Rain Gardens:

Where can I find resources to help me design a rain garden?

For homeowner/cost-efficient retrofit projects:

This is the NJ Rain Garden Manual:
http://water.rutgers.edu/Rain_Gardens/RGWebsite/RainGardenManualofNJ.html

This is the Green Infrastructure Guidance Manual for NJ:
http://water.rutgers.edu/GreenInfrastructureGuidanceManual.html

For projects meeting NJDEP criteria:

https://dep.nj.gov/wp-content/uploads/stormwater/bmp/nj_swbmp_9.7-small-scale-bioretention-systems.pdf

Can I use a rain garden to solve drainage issues on my property?

Rain gardens can help manage and redirect excess water, but they may not be suitable for resolving severe drainage problems. It is advisable to consult with a landscape professional or stormwater engineer to assess the feasibility of a rain garden for addressing specific drainage issues.

Can I put a rain garden next to my house? How far away from a building can I install a rain garden?

It is common to site rain gardens at least 10 feet away from a structure to prevent stormwater from impacting the building foundation or infiltrating into a basement. The rain garden portion that holds water should also be a minimum of 2 feet away from any structure. A rain garden can also be lined with an impermeable liner to help protect building foundations and avoid basement infiltration. Be sure to locate any underground utilities before constructing a rain garden near a structure.

Do rain gardens attract mosquitoes?

Mosquitoes can be a concern in poorly designed or maintained rain gardens. To minimize mosquito breeding, it is important to ensure that rain gardens drain within 24-48 hours.

What are the pollutant removal rates for rain gardens?

Rain gardens typically achieve 90% TSS (Total Suspended Solids) removal. Additionally, they achieve approximately a 60% Phosphorous removal rate and a 30% Nitrogen removal rate. The Nitrogen removal rate can be increased if the system utilizes an internal storage reservoir (ISR). Phosphorous removal rates can be increased if the system utilizes admixes like wastewater treatment residuals. Systems that infiltrate into the native soils often offer higher pollutant removal rates than systems that are lined with underdrains.

How do I prepare my soil for a rain garden? What is the purpose of the filter media in a rain garden?

Rain garden filter media is typically a mix of coarse sand and compost. In watersheds impacted by phosphorous, compost may be replaced with good quality loam or a low-phosphorous compost mix. A layer of shredded hardwood mulch is typically applied above the filter media layer to help prevent weed growth and offer additional moisture retention. Keep in mind that some areas may not require any soil

amendments for a rain garden to function optimally, but existing soils would need adequate drainage and nutrient composition beyond the first few inches of the soil.

The purpose of the filter media is to facilitate vegetation growth and provide stormwater quality treatment. Vegetation assists with evapotranspiration and can remove nutrients like phosphorous and nitrogen from the stormwater. The roots also assist with infiltration of stormwater into the native soils. The filter media helps to physically screen suspended sediment particles in stormwater and the microbes present in the soil and around the vegetation root structures provide additional breakdown of pollutants.

Layer thickness varies, but mulch is typically applied in a 3 inch layer and the filter media typically ranges from 12-24 inches depending on treatment goals.

Can I plant trees in a rain garden? Can trees be planted in green infrastructure?

Of course, trees provide great water quality treatment and provide other co-benefits like carbon sequestration, wildlife habitat, noise reduction, reduction of the heat island effect, and reduction of stormwater volume.

Keep in mind, adding trees can potentially increase the amount of maintenance required (removal of fallen leaves/branches). Additionally, planting trees in sloped areas or along the berm of green infrastructure practices should generally be avoided. Trees blown over by high winds or collapsing due to erosion can negatively impact the structural integrity of the side walls. Planting woody vegetation above pipes, underdrains, culverts, and outlet structures should also be avoided.

What's the difference between a bioswale and a rain garden?

Bioswales and rain gardens are similar but work in slightly different ways. The primary difference is the slope of the feature. Bioswales are sloped bottom systems designed to convey stormwater from one location to another while filtering out pollutants whereas rain gardens are typically flat-bottom systems designed to capture stormwater. Bioswales are typically open channels or drainage ditches that are planted as bioretention systems (like a rain garden). The term bioswale is also sometimes used by other groups to describe a linear rain garden feature or small curbed roadside project, but it is recommended to simply call these rain gardens or stormwater planters to avoid confusing the term bioswale.

Porous Pavement:

Where can porous pavement be used?

Porous pavement can be used in various applications, such as parking lots, recreational areas (tennis courts/basketball courts), sidewalks, driveways, bike paths, and low-volume roadways (though there are some case studies for higher volume roadways and even for loading docks). It is suitable for both residential and commercial developments and can be implemented in new construction or retrofitted into existing paved areas.

Can vehicles park or drive on porous pavement?

Yes, porous pavement is designed to support the weight of vehicles. However, it is essential to consider the appropriate thickness and strength requirements based on the anticipated traffic load and consult design guidelines or specifications for certain applications.

Does porous pavement freeze in winter climates? Is it susceptible to potholes like standard asphalt?

Winter climate studies show that porous pavement is effective in cold climates and has similar or better performance to standard asphalt if handled correctly. The storage reservoir and void spaces in the surface allow air circulation that can keep the pavement at higher baseline temperatures. Properly designed systems will have storage reservoirs that are deep enough of to avoid fully freezing which helps prevent damage to the pavement. Snow melt is allowed to pass through the surface of the pavement meaning that meltwater is less likely to re-freeze and create black ice / slipping hazards. Care should be given to not sand and avoid salting porous pavement surfaces as these de-icing methods can degrade the surface and fill the void spaces. If salt must be used, brine solutions work better on pervious pavements and reduce impact on the system. Certain salts are also recommended, such as calcium magnesium acetate and potassium acetate. Additionally, snowplow blades should be slightly elevated to prevent scraping the surface. Snow should not be stored on porous pavement surfaces.

Rain Barrels & Cisterns:

How do you prevent Cisterns/Rain Barrels from freezing during winter?

Rain barrels and cisterns should be drained of water during months where freezing is a possibility. During the winter months, water should either be diverted away from these storage options or they should be closed from accepting meltwater.

Can I use my rain barrel to water my vegetable garden?

Harvested rainwater can be used for irrigation. Be aware that while roof runoff typically contains far fewer pollutants than stormwater runoff from high use parking lots and roadways, it can still contain some contaminants (especially if located in an industrial area with smokestacks). Utilizing root watering strategies can help mitigate risks associated with pollutants. Vegetation should always be washed and properly prepared for human consumption. Filters can be installed to provide additional treatment if desired.

Who do you use for cistern installations?

Bill Hoffman from American Water Management is our go-to. Visit their site: https://www.americanwatermanagement.com/

Wet Pond / Retention Pond:

What is the difference between a retention basin and a detention basin?

Detention basins are designed to slowly release captured water over time and drain completely between storm events. Retention basins or “wet ponds” are designed to have a permanent pool of water. During rain events, additional stormwater runoff is stored above the permanent pool volume.

How does a retention pond work?

Retention ponds collect, detain, and treat stormwater runoff. These systems have a permanent pool of water during dry conditions and have additional storage above this pool to store stormwater runoff when it rains. Water enters the system and flows across the pond to an outlet structure. While water is traveling across the pond, suspended particles are allowed to settle out of the water and microorganisms in the water help break down some pollutants. Outlet structures are sized to slowly release the additional volume of runoff resulting from a storm event, assisting with flood control. Outlet structures are often designed to have additional openings to handle very intense storm events. They also include an emergency spillway that can direct overflow water in a controlled manner in the event of failures in the outlet structure or the system becomes overwhelmed in extremely intense storm events.

How do we discourage geese from using retention ponds?

Geese can be both a nuisance and a destructive force on retention ponds. Young vegetation is particularly attractive to geese. There are several methods for repelling geese that should be considered in the design process. The most natural and effective is the use of vegetative buffers. Buffers should include tall grasses around the perimeter of the retention pond.

Soils, Drainage, and Vegetation:

How do I learn what type of soil I have at my site?

USDA and NRCS have a soil survey tool called "Web Soil Survey." This is the link to the tool: https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Here is a link to a fact sheet prepared by the cooperative extension on using the tool: https://njaes.rutgers.edu/fs1346/

You can also conduct a ribbon test on the soils:

http://water.rutgers.edu/Projects/SWMIYSchoolyard/K-8/Rain%20Garden%20Soil%20Considerations/Soil%20Ribbon%20Test%20Handout.pdf

How do I install green infrastructure if I have poor soil conditions on site?

Soil amendments can be used – similar to adding filter media composed of compost and sand into a rain garden. Additionally, underdrains can be installed to direct stormwater in sites with slow infiltration rates. NJ Future has a helpful guide to address this challenge: https://developersguide.njfuture.org/overcoming-challenges/

Where can I find rainfall data for my area?

Chapter 5 in the NJ Stormwater BMP Manual provides a table with 24-hour rainfall frequency data on page 13: https://dep.nj.gov/wp-content/uploads/stormwater/bmp/nj_swbmp_chapter-5_april_2021.pdf

This chapter also describes additional methods of determining rainfall at a particular site.

If you're looking for precipitation projections resulting from climate change, NJ has a tool that projects extreme precipitation estimates that can be accessed here:
https://njprojectedprecipitationchanges.com/

How do I prevent erosion resulting from stormwater runoff?

Designs typically include rip-rap or rock armoring consisting of angular rocks or stones of various sizes. The stone armoring dissipates water velocity, reducing the erosive force associated with runoff.

What is peak flow and how is it determined?

Peak flow typically refers to the maximum flow rate of stormwater runoff leaving a defined area (also known as a subcatchment). Peak flow rates for the pre-development and post-development site are often created with stormwater modeling programs like HydroCAD. These models are the method engineers utilize to demonstrate they're complying with NJDEP stormwater quantity rules that require reducing the peak flow in the post-development site condition. The models incorporate many parameters, including site topography, land cover types, hydrologic soil classifications, and rainfall intensities.

Peak flow can also refer to the maximum measured flow rate in a stream or river.

What constitutes "good" grass?

Good grass refers to the curve number (number representing how much stormwater runoff will occur based on a specific land cover and soil group) in stormwater modeling programs. Grass is considered "good condition" if the grass covers 75% or greater of the area being modeled. Fair condition means a grass cover of 50%-75% and poor condition means a grass cover of <50%.

For more information on curve numbers, visit this link:
https://www.hec.usace.army.mil/confluence/hmsdocs/hmstrm/cn-tables

How do I locate the water table?

To avoid groundwater intrusion into green infrastructure practices, designers should locate the seasonal high groundwater table prior to installation. The seasonal high groundwater table can be directly measured during the months of January – April. Alternatively, redoximorphic features in a soil test pit can be an indicator for seasonal high groundwater. Consult a soil scientist or other professional familiar with soil investigation for more information. In some cases, the USDA web soil survey may list the estimated seasonal high water table for a specific location. For more information, visit this website:
https://websoilsurvey.nrcs.usda.gov/app/
More information about soil testing can be found in the NJ BMP manual chapter 12:
https://dep.nj.gov/wp-content/uploads/stormwater/bmp/nj_swmp_12.pdf

Can I still use green infrastructure if I have high groundwater on my site?

Yes, it is still possible to utilize green infrastructure techniques even if you have high groundwater levels on your site. Green infrastructure can be adapted to accommodate high groundwater conditions. One method is to create shallower systems with larger surface areas to maintain a good separation from groundwater levels. Lining green infrastructure practices with impermeable liners can also help prevent groundwater intrusion. Keep in mind, lined systems will not provide groundwater recharge. Green

infrastructure practices like constructed wetlands may actually benefit from having high groundwater, since these systems are designed to maintain certain water levels.
NJ Future has a helpful guide to address this challenge:
https://developersguide.njfuture.org/overcoming-challenges/

What should I plant? Do you have a list of native plants?

Several websites can provide NJ-specific information on native plants that work well in green infrastructure practices. A few are linked below:
https://www.jerseyyards.org/plant/
https://dep.nj.gov/wp-content/uploads/stormwater/bmp/nj_swbmp_7.pdf
https://npsnj.org
http://water.rutgers.edu/Rain_Gardens/RGWebsite/misc/3_Planning_14-31.pdf

Maintenance:

How much maintenance does a rain garden require?

Rain gardens require some maintenance, particularly during the first year of establishment. Regular tasks include watering during dry periods, weeding, pruning, and occasional replanting. Inlets and outlets should be checked regularly and cleaned as needed. Once established, rain gardens generally require less maintenance than traditional lawns or gardens.

Who is responsible for maintenance of installed green infrastructure practices?

In addition to designing the green infrastructure practices, the Water Resources Program also provides a comprehensive maintenance plan to educate and guide the responsible party through the necessary maintenance procedures. Some towns have the capacity to inspect and maintain their green infrastructure with their department of public works. Some towns have a green team or other local environmental group that assists with inspection and maintenance of green infrastructure practices. Maintenance is incredibly important to the long-term success of green infrastructure, and it's important to have a plan in place for who will take on that responsibility.

Example Maintenance Guidelines:

http://water.rutgers.edu/Projects/GreenInfrastructureChampions/Talks_2020/MAINTENANCE_GUIDELINES_02142020.pdf

How is porous pavement maintained?

Regular maintenance is essential to ensure the effectiveness of porous pavement. It typically involves routine inspections, removal of debris, occasional vacuuming & sweeping, and periodic power washing to prevent clogging of the pavement's void spaces. Regenerative air vacuum trucks are widely considered to be the most effective for large-scale maintenance of porous pavement.

Where can I find a landscaping contractor that has experience with green infrastructure?

Chesapeake Bay Landscape Professionals undergo special certification for work with green infrastructure practices. Find out more information and access a list of certified individuals here: https://cblpro.org/

Additionally, the National Green Infrastructure Certification Program (recently acquired by EnviroCert International) provides a comprehensive green infrastructure certification program. Visit this website for more information: https://ngicp.org/

Retrofits:

Are there any good resources for retrofitting stormwater infrastructure?

Here's a fact sheet for converting dry detention basins into natural ecosystems:
https://njaes.rutgers.edu/fs1195/

Additionally, the Southern New England Program (SNEP) created the New England Stormwater Retrofit Manual that provides in-depth guidance on retrofitting stormwater infrastructure.
Find out more here: https://snepnetwork.org/stormwater-retrofit-manual/

Is there a GIS layer to find detention basins near me?

Yes, NJ DEP GeoWeb has a layer that shows detention basins. It's under the Sites & Facilities category drop down. https://www.nj.gov/dep/gis/geowebsplash.htm

If you're looking for what is classified as a stormwater basin, its under the master Land-Use/Land Cover 2015 layer.

NJ DEP GeoWeb currently has limited data however for certain regions outside Middlesex County. Another good reference is the New Jersey Hydrologic Modeling Database. https://hydro.rutgers.edu/

Miscellaneous / General:

Can you provide information / guidance for Eagle Scouts looking to install green infrastructure as part of their Eagle Scout Project?

For an Eagle Scout Project, the best resources is to look at the Rain Garden Manual of NJ which is ideal for this scale of project:
http://water.rutgers.edu/Rain_Gardens/RGWebsite/RainGardenManualofNJ.html

How do I find overburdened communities near me?

Visit this website: https://dep.nj.gov/ej/communities/

What is a stormwater utility?

A stormwater utility, also known as a stormwater management fee or a stormwater service charge, is a dedicated funding mechanism implemented by local governments to finance stormwater management programs and infrastructure. It is a system where property owners within a defined jurisdiction pay a fee or utility charge based on the amount of impervious surface on their property, such as roofs, driveways, parking lots, and sidewalks.

The purpose of a stormwater utility is to generate revenue to support the operation, maintenance, and improvement of stormwater management infrastructure and programs. These utilities help address the challenges associated with stormwater runoff, including flood control, water quality management, and erosion prevention which typically lack dedicated funding streams.

Where can I find more resources to help plan and design green infrastructure?

Additional Resources can be found below:

NJDEP BMP Manual
https://dep.nj.gov/stormwater/bmp-manual/
Rutgers Stormwater Tree Bed Guidance Manual
http://water.rutgers.edu/GreenInfrastructureGuidanceManual.html

New England Stormwater Retrofit Manual
https://snepnetwork.org/stormwater-retrofit-manual/

Philadelphia Stormwater Management Guidance Manual
https://water.phila.gov/development/stormwater-plan-review/manual/

Green Values Stormwater Management Calculator
https://greenvalues.cnt.org/index.php

EPA's Green Infrastructure Guidance
https://www.epa.gov/green-infrastructure