RUTGERS
New Jersey Agricultural
Experiment Station

Impervious Cover Assessment
for
Netcong Borough, Morris County, New Jersey

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

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WILLIAM PENN
FOUNDATION

Introduction

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

Figure 1: Stormwater draining from a parking lot

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

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

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

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

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

Green infrastructure is an approach to stormwater management that is cost-effective, sustainable, and environmentally friendly. Green infrastructure projects capture, filter, absorb, and reuse stormwater to maintain or mimic natural systems and to treat runoff as a resource. As a general principal, green infrastructure practices use soil and vegetation to recycle stormwater runoff through infiltration and evapotranspiration. When used as components of a stormwater management system, green infrastructure practices such as bioretention, green roofs, porous pavement, rain gardens, and vegetated swales can produce a variety of environmental benefits. In addition to effectively retaining and infiltrating rainfall, these technologies can simultaneously help filter air pollutants, reduce energy demands, mitigate urban heat islands, and sequester carbon while also providing communities with aesthetic and natural resource benefits (USEPA, 2013).

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

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

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

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

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

Netcong Borough Impervious Cover Analysis

Located in Morris County in northern New Jersey, Netcong Borough covers approximately 0.96 square miles. Figures 3 and 4 illustrate that Netcong Borough is dominated by urban land uses. A total of 69.7% of the municipality's land use is classified as urban. Of the urban land in Netcong Borough, medium density residential is the dominant land use (Figure 5).

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

The New Jersey Department of Environmental Protection's (NJDEP) 2012 land use/land cover geographical information system (GIS) data layer categorizes Netcong 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 Netcong Borough. Based upon the 2012 NJDEP land use/land cover data, approximately 31% of Netcong Borough has impervious cover. This level of impervious cover suggests that the streams in Netcong Borough are likely non-supporting streams.

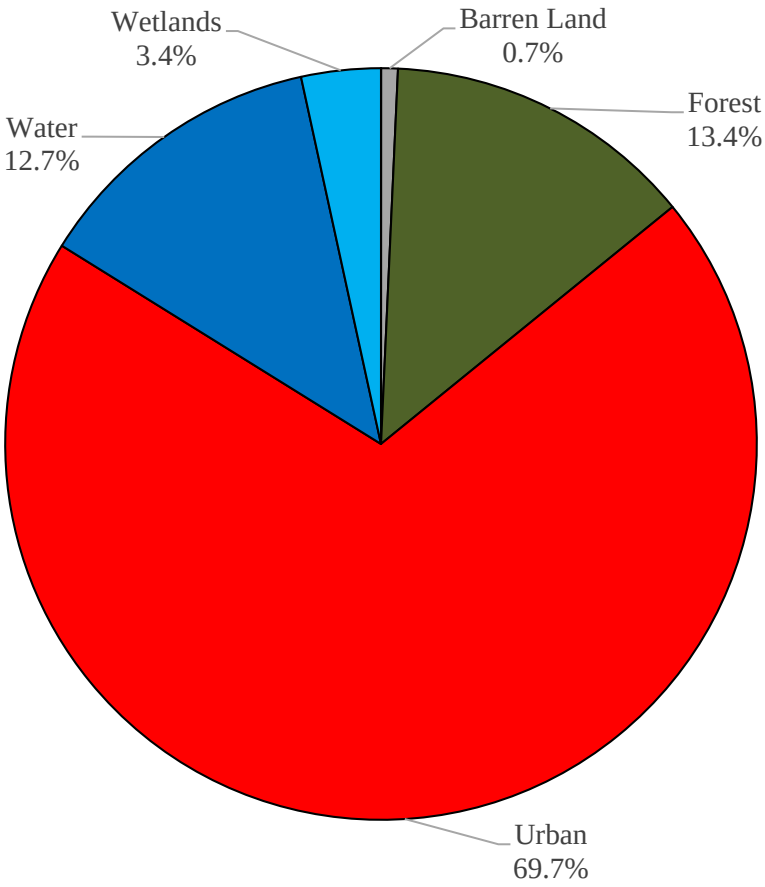


Figure 3: Pie chart illustrating the land use in Netcong Borough

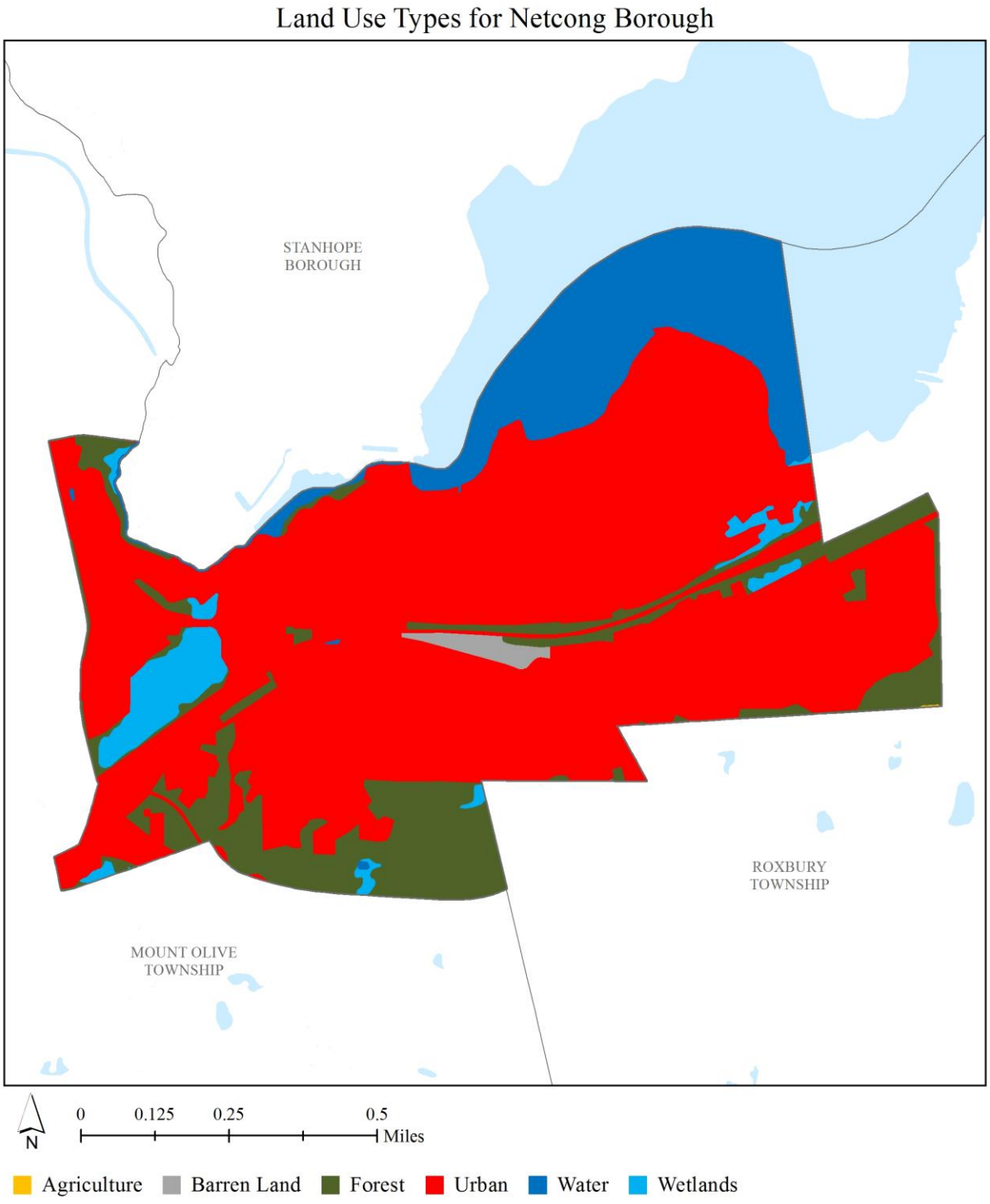


Figure 4: Map illustrating the land use in Netcong Borough

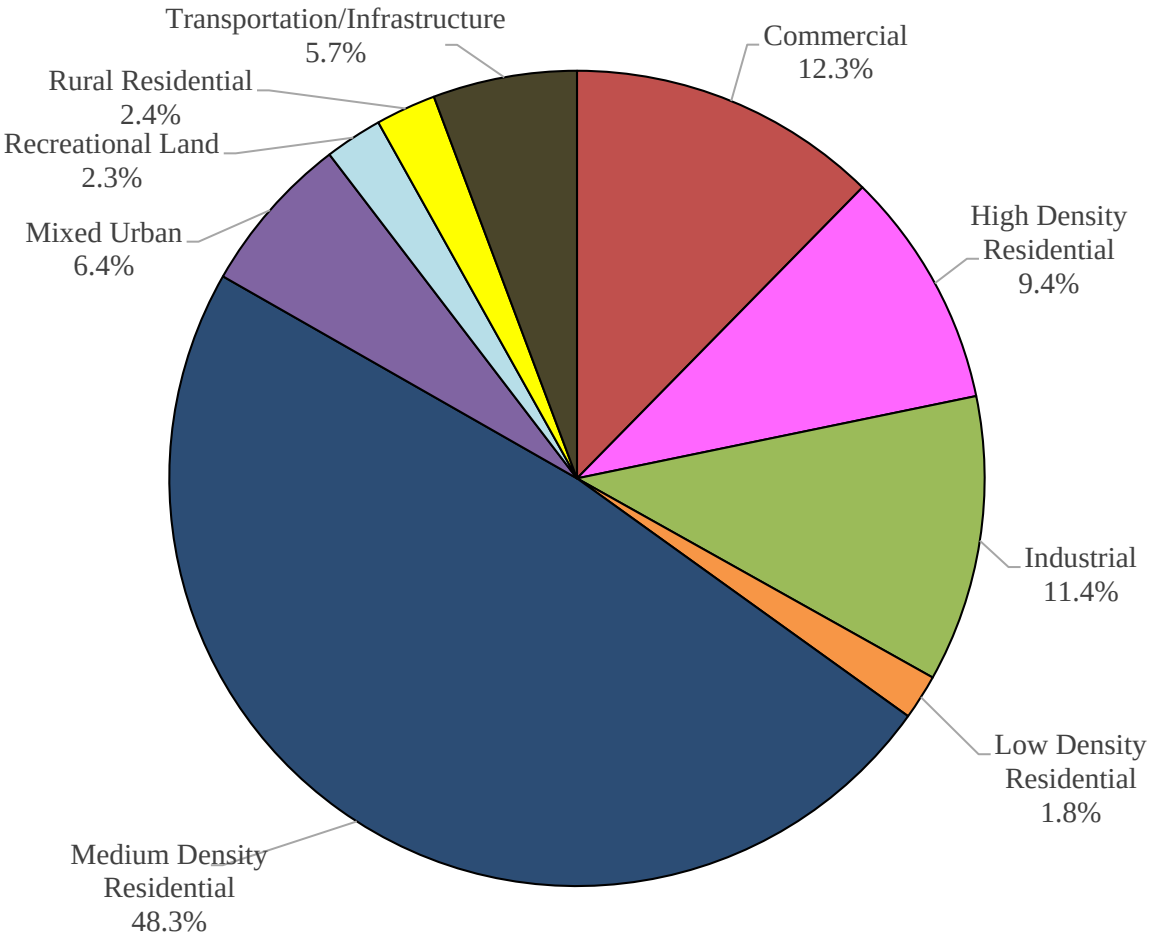


Figure 5: Pie chart illustrating the various types of urban land use in Netcong Borough

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each subwatershed within Netcong Borough (Table 1 and Figure 6). In Netcong, the Musconetcong River is the only subwatershed, and its impervious cover is 31%. 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 Netcong Borough, Morris 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 (3.5 inches of rain), the 10-year design storm (5.2 inches of rain), and the 100-year design storm (8.3 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater drains from impervious surfaces in Netcong Borough. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Musconetcong River subwatershed was harvested and purified, it could supply water to 51 homes for one year[1].

[1] Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for Netcong Borough

Subwatershed	Total Area		Land Use Area		Water Area		Impervious Cover		
	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(%)
Musconetcong River	612.0	0.96	534.0	0.83	77.9	0.12	165.6	0.26	31.0%
Total	612.0	0.96	534.0	0.83	77.9	0.12	165.6	0.26	31.0%

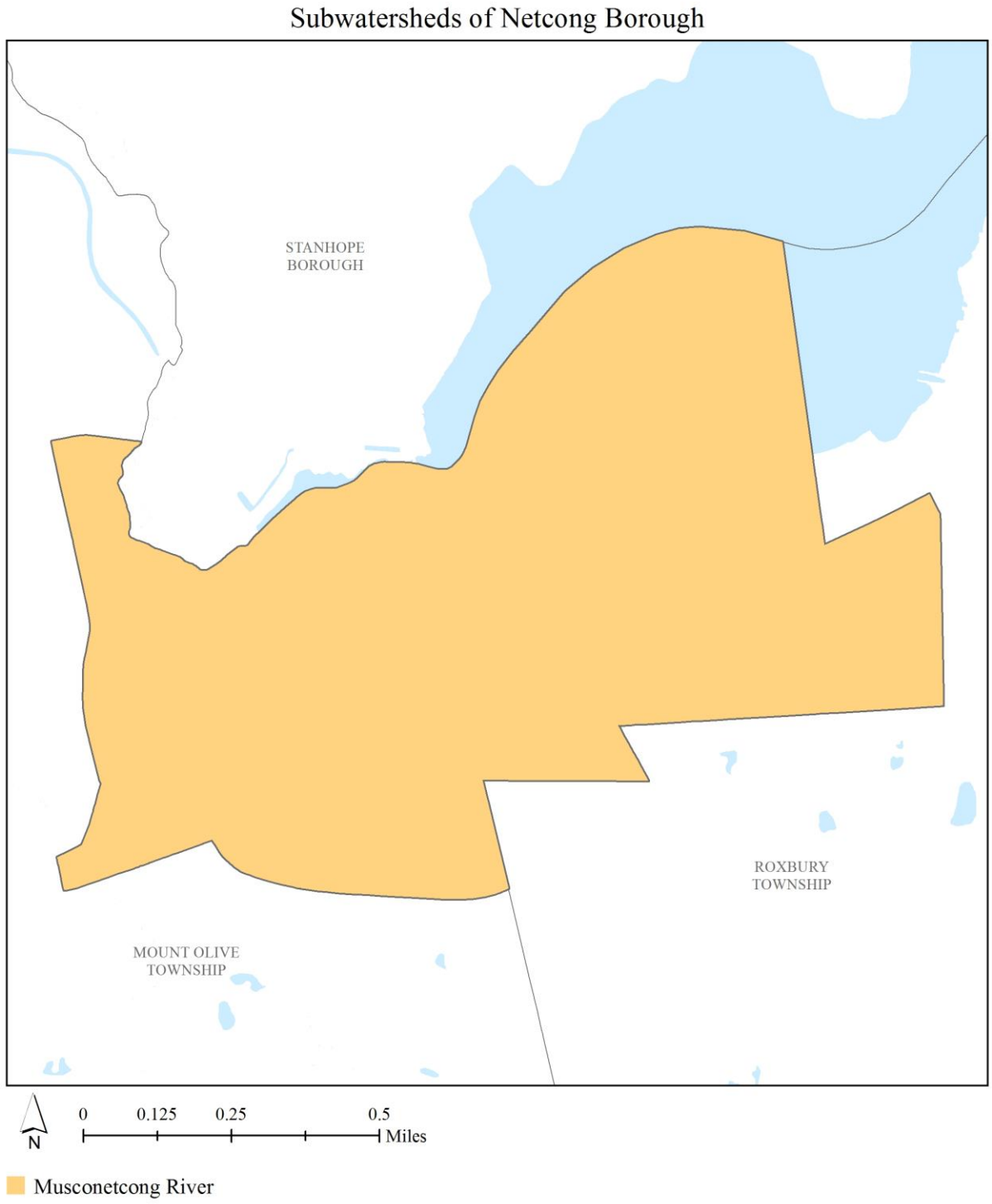


Figure 6: Map of the subwatersheds in Netcong Borough

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

Subwatershed	Total Runoff Volume for the 1.25" NJ Water Quality Storm (MGal)	Total Runoff Volume for the NJ Annual Rainfall of 44" (MGal)	Total Runoff Volume for the 2-Year Design Storm (3.5") (MGal)	Total Runoff Volume for the 10-Year Design Storm (5.2") (MGal)	Total Runoff Volume for the 100-Year Design Storm (8.3") (MGal)
Musconetcong River	5.6	197.8	15.7	23.4	37.3
Total	5.6	197.8	15.7	23.4	37.3

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 Netcong 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 (3.5 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 Netcong Borough

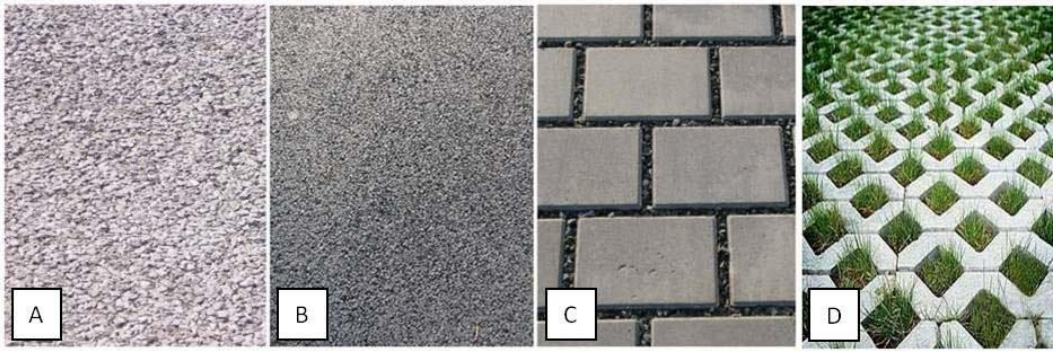
Subwatershed	**Recommended Impervious Area Reduction (10%) (ac)**	**Annual Runoff Volume Reduction[2] (Mgal)**
Musconetcong River	16.6	18.8
Total	16.6	18.8

[2] Annual Runoff Volume Reduction =
Acres of IC x 43,560 ft^2/ac x 44 in x (1 ft/12 in) x 0.95 x (7.48 gal/ft^3) x (1 MGal/1,000,000 gal)
All BMPs should be designed to capture the first 3.5 inches of rain from each storm. This would allow the BMP to capture 95% of the annual rainfall of 44 inches.

Pervious Pavement

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

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



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

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

Impervious Cover Disconnection Practices

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

- Simple Disconnection: This is the easiest and least costly method to reduce stormwater runoff for smaller storm events. Instead of piping rooftop runoff to the street where it enters the catch basin and is piped to the river, the rooftop runoff is released onto a grassed

area to allow the water to be filtered by the grass and soak into the ground. A healthy lawn typically can absorb the first one to two inches of stormwater runoff from a rooftop. Simple disconnection also can be used to manage stormwater runoff from paved areas. Designing a parking lot or driveway to drain onto a grassed area, instead of the street, can dramatically reduce pollution and runoff volumes.

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

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

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

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

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

Examples of Opportunities in Netcong 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 Netcong 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

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

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Appendix A

Examples of Impervious Cover Reduction Action Plan Projects

Concept Plans and Detailed Green Infrastructure Information Sheets

Netcong Borough
Impervious Cover Assessment
Municipal Garage and Fire Department, 40 Maple Avenue

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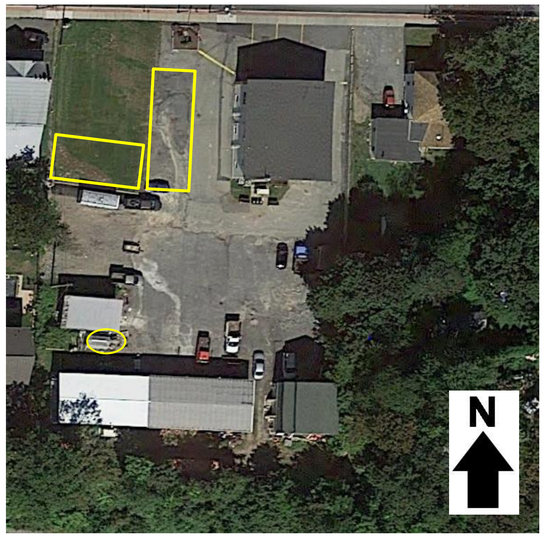
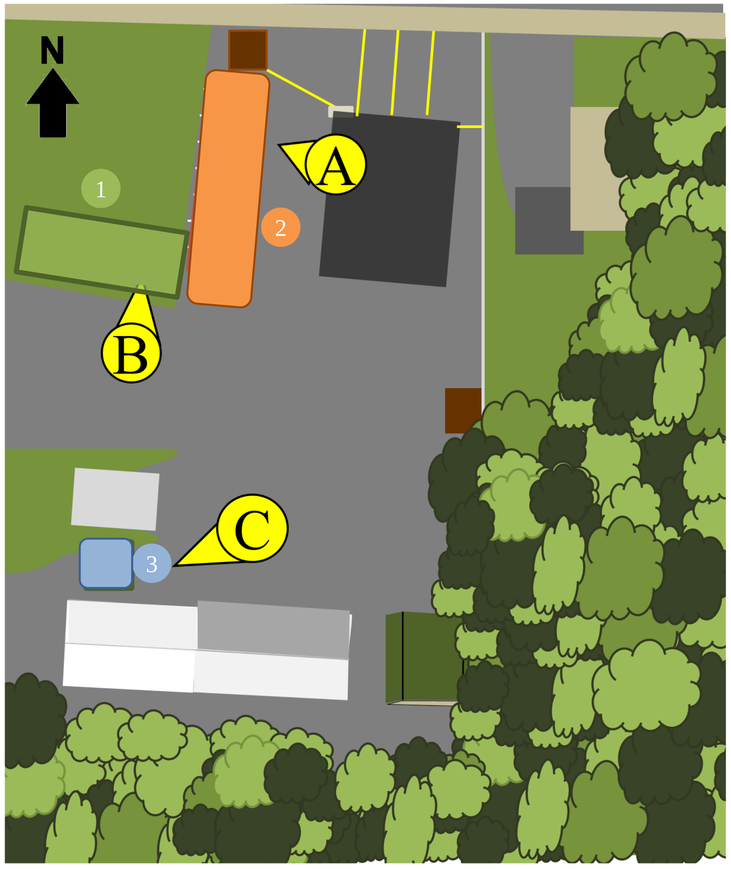
PROJECT LOCATION:



SITE PLAN:



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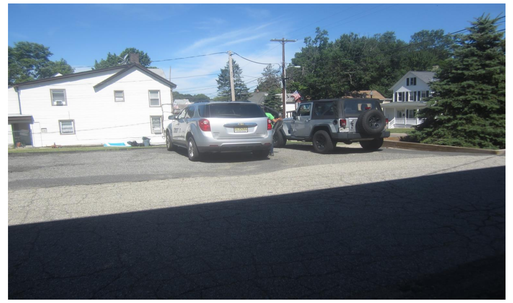

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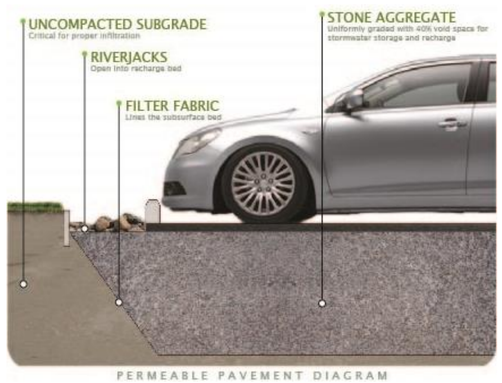
1 **BIORETENTION SYSTEM:** A bioretention system can be used to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge. One can be placed on the southern edge of the northwest grass area, which will receive stormwater from the area south of it, which is uphill.

2 **POROUS PAVEMENT:** Porous pavement promotes groundwater recharge and filters stormwater. The parking spots west of the fire house can be replaced with porous pavement.

3 **RAINWATER HARVESTING SYSTEM:** Rainwater can be harvested from the roof of the garage on the southwest corner and stored in a cistern. The water can be used to wash any DPW or Fire Department vehicles.

1 BIORETENTION SYSTEM

2 POROUS PAVEMENT



3 RAINWATER HARVESTING SYSTEM

<table>
<tr><td rowspan="2">Location:
40 Maple Avenue
Netcong, NJ 07857</td><td>Municipality:
Netcong Borough</td></tr>
<tr><td>Subwatershed:
Musconetcong River</td></tr>
<tr><td>Green Infrastructure Description:
bioretention system
porous pavement
rainwater harvesting system</td><td>Targeted Pollutants:
Total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff</td></tr>
<tr><td>Mitigation Opportunities:
recharge potential: yes
stormwater peak reduction potential: yes
TSS removal potential: yes</td><td>Stormwater Captured and Treated Per Year:
rain garden: 113,600 gal.
pervious pavement: 98,740 gal.
rainwater harvesting system: 43,420 gal.</td></tr>
<tr><td colspan="2">Existing Conditions and Issues:
The site has various impervious surfaces that include pavement and four buildings. The impervious surfaces drain to the street. There are no catch basins on the property. The site slopes south to north and begins to slope westward as it becomes parallel with the start of the northwest grass area. The firehouse has two disconnected downspouts on its south side as well as two on the west side. The garage to the southwest has four downspouts on both the north and south sides, all spaced evenly. The smaller buildings did not have any downspouts allowing runoff to empty directly onto the pavement. The property is bordered on the east (uphill) by a small wall that blocks any rain from flowing directly down the hill. It appears rainwater drains toward the grass area in the northwest corner of the lot, as the ground is sloped towards it and has no curb.</td></tr>
<tr><td colspan="2">Proposed Solution(s):
A rain garden could be installed in the northwestern grass area, which would capture runoff flowing downhill from the south as well as from the west side of the firehouse. Porous pavement could be used to replace the parking spots west of the firehouse, which would infiltrate runoff from the firehouse as well as any water flowing towards the street from the south or downhill from the east. A rainwater harvesting system could be put in place on the southern building with a cistern being placed on the western half of the northern side of the building. The downspouts could be rerouted so that they drain into the cistern. The harvested rainwater can be used to wash DPW and fire department vehicles.</td></tr>
<tr><td colspan="2">Anticipated Benefits:
Since the bioretention system would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.5 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. A bioretention system would also provide ancillary benefits, such as enhanced wildlife and aesthetic appeal.</td></tr>
</table>

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

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

Possible Funding Sources:
Netcong Borough
mitigation funds from local developers
NJDEP grant programs
Netcong Department of Public Works
Netcong Fire Department
local social and community groups

Partners/Stakeholders:
Netcong Borough
Netcong Department of Public Works
Netcong Fire Department
local social and community groups
local residents
Rutgers Cooperative Extension

Estimated Cost:
The rain garden is approximately 1,090 square feet, and at $5 per square foot it will cost approximately $5,450. The proposed pervious pavement covers approximately 1,170 square feet, and at $25 per square foot it will cost approximately $29,250. The cistern, which will hold 2,800 gallons of water at a time costs approximately $2 per gallon, making a cistern of that size cost $5,600. The total cost to complete all suggested practices will be approximately $40,300.

Netcong Borough

Impervious Cover Assessment

Netcong Elementary School, 26 College Road

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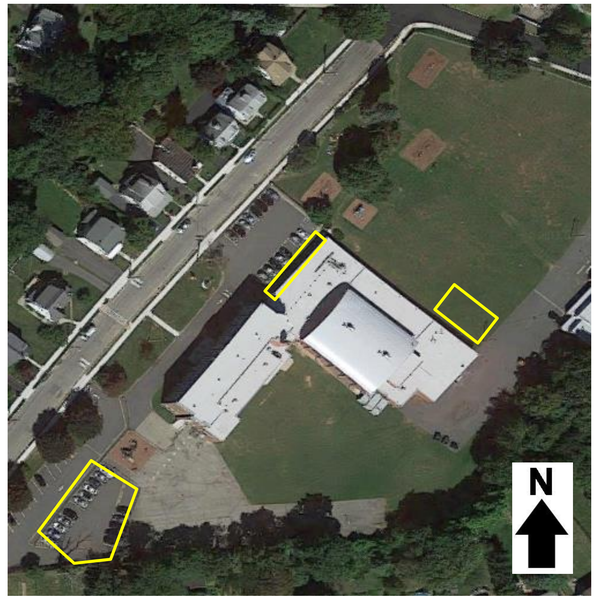
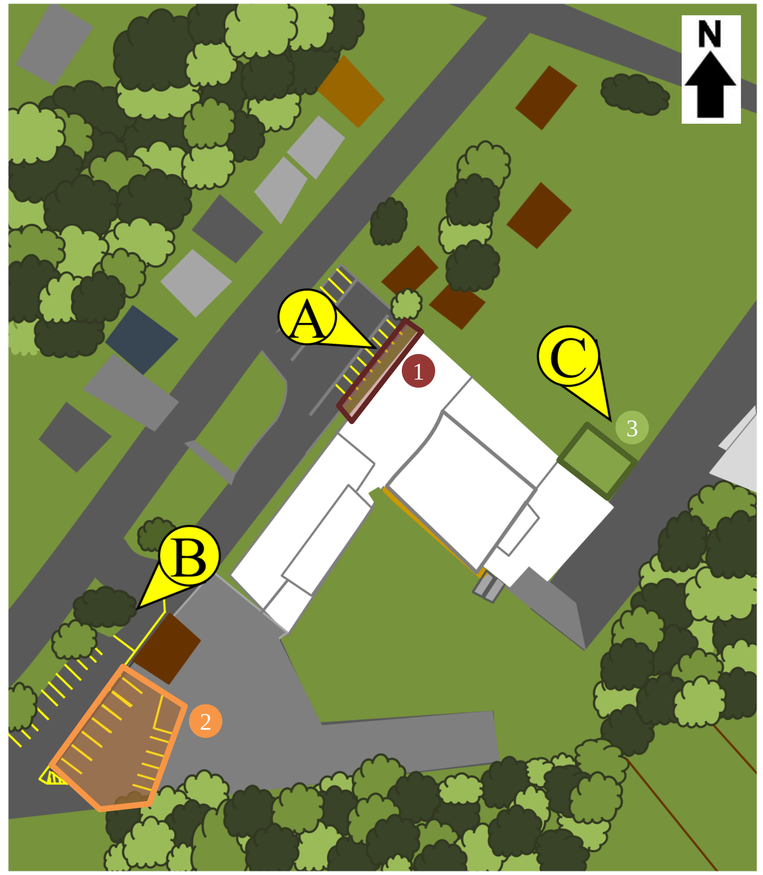
PROJECT LOCATION:



SITE PLAN:



1 **DOWNSPOUT PLANTER BOXES:** Downspout planter boxes are wooden boxes with plants that are installed at downspouts which provide an opportunity to reuse rooftop runoff. The northwest corner of the school could have these placed under the downspouts.

2 **POROUS PAVEMENT:** Porous pavement promotes groundwater recharge and filters stormwater. Porous pavement can be used to replace a portion of the southwest parking lot.

3 **BIORETENTION SYSTEM:** A rain garden can be installed to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge. This site has area for one rain garden to be installed off the northeastern side of the school.

A

B

C

1 DOWNSPOUT PLANTER BOX

2 POROUS PAVEMENT

PERMEABLE PAVEMENT DIAGRAM

3 BIORETENTION SYSTEM

Netcong Elementary School
Green Infrastructure Information Sheet

Location: 26 College Road Netcong, NJ 07857	**Municipality:** Netcong Borough
	Subwatershed: Musconetcong River
Green Infrastructure Description: bioretention system porous pavement rainwater harvesting system	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (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:** planter boxes: 23,886 gal. bioretention system: 78,166 gal. porous pavement: 233,456 gal.

Existing Conditions and Issues:

The school's impervious cover includes the building at the center and parking lots northwest, southwest, and east of it. The building is surrounded by disconnected downspouts, with three on the northern half of the northwest side that all drain to a catch basin in the lot. There are five on the northeast side that drain to the southeast in the eastern parking lot along with other sources that are causing standing water in depressions of the pavement. These downspouts have started to cause erosion next to the building as the water flows out of the downspouts and along a path parallel to that side of the building. The wall on the east half of the building that is facing southwest also has about four downspouts, all of which empty onto the ground. There is some visible erosion especially on the cement pathway which is almost covered in sediment. The eastern parking lot has dumpsters, meaning heavy vehicles use this on a regular basis, and pervious pavement is not an option there.

Proposed Solution(s):

Downspout planter boxes could be placed on the northwest facing side of the building. When connected to downspouts these boxes would reduce the runoff going directly into the catch basin and minimize erosion. Second, porous pavement can be installed in the southern parking lot to infiltrate runoff. A rain garden could be installed on the eastern edge of the northeastern side of the building. This would reduce the runoff from the northeastern side, as this part of the building has disconnected downspouts that drain downhill to the eastern parking lot.

Anticipated Benefits:

Since the bioretention system would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.5 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.

Planter boxes will take in runoff from downspouts and achieve similar reductions in TN, TP, and TSS as the bioretention systems.

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

Possible Funding Sources:
Netcong Borough
mitigation funds from local developers
NJDEP grant programs
Netcong Board of Education
Netcong Elementary School
Netcong Elementary School families

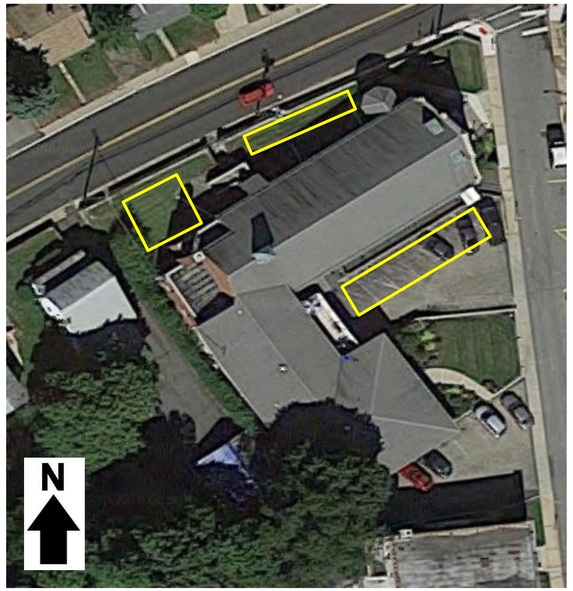
Partners/Stakeholders:
Netcong Borough
Netcong Elementary School
Netcong Board of Education
local social and community groups
local residents
Rutgers Cooperative Extension

Estimated Cost:
The planter boxes cost $300 each, therefore installing nine planter boxes would cost $2,700. The rain garden would need to be approximately 750 square feet. At $5 per square foot, the rain garden will cost approximately $3,750 in total. The porous pavement would cover 1,600 square feet. At $25 per square foot, the cost of the porous pavement system would be $40,000. The combined total to complete all the suggested green infrastructure practices would be $46,450.

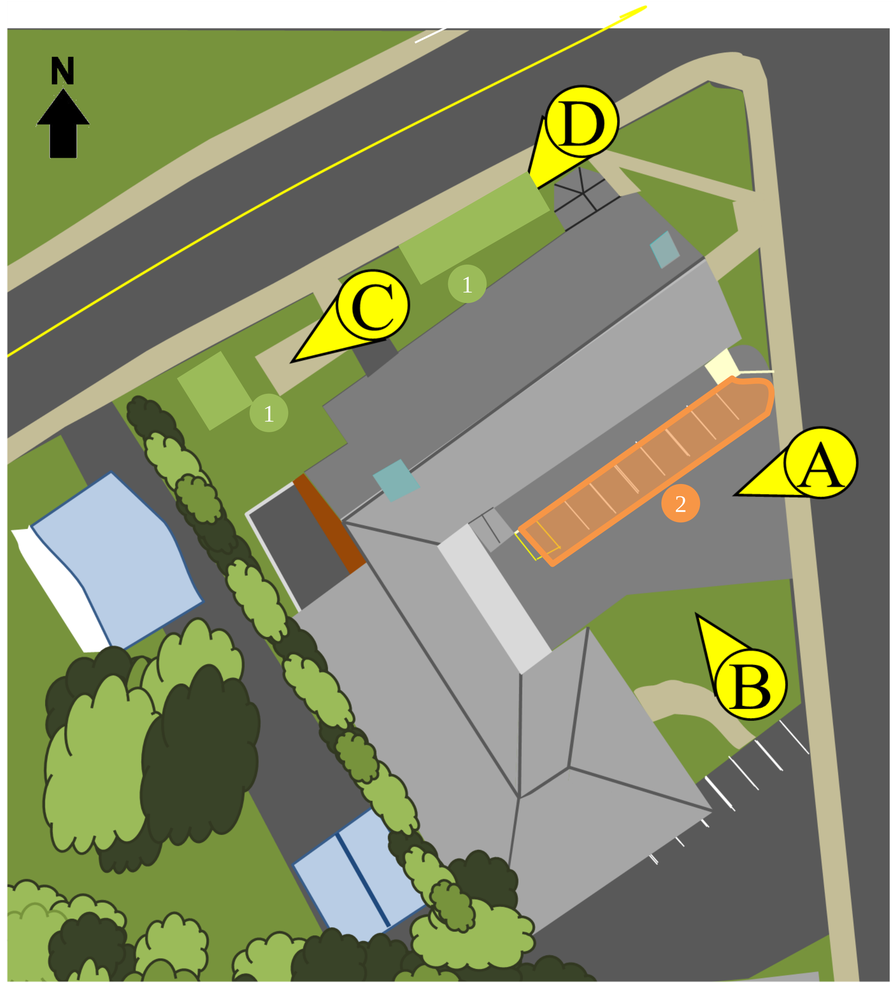
Netcong Borough
Impervious Cover Assessment
Saint Michael's Catholic Church, 4 Church Street

RUTGERS
New Jersey Agricultural Experiment Station

PROJECT LOCATION:



SITE PLAN:



A

B

C

D

1 **BIORETENTION SYSTEM:** Bioretention systems can be used to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge. There are opportunities to install rain gardens on the northwestern side of the church.

2 **POROUS PAVEMENT:** Portions of the northern parking lot, on the east side of the picture's center, can be retrofitted to porous pavement, which promotes groundwater recharge and filters storm water

1 BIORETENTION SYSTEM

2 POROUS PAVEMENT

Saint Michael's Catholic Church
Green Infrastructure Information Sheet

Location: 4 Church Street Netcong, NJ 07857	**Municipality:** Netcong Borough
	Subwatershed: Musconetcong River
Green Infrastructure Description: bioretention system (rain garden) porous pavement	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (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: 30,485 gal. bioretention system #1: 11,334 gal. porous pavement: 204,795 gal.

Existing Conditions and Issues:
The impervious cover at the church includes the building, two parking lots, and walkways. The parking lots are surrounded by curbs or brick walls. The northern lot has a catch basin in the northeast corner. The northern side of the building has four disconnected downspouts, with 10 foot extensions that allow runoff to drain in the turf grass.

Proposed Solution(s):
Installing two rain gardens on the northern side of the building would help reduce the amount of stormwater that reaches the catch basins. The two parking lots could be replaced with porous pavement, which would provide stormwater an opportunity to infiltrate and reduce the amount of runoff that enters the nearby catch basins.

Anticipated Benefits:
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.5 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. A bioretention system would also provide ancillary benefits, such as enhanced wildlife and aesthetic appeal.

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

Possible Funding Sources:
Netcong Borough
mitigation funds from local developers
NJDEP grant programs
Saint Michael's Catholic Church
local social and community groups

Partners/Stakeholders:
Netcong Borough
Saint Michael's Catholic Church
clergy and parishioners
local social and community groups
local residents
Rutgers Cooperative Extension

Estimated Cost:
Rain garden #1 would need to be approximately 300 square feet. At $5 per square foot, the estimated cost is $1,500. Rain garden #2 would need to be approximately 100 square feet. At $5 per square foot, the estimated cost is $500. The porous asphalt would cover 1,400 square feet and have a 2-foot stone reservoir under the surface. At $25 per square foot, the cost of the porous asphalt system would be $35,000. The total cost of the project will thus be approximately $37,000.