RUTGERS
New Jersey Agricultural
Experiment Station

Draft

Impervious Cover Assessment
for
Englishtown Borough, Monmouth County, New Jersey

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

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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 also has 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

Englishtown Borough Impervious Cover Analysis

Located in Monmouth County in central New Jersey, Englishtown Borough covers approximately 0.59 square miles. Figures 3 and 4 illustrate that Englishtown Borough is dominated by urban land uses. A total of 70.6% of the municipality's land use is classified as urban. Of the urban land in Englishtown 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) 2007 land use/land cover geographical information system (GIS) data layer categorizes Englishtown 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 Englishtown Borough. Based upon the 2007 NJDEP land use/land cover data, approximately 28.3% of Englishtown Borough has impervious cover. This level of impervious cover suggests that the streams in Englishtown Borough are likely non-supporting streams.

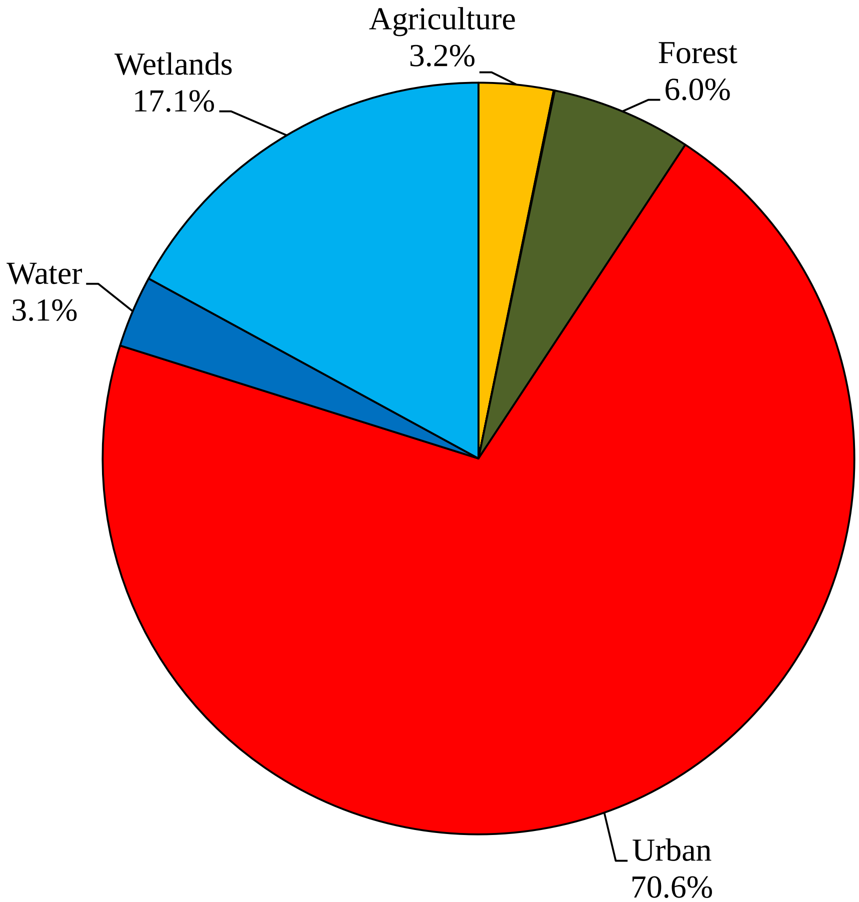


Figure 3: Pie chart illustrating the land use in Englishtown Borough

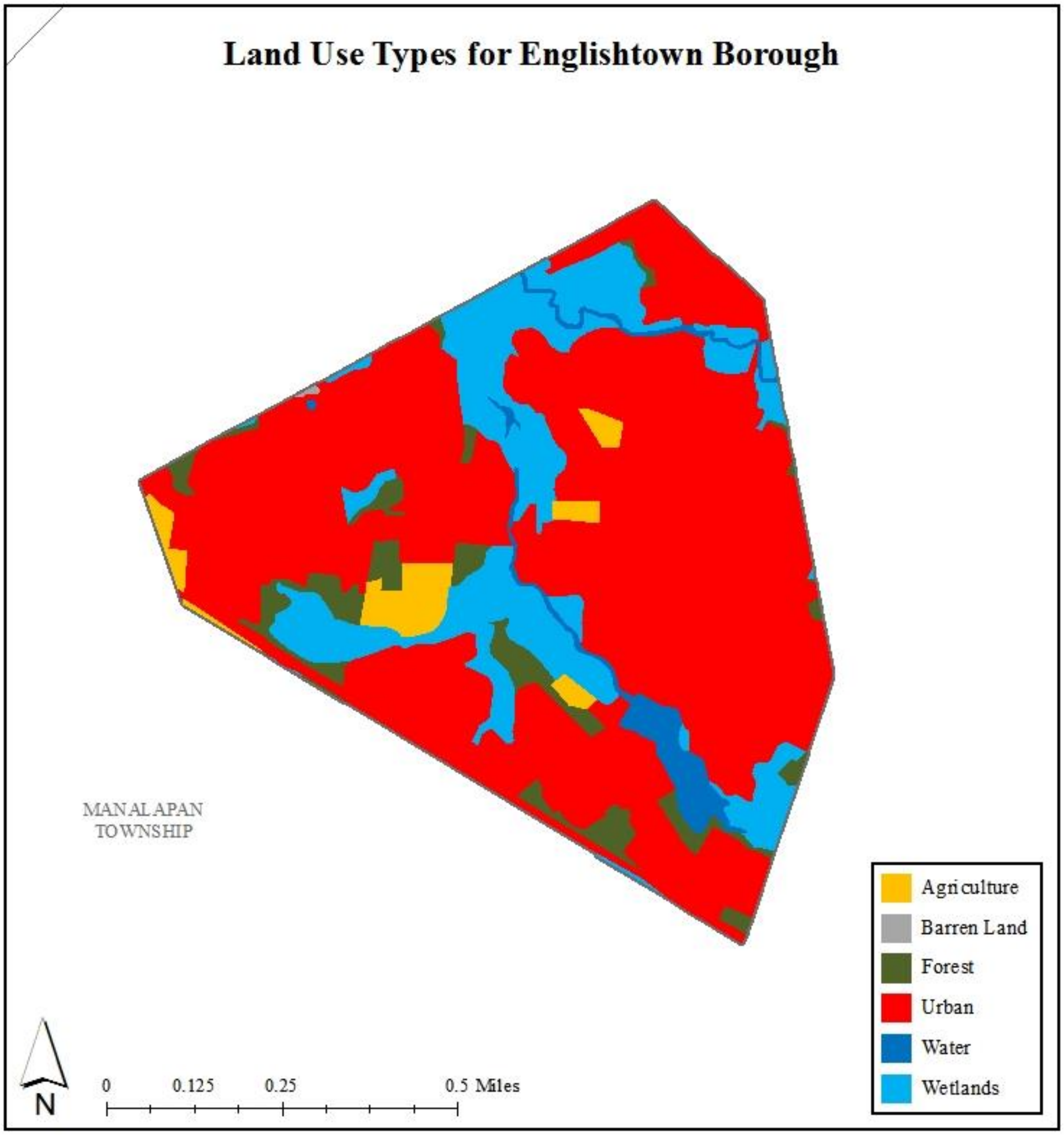


Figure 4: Map illustrating the land use in Englishtown Borough

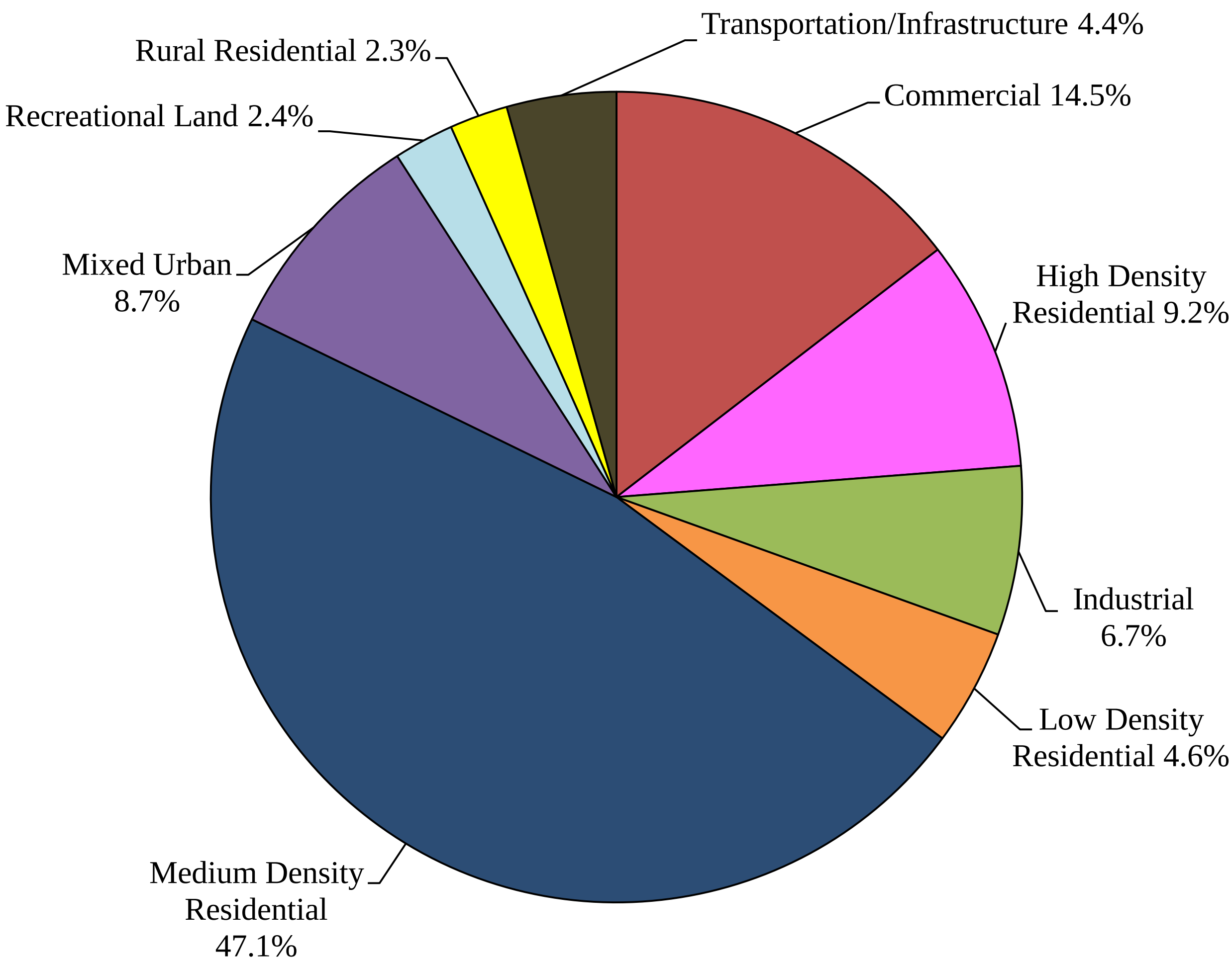


Figure 5: Pie chart illustrating the various types of urban land use in Englishtown Borough

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each Raritan River subwatershed within Englishtown Borough (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 0.25% in the Matachaponix Brook subwatershed to 29.0% in the Weamaconk 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 Englishtown Borough, Monmouth 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 (3.4 inches of rain), the 10-year design storm (5.2 inches of rain), and the 100-year design storm (8.9 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater drains from impervious surfaces in Englishtown Borough. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Weamaconk Creek subwatershed was harvested and purified, it could supply water to 26 homes for one year[1].

[1] Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for Englishtown Borough

Subwatershed	Total Area		Land Use Area		Water Area		Impervious Cover		
	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(%)
Manalapan Brook	3.63	0.01	3.63	0.01	0.00	0.00	0.64	0.00	17.6%
Matchaponix Brook	3.94	0.01	3.94	0.01	0.00	0.00	0.01	0.00	0.25%
McGellairds Brook	62.8	0.10	60.5	0.09	2.27	0.00	16.4	0.03	27.0%
Weamaconk Creek	308.0	0.48	298.6	0.47	9.43	0.01	86.6	0.14	29.0%
Total	378.3	0.59	366.6	0.57	11.7	0.02	103.6	0.16	28.3%

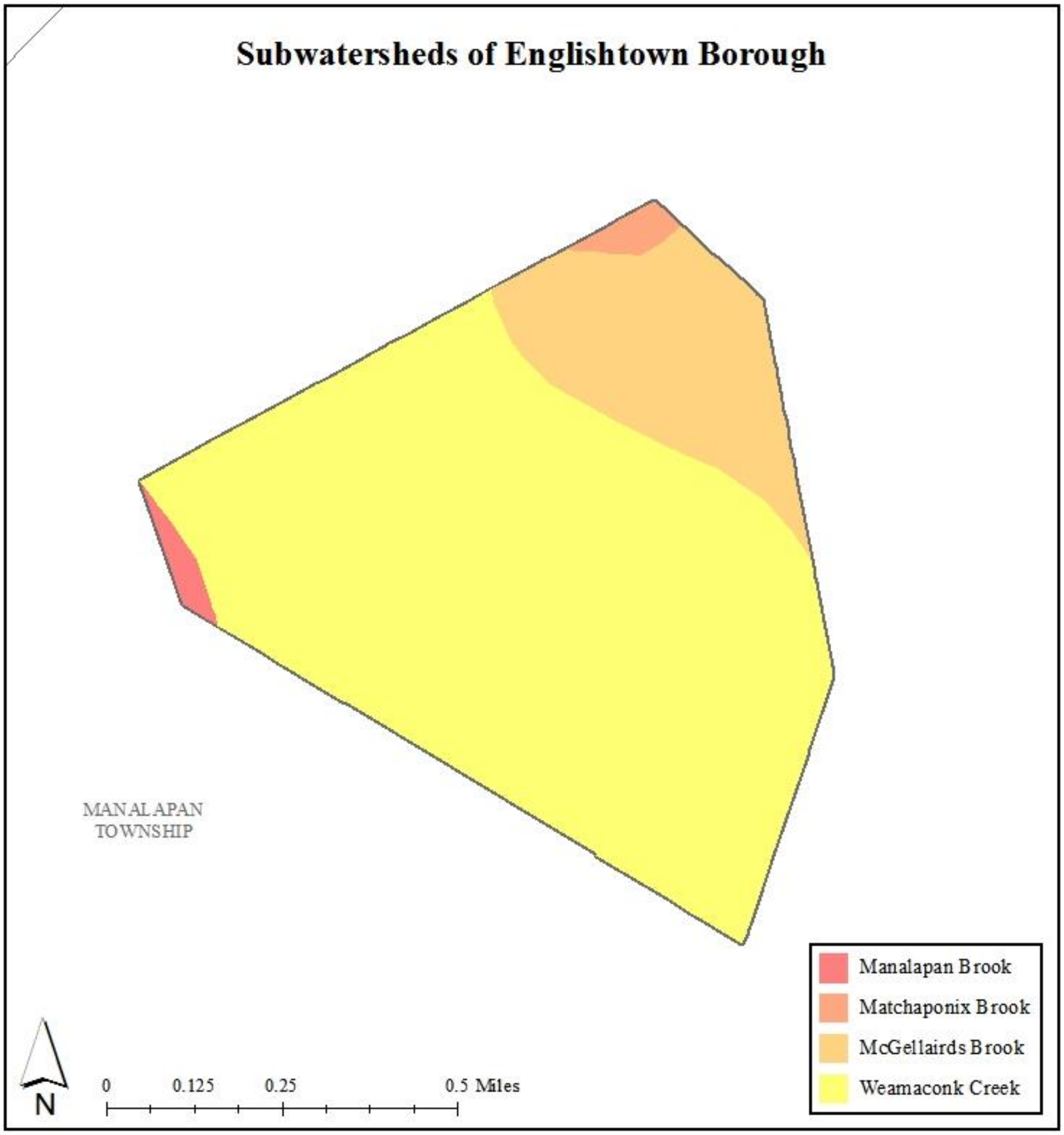


Figure 6: Map of the subwatersheds in Englishtown Borough

Table 2: Stormwater runoff volumes from impervious surfaces by subwatershed in Englishtown 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 (3.4") (MGal)	Total Runoff Volume for the 10-Year Design Storm (5.2") (MGal)	Total Runoff Volume for the 100-Year Design Storm (8.9") (MGal)
Manalapan Brook	0.0	0.8	0.1	0.1	0.2
Matchaponix Brook	0.0	0.0	0.0	0.0	0.0
McGellairds Brook	0.6	19.5	1.5	2.3	4.0
Weamaconk Creek	2.9	103.5	8.0	12.2	20.9
Total	3.5	123.8	9.6	14.6	25.0

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 Englishtown 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 (3.4 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 Englishtown Borough

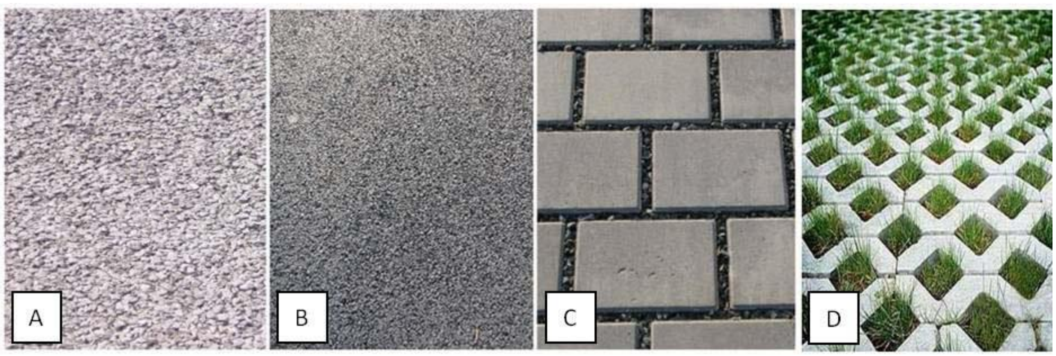
Subwatershed	**Recommended Impervious Area Reduction (10%) (ac)**	**Annual Runoff Volume Reduction [2] (MGal)**
Manalapan Brook	0.1	0.1
Matchaponix Brook	0.0	0.0
McGellairds Brook	1.6	1.9
Weamaconk Creek	8.7	9.8
Total	10.4	11.8

[2] Annual Runoff Volume Reduction =
Acres of impervious cover 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 green infrastructure should be designed to capture the first 3.4 inches of rain from each storm. This would allow the green infrastructure 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 Englishtown 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 Englishtown 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

Englishtown 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.

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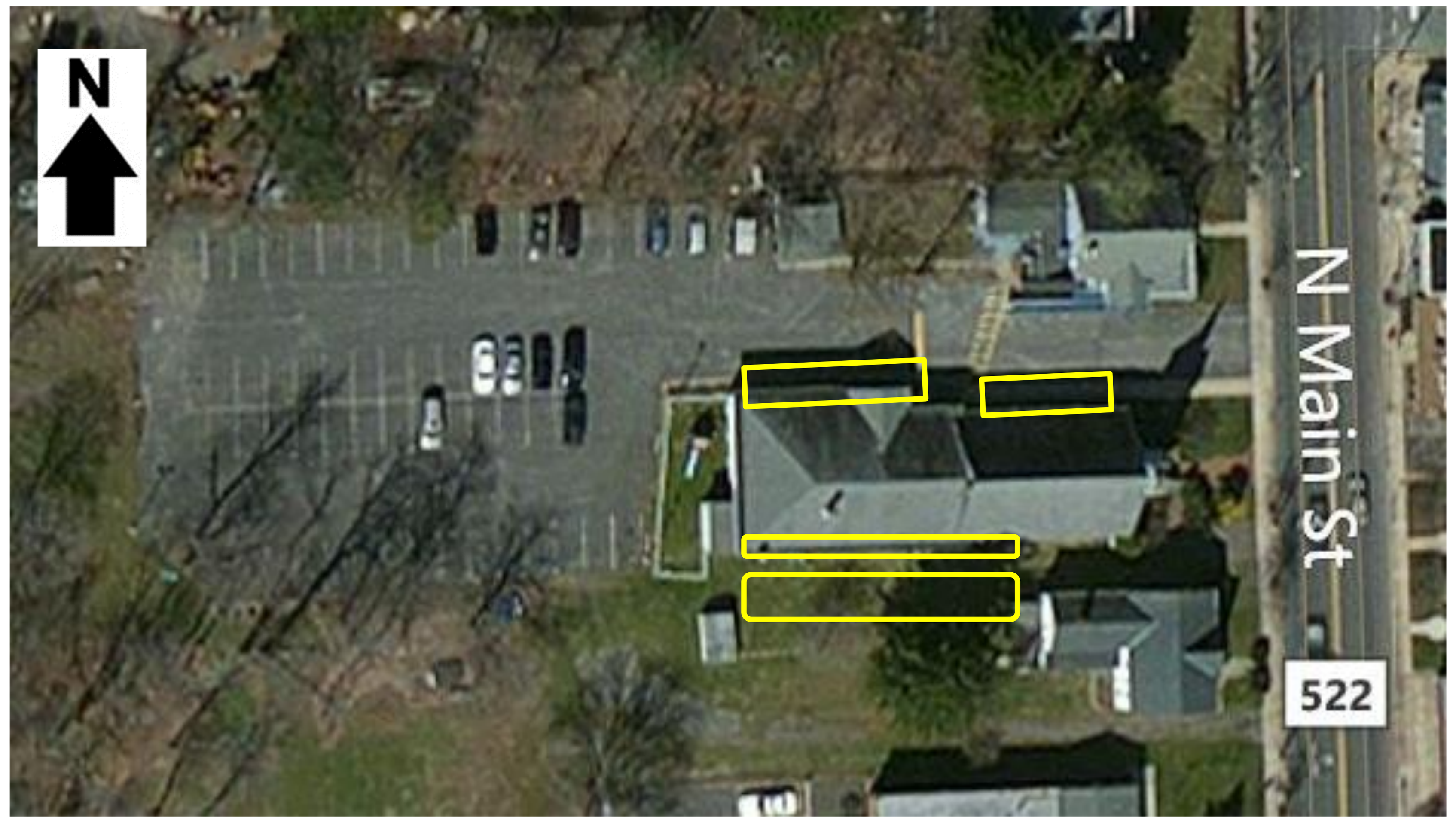
Appendix A

Examples of Impervious Cover Reduction Action Plan Projects

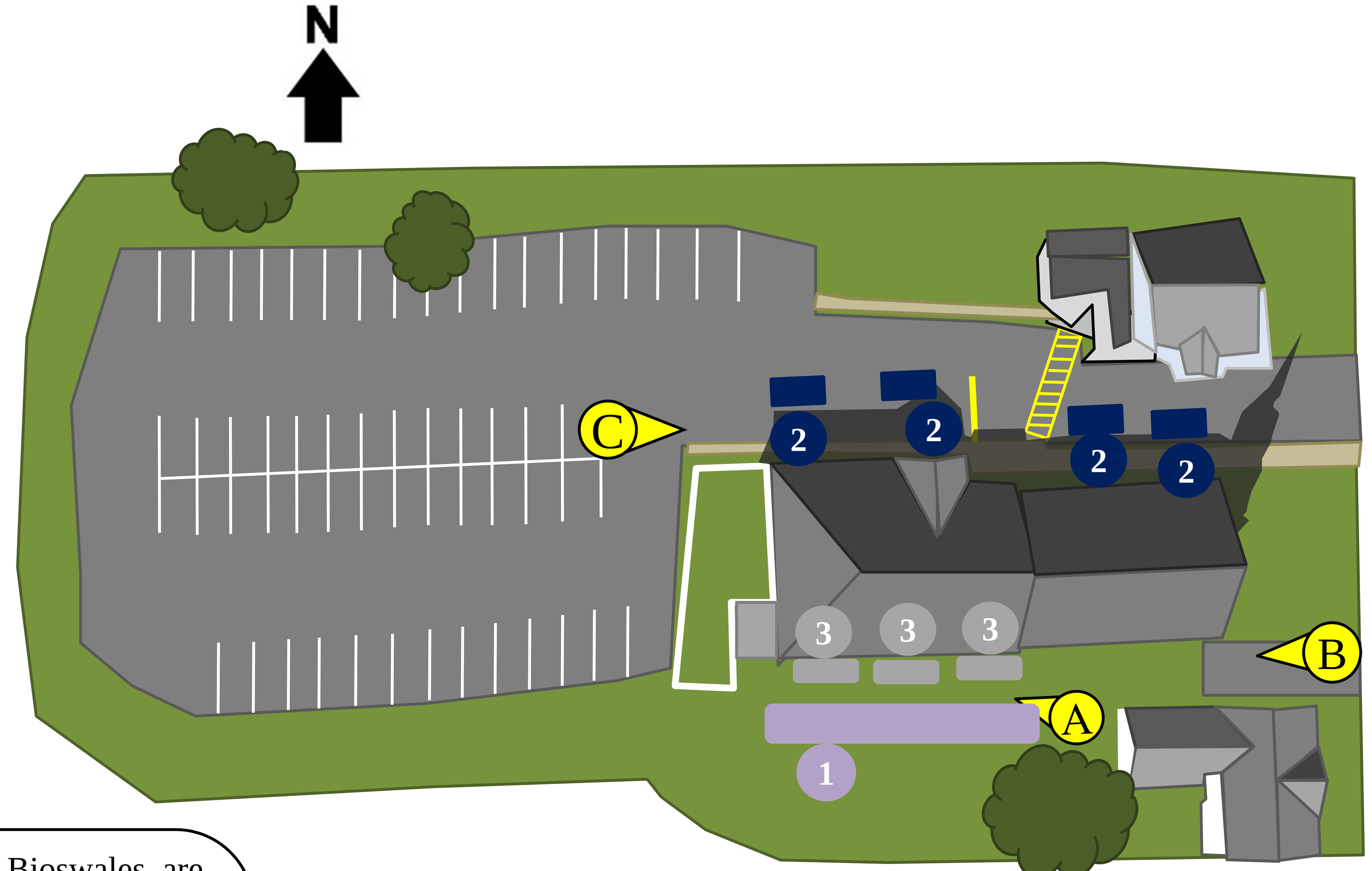
Concept Plans and Detailed Green Infrastructure Information Sheets

Englishtown Borough
Impervious Cover Assessment
Crossroads Assembly of God, 19 Main Street

PROJECT LOCATION:



SITE PLAN:



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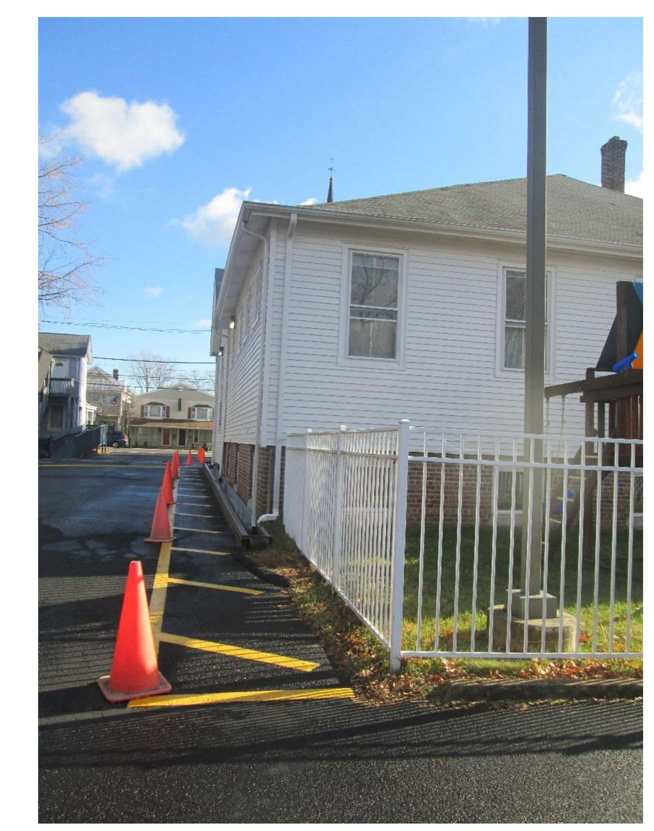

1. **BIOSWALE:** A bioswale can be installed to treat runoff from the church roof. Bioswales are landscape features that convey stormwater from one location to another while removing pollutants and providing water an opportunity to infiltrate.

2. **DOWNSPOUT PLANTER BOX:** Four downspout planter boxes could be installed at the north side of the building to collect water from the nearby downspout. Downspout planter boxes reduce runoff and allow water to slowly infiltrate while being treated for pollutants.

3. **DISCONNECTED DOWNSPOUTS:** Downspouts can be disconnected to allow rainwater to flow into the grassed areas which will help remove pollutants and allow for the stormwater to infiltrate into the ground.

1 BIOSWALE

2 DOWNSPOUT PLANTER BOX

3 DISCONNECTED DOWNSPOUTS

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Location: 19 Main Street Englishtown, NJ 07726	**Municipality:** Englishtown Borough **Subwatershed:** Weamaconk Creek
Green Infrastructure Description: bioswale downspout disconnection downspout planter boxes	**Targeted Pollutants:** total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes	**Stormwater Captured and Treated Per Year:** bioswale: 41,689 gal. 4 stormwater planters: 5,600 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. On the northern face of the church, there are four downspouts routed into a metal channel, which is not set into the ground. There is a parking space at the front of the church. A downspout runs into this parking space and the pavement allows runoff to flow into the street. A water valve was observed in the grass near this drive, and other utilities may be present. A depression runs along the southern side of the church where there are five downspouts (including the downspout near the parking space).

Proposed Solution(s):
A bioswale could be placed in the depression that runs along the southern edge of the church to manage the stormwater runoff from the roof. Four stormwater planters could be placed in the space where the metal channel directs runoff from the church's downspouts.

Anticipated Benefits:
The bioswale would reduce TN by 30%, TP by 60%, and TSS by 90%. Downspout planter boxes would harvest runoff from the roof of the church to water plants.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs
Englishtown Borough
Crossroads Assembly of God
local social and community groups

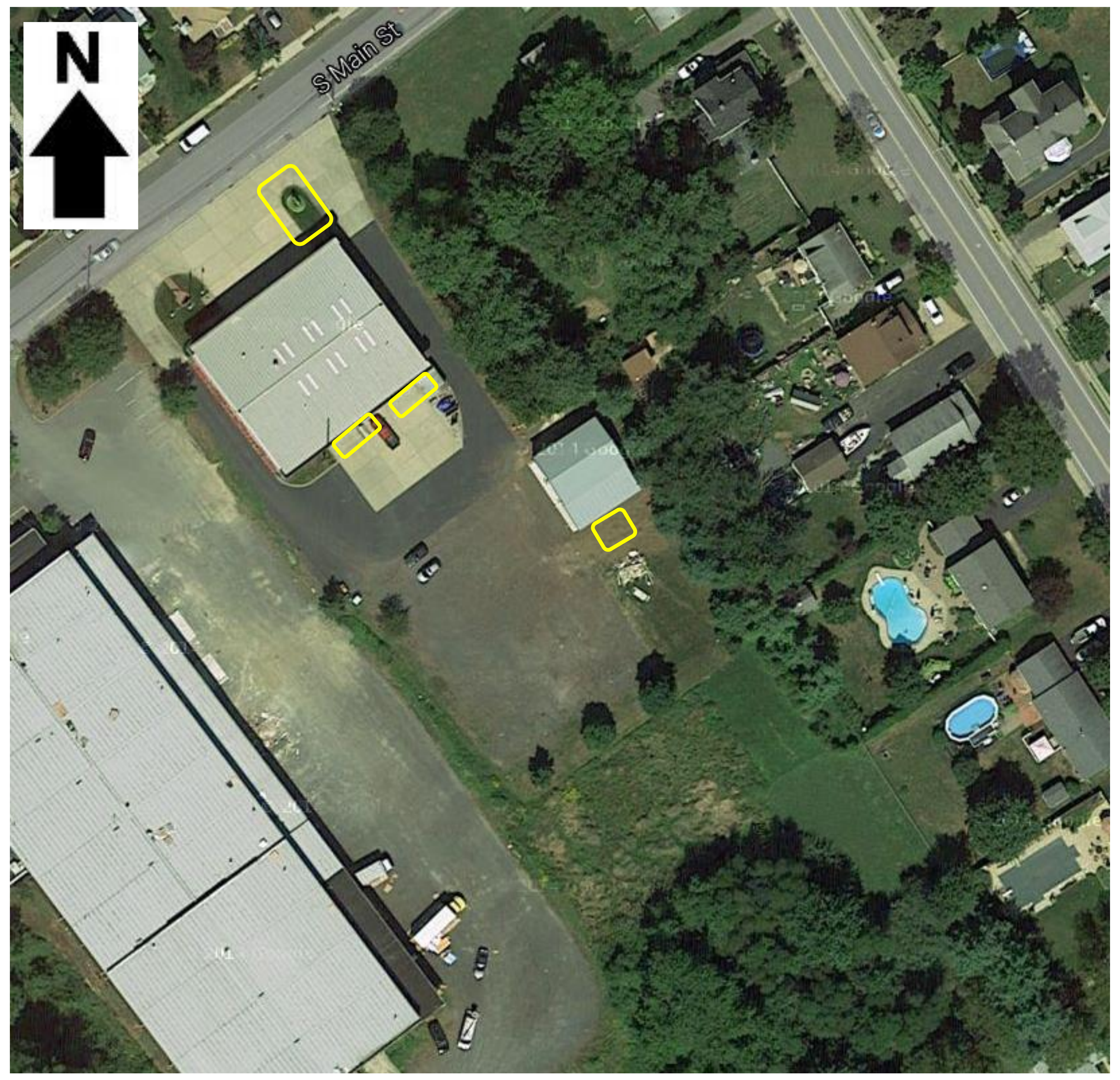
Partners/Stakeholders:
Englishtown Borough
Crossroads Assembly of God
clergy and parishioners
local social and community groups
local residents
Rutgers Cooperative Extension

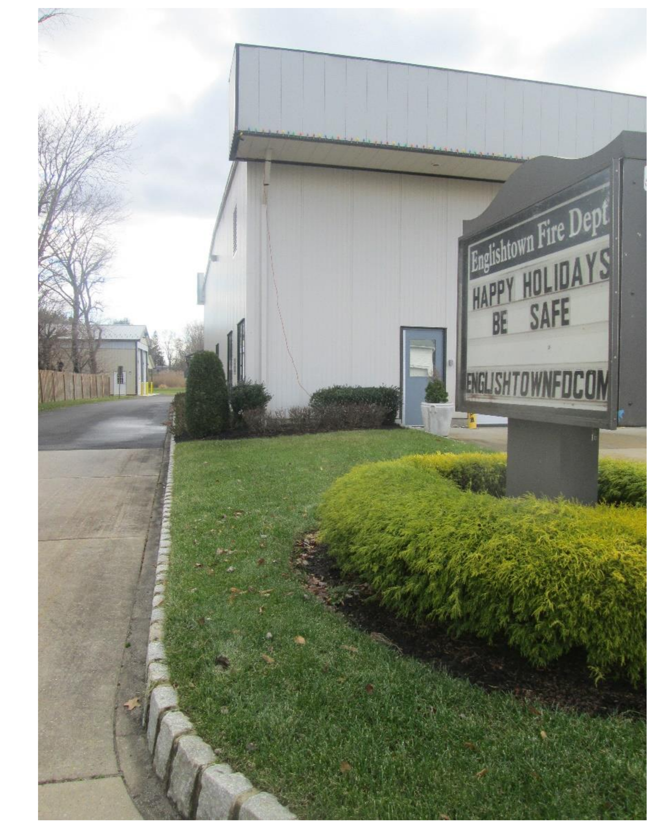
Estimated Cost:
The bioswale would be approximately 400 square feet. At $5 per square foot, the estimated cost of the bioswale is $2,000. Five downspouts would need to be routed to this system, which adds $1,250 to the estimated cost of this system. Each downspout planter boxes would cost approximately $300 each to purchase and install. Four downspout planter boxes have been proposed for this site. The total cost of the proposed downspout planter boxes is $1,200. The total cost of the project will thus be approximately $4,450.

Englishtown Borough
Impervious Cover Assessment

Englishtown Fire Department, 66 South Main Street

PROJECT LOCATION:





SITE PLAN:

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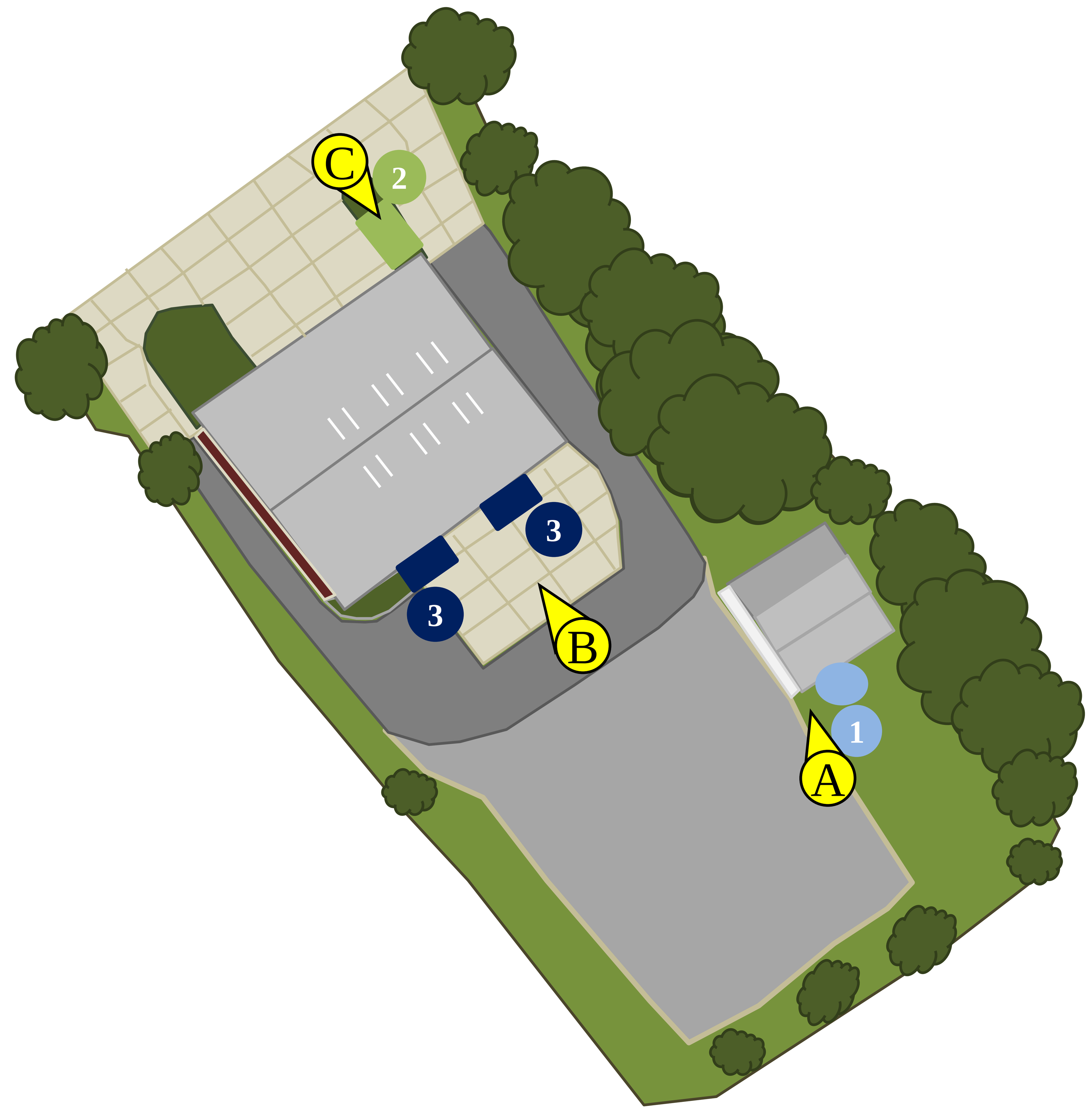


1 **RAINWATER HARVESTING SYSTEM:** Rainwater could be harvested from the roof of the south eastern building and stored in a cistern. The water can then be used to wash vehicles.

2 **BIORETENTION SYSTEM:** A rain garden can be installed on a patch of turf grass to capture roof runoff by disconnecting the downspout located off the front of the building at the northeast corner. The bioretention system can reduce sediment and nutrient loading to the local waterways and increase groundwater recharge.

3 **DOWNSPOUT PLANTER BOX:** A downspout planter boxes could be installed at the southeast side of the building to collect water from the nearby downspout. Downspout planter boxes reduce runoff and allow water to slowly infiltrate while being treated for pollutants.

1 RAINWATER HARVESTING SYSTEM

2 BIORETENTION SYSTEM

3 DOWNSPOUT PLANTER BOX

Location: 66 S Main Street Englishtown, NJ 07726	**Municipality:** Englishtown Borough **Subwatershed:** Weamaconk Creek
Green Infrastructure Description: bioretention system (rain garden) downspout disconnection rainwater harvesting system (cistern) downspout planter boxes	**Targeted Pollutants:** total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes	**Stormwater Captured and Treated Per Year:** bioretention system: 29,182 gal. cistern: 15,798 gal. two downspout planter boxes: 2,800 gal.

Existing Conditions and Issues:
This site contains several impervious surfaces including driveways, a parking lot, a garage, and the firehouse. The front of the firehouse is directly connected to a storm sewer system. The site's impervious surfaces produce stormwater runoff during rain events. Downspouts run in between each rear garage door, and there is approximately 5 feet of room between each door. At the time of the site visit, a picnic table was observed between one of these garage doors. There are two turf grass areas at the front of the building. There is a connected downspout at the northeastern corner of the firehouse. A garage is located to the east of the property. The parking lot is gravel and pavement, and both are in good condition. It should be noted that there is an existing wetland to the southeast of the site and an existing swale that runs into it from the western edge of the property. The swale is shared with the commercial property next door – a large warehouse, whose parking lot is littered with debris and sediment. Severe ponding was observed on this property at the time of the site visit, and the swale was full after a recent rain storm.

Proposed Solution(s):
One bioretention system could be installed at this site to collect a portion of the runoff from the firehouse's roof and enhance the site's aesthetic quality. It could be installed in the turf grass area that runs off the northeastern corner of the firehouse and have one downspout routed to it. A cistern could be installed off the garage located to the southeast to collect roof runoff to be used to wash fire department vehicles. Two downspout planter boxes could be placed in between the rear garage doors of the firehouse.

Anticipated Benefits:
Since the bioretention system would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.4 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. A bioretention system would also provide ancillary

benefits such as enhanced wildlife habitat and aesthetic appeal. A cistern can harvest stormwater which can be used for washing the fire department vehicles or other purposes which cuts back on the use of potable water for nondrinking purposes. Since the rainwater harvesting system would be designed to capture the first 0.75 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 chance of freezing). Downspout planter boxes would harvest runoff from the roof of the building to water plants.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs
Englishtown Borough
Englishtown Fire Department
local social and community groups

Partners/Stakeholders:
Englishtown Borough
Englishtown Fire Department
local social and community groups
local residents
Rutgers Cooperative Extension

Estimated Cost:
The bioretention system would need to be approximately 280 square feet. At $5 per square foot, the estimated cost of this bioretention system is $1,400. The cistern would be 1,000 gallons and cost approximately $2,000 to purchase and install. Each downspout planter boxes would cost approximately $300 to purchase and install. Two downspout planter boxes have been proposed for this site. The total cost of the proposed downspout planter boxes is $600. The total cost of the project will thus be approximately $4,000.

Englishtown Borough
Impervious Cover Assessment

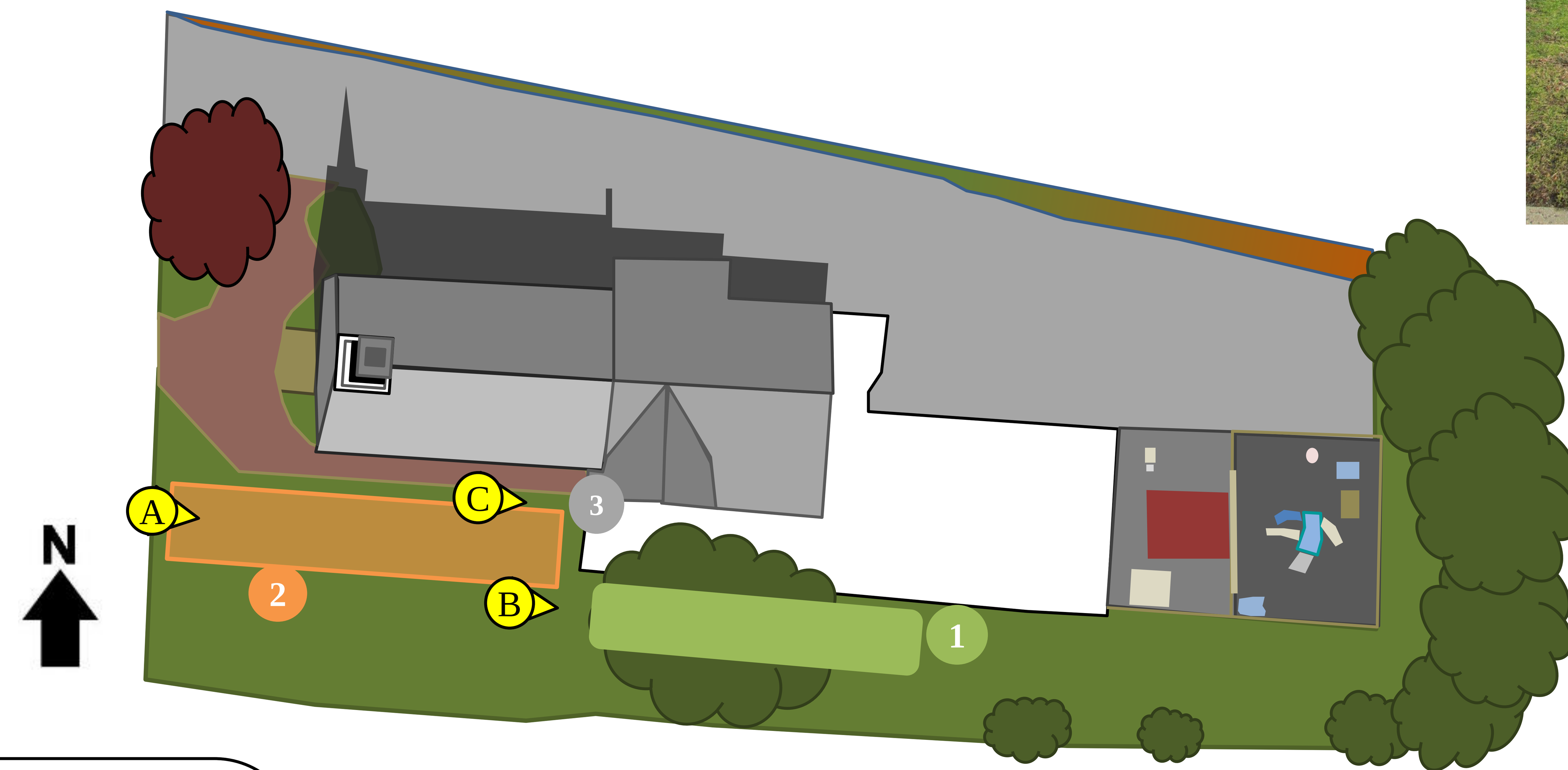
First Presbyterian Church of Englishtown, 50 Main Street

A

RUTGERS
New Jersey Agricultural Experiment Station

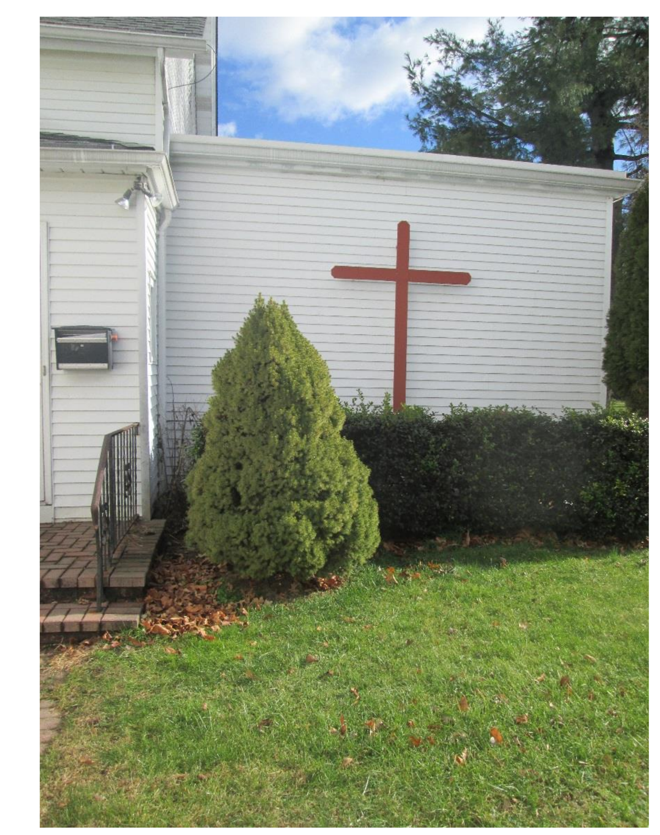
PROJECT LOCATION:

SITE PLAN:



B

C

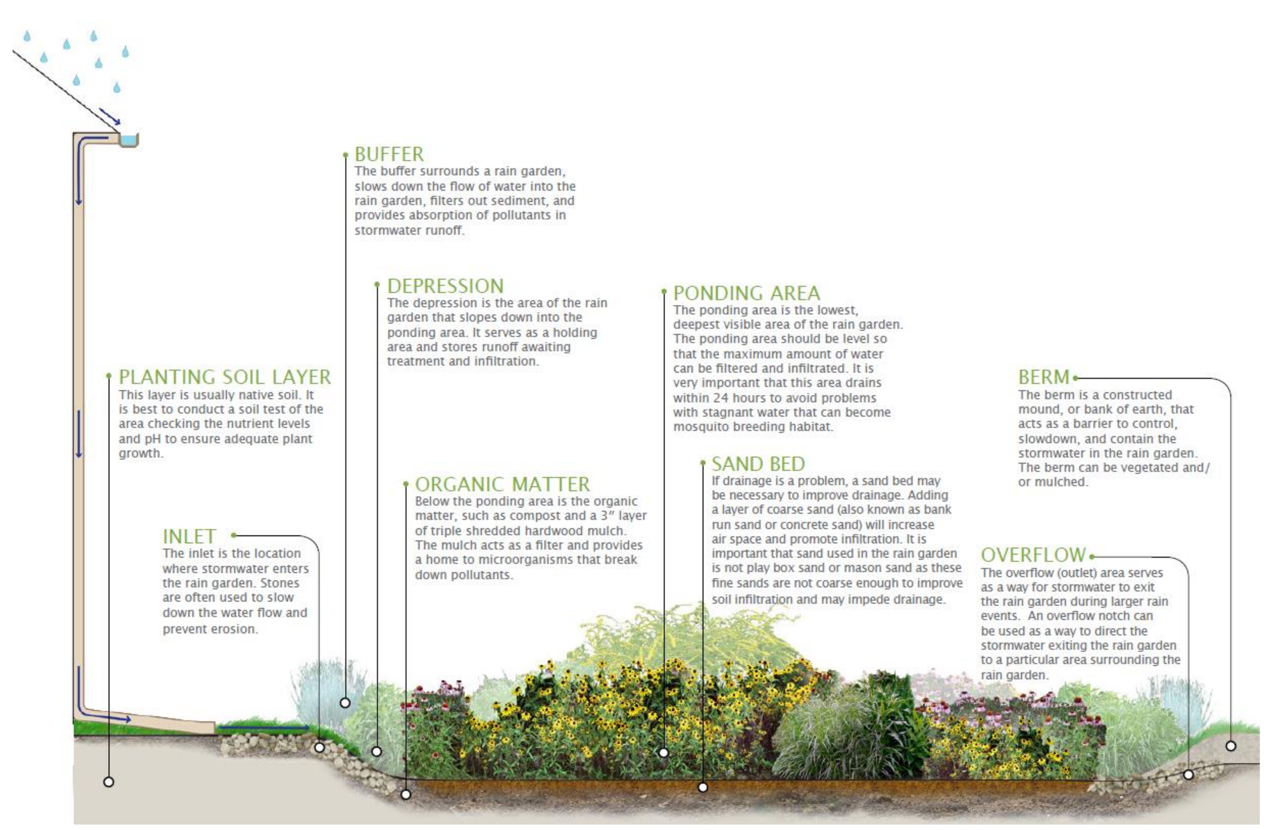


1 **BIORETENTION SYSTEM:** A bioretention system could be installed at this site to manage the stormwater runoff from the southern face of the building. A bioretention system will reduce runoff and allow stornwater infiltration, decreasing the amount of contaminants that reaches catch basins.

2 **PERVIOUS PAVEM,ENT:** Grass pavers, a type of pervious pavement, could be installed to replace the existing drive up area located to the right in front of the church. Grass pavers promote groundwater recharge and filter stormwater.

3 **DISCONNECTED DOWNSPOUTS:** Downspouts can be disconnected to allow rainwater to flow into the grassed areas which will help remove pollutants and allow stormwater to infiltrate into the ground.

1 BIORETENTION SYSTEM



2 PERVIOUS PAVEMENT

3 DISCONNECTED DOWNSPOUTS

Location: 50 Main Street Englishtown, NJ 07726	**Municipality:** Englishtown Borough **Subwatershed:** Weamaconk Creek
Green Infrastructure Description: bioretention system (rain garden) downspout disconnection pervious pavement	**Targeted Pollutants:** total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes	**Stormwater Captured and Treated Per Year:** bioretention system: 36,477 gal. pervious pavement: 44,294 gal. simple disconnection: 19,747 gal.

Existing Conditions and Issues:
This site contains several impervious surfaces including driveways, walkways, a parking lot, and a church-school complex. The site's impervious surfaces produce stormwater runoff during rain events. At the front of the church there is a paver walkway, a paved driveway, and a second unpaved driveway of grass. This grass driveway is being compressed and eroded by vehicles. At the southern side entrance to the church there is a directly connected downspout surrounded by bushes. There are several downspouts that line the southern edge of the church complex (where there is a Sunday school). The parking lot appeared to be in poor condition at the time of the site visit.

Proposed Solution(s):
One bioretention system could be installed at this site to manage the stormwater runoff from the southern face of the school. This system could have at least three downspouts routed to it. Grass pavers, a form of pervious pavement, could be installed in the grass driveway to enhance the space, treat runoff from the pavers, mitigate erosion, and restore permeability. The directly connected downspout at the side entrance to the church also could be disconnected and allowed to flow into the existing landscape.

Anticipated Benefits:
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.4 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. A bioretention system would also provide ancillary benefits such as enhanced wildlife habitat and aesthetic appeal. The pervious pavement (grass pavers) would have a one foot stone reservoir beneath it to store the stormwater and slowly let it infiltrate into the ground. The system would contain an underdrain so larger rainfall events could bypass the system. The simple disconnection also would reduce the pollutant loading by 90% since it will manage the water quality design storm of 1.25 inches of rain.

Possible Funding Sources: mitigation funds from local developers NJDEP grant programs Englishtown Borough First Presbyterian Church of Englishtown local social and community groups
Partners/Stakeholders: Englishtown Borough First Presbyterian Church of Englishtown clergy and parishioners local social and community groups local residents Rutgers Cooperative Extension
Estimated Cost: The bioretention system would be approximately 350 square feet. At $5 per square foot, the estimated cost of this bioretention system is $1,750. The simple disconnection of the downspout would cost $250 to implement. The pervious pavement, will cover approximately 1,700 square feet. At $15 per square foot, including only the raw materials, this system will cost approximately $25,500. The total cost of the project will thus be approximately $27,500.