



**Impervious Cover Assessment
for
Pilesgrove Township, Salem County, New Jersey**

*Prepared for Pilesgrove Township 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, 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 that drain 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 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

Pilesgrove Township Impervious Cover Analysis

Located in Salem County New Jersey, Pilesgrove Township covers nearly 50 square miles. Figures 3 and 4 illustrate that Pilesgrove Township is dominated by agricultural land uses. Only 12.7% of the municipality's land use is classified as urban (Figure 3). Of the urban land in Pilesgrove Township, rural 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 Pilesgrove 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 Pilesgrove Township. Based upon the 2007 NJDEP land use/land cover data, approximately 2.2% of Pilesgrove Township has impervious cover. This level of impervious cover suggests that the streams in Pilesgrove Township are likely considered to be sensitive streams.

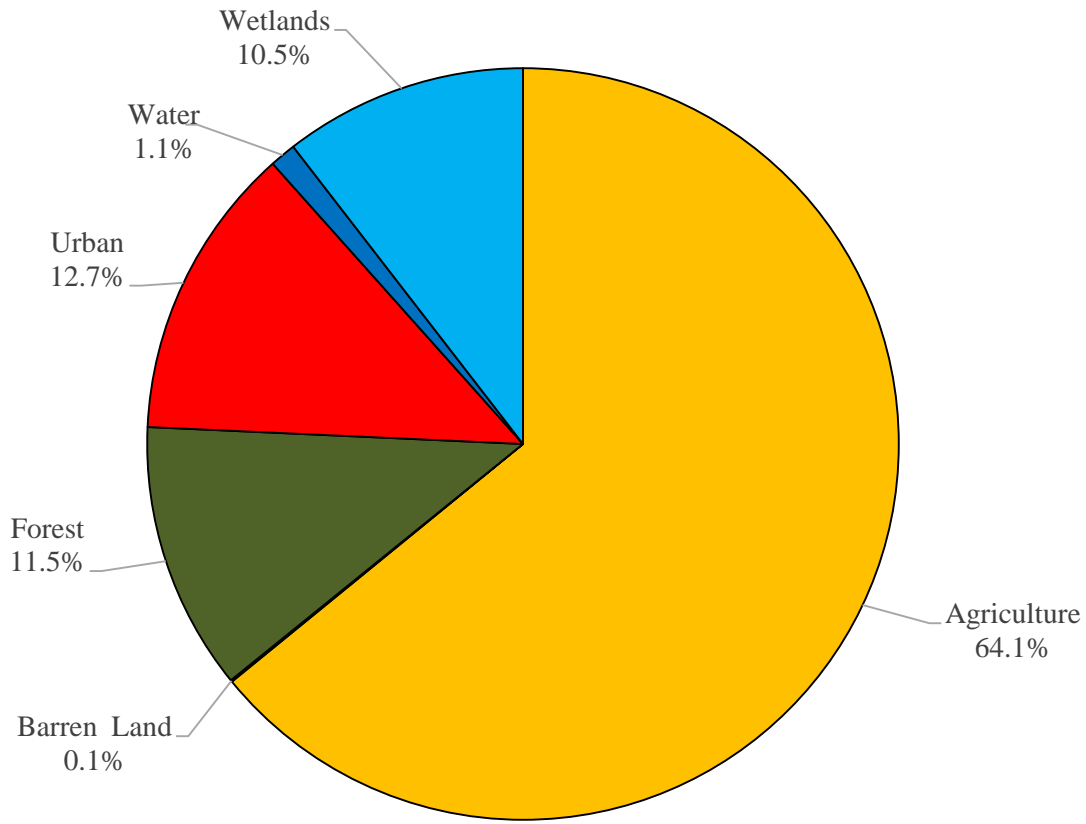


Figure 3: Pie chart illustrating the land use in Pilesgrove Township

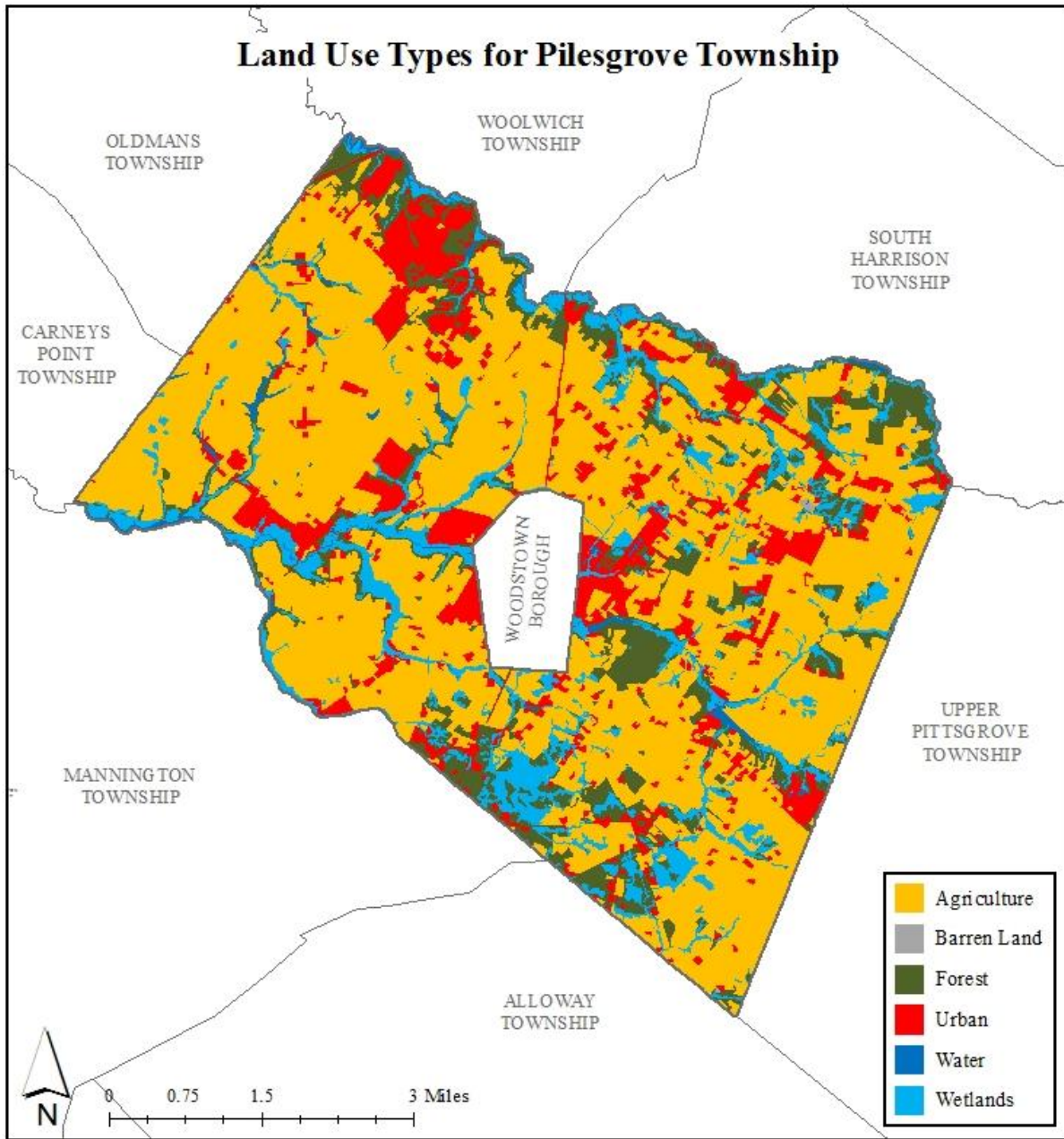


Figure 4: Map illustrating the land use in Pilesgrove Township

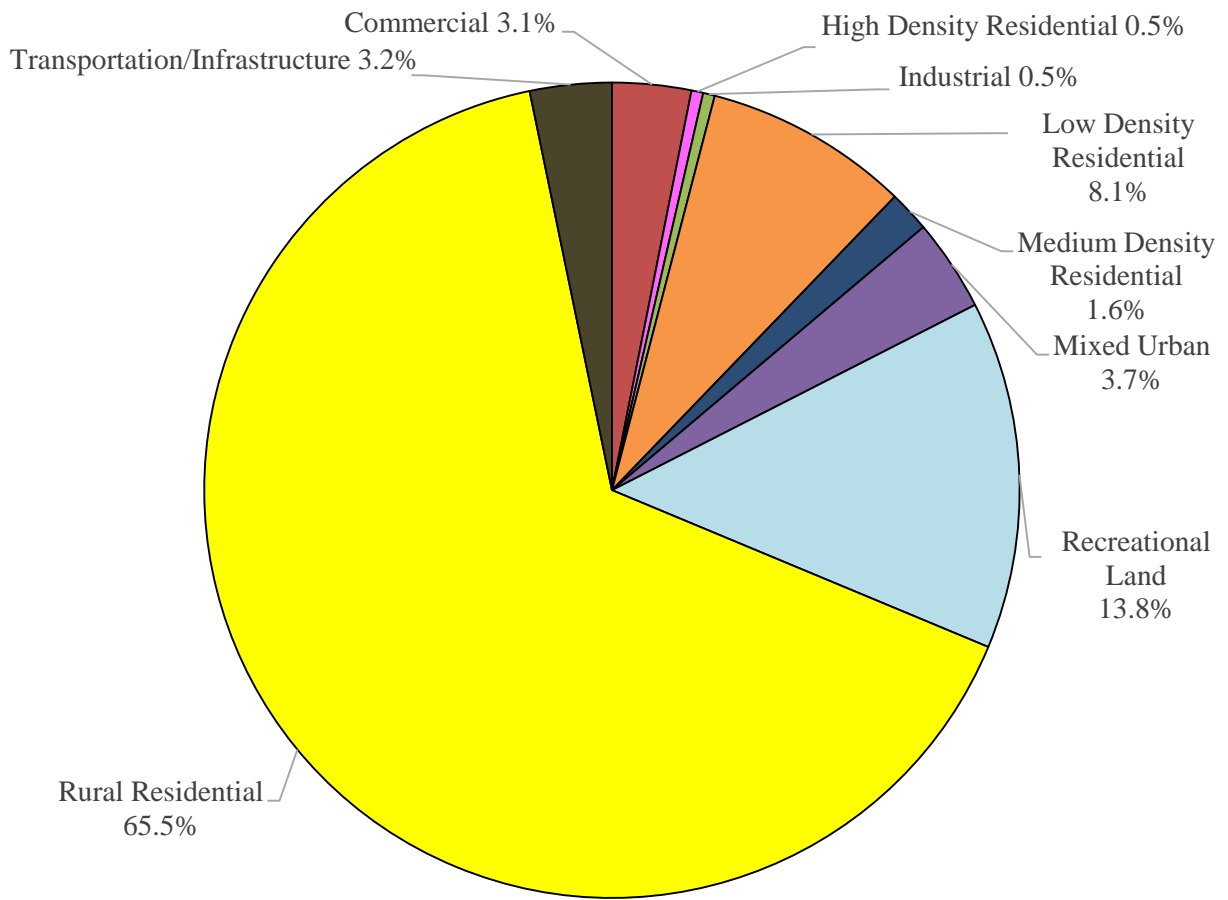


Figure 5: Pie chart illustrating the various types of urban land use in Pilesgrove Township

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each subwatershed within Pilesgrove Township (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 1.1% in the Alloway Creek subwatershed to 2.8% in the Oldsmans 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 Pilesgrove Township, 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 Pilesgrove Township. 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 80 homes for a year¹.

¹ Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for Pilesgrove Township

Subwatershed	Total Area		Land Use Area		Water Area		Impervious Cover		
	(ac)	(mi ²)	(ac)	(mi ²)	(ac)	(mi ²)	(ac)	(mi ²)	(%)
Alloway Creek	1,177	1.8	1,177	1.8	0.34	0.00	13.3	0.02	1.1%
Game Creek	1,193	1.9	1,175	1.8	17.5	0.03	16.9	0.03	1.4%
Mannington Creek	38.8	0.1	38.8	0.1	0.00	0.00	0.5	0.00	1.3%
Nichomus Run	2,930	4.6	2,925	4.6	5.5	0.01	49.6	0.08	1.7%
Oldmans Creek	5,265	8.2	5,198	8.1	67.3	0.11	147.8	0.23	2.8%
Salem River	11,885	18.6	11,722	18.3	163.3	0.26	258.7	0.40	2.2%
TOTAL	22,489	35.20	22,236	34.7	253.94	0.41	486.8	0.76	2.2%

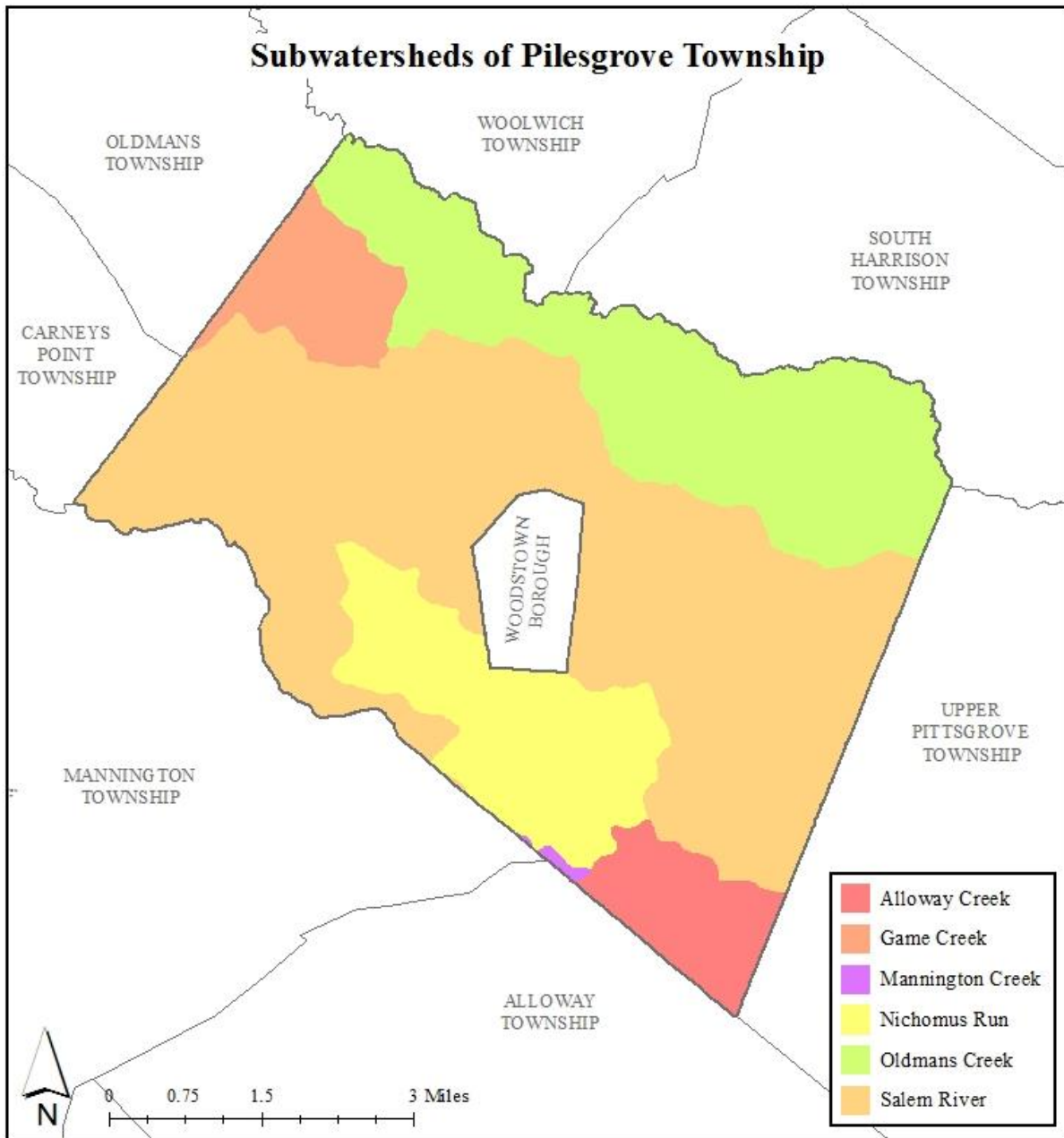


Figure 6: Map of the subwatersheds in Pilesgrove Township

Table 2: Stormwater runoff volumes from impervious surfaces by subwatershed in Pilesgrove 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 (5.0") (MGal)	Total Runoff Volume for the 100-Year Design Storm (8.5") (MGal)
Alloway Creek	0.45	15.89	1.19	1.81	3.07
Game Creek	0.57	20.19	1.51	2.29	3.90
Mannington	0.02	0.60	0.04	0.07	0.12
Nichomus Run	1.68	59.26	4.44	6.73	11.45
Oldmans Creek	5.02	176.58	13.24	20.07	34.11
Salem River	8.78	309.07	23.18	35.12	59.71
TOTAL	16.52	581.58	43.62	66.09	112.35

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 Pilesgrove 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 Pilesgrove Township

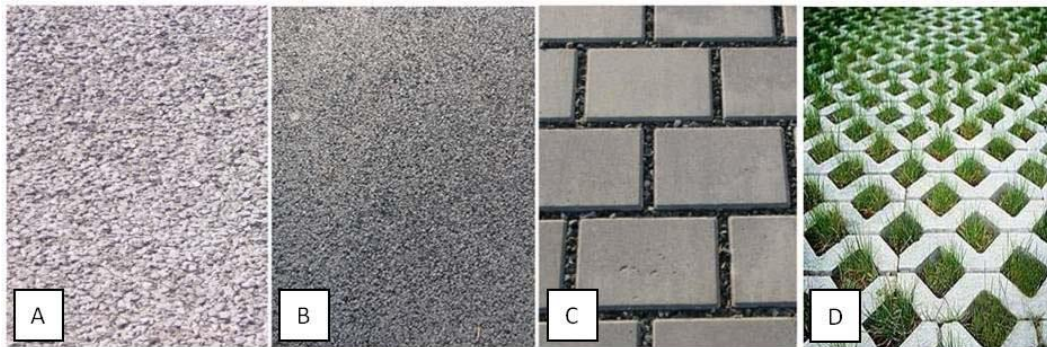
Subwatershed	Recommended Impervious Area Reduction (10%) (ac)	Annual Runoff Volume Reduction ² (MGal)
Alloway Creek	1.43	1.51
Game Creek	1.80	1.92
Mannington	0.05	0.06
Nichomus Run	5.71	5.63
Oldmans Creek	14.78	16.77
Salem	27.56	29.36
TOTAL	51.33	55.25

² Annual Runoff Volume Reduction =
 Acres of impervious cover x 43,560 ft²/ac x 44 in x (1 ft/12 in) x 0.95 x (7.48 gal/ft³) x (1 MGal/1,000,000 gal)
 All green infrastructure practices should be designed to capture the first 3.3 inches of rain from each storm. This would allow the green infrastructure practices to capture 95% of the annual rainfall of 44 inches.

Pervious Pavement

There are four different types of permeable pavement systems that are commonly 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 Pilesgrove 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 Pilesgrove 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

Pilesgrove 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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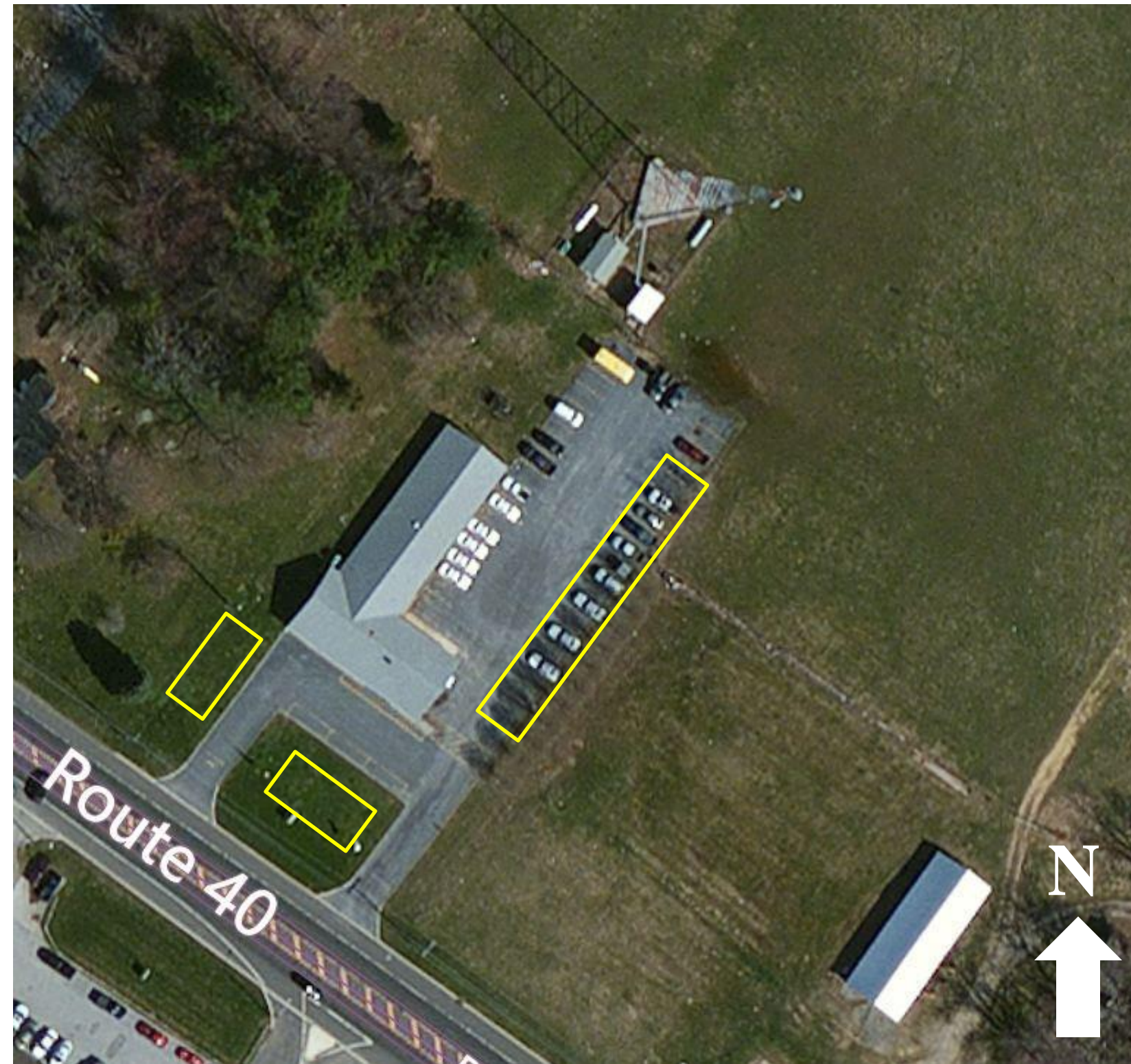
Appendix A

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

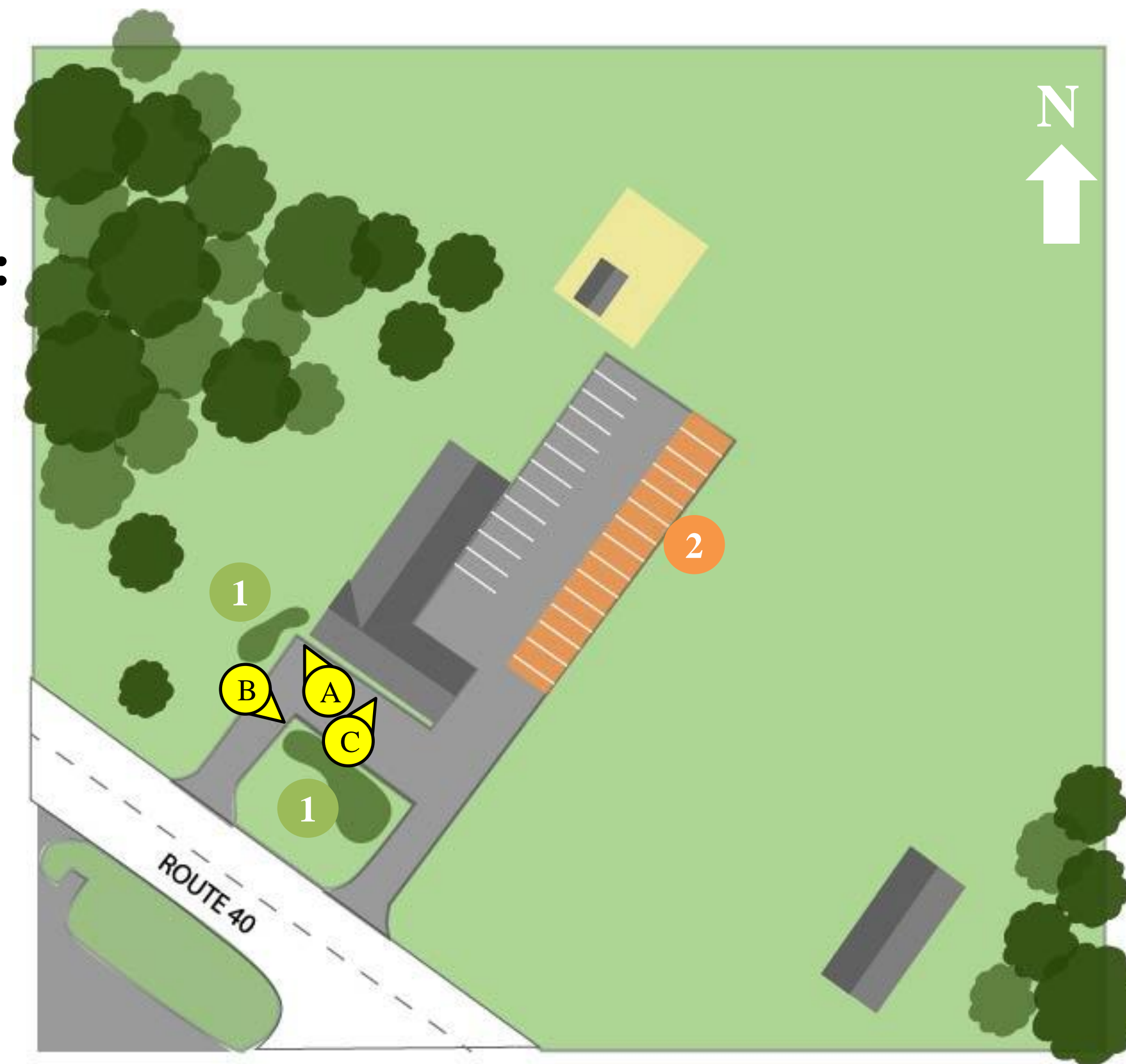
Pilesgrove Township Impervious Cover Assessment

Woodstown NJ State Police Station, 769 US 40

PROJECT LOCATION:



SITE PLAN:



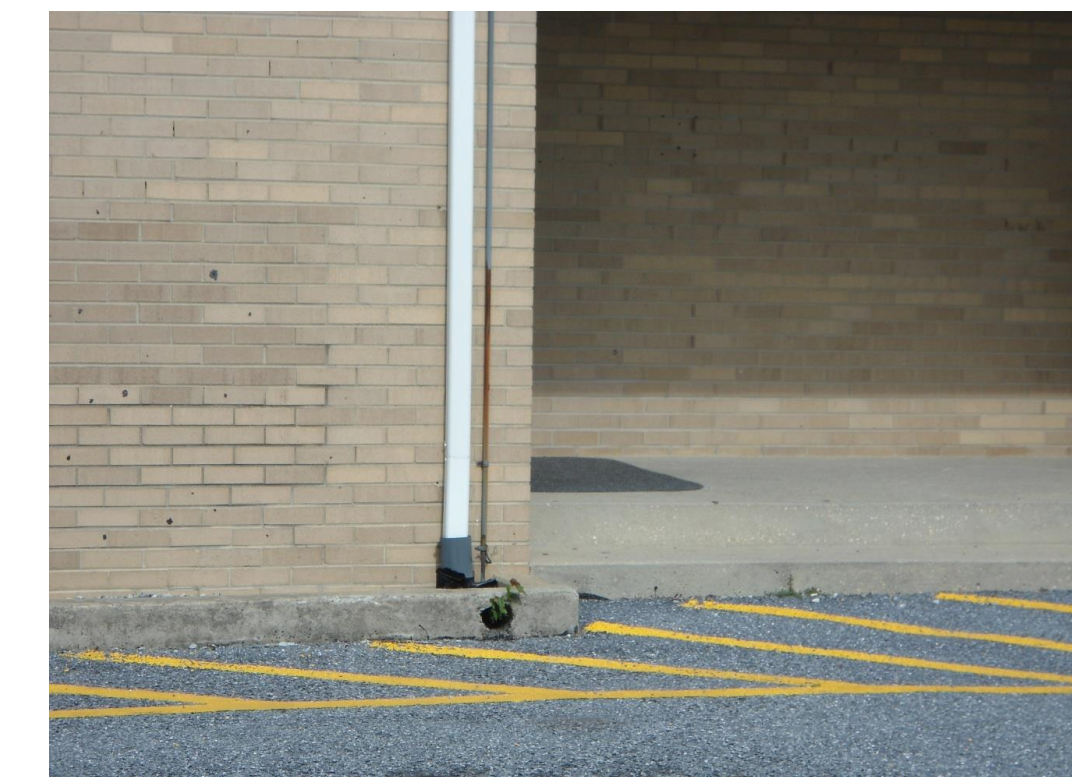
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B



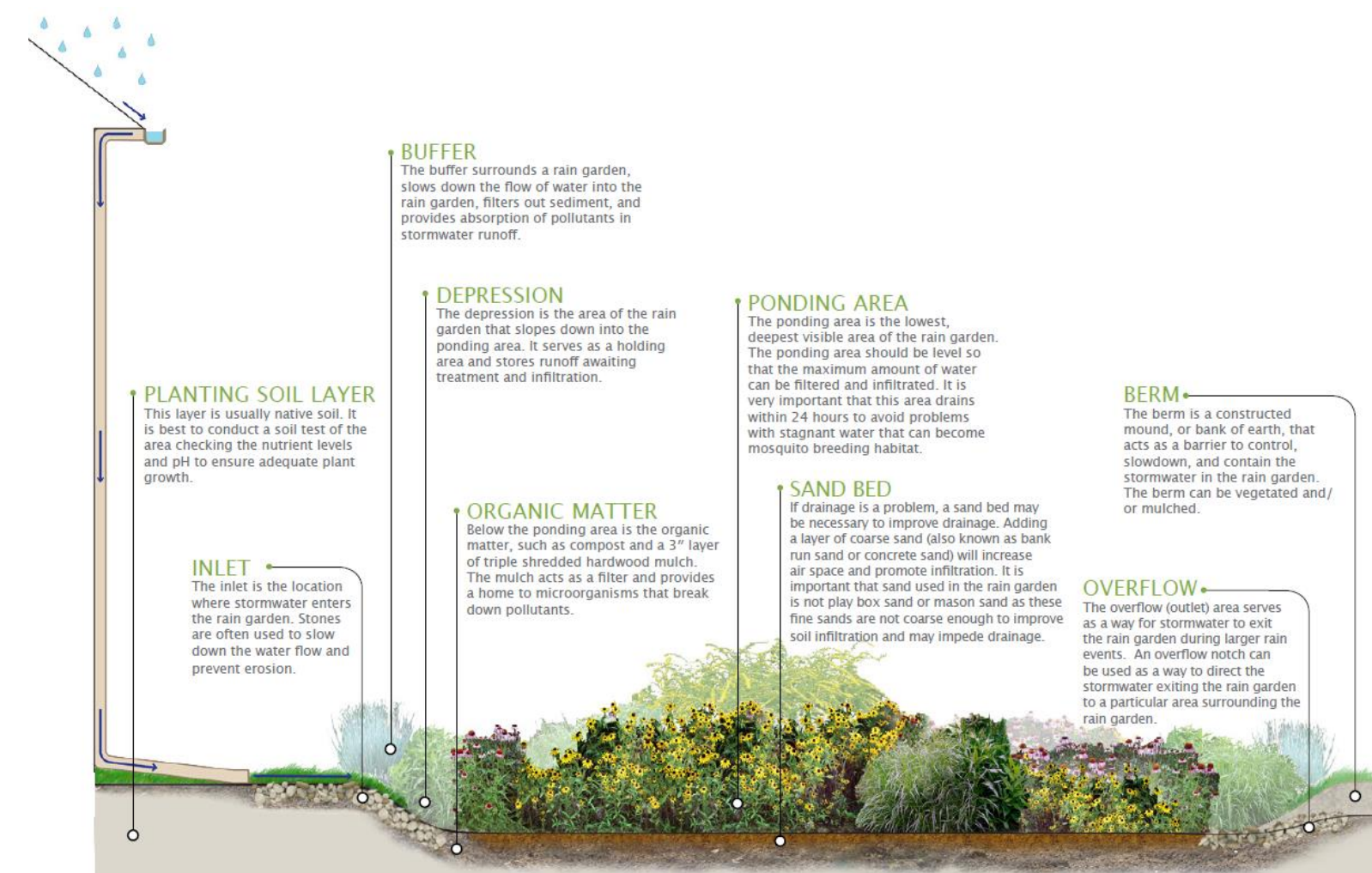
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1 BIORETENTION SYSTEMS: The bioretention systems will reduce sediment and nutrient loading to the local waterway. Curb cuts will be used to allow stormwater runoff from the driveway to enter into the bioretention systems.

2 POROUS ASPHALT: Porous asphalt promotes groundwater recharge and filters stormwater.

1 BIORETENTION SYSTEM



CURB CUTS



2 POROUS ASPHALT



Woodstown NJ State Police Station
Green Infrastructure Information Sheet

Location: 769 US 40 Pilesgrove, NJ 08098	Municipality: Woodstown Subwatershed: Salem River
Green Infrastructure Description: bioretention systems (rain garden) 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: rain garden #1: 31,266 gal. rain garden #2: 91,194 gal. porous asphalt: 429,913 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 downspouts from the rooftop drain directly to the pavement and then to catch basins that carry the runoff to local waterways. The pavement appears to be in good condition.	
Proposed Solution(s): Bioretention systems or rain gardens could be installed to capture some of the rooftop runoff and driveway runoff. Rain garden #1 would be constructed on the west side of the paved driveway loop in front of the building. This rain garden would intercept part of the rooftop runoff and part of the pavement runoff. Rain garden #2 would be constructed in the grassed island in front of the building. This rain garden would intercept primarily pavement runoff and the downspout that discharges from the center of the front of the building. These bioretention systems would capture, treat, and infiltrate the stormwater runoff, thereby reducing localized flooding and improving water quality. While the parking lot is in good condition, a section could be converted to porous asphalt to capture the entire parking area and part of the rooftop runoff. Porous pavement will treat the stormwater runoff and slowly allow it to infiltrate into the ground.	
Anticipated Benefits: Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. The porous asphalt system will achieve the same level of 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 and police officers at the facility.	
Possible Funding Sources: mitigation funds from local developers NJDEP grant programs	
Partners/Stakeholders: Pilesgrove residents	

Woodstown NJ State Police Station
Green Infrastructure Information Sheet

local community groups (Boy Scouts, Girl Scouts, etc.)
students
American Littoral Society
Rutgers Cooperative Extension

Estimated Cost:

Rain garden #1 would need to be approximately 300 square feet. At \$5 per square foot, the estimated cost of the rain garden is \$1,500. Rain garden #2 would need to be approximately 875 square feet. At \$5 per square foot, the estimated cost of the rain garden is \$4,375. The porous asphalt would cover 1,950 square feet and have a three foot stone reservoir under the surface. At \$30 per square foot, the cost of the porous asphalt system would be \$58,500. The total cost of the project would be approximately \$64,375.

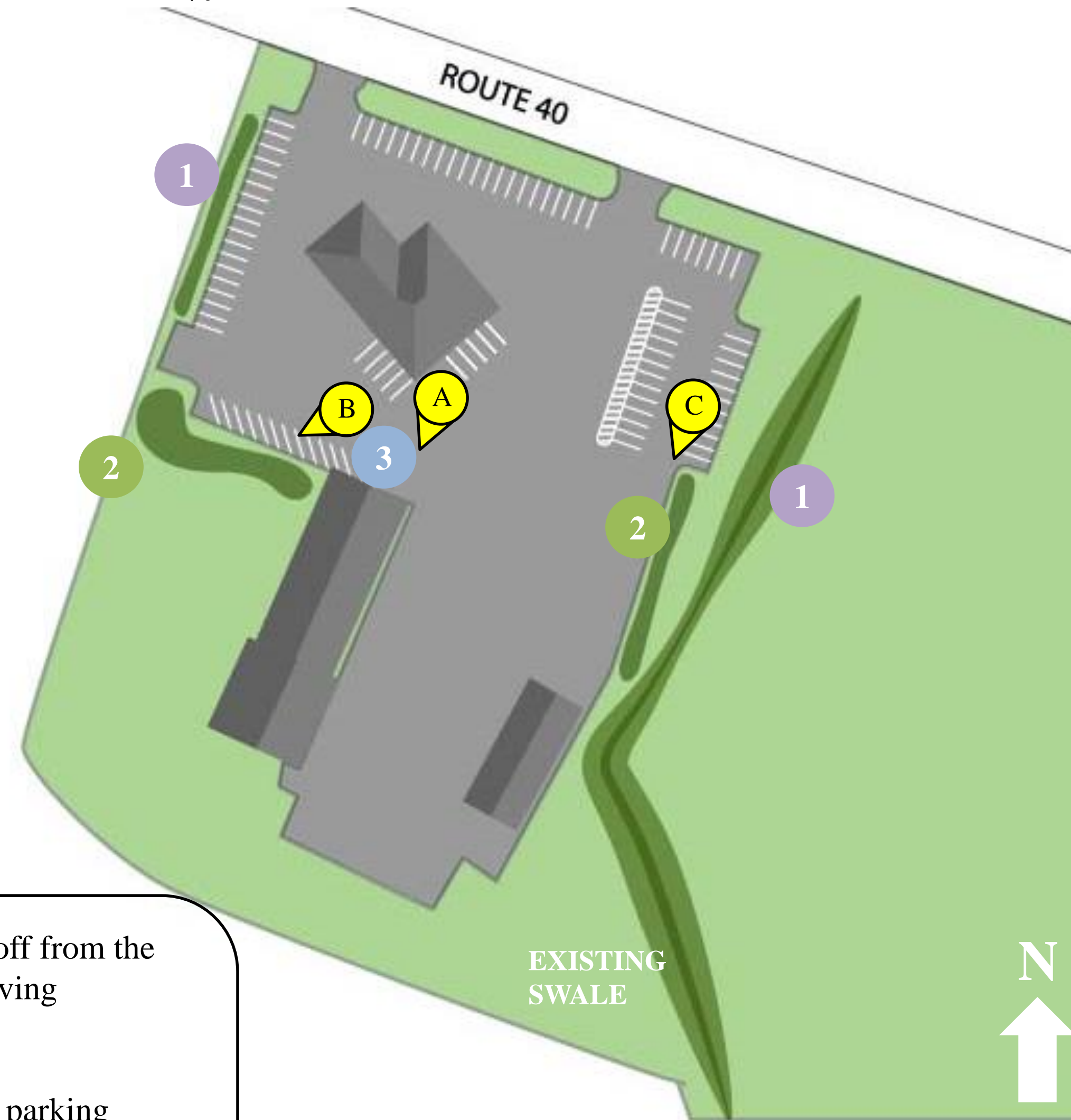
Pilesgrove Township Impervious Cover Assessment

Pilesgrove Municipal Building, 1180 US 40

PROJECT LOCATION:



SITE PLAN:



- 1 BIOSWALE:** An existing swale could be modified into a bioswale to accommodate the runoff from the parking lot. A bioswale is a vegetated system that will convey stormwater runoff while removing sediment and nutrients.
- 2 BIORETENTION SYSTEMS:** Curb cuts will be used to allow stormwater runoff from the parking areas to enter into the bioretention systems. The bioretention systems will reduce sediment and nutrient loading to the local waterway.
- 3 RAINWATER HARVESTING SYSTEM:** A rainwater harvesting system could be installed to capture stormwater runoff from one of the rooftops to wash vehicles, fill street sweepers, etc.

A



B



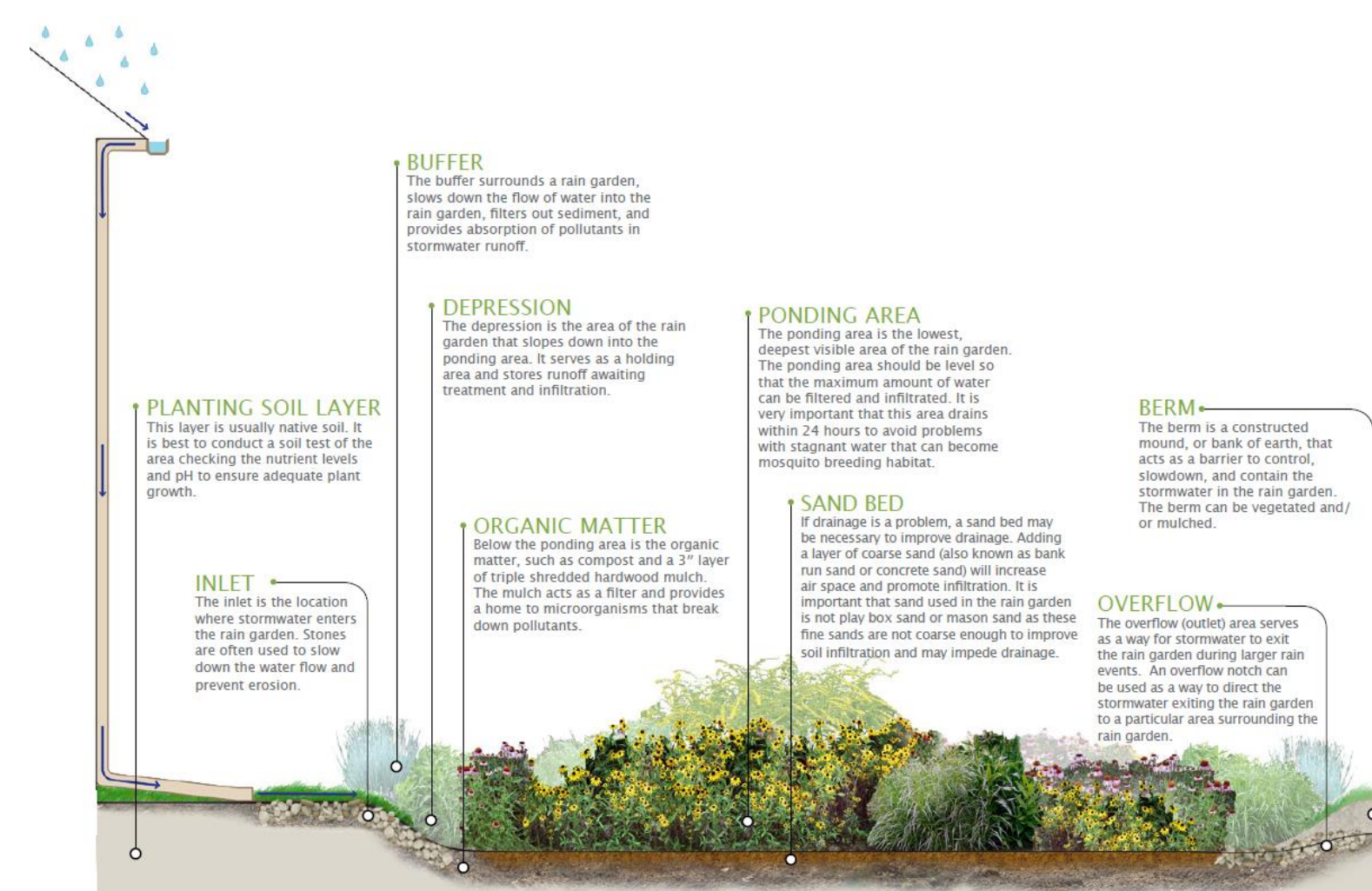
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1 BIOSWALE



2 BIORETENTION SYSTEM



3 RAINWATER HARVESTING SYSTEM



Pilesgrove Municipal Building
Green Infrastructure Information Sheet

<p>Location: 1180 U.S. 40 Pilesgrove, NJ 08098</p>	<p>Municipality: Pilesgrove</p> <hr/> <p>Subwatershed: Salem River</p>
<p>Green Infrastructure Description: bioretention systems (rain gardens) bioswales rainwater harvesting system (cistern)</p>	<p>Targeted Pollutants: total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff</p>
<p>Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes</p>	<p>Stormwater Captured and Treated Per Year: bioswale west: 115,946 gal. rain garden southwest: 161,543 gal. rain garden east: 354,353 gal. bioswale east: 369,986 gal. rainwater harvesting system: 22,216 gal.</p>
<p>Existing Conditions and Issues: There are large amounts of impervious surfaces at this site including building rooftops and pavement 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 stormwater from the municipal building flows to a grassed portion of site. Evidence of sediment accumulation was found near the outflow drain. The pavement is in good condition.</p>	
<p>Proposed Solution(s): Most of the stormwater runoff could effectively be managed with bioretention systems and bioswales. The existing storm sewer system could be used to capture overflow from these systems. These bioretention systems and bioswales would capture, treat, and infiltrate the stormwater runoff, thereby reducing localized flooding and improving water quality. A bioswale would be installed along the west side of the parking lot. A rain garden would be installed along the southwest side of the parking lot. A rain garden and bioswale would be installed along the east side of the parking area. The overflow from the rain garden would discharge into the bioswale. A rainwater harvesting system would be installed to capture stormwater runoff from one of the rooftops. This captured rainwater can be used to wash vehicles, fill street sweepers, or fill water trucks.</p>	
<p>Anticipated Benefits: Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. The porous asphalt system will achieve the same level of pollutant load reduction for TN, TP and TSS. The bioswale would reduce TN by 30%, TP by 60%, and TSS by 90%. The bioretention systems and bioswales would also provide ancillary benefits such as enhanced wildlife and aesthetic appeal to the community. Since the rainwater harvesting system would be designed to capture the first 1.25 inches of rain, it would reduce the pollutant loading by 90% during the periods it is operational (i.e., it would not be used in the winter when there is chance of freezing).</p>	
<p>Possible Funding Sources:</p>	

Pilesgrove Municipal Building
Green Infrastructure Information Sheet

mitigation funds from local developers
NJDEP grant programs

Partners/Stakeholders:

Pilesgrove residents
local community groups (Boy Scouts, Girl Scouts, etc.)
students
American Littoral Society
Rutgers Cooperative Extension

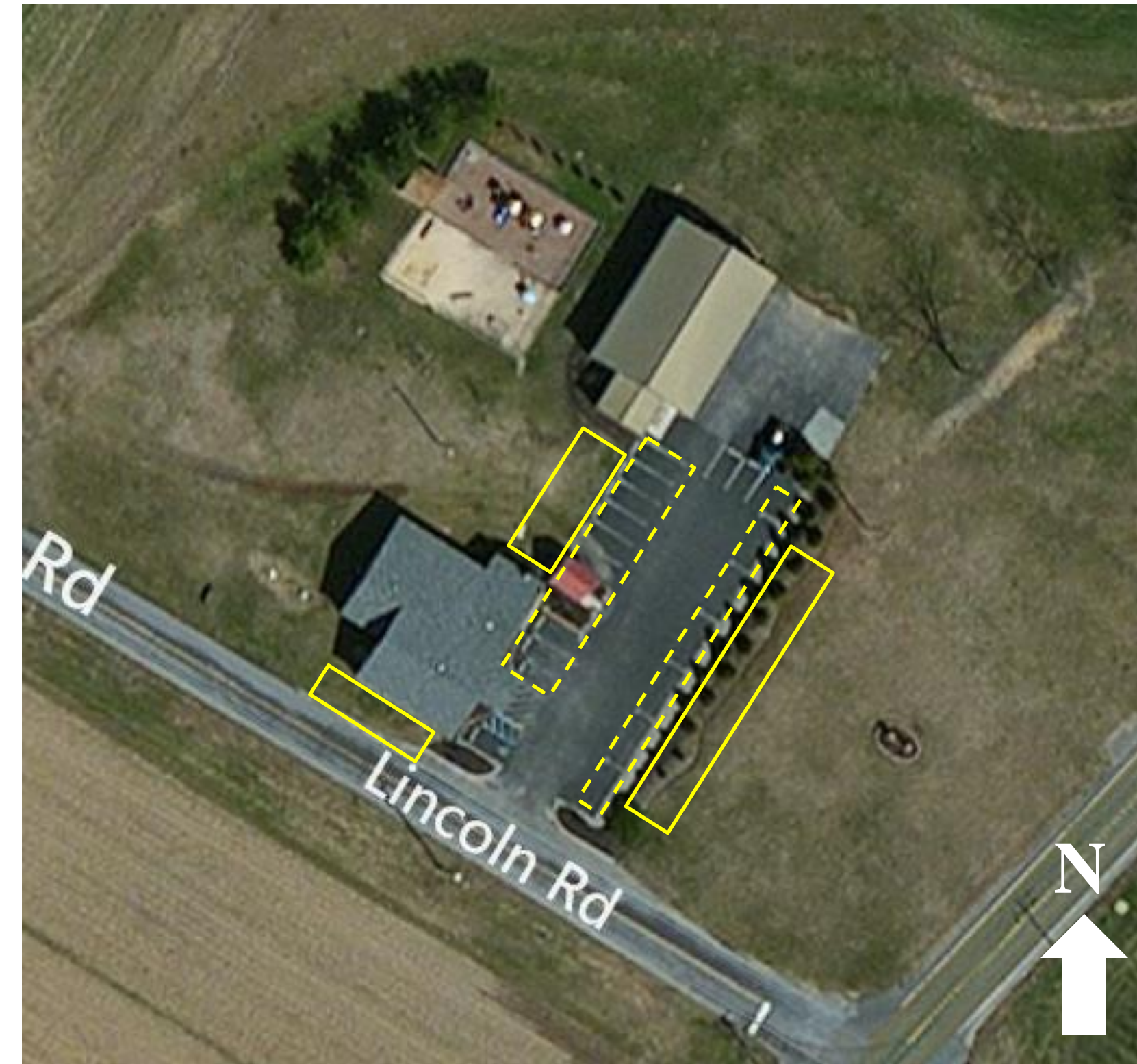
Estimated Cost:

The bioswale on the west side of the property would be 135 feet long and 8 feet wide (1,080 sq.ft.). At \$5 per square foot, the estimated cost of the bioswale is \$5,400. The rain garden on the southwest side of the property would need to be approximately 1,550 square feet. At \$5 per square foot, the estimated cost of the rain garden is \$7,750. The rain garden on the east side of the property would need to be approximately 3,400 square feet. At \$5 per square foot, the estimated cost of the rain garden is \$17,000. The bioswale on the east side of the property would be 250 feet long and 14 feet wide (3,500 sq.ft.). At \$5 per square foot, the estimated cost of the bioswale is \$17,500. The cistern would be 2,000 gallons and cost approximately \$4,000 to purchase and install. The total cost of the project would be approximately \$51,650.

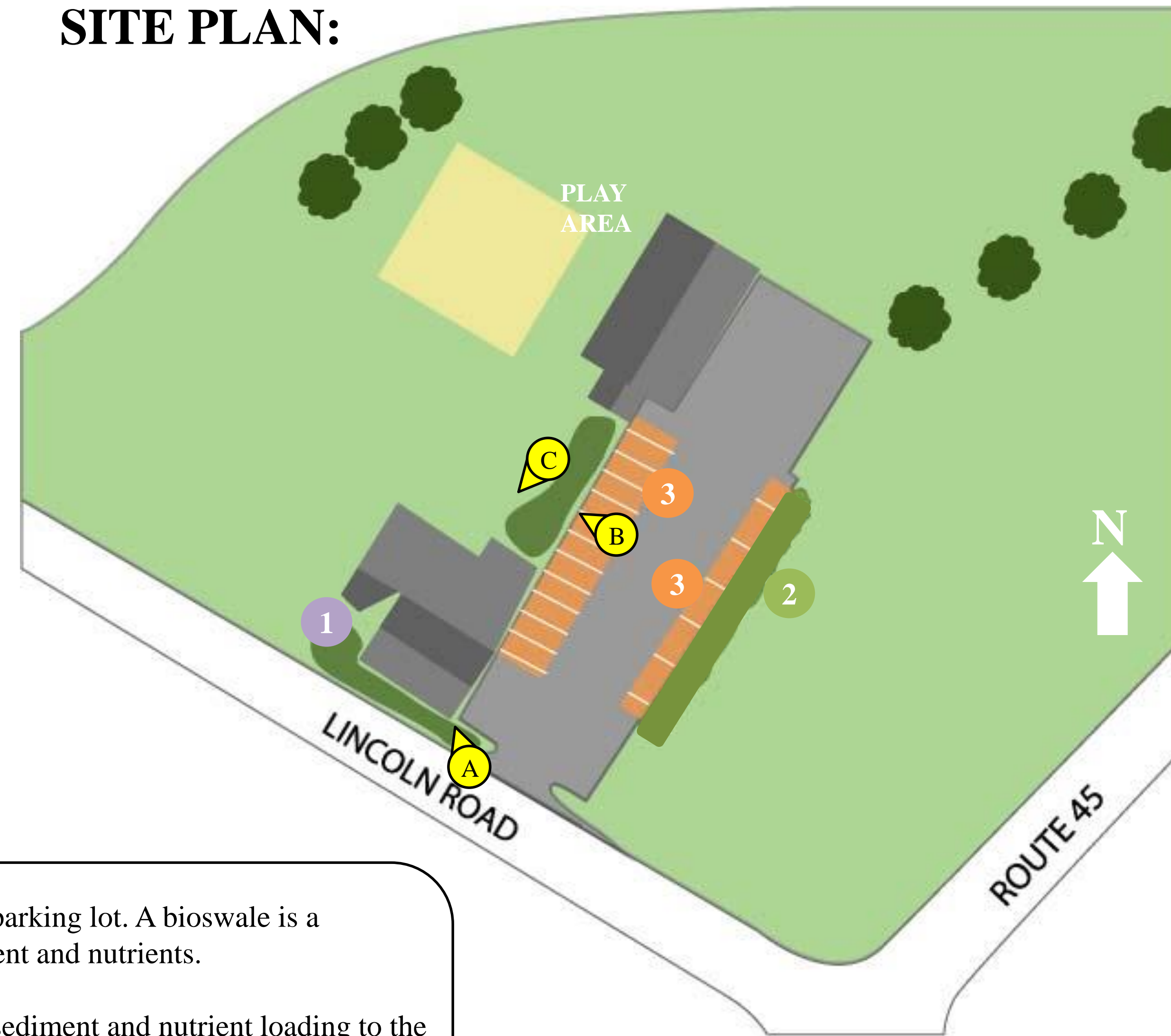
Pilesgrove Township Impervious Cover Assessment

Woodstown Preschool Academy, 343 Lincoln Road

PROJECT LOCATION:



SITE PLAN:



A



B



C

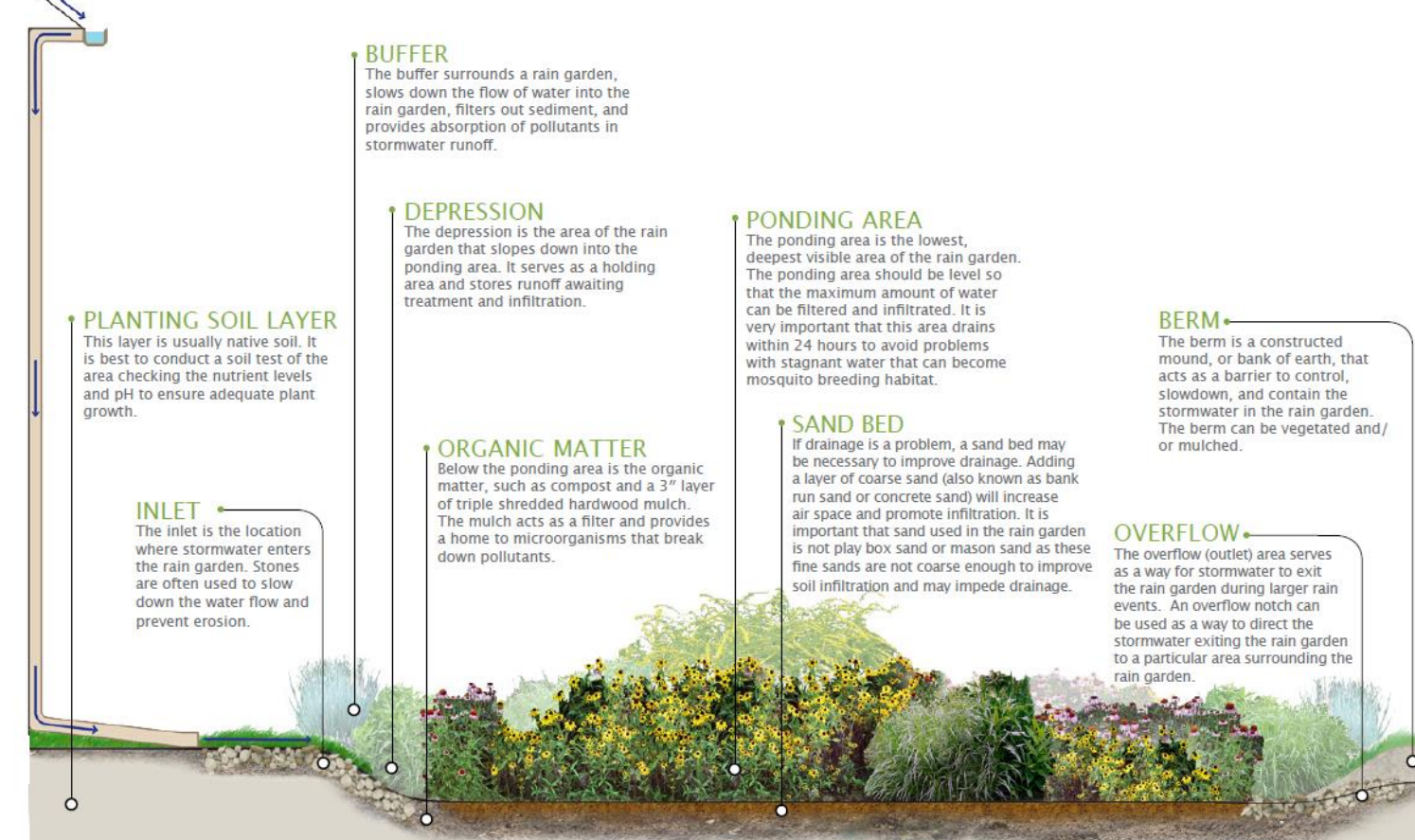


- 1 **BIOSWALE:** A bioswale could be installed to treat runoff from the parking lot. A bioswale is a vegetated system that will convey stormwater while removing sediment and nutrients.
- 2 **BIORETENTION SYSTEM:** The bioretention system will reduce sediment and nutrient loading to the local tributary. Curb cuts will be used to allow stormwater runoff from the parking areas to enter into the bioretention system.
- 3 **POROUS ASPHALT:** Porous asphalt promotes groundwater recharge and filters stormwater.

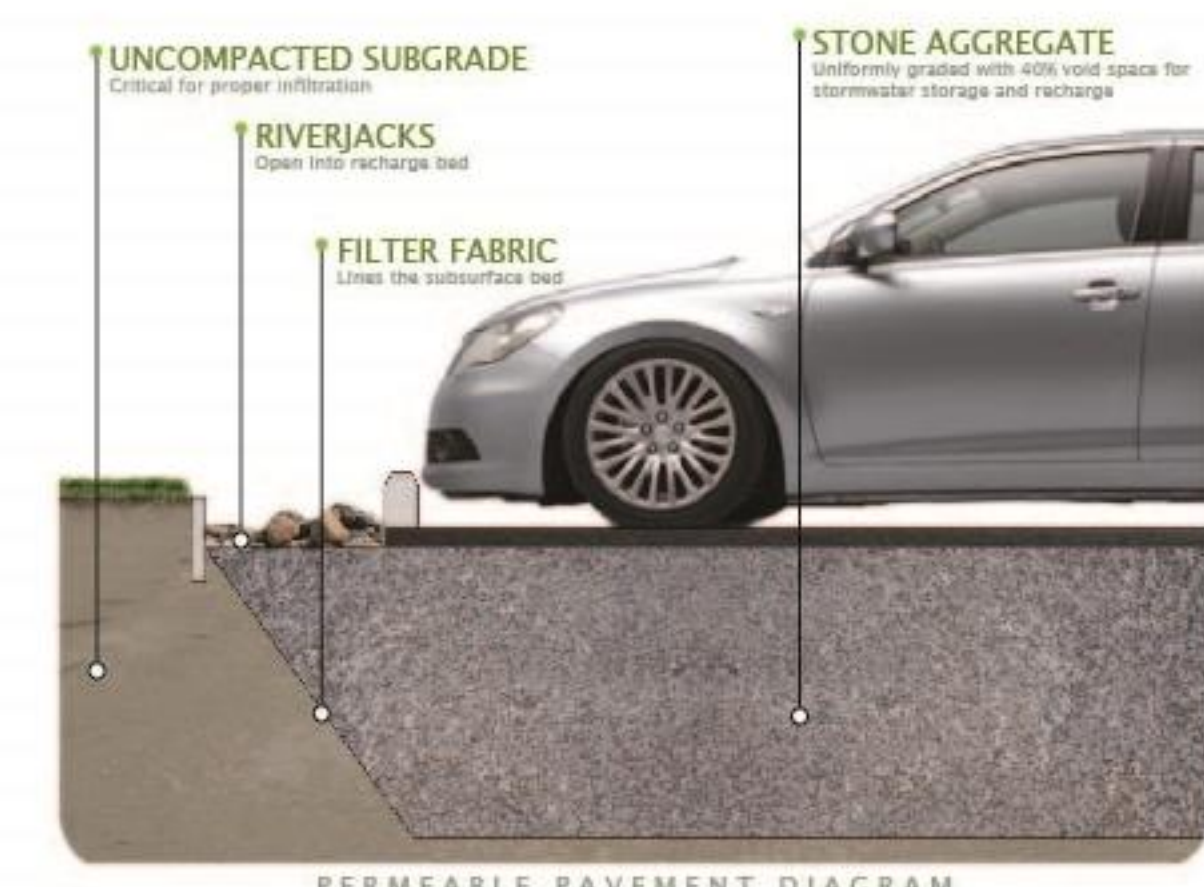
1 BIOSWALE



2 BIORETENTION SYSTEM



3 POROUS ASPHALT



Woodstown Preschool Academy
Green Infrastructure Information Sheet

<p>Location: 343 Lincoln Rd. Pilesgrove, NJ 08098</p>	<p>Municipality: Pilesgrove</p>
<p>Green Infrastructure Description: bioretention systems (rain gardens) bioswale porous asphalt</p>	<p>Subwatershed: Oldmans Creek</p> <p>Targeted Pollutants: total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff</p>
<p>Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes</p>	<p>Stormwater Captured and Treated Per Year: bioswale: 62,533 gal. parking lot rain garden: 78,166 gal. roadside rain garden: 17,587 gal. porous asphalt: 140,699 gal.</p>
<p>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 shallow swale conveys runoff from the preschool parking lot through the backyard of the school. The downspout for the building discharges stormwater onto the roadway. The pavement is in good condition.</p>	
<p>Proposed Solution(s): The best option for this site is to install a bioswale to capture, treat, and infiltrate stormwater runoff from the parking lot through the backyard of the school. To further address stormwater runoff, installing bioretention systems or rain gardens to treat parking lot runoff and rooftop runoff also would be a cost effective solution. Another option would be to replace the parking spaces with porous asphalt to capture, treat, and infiltrate stormwater runoff. If porous asphalt is used, there would be no need for the bioswale or the rain garden to treat parking lot runoff. The rain garden along the road would still be recommended to capture, treat, and infiltrate rooftop runoff. Rain barrels are also an option for the preschool, and the students could use the rainwater to water their gardens.</p>	
<p>Anticipated Benefits: Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. The porous asphalt system will achieve the same level of 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 children at the preschool as well as a learning opportunity.</p>	
<p>Possible Funding Sources: mitigation funds from local developers NJDEP grant programs</p>	
<p>Partners/Stakeholders: Pilesgrove residents</p>	

Woodstown Preschool Academy
Green Infrastructure Information Sheet

local community groups (Boy Scouts, Girl Scouts, etc.)
students and parents
American Littoral Society
Rutgers Cooperative Extension

Estimated Cost:

For the first option, the bioswale would be 50 feet long and 12 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 need to be approximately 750 square feet. At \$5 per square foot, the estimated cost of the rain garden is \$3,750. The rain garden to capture the rooftop runoff would need to be approximately 170 square feet. At \$5 per square foot, the estimated cost of the rain garden is \$850. The total cost of the project using the first option would be approximately \$7,600.

The second option includes porous asphalt in the parking lot and the roadside rain garden. The porous asphalt would cover 2,300 square feet and have a one foot stone reservoir under the surface. At \$20 per square foot, the cost of the porous asphalt system would be \$46,000. The total cost of the project using the second option would be approximately \$46,850.