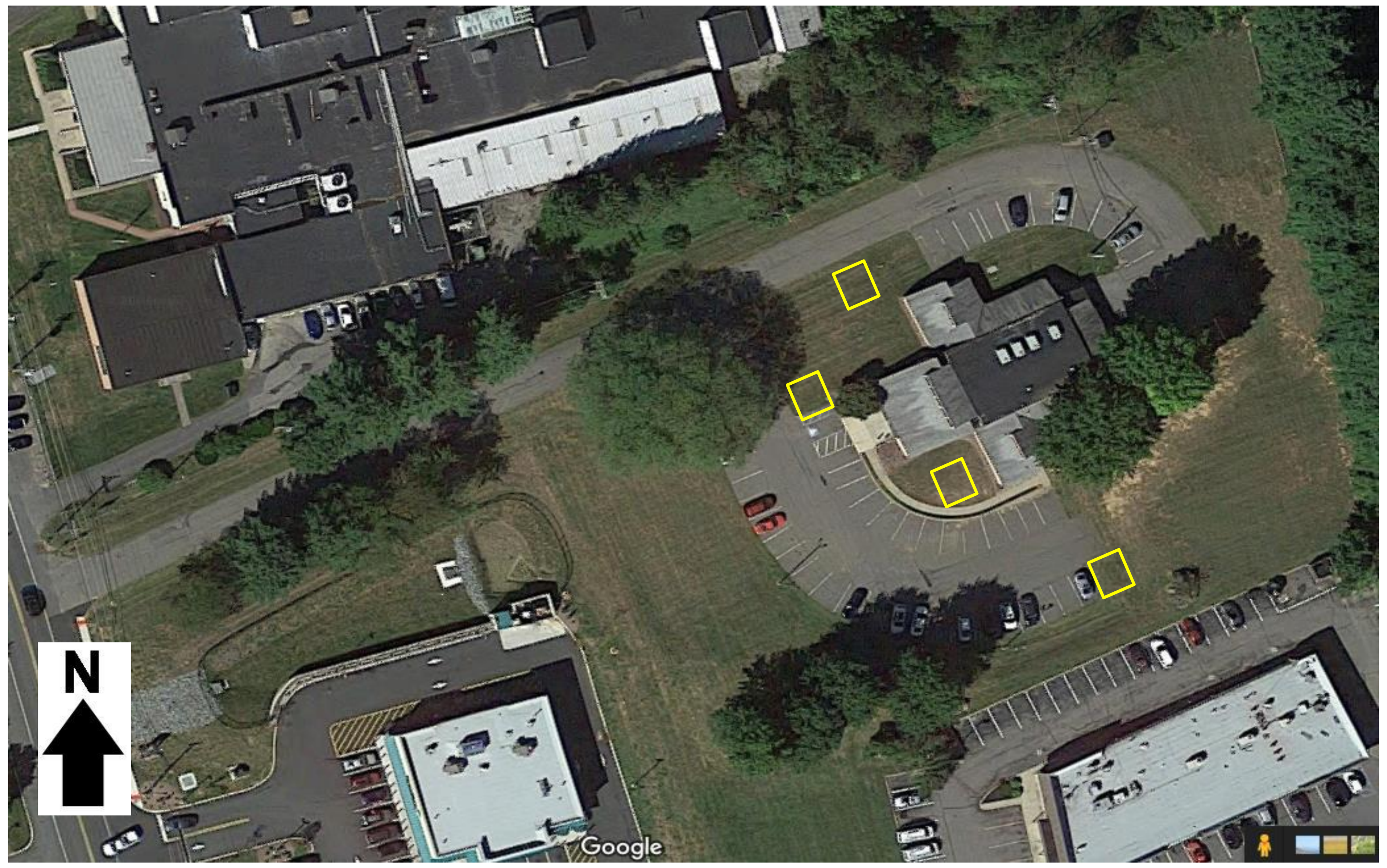
## Examples of Impervious Cover Reduction Action Plan Projects

## Concept Plans and Detailed Green Infrastructure Information Sheets

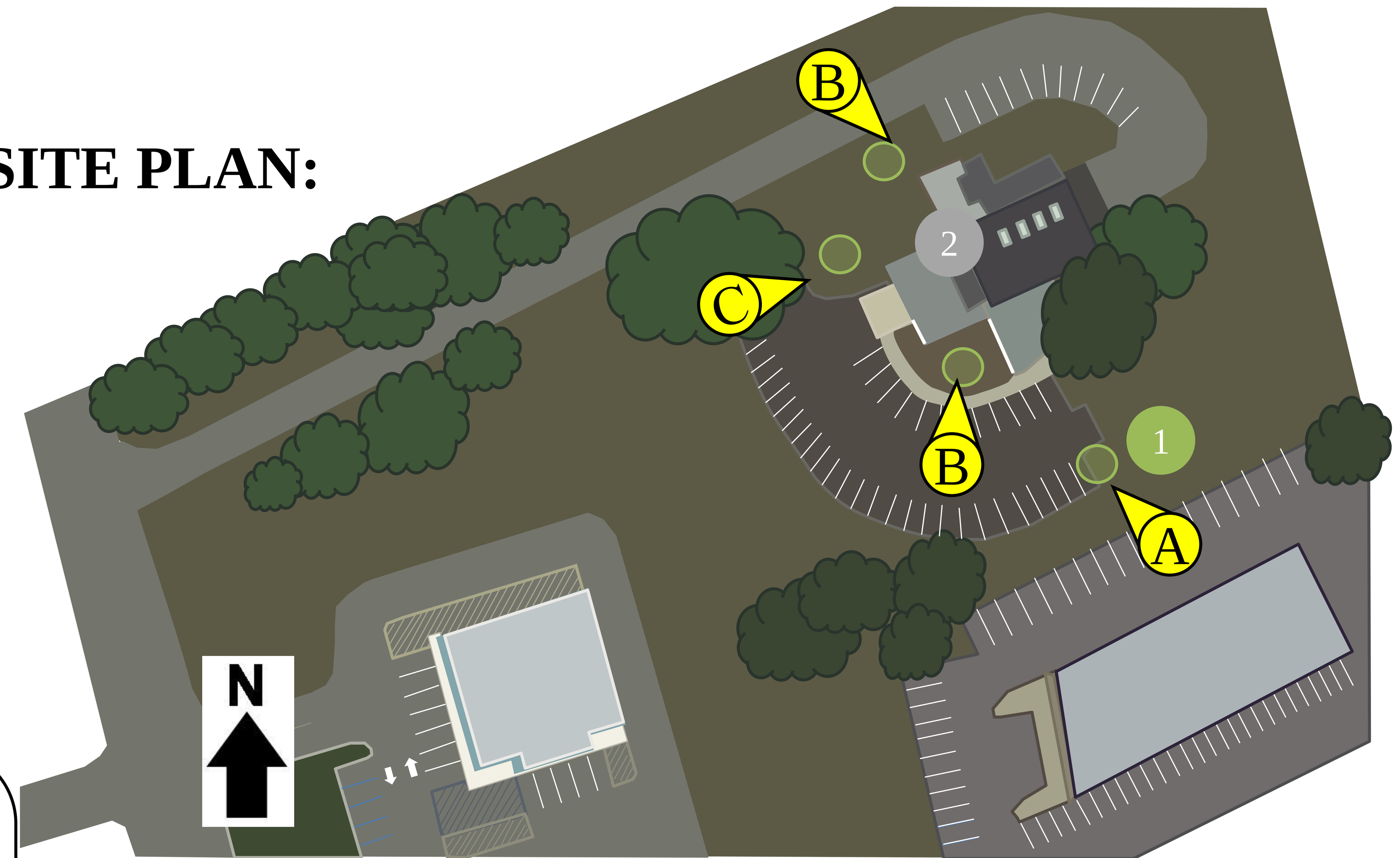
# Washington Borough
# Impervious Cover Assessment
## *Warren County Convention and Visitors Bureau, 10 Brass Castle Road*

RUTGERS
New Jersey Agricultural Experiment Station

### PROJECT LOCATION:




### SITE PLAN:



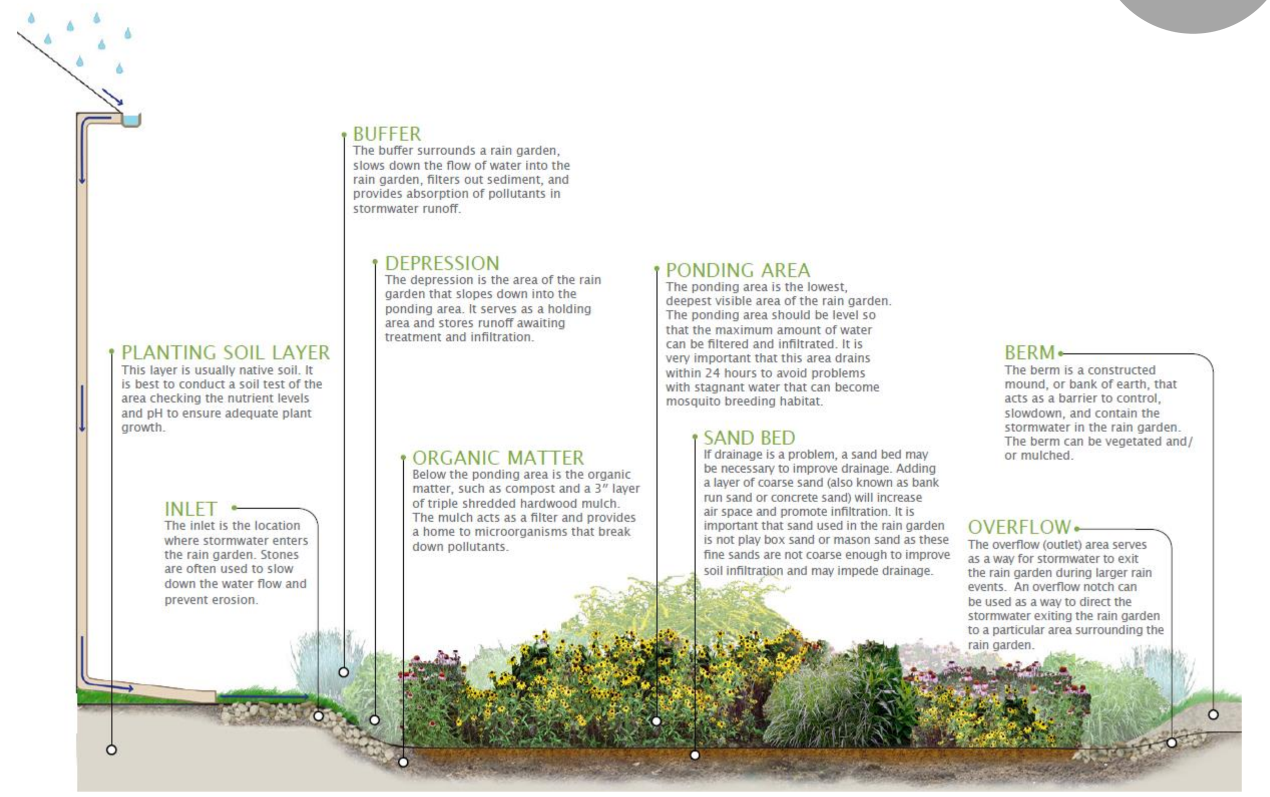





1 **BIORETENTION SYSTEM:** Rain gardens can be installed on this property to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge. There are opportunities to install rain gardens at the main entrance and throughout the property of the convention bureau.

2 **DISCONNECTED DOWNSPOUTS:** Downspouts can be disconnected to allow rainwater to flow into the rain gardens that may be installed on this site. This will help to remove pollutants and allow stormwater to infiltrate into the ground.

## 1 BIORETENTION SYSTEM




## 2 DISCONNECTED DOWNSPOUTS

| **Location:**<br>10 Brass Castle Road<br>Washington, NJ 07882 | **Municipality:**<br>Washington Borough<br><br>**Subwatershed:**<br>Pohatcong Creek |
|---|---|
| **Green Infrastructure Description:**<br>bioretention system<br>disconnected downspouts | **Targeted Pollutants:**<br>total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff |
| **Mitigation Opportunities:**<br>recharge potential: yes<br>TSS removal potential: yes<br>stormwater peak reduction potential: yes | **Stormwater Captured and Treated Per Year:**<br>rain garden #1: 28,452 gal.<br>rain garden #2: 47,108 gal.<br>rain garden #3: 21,157 gal.<br>rain garden #4: 27,619 gal. |

**Existing Conditions and Issues:**
This site contains several impervious surfaces including driveways, walkways, a parking lot, and a convention hall. The entire area slopes down to the northern end of the parking lot which shows considerable flooding and erosion by the grass area near the parking spots. By the building there are two grass areas where downspouts are connected by a channel leading water away from the building and directly on to the parking lot. There are three downspouts in the first grass area and four downspouts in the second grass area.

**Proposed Solution(s):**
The two grass areas by the building could have three rain gardens built to capture rainfall coming off of the roof. This could be achieved by disconnecting the downspouts from the retrofitted channel that leads water away from the grass and on to the parking lot. Another rain garden can be implemented by the northern end of the parking lot to capture runoff coming from the parking lot and building.

**Anticipated Benefits:**
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. The bioretention systems would provide additional benefits such as aesthetic appeal and wildlife habitat.

**Possible Funding Sources:**
Washington Borough
mitigation funds from local developers
NJDEP grant programs
grants from foundations

**Partners/Stakeholders:**
Washington Borough
local community groups (Boy Scouts, Girl Scouts, etc.)
residents
Rutgers Cooperative Extension

**Estimated Cost:**
For rain gardens 1, 2, 3, 4 the rain gardens are 273, 452, 203, 265 square feet in size, respectively. At $5 per foot, the estimated cost of the rain gardens are $1,365, $2,260, $1,015, $1,325 respectively. The total cost of the project is $5,965.

Washington Borough
Impervious Cover Assessment

*Washington Memorial Elementary School, 300 West Stewart Street*

## PROJECT LOCATION:

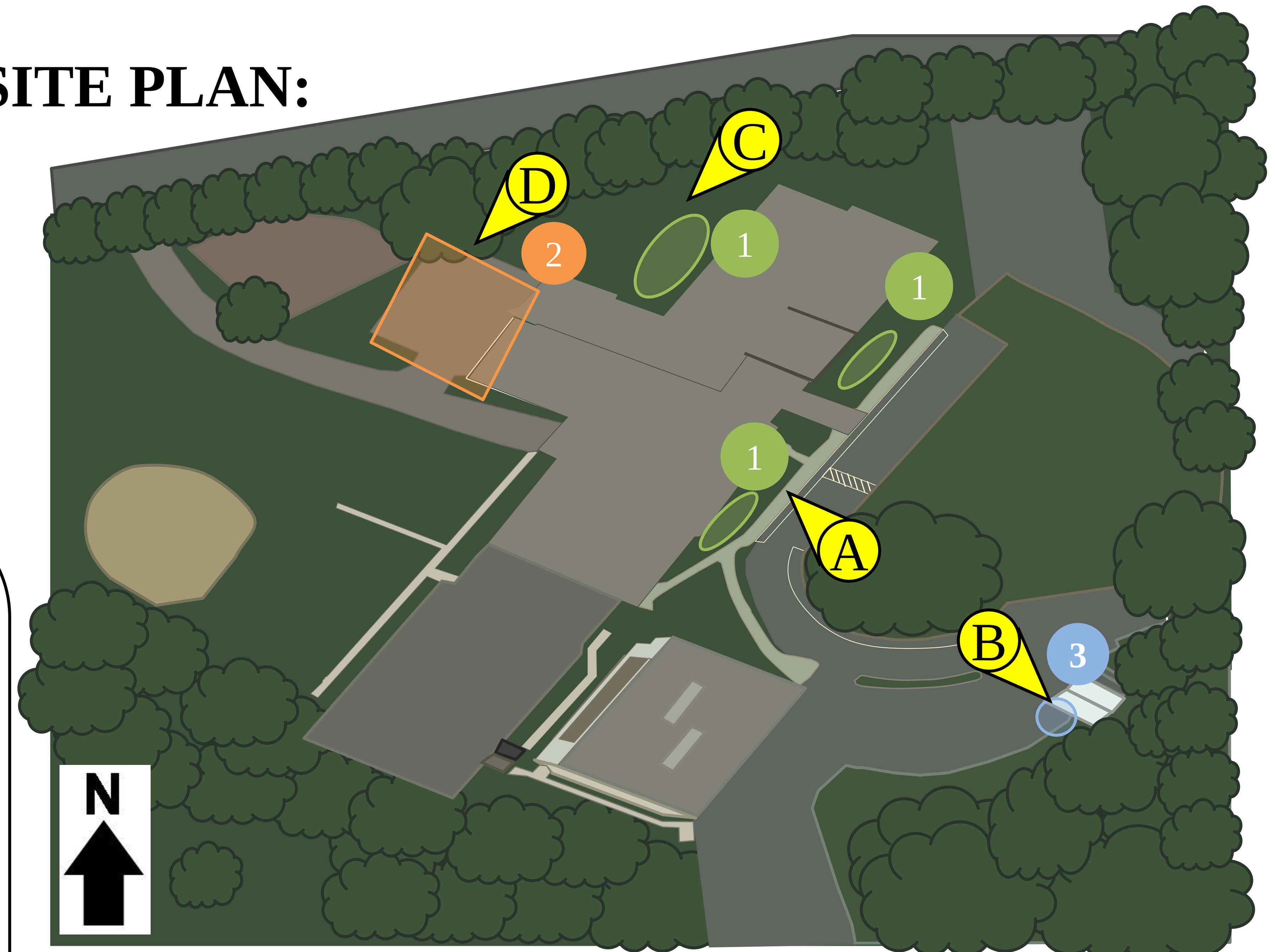

A

B

C

D

## SITE PLAN:




1 **BIORETENTION SYSTEM:** A rain gardens can be installed on this property to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge. There are opportunities to install rain gardens in front of the school and in the rear courtyard.

2 **POROUS PAVEMENT:** The basketball court could be replaced with porous asphalt. This will help to remove pollutants and allow stormwater to infiltrate into the ground.

**EDUCATIONAL PROGRAM:** The RCE Water Resources Program's *Stormwater Management in Your Schoolyard* can be delivered at Washington Memorial School to educate the students about stormwater management and engage them in designing and building the bioretention systems.

3 **RAINWATER HARVESTING SYSTEM:** 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.

## 1 BIORETENTION SYSTEM

## 2 POROUS PAVEMENT


## EDUCATIONAL PROGRAM

## 3 RAINWATER HARVESTING SYSTEM

| | |
|---|---|
| **Location:**<br>300 West Stewart Street<br>Washington, NJ 07882 | **Municipality:**<br>Washington Borough<br><br>**Subwatershed:**<br>Pohatcong Creek |
| **Green Infrastructure Description:**<br>bioretention system<br>educational program<br>porous pavement<br>rainwater harvesting system | **Targeted Pollutants:**<br>total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff |
| **Mitigation Opportunities:**<br>recharge potential: yes<br>TSS removal potential: yes<br>stormwater peak reduction potential: yes | **Stormwater Captured and Treated Per Year:**<br>rain garden #1: 98,463 gal.<br>rain garden #2: 162,481 gal.<br>rain garden #3: 95,545 gal.<br>porous pavement #1: 444,733 gal.<br>cistern #1: 4,295 gal. |

**Existing Conditions and Issues:**
There is a butterfly garden on the property by the main entrance. There are several connected downspouts in the front of the building. There is also a shed behind the butterfly garden which has a broken downspout. In the back of the school there is a large grass area that has five connected downspouts. There are two connected downspouts near the basketball court behind the building.

**Proposed Solution(s):**
The shed's downspout could be fixed and connected to a cistern to help water the butterfly garden in the front. By the front entrance two rain gardens could be built to infiltrate water from the downspouts in the front. Another rain garden could be installed in the back of the school to capture runoff from the five downspouts that could be disconnected. A porous pavement basketball court could be installed to replace the existing court to collect rain water from the two downspouts nearby.

**Anticipated Benefits:**
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. The bioretention systems would provide additional benefits such as aesthetic appeal and wildlife habitat.

Porous pavement allows stormwater to infiltrate through to soil layers which will promote groundwater recharge as well as intercept and filter stormwater runoff. The porous pavement system will achieve the same level of pollutant load reduction for TN, TP, and TSS as the bioretention system.

Cisterns can harvest stormwater which can be used for watering plants, or other purposes which cuts back on use of potable water for nondrinking purposes. Since the rainwater harvesting system would be designed to capture the first 1.25 inches of rain, it would reduce the pollutant loading by 90% during the periods it is operational (i.e., it would not be used in the winter when there is a chance of freezing).

**Possible Funding Sources:**
Washington Borough
mitigation funds from local developers
NJDEP grant programs
grants from foundations
home and school associations

**Partners/Stakeholders:**
Washington Borough
students and parents
local community groups (Boy Scouts, Girl Scouts, etc.)
Rutgers Cooperative Extension

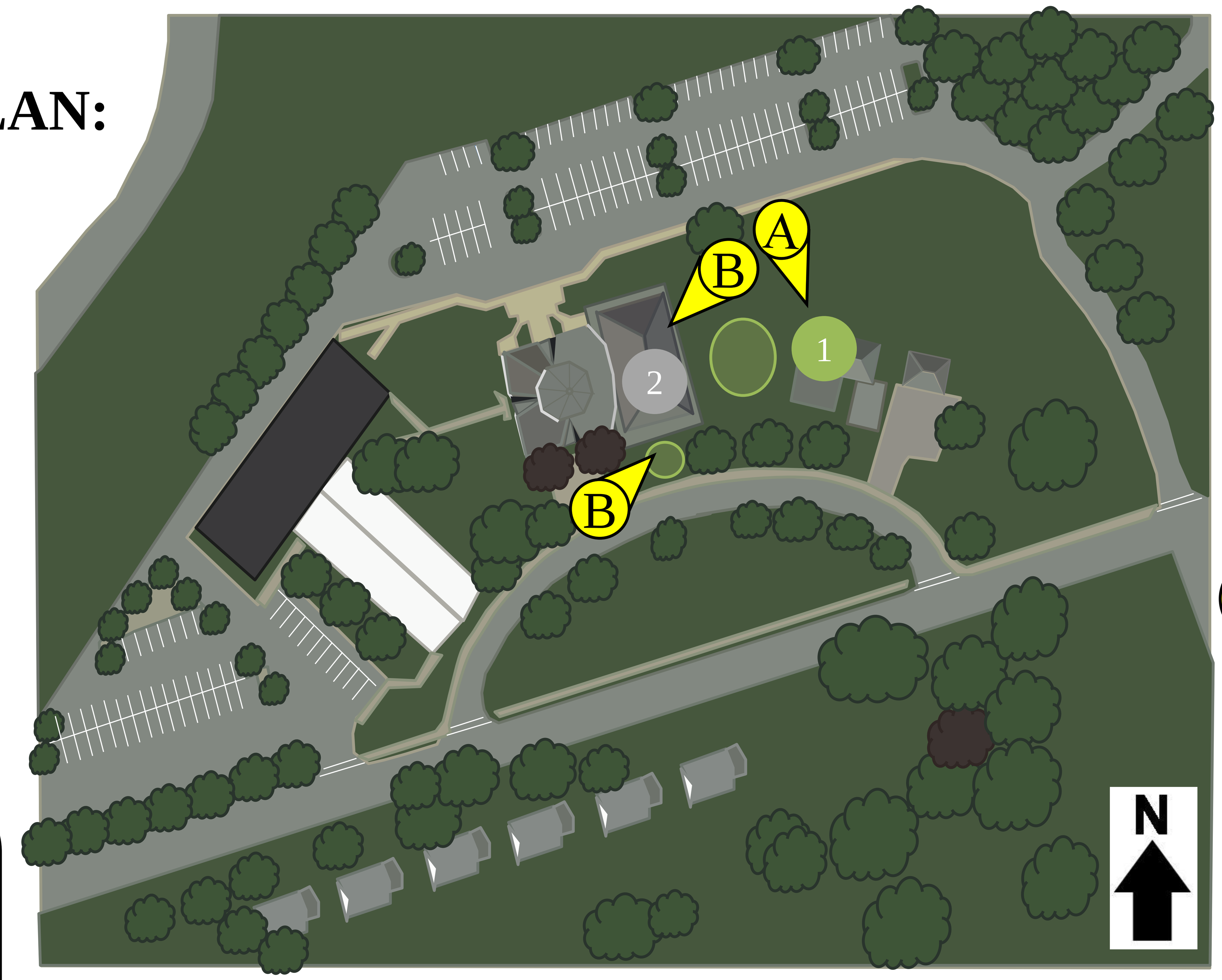
**Estimated Cost:**
Rain garden #1 would need to be approximately 950 square feet. At $5 per square foot, the estimated cost is $4,750. Rain garden #2 would need to be approximately 1,500 square feet. At $5 per square foot, the estimated cost is $7,500. Rain garden #3 would need to be approximately 900 square feet. At $5 per square foot, the estimated cost is $4,500. The porous pavement system that is 3,050 square feet, with a one-foot stone layer, is $61,000. The cistern that is 270 gallons is estimated to cost $540. The total cost of the project is $78,290.

Washington Borough
Impervious Cover Assessment
*St. Joseph Catholic Church, 200 Carlton Avenue*

RUTGERS
New Jersey Agricultural Experiment Station

## PROJECT LOCATION:


## SITE PLAN:




A

B

C

1 **BIORETENTION SYSTEM: R**ain gardens can be used on this property to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge. There are opportunities to install rain gardens at the main entrance and in the rear courtyard of the church.

2 **DISCONNECTED DOWNSPOUTS:** Downspouts can be disconnected to allow rainwater to flow into the rain gardens that may be installed on this site. This will help to remove pollutants and allow stormwater to infiltrate into the ground.

## 1 BIORETENTION SYSTEM

## 2 DISCONNECTED DOWNSPOUTS

St. Joseph Catholic Church
Green Infrastructure Information Sheet

| | |
|---|---|
| **Location:**<br>200 Carlton Avenue<br>Washington, NJ 07882 | **Municipality:**<br>Washington Borough<br><br>**Subwatershed:**<br>Pohatcong Creek |
| **Green Infrastructure Description:**<br>bioretention system<br>disconnected downspouts | **Targeted Pollutants:**<br>total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff |
| **Mitigation Opportunities:**<br>recharge potential: yes<br>TSS removal potential: yes<br>stormwater peak reduction potential: yes | **Stormwater Captured and Treated Per Year:**<br>rain garden #1: 70,219 gal.<br>rain garden #2: 29,990 gal. |

**Existing Conditions and Issues:**
This site contains several impervious surfaces including driveways, walkways, a parking lot, and a church. These impervious surfaces are directly connected to a storm sewer system. The church's parking lot is relatively flat, and the pavement is in good condition throughout the property. There are several downspouts that run down the northern and southern faces of the church. Near the east face of the church and west face of the nearby meeting room, there are a total of eight downspouts that are connected. There are connected downspouts along the front face of the church as well.

**Proposed Solution(s):**
Two rain gardens can be constructed to collect rainfall from the nearby area. This can be achieved by disconnecting the downspouts along the church and meeting room. Another smaller rain garden can be implemented at the north face of the church to collect rainfall there.

**Anticipated Benefits:**
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. This bioretention system would provide additional benefits such as aesthetic appeal and wildlife habitat.

**Possible Funding Sources:**
mitigation funds from local developers
NJDEP grant programs
grants from foundations

**Partners/Stakeholders:**
City of Washington
parishioners
local community groups (Boy Scouts, Girl Scouts, etc.)
Rutgers Cooperative Extension

**Estimated Cost:**
For rain gardens 1 and 2 the rain gardens are 675 and 300 square feet in size, respectively. At $5 per foot, the estimated cost of the rain gardens are $3,375 and $1,500 respectively. The total cost of the project is approximately $4,875.