# Rutgers River Friendly Business Program
# Morris County Program Guidance

Bulletin E346b

RIVER FRIENDLY BUSINESS PROGRAM

## Cooperative Extension

*Pat Rector, County Agent, Agriculture & Resource Management*
*Christopher C. Obropta, PhD., P.E., Environmental Specialist Water Resources, Rutgers Water Resources Program, RCE*
*Jessica T.R. Brown, Program Associate, Rutgers Water Resources Program, RCE*

## Acknowledgements

We owe much within these pages to New Jersey Water Supply Authority, Watershed Protection Programs Division, who runs a sister program in Somerset and Hunterdon Counties. They, in turn, owe much to Stony-Brook Millstone Watershed Association who began a River Friendly Program in 2003. In the environmental field, as in many fields, the best we can hope, is to gratefully and humbly build utilizing tools others have provided.

The Rutgers River Friendly Program in Morris County is collaboration between Rutgers Cooperative Extension of Morris County and Rutgers Water Resources Program. Contributions and expertise has been provided by Pat Rector, Environmental and Resource Management Agent for Morris and Somerset Counties, Dr. Christopher C. Obropta, Extension Specialist, Rutgers Cooperative Extension; Michele Bakacs, Environmental and Resource Management Agent for Middlesex and Union Counties; Jessica T.R. Brown, Program Associate, Rutgers Water Resources Program; Dr. Salvatore S. Mangiafico, Environmental and Resource Management Agent for Salem and Cumberland Counties; Dr. Brooke Maslo, Wildlife Specialist, Rutgers Cooperative Extension; and Dr. Amy Rowe, Environmental and Resource Management Agent for Passaic and Essex Counties.

This project has been funded by the New Jersey Department of Environmental Protection under Section 319(h) of the Clean Water Act (Grant Identifier: RP11-048 Troy Brook Implementation Project Phase II) and by the New Jersey Agricultural Experiment Station.

## Table of Contents


| | |
|---|---|
| Overview | 2 |
| Program Structure | 2 |
| **Stormwater Management: The Road to Disconnection** | |
| Introduction | 3 |
| Objective | 3 |
| Option 1: Rain Garden | 4 |
| Option 2: Bioswale | 5 |
| Option 3: Pervious Pavement | 6 |
| Option 4: Rain Harvesting | 8 |
| Option 5: Tree Box | 8 |
| References/Resources | 9 |
| **Outdoor Water Conservation** | |
| Introduction | 11 |
| Objective | 12 |
| Option 1 | 13 |
| Option 2 | 14 |
| Option 3 | 14 |
| Option 4 | 14 |
| References/Resources | 15 |
| **Lawn Maintenance: a Greener Corporate Campus** | |
| Introduction | 17 |
| Objective | 17 |
| Option 1 | 18 |


RUTGERS
New Jersey Agricultural Experiment Station

Rutgers, The State University of New Jersey
88 Lipman Drive, New Brunswick, NJ 08901-8525
Phone: 848.932.5000

| | |
|---|---|
| Option 2 | 18 |
| Option 3 | 19 |
| Option 4 | 20 |
| References/Resources | 23 |
| **Wildlife Management** | |
| Introduction | 25 |
| Objective | 26 |
| Option 1 | 26 |
| Option 2 | 28 |
| Option 3 | 28 |
| References/Resources | 29 |


## Overview

The River-Friendly Business Program (RFBP) is a voluntary certification program in Morris County to encourage businesses to adopt various conservation and stormwater practices to reduce their environmental impact on the local waterways. The initial funding for this program is being provided by a grant from New Jersey Department Environmental Protection (NJDEP) through funding from Section 319(h) of the Clean Water Act. While this grant targets the Troy Brook watershed, the RFBP is available to all businesses in Morris County. The Program is intended to be a collaboration between businesses within Morris County, their employees, and Rutgers Cooperative Extension. Upon completion of the RFBP Certification requirements businesses receive public recognition of their achievement at an award ceremony. Rutgers will provide public acknowledgment of the tremendous achievement attained with a plaque suitable for roadside display. Businesses who achieve RFB Certification will be acknowledged on the Rutgers University, Cooperative Extension Water Resources Program, and the Rutgers Cooperative Extension of Morris County websites. In participating municipalities, the mayor will present a plaque to the business recognizing their leadership as a sustainable business within their community.

The goal of the RFBP program is to work with businesses to adopt various sustainable practices that reduce their environmental impact on the local waterways. These practices will not only improve water quality and help reduce flooding, but also promote wildlife habitat and provide economic benefits to the business and the community. Estimates are that annual ecosystem services provided by forests, wetlands, oceans, grasslands and other natural landscapes are approximately $33 trillion/year on a global scale while the global gross national product is $18 trillion/year (Sustainable Sites Initiative 2009). Goldman Sachs has dubbed water "the petroleum for the next century." It makes economic sense to be a leader in the community by creating a sustainable river friendly business campus. It can have a dramatic improvement on the business's "triple bottom line ."

There are four leadership aspects related to River Friendly Businesses: Improving the Environment; Increasing Employee Satisfaction and Productivity; Being a Good Community Partner; and Providing True Business and Economic Leadership.

## Program Structure

The RFBP is a voluntary program and structured around the needs of the individual business. The program is structured so that for each category; 1) stormwater management, 2) water conservation, 3) lawn maintenance and 4) wildlife management the business will choose from various options to achieve each category's objective. Certification is achieved when the business achieves all four category objectives. Site visits will be conducted with Rutgers Cooperative Extension (RCE) to determine with the business which site-specific actions would be most appropriate based on the technical aspects, individual location and business characteristics. RCE faculty and/or staff will work with the business to develop a Plan for achieving the desired objectives.


Sustainable Sites Initiative. (2009). The Sustainable Sites Initiative: Guidelines and Performance Benchmarks 2009. Retrieved January 23, 2013. Available at sustainablesites.org/report.


[1]The triple bottom line is made up of "social, economic and environmental" factors. Triple bottom line accounting expands the traditional reporting framework to take into account social and environmental performance in addition to financial performance.

# Stormwater Management: The Road to Disconnection

Pat Rector, Rutgers Cooperative Extension[2]
Environmental and Resource Management Agent
Morris and Somerset Counties

Christopher C. Obropta, Ph.D., P.E.[3]
Rutgers Cooperative Extension
Rutgers Water Resources Program

## Introduction

Several impacts can be associated with increases in impervious surfaces such as increased pollution to the stream, increased flooding, reduced groundwater supplies due to less infiltration, and stream bank erosion. As Booth et al. put it, "thus no single change defines urbanization; instead, the cumulative effect of the variety of human activities in urban basins profoundly influences urban streams and their biota." Pollutants such as oils, fecal coliform, nutrients and metals collect on impervious surfaces and are washed into the storm sewer system or directly to the local waterway during rainfall events. These pollutants can degrade the stream quality, harming the aquatic life in the stream and possibly causing human health issues for those using the stream for recreation. The sediment carried by the stormwater can smother immature fish and also insects that fish depend on for feeding, thus changing the food web and the ecosystem. The flashy hydrology (i.e., the rapid rising of streams to exceeding its banks) caused by increase in impervious surfaces not only causes flooding but also causes stream bank erosion (Fig.1), damaging the infrastructure such as roads, bridges and buildings. Additionally, these impervious surfaces reduce the opportunity for rainwater to infiltrate and replenish the groundwater.

> ***Impervious surfaces*** *are defined as any surface that has been covered with a layer of material so that it is highly resistant to infiltration by water. Examples include but are not limited to paved roadways, paved parking areas, and building roofs.*

Economic impacts of excess nutrients in our streams and lakes can vary. Some of these impacts include increased costs of water treatment, loss of lake property values, loss of tourism, and loss of recreation and angling.



*Fig. 1. Evidence of erosion in NJ stream. Photo credit: Pat Rector.*

It is estimated that 15% of a lakefront home value is lost for every three feet in water clarity that is lost. The most common reason for loss of water clarity is due to increased algal activity with increased nutrients in the water. U.S. lakefront property value loss estimates based on changes in water quality due to nutrients were $0.3-$2.8 billion dollars per year (Dodds et al. 2008). Water treatment costs also increase due to turbidity from increased sediment loads entering waterways.

Connected impervious surfaces flow directly to local waterways or to a stormwater collection system that carries the flow through pipes to the stream. As the stormwater runoff moves from the connected impervious surface to the local waterway, the runoff is not treated or allowed to infiltrate. A decrease in connected impervious surfaces allows for the stormwater that falls onto the impervious surface to be stopped from entering the storm sewer system or from flowing directly to the local waterway.

**Objective: Reduce Connected Impervious Area (rooftops and/or paved areas) by 20% on site:**

*Baseline Required Actions:*

Provide a site plan or sketch with delineation of pervious and impervious surfaces including the area of each in square feet

2. Identify areas of impervious surface that are currently disconnected.
3. Host one educational stormwater management workshop/event for employees. An example would be a rain garden workshop for employees that includes installation of a rain garden along with education of employees.

[2]P.O. Box 900, Morristown, N.J. 079630900 rector@njaes.rutgers.edu
[3]G.H. Cook Campus, 14 College Farm Road, New Brunswick, N.J. 08901

*Site-Specific Options:*

There are several options to assist in achieving this objective of reducing connected impervious surfaces by 20% such as installing rain gardens, bioswales, pervious pavement, rainwater harvesting system, tree boxes or another stormwater management practice that fits within your site conditions. All systems are not suitable for all sites, and varying methods to achieve disconnection and infiltration will be based on the site specific considerations such as soil permeability. The site-specific options will be developed for the River Friendly Plan based on the site conditions and the business preferences.

**Option 1: Install a rain garden(s) to disconnect roof top or parking lot/road runoff.**

Pat Rector, Rutgers Cooperative Extension[4]
Environmental and Resource Management Agent
Morris and Somerset Counties

A rain garden is a landscaped, shallow depression that captures, filters, and infiltrates stormwater at the source, before it becomes runoff (Obropta and Salisbury 2010). Rain gardens are not designed to control large flooding events. The purpose of a rain garden is to help reduce runoff from the smaller storms. In New Jersey almost 90% of rain events are one-inch or less. Many rain gardens will capture and infiltrate runoff from rain events of two-inches or more. More than one rain garden can and may need to be installed to capture, treat and infiltrate the rooftop runoff or parking lot runoff. At the Parsippany-Troy Hills Municipal Building two rain gardens were planted in the front by volunteers (Figs. 2 and 3 ) (150 $ft^2$/each garden) and a large rain garden was installed in the rear (1,700 $ft^2$) (Fig. 4) disconnecting a total of 9,400 $ft^2$ or 75% of an 12,500 $ft^2$ roof (Obropta and Pearson 2012). The rain gardens capture, treat and infiltrate 50,000 gallons of stormwater runoff annually; this is stormwater that originally entered the storm sewer system in the parking lot and fed directly into the Troy Brook.

A significant amount of runoff can be reduced from the storm sewer system and ultimately from the rivers and streams if a community undertakes a dedicated effort to install rain gardens. In a paired study of two neighborhoods in Burnsville, MN researchers found a 90% reduction of average runoff volumes after the installation of 17 rain gardens ci.burnsville.mn.us/DocumentCenter/Home/View/449. In Seattle, WA a neighborhood stormwater management program using various practices, including rain gardens,



*Fig. 2. Parsippany-Troy Hills Municipal Building Rain Garden after a 2.46 inch rain storm over 24 hours in January. Photo credit: Pat Rector.*



*Fig. 3. Parsippany-Troy Hills Municipal Building Rain Garden 22 hours after the same storm as Fig. 2. Photo credit: Pat Rector.*



*Fig. 4. Rain Garden at the rear of the Parsippany-Troy Hills Municipal Building. Photo credit: Pat Rector.*

[4]P.O. Box 900, Morristown, N.J. 079630900 rector@njaes.rutgers.edu

bioswales, and tree planting reduced impervious surfaces by 11% over 2.3 acres and reduced 98% of wet season flow leaving the neighborhood (US EPA 2012).

Rain gardens remove pollutants in addition to reducing the amount of water that enters the storm sewer system. The soils in the rain garden help to filter pollutants as a physical process and pollutants also cling to the soil particles in a chemical process. The plants in a rain garden help remove nutrients, a source of increased algae and plant growth in lakes and streams in New Jersey, and also remove some heavy metals that are harmful to aquatic life.

Rain gardens function not only to infiltrate rain water runoff and to provide pollutant removal, but also can provide wildlife habitat. Native plants are often planted in rain gardens and help provide habitat for native insects such as bees, butterflies, birds, etc. Native plants are adapted to the local climate and soils and tend to require less fertilizer, lime and other soil amendments than some other ornamental landscape plants. This can help reduce landscape maintenance costs. Rain gardens do require maintenance such as weeding, including invasive species removal, replacing mulch and awareness and remediation of areas of erosion or gully formation. This maintenance should still be less than a traditional garden, typically on a spring and fall schedule.

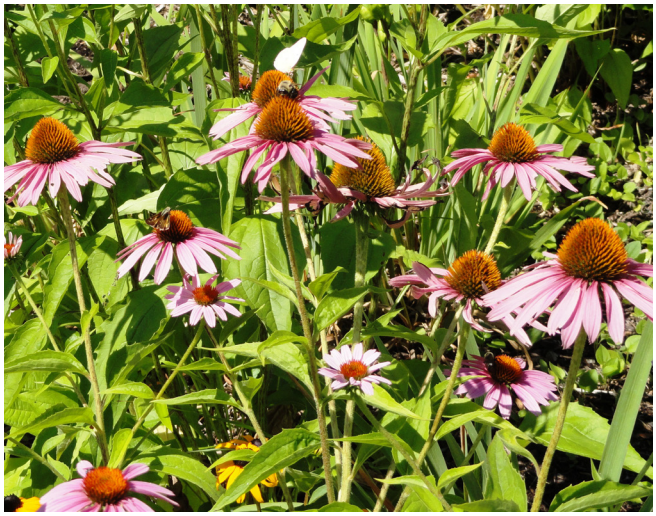


*Fig. 5. Bees on Purple coneflowers (Echinacea) plants in a rain garden. Photo credit Pat Rector.*

The installation costs of a residential rain garden in New Jersey are estimated to be $3 to $5/ft2 if it is constructed by the homeowner (Obropta and Salisbury 2010). Rain gardens can often be installed with assistance from volunteers or as part of an employee educational workshop after the site is prepared. For a list of certified landscapers who have received rain garden training please visit the Rain Garden Installation Services Directory at njaes.rutgers.edu/pubs/publication.asp?pid=E326.

**Option 2: Install a bioswale(s) to disconnect parking lot runoff**

Jessica T.R. Brown, Program Associate[5]
Rutgers Cooperative Extension
Rutgers Water Resources Program,
Christopher C. Obropta, Ph.D., P.E.[6]
Rutgers Cooperative Extension
Rutgers Water Resources Program

Bioswales are vegetated channels with gently sloped sides that are designed to remove or reduce the amount of pollutants in stormwater runoff. Bioswales are also often referred to as vegetated stormwater conveyances (NJ Department of Environmental Protection Stormwater Manual, 2004). These swales can be vegetated or grassed, depending upon the magnitude and type of pollutants that are being targeted. It is important to note that all runoff entering the bioswale must enter and flow through the swale as sheet flow to obtain maximum pollutant removal. Sheet flow is when the water enters and flows in a thin, uniform layer of runoff flowing over the ground surface. Turbulence in the water flow can reduce pollutant removal. To increase detention time and therefore allow pollutants to settle, check dams can be added to the design of swales. Check dams create small pools of water along the length of a swale that can slow the peak rate at which water flows through (Fig. 6).

The main purpose of bioswale implementation is to treat stormwater runoff before it is released back into our local waterways. These natural draining systems help recharge groundwater while decreasing the need to implement other retention systems. Various common applications for bioswales are treating stormwater runoff from small impervious surface areas, such as alongside parking lots, roadways and in residential areas.

[5]G.H. Cook Campus, 14 College Farm Road, New Brunswick, N.J. 08901 jess@envsci.rutgers.edu
[6] G.H. Cook Campus, 14 College Farm Road, New Brunswick, N.J. 08901 obropta@envsci.rutgers.edu



*Fig. 6. Check dam at Parsippany-Troy Hills Department of Public Works facility. Photo credit Pat Rector.*

Various types of vegetation can be used in a bioswale. Native plants or turfgrass are the most common vegetation used. The more well-established the vegetation, the greater the chances are of trapping particulate pollutants. In addition, dense vegetation can reduce the flowrate at which the stormwater runoff flows. The use of plants to remove or neutralize pollutants, a process known as phytoremediation, has been found to work best with some pollutants and some studied plants have shown good removal properties. Vegetated swales have been found to remove pollutants through phytoremediation, including hydrocarbons that are often a byproduct of fuel. Certain species of plants are better suited to removal of hydrocarbons, including Big bluestem (*Bouteloua curtipendula*), perennial ryegrass (*Lolium perenne*) and switchgrass (*Panicum virgatum*) (Fricke et al. 1999) and these are also good plants for a vegetated swale (Fig. 7).

Vegetated swales can be implemented wherever the local climate and soils can permit the growth and establishment of dense vegetation. Areas of higher slopes, larger areas and irregular land settings must be taken into account as well when implementing swale systems.

Cost predictions for vegetative swales can vary greatly. The variations in design, local labor, plant selection, materials, and other factors play an essential role throughout the cost analysis. It is recommended that native plants are planted within the swale due to climate and soil adaptation. Estimating the cost for grassed swales varies due to the types of grasses that can be chosen. Structural retrofits and enhancements can add additional costs as well. Actual costs for swale implementation range from $10-$80 per linear foot depending on the swale dimensions, amendments, and vegetation.

Grassed swales cost less to construct than most other BMP's because typically there is no need for excavation and constructing underground piping systems. However, underdrains may be used in areas that need additional drainage mechanisms. The design of bioswale systems is relatively standard, and usually no special permitting costs are required (M. Clar et al., 2004).



*Fig. 7. Bioswale installed at the Parsippany-Troy Hills Department of Public Works facility to treat runoff from the parking lot. Perennial ryegrass, planted to reduce hydrocarbon concentrations, grows in the channel of the vegetated swale. Photo credit Pat Rector.*

Effective performance of the swale system requires periodic maintenance. All swales are expected to trap a significant amount of debris and sediment accumulation after large rain storms exceeding 1 inch of rainfall. Excessive accumulations of debris and sediment may impede the swale's functionality, especially if designed with check dams. A pretreatment device, such as a forebay, should be used to capture sediment, particularly if there is excess sediment entering the swale. A forebay is a small pool, or device, located near the inlet of a stormwater management practice that will provide storage area as sediment is dropped out of the water, and easy access to remove the sediment. The pretreatment device will extend the lifetime of the swale by reducing clogging and the replacement of plants. Pretreatment devices are also helpful for the maintenance of the practice, reducing the area of impact and the frequency of maintenance along the entire swale system.

**Option 3: Install pervious pavement**

Amy Rowe, Ph.D., Rutgers Cooperative Extension[7]
Rutgers Environmental and Resource Management Agent, Passaic and Essex Counties

A permeable (also called porous or pervious) surface is any surface that allows water to pass through it. Permeable pavement is a system that allows rainwater and stormwater runoff to move through the pavement's surface to a storage layer below and then to eventually seep into the underlying soil where this water can then replenish groundwater or local waterways. Generally, a permeable pavement system consists of the permeable surface, the storage layer of large open-graded stone gravel, a separation layer of small stone or a permeable geotextile filter fabric for stability, and the underlying soil. The depth of this storage layer is usually between 6 and 12 inches, but it can be increased if more storage is required or if there are poorly draining soils below the system (Fig. 8). The depth of the storage layer may also vary over the length of the permeable pavement system if the pavement area is sloped. These pavement systems are ideal for parking lots, driveways, alleys, sidewalks, and playgrounds. Permeable pavement systems can handle large stormwater volumes while also providing both economic, environmental, and safety benefits.

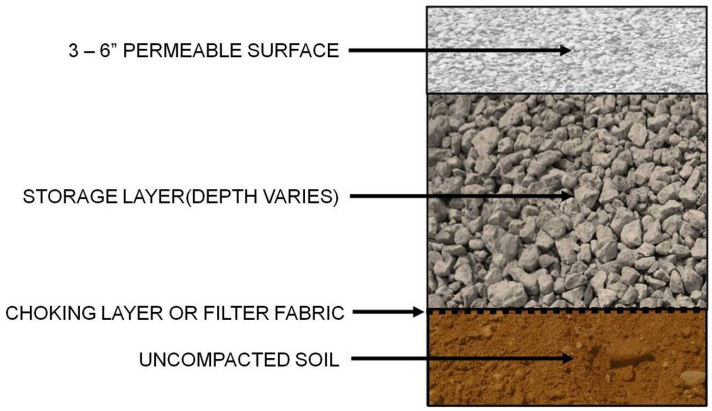



*Fig. 8. Schematic of permeable pavement profile. Courtesy of Amy Rowe, N.J. Agricultural Experiment Station.*

Permeable pavement can provide environmental benefits by reducing stormwater volume as runoff is captured and infiltrated into the native soil below the system. Peak runoff flow can be decreased and delayed because permeable pavement holds stormwater back, infiltrates the water into the underlying soil over time, and reduces the burden on the storm sewer system. Nonpoint source pollution in streams can be prevented by filtration of contaminants as runoff flows through the system and as organic pollutants are broken down by microbes that live in the pore spaces and storage layers. Permeable pavement systems allow for infiltration to the native soil, which can lead to the replenishment of the groundwater supply. Permeable pavement allows for air movement through the pore spaces, making the pavement cooler than traditional pavement (Rowe, 2012).

Permeable pavement can provide a number of safety benefits that are related to the surface openings. Black ice does not form on permeable pavements because as snow melts in the day's sunshine, the meltwater flows quickly past the surface into the storage layer. On traditional asphalt, meltwater often has nowhere to go and freezes as temperatures drop leading to black ice formation. Permeable pavement roadways and parking lots are not susceptible to pot holes because water flows quickly through the surface layer without any opportunity for freezing. There is no freeze-thaw heaving because the permeable surface infiltration rates are so high that meltwater does not freeze and expand in the pores. The open pore structure of permeable pavement also leads to reduced road spray which results in increased visibility during precipitation events. Finally, permeable pavements can reduce road noise because some sound waves are absorbed rather than reflected.

Permeable pavement systems can offer a variety of economic benefits. With permeable pavement, traditional stormwater-handling techniques are often not necessary. There will be less need for stormwater inlets and catchbasins, conveyance pipes, land for detention basins, or detention basins. Disconnection from the sewer system through the installation of permeable pavement reduces any sewer utility fees at the site. Some cities charge additional stormwater fees based on the impervious cover on the property. Since permeable pavement can be used to combine stormwater management with parking areas, the property that would have been used for a detention pond can be used for another function. This may increase income while reducing costs by having more storefront available for vendors, being able to accommodate more customers, or providing green space that attracts people to the area. Permeable pavement can cost less in the long-term than traditional pavement due to increased durability and better freeze-thaw performance in the winter. The occurrence of potholes is greatly reduced because water does not become trapped at the permeable pavement surface the way it does with traditional asphalt. This means less patching, increased safety, and longer-lasting pavement. Permeable pavement can also reduce other winter-related costs. Snow melts more quickly on

[7]621a Eagle Rock Avenue, Roseland, N.J. 07068. rowe@njaes.rutgers.edu

a permeable surface in a sunny location, which results in a lack of black ice formation, so there is reduced de-icing chemical usage.

Permeable pavement has some upfront costs that are not a part of traditional asphalt surfacing due to the complex system that is installed. There are some approaches to reducing the costs of a permeable pavement installation. One popular installation technique is to pave parking stalls with permeable surfaces, but leave the driving lanes as traditional asphalt. This will reduce cost and will also improve the lifetime of the permeable surface without giving up stormwater management benefits. Some site owners install permeable pavement selectively to prevent drainage issues in high-traffic or "trouble" spots.

Permeable pavement is an engineered system and there are many factors that need to be examined prior to determining site suitability. It is recommended that permeable pavement be installed by an industry-certified contractor with a site design approved by a licensed engineer.

**Option 4: Disconnect roof runoff utilizing a rain harvesting system. Note the system must disconnect a connected impervious surface.**

Pat Rector, Rutgers Cooperative Extension[8]
Environmental and Resource Management Agent
Morris and Somerset Counties

Cisterns collect water that typically runs off an impervious surface, commonly roof tops (Fig. 9). Cisterns vary in size from 100 gallons to 10,000 gallons, and larger depending upon the size of the source. Cisterns enable harvesting of rain water for irrigation or other non-potable water uses. Rain water collected in cisterns and rain barrels is not usable for drinking and is not suggested for vegetable gardens without laboratory testing.

The economic benefit of cisterns will vary depending upon several factors; predominately the amount of rainfall in a given year and the cost of potable water. Average rainfall amount is typically used to provide an estimate. For example, rainfall data analyzed by The Weather Channel for Parsippany, NJ, 2011 (weather.com/weather/wxclimatology/monthly/graph/USNJ0391 ) estimates a low monthly precipitation of 2.9 inches and a high of 4.89 inches, with a total for the year of 50.9 inches and an average monthly precipitation of 4.24 inches. Many cisterns will not be connected during the winter months (typically from November through March) so the total rainfall that can be expected on average to be harvested would be 36.2 inches per year.

The benefit will also depend upon the amount of water conserved and utilized for irrigation, thereby saving the cost of water from the potable public supply system. The cost of water varies by municipality and often by use. Frequently there is a higher cost rate per gallon as usage increases.



*Fig. 9. Rainwater harvesting at Parsippany-Troy Hills Department of Public Works facility, 5,000 gallon cistern. Photo credit Pat Rector.*

**Option 5: Install tree boxes to disconnect impervious surfaces**

Pat Rector, Rutgers Cooperative Extension[9]
Environmental and Resource Management Agent
Morris and Somerset Counties

Jessica Brown, Program Associate[10]
Rutgers Cooperative Extension
Rutgers Water Resources Program

Christopher C. Obropta, Ph.D., P.E.[11]
Rutgers Cooperative Extension
Rutgers Water Resources Program

Tree boxes are a green infrastructure stormwater control measure for which the treatment system consisting of vegetation (tree or shrub) and soil media in a container. These systems are designed to interrupt the flow of stormwater, treating it prior to entry into the storm sewer system or discharge to the subsoil. The tree box functions as a bioretention system, similar to other green infrastructure and low impact development stormwater controls. In urban or built-out areas where space is limited, tree boxes can fit within a small, existing footprint. The tree box chamber is encased

[8]P.O. Box 900, Morristown, N.J. 07963-0900 rector@njaes.rutgers.edu
[9]P.O. Box 900 Morristown, N.J. 07963-0900 rector@njaes.rutgers.edu

in concrete; therefore they work well in areas where infiltration is not suggested, such as karst/limestone soils or potential contamination sites. A closed system tree box does not reduce impervious surface area but rather it captures and filters the stormwater runoff prior to discharging the water to the local sewer system. The open system tree box can reduce impervious area because it not only captures and treats stormwater runoff but it also allows the treated water to infiltrate into the surrounding soil.

A tree box consists of three primary components: a chamber, soil media, and plants (Fig. 10). The underground storage chamber, typically casted in concrete, contains a specially formulated soil media which filters stormwater. A portion of pollutants adsorb or cling physically or chemically to the soil media. Tree boxes provide some nutrient uptake by the vegetation in addition to physical filtration. The chamber is specifically designed to connect to the existing stormwater piping system, allowing less frequent, high-intensity storm events to bypass the system. The chamber is filled with specially designed soil media, specified as 80% sand and 20% compost. The system is planted with one or more tree(s) and mulch is applied to a depth of three inches. The top of the chamber typically has a swing grate that protects the system from large floatables and vegetation disturbance. During the smaller, water quality storms water will enter the chamber from the road or parking lot. Within the chamber there is an additional 4-6 inches of storage for stormwater runoff. After a storm event the storage volume filtrates through the systems, adsorbs to the media, is taken up as a product of microbial activity, infiltrates in open systems or exits to the piping system in closed systems. The chamber can be either a closed system concrete box or an open system box, where the bottom of the box is open. In a closed system after stormwater is filtered, processed through the media and microbial activity has occurred the water will exit to the piping system, similar to taking a detour from water quality and then returning to the storm sewer system. In an open system the storm water will go through the water quality treatment process as previously described and then be infiltrated into the subsoil below through the open bottom. If space is at a premium and water quality is a high concern but for various reasons such as; compacted soil, contaminated subsurface, high ground water table, or other factors that would not be beneficial for infiltration than a closed system for water treatment is the better option. If it is possible the installer may want to investigate the open box system.

The utility of a tree box is the ability to be installed in a built-out area; whether a residential street or a commercial, industrial or suburban parking lot, tree boxes are designed to capture and treat small drainage areas within a small footprint. Each tree box is designed to treat approximately 0.25 to 0.5 acre. For example, the required minimum size filter for 0.25 acre (10,890 square feet) of impervious surface would be 36 square feet of filter surface area or one 8 ft by 6 ft filter box (internal) for New Jersey sizing (Rector et al. 2013). The area to be treated, and the available area needed for the size of the tree box can be a constraint on a selected site.



*Fig. 10. Filterra® tree box. Parsippany-Troy Hills Municipal Court Parking Lot. Photo credit Pat Rector.*

## References and Further Reading for Stormwater Management


Booth, D.B., J.R. Karr, S. Schauman, C.P. Konrad, S.A. Mouley, M.G. Larson, and S.J. Burges. (2004). Reviving Urban Streams: Land Use Hydrology, Biology, and Human Behavior. Journal of American Water Resources Association, 40(5), 1351-1364.

Boyajian, A., M. Cummings, M. Flahive-DiNardo, C. Obropta and G. Rusciano. (2010). Rain Garden Installation Services Directory for New Jersey. Rutgers NJAES Cooperative Extension, New Brunswick, N.J. 12pp. njaes.rutgers.edu/pubs/publication.asp?pid=E326.

Burnsville Stormwater Retrofit Study. (2006). ci.burnsville.mn.us/DocumentCenter/Home/View/449.



[10]G.H. Cook Campus, 14 College Farm Road, New Brunswick, N.J. 08901 jess@envsci.rutgers.edu

[11]G.H. Cook Campus, 14 College Farm Road, New Brunswick, N.J. 08901 obropta@envsci.rutgers.edu

Clar, M. L., Barfield, B.J., O'Connor, T. P. (2004). Stormwater Best Management Practice Design Guide Volume 2 Vegetative Biofilters. USEPA National Service Center for Environmental Publications (NSCEP). 600R04121A.

Dodds, W.K., W.W. Bouska, J.L. Eitzmann, T.J. Pilger, K.L. Pitts, A.J. Riley, J.T. Schloesser, and D.J. Thornbrugh. (2009). Eutrophication of U.S. freshwaters: Analysis of Potential economic damages. Environmental Science & Technology. 43(1):12-19.

Frick, C.M., R.E. Farrell and J.J. Germida. (1999). Assessment of phytoremediation as an in-situ technique for cleaning oil-contaminated sites. Report submitted to the Petroleum Technology Alliance of Canada (PTAC), Calgary, AB. clu-in.info/download/remed/phyassess.pdf.

New Jersey Department of Environmental Protection. (2004). New Jersey Storm Water Best Management Practices Manual," Vegetative Filters.

Obropta, C. and K. Salisbury. (2010). Rain Garden Manual of New Jersey. Rutgers Cooperative Extension: Rutgers, The State University of New Jersey. New Brunswick, NJ. water.rutgers.edu/Rain_Gardens/RGWebsite/RainGardenManualofNJ.html.

Obropta, C.C. and B.Pearson. (2012). Final Report for the Troy Brook Implementation Project, Phase I. NJDEP Grant Project RP08-056. Rutgers Cooperative Extension. Rutgers, The State University, New Brunswick, NJ.

Rector, P., C.C. Obropta, and J.T.R. Brown. (2012). Green Infrastructure Practices: Tree Boxes. Fact Sheet #1177. Rutgers, The State University of New Jersey. Rutgers, New Brunswick. njaes.rutgers.edu/pubs/publication.asp?pid=FS1177.

Rowe, A. (2012). Green Infrastructure Practices: Permeable Pavement. Fact Sheet #1209. Rutgers, The State University of New Jersey. Rutgers, New Brunswick. njaes.rutgers.edu/pubs/fs1209.

The Weather Channel (2013). weather.com/weather/wxclimatology/monthly/graph/USNJ0391.

U.S. Environmental Protection Agency. (2012). Grassed Swales Fact Sheet. cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=75.

# Water Conservation

Salvatore Mangiafico, Ph.D., Rutgers Cooperative Extension[12]
Environmental and Resource Management Agent
Salem and Gloucester Counties

# Introduction

Some business owners may be surprised that water conservation is an important goal in New Jersey. Despite ample rainfall in the state, water resources are subject to stress from overuse. This is both because New Jersey is the most densely populated U.S. state, and because there are a variety of water users including agriculture and industry. Your business can be part of the effort to conserve New Jersey's water supply.

Residential and business use is the biggest consumer of water in New Jersey, and these uses account for a majority of water use if thermoelectric[13] use is excluded. The following table shows water use for different water-use categories for New Jersey. Most residential and business use is included in the categories Public Supply and Domestic.

Table 1. Freshwater use in New Jersey by water use category.

| Freshwater use in New Jersey by water-use category (2005) | Millions gallons per day (mgd) |
|---|---|
| Public Supply | 958 |
| Domestic (well) | 80 |
| Crop Irrigation | 95 |
| Industrial | 86 |
| Mining | 38 |
| Thermo-electric | 663 |
| Total | 1930 |

From Mangiafico et al. (2012). Two water-use categories with low usage in New Jersey, Livestock Watering and Aquaculture, are excluded from this table. Public Supply includes all municipal water companies and other suppliers of water to the public. Domestic refers to privately-owned wells.

For businesses which maintain irrigated lawns and other landscape plantings, outdoor water use can represent a significant amount of water as well as a significant cost. Moreover, if set improperly, automatic in-ground irrigation systems can use considerably more water than is actually needed to maintain landscapes. For example, a 100,000 square-foot lawn (2.3 acre), irrigated at 1 inch of water per week for 22 weeks a year regardless of the weather, uses 1,370,000 gallons of water (extrapolated from Mangiafico et al. 2012). . Towns often raise water rates, dependent upon usage. For example one Northern N.J. Morris County town would charge $1.25/1,000 for usage of 18,000 – 20,000 gallons of water but at 200,000 + the rate would be $7.50/1,000 gallons. and could cost $630 at typical water rates for New Jersey (Mangiafico et al., 2012). Obviously, this cost depends on the amount of water actually applied in a year and the volume charges of your water supplier. This is not the recommended irrigation schedule or amount, nor is it the necessarily the norm in 2013, rather it is used as an example. But often the irrigation water on a corporate campus and the cost can be reduced significantly, with a more careful irrigation schedule or by using more drought-tolerant landscape features. One estimate is that the amount of water use could be reduced by 50 to 70 percent by using smart irrigation controllers compared with this scheduled application (Mangafico et al., 2012).

By committing to a program of outdoor water conservation, your business can contribute to several positive achievements:

- Saving potable water sources for other critical uses like drinking water and agricultural irrigation
- Maintaining the baseflow of local streams for wildlife and recreational uses
- Promoting a positive image for your business as a "green" enterprise and good steward of natural resources
- In coastal and bayshore areas, decreasing the likelihood of saltwater intrusion into groundwater

A beautiful, low water use landscape for your business can be achieved with a variety of actions:

- Choosing drought-tolerant landscape plants including native plants
- Using smart irrigation controllers that irrigate only when soils are dry or weather conditions indicate the need for watering
- Irrigating lawn areas only when needed to maintain dense, healthy turf

[12]Suite 1, 51 Cheney Road, Woodstown, N.J. 08098-9982. Mangiafico@njaes.rutgers.edu

[13]Thermoelectric use includes water used to turn turbines for hydropower, water used for steam in thermoelectric power, and water to cool equipment used in power generation (USEPA 2012).

- Choosing turf species that are more drought tolerant, such as turf-type tall fescue, fine-leaf fescues, or zoysiagrass
- Increasing the drought-tolerance of your landscape by improving soil health factors, such as increasing organic matter in the soil, improving soil structure, or increasing the aeration of compacted soil
- Using non-living landscape features which do not need irrigation, such as mulched areas and stone features

**Objective: Optimize outdoor irrigation of lawns and landscapes to conserve water**

*Baseline Required Actions:*

1. Assess lawns and landscape areas to determine the amount of irrigated turf, trees, shrubs, and other landscape plants.
2. Assess outdoor irrigation systems to determine how often they run, under what conditions they run, and how much water they put out.

The approximate area of turf and landscape beds should be determined; along with if those areas are irrigated. The turfgrass species (e.g. tall fescue, Kentucky bluegrass, zoysiagrass) should be determined if possible. Any available information on if landscape plants are reasonably drought tolerant should be gathered.

Information on the operation of any irrigation system should be gathered. Does the irrigation run on a schedule? Is this schedule adjusted for seasonal weather variations? Is there a rainfall shut-off device?

The amount of water irrigation systems deliver should be determined and recorded. Is it, for example, one-inch of water per week for turf areas?

*Working with Landscape Providers and Other Sources of Information*

Your in-house landscaping staff or professional landscape contractor may be able to give you a quick assessment of the plants and irrigation at your business, with some suggestions on the best way to conserve water while maintaining a beautiful landscape. They are often knowledgeable about the soils, plants, and irrigation schedule at the site, as well as options for drought-tolerant plants, mulch, and other landscape features. By simply letting them know you are concerned with water conservation, you may find that they already have quite a bit of knowledge about the landscaping at your business and thoughts on improvements that could be made.

A good deal of knowledge about plants and landscaping can also be gathered from other sources such as:

- Rutgers Master Gardeners Helpline at your local Cooperative Extension office. (See njaes.rutgers.edu/mastergardeners/helplines.asp)
- Rutgers Cooperative Extension publications. (See njaes.rutgers.edu/pubs)
- Other books and publications, provided care is taken that the information is applicable to this section of the country and to the specific conditions for your property

*Maintaining a Beautiful and Effective Landscape*

Before any changes are made to the types of plants, features, or irrigation schedule of the landscape at your business, an assessment should be made as to the desired function of the landscape. As changes are instituted, care should be taken to not compromise these functions and uses.

Some uses of landscape plantings to consider:

- Preventing soil erosion. Soil erosion is prevented by having dense turf cover, a dense cover of other vegetative ground covers, or ample mulch or stone or other soil protection. Allowing soil erosion could decrease the health of the soil at your site; allow pollution to nearby waterbodies; and leave unsightly soil patches or ruts. Care should be taken to not decrease irrigation of turf or other vegetative covers to the point where they thin or die and thus allow soil erosion.
- Deer-resistance. Some native plants are drought tolerant, and some are also delicious treats for deer. If deer browsing is a concern on your site, consider water conservation options that don't necessitate fighting to maintain your plants against hungry deer. For information on deer resistant landscape plants see Rutgers Fact Sheet FS271 at njaes.rutgers.edu/pubs/publication.asp?pid=e271.
- Aesthetics. There are many low water use landscape options that are attractive and inviting. Some thought should be given, however, to the overall appearance desired for your business. Would you like clean look that relies on large areas of turf or other vegetative ground covers? Or a more complex look with a variety of beds, perhaps featuring native plants, mulch, and stone?
- Recreation. Consider the uses employees and guests make of your landscaped areas. Do employees utilize turf areas for lunch breaks? Do you hold an annual picnic on the lawn? Would visitors be engaged to walk a path among beds of interesting plants?

*Outreach to Employees*

The topic of water conservation provides many opportunities for the education of your employees and associates. Consider hosting a class on lawn irrigation, indoor water conservation, or rain barrels. Your employees will likely be thankful to learn about how they can improve their own landscapes, conserve water, and save money.

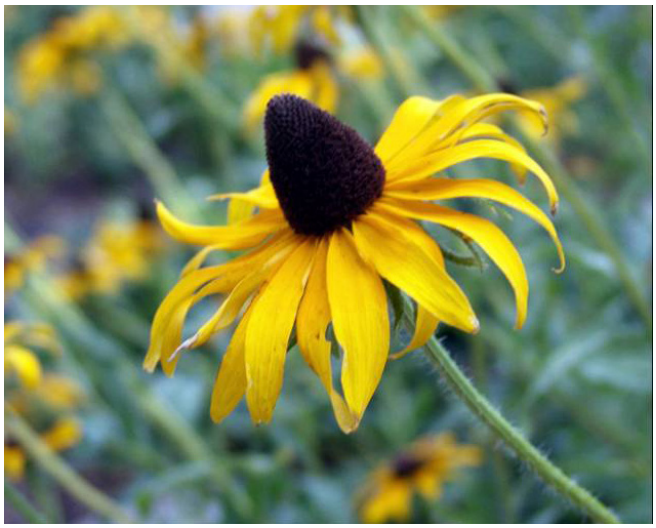


*Fig. 11. Black-eyed Susan, Rudbeckia hirta, is a drought-tolerant native plant. Photo credit Rutgers Water Resources Program.*



*Fig. 12. This demonstration rain garden uses stone and mulch as decorative, water-conserving landscape features. Photo credit Rutgers Cooperative Extension Water Resources Program.*



*Fig. 13. Stone is used as a water-conserving feature in this home landscape. Photo credit Gene Doebley, Doebley and Dad Construction Company.*

*Site-Specific Options:*

**Option 1: Reduce outdoor water use by 15%**

Perhaps the simplest way to demonstrate your business's commitment to water conservation is to document a decrease in water use. A decrease in water use could be documented in any one of a couple of ways:

- A decrease in the volume indicated on a water bill
- A decrease in the area irrigated, the frequency of irrigation, or the amount delivered by each irrigation

A few considerations:

- *Seasonal differences*. In documenting a decrease in water use, one should be careful not to confuse seasonal differences with an actual decrease. That is, it is best to compare the water use from one summer to another, and not to compare water use in the summer to use in the fall. Even when comparing one summer to another, one should be cautious of weather differences between those two summers: Was the second summer cooler or rainier so that the irrigation system was run less? Ideally, one would look at water use across several years to continue to document improvements, and your business may wish to do this as an on-going project.
- *Indoor water use.* If a water bill is used, a decrease in water use might be an effect of changes to indoor water use and not to outdoor water use. Likewise, a decrease in outdoor water use might be masked by a coincidental increase in indoor water use.

**Option 2: Update irrigation controllers to smart controllers on 80% of the landscape**

Smart irrigation controllers are capable of running irrigation systems only when irrigation is needed. These controllers make this determination based on measurements of soil moisture or on recent weather conditions. In a sense, they act like a thermostat: running the irrigation system when the soil is dry, but leaving the irrigation system off when soil moisture is sufficient for plants.

Using smart irrigation controllers can be better than watering on a simple timed schedule, both in terms of water conservation and in terms of plant health. This is especially the case where smart controllers are compared with an irrigation schedule that delivers the same amount of water throughout the year, and especially if this scheduled amount would be needed only in the hottest months of the year, about 1 to 1½ inches per week.

A few considerations:

- Smart irrigation controllers typically require professional installation, since information about vegetation, soils, and the irrigation system need to be programmed into the controller for each site. After initial programming, smart controllers should be easy enough to operate without professional intervention, although the services of a professional landscaper may be needed during startup in the spring, shut-down in the autumn and periodic maintenance.
- Investing in smart irrigation controllers may be most advantageous in landscapes with large areas of lawn, where water costs are significant and the uniformity of vegetation allows controllers to accurately deliver the correct water amounts.
- The United States Environmental Protection Agency has approved certain smart irrigation controllers for inclusion in their WaterSense program. For more information about the WaterSense program or WaterSense labeled irrigation controllers, see USEPA in the References and Further Reading section of this chapter.

**Option 3: Maintain 70% of the landscape without irrigation**

One way to dramatically limit outdoor water use is to maintain a large portion of the landscape without irrigation.

- Don't simply stop irrigating irrigated plants. One should be careful to not simply stop irrigating turf or landscape plants. This can harm or kill plants, and leave exposed to soils subject to erosion.
- Improve soils and the drought tolerance of existing plants. One alternative is to slowly improve the drought-resistance of turf and plants by increasing organic matter in the soil, improving soil structure, or increasing the aeration of compacted soil. At the same time, the frequency and amount of irrigation can be decreased to build plants' tolerance for surviving dry periods between rain events. In all cases, however, the potential for drought tolerance of the specific plants included in the landscape should be considered. Not all plants will do well in our climate without some supplemental irrigation. It is best to work with a landscaper or other knowledgeable person to help build the drought tolerance of your landscape. It may also be prudent to leave irrigation systems functional for emergency irrigation in periods of unusually dry weather without rain. For more information on soil quality, soil compaction, and other soil properties, see Mangiafico (2011) and Mangiafico et al. (2012) in the References and Further Reading Section of this chapter.
- Replace existing vegetation with drought-tolerant vegetation and non-living landscape features. A second alternative is to replace current vegetation with more drought tolerant turf, drought tolerant plants, mulched beds, and other landscape features which do not need irrigation.
- A good option for small landscapes or incremental changes. Because maintaining a nearly irrigation-free landscape may require an investment in improving soil or replacing existing plants, this option may be most applicable for businesses with a small landscape, or as an incremental on-going project for larger landscapes.

**Option 4: Demonstrate that you are already optimizing irrigation of outdoor landscapes**

A final option to show your business's commitment to water conservation is to document the ways that it is already optimizing landscape irrigation. A water conservation strategy should include several of the following components, with consideration to how they conserve water in the managed landscape as a whole:

- *Efficient irrigation.* Irrigation water is not applied to sidewalks or driveways. The irrigation system is free of leaks. Irrigation is applied only to plants that need it.
- *Judicious irrigation.* The amount of irrigation applied is known and it is a reasonable amount. If the irrigation system is run on a schedule, the schedule is adjusted for seasonal weather variations. It has a rainfall cutoff switch. Ideally, irrigation

is controlled by a smart irrigation controller, or the runtime is reduced for rainfall amounts. A reasonable amount of irrigation is applied, depending on plant species and soil properties: for turfgrass, irrigation might be ¾ to 1½ inches per week minus rainfall in July and ½ to ¾ inches per week minus rainfall in April or September. The appropriate values will depend on turfgrass species, weather, and site conditions. For more information in irrigation of turfgrass, see Murphy and Perdomo (2001) and Mangiafico et al. (2012).

- *Drought tolerant turf species are used.* Turf-type tall fescue, fine-leaf fescues, and zoysiagrass are relatively drought tolerant turf species. In all cases, though, care should be taken to choose species which are tolerant of the conditions of the site, such as shady conditions, wet soils, and exposure to salt stress. For a simple table of the tolerances of different turf species, see Crawford and Guillard (2000) in the References and Further Reading in this chapter.
- *Drought tolerant landscape plants are used.* This might include non-irrigated plant beds, such as rain gardens. For some suggestions for drought tolerant plants, see the list at the end of Mangiafico et al. (2012).
- *Non-living features that don't need irrigation, such as mulch and stone are used.*
- *Rainwater is harvested to use for irrigation of landscape plants. Options to harvest rainwater include rain barrels and larger rainwater collection systems.*
- *Some combination of Option 1, Option 2, and Option 3 that best conserves water for the conditions of your site.*



*Fig. 14. Rainwater can be harvested for irrigation of landscape plants. A rain barrel, left, and a larger rain harvesting system at a school, right. Photo credits: Michele Bakacs, Rutgers Cooperative Extension and Elaine Rossi-Griffin, Rutgers Cooperative Extension, respectively.*




*Fig. 15. A rain garden can be used as an attractive landscape feature that does not require supplemental irrigation. Photo credit: Christine Boyajian, Rutgers Cooperative Extension, Water Resources Program. For more information on rain gardens, see Obropta et al. (2010).*

## References and Further Reading for Water Conservation


Crawford, H.M., and K. Guillard. (2000). Lawn Care the Environmentally-Friendly Way. Connecticut Sea Grant: Groton, CT. turf.uconn.edu/pdf/research/fact-sheets/Water_Quality_Lawn_Care.pdf.

Mangiafico, S.S. (2011). Soils and Stormwater Management: Soil Quality, Compaction, and Residential Development, E338. Rutgers Cooperative Extension: New Brunswick, NJ. njaes.rutgers.edu/pubs/publication.asp?pid=E338.

Mangiafico, S.S., C.C. Obropta, E. Rossi-Griffin, and C. Higgins. (2012). Landscaping for Water Conservation, E341. Rutgers Cooperative Extension: New Brunswick, NJ. njaes.rutgers.edu/pubs/publication.asp?pid=E341.

Murphy, J.A., and P. Perdomo. (2001). Best Management Practices for Watering Lawns, FS555. Rutgers Cooperative Extension: New Brunswick, NJ. njaes.rutgers.edu/pubs/publication.asp?pid=FS555.

Obropta, C.C., J.D. Bergstrom, A.C. Boyajian, C. Higgins, K. Salisbury, and W.E. Young. (2010). Rain Garden Manual of New Jersey. New Brunswick, NJ: Rutgers Cooperative Extension Water Resources Program and Native Plant Society of New Jersey. water.rutgers.edu/Rain_Gardens/RGWebsite/rginfo.html.

Rutgers Master Gardeners Program helpline: njaes.rutgers.edu/mastergardeners/helplines.asp.

Rutgers Publications: njaes.rutgers.edu/pubs/subcategory.asp?cat=1001&sub=1001

(USEPA) U.S. Environmental Protection Agency. (2012). "Water & Energy Efficiency by Sectors : Thermoelectric Power." epa.gov/region9/waterinfrastructure/thermoelectric.html.

(USEPA) U.S. Environmental Protection Agency. No date a. WaterSense: An EPA Partnership Program. epa.gov/WaterSense.

(USEPA) U.S. Environmental Protection Agency. No date b. WaterSense: Landscape Irrigation Controllers. epa.gov/watersense/products/controltech.html.

# Lawn Maintenance: A Greener Corporate Campus

Pat Rector, Rutgers Cooperative Extension[14]
Environmental and Resource Management Agent
Morris and Somerset Counties

## Introduction

The goal of this action is to reduce the pollutants entering local waterways by using environmentally sound lawn maintenance practices. Grassed areas are typical of many commercial properties and offer many environmental benefits when managed properly. Properly managed turf helps prevent erosion and stabilize soil on steep slopes, prevents or reduces the movement of nutrients to the groundwater, and reduces the flow of sediment to streams. Many turfgrasses are drought resistant, having deep roots that help to aerate the soil and they are capable of responding quickly to rain events and using excess rain water.

The excess use of chemicals, fertilizers and water to lawn areas wastes money and harms the environment. When nutrients are added in excess of plant nutrient requirements there is a potential for runoff and leaching. High nutrient levels can cause eutrophication, which is excess algal and plant growth in our waterbodies that has potential to reduce the amount of dissolved oxygen in the waterway, at times resulting in fish kills. Additionally, excessive nitrogen can also cause a health concern for drinking water.

Fertilization is used to improve the health and growth of landscape plants including turfgrass. Plants require 13 mineral nutrients for growth, which are typically taken up from the soil. A soil test is required to determine if additional nutrients, above those available in the soil are needed. If soil is lacking a certain nutrient, for example calcium, adding additional phosphorus will not improve lawn growth. The pH of the soil is often an important determinant in how well the grass is growing. The local Rutgers Cooperative Extension office in your county offers soil testing mailers for sale for the Rutgers Soil Testing Lab, which can perform the analysis. It is suggested the test be performed every three years at minimum. In many areas of the state the soil has sufficient phosphorus for turf growth and does not need additional phosphorus fertilizer. New Jersey has enacted fertilizer legislation to provide a statewide standard to reduce phosphorus content and require slow release nitrogen in fertilizer sold to retail consumers. Excess nitrogen impairs our estuaries and bays and excess phosphorus leads to freshwater impairments. Regulations that provide for guidance on fertilizer usage help to protect these waterways. A guide to the law with a fertilizer application rate calculator and a spreader calculator is available at snyderfarm.rutgers.edu/fertspreadercalibration.html. The law also establishes timing restrictions for fertilizer application.

The excess use of pesticides can have detrimental impacts on water quality. A decade-long USGS study detected at least one pesticide in all streams studied, and in 97% of urban and 94% of mixed-use watersheds pesticide compounds were found during most of the year. In urban streams 83% of streams had one or more pesticides in the water that exceeded at least one aquatic-life benchmark (USGS 2006).

**Objective: To reduce the area of large, frequently mowed lawn by:**

1. Converting 20% of weekly mowed lawn to either a infrequently-mowed area or a meadow, or
2. Converting 10% of traditional lawn to either a infrequently-mowed area or a meadow **and** implement an Integrated Pest Management Program or follow an organic lawn care program. In organic lawn care phosphorus should still be kept to the lowest possible level, while maintaining a healthy lawn area. Phosphorus is a nutrient that along with nitrogen and other minerals promotes healthy plant growth. Phosphorus applied in excess of the requirements of the turf grass will run off during rain and cause pollution in streams and lakes. A soil test is required to assure the needed amount of phosphorus for the lawn area.
3. For properties that are too small or without a significant lawn area an option of IPM or organic practices for the vegetated area should be considered.

Baseline Required Actions:

1. Provide a landscape plan that includes the amount of lawn area in square feet. The site map should include delineation of areas of high maintenance/high visibility versus areas of lesser maintenance requirements and visibility. If a stream or pond is on the property this should be clearly marked.
2. Have a soil test conducted if there has not been a soil test conducted within the last three (3) years. The soil test should include soil fertility. For more information and directions on how to collect a soil sample, visit njaes.rutgers.edu/soiltestinglab.

[14]P.O. Box 900, Morristown, N.J. 07963-0900 rector@njaes.rutgers.edu

3. Provide a lawn maintenance schedule that includes "typical" watering, fertilizer application and herbicide application (including frequency, dosage and type). Include rates for the previous 3-5 years.
4. Assure that all lawn areas follow Best Management Practices for nutrients and water management: Best Management Practices for Nutrient Management of Turf in New Jersey Bulletin E327 (njaes.rutgers.edu/pubs/publication.asp?pid=E327), Landscaping for Water Conservation Bulletin E341 (njaes.rutgers.edu/pubs/publication.asp?pid=E341), Your Lawn and Its Care FS102 (njaes.rutgers.edu/pubs/publication.asp?pid=FS102) and document how the BMPs are being enacted.
5. One educational workshop/event with employees on Residential Sustainable Lawn Practices.
6. Develop a Fertilizer application plan that follows the NJ Fertilizer Law (snyderfarm.rutgers.edu/_pdf/Quick-Facts-2011-New-Jersey-Fertilizer-Law.pdf) and the Rutgers Cooperative Extension Guidance in "How to Protect Water Quality and Have a Beautiful Lawn: Ten Steps to Proper Fertilization" FS829(njaes.rutgers.edu/pubs/publication.asp?pid=FS829).
7. If there is a pond on the site: The pond border should be utilized to create a habitat to support native birds and pollinators and provide a disincentive for Canada goose populations. Often corporate campuses have ponds, whether designed ponds or stormwater detention ponds included in their landscape. These ponds can be a source of nuisance wildlife such as Canada goose populations or they can be planted to provide a buffer and provide a seed source for native birds and a safe haven for small fish and other aquatic life.




*Fig. 16. A buffer planted on the shoreline of an urban pond, Morristown, N.J. Photo credit: Pat Rector.*

Site-Specific Options:

The decrease of weekly mowed traditional lawn provides a more economical management of the property, with a more environmentally friendly landscape. Within the Lawn Management Objective there are four site-specific options from which the business may choose to achieve the river friendly objective for this category.

**Option 1: Create an infrequently mowed area consistent with the Rutgers, Snyder Research Farm "Back Acres" Guidance.**

If the property consists of 2-10 acres (72,000-360,000 $ft^2$) consider installing a "back acres" section with a lawn area that is mowed at a height of 5-6 inches. (snyderfarm.rutgers.edu/largelots.html). Typically a back acres area would be mowed approximately 4 times per year as compared to 20 times per year for a traditional lawn area. Guidance is provided at the Turf Field Days at the Rutgers, Clifford E. and Melda C. Snyder Research and Extension Farm, Pittstown, NJ, Managing Large Lots clinics. (snyderfarm.rutgers.edu/largelots.html) For information on seed selection see snyderfarm.rutgers.edu/pdfs/fs684.pdf. A "back acres" section may require herbicide applications for initial establishment, but often requires infrequent application for long-term maintenance.

**Option 2: Development and implementation of an Integrated Pest Management Program to reduce landscape chemical applications.**

Integrated Pest Management (IPM) provides for a more holistic approach to addressing landscape problems from pests. The concept of IPM is to take advantage of all appropriate pest management options and to have prevention be the first option. Prevention is often cheaper and more environmentally friendly than most other control measures.

IPM is a program that consists of four steps: 1) setting an action threshold, the predetermined point at which action is required determined by either the pest population or the environmental conditions; 2) monitoring and identifying pests, assuring that the insect/disease/weed is present and correctly identified; 3) prevention, and 4) control (Prostak 1999, Perdomo 2003). The economic benefit will vary depending upon several factors; predominately the amount of infestation and the level at which it is deemed necessary to take action. Rutgers Cooperative Extension offers several Fact Sheets, each devoted to specific pests, as identification of the pest is the first step in management (see identification resources at the end of Lawn Management section).

Action thresholds are set to identify the level at which corrective action needs to be taken. Monitoring of pests then occurs to determine if that level has been reached. Control is attempted through various means with broadcast spraying as the last resort in order to be the least disruptive to the ecosystem. Other methods are attempted first including cultural, biological, natural, miscellaneous, and alternative chemicals, along with targeted and then broadcast spraying if the action thresholds have been exceeded and no other options have been successful. Often a cultural control such as pruning, raking, barriers, irrigation, mulching and maintenance can be effective; dependent upon the species. Sometimes, solutions such as soap, sulfur, diatomaceous earth, horticultural oils or something as simple as boiling water for ant hills are alternative options that may be used. For further information please see: The "Nuts and Bolts of Your IPM Toolbox: Knowing Your Options (njaes.rutgers.edu/pubs/publication.asp?pid=FS022). For information on attracting insects to help control pests please read Natural Pest Control: Using beneficial insects to control landscape pests (njaes.rutgers.edu/pubs/publication.asp?pid=FS930).

Requirements for the Plan:

The plan will require a written plant inventory with a map of woody and herbaceous plants and their condition. The plan should list locations of plants and pests. The plant species should include the pests common to each of the species.

The plan should identify that a minimum of five (5) site inspections of key plants and pests will be made each year and a record kept of plant stress and environmental concerns along with pest levels and beneficial insects and actions taken.

The Plan should contain:

- The goals of the facilities IPM management plan.
- The chemicals that are presently in use and any organic or less toxic forms that might be utilized to achieve the same outcome.
- A set of maps with narrative descriptions:
- A site map that delineates and prioritizes areas as high, medium and low maintenance. The map should include a description of what these designations mean for the site.
- A map of key plants, key pests that have been found previously and key locations. The description should include a written plant inventory with a map of woody and herbaceous plants and their conditions.
- A "pest map" that identifies pest hotspots should be included and updated yearly. These maps serve as indicators of a pest problem and help to identify where additional monitoring or action should be taken. List the various cultural, physical, biological and chemical controls for each pest. In each description list the potential water quality impacts of that technique. For each pest, list the threshold for action for each management area delineated and described.
- IPM begins with proper prevention, including proper landscape management. The plan should describe the methods undertaken as "normal business practice" for healthy landscape, including but not limited to: soil tests, proper watering, turf aeration, proper storage and disposal of chemicals, the use of plants that are more resistant to pests, attracting birds, bats and beneficial insects, no spraying within 25 feet of a waterbody, improving air circulation to reduce fungal growth.
- Monitoring is a critical component of the IPM program. One growing season of completed monitoring sheets shall be included with the plan.
- The Plan should identify an IPM Coordinator and the duties of the position.

Rutgers Office of Continuing Professional Education provides training in Landscape Integrated Pest Management (IPM). For more information on classes please go to cpe.rutgers.edu/courses/current/al0401ca.html

Footnote: IPM guidance adapted and modified from NJWSA River Friendly Business Program Integrated Pest Management Guidance and Rutgers Cooperative Extension Sample IPM Landscape Agreement Contract.

**Option 3: Install a meadow area to replace an area of lawn.**

Meadow areas may be a source of beauty and provide food and habitat for wildlife. A study of economic and cost considerations of utilizing traditional turf versus meadow areas of native vegetation conducted in 2003 in Grayslake, IL found that the average installation for turfgrass was more expensive than for native landscaping, although costs vary for different areas. Maintenance costs may be more expensive for turfgrass also than for native landscaping, as native landscaping has a reduced mowing and reduced or no fertilizer (US EPA 2004). A reduced mowing schedule and reduced fertilizer applications in the meadow may also lead to a greater diversity of plant species (Zechmeister et al. 2003).

**References and Further Reading for Installing a Meadow:**

Further information on installing a meadow may be found in the Wildlife section.

**Option 4: Organic Land Care**

Michele Bakacs, Rutgers Cooperative Extension[15]
Environmental and Resource Management Agent
Middlesex and Union Counties

Organic Land Care is "a sustainable ecological landscaping system that promotes and enhances biodiversity, biological cycles, and soil biological activity" (Northeast Organic Farming Association (NOFA) Organic Land Care Program, 2001). The Organic Land Care philosophy centers on working with natural systems. Organic land care is not simply about the types of fertilizers or pesticides used on the landscape. Organic land care is a series of practices that together create a holistic approach to land management; the soil, plants, and animals within that system are interdependent and should sustain each other. The term "organic" as it applies to landscaping means landscaping with no synthetic pesticides of any kind and with no synthetic fertilizers and soil amendments.

The question of what "organic" actually means can lead to a lot of confusion. To provide clarity, the federal government through the National Organic Program (NOP) developed national organic standards and a certification program identified by the familiar green and black USDA symbol, which certifies that agricultural products meet federal organic standards. However, there are NO federal standards for organic land care.

In order to educate and assist land care practitioners in determining what is acceptable under an organic program, Rutgers Cooperative Extension has developed an Organic Land Care Certificate program- www.njaes.rutgers.edu/organiclandcare. Several other organizations have developed their own policies and standards for organic land care. These programs are listed at the end of this section and provide guidance for what practices would be allowed and prohibited under an organic program.

This portion of the manual is an overview of key concepts, as well as where to go for more detailed information on organic land care practices. Other sections of this manual address specific practices that may be used for an organic land care program through reducing inputs (such are fertilizer and pesticides), lawn maintenance, water savings, reducing stormwater runoff, and increasing biodiversity through the use of native plants, no mow zones, and riparian buffers.

**Soil**

The basis of any organic land care program is promoting soil health which translates into healthy plants. No soil inputs should be made without a soil test, which will contain information about soil nutrients, pH, composition, and the amount of organic matter. The objectives of promoting soil health include:

- Increasing organic matter, if needed, through the use of compost
- Correcting soil pH to maximize nutrient uptake by plants
- Promoting beneficial soil organisms, both large and small, which help make nutrients available to plants

**Fertilizers and Soil Amendments**

Synthetic fertilizers are not allowed in an organic program. These fertilizers differ from natural organic fertilizers in that synthetic fertilizers are generated from material(s) by means of a chemical reaction; many, but not all, synthetic fields are soluble and immediately available for plant uptake. Natural organic fertilizers need the biological organisms in the soil to breakdown the organic material which slowly releases nutrients to the plants. Be aware that many natural organic fertilizers contain more phosphorus than nitrogen; consequently these fertilizers should not be used as a nitrogen fertilizer otherwise phosphorus will be applied in excess and pose a water pollution risk. For this reason, it is illegal to apply a natural organic fertilizer at more than 0.25 pounds of phosphate per 1,000 square feet in New Jersey. **The ultimate goal of organic land care is to create a sustainable system where as little inputs are need as possible to have a healthy lawn and garden.**

Examples of soil practices that may be prohibited in an organic land care program would be:

- Adding soil amendments and fertilizers without a soil test
- Using any synthetic fertilizer or soil amendment
- Using chemically treated wood, burlaps, stakes, and twines
- Using mulch made from ground up tires
- Using newspaper with colored inks to suppress weeds.
- Using sewage sludge (biosolids) as a soil amendment

[15]42 Riva Ave., North Brunswick, N.J. 08902-4732. Bakacs@njaes.rutgers.edu

**Compost and Compost Tea**

Using compost as a soil amendment is beneficial because it increases soil organic matter. The amount of organic matter in the soil is important for improving soil structure, increasing water retention, increasing biological activity, buffering pH, and providing nutrients. Ideally, topsoil should have 3-5% organic matter content, depending on the soil type, and should be at least 6 inches deep. Organic matter can be increased by tilling in compost down to 2-4 inches at establishment. Alternatively, on established lawns, up to a ¼" compost layer can be spread in the early fall and spring as a topdressing. Be aware that manure based composts typically contain a large amount of phosphorus. It is best to blend manure-based compost with a low phosphorus containing peat or compost to reduce the phosphorus load being applied.

Utilizing compost helps to increase the activity of soil organisms, such as insects, earthworms, fungi, and bacteria. It is the activity of these organisms, termed biological activity, which releases plant available nutrients from compost and natural organic fertilizer. A key aspect of organic land care is maintaining or restoring the soil's biology, which could take years on heavily degraded soils.

Compost tea refers to liquid extracts of compost. Compost teas are generally used as microbial inoculants on soil and plants, and provide very small amounts of quickly available plant nutrients extracted from the compost. Large-scale compost tea brewers are on the market which can be used to brew large batches. There are few peer-reviewed studies describing scientific evidence of the effectiveness of compost tea. Most of the information about its use and effectiveness comes from the experience of compost tea practitioners who have reported increases in plant growth and disease suppression. There is much interest in the organic land care industry on utilizing compost teas as a tool for improving soil biology and plant vigor. Further scientific research is needed to determine compost tea's efficacy and mechanisms of impact for use in land management.

**Lawns and Lawn Alternatives**

In an organic program lawns should be designed to a size that matches the function(s) of that landscape space. Large lawn designs require more energy and resources to maintain them. Low maintenance turfgrass varieties should be chosen such as tall, hard, and Chewings fescues. Lawns should be mowed to maintain a height of at least 3 inches which helps to stimulate root growth and shade out unwanted weeds. In addition, organic management considers lawn irrigation a nonessential use of water and should be sustainable with natural rainfall with rare exceptions such as during the initial establishment. The organic philosophy strives for a healthy lawn that is capable of going dormant to survive drought. As much as possible, grass clippings should be left on the lawn which will help to cycle nutrients back into the soil. Studies have shown that returning grass clippings to a lawn can provide 25% or more of the nitrogen requirements for the year. Incorporating nitrogen fixing legumes such as white clover into a lawn area is also beneficial for decreasing fertilizer applications; however, lawns that are strictly white clover should avoided since clover has a risk of severe stand loss from winterkill.

Understanding the functions of various landscape features are an important aspect of site assessment in an organic land care program. For example, where are lawn areas necessary for recreation and leisure? Which areas of the property are suitable as no-mow zones, native grasses and wildflower meadows, low maintenance perennials, herbs, and shrubs, and woodlots? Keep in mind that landscape features are often designed for improved sightlines for safe operation of vehicles; high visibility for security; and firebreaks to reduce fire hazard. Landscape features also have environmental functions including soil erosion control and dust stabilization; improved recharge and quality protection of surface and ground water; flood control; enhanced entrapment and biodegradation of synthetic organic compounds; soil improvement that includes CO2 conversion; accelerated restoration of disturbed soils, heat dissipation and temperature moderation; reduced noise, glare and visual pollution; and decreased noxious pests and allergy-related pollens (Beard and Green 1994).



*Fig. 17. An organic lawn. Photo credit: Amy Rowe.*

### Insect and Disease Management

Insect and disease problems are often indicate an underlying problem, be it shallow topsoil, too much water or fertilizer, a plant in the wrong location, or inappropriate mowing practices. Identifying the root cause of the pest or disease is the first step for solving the problem in an organic land care program. If the pest remains above tolerance levels, any use of organic pesticides should be the last option after correctly identifying the problem, correcting any underlying problem(s), and altering cultural practices. This approach is very similar to Integrated Pest Management (IPM); the difference is, in an organic program, an approved organic pesticide would be used instead of a synthetic pesticide. Examples of pesticides allowed under an organic program include, but are not limited to, insecticidal soaps, horticultural spray oils, botanical insecticides such as neem, boric acid, food-grade extracts such as from hot pepper, Bacillus thuringiensis or BT based products, elemental sulfur, and biological fungicides such as Bacillus subtilis.

The Organic Materials Review Institute (OMRI), omri.org, is a nonprofit, third party reviewer of organic products. This organization determines which input products are allowed for use in organic production and processing. Products that are OMRI certified may be used on operations that are certified organic under the USDA National Organic Program, as well as in an organic land care program. To determine whether a pesticide would be approved for use in an organic program, look for the OMRI label, or search the product list on their website.

### Weed Management

In a similar manner that insects and diseases play a "canary in the coal mine" role, the types of weeds that exist in a lawn may indicate specific underlying problems. Correcting the underlying problem will help to suppress the weeds. For example, crabgrass can proliferate on compacted and acidic (low pH) soils. Aerating the soil, and applying compost and limestone, as well as physically removing the crabgrass will improve the health and vigor of the desired turfgrasses , which crowds out the crabgrass.

In addition, overseeding the lawn with a perennial turfgrass mixture in late summer and early fall will help to re-invigorate the lawn and crowd out weeds. Always seed bare spots and areas with sparse (thin) grass cover. Applying a ¼ inch of compost at seeding will help in the germination of grass seeds. Raising the lawn mower blade to cut grass at 3 or 4 inches will shade the soil surface and prevent many weeds from germinating and growing. Lastly, hand pulling where the problem is small, before weeds set seed and get out of control, will help deter future weed growth as long as the underlying soil problem or cultural practice causing the weeds are identified.

In an organic program, it is important to define a tolerance level of weeds and understand which weeds, if allowed to persist and spread, represent a threat to the function(s) of a lawn. For example, crabgrass is a summer annual plant that dies every fall with cooler weather. Lawns that stabilize soil and prevent erosion from sloped landscapes will lose this capability (function) during the winter and spring if crabgrass is allowed to dominate and crowd out the perennial grasses during the summer. An organic lawn will never be completely weed-free; but a well balanced lawn with high quality soil will promote healthy turf that can outcompete most weeds.



*Fig. 18. An organic lawn, healthy and well balanced. Photo credit: Amy Rowe.*

### Requirements for Organic Land Care Option

Site Specific Option 1. Utilize the services of a land care professional that has completed the Rutgers Cooperative Extension Certificate Program, NOFA, or another equivalent organic land care program.

Site Specific Option 2. The facility manger should require their land care professional to receive training in organic land care through Rutgers or another equivalent program or show the knowledge, skills and aptitude to provide a quality organic land care option.

# References and Further Reading Lawn Maintenance, IPM, Meadows, Organic Land Care


Beard, J.B., and R.L. Green. (1994). The Role of Turfgrasses in Environmental Protection and Their Benefits to Humans. Journal of Environmental Quality. agronomy.org/publications/jeq/pdfs/23/3/JEQ0230030452.

Gyurian, J.M. and N.Polanin. (2005). The "Nuts and Bolts" of your IPM toolbox: Knowing Your Options. Rutgers Cooperative Research & Extension Fact Sheet FS022. Rutgers, The State University of New Jersey, New Brunswick, N.J. njaes.rutgers.edu/pubs/publication.asp?pid=FS022.

Heckman, J., J.A. Murphy and S. Scibilia. (1996). How to Protect Water Quality and Have a Beautiful Lawn: Ten Steps to Proper Fertilization. Rutgers, New Jersey Agricultural Experiment Station, Cooperative Extension. Fact Sheet FS829. New Brunswick, N.J. 2 pp. njaes.rutgers.edu/pubs/publication.asp?pid=FS829.

Higgins, K., S.S. Mangiafico, C. Obropta and E. Rossi-Griffin. (2012). Landscaping for Water Conservation. Rutgers, New Jersey Agricultural Experiment Station, Cooperative Extension. Bulletin E341. New Brunswick, N.J. 30 pp. njaes.rutgers.edu/pubs/publication.asp?pid=E341.

Koppenhöfer, A.M. (2010). An integrated approach to insect management in turfgrass: White grubs. Rutgers Cooperative Research & Extension Fact Sheet FS1009. Rutgers, The State University of New Jersey, New Brunswick, N.J. njaes.rutgers.edu/pubs/publication.asp?pid=FS1009.

Murphy, J.A. (1995). Turfgrass Seed Selection for Home Lawns. Fact Sheet FS684. Rutgers, New Jersey Agricultural Experiment Station, Cooperative Extension. New Brunswick, N.J. 4 pp. njaes.rutgers.edu/pubs/publication.asp?pid=FS684.

Murphy, J.A. (2004). Your Lawn and Its Care. Fact Sheet #102. Rutgers, New Jersey Agricultural Experiment Station, Cooperative Extension. New Brunswick, N.J. 4 pp. njaes.rutgers.edu/pubs/publication.asp?pid=FS102.

Murphy, S. and J.A. Murphy. (2009). Best Management Practices for Nutrient Management of Turf in New Jersey. Bulletin E327. Rutgers, New Jersey Agricultural Experiment Station. New Brunswick, N.J. 5 pp. njaes.rutgers.edu/pubs/publication.asp?pid=E327.

National Organic Standards Board. (2004). Compost Tea Task Force Report. United States Department of Agriculture. ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5058470.

Perdomo, P. (2003). IPM in the home landscape. Rutgers Cooperative Research & Extension Fact Sheet \ FS316. Rutgers, The State University of New Jersey, New Brunswick, N.J. njaes.rutgers.edu/pubs/publication.asp?pid=FS316

Prostak, D.J. (1999).What is IPM? The "Nuts and Bolts" of your IPM toolbox: knowing your options. Rutgers Cooperative Research & Extension Fact Sheet FS748. Rutgers, The State University of New Jersey, New Brunswick, N.J. njaes.rutgers.edu/pubs/publication.asp?pid=FS748

Rutgers, Clifford E. and Melda C. Snyder Research Farm New Jersey Agricultural Experiment Station Fertilizer Spreader Calibration. snyderfarm.rutgers.edu/fertspreadercalibration.html.

Rutgers, Clifford E. and Melda C. Synder Research Farm, New Jersey Agricultural Experiment Station Quick Facts (2011) N.J. Fertilizer Law. snyderfarm.rutgers.edu/_pdf/Quick-Facts-2011-New-Jersey-Fertilizer-Law.pdf.

Rutgers, Clifford E. and Melda C. Snyder Research Farm, New Jersey Agricultural Experiment Station. Managing Large Lots: The Back Acres. snyderfarm.rutgers.edu/_pdf/Managing-Large-Lots.pdf.

Rutgers Soil Testing Laboratory. Rutgers New Jersey Agricultural Experiment Station. New Brunswick, N.J. njaes.rutgers.edu/soiltestinglab/howto.asp.

Smith-Fiola, D. and J. Morris. (1999). Sample IPM landscape maintenance agreement. Rutgers Cooperative Research & Extension Fact Sheet FS079. Rutgers The State University of New Jersey, New Brunswick, N.J. njaes.rutgers.edu/pubs/publication.asp?pid=FS079.

Smith-Fiola, D. (2003). Natural Pest Control- Using Beneficial Insects to control landscape. njaes.rutgers.edu/pubs/publication.asp?pid=FS930.

State of Washington Department of Environmental Protection, Water and Rivers Commission. (2001). Environmental guidelines for the establishment and maintenance of turf and grassed areas. December 2001. water.wa.gov.au/PublicationStore/first/32549.pdf.

U.S. Environmental Protection Agency (2004). How do IPM Programs Work? epa.gov/oecaagct/tipm.html#How%20do%20IPM

U.S. Geological Survey (USGS) (2006). Pesticides in the Nation's streams and ground water, 1992-2001 a summary. Fact Sheet 2006-3028. http://pubs.usgs.gov/fs/2006/3028.

Zechmeister, H.G., I. Schmitzberrger, B.Steurer, J. Peterseil, T. Wrbka. (2003). The influence of land-use practices and economics on plant species richness in meadows. Biological Conservation 114:165-177 ingentaconnect.com/content/els/00063207/2003/00000114/00000002

## References and Further Reading Lawn Maintenance Organic Land Care

Banes, R. (1990). Fertile Soil: A Grower's Guide to Organic and Inorganic Fertilizers. Davis, CA.

Buckley, R.J., A.M. Kpooenhöfer, and S.Tirpak. (2010). An integrated approach to insect management in turfgrass: Billbugs. Rutgers Cooperative Research & Extension Fact Sheet FS1015. Rutgers, The State University of New Jersey, New Brunswick, N.J. njaes.rutgers.edu/pubs/publication.asp?pid=FS1015

Gimenez, D., J. Heckman, L. Muldowney and S. Murphy. (2012). Improving soil quality by increasing organic matter content. Fact Sheet FS1137. Rutgers, The State University of New Jersey. New Brunswick, N.J. 3pp. njaes.rutgers.edu/pubs/publication.asp?pid=FS1137.

Gimenez, D., J. Heckman, L. Muldowney and S. Murphy. (2012). Soil organic matter. Fact Sheet FS1135. Rutgers, The State University of New Jersey. New Brunswick, N.J. 3pp. njaes.rutgers.edu/pubs/publication.asp?pid=FS1135.

Lowenfels, J. (2013). The Organic Gardener's Guide to Optimizing Plant Nutrition. Timber Press. Portland, Oregon. 250 pp.

Northeast Organic Farming Association of Connecticut. (January 2011). Standards for Organic Land Care; Practices for the Design and Maintenance of Ecological Landscapes 5th edition. organiclandcare.net

The Organic Materials Review Institute (OMRI), omri.org

Rutgers Cooperative Extension Organic Land Care Certification Program. njaes.rutgers.edu/organiclandcare.

Tukey, P. (2007). The Organic Lawn Care Manual, A Natural Low Maintenance System for a Beautiful Safe Lawn. 265 pp. Storey Publishing. North Adams, MA.

# Wildlife Management

Brooke Maslo, Ph.D. Assistant Research Professor[16]
Department of Ecology, Evolution, and Natural Resources Rutgers, The State University of New Jersey.

# Introduction

Decades of development in New Jersey have destroyed thousands of acres of wildlife habitat, replacing it with an ecologically less diverse landscape. While the negative impacts to wildlife species have been well documented, only recently have we begun to quantify the impacts of these anthropogenic activities on humans through the loss of ecosystem services. **Ecosystem services** are the direct and indirect contributions of ecosystems to human well-being. More simply, they are the services that nature provides us for free. Whether it's providing goods (i.e. food, timber, fuel), regulating the environment (e.g., filtering air, purifying water), or simply providing us with an emotional uplift, ecosystem services have tremendous value.

Wildlife species are significant purveyors of ecosystem services, responsible for such benefits as pollination, seed dispersal, insect pest regulation, and nutrient cycling. In the past decade, economists have begun to assign dollar amounts to some of these services. For example, European honeybees are worth an estimated $12-16 billion dollars annually to the United States agricultural industry (Morse and Caldarone 2000). These values reflect the standard use of this species for pollination services; however, the 400 species of native pollinating insects in the US pull significant weight as well, providing $3 billion annually (Losey and Vaughn 2006). It has been shown also that many native bees are more efficient pollinators than European honeybees, leading to higher pollen deposition and increased fruit and vegetable production. With the looming effects of Colony Collapse Disorder, a phenomenon that is significantly reducing honeybees in this country, preserving populations of native pollinating insects is even more critical.

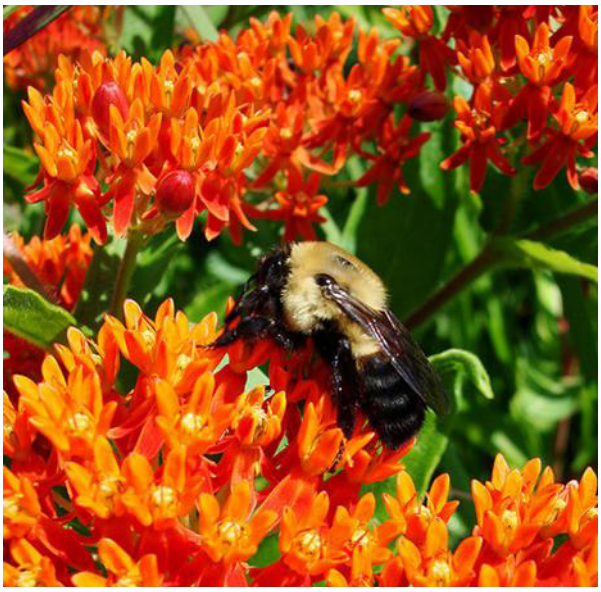


*Fig. 19. Butterfly weed with pollinator. Photo credit: Elena Taraglia.*



*Fig. 20. Goldfinch enjoying native plants in a meadow. Birds help pollinate and use native plants for food. Photo credit: Bill Lynch.*

Bats are another group of species that provide us with sizeable benefits. While many bat species in the tropics are important pollinators, bat species in New Jersey are insectivores, consuming substantial amounts of night-flying insects. Bats in the United States are worth an estimated $23 billion to our agricultural industry in avoided costs of pesticide application. While the economic value of these species has not been quantified for non-agricultural insect pests, documented prey items of bats include moths, beetles, stink bugs, and mosquitoes (Kunz et al. 2011).

[16]College Farm Road, New Brunswick, NJ 08901 brooke.maslo@rutgers.edu

*Wildlife Habitat on the Corporate Landscape*

Corporate landscapes, by designs, often consist of large expanses of neat and manicured lawn accented by ornamental (and often non-native) plantings. There is often less biodiversity, or variety of species, on corporate landscapes. Unfortunately, the traditional corporate landscape may also place significant stress on native wildlife by reducing the availability of food and water, shelter and nesting sites. Therefore, increasing habitat on corporate properties can be mutually beneficial to both business and wildlife.

For the business owner increasing wildlife habitat on corporate landscapes has many advantages. Strategically placed trees can regulate the temperature by providing shade from the summer sun and a natural windbreak from the winter winds. Trees also trap pollutants from the air and reduce stormwater runoff and erosion. They buffer noise pollution along roadways and increase the overall aesthetic value of the landscape. Replacing lawn with native vegetation can drastically lower maintenance costs, particularly by reducing the amount and frequency of mowing and irrigation. Studies in Illinois have documented that a shift from lawn to native vegetation reduced maintenance costs by nearly half over a 10-year period. In addition, natural landscapes have been shown to increase employee productivity by boosting morale and refreshing cognitive mechanisms. Finally, publicizing the adoption of sustainable landscaping practices offers a highly visible public relations advantage.

**Objectives: Enhance onsite wildlife habitat by:**

1. Reducing the total area of lawn by 10% and replacing with native vegetation,
2. Enhancing habitat quality with additional habitat features (nest boxes, etc.), **AND**
3. Reducing/controlling invasive species on-site and replacing with native vegetation.

Baseline Required Actions:

1. Submit a current site plan, delineating building locations, driveways and walking paths, topography, and other site features (stormwater basin, picnic area, etc).
2. Identify current vegetation types on-site (lawn, woodland, foundation plantings. To the extent possible, create a species inventory of existing vegetation.
3. Identify areas of existing habitat and potential areas for habitat enhancement.
4. Schedule one workshop aimed at educating landscape management personnel on how to maintain natural landscapes.

**Habitat Alternatives**

Site-specific Options:

**Option 1: Reduce the total area of lawn by 10% and replace with native vegetation.**

Create habitat for beneficial wildlife species by replacing 10% of the total area of lawn with one or a combination of the habitats listed below. To successfully create wildlife habitat, it is critical to install the appropriate vegetation to support feeding, nesting, and resting of target species. Reference documents for each habitat are listed below. Habitats must be designed appropriately and managed until successfully established. The applicant must submit a proposed management plan.

*Perennial Meadow*

The perennial meadow is a collection of both perennial grasses and native wildflowers. Blooming from spring through the fall, a meadow offers a vibrant display of colors and textures. During the growing months, meadows provide food resources (pollen and nectar) for butterflies and other native pollinators and nesting areas and perching areas for many birds. During winter, the seeds produced in the meadow are a critical resource for overwintering small birds and mammals. Meadows generally establish quickly and are relatively inexpensive because they can be created from seed. Once a meadow is established, very little maintenance is required.

Converting - lawn to perennial meadow requires careful planning and implementation during the initial stages. The steps for creating a successful meadow are:

Step 1: Site Selection & Analysis

Since meadows generally consist of grasses and wildflowers, they require quite a bit of sun. Select an area that gets at least 6 hours of full sunlight a day, preferably more. Assess the site conditions, including the slope of the ground, moisture levels, and soil composition. Having an idea of how water drains in this area and whether your soils are sandy or clayey will help in the selection of appropriate plants. Finally, identify and remove any noxious weeds or invasive plants growing in and around your meadow location. **These plants will challenge your ability to grow a sustainable meadow.**

Step 2: Determine Who Will Plant the Meadow

There are several choices to make when installing a meadow, including its size and shape, plant material, and how to prepare the ground. Constructing a perennial meadow can be a fun activity for company employees, but a professional may be preferred,

especially converting a large area of lawn. Removing lawn is a labor-intensive (but manageable) task, and planting several pots can be time-consuming. If a professional is desired, hire a contractor that has some experience in creating natural landscapes.

Step 3: Site Preparation

Proper site preparation is the MOST IMPORTANT task when constructing a meadow. First, the pre-existing - lawn must be killed. There are several methods for killing turf; however, the quickest and most effective way is with herbicides. Once the turf is killed and removed, dormant seeds in the exposed soil will begin to grow. These emerging weeds must be controlled effectively. After removing the turf, water the bare soil for 2 weeks, allowing weed seeds to germinate. Once they reach an average height of 6-8in, spray with herbicides. Repeat this grow-kill cycle at least 2 more times or until the seed bank is exhausted. To prevent mud or erosion during the grow-kill cycles, you may want to add a thin layer of bark mulch or straw to your meadow site.

After the site has been prepared but before planting, consider re-grading the soil to add some more complex topography. By creating shallow depressions and mounds throughout the site, areas within the meadows will differ subtly in moisture, temperature, and sunlight, which can maximize the diversity of species that will grow. The more plant diversity you have, the more animal diversity the meadow can support.



*Fig. 21. A meadow planted with a diversity of species. Photo credit: Steven N. Handel.*

Step 4: Plant Selection

Plants should be selected to help maximize the amount of biodiversity on the property. Several resources exist on native plants in the region (Melendez and Pinto 2010). Rutgers Cooperative Extension staff can also assist in the creation of suitable plant lists. Two important points to remember are: 1) select plants that will survive in the conditions on your site, and 2) make sure that flowers are in bloom throughout the entire growing season to provide a constant food source for insects. A constant source of insects will, in turn, attract a great diversity of birds.

Step 5: Planting

Planting should occur in the spring or fall, when there is no threat of a frost, either by seeding or potted plants. When determining how much seed to buy, a good rule of thumb is that one ounce of seed will cover between 100 and 300 square feet of ground.

To plant seeds on bare ground, lightly rake the soil in the prepared area. Transfer the seed mixture into a bucket and mix in playground sand at a ratio of 10 parts sand to 1 part seed. The sand will help dilute the seed density for more even coverage. Use a hand or drop spreader to evenly disperse the seed throughout the prepared area, perhaps switching directions half way through to encourage even coverage. With a lawn roller or by lightly walking over the area, lightly press the seeds into the soil. Do NOT rake. Wildflower seeds will not germinate if buried.

Potted plants are more expensive, but they have a greater chance of success than a single seed because they are already established. Finding a good selection of rooted native plants can be difficult at local nurseries or garden centers; however, some wholesale native plant nurseries do exist. Decide how many plants to purchase by estimating the full grown spread of your selected plants. When you are ready to plant, lay the pots out across the prepared area to see how things will look as the plants grow. Be sure to provide the young plants with enough space to grow to maturity. Many grasses and wildflowers are clonal, meaning they will spread out vegetatively through the ground each year, covering more and more land. If enough plant material is installed, the open spots will eventually grow in.

Step 6: Care of Plants in Year 1

Meadows require very little maintenance relative to lawns, but first-year plantings must be watered to ensure that their root systems develop properly. For planted seeds, water the meadow at least once a week (or more depending on conditions) until the young plants have reached approximately 6 inches in height.

After that, water only during dry spells.

For potted plants, deep water them once or twice a week. Spread a 2-3in. layer of mulch throughout the planting bed to reduce erosion, increase water retention, and discourage weeds. Depending on the density of plantings, mulching with hay or salt hay will most likely only be required in this first year.

*Hummingbird Garden*

Hummingbird gardens consist of nectar-producing plants, generally those that produce tubular-shaped flowers. These habitats are usually created on a smaller scale, and successful establishment most often occurs by planting young plants rather than seed. While most hummingbird plants are more expensive than the more common native wildflowers, these habitat features offer unparalleled aesthetic value. The same general steps for perennial meadows apply to hummingbird gardens.

*Shrubland*

Shrublands are characterized by dense thickets of woody plants less than 20 feet tall and are critical nesting habitat for a wide array of birds. As landscapes in the mid-Atlantic and Northeast have transitioned over time from post-agriculture to mature forest, shrubland habitats have declined precipitously. In addition to nesting areas, many shrub species produce fall and winter fruits, helping to support both migratory and resident birds. No ground preparation is required for shrubland plantings. Native shrubs can be purchased from wholesale native plant nurseries. These habitats are established from seedlings or saplings and will require up to 3 years of supplemental watering to ensure establishment. After this initial period, virtually no maintenance is required for several years. Depending on the density of plantings, land managers may choose to mow or trim grasses and weeds growing in between shrubs to maintain aesthetics and reduce resource competition between shrubs and weeds. As the landscape matures (>10 years), land managers can decide whether to maintain the shrubland (which would require additional maintenance) or allow it to transition to a woodland habitat.

*Woodland*

Woodland habitats can consist of either deciduous or evergreen trees, or a combination of both, depending on the environmental conditions of the proposed site. Once mature, woodlands provide shelter, nesting sites, and food resources for many wildlife species. In addition, woodland habitats provide shade, improve air and water quality, and sequester carbon. These landscapes require many years to mature, and the planted area must be maintained to promote proper establishment and growth. Trees can be purchased from wholesale native plant nurseries in a variety of sizes. In addition, many standard commercial nurseries carry several native trees in stock. Trees can be planted as seedlings or saplings, and success is correlated with size of initial plantings. Plantings require supplemental watering for up to 3 years after initial planting. Mowing or weed-whacking grasses, vines, and other weeds growing between tree plantings may be necessary for several years.

*Riparian Edge/Buffer*

Riparian edge habitats stabilize slopes and prevent erosion by slowing stormwater as it enters a water body. Strategically planted with the appropriate materials, riparian buffers can also serve as refuge sites, perching locations, or food patches for wildlife. Because the plant material also traps pollutants, water quality is improved for fish, amphibians, and other aquatic life. Creating a naturalized shoreline usually requires the installation of natural slope stabilizing materials to allow for plants to establish. As time passes, these materials decay, providing nutrients for the growing plants, and the vegetation slowly takes over the slope stabilization services. Rutgers Cooperative Extension staff can assist in the design and implementation of riparian edge habitats.

**Option 2: Enhance habitat quality with additional habitat features (nest boxes, etc.)**

Natural wildlife habitat can be enhanced with through the installation of several manmade features, including nest boxes, bat houses, perching sites, and wood piles. Indeed many animals (eastern bluebirds, barn swallows, big brown bats, etc.) rely on artificial structures for successful rearing of their young. As with natural landscapes, artificial structures must be installed in the proper locations to successfully attract target species. Guidance documents for several habitat features are listed below, and Rutgers Cooperative Extension can assist in the determination of suitable locations.

**Option 3: Reduce/control invasive species on-site and replace with native vegetation.**

Non-native plants are those species that originated in other countries our outside our geographic region. Because these plant species were brought in, many of them do not offer the same benefits to wildlife as those that originated here. Many non-native plants are poor food and refuge resources. While many non-native plants do not pose a major threat to natural ecosystems, some species quickly destroy natural

habitats. Therefore, native plant species should be used on corporate landscapes whenever possible, and invasive species should always be avoided. Japanese barberry (Berberis thunbergii) and winged euonymus (Euonymus alatus) are common foundation and focal species planted on corporate campus.

**Management of Nuisance Wildlife Species**

Due to the combination of several anthropogenic factors, some wildlife species have become overpopulated. In our region, white-tailed deer and Canada geese are considered pest species in many cases, and they have the potential to destroy any habitat enhancements initiated on-site. For this reason, it is critical to plan for, monitor, and manage newly created habitat.

*White-tailed Deer*

White-tailed deer are considered herbivorous browsers, consuming many different parts of several plants. While moderate browsing promotes the health of natural landscapes, overbrowsing can be very destructive. Several management alternatives exist, depending on the type of habitat being created. In general, wildflower meadows may be the most resistant to deer browsing, and steps can be taken in the planning stages to select deer-resistant species (NOTE: Deer-resistant does not mean deer-proof).

Newly planted woody species must be protected either individually with tube shelters or by placing a deer-proof fence around the entire planted area. Pros and cons exist for alternatives. Detailed information on deer management can be found in the Rutgers Cooperative Extension Fact Sheet 1202 (Maslo, 2013).

*Canada Geese*

While the majority of complaints occur as a response to the collection of feces on lawns or public areas, Canada geese can also cause severe damage to habitat restoration areas by grazing and trampling young plants. Appropriate management actions can successfully or eliminate both these issues.

In general, Canada geese prefer to feed in open grassy areas near surface water bodies, especially where a lawn is maintained to the edge of the water body. Therefore, eliminating - lawn and replacing it with native wildflowers and tall grasses automatically reduces habitat quality for geese. In addition, Canada geese often congregate in open areas close to water bodies (lakes, retention basins, etc.). Creating vegetated buffer zones along riparian edges can deter geese from using these habitats. To protect new plantings, installing temporary fencing and Mylar balloons has been shown to be successful. More details on Canada goose management can be found below.

## References and Further Reading for Habitat Creation


Abbey, T.M. 2004. Alternatives for invasive ornamental plant species. The Connecticut Agricultural Experiment Station, New Haven, CT. ct.gov/caes/lib/caes/documents/special_features/nativealternatives.pdf.

Bat Conservation and Management. Building a Better Bat House: The Complete Guide to Assembling, Placing, and Maintaining BCM Multi-Chamber Bat Houses and the BCM at House Kit. batmanagement.com/BatHouseManual2010.pdf.

Bowman's Hill Wildflower Preserve. Deer Tolerant/Resistant Native Plants. Bowman's Hill Wildlflower Preserve, New Hope, PA. bhwp.org/cms/files/file_ID96121.pdf.

Burrell, C.C. 2006. Native Alternatives to Invasive Plants. Brooklyn Botanic Garden, Inc., Brooklyn, NY.

Duke Farms. (2012). Woodland habitats. dukefarms.org/Documents/Images/Stewardship/Woodland%20Plants.pdf.

Grande, J. L. Katz, and G. Slifer. (2010). High-tensile woven wire fences or reducing wildlife damage. Fact Sheet FS889. Rutgers Cooperative Extension. Rutgers, The State University of New Jersey, New Brunswick, NJ. snyderfarm.rutgers.edu/pdfs/fs889.pdf.

ISU Forestry Extension. (2012). Tree shelters for hardwood plantings. Iowa State Forestry Extension, Ames, IA. extension.iastate.edu/forestry/publications/PDF_files/F-364.pdf.

Kaufman, S.R. and W. Kaufman. (2007). Invasive Plants: A Guide to Identification and the Impacts and Control of North American Species. Stackhole Books, Mechanicsburg, PA.

Kress, S.A. 2006. The Audubon Society Guide to Attracting Birds: Creating Natural Habitats for Properties Large and Small. Cornell University Press: Ithaca, NY.

Kunz, T.H., E.B. deTorrez, D. Bauer, T. Lobova and T.H. Fleming. (2011). Ecosystem services provided by bats. Annals of the New York Academy of Sciences. 1223:1-38.

Losey, J.E. and M. Vaughn. (2006). The economic value of ecological services provided by insects. Bioscience 56:311-323.

Morse, R.A. and N.W. Caldarone. (2000). The value of honey bees as a pollinator of U.S. crops in 2000. Bee Culture 128:1-15.

New Jersey Audubon. (2013). How to create a butterfly and hummingbird garden. njaudubon.org/sectionbackyardhabitat/createagarden.aspx.

Maslo, B. (2012). The perennial meadow as an alternative to turf lawns. dukefarms.org/en/Resources/Landscapes/Perennial-Meadow1.

Melendez, M. and D. Pinto. (2010). Incorporating Native Plants in Your Residential Landscape. Fact Sheet #1140. Rutgers, New Jersey Agricultural Experiment Station, Cooperative Extension. New Brunswick, N.J. 4pp.

Obropta, C. and K. Salisbury. (2010). Rain garden Manual of New Jersey. Rutgers Cooperative Extension: Rutgers, The State University of New Jersey. New Brunswick, NJ. water.rutgers.edu/Rain_Gardens/RGWebsite/RainGardenManualofNJ.html.

Illinois Department of Natural Resources. 2013. Creating new woody habitat. dnr.state.il.us/orep/pfc/guide/habitats/woodlands/creatnew.htm.

The Xerces Society. 2011. Attracting Native Pollinators. North Adams, MA: Storey Publishing.

UNH Cooperative Extension. 2009. Habitat stewardship series: shrublands. University of New Hampshire Cooperative Extension. extension.unh.edu/resources/files/Resource001109_Rep1536.pdf.

USDA. 2011. Fact sheet: Managing Canada goose damage. United States Department of Agriculture Animal and Plant Health Inspection Service, Pittstown, NJ. nj.gov/agriculture/pdf/managingcanadagoosedamage.pdf.

Weaner, L. 1996. Wildflower meadows: let's get real. Landscape Design 9(1):1-5. uri.edu/cels/ceoc/documents/LarryWeaner_wildflowermeadows.pdf.

Mader, E., M.Shepherd, M. Vaughan, S.H. Black, and G. LeBuhn. 2011. Attracting Native Pollinators Protecting North America's Bees and Butterflies. The Xerces Society Guide. Storey Publishing. North Adams, MA. Pp1-14.

Herzog, T.R., A.M. Black, K.A. Fountaine and D.J. Knotts. Reflection and attentional recovery as distinctive benefits of restorative environments. Journal of Environmental Psychology. 17:165-170.

© 2014 Rutgers, The State University of New Jersey. All rights reserved.

*For a comprehensive list of our publications visit www.njaes.rutgers.edu* *February 2014*

*Cooperating Agencies:* Rutgers, The State University of New Jersey, U.S. Department of Agriculture, and County Boards of Chosen Freeholders. Rutgers Cooperative Extension, a unit of the Rutgers New Jersey Agricultural Experiment Station, is an equal opportunity program provider and employer.

RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

Rutgers, The State University of New Jersey
88 Lipman Drive, New Brunswick, NJ 08901-8525
Phone: 848.932.5000