



**Impervious Cover Assessment  
For  
Woodstown Borough, Salem County, New Jersey**

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

November 11, 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, and 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 cart ways could be converted to one-way cart 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

### **Woodstown Borough Impervious Cover Analysis**

Located in Salem County, New Jersey, Woodstown Borough covers just over 1.5 square miles in southern New Jersey. Figures 3 and 4 illustrate that Woodstown Borough is dominated by urban land uses. A total of 66.1% of the municipality's land use is classified as urban. Of the urban land in Woodstown 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 streams 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 Woodstown 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 Woodstown Borough. Based upon the 2007 NJDEP land use/land cover data, approximately 20.7% of Woodstown Borough has impervious cover. This level of impervious cover suggests that the streams in Woodstown Borough are likely impacted.

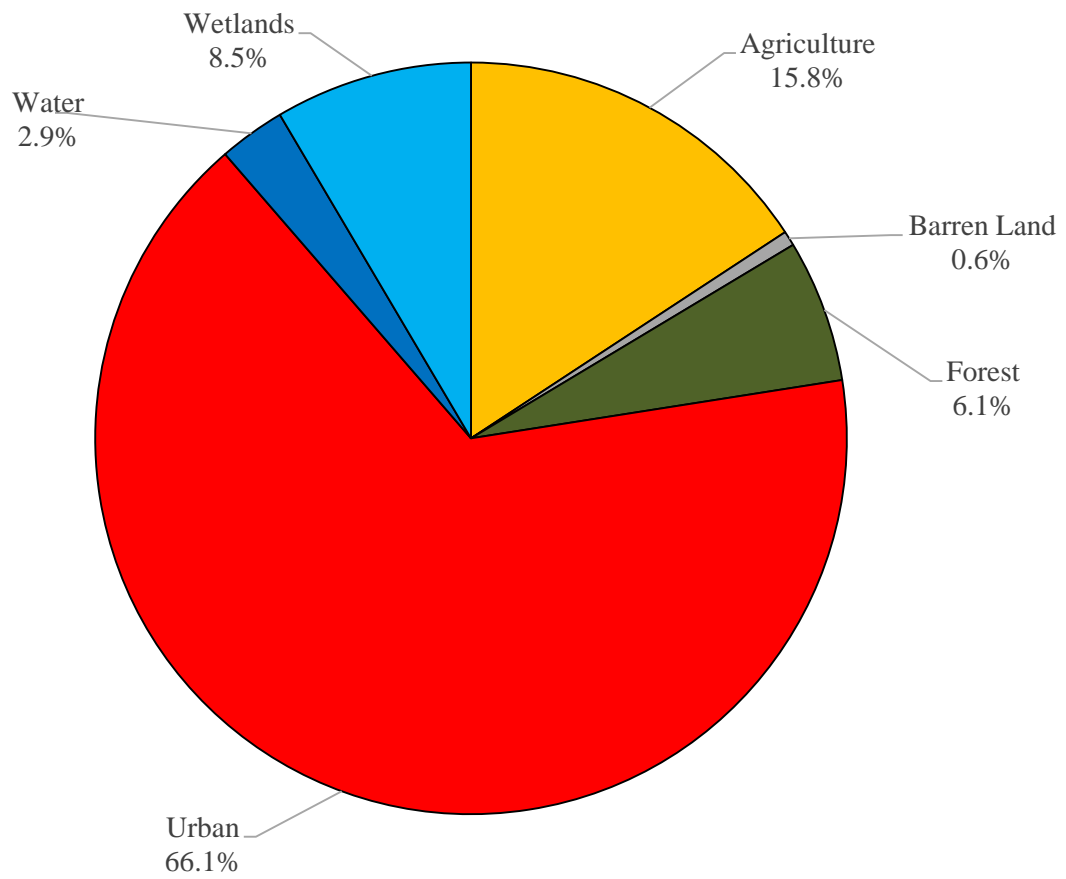


Figure 3: Pie chart illustrating the land use in Woodstown Borough

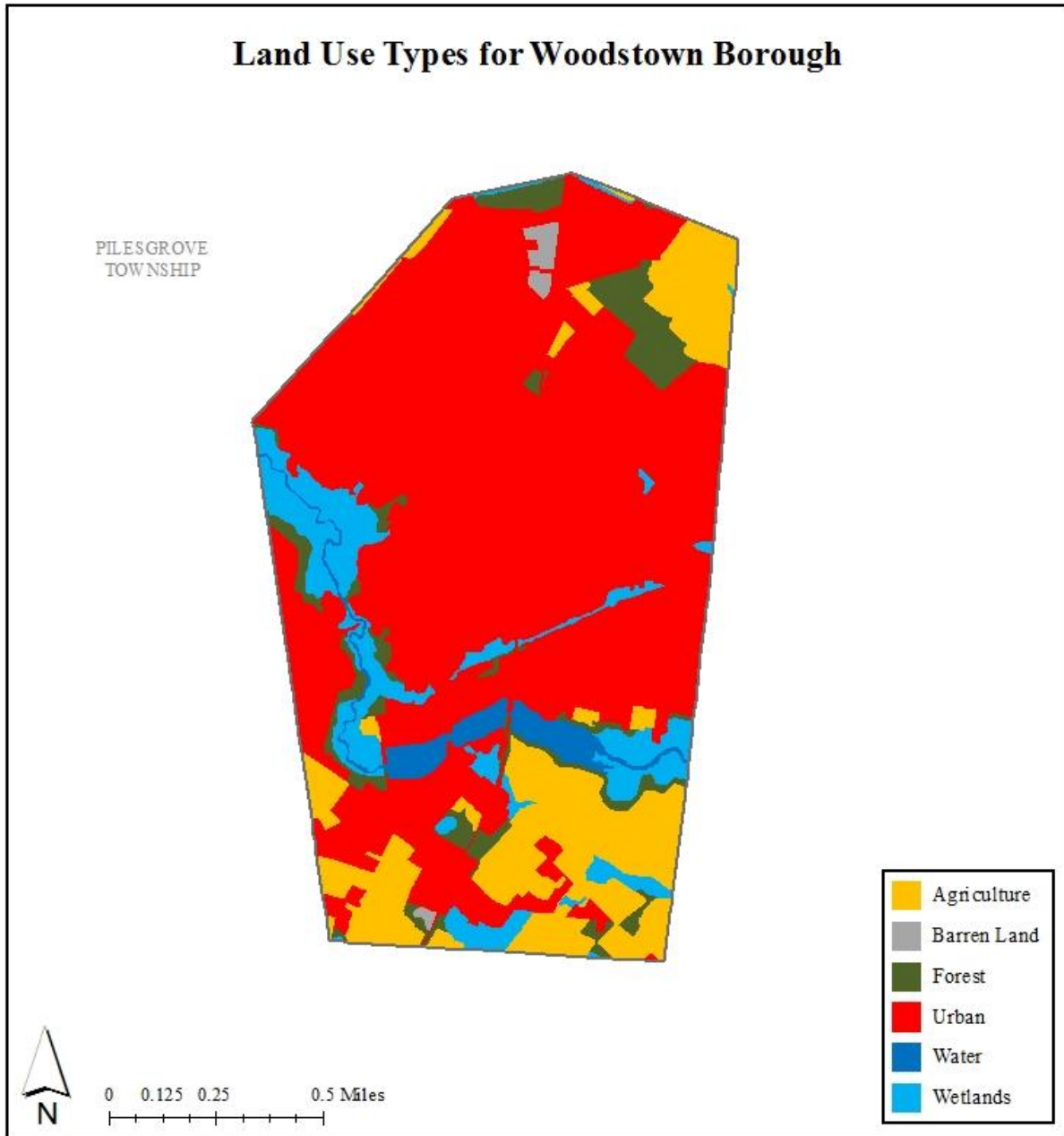


Figure 4: Map illustrating the land use in Woodstown Borough

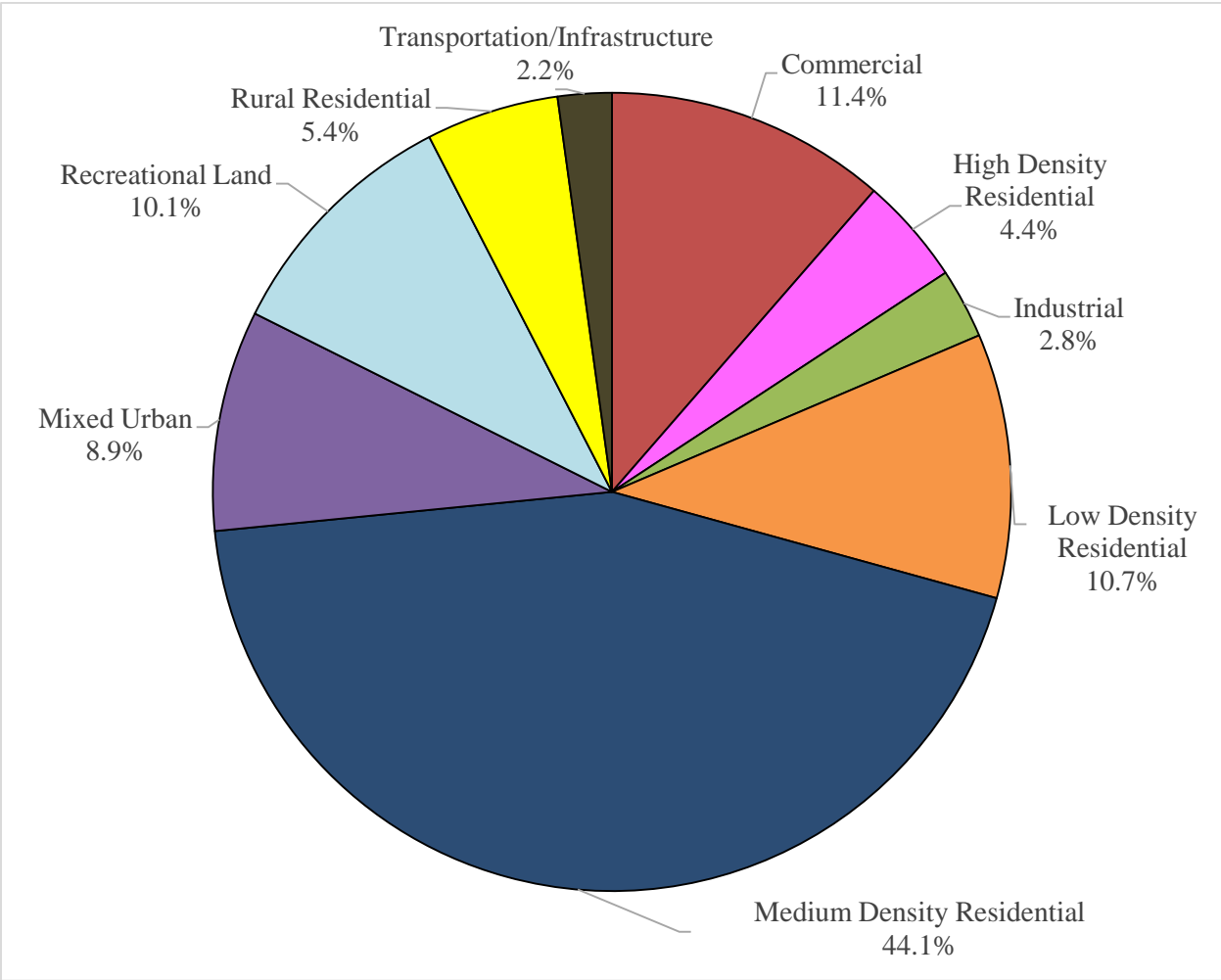


Figure 5: Pie chart illustrating the various types of urban land use in Woodstown Borough



Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each watershed within Woodstown Borough (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 9.7% in the Nichomus River subwatershed to 21.9% in the Salem River 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 Woodstown Borough, Salem 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 (5.0 inches of rain), and the 100-year design storm (8.5 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater drains from impervious surfaces in Woodstown Borough. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Salem River subwatershed was harvested and purified, it could supply water to 61 homes for a year<sup>1</sup>.

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<sup>1</sup> Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for Woodstown Borough

Subwatershed	Total Area		Land Use Area		Water Area		Impervious Cover		
	(ac)	(mi <sup>2</sup> )	(ac)	(mi <sup>2</sup> )	(ac)	(mi <sup>2</sup> )	(ac)	(mi <sup>2</sup> )	(%)
Nichomus Run	98.46	0.15	98.11	0.15	0.34	0.00	9.48	0.01	9.66%
Salem River	936.19	1.46	906.60	1.42	29.59	0.05	198.69	0.31	21.92%
TOTAL	1,034.65	1.62	1,004.71	1.57	29.94	0.05	208.17	0.33	20.72%

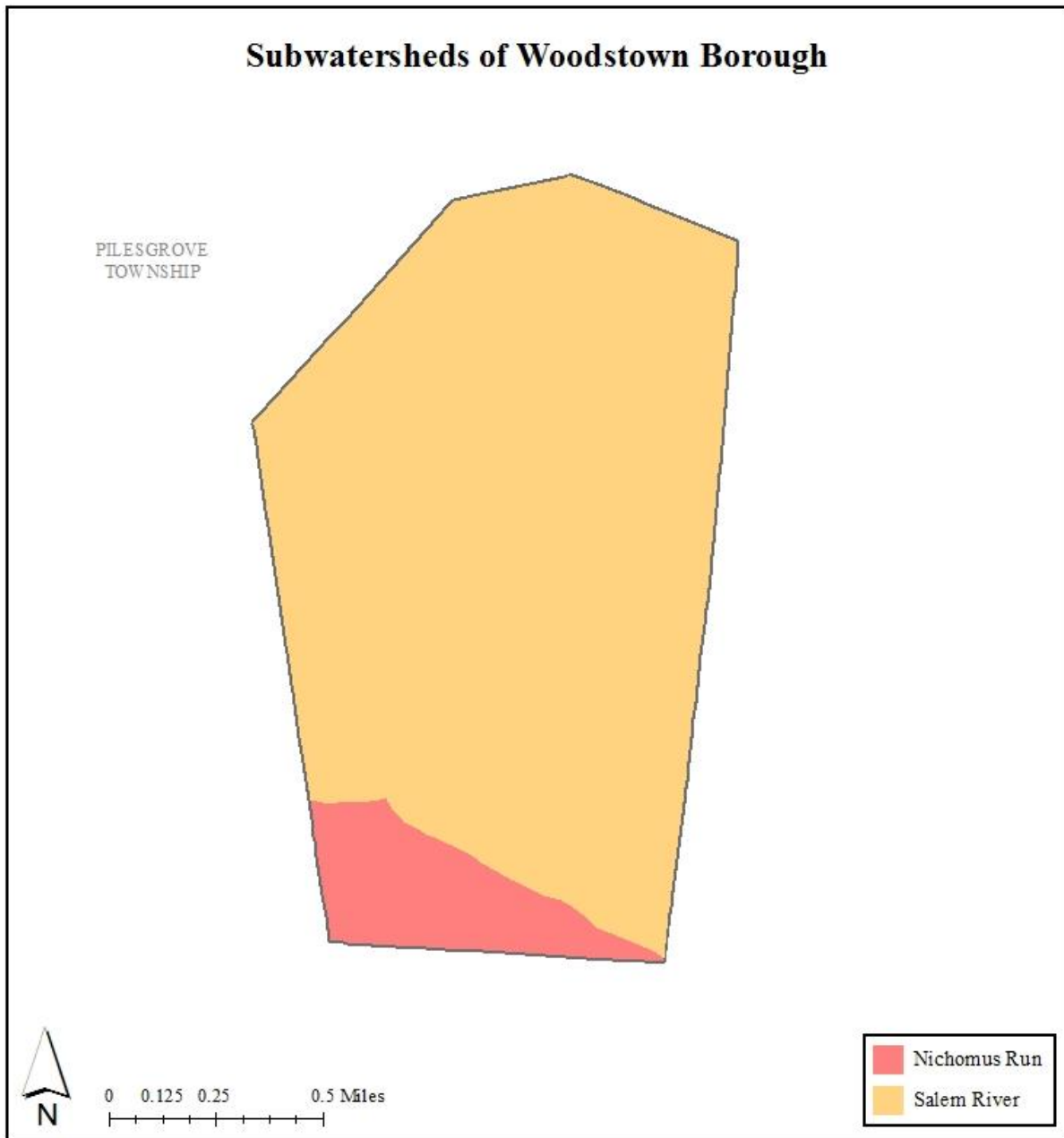


Figure 6: Map of the subwatersheds in Woodstown Borough

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

<b>Subwatershed</b>	<b>Total Runoff Volume for the 1.25" NJ Water Quality Storm (MGal)</b>	<b>Total Runoff Volume for the NJ Annual Rainfall of 44" (MGal)</b>	<b>Total Runoff Volume for the 2-Year Design Storm (3.3") (MGal)</b>	<b>Total Runoff Volume for the 10-Year Design Storm (5.1") (MGal)</b>	<b>Total Runoff Volume for the 100-Year Design Storm (8.6") (MGal)</b>
Nichomus River	0.32	11.35	0.85	1.29	2.19
Salem River	6.75	237.75	17.83	27.02	45.93
<b>TOTAL</b>	<b>7.08</b>	<b>249.10</b>	<b>18.68</b>	<b>28.31</b>	<b>48.12</b>

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 Woodstown 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, there 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 Woodstown Borough

<b>Subwatershed</b>	<b>Recommended Impervious Area Reduction (10%) (ac)</b>	<b>Annual Runoff Volume Reduction <sup>2</sup> (MGal)</b>
Salem River	19.9	22.6
Nichomus River	0.95	1.1
TOTAL	20.85	23.7

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<sup>2</sup> Annual Runoff Volume Reduction =

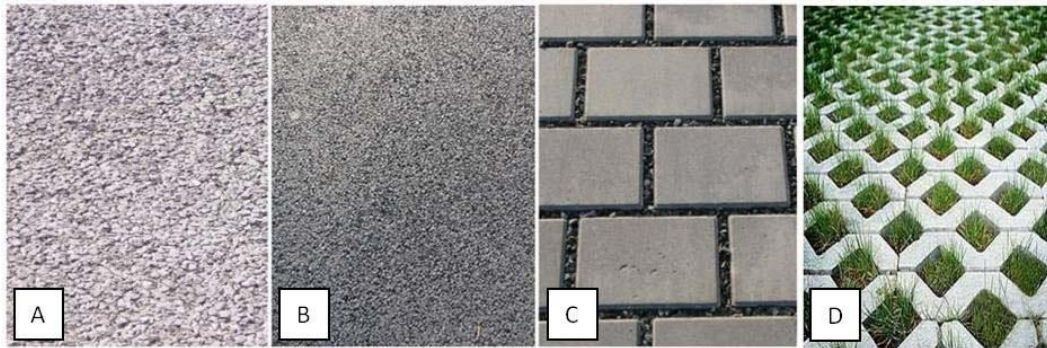
Acres of impervious cover x 43,560 ft<sup>2</sup>/ac x 44 in x (1 ft/12 in) x 0.95 x (7.48 gal/ft<sup>3</sup>) x (1 MGal/1,000,000 gal)

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 and treat 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 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 Woodstown 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 Woodstown 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**

Woodstown 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**

Arnold, C.L. Jr. and C.J. Gibbons. 1996. Impervious Surface Coverage The Emergence of a Key Environmental Indicator. *Journal of the American Planning Association* 62(2): 243-258.

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

May, C.W., R.R. Horner, J.R. Karr, B.W. Mar, E.G. Welch. 1997. Effects of Urbanization on Small Streams in the Puget Sound Lowland Ecoregion. *Watershed Protection Techniques* 2(4): 483-493.

Nowak, D. J., and E. J. Greenfield, 2012. Trees and Impervious Cover in the United States. *Landscape and Urban Planning* 107 (2012): 21-30.  
[http://www.nrs.fs.fed.us/pubs/jrnl/2012/nrs\\_2012\\_nowak\\_002.pdf](http://www.nrs.fs.fed.us/pubs/jrnl/2012/nrs_2012_nowak_002.pdf)

Rowe, A., 2012. Green Infrastructure Practices: An Introduction to Permeable Pavement. Rutgers NJAES Cooperative Extension, FS1177, pp. 4.  
<http://njaes.rutgers.edu/pubs/publication.asp?pid=FS1177>

Schueler, T. 1994. The Importance of Imperviousness. *Watershed Protection Techniques* 1(3): 100-111.

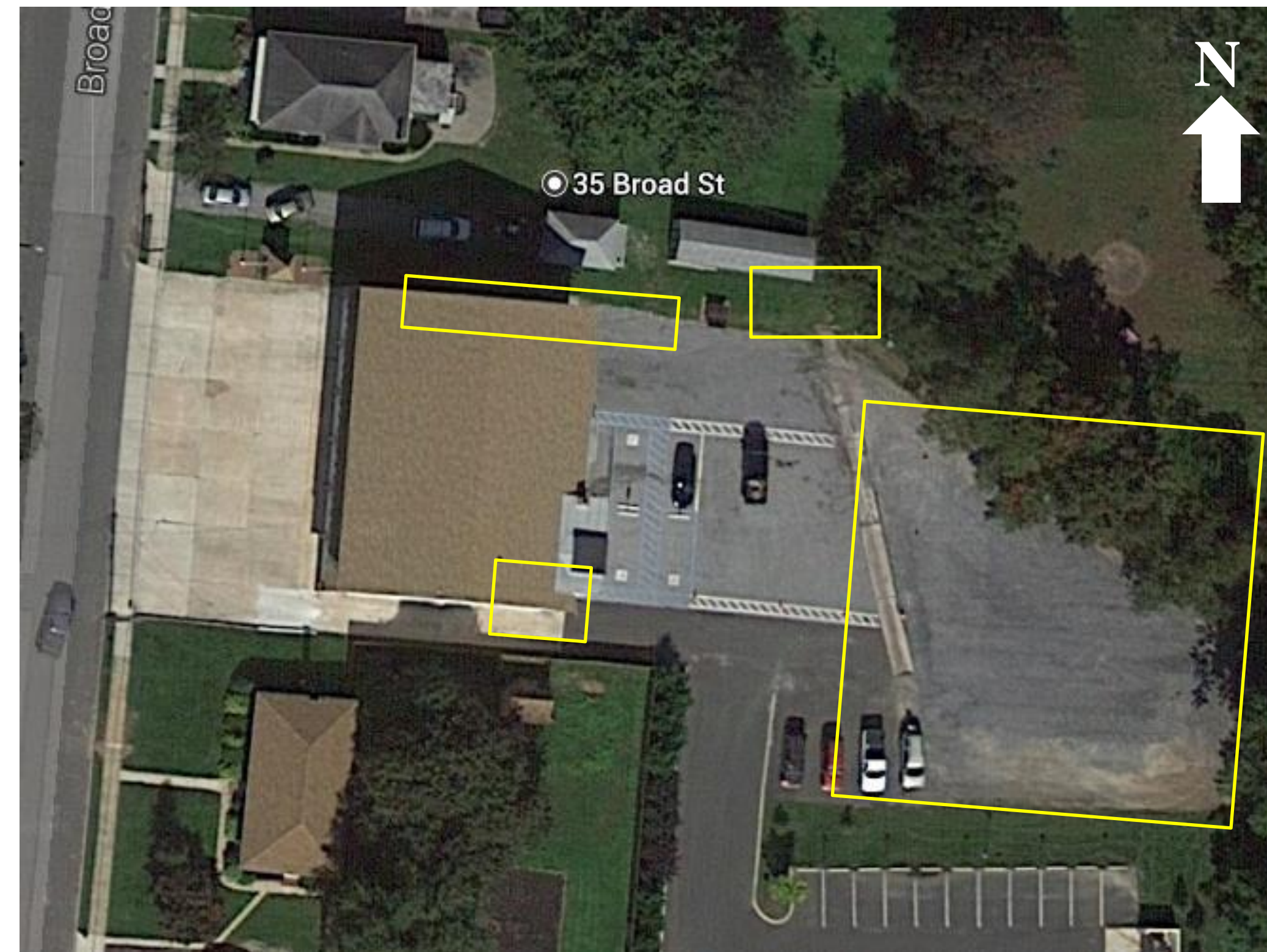
United States Environmental Protection Agency (USEPA), 2013. Watershed Assessment, Tracking, and Environmental Results, New Jersey Water Quality Assessment Report.  
[http://ofmpub.epa.gov/waters10/attains\\_state.control?p\\_state=NJ](http://ofmpub.epa.gov/waters10/attains_state.control?p_state=NJ)

## **Appendix A**

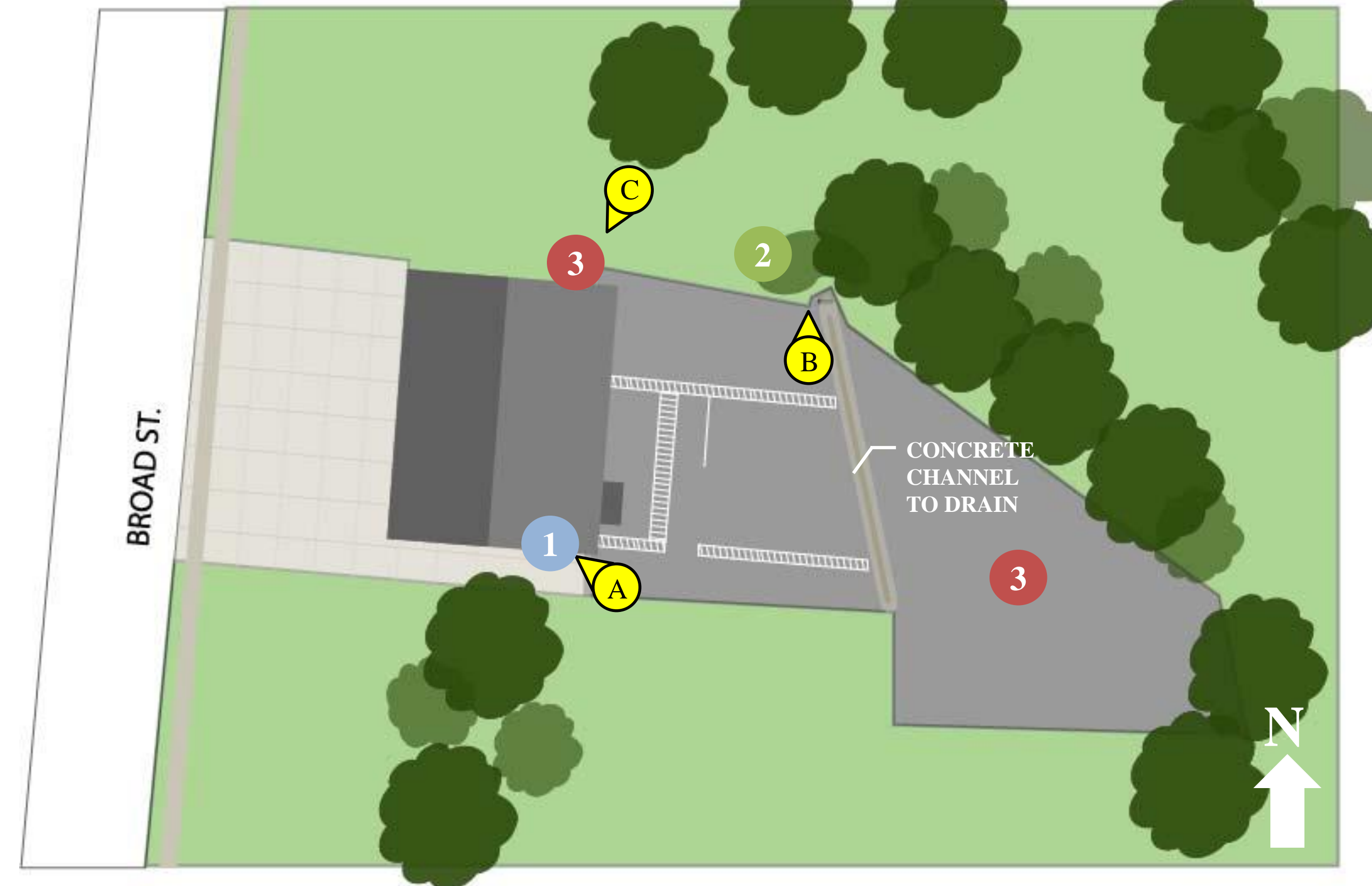
### **Examples of Impervious Cover Reduction Action Plan Projects Concept Plans and Detailed Green Infrastructure Information Sheets**

Woodstown, New Jersey  
 Impervious Cover Assessment  
*Reliance Fire Company, 35 Broad St.*

**PROJECT LOCATION:**



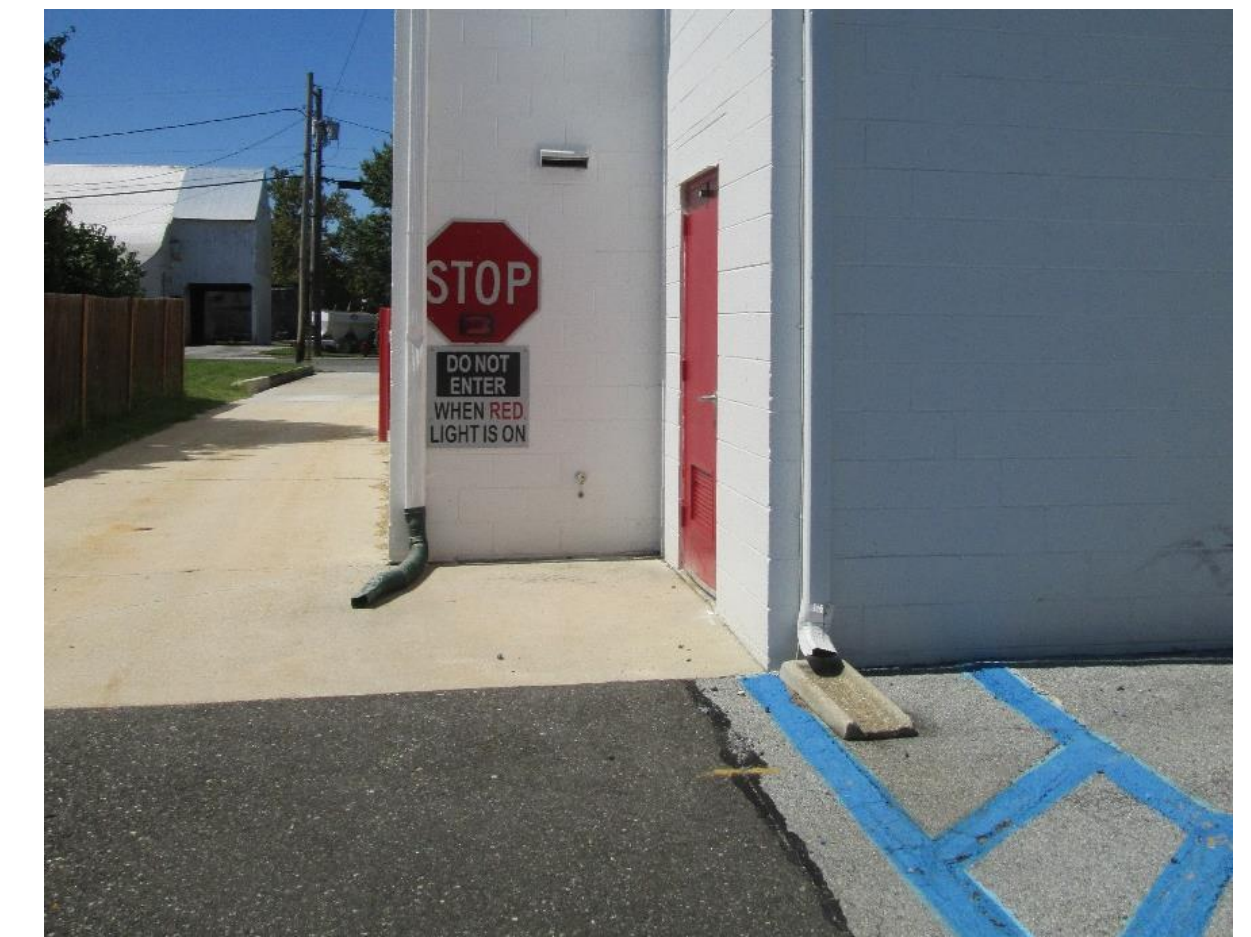
**SITE PLAN:**



A

B

C

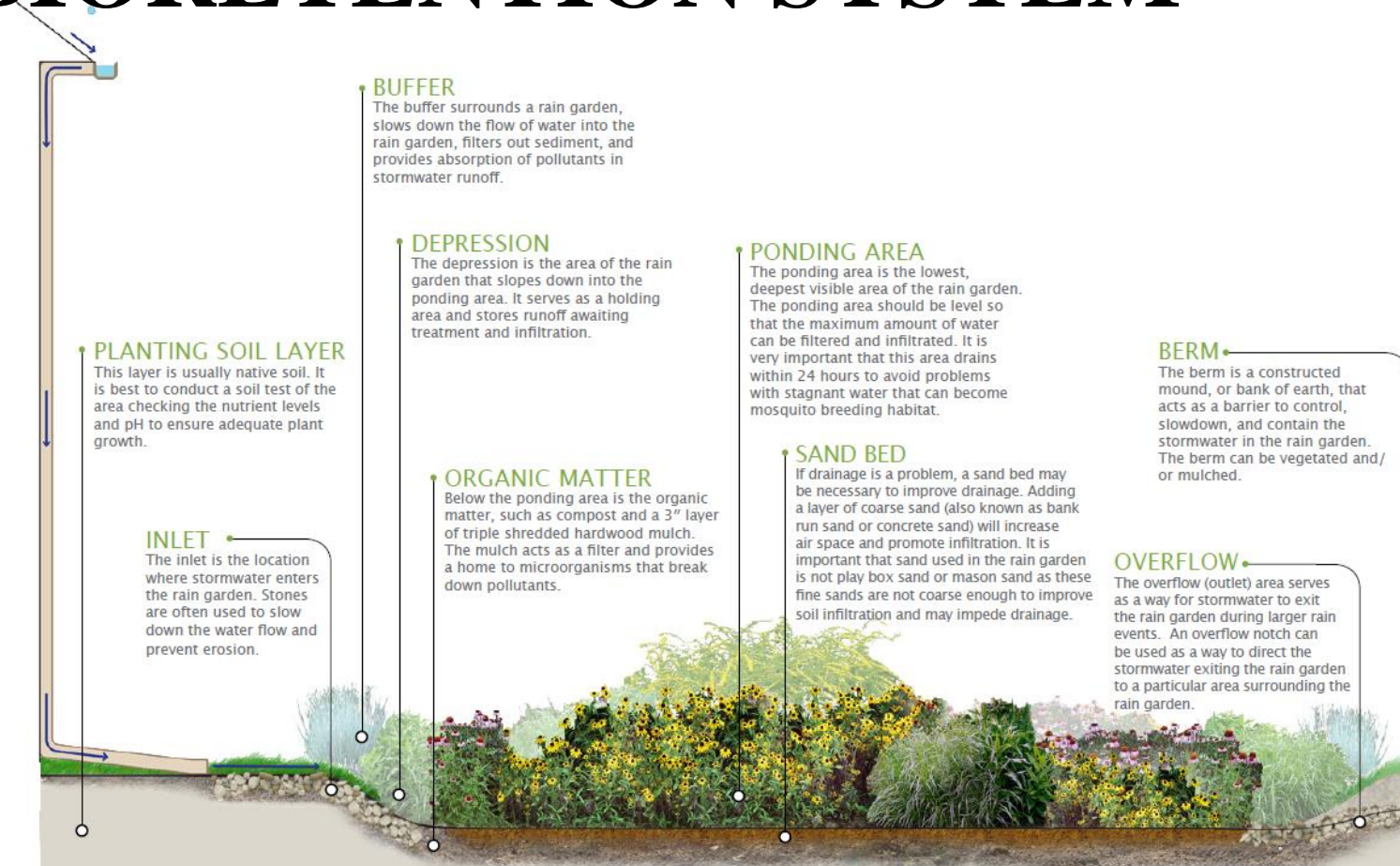


- 1 **RAINWATER HARVESTING SYSTEM:** Rainwater can be harvested from the roof of the building and stored in cisterns. The water can be used to wash the fire trucks.
- 2 **BIORETENTION SYSTEM:** A bioretention system could be installed to capture stormwater runoff from the parking lot. The bioretention system will reduce sediment and nutrient loading to the local waterway.
- 3 **GRASS PAVERS:** Grass pavers promote groundwater recharge and filters stormwater.

**1 RAINWATER HARVESTING SYSTEM**



**2 BIORETENTION SYSTEM**



**3 GRASS PAVERS**



Reliance Fire Company  
Green Infrastructure Information Sheet

<p><b>Location:</b> 35 Broad Street Woodstown, NJ 08098</p>	<p><b>Municipality:</b> Woodstown</p>
<p><b>Green Infrastructure Description:</b> rainwater harvesting system bioretention system (rain garden) grass pavers</p>	<p><b>Subwatershed:</b> Salem River</p>
<p><b>Green Infrastructure Description:</b> rainwater harvesting system bioretention system (rain garden) grass pavers</p>	<p><b>Targeted Pollutants:</b> total nitrogen (TN), total phosphorous (TP), total suspended solids (TSS) in surface runoff</p>
<p><b>Mitigation Opportunities:</b> recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes</p>	<p><b>Stormwater Captured and Treated Per Year:</b> rainwater harvesting system: 35,792 gal. bioretention system: 136,791 gal. grass pavers: 196,066 gal.</p>
<p><b>Existing Conditions and Issues:</b> On the side of the building there are two disconnected downspouts adjacent to a small turf grass area. At the back of the building there are two disconnected downspouts which lead into the back parking lot. The back parking lot is in poor condition and very eroded. There is a channel in the middle of the lot that leads into a drain at the back of the lot.</p>	
<p><b>Proposed Solution(s):</b> On the southern side of the building a cistern could be installed to collect rainwater from the disconnected downspouts, reducing the water volume into the parking lot. On the north side, grass pavers can be put in by the side door along the path and along the path past the stairs. This grass paver strip will help manage stormwater runoff from the building rooftop. A bioretention system can be installed next to the grass pavers. The back parking lot could be replaced with grass pavers to evenly distribute the water in the lot and reduce the volume of water into the back drain.</p>	
<p><b>Anticipated Benefits:</b> A rainwater harvesting system will harvest rainwater from the roof of the building and store it in cisterns, which can be used for watering plants and washing the fire trucks. Since the bioretention system would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), this system is 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 and aesthetic appeal to the community. The grass pavers 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.</p>	
<p><b>Possible Funding Sources:</b> mitigation funds from local developers NJDEP grant programs like 319(h) Woodstown Borough</p>	
<p><b>Partners/Stakeholders:</b> Woodstown residents and parishioners local community groups (Boy Scouts, Girl Scouts, etc.)</p>	

Reliance Fire Company  
Green Infrastructure Information Sheet

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American Littoral Society  
Rutgers Cooperative Extension

**Estimated Cost:**

The cistern would be 3,000 gallons and cost approximately \$6,000 to purchase and install. A rain garden to capture the parking lot runoff would need to be approximately 1,300 square feet. At \$5 per foot, the estimated cost of the rain garden is \$6,500. The grass pavers will cover approximately 5,500 square feet and cost approximately \$82,500. The total cost of the project would be approximately \$95,000.

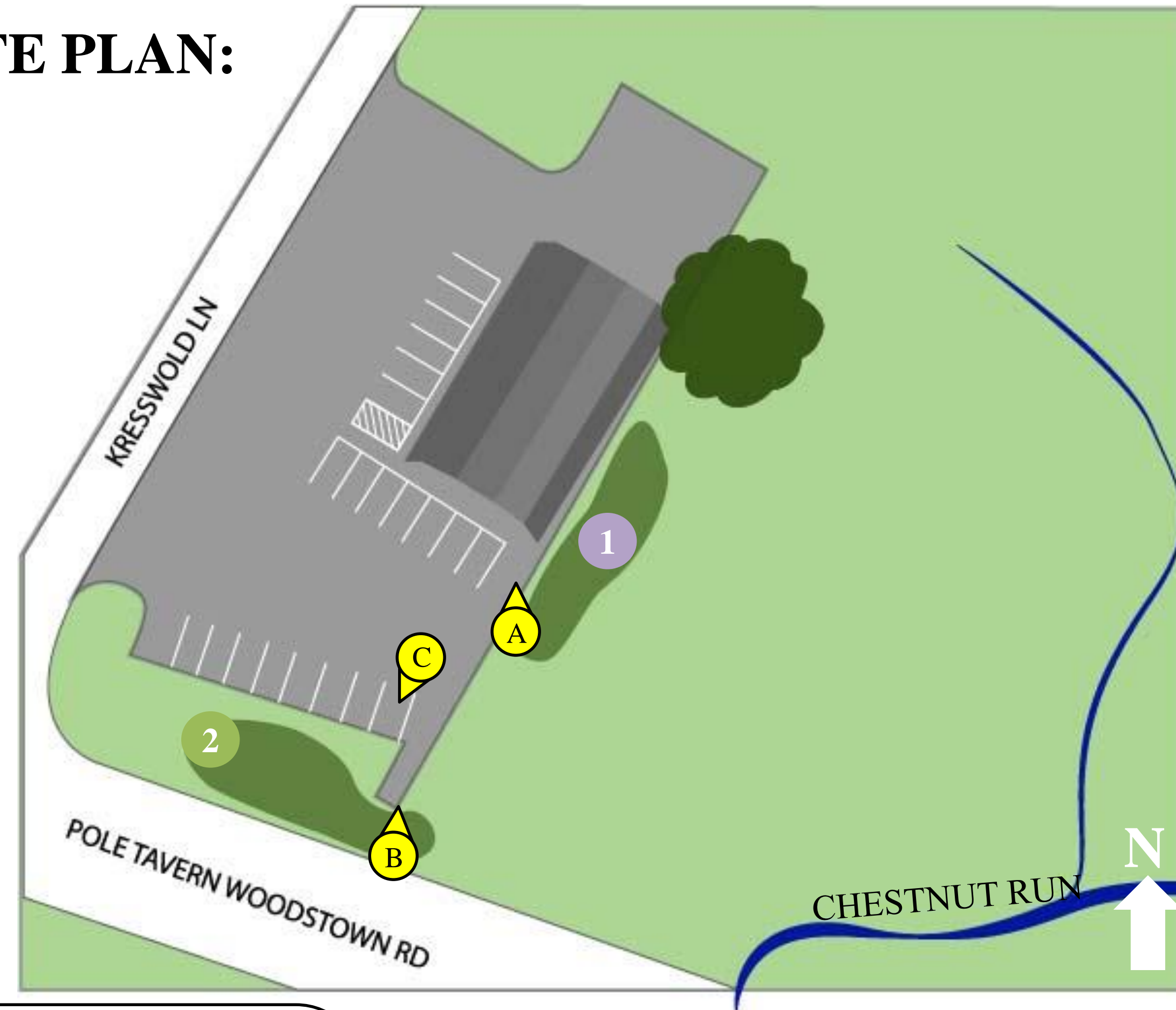
# Woodstown, New Jersey Impervious Cover Assessment

*Heritage's Dairy Stores, 199 Pole Tavern Woodstown Rd.*

## PROJECT LOCATION:



## SITE PLAN:



A



B



C

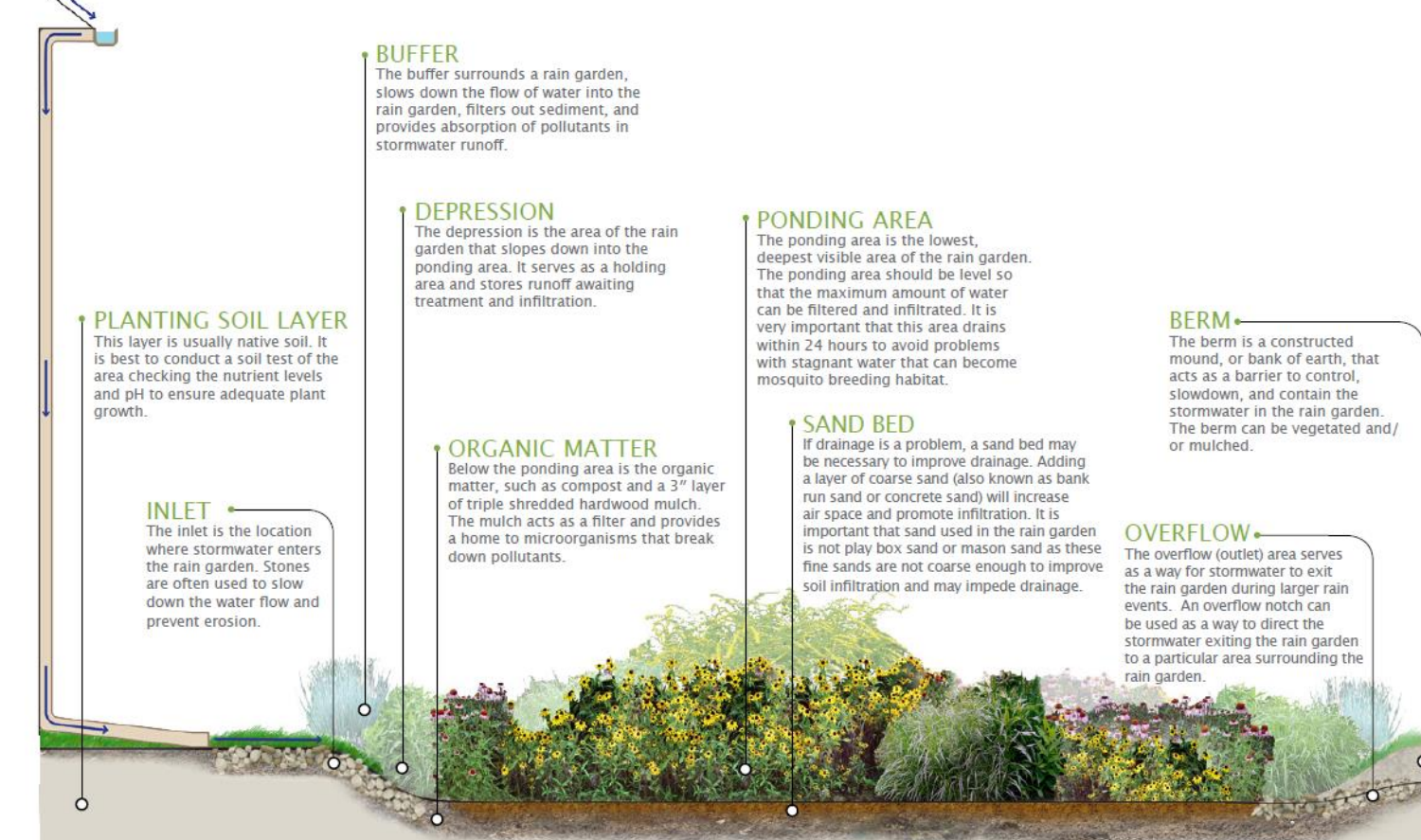


- 1 **BIOSWALE:** A bioswale could be installed to treat runoff from the parking lot and rooftop. A bioswale is a vegetated system that will convey stormwater to the waterway on the north edge of the property while removing sediment and nutrients.
- 2 **BIORETENTION SYSTEM:** The bioretention system will reduce sediment and nutrient loading to the local waterway. Curb cuts will be used to allow stormwater runoff from the parking areas to enter into the bioretention system. The existing catch basins will be used to handle overflow from the system.

## 1 BIOSWALE



## 2 BIORETENTION SYSTEM





Heritage's Dairy Stores  
Green Infrastructure Information Sheet

<b>Location:</b> 199 Pole Tavern Woodstown, NJ 08098	<b>Municipality:</b> Woodstown
<b>Green Infrastructure Description:</b> bioretention system (rain garden) bioswale	<b>Subwatersheds:</b> Salem River
<b>Mitigation Opportunities:</b> recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes	<b>Targeted Pollutants:</b> total nitrogen (TN), total phosphorous (TP), total suspended solids (TSS) in surface runoff  <b>Stormwater Captured and Treated Per Year:</b> bioretention system: 100,313 gal. bioswale: 59,927 gal.
<b>Existing Conditions and Issues:</b> The Heritage's Dairy Stores is located on the corner of Pole Tavern Woodstown Road and Kresswold Lane. The pavement is in good condition. All of the stormwater runoff from the parking lot drains to a catch basin at the southern side of the lot. Stormwater runoff from the rooftop drains to the parking lot.	
<b>Proposed Solution(s):</b> A bioswale can be implemented along the eastern side of the lot, directly alongside the building. This will capture, treat, and infiltrate stormwater runoff from the rooftop and pavement. A bioretention system or rain garden can be implemented along the road in front of the parking lot. The bioretention system will capture, treat, and infiltrate stormwater runoff from the parking lot. The existing catch basin can be used to handle the overflow.	
<b>Anticipated Benefits:</b> Since the bioretention system 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 bioswale would reduce TN by 30%, TP by 60%, and TSS by 90%. A bioretention system and bioswale would also provide ancillary benefits such as enhanced wildlife and aesthetic appeal to the community.	
<b>Possible Funding Sources:</b> mitigation funds from local developers NJDEP grant programs like 319(h) and 604(b) local social and community groups	
<b>Partners/Stakeholders:</b> Woodstown residents local community groups (Boy Scouts, Girl Scouts, etc.) students and parents American Littoral Society Rutgers Cooperative Extension	
<b>Estimated Cost:</b> The bioswale would be 75 feet long and 8 feet wide (600 sq.ft.). At \$5 per square foot, the estimated cost of the bioswale is \$3,000. The rain garden to capture the parking lot runoff would	

Heritage's Dairy Stores  
Green Infrastructure Information Sheet

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need to be approximately 960 square feet. At \$5 per foot, the estimated cost of the rain garden is \$4,800. The total cost of the project would be approximately \$7,800.

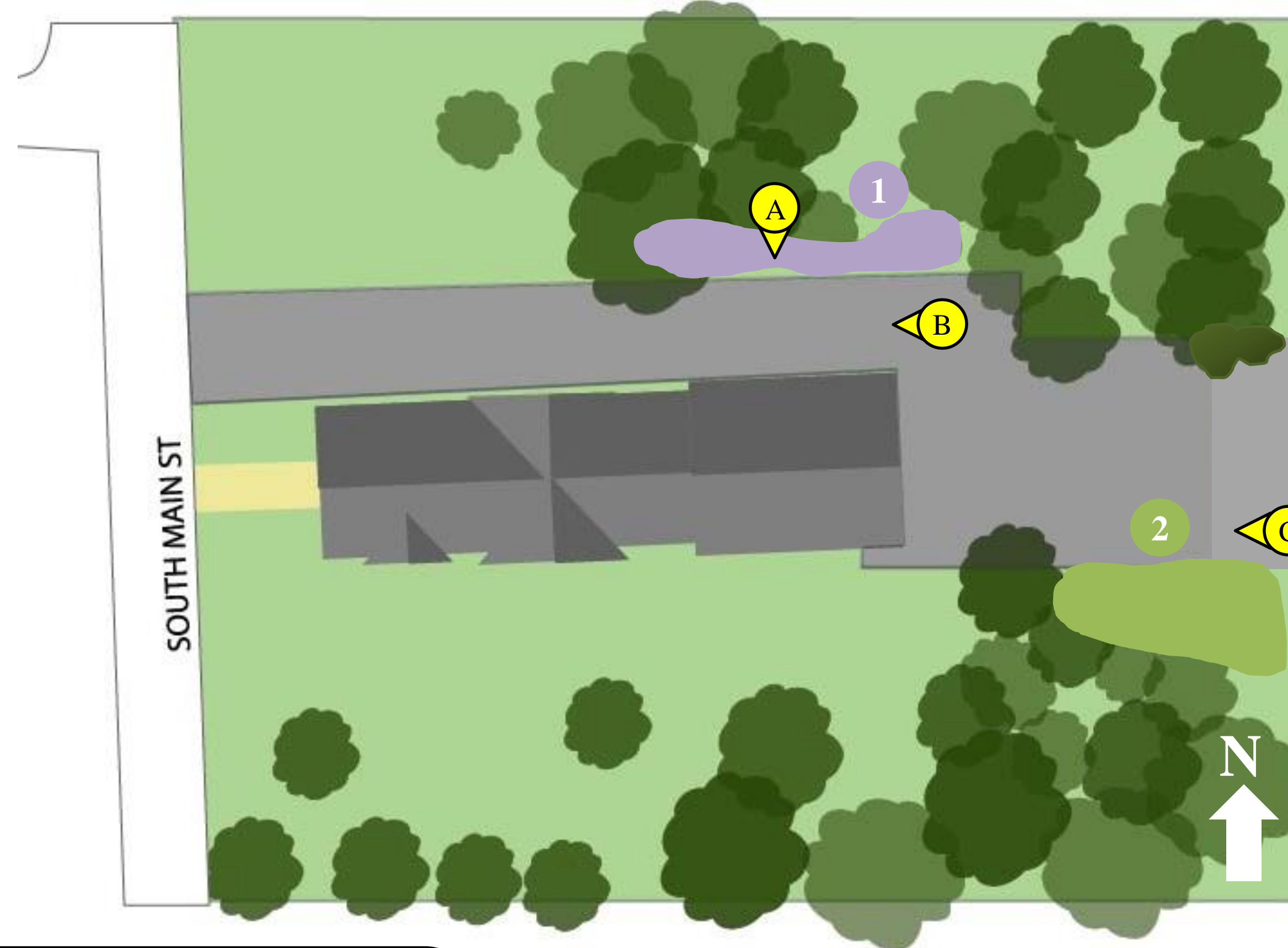
# Woodstown, New Jersey Impervious Cover Assessment

*Asbury United Methodist Church, 149 South Main St.*

## PROJECT LOCATION:



## SITE PLAN:



A



B



C

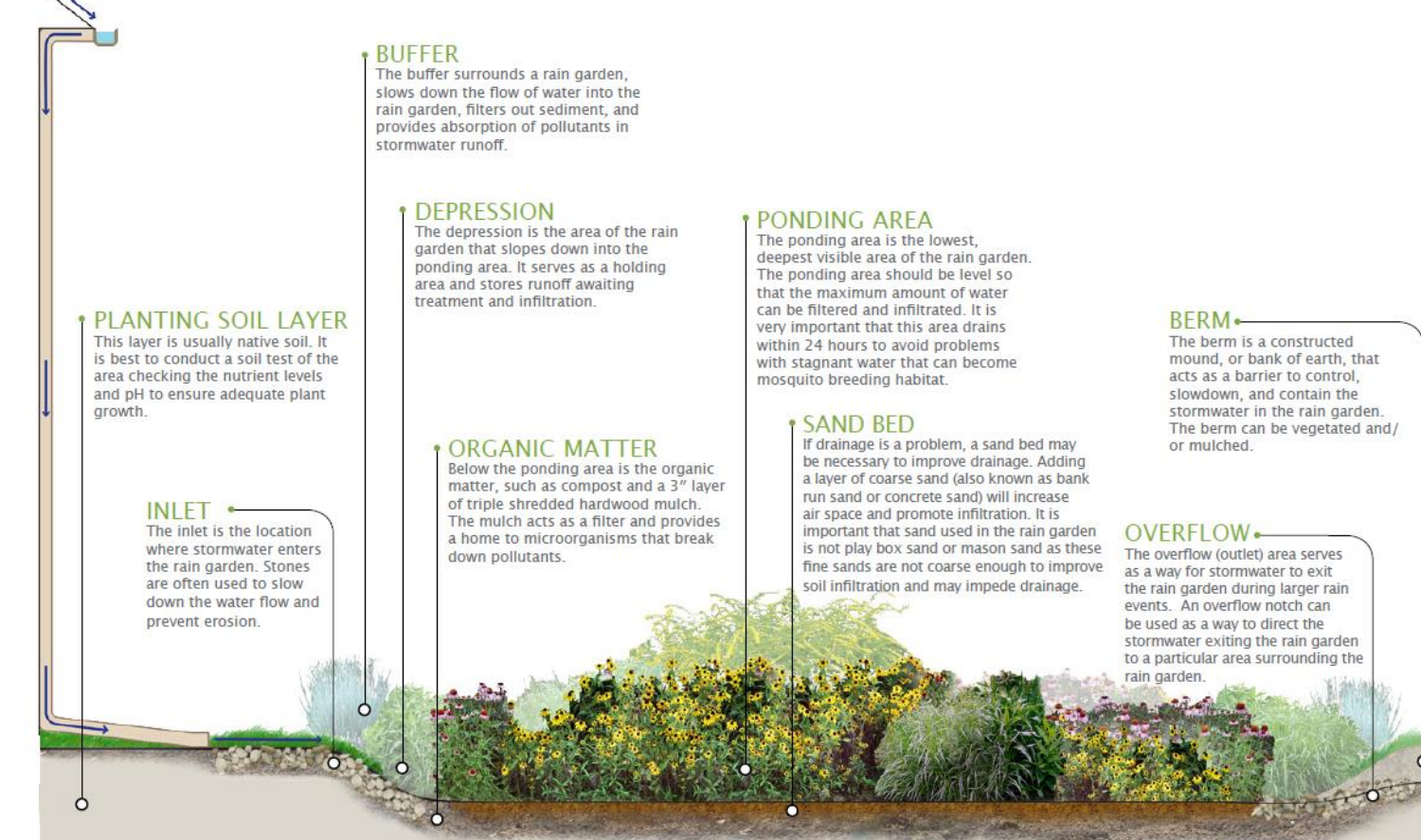


- 1 **BIOSWALE:** A bioswale could be installed to treat runoff from the parking lot. A bioswale is a vegetated system that will convey stormwater while removing sediment and nutrients.
- 2 **BIORETENTION SYSTEM:** The bioretention system will reduce sediment and nutrient loading to the local waterway.

## 1 BIOSWALE



## 2 BIORETENTION SYSTEM



Asbury United Methodist Church  
Green Infrastructure Information Sheet

<p><b>Location:</b> 149 South Main Street Woodstown, NJ 08098</p>	<p><b>Municipality:</b> Woodstown</p>
<p><b>Green Infrastructure Description:</b> bioretention system (rain garden) bioswale</p>	<p><b>Subwatershed:</b> Salem River</p> <p><b>Targeted Pollutants:</b> total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff</p>
<p><b>Mitigation Opportunities:</b> recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes</p>	<p><b>Stormwater Captured and Treated Per Year:</b> bioretention system: 231,892 gal. bioswale: 217,562 gal.</p>
<p><b>Existing Conditions and Issues:</b> Asbury United Methodist Church is located on South Main Street. Stormwater runoff from the parking lot flows to the northwestern corner of the lot where sediment is building up. Runoff is able to flow between the parking blocks and into the turf grass area behind the lot, where there is a nearby stream. This runoff carries nonpoint source pollution such as sediments, nutrients, oil and grease directly into the stream. There are disconnected downspouts on the north side of the building that discharge stormwater directly onto the driveway, which drains to a nearby turf grass area. This runoff is carrying nonpoint source pollution to the grass where it is infiltrating without being treated.</p>	
<p><b>Proposed Solution(s):</b> A bioretention system could be installed in the turf grass area to the south side of the parking lot to capture runoff before it recharges groundwater or flows into the stream. This will also alleviate flooding and sediment buildup. A bioswale could be installed in the turf grass area on the side of the building to capture and treat runoff from the downspouts and the driveway.</p>	
<p><b>Anticipated Benefits:</b> Since the bioretention system would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), this system is estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. The bioswale would reduce TN by 30%, TP by 60%, and TSS by 90%. A bioretention system and bioswale would also provide ancillary benefits, such as enhanced wildlife and aesthetic appeal to the church and its parishioners.</p>	
<p><b>Possible Funding Sources:</b> mitigation funds from local developers NJDEP grant programs like 319(h) and 604(b)</p>	
<p><b>Partners/Stakeholders:</b> Woodstown residents and parishioners local community groups (Boy Scouts, Girl Scouts, etc.) American Littoral Society Rutgers Cooperative Extension</p>	

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**Estimated Cost:**

The bioswale would be 105 feet long and 20 feet wide (2,100 sq.ft.). At \$5 per square foot, the estimated cost of the bioswale is \$10,500. The rain garden to capture the parking lot runoff would need to be approximately 1,800 square feet. At \$5 per foot, the estimated cost of the rain garden is \$9,000. The total cost of the project would be approximately \$19,500.