Rutgers
New Jersey Agricultural
Experiment Station

Impervious Cover Assessment
for
East Brunswick Township, Middlesex County, New Jersey

Prepared for East Brunswick Township by the
Rutgers Cooperative Extension Water Resources Program

November 24, 2014

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

East Brunswick Township Impervious Cover Analysis

Located in Middlesex County in central New Jersey, East Brunswick Township covers approximately 22.4 square miles east of Raritan. Figures 3 and 4 illustrate that East Brunswick Township is dominated by urban land uses. A total of 61.4% of the municipality's land use is classified as urban. Of the urban land in East Brunswick Township, 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 East Brunswick 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 East Brunswick Township. Based upon the 2007 NJDEP land use/land cover data, approximately 23.0% of East Brunswick Township has impervious cover. This level of impervious cover suggests that the streams in East Brunswick Township are likely impacted.

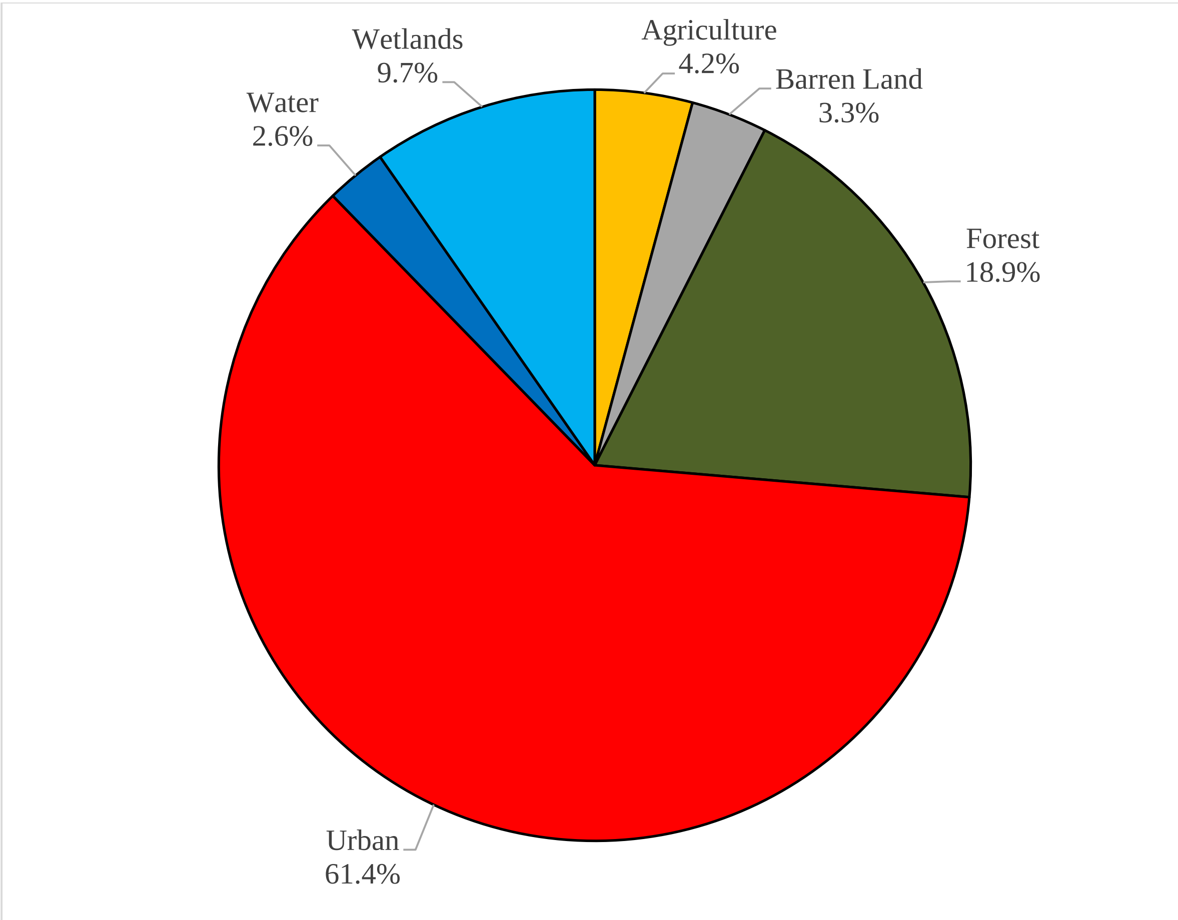


Figure 3: Pie chart illustrating the land use in East Brunswick Township

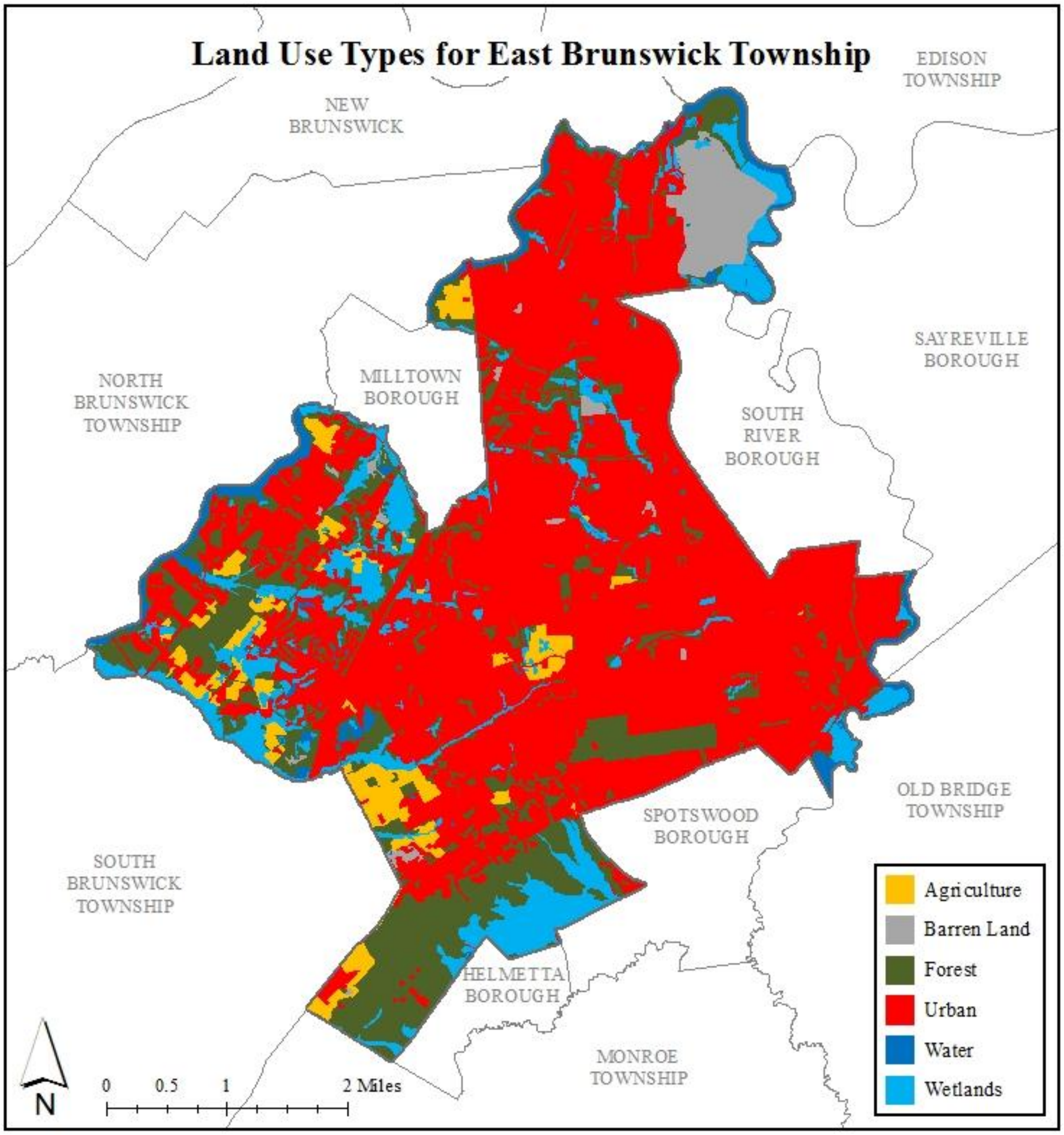


Figure 4: Map illustrating the land use in East Brunswick Township

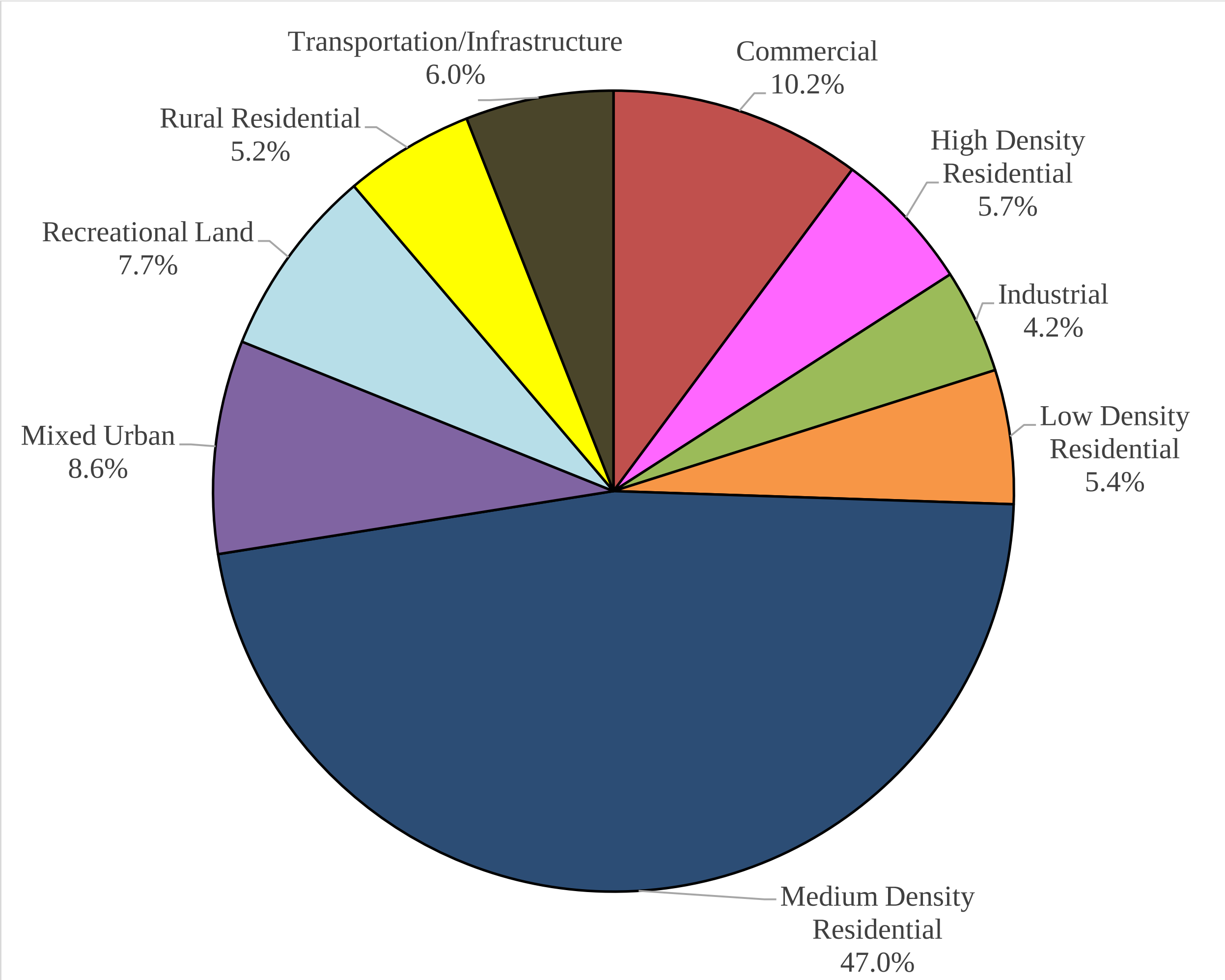


Figure 5: Pie chart illustrating the various types of urban land use in East Brunswick Township

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each Raritan River subwatershed within East Brunswick Township (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 0% in the Lower Raritan River subwatershed to 28.8% in the Lawrence Brook 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 East Brunswick Township, Middlesex 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 (5.1 inches of rain), and the 100-year design storm (8.6 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater drains from impervious surfaces in East Brunswick Township. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Lawrence Brook Watershed was harvested and purified, it could supply water to 568 homes for one year[1].

[1] Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for East Brunswick Township

Subwatershed	**Total Area**		**Land Use Area**		**Water Area**		**Impervious Cover**		
	(ac)	**(mi^2)**	**(ac)**	**(mi^2)**	**(ac)**	**(mi^2)**	**(ac)**	**(mi^2)**	**(%)**
Duhernal Lake	571	0.89	551	0.86	19.7	0.03	158	0.25	28.6%
Ireland Brook	3,374	5.27	3,325	5.19	49.7	0.08	749	1.17	22.5%
Lawrence Brook	6,567	10.26	6,371	9.96	195.3	0.31	1,834	2.87	28.8%
Manalapan Brook	2,133	3.33	2,133	3.33	0.78	0	222	0.35	10.4%
Lower Raritan River	291	0.45	247	0.39	43.6	0.07	0	0	0.0%
South River	1,404	2.19	1,340	2.09	63.5	0.1	342	0.53	25.5%
Total	14,340	22.39	13,967	21.82	373	0.59	3,304	5.17	23.0%

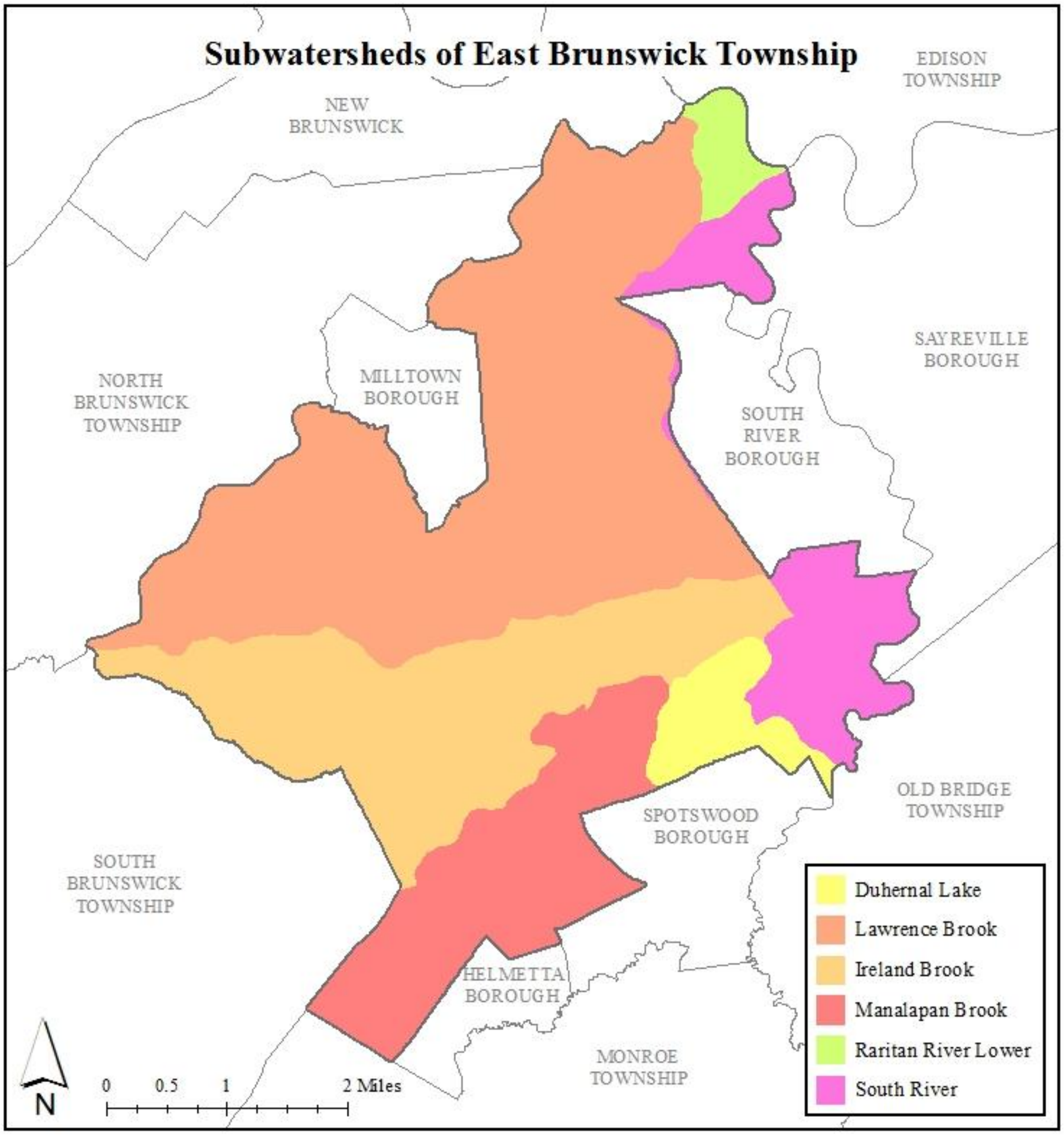


Figure 6: Map of the subwatersheds in East Brunswick Township

Table 2: Stormwater runoff volumes from impervious surfaces by subwatershed in East Brunswick Township

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 (5.1") (MGal)	Total Runoff Volume for the 100-Year Design Storm (8.6") (MGal)
Duhernal Lake	5.4	188.4	14.1	21.8	36.8
Ireland Brook	25.4	895.0	67.1	103.7	174.9
Lawrence Brook	62.2	2,190.7	164.3	253.9	428.2
Manalapan Brook	7.5	264.8	19.9	30.7	51.8
Lower Raritan River	0.0	0.0	0.0	0.0	0.0
South River	11.6	408.3	30.6	47.3	79.8
Total	112.1	3,947.2	296.0	457.5	771.5

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 East Brunswick Township. 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 East Brunswick Township

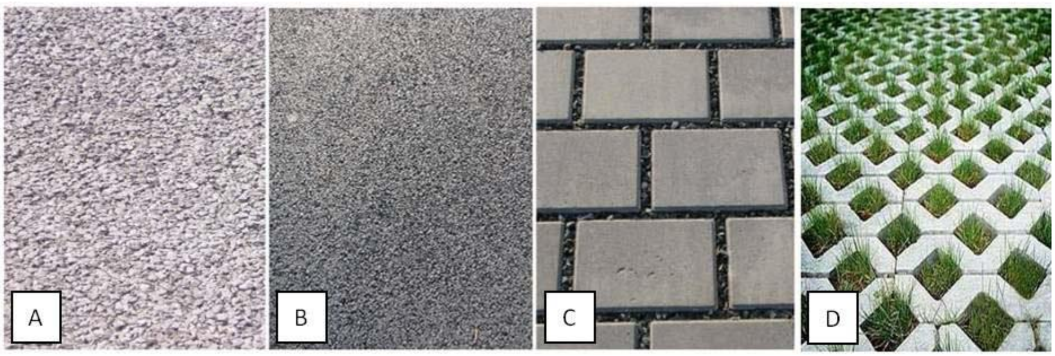
Subwatershed	**Recommended Impervious Area Reduction (10%) (ac)**	**Annual Runoff Volume Reduction [2] (MGal)**
Duhernal Lake	15.8	17.9
Ireland Brook	74.9	85.0
Lawrence Brook	183.4	208.1
Manalapan Brook	22.2	25.2
Lower Raritan River	0.0	0.0
South River	34.2	38.8
Total	330.4	375.0

[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 3.3 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 East Brunswick Township

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 East Brunswick Township, 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

East Brunswick Township 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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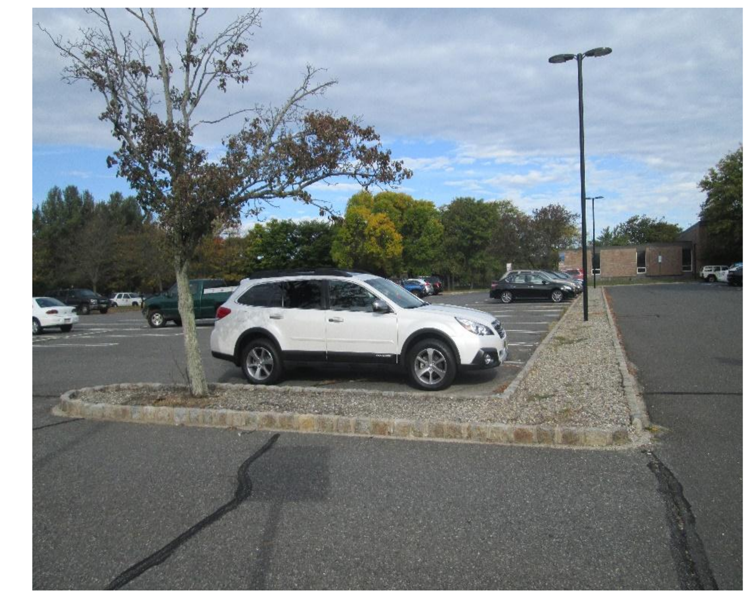
Appendix A

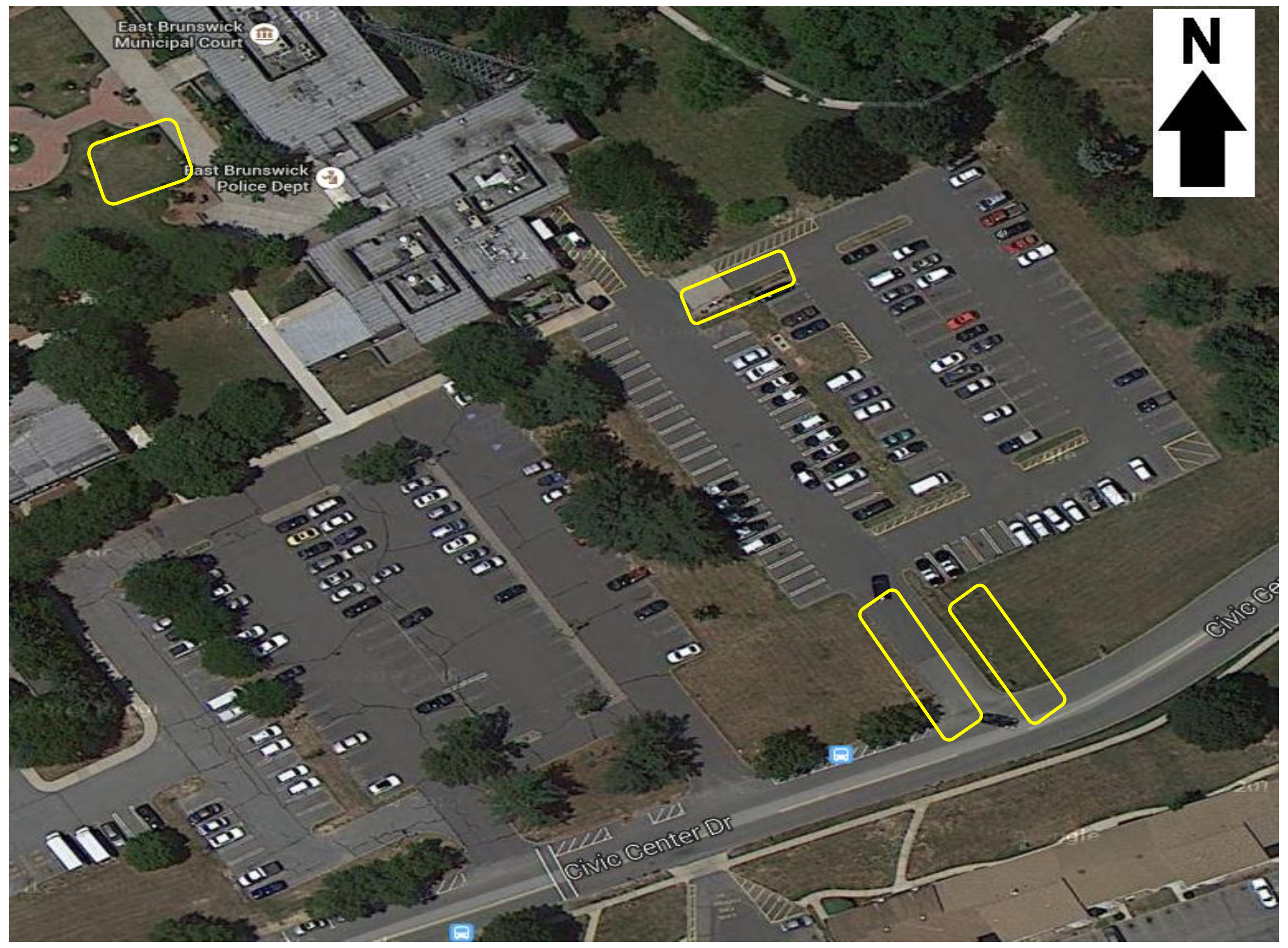
Examples of Impervious Cover Reduction Action Plan Projects

Concept Plans and Detailed Green Infrastructure Information Sheets

East Brunswick Township
Impervious Cover Assessment
East Brunswick Police Department, 1 Civic Center Drive



PROJECT LOCATION:



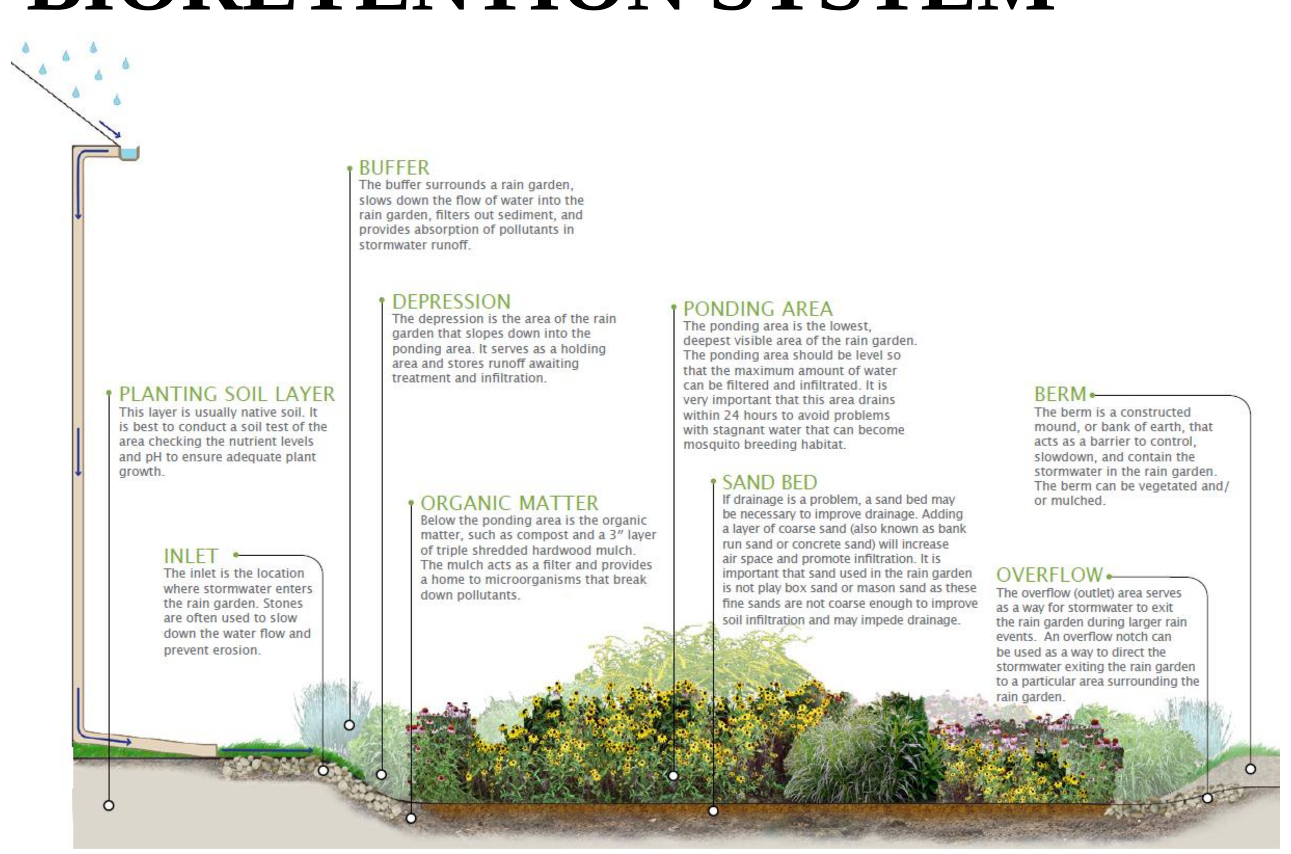
SITE PLAN:

N

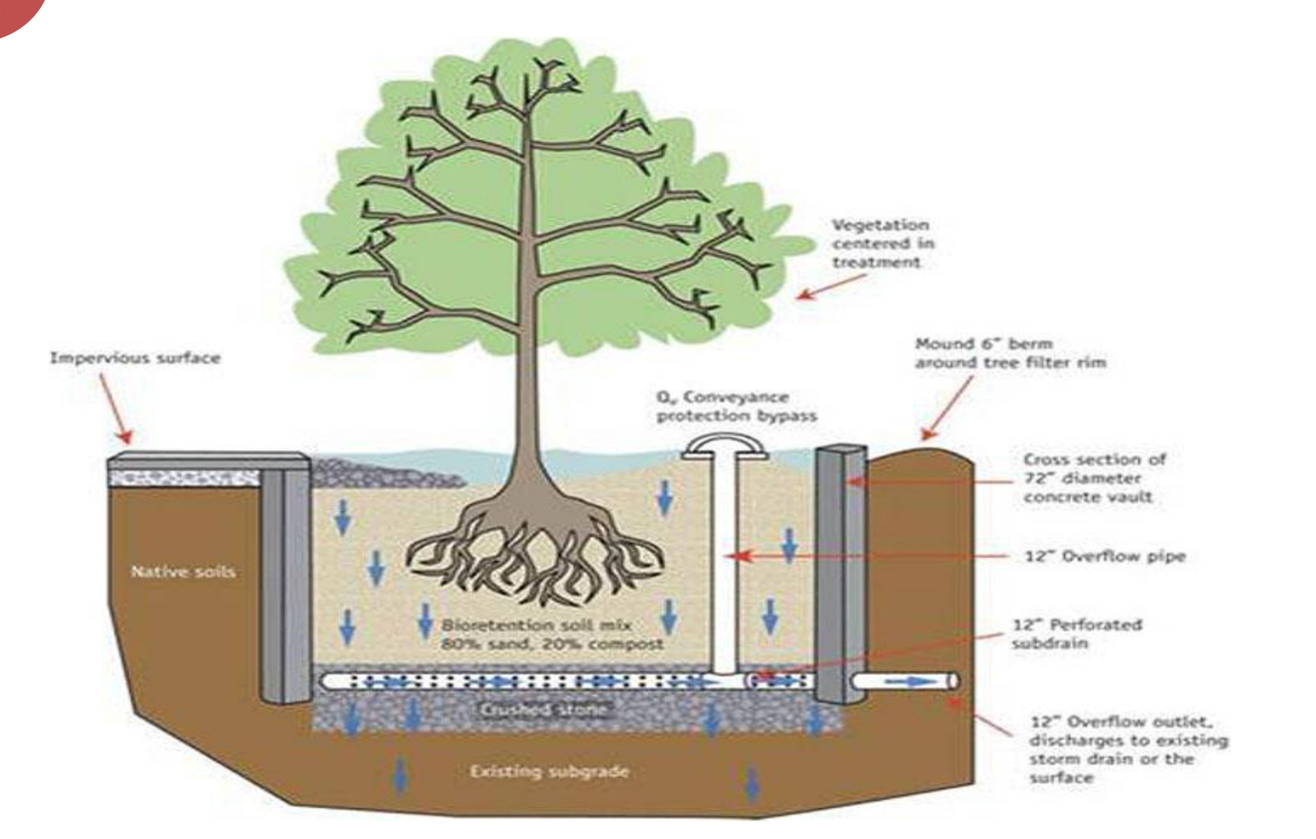
1 **BIORETENTION SYSTEMS:** Bioretention systems should be installed to intercept pathway runoff and parking lot runoff, respectively. The bioretention systems will reduce sediment and nutrient loading reaching catch basins.

2 **TREE FILTER BOXES:** Tree boxes can be installed in the parking strips to catch the first flush of stormwater and treat it prior to discharge to the storm sewer system.

1 BIORETENTION SYSTEM



2 TREE FILTER BOX



East Brunswick Police Department
Green Infrastructure Information Sheet

Location: 1 Civic Center Drive East Brunswick, NJ 08816	**Municipality:** East Brunswick **Subwatershed:** Ireland Brook
Green Infrastructure Description: bioretention system tree filter box	**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 #1: 154,726 gal. bioretention system #2: 229,287 gal. bioretention system #3: 539,345 gal. tree filter box: 260,553 gal.

Existing Conditions and Issues:

There are large amounts of impervious surfaces at this site that contribute to stormwater runoff volumes and nonpoint source pollution. Runoff is carrying nonpoint source pollution such as sediments, nutrients, oil, and grease to local waterways. The parking lots slope down toward Civic Center Drive, where runoff flows into waterways. Three grassed areas blocking the parking lot are elevated and curbed, directing the runoff through the driveways into the street. Gullying is occurring around a storm grate in the grassed area near the municipal courtyard.

Proposed Solution(s):

Bioretention systems, or rain gardens, should be installed with curb cuts in the three lawn areas between the parking lot and Civic Center Drive. These rain gardens would capture much of the runoff from the parking lot before it reaches the street. Another bioretention system should be installed in the gullied lawn area surrounding the storm grate, with the storm grate serving to capture overflow. Tree filter boxes should be installed in the strips of the parking lots that do not contain utility lines.

Anticipated Benefits:

Bioretention systems achieve estimated removal rates of 30% for TN and 60 % for TP, and may reduce TSS loadings by up to 80% (NJDEP BMP Manual). When designed to capture and infiltrate stormwater runoff from the 2-year design storm (3.3 inches of rain over 24 hours), bioretention systems will prevent approximately 95% of the TN, TP and TSS from the runoff from flowing into local waterways. Additionally, as this site is part of the central municipal complex of East Brunswick, the aesthetic enhancement of the site and educational opportunities associated with bioretention systems would likely benefit the site significantly. Tree filter boxes can be installed in the parking strips to catch the first flush of stormwater and treat it prior to discharge to the storm sewer system. The tree filter box will remove 74% TP, 68% TN, and 85% TSS from the stormwater runoff being treated.

Possible Funding Sources:

mitigation funds from local developers
NJDEP grant programs like 319(h) and 604(b)
local social and community groups

Partners/Stakeholders:

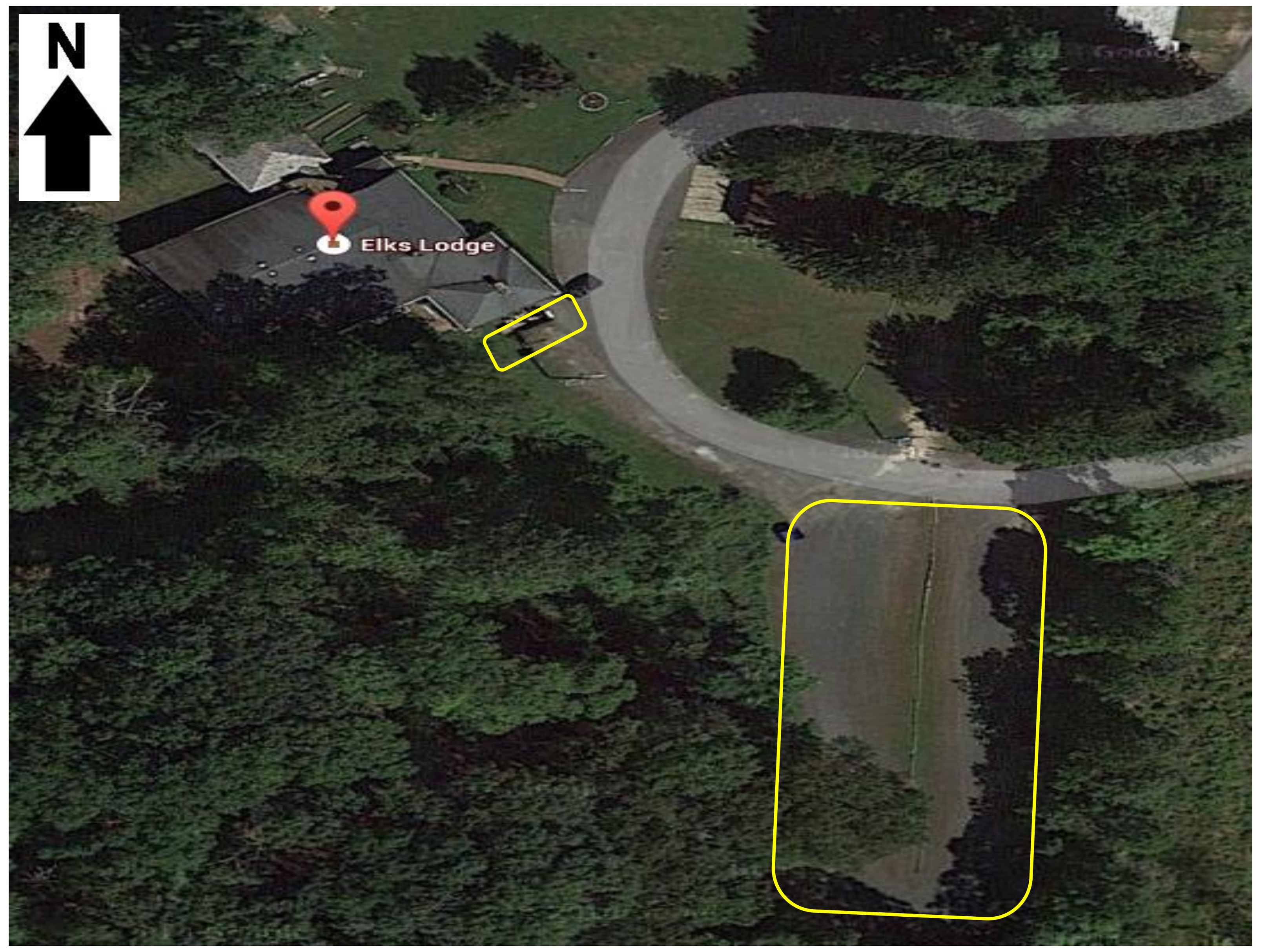
East Brunswick Township local community groups (Boy Scouts, Girl Scouts, etc.) students and parents American Littoral Society Rutgers Cooperative Extension
Estimated Cost: Rain garden #1 in the gullied lawn, around the storm grate would need to be approximately 1,475 square feet. At $5 per square foot, the estimated cost of the rain garden is $7,375. Rain garden #2 would need to be approximately 2,200 square feet. At $5 per square foot, the estimated cost of the rain garden is $11,000. Rain garden #3 would need to be approximately 5,175 square feet. At $5 per square foot, the estimated cost of the rain garden is $25,875. One tree filter box will treat 10,000 square feet of pavement and cost $7,500. The total cost of the rain gardens for this project would be approximately $51,750.

East Brunswick Township
Impervious Cover Assessment
Elks Lodge, 21B Oakmont Avenue

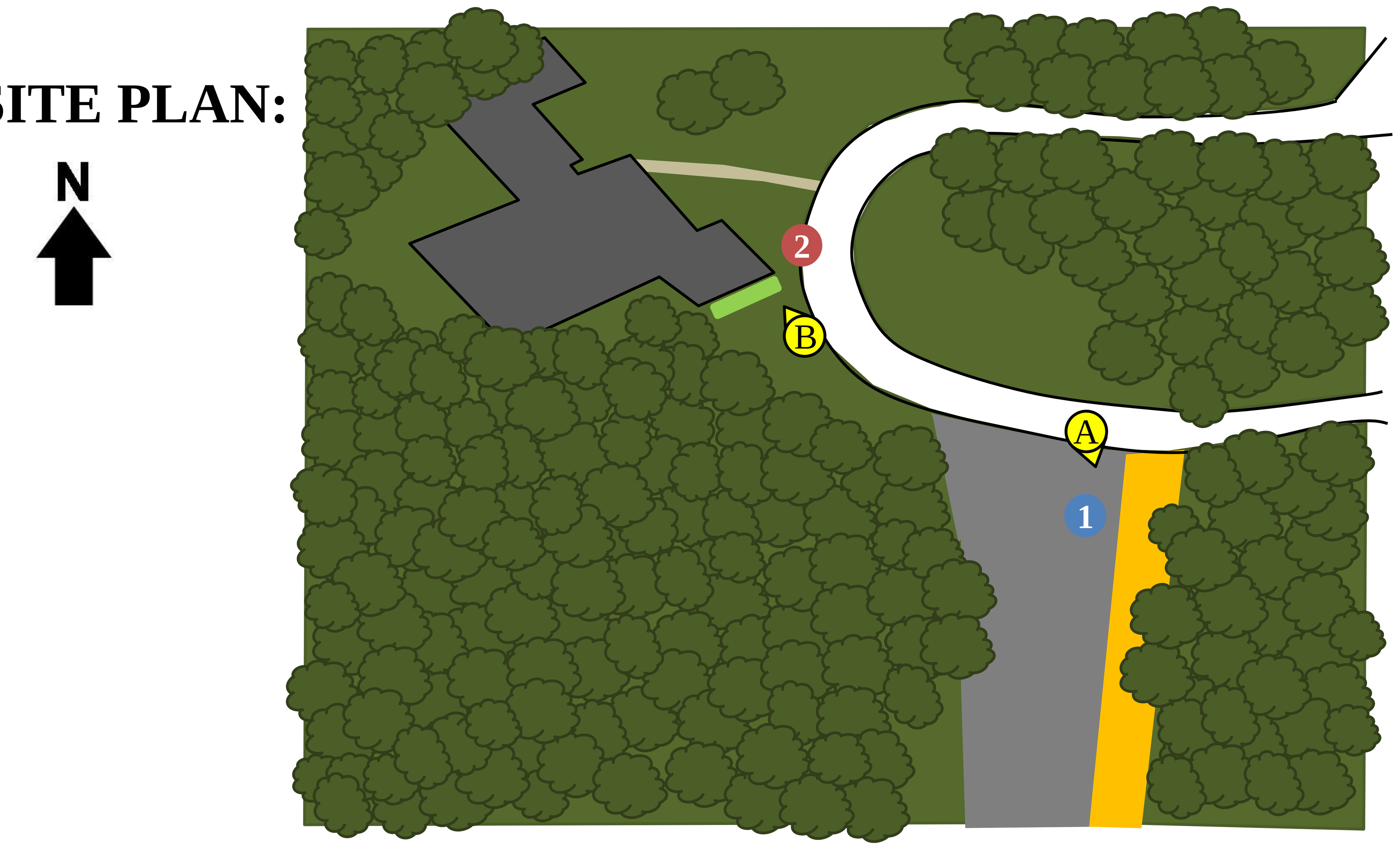
A

B

PROJECT LOCATION:



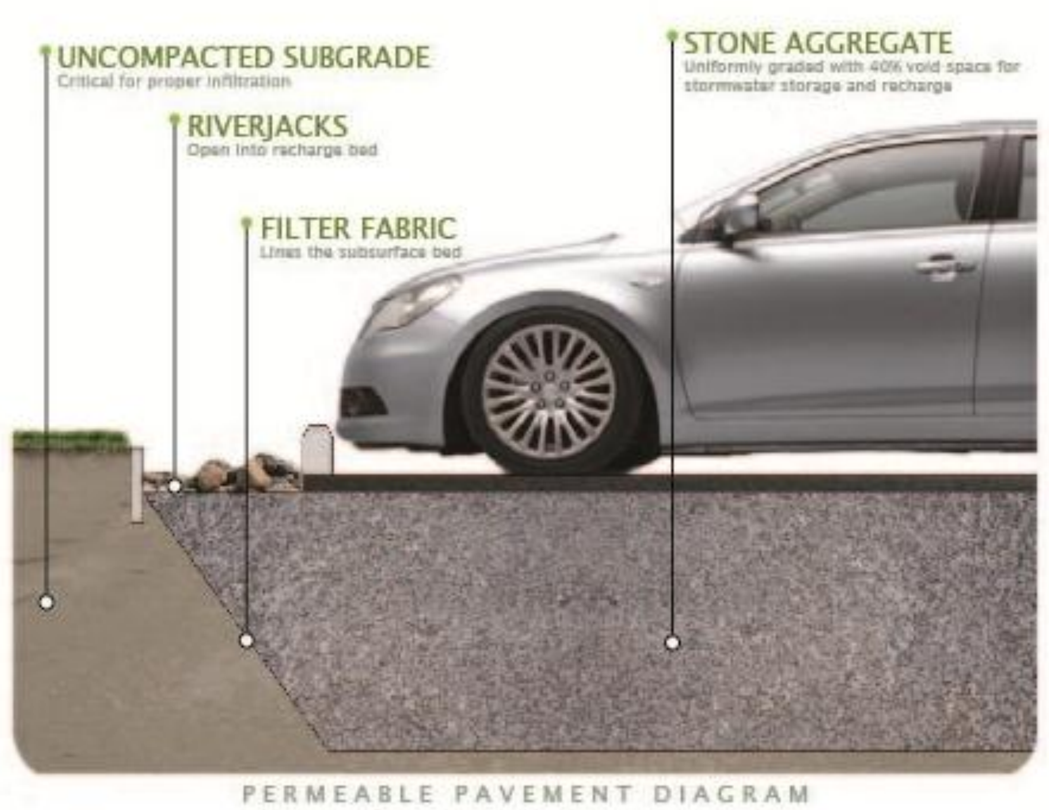
SITE PLAN:



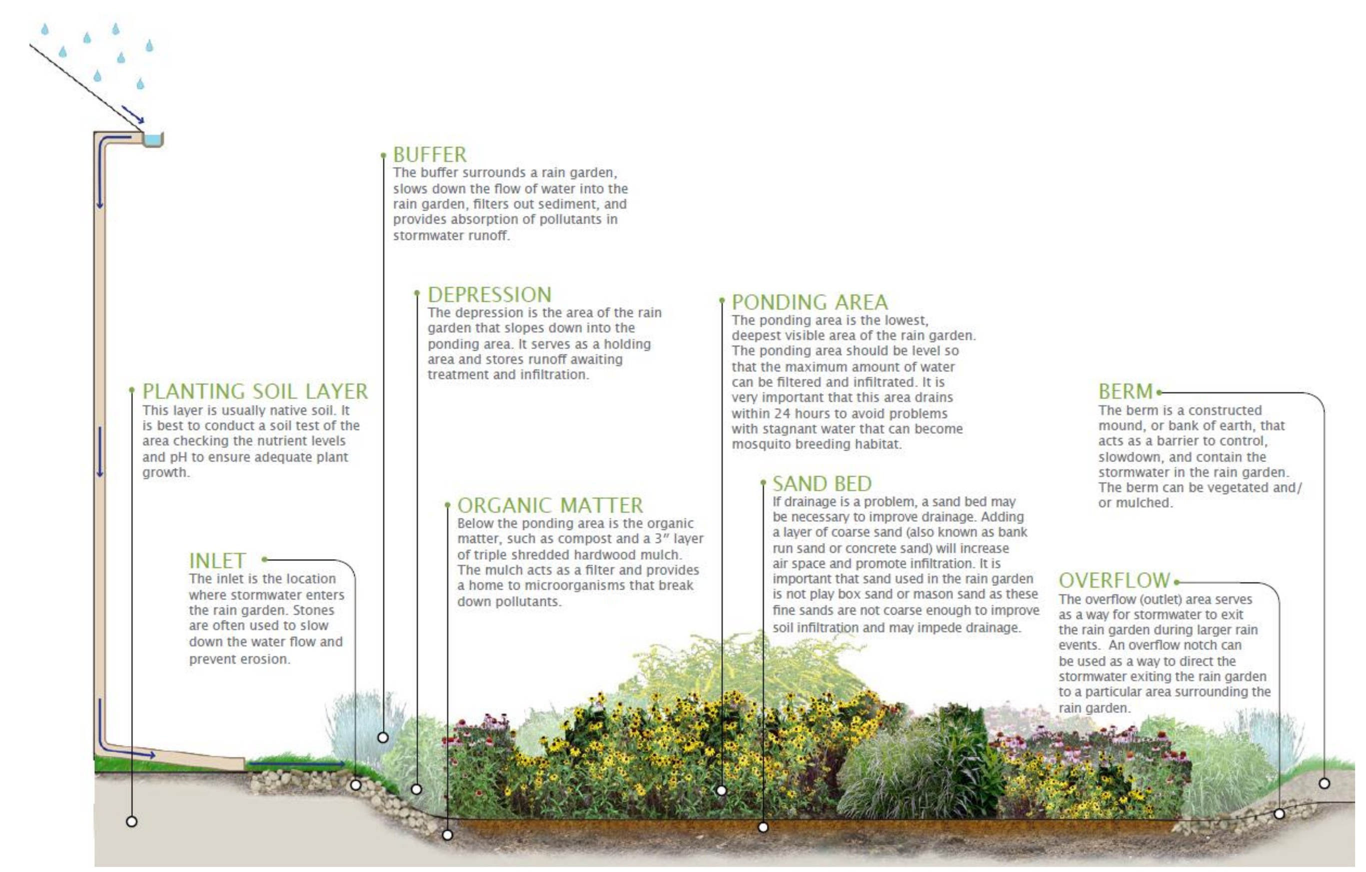
1 **POROUS ASPHALT:** Porous asphalt should be installed to capture runoff from the parking lot and driveway.

2 **BIORETENTION SYSTEM:** Downspouts should be re-directed to a bioretention system along the side of the Elks lodge to capture rooftop runoff. A bioretention system will reduce runoff and allow stormwater infiltration, decreasing the amount of contaminants that reach catch basins.

1 POROUS ASPHALT



2 BIORETENTION SYSTEM



Location: 21 B Oakmont Avenue East Brunswick, NJ	**Municipality:** East Brunswick **Subwatershed:** Lawrence Brook
Green Infrastructure Description: bioretention system porous asphalt	**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: 52,111 gal. porous asphalt: 677,516 gal.

Existing Conditions and Issues:
There are large amounts of impervious surfaces at this site that contribute to stormwater runoff volumes and nonpoint source pollution. Runoff carries nonpoint source pollution such as sediments, nutrients, oil, and grease to local waterways. A downspout directs stormwater from the roof onto the pavement of the parking lot. The parking lot is in poor condition, which could be a result of the increased volume of stormwater runoff it receives from the rooftop.

Proposed Solution(s):
The downspout, which currently drains to the parking lot, should be redirected to the lawn on the southern side of the building. A bioretention system (rain garden) should be installed in this lawn area between the building and the parking lot to capture and treat the roof stormwater, while also removing the stress this water was previously putting on the parking lot. The parking lot at the southern end of the property could further benefit from being repaved with porous asphalt. Porous asphalt would allow the water to drain under the parking spaces, and eliminate the sediment build up throughout the lot.

Anticipated Benefits:
Bioretention systems achieve estimated removal rates of 30% for TN and 60 % for TP, and may reduce TSS loadings by up to 80% (NJDEP BMP Manual). When designed to capture and infiltrate stormwater runoff from the 2-year design storm (3.3 inches of rain over 24 hours), bioretention systems will prevent approximately 95% of the TN, TP and TSS from the runoff from flowing into local waterways. The reduction in stormwater runoff on the parking lot may also help prevent further deterioration of the pavement. The porous asphalt system will achieve the same level of pollutant load reduction for TN, TP and TSS. The porous asphalt would have a one and one-half 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.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs like 319(h) and 604(b)
East Brunswick Township associations

Partners/Stakeholders:

East Brunswick Township
local community groups (Boy Scouts, Girl Scouts, etc.)
students and parents
Rutgers Cooperative Extension

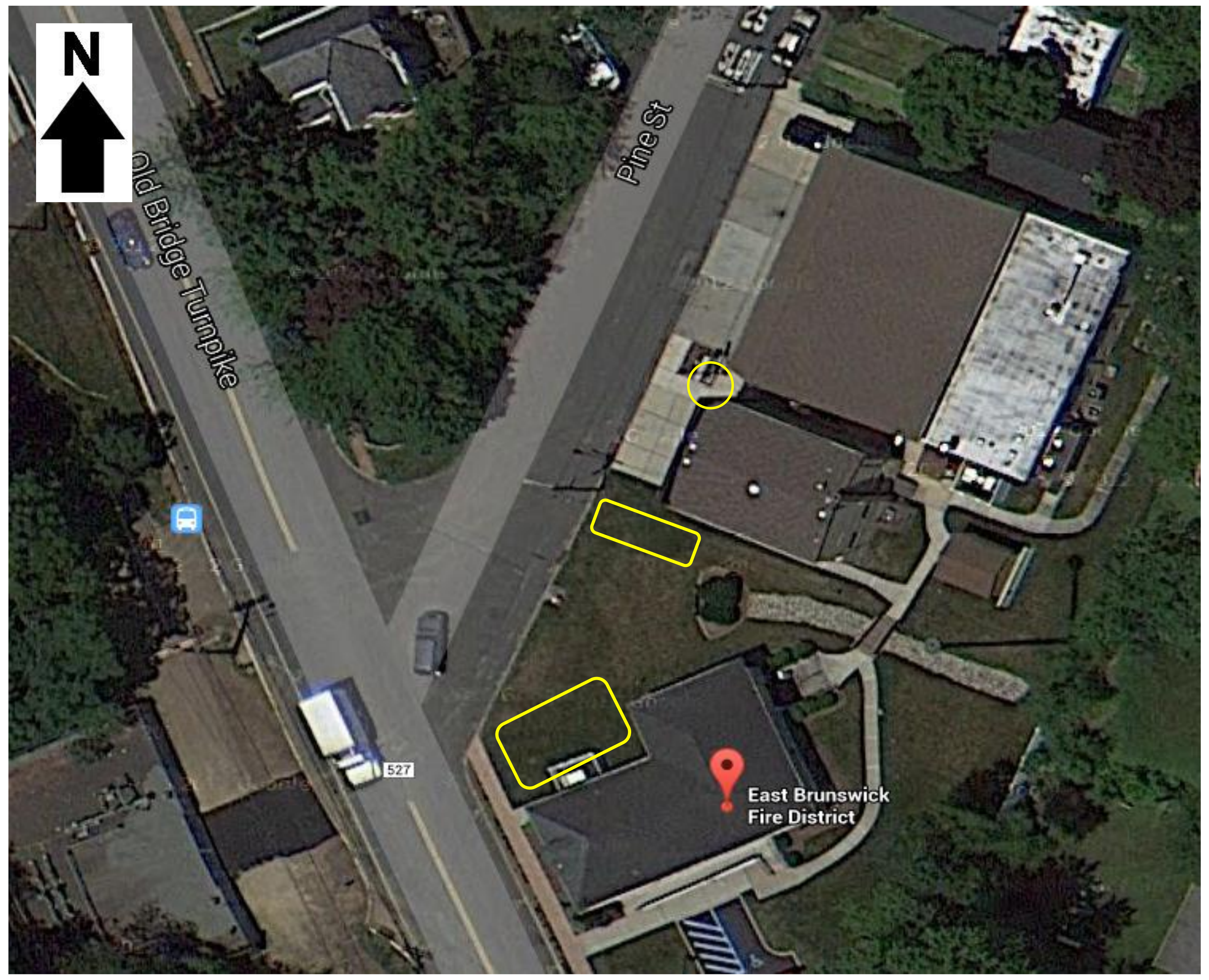
Estimated Cost:
The bioretention system would need to be approximately 500 square feet. At $5 per square foot, the estimated cost of the rain garden is $2,500. The porous asphalt would cover 8,713 square feet and have a 1.1 foot stone reservoir under the surface. At $30 per square foot, the cost of the porous asphalt system would be $261,390. The total cost of the project would be approximately $263,890.

East Brunswick Township
Impervious Cover Assessment
Old Bridge Volunteer Fire Company & Board of Fire Commissioners, 680 Old Bridge Turnpike

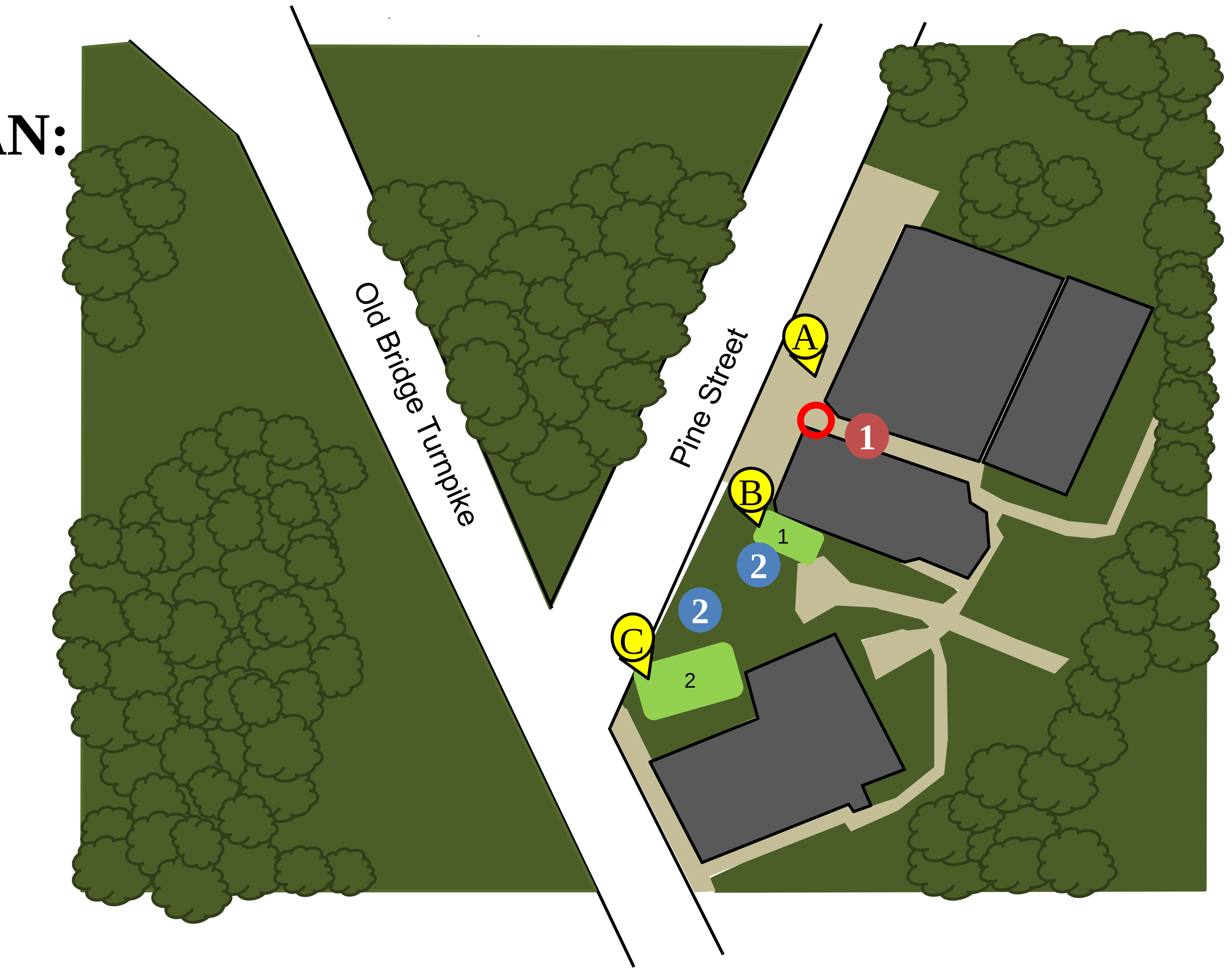
A

B

PROJECT LOCATION:



SITE PLAN:



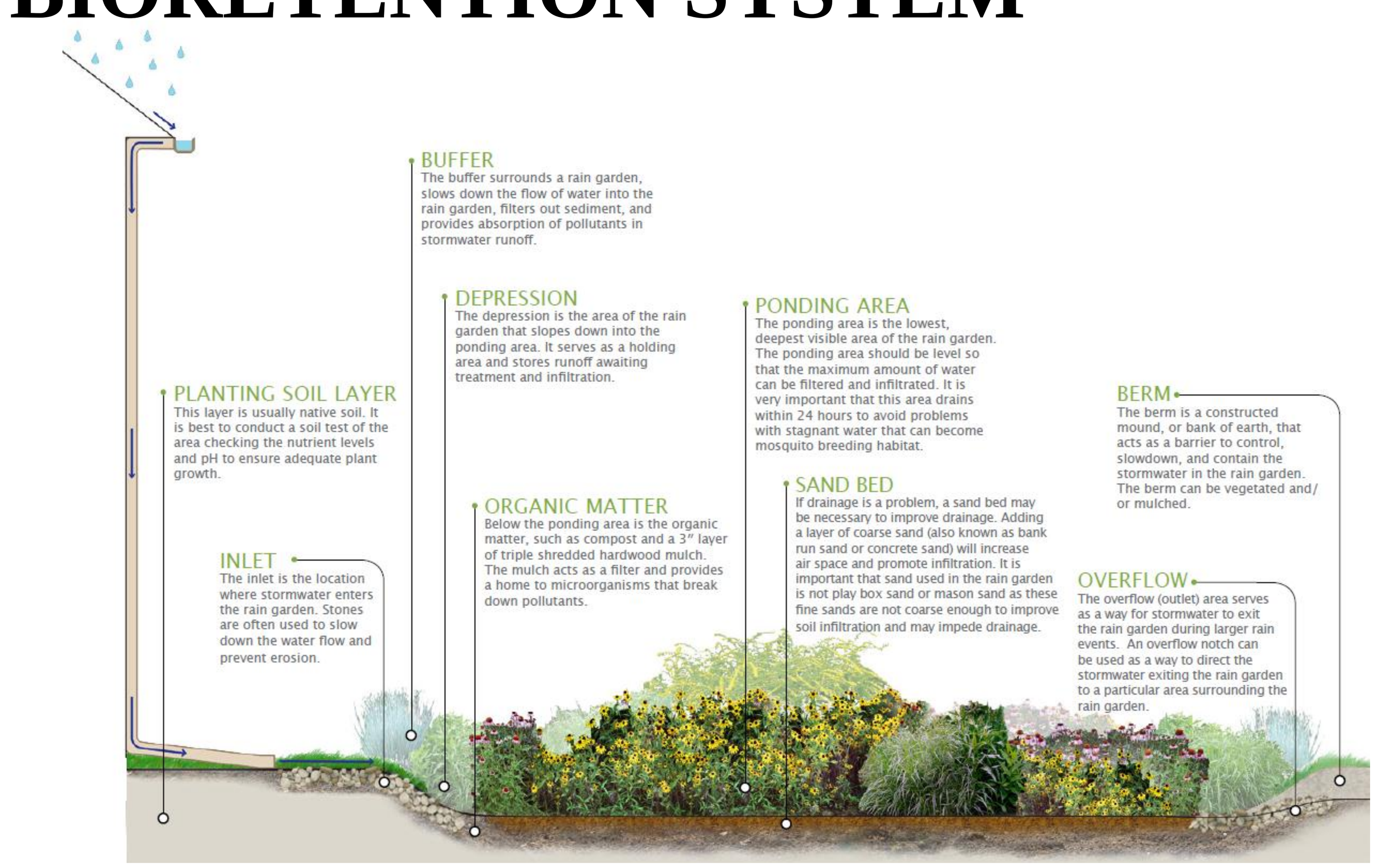
C

1 **RAINWATER HARVESTING SYSTEM:** Rainwater will be harvested from the roof of the building and stored in cisterns. The water will be used to wash the fire trucks.

2 **BIORETENTION SYSTEMS:** Bioretention systems should be installed to intercept pathway runoff and parking lot runoff, respectively. The bioretention systems will reduce sediment and nutrient loading reaching catch basins.

1 RAINWATER HARVESTING SYSTEM

2 BIORETENTION SYSTEM



Location: 680 Old Bridge Turnpike East Brunswick, NJ 08816	**Municipality:** East Brunswick **Subwatershed:** South River
Green Infrastructure Description: bioretention systems (rain garden) cistern	**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 #1: 7,817 gal. bioretention system #2: 19,932 gal. cistern: 13,430 gal.

Existing Conditions and Issues:
There are large amounts of impervious surfaces at this site that contribute to stormwater runoff volumes and nonpoint source pollution. Runoff is carrying nonpoint source pollution such as sediments, nutrients, oil, and grease to local waterways. Directly connected downspouts around the Fire Company building and the Board of Fire Commissioners building directs roof stormwater runoff directly into local waterways.

Proposed Solution(s):
The connected downspout in front of the Fire Company garage could be disconnected and rerouted into a cistern. The cistern would collect the water from the roof for use by the fire company or municipality for purposes such as washing vehicles and gardening. The connected downspouts on the side of the Fire Company building and the Board of Fire Commissioners building could be disconnected and redirected into bioretention systems.

Anticipated Benefits:
The disconnection of the roof runoff into a cistern provides a system for harvesting rainwater. This water could be used for washing vehicles and equipment as well as potential other purposes, therefore reducing the use of potable water. Additionally, some of the water used from the cistern can be allowed to infiltrate into the ground naturally, promoting groundwater recharge. Rainwater will be harvested from the roof of the building and stored in cisterns. The water will be used to wash the fire trucks. 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 attraction.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs like 319(h) and 604(b)
local social and community groups

Partners/Stakeholders:
East Brunswick Township
local community groups (Boy Scouts, Girl Scouts, etc.)
students and parents

American Littoral Society Rutgers Cooperative Extension
Estimated Cost: The cistern would have a volume of 3,000 gallons. The cistern would cost approximately $6,000. Bioretention system 1 would be 300 square feet. At $5 per square foot, it would cost $1,500. Bioretention system 2 would be 765 square feet. At $5 per square foot, it would cost $3,825. The total project cost would be $11,325.