Homeowner Guide to Make Your Property Bay Friendly

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Introduction

In the Chesapeake Bay watershed, one of the greatest threats to the health of the Bay comes from increased development of the land. Increased development and transformation of the landscape leads to less rainwater soaking into the ground where it is naturally filtered before returning to our streams and rivers. Instead, more water "runs off" our properties and travels along our impervious corridors of driveways and streets picking up pollutants along the way which are then delivered to our streams and ultimately the Chesapeake Bay.

So what can YOU do? Every parcel of land in the watershed impacts the quality of the Bay including your individual property. You can decrease the impact that your property has on the Bay by reducing the amount of pollutants and stormwater generated from your lot.

Photo Credit: Chesapeake Bay Program

This guide presents a step by step approach for analyzing your property to find out whether it makes sense to install a rain garden or other residential stewardship practices. We then take you through the design and installation of several of the homeowner practices that can be installed on your own. Many Bay communities offer technical and financial assistance to help you build stewardship practices on your lot. Check out Appendix D for a list of links to these programs.

Methods for a "Bay-Friendly" Property

The goal is to manage the stormwater coming off of your individual property to reduce it and treat it for pollutants before it gets back into our streams and eventually the Chesapeake Bay. There are multiple ways that a homeowner can do this. The following is a list of some potential practices that a homeowner can employ to reduce runoff and pollutants coming off of the property.

Rain Gardens

Rain gardens accept runoff from a roof, driveway, or parking lot that would otherwise go to the street or storm drain. The garden has a shallow depression that allows stormwater to collect and pool. Natural soils are replaced with sandier ones to allow the water to soak into the ground instead of running "off" into the storm sewer system. The garden is planted with a mix of native plants that filter out pollutants and attract wildlife.

Conservation Landscaping

Conservation landscaping is the creation of mulched beds that are planted with perennial plants, shrubs and/or small trees that retain rainfall and absorb runoff from adjacent turf or paved surfaces. Native plants are preferred, but ornamental plants are acceptable if they are adapted to regional climates and are not invasive spreaders.

Tree Planting

Tree planting is the practice of planting deciduous or evergreen trees in grassy areas that will grow and create a leafy canopy that intercepts rainfall and reduces runoff. Native tree species are preferred. Trees can be planted by the owner or a contractor, but species should be selected that will grow best given the soil conditions and solar exposure at your planting site.

Cisterns and Rain Barrels

Cisterns and rain barrels are used to capture roof runoff in a barrel or tank and then re-using it for outdoor irrigation/watering and/or for selected indoor uses. While rain barrels can be installed by a homeowner, larger tanks and cisterns require a qualified design and installation professional. If stored runoff is used for indoor purposes, special measures may need to be taken to improve water quality

Permeable Pavement

Permeable pavement refers to the installation of pavers on driveways and sidewalks that allow rainfall to rapidly pass through the paver and into a shallow stone reservoir that allows the water to soak into the ground. The practice applies to both residential and non-residential paved areas, and may be a great option to replace deteriorating pavement. Most permeable pavers require the assistance of an experienced designer and pavement installation contractor.

Impervious Cover Removal

Impervious cover removal consists of the breaking up of existing hard surfaces and properly disposing or recycling of the asphalt or concrete, followed by roto-tilling of the underlying soils to relieve compaction, and planting them with grass or other vegetation. Pavement removal can occur on residential or non-residential properties. Some owners may be able to remove pavement, but it is often a good idea to hire a contractor to do the job.

Green Roof

Green roofs are systems that store and filter rainfall that lands on the roof through a thin layer of soil media and specialized vegetation. These practices are commonly applied to non-residential rooftops, and must be designed and installed by a qualified designer/contractor.
(Photo credit: Christin Jolicoeur, Arlington County)

Dry Wells

Dry wells are created by excavating a shallow trench that is filled with stone that is used to temporarily store runoff so it can soak into the ground. Dry wells can be designed and installed by the owner, although some technical assistance may be needed if they are located close to a basement.
(Photo credit: Philadelphia Water Department)

Several other environmental site design practices may be used to treat runoff from some properties, such as bioswales, landscape infiltration, submerged gravel wetlands, rooftop disconnection and stormwater planters. In addition, property owners can reduce their impact on local streams and the Bay by using Bay-friendly lawn care.

Bay-Friendly Lawn Care

Lawns make up a significant portion of individual properties and have been shown to produce more runoff than their forested counterparts. A recent research report by the Chesapeake Bay Program recommends ten practices that can make your lawn more Bay-friendly (USWG, 2013: http://chesapeakestormwater.net/training-library/urban-restoration-techniques/urban-nutrient-management/).

Maintain a dense cover of grass or conservation landscaping to reduce runoff, prevent erosion, and retain nutrients

Dense grass or plant cover helps to reduce surface runoff which can be responsible for significant nutrient loss from the lawn, regardless of whether it is fertilized or not. Lawns with poor turf cover have a high risk for nutrient loss, especially if soils are compacted or slopes are steep. Any bare spots or eroding areas should be re-seeded, and may require some soil amendments, spot fertilization and, in extreme cases, stabilized with a biodegradable erosion control cover.

Choose not to fertilize, OR Adopt a Reduce Rate/Monitor Strategy, OR Apply less than a pound of N per 1000 square feet per each individual application.

You have three fertilization options to reduce the risk that fertilizer from your lawn will reach the Bay, depending on the conditions of your lawn and your aesthetic preferences.

The easiest strategy is to not fertilize at all, which make sense for lawns that are relatively flat and mature, and have a dense grass cover. This strategy relies on soil mineralization, lawn clippings and atmospheric deposition to supply the nutrients needed for growth, but should NOT be used on lawns that have poor turf cover or exposed soils.

The second strategy relies on a "reduced rate and monitor" fertilization approach. In this strategy, you only apply one-third to a half of the recommended application rate on the fertilizer bag label, and then monitor how your lawn responds over the next couple of months. If you are unsatisfied with the look of your lawn at that point, you can always re-

apply fertilizer at the smaller dose. In most situations, however, you will find it hard to notice much of a difference in how good your lawn looks.

The third strategy is to fertilize at the recommended nitrogen fertilization rate but split it into 3 or 4 small doses during the growing season. Individual application rates should be no more than 0.9 pound of nitrogen per 1000 square feet of lawn in most parts of the Bay watershed

When assessing your property, we recommended that you measure your lawn area which will help you to figure out how much fertilizer you will need to buy.

If you choose to fertilize, the following practices can further reduce the risk that fertilizer you do apply ever reaches the Chesapeake Bay.

Do not apply fertilizers before spring green up or after the grass becomes dormant

Researchers have concluded that the highest fertilizer loss occurs in the winter when grass is dormant. In the northern part of the Bay watershed, dormancy usually begins around Halloween, whereas it begins around Thanksgiving in the southern part of the watershed.

Maximize use of slow release N fertilizer

The risk of nutrient loss during the growing season can be further reduced if you buy slow release fertilizer products. Check the bag label when you shop to see how much water insoluble nitrogen or WIN it contains -- at least 20 to 50% of WIN is generally desirable.

Immediately sweep off any fertilizer those lands on a paved surface

Rotary spreaders are the most common method to apply fertilizers and can broadcast fertilizer granules near the edge of the lawn, street or driveway, where they can be washed away in the next storm. Some experts think as much as 2 to 4 % of applied fertilizer can be washed away in this manner. If you are buying a new spreader, consider models that have side broadcast deflectors that can sharply reduce off-target fertilization.

Never apply fertilizer within 15 to 20 feet of any water feature and manage this zone as a grass, meadow, or forest buffer.

The risk of nutrient loss is also high when fertilizer is applied close to water features such as swales, drainage ditches, streams, shorelines, sinkholes and wetlands. So it is a real good idea to create a "fertilizer-free" buffer zone around these water features, and manage this area as a conservation landscape.

Even if you don't fertilize your lawn, there are still other good practices to make your yard more Bay-friendly.

Keep clippings and mulched leaves on the lawn and keep them out of streets and storm drains

Lawn clippings are an important nutrient and organic matter source which can enhance the health of your soils and your lawn. Using a composting lawn mower to keep the clippings on your lawn adds about one pound of N per 1000 square feet of natural (and free) fertilizer to your lawn each year.

You should treat lawn clippings and tree leaves as if they were a bag of fertilizer, and strive to keep them on your lawn, and out of the gutter, street or storm drain system.

When you rake your leaves in the Fall, it is good practice to run over them with your composting mower to mulch them into small fragments and add them to your compost pile in the backyard. Come late Spring, they will decompose into a fine organic mulch that you can add to your rain garden or conservation landscape as a top dressing (assuming that you turn over the pile every couple of months)

Set mower height at 3 inches or taller

Maintaining taller grass produces a deeper and more extensive root system, which in turn, increases nutrient uptake and reduces lawn runoff volume. The deeper roots also reduce the need for supplemental irrigation during times of drought, suppress weeds and increase turf density.

Use other practices to increase the porosity and infiltration capability of your lawn to treat stormwater.

Disconnecting you downspouts and installing practices like rain gardens have been shown to increase your lawn's ability to retain and manage stormwater on-site.

Consult with your local extension service office or lawn care company to get the best advice on how to have a Bay-friendly lawn, which might involve a soil test analysis.

Many lawn care professionals can help you get a good looking and Bay-friendly lawn, given your type of grass, soil conditions, and shading, and your landscape preferences. Some good links to get expertise to help reach your lawn goals can be found in Appendix E.

Assessing Your Property

A good first step to helping the Chesapeake Bay is to walk around your lot and assess the site conditions. This simple and fast assessment of your site will help you determine which stewardship practices are best for your property.

Step 1: Map your Lot

You begin by obtaining a recent aerial photo of your property. You can do this by using Google Earth or http://landserver.org/ also, many localities have great online resources for mapping your property. In some cases, you may want to simply pace off the boundaries of your property.

You can take the roof dimensions directly off your property deed. Most homes have a roof area around 1500 to 2500 square feet.

Next, draw the boundary dimensions of your property on a piece of graph paper (Appendix A), and then sketch in the roof, any decks or sheds, the driveway and sidewalks, major trees, and any landscaping beds. The rest is usually turf.

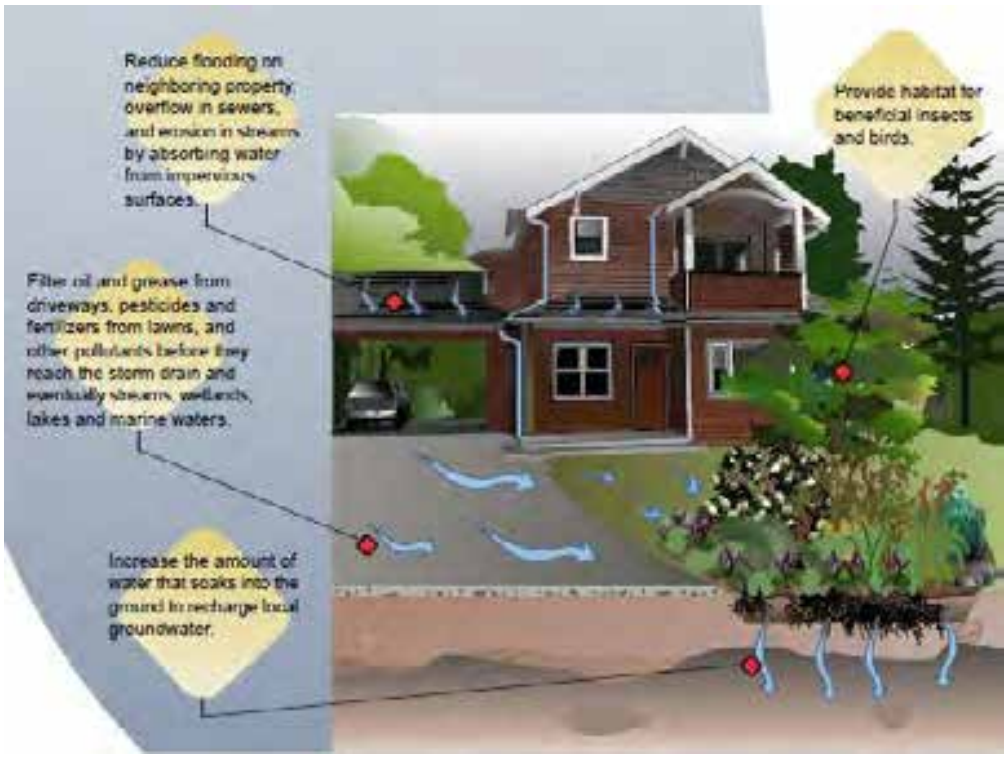
You don't need to be a Rembrandt, but try to draw it to scale, using five or ten feet per square on the graph paper, depending on the size of your lot. Next, pace off (or measure) the approximate dimensions of all your hard surfaces and landscaping areas, and enter them into the table provided in Box A to determine how much hard surface you have.

Box A. Basic Data on Lot Cover for My Home and Impressive Sketch			
LOT COVERAGE	Area: Square Feet	% of Lot	Sketch of Property
Hard Surfaces		28%	
Roof-tops	3360		
Driveway/Sidewalk	2790		
Pervious Cover		72%	
Trees/Landscaping	5500		
Lawn	10,130		
TOTAL	21,780		
Note: 43,560 square feet = one acre			

Step 2: Figure Out Your Natural Plumbing

It's pretty simple, water flows downhill. Most lots are graded to move rainwater away from the home and down to the street, or in some cases, the back yard. So your job is to define the flow path of runoff in your lot.

Most lots have multiple flow paths, so start out by finding each of your downspouts, and look down slope to see where the water goes. Pay special attention to see if the flow path extends to your driveway and from there to your street. These areas are usually great candidates for stewardship practices because you can divert the runoff to them to soak up runoff and remove pollutants.



(Credit: Rain Garden Handbook for Western Washington Homeowners, WSU Extension)

Some downspouts already flow over lawn, landscaping or trees and infiltrate into the ground. These downspouts are good, as the runoff is disconnected and never reaches the street or stream.

In other cases, the flow path from the downspout runs over a few feet of grass before reaching the street or driveway. These are often excellent locations for stewardship practices, such as rain gardens.

Lastly, there are a few cases where the downspout is plumbed directly to the street via an underground pipe (see Box B). With a bit of ingenuity, the underground pipe can be partially dug out, and replaced with a rain garden.

Box B. Be a Downspout Detective

Downspouts discharging near driveways are usually connected to the street, and are prime candidates for locating a rain garden

This downspout is plumbed directly to the street, and would be quite easy to retrofit as a rain garden

This downspout is too far away from any pervious areas for a rain garden, but a rain barrel might work

Runoff from both of these downspouts travels at least 40 feet over grass which effectively disconnects them, making them a poor candidate for a rain garden

Step 3: Figure Out Your Other Plumbing

Underground plumbing was definitely one of the great inventions of the 20th century, but it can complicate the design of your residential stewardship practices.

Things to locate on your lawn and avoid		
Natural gas feeder line	Underground electric lines	Street right of way
Sewer lateral and cleanout	Cable and fiber optic lines	Septic field (if present)
Water lines	Sump pump discharges	Overhead forest canopy

After all, you probably wouldn't want blow up your house, create a gusher, back up sewage into your basement, electrocute yourself, or God forbid, shut down cable access to your entire neighborhood during the big game. I bet you didn't think a little digging could be so dangerous!

Most states have "call before you dig" rules and provide a hotline to help you locate your underground utilities. The following table provides the contact information for individual Chesapeake Bay states however, in any state you can call "811" and you will be directed to your local call center. In many cases you will need to call several days in advance so you should check with your specific state. More information about this free resource can be found: http://www.call811.com/state-specific.aspx

State/District	Resource	Contact Information
MD	Miss Utility of Maryland*	811 or 1-800-257-7777**
DE	Miss Utility of Delmarva	811 or 1-800-282-8555
DC	District One Call	811 or 1-800-257-7777
PA	Pennsylvania One Call System, Inc.	811 or 1-800-242-1776
VA	Virginia 811	811 or 1-800-552-7001
WV	WV811	811 or 1-800-245-4848
* For the Eastern Shore of MD call Miss Utility of Delmarva ** or use website link http://www.missutility.net/homeowners/		

However the Miss Utility and similar hotlines do not mark private utilities. You will need to scout your lawn to locate where utilities leave the street or right of way, and cross your yard to enter or leave your home. Box C provides some examples of "visual indicators" for locating underground utilities.

Box C. Visual Indicators for Areas to Avoid When Assessing Your Yard for Stewardship Practices

		
Water Lines	Natural Gas Lines	Sewer Lines
		
Underground Cable	Storm Drain Manhole	Sewage Pipe Cleanout
		
Basement	Sump Pump Discharge	Street Right of Way

You should try to mark these on your property sketch and work around them when locating the best area for your stewardship practices. In general, it is not advisable to install practices in your street right of way, since your local government and utilities have the right to dig it up for street improvements and utility repairs.

Step 4. Assess Soil Quality in Your Yard

Healthy soils are the foundation for any vigorous lawn, conservation landscape, or rain garden, so it is a good idea to do some simple tests to assess your soil quality.

Take a soil test in the areas of your lawn where grass doesn't grow very well. Take a trowel and dig 8 or 10 thin slices from the top 2 or 3 inches of soil in your lawn "problem areas". Mix the slices together so that you have a total sample of between 1 and 2 cups. Remove any rocks, debris or grass thatch, and put them into the sample bag provided by the testing lab.

A list of testing labs in the Bay watershed can be found at the end of the following link. http://www.hgic.umd.edu/content/documents/SelectingandUsingaSoilTestLabwithchart2_09.pdf.

The cost for most soil tests is about $10 to $12, and most labs can e-mail you the results in less than a week, and recommend any needed soil amendments (such as lime) to improve growing conditions.

Additional soil information may be necessary for implementing specific stewardship practices and can be found in those sections of the document.

Step 5. Check Your Solar Exposure and Tree Canopy

Go back to your aerial photo of your yard that you retrieved in Step 1, and check to see how much tree canopy exists over your yard. If you have less than 25% tree canopy, you may want to consider planting more trees, since they add to the market value of your home and can help reduce your heating and cooling costs.

There are a few tips to locate the best spots to plant a tree and figure out which tree species will grow best under your yard conditions and landscaping preferences. Not to worry, the Center for Watershed Protection has a handy reference called *Part 3 Urban Tree Planting Guide* which can quickly help you figure out which tree species you want and where to plant them. The guide can be accessed at: http://www.na.fs.fed.us/pubs/uf/watershed3/urban_watershed_forestry_manual_part3.pdf

The next task is to determine the solar exposure of your property to see if the plants will receive full sun or will be partially shaded. Your solar exposure is determined by three factors: the orientation of your property in relation to the east-west path of the sun, shading by the existing tree canopy in your yard (and often your neighbors), and the shading effect of your home.

Often, North or West-facing areas of your yard will be shadier, but you can do a quick shade analysis and add it your property sketch by clicking: http://www.thegardencontinuum.com/blog/bid/28513/How-much-sun-does-your-garden-have. The shade analysis will help you decide to buy sun or shade tolerant plants for your yard.

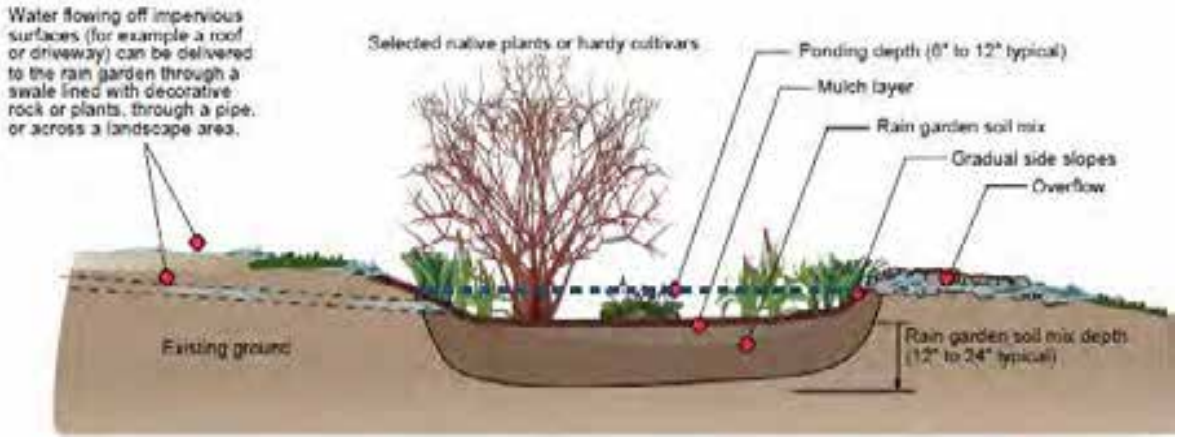
Step 6: Pulling it all Together in a Plan

Now you have all the basic data needed to make your property more Bay friendly, and to choose the right stewardship practices that meet your environmental objectives and your lawn and landscaping preferences. The next several sections describe how to design and install the different options for residential stewardship practices

Rain Gardens

Rain gardens treat stormwater runoff generated by your property by acting like a native landscape whose soils and plants to filter the water and remove pollutants.

A rain garden works by collecting stormwater runoff from a roof, driveway, or parking lot that would otherwise go to the street or storm drain. The water temporarily ponds on the surface of the garden and then slowly filters through the soil media and/or is taken up and used by the plants. The garden is planted with a mix of native plants that filter out pollutants and attract wildlife.



Cross Section of a Rain Garden (Credit: Rain Garden Handbook for Western Washington Homeowners, WSU Extension)

Test Your Soils to See if a Rain Garden Will Work

You will need to run some additional soil "tests" in order to design and building your rain garden.

Step 1: Figure out your maximum digging depth and get a better sense of the actual soil properties where you intend to dig your rain garden. Using a post hole digger, do a penetration test to see how deep into the soil profile you can physically dig. The goal is to see if you can make a hole that is at least two feet deep, although sometimes tree roots, clay layers or even bedrock can prevent you from reaching that far.

If you do encounter bedrock or the hole fills up with water, then it may not be feasible to install a rain garden in that location. In general, you need a digging depth of at least 18 inches to 2 feet to make a rain garden work.

Step 2. Examine your soil properties. Next, look at the profile of soils that you have excavated to see the break between your topsoil layer and the underlying sub soils which you will need to remove during construction (Box D).

Box D. Use Your Hole Digging to Check Out Soil Quality

The first six inches or so of soil are usually dark, loamy and rich in organic matter and nutrients

As you go farther down into the sub soils, soil quality gets poorer, and often has more clay. The soils in the bottom 6 to 12 inches of soil are always removed from the rain garden and disposed of somewhere on your yard. This can be a lot of dirt -- 4 to 6 cubic yards -- for a typical rain garden, so have a plan where you can fill depressions, holes or create berms somewhere on your property

Otherwise, you end up like I did, and have a pile of dirt that is extremely hard to grow anything on. I intend to mix the fill soil with a lot of leaf compost and eventually spread it over some conservation landscaping

Step 3: Do a simple infiltration test in your hole to see how quickly water will soak into the bottom of your planned rain garden. Simply follow the procedures shown in Box E and you can calculate the soil infiltration rate (in inches per hour). Once again, you should jot this number down, as you will need it later in the design stage.

Box E. The Post Hole Digger Method to Measure Your Soil Infiltration Rate

Using the post hole digger, make a hole about two feet deep

Fill bucket of water and fill hole to brim

Note the time that you started

	Note the number of hours it takes for the hole to completely drain Divide the depth of the hole (inches) by the number of hours to drain In this case, 24 inches/12 hours = 2 inches/hour, which is a good infiltration rate. If your infiltration rate is less than 0.5 inches/hr, you will need to increase surface area of the rain garden

You now have all of the information you need to design your rain garden, so grab a calculator and tape measure, and get cracking.

Design Your Rain Garden

Step 1: Estimate rooftop area draining to each of your most promising downspout(s). Simply, take the total rooftop area you entered in Box A of the property assessment section, and divide by the total number of downspouts at your home:

Total Roof Area	No. of Downspouts	Area Draining to Rain Garden
2650 sf	5	530 sf
Note: For the most accurate estimate, you can measure the actual roof area draining to each downspout		

Step 2: Determine minimum surface area for rain garden. Assume that your garden will be 6 inches deep, and will capture the first inch of rainfall that lands on your roof. The minimum surface area for your rain garden is computed using the following equation:

Surface Area Draining to the Rain Garden	"Engineering Factor" (multiply by 0.12)	Minimum Surface Area For Rain Garden
530	0.12	64 square feet
Note that one 4 by 8 tarp would be 32 square feet, so you would need an area equivalent to two tarps to locate a rain garden at this downspout		
The engineering factor computes how much surface area is needed in your rain garden to capture one inch of rainfall that falls on your roof.		

Step 3. Go outside to your downspout with some tent stakes and mark out the potential surface area available for your rain garden. Place the first stake at least 5 feet away from the downspout (if you don't have a basement) or 15 feet (if you do).

Check your property sketch to see if there are any underground utilities in the vicinity of your planned rain garden and then stake out a line at least two feet away from them. Contact Miss Utility to request an on-site utility check: they will usually come to your home within a few business days to confirm that your proposed digging area is utility free.

Walk in a downhill direction until you reach your property boundary and place a stake there. The line from your downspout to this stake is called the plumb line. Tie a string to the stake and then run it back to the downspout to measure how many inches of drop you have. If you have more than six inches of drop, you will be able to construct a soil berm on the downstream end of the rain garden to increase the ponding area.

Walk in a perpendicular direction on each side of the plumb line until you reach a major tree (think roots), hard surface, or start going seriously uphill. Stake out the lateral boundaries, and you have now defined the maximum envelope that is available for digging your rain garden.

Go out to your garage and get a small tarp and multiply its length and width to see how many square feet it covers. I use a 4' by 8' tarp that is 32 square feet in area. If I can get the equivalent of two tarps within the envelope defined by the stakes, then I am good to go (e.g. minimum area needed = available area).

You can still make a rain garden work with only half of the recommended minimum surface area, but you should expect that your rain garden will be wet-footed (see planting guide).

If you still can't make it work, consider another practice, such as a rain barrel connected to a conservation landscape...especially if you have an infiltration rate of less than a quarter inch per hour. Some tips for installing rain barrels can be found in the Rain Barrel Design Section.

Step 4. The last step is to figure out how much excess fill needs to disposed of, and how much sand and mulch to order. So we go back to our earlier measurements of the maximum digging and topsoil depth, and use the calculator provided below (also provided in Appendix B).

Calculator to Estimate Excess Fill and Materials to Buy		
Design Factor	Example	Your Calculation
EXCESS FILL		
Max Digging Depth	24 inches	
Ponding Depth	6 inches	
Top Soil Depth	6 inches	
Subsoil Depth	12 inches	
Divide Subsoil Depth by 2, and then divide this by 12	[12inches/2]/12 X = 0.5 feet	
Garden Surface Area	64 square feet = Y	
Z = Multiply X and Y and divide the product by 27	[(64)(0.5)]/27 = 1.2 cubic yards	
Note: About 6 Wheelbarrow loads per cubic yard	**About 7 loads of subsoil to dispose of elsewhere on your lawn**	
MULCH CALCULATOR		
Garden Surface Area	64 square feet	
1 cubic yard for each 64 square feet of garden area	1 cubic yard of mulch to order [1]	
SAND CALCULATOR		
Take Z and multiply by 1.4	= 1.7 tons of sand to order (round up to 2 tons)	
RIVER STONE CALCULATOR		
Assume 0.2 tons per inlet	0.2 tons (400 pounds) [1]	

[1] Most bulk orders must be done in one cubic yard or ton increments. Last time I checked, the delivered price of sand is about $45, double shredded hardwood mulch costs around $35 a cubic yard and river stone runs $100/ton. You may want to budget about $250 for plants, the connector pipe and other stuff.

Some Cool Rain Garden Design Solutions

Not every rain garden design is the same; Box F demonstrates some creative ways to fit in a rain garden in a specific design situation.

Box F. Some Cool Rain Garden Design Solutions

Two downspouts, one rain garden and a large area of conservation landscaping

Stone walkway over rain garden

Narrow stone trench across driveway leads to rain garden on the other side

Under drain pipe collects runoff from the bottom of the rain garden and discharges it down-gradient

Constructing Your Rain Garden

Now it's time to order your bulk supplies for your rain garden, after a brief break to partake of a cold beverage. You will need a series of hand tools, tarps and wheelbarrows to install your rain garden, as shown in Box G.

Box G. The Tools of the Rain Garden Trade

Post Hole Digger for Soil Test

The axe helps to whack pesky tree roots

Two tarp method: one for topsoil and one for subsoil. May need a third for your sand/mulch

You will be moving a few tons of soil and other materials, so make sure to get a sturdy wheel barrow

You need more than just a shovel to install a rain garden. In addition to what is shown above, make sure to get a can of spray paint, some 2 ml black plastic, and a flexible downspout connector.

Step 1. Use a can of spray paint to delineate where you plan to dig, keeping at least 3 feet from any known utilities and out of the street right of way. If you have not yet called Miss Utility, get on the phone now.

Step 2. Connect a flexible connector pipe to your downspout and use it move the rainwater where you won't be digging. Dig a shallow trench at least a foot wide and six inches deep that extends at least ten feet from the foundation of your house to the head of the rain garden. Make sure that you have enough slope to move runoff away from the house...3 to 6 inches of drop from the downspout to the head of the rain garden is usually enough.

Step 3. Line the trench with plastic sheeting that can be purchased at any home and garden store. You can test this by running a garden hose through it to make sure water quickly reaches the downstream end of your inlet trench.

Step 4. You have two options at this point (Box H). You can either bury the connector pipe in the shallow trench and cover it with soil up to the existing lawn grade, or you can create a river stone channel, which is my preference.

Box H. Options for Your Rain Garden Inlet

Attach Flexible Connector Pipe to Downspout

Make Sure it Extends 15 feet if you have a basement

Line Trench with Plastic: lay down some impermeable black plastic (3 to 5 ml thick) to wrap on the bottom and sides of the inlet channel to make runoff gets to your rain garden and not in your basement

Example of River Stone Inlet

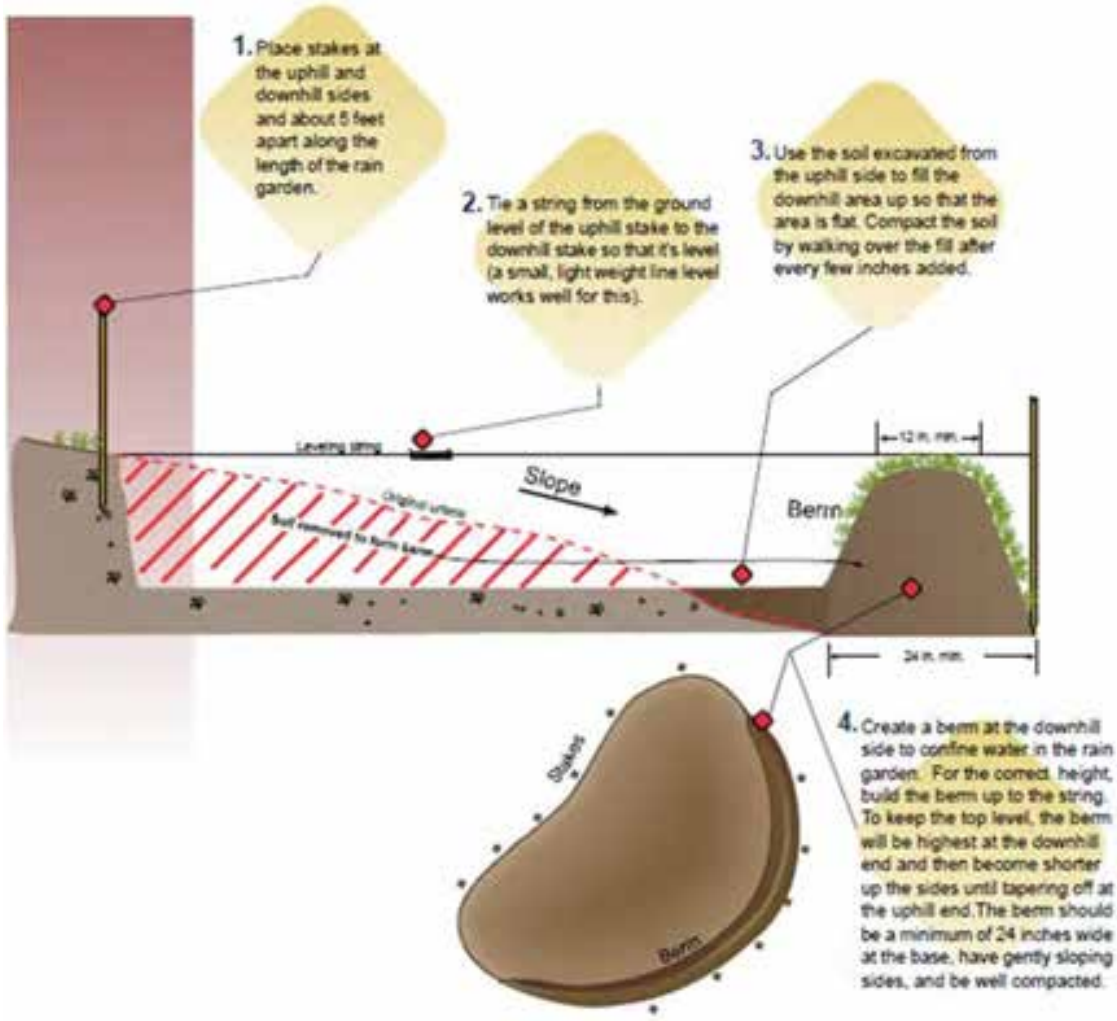
Step 5. Now is the time for some serious digging. The first part is pretty tedious…separating the turf from your topsoil and throwing each onto Tarp 1. You may need to use the root axe to get around underground tree roots, but keep going until you dig down about 9 to 12 inches, where you will reach your poorer sub-soils or clay layer (see Box D).

Step 6. At this point you will need to use a pick or adze to break up these compacted soils. Make sure to separate these lousy soils from the good ones by throwing them onto Tarp

No. 2. Keep on digging until you get to your maximum digging depth, which is usually around 18 to 24 inches.

Step 7.The bottom of the bed should generally be flat, although it is OK to have a few inches of drop going in a downhill direction. At this point, you want to take a pick or a hoe and loosen up the subsoil at the bottom of your rain garden to improve infiltration.

Step 8 Install a ponding berm (optional). If you measured more than six inches of drop from your original plumb-line, you can take some of your lousy dirt from Tarp 2 and form a soil berm nine inches wide and six inches high (or level with the bottom of the downspout) around the perimeter of your rain garden. Make sure to tamp the berm down so it can hold water during a storm. See below.



Installing a Ponding Berm (Diagram credit: Rain Garden Handbook for Western Washington Homeowners, WSU Extension)

Step 9. Install a surface overflow channel. Remember that your rain garden is only designed to capture one inch of rain, so storms more intense than that must be able to find an easy downhill exit out of the rain garden. I usually dig a small overflow channel at the down-gradient end of the rain garden that is a few inches below the grade of the lawn and discharges directly to the street or right of way. The channel can be back-filled with river stone to make it more attractive.

Step 10. You can backfill now by alternating a shovelful of sand with a shovelful of your good Tarp 1 topsoil until you are about six inches below the grade of your lawn (over the next month or so, it will settle a few more inches, but don't worry about that).

Step 11. Spread no more than 2 or 3 inches of double shredded hardwood mulch on the bed.

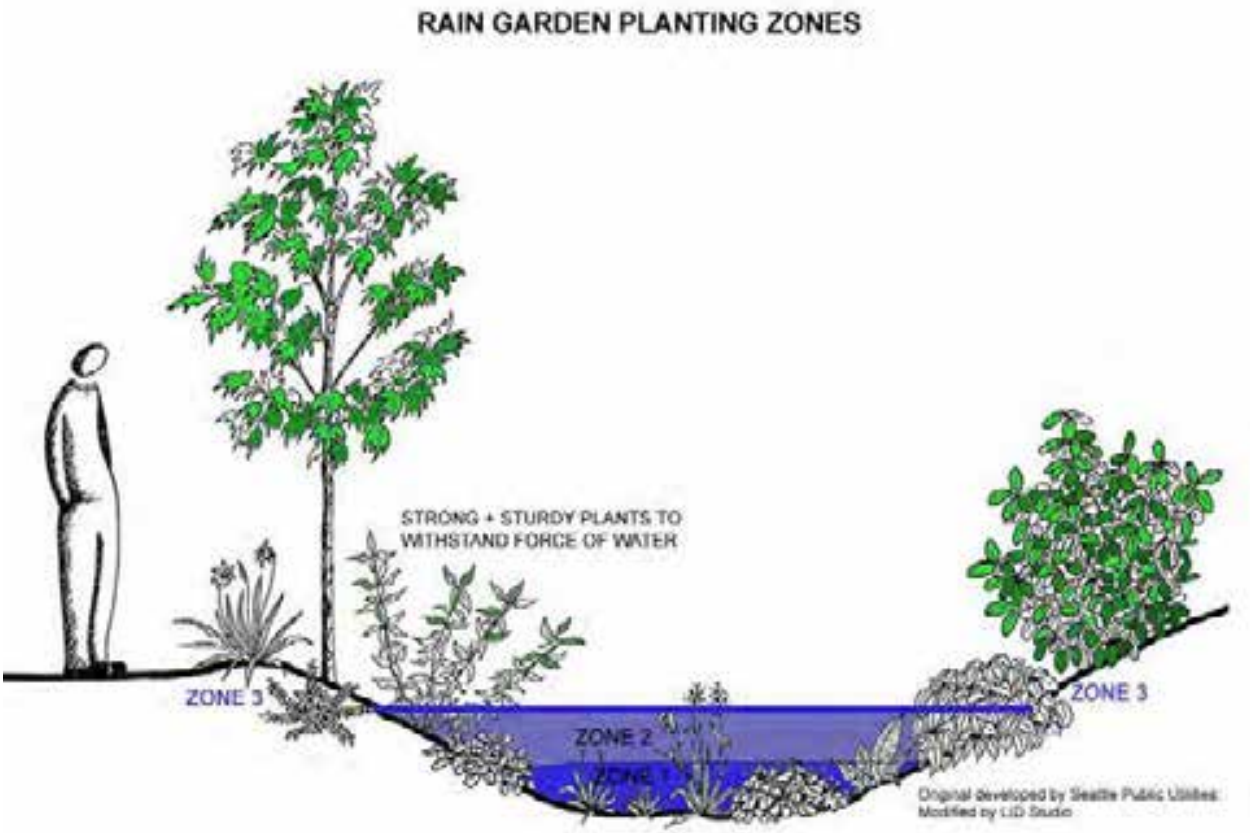
Step 12. You can then dispose of your fill soils elsewhere on your yard to fill holes, depressions or gullies. It is a good idea to amend the soils with compost, and re-seed them with a grass or conservation landscaping seed mix. You may also need to reseed the turf underneath your tarps if they were on the ground long enough to kill the grass. You can now retire to your deck, partake of another cold beverage and admire your work.

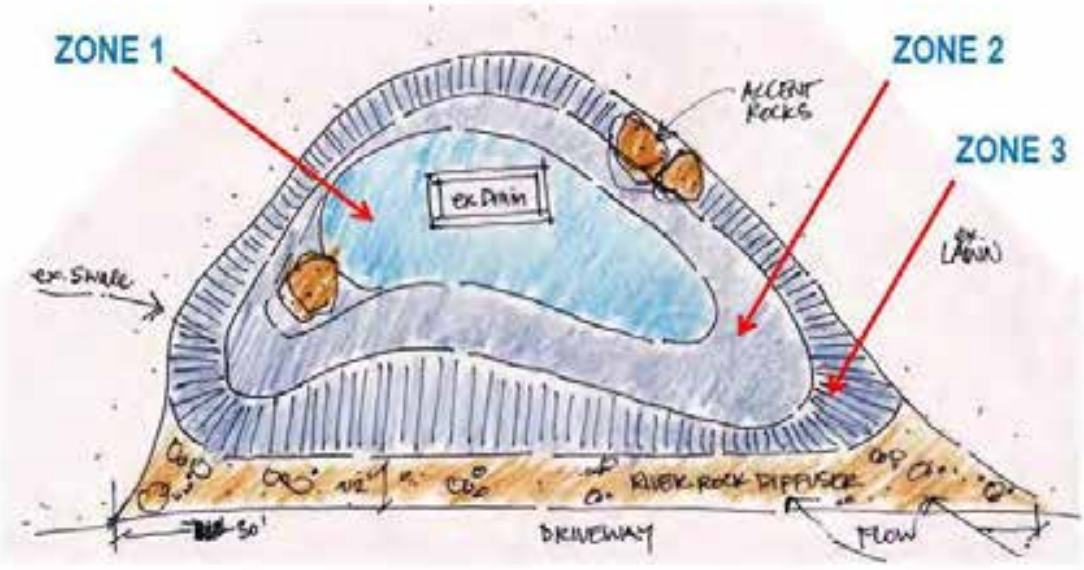
Planting Your Rain Garden

It is easiest to design a successful and flourishing rain garden if you think about the anatomy of a rain garden, how they retain water, and categorizing plants in three types of zones. Rain Gardens are planted with various types of plants because some plants tolerate sitting in water for an extended time (Zone 1), some tolerate sitting in water for a shorter time (Zone 2), and other plants do not like sitting in water at all (Zone 3). In the plant world scientists determine plants tolerance for 'wet feet' which means how much they like their roots to be wet. The plants in Zones 1 and 2 are more 'wet footed' and Zone 3 plants are edge plants. Edge plants are essentially plants which can be used everywhere in your landscape. Interestingly enough many 'wet footed' Zone 1 plants also thrive during times of drought and heat. The wonders and resilience of nature!

Some homeowners may choose to wait a few weeks after construction before developing a planting plan in order to see where the water settles (literally) and more importantly, observe the water zones that are created in the rain garden. Water seeks its own level, and there will be some areas of the rain garden which hold water and are more saturated than others. Understanding these planting zones is critical to picking the native plants which will thrive best in your rain garden. Box I shows the water zones that can be found in a rain garden.

Box I. The Water Zones in a Rain Garden and What they Mean (profile and plan)





Source: Anne Guillette, Low Impact Design Studio

Planting Design

Now that you have assessed your property and you understand the soils, the amount of sun, the amount of rainwater coming to your rain garden, etc. you are now ready to prepare your planting design. When preparing your planting plan consider a few design principles…

Group plants together in a series as they will have more visual impact.

Your design is a "composition" – like a painting or a group of objects on a shelf.

Use the 'Rule of Thirds" to make it more dynamic. This means placing an odd number of plants together in a grouping (1, 3, 5, etc.) rather than even numbers. The odd numbers leads your eyes to move through your composition (your rain garden!) because the brain can't "pair them." This principle creates visual interest and harmony

Vary plants heights, textures, colors, shapes, and sizes throughout the garden

If you seek a garden which is more random, consider a variation on this theme: place seven cardinal flowers in one location of the garden and then spot one additional cardinal flower in another part of the garden. This 'breaks' the rules, so to speak, and creates a more lively composition.

Try creating a garden which is not symmetric, especially if you are used to a lot of order in your life…random organization can be interesting!
Now for the practical steps:

1) Considering the planting zones: Make sure you locate Zone 1 plants in the basin, Zone 2 plants in the sides, and Zone 3 plants on the edge. Separate them out accordingly.

2) Think about the "structural" components of the garden first - what will it look like in the winter when all of the perennials have died back? Do you have any evergreen plants? Are there any grasses, rushes or sedges that have winter interest (something that looks good in winter)? This will help you locate plants with winter interest first. As a note, sometimes people place accent stones and/or river rock through the middle of the rain garden so that there is more visual interest in the winter. A focal element such sculpture or a garden ornament is also an option.

3) Locate the taller plants along the back or the edges, such as shrubs, hibiscus, or ironweed.

4) Place sturdy plants near where the water flows into the rain garden. Blue flag iris, soft rush, and white turtlehead are good candidates as they will withstand some velocity of water.

5) Think about the visual characteristics of the plants you would like to use to include their leaf structure (whether rounded or grass-like), bloom color, height and width. ***The most important aspect here is that you place taller growing plants behind shorter plants.*** Other than that there are no rules. Place them in an arrangement which pleases you.

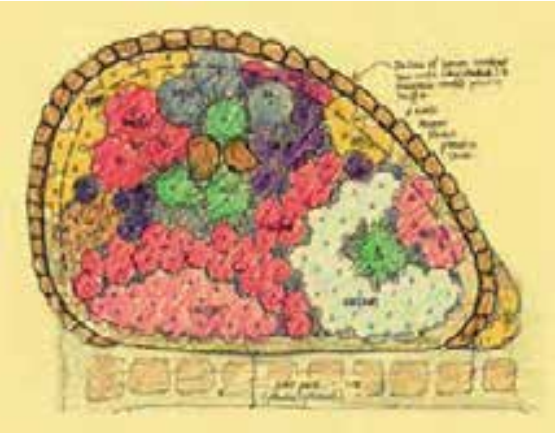
6) Consider the bloom time of the plants as it is rewarding to have a garden with spring, summer and fall blooms spotted throughout the garden.

In summary, have fun designing the plants where you want! Aside from placing them in the right zones there is no right way or wrong way. Besides, you can always move them around! Enjoy!

What follows are a couple of sample planting plans for rain gardens depending on them amount of sun or shade that they receive.

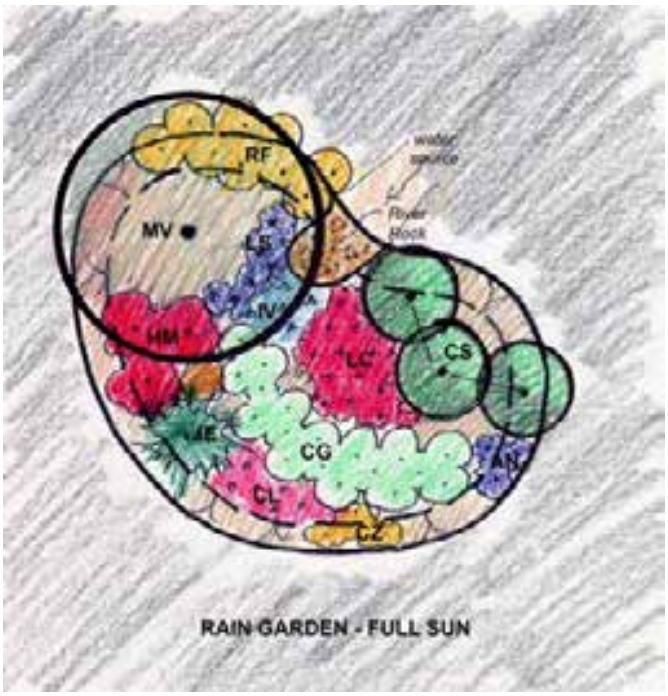
Sample Planting Plans

Sunny Rain Gardens



Option 1: Planting Plan for a Sunny Rain Garden with Perennials

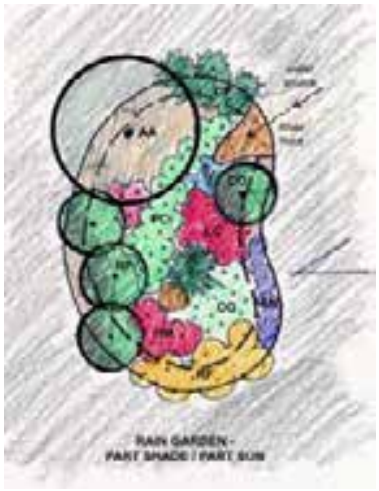
Option 1: Plant List for a Sunny Rain Garden with Perennials							
LABEL	LATIN NAME	COMMON NAME	SIZE[1]	QTY	PLANTING ZONE		
					1	2	3
PERENNIALS, SEDGES + GRASSES							
ANA	Anemone Canadensis	Windflower	#1	3			◆
AT	Asclepias incarnata	Swamp Milkweed	#1	3	◆	◆	
BA	Baptisia australis	False Indigo	#1	3	◆	◆	
CG	Chelone glabra	White Turtlehead	QT	24	◆	◆	
CHL	Chelone 'Hot Lips'	Pink Turtlehead	QT	18	◆	◆	
CZ	Coreopsis 'Zagreb'	Tickseed Coreopsis	#1	3			◆
EP	Echinacea purpurea 'Magnus'	Coneflower	#1	12		◆	◆
HM	Hibiscus coccineus 'Blaze Star'	Rose Mallow	#1	3	◆	◆	
IC	Iris cristata	Crested Iris	QT	6	◆	◆	
IV	Iris versicolor	Blue Flag Iris	#1	5	◆	◆	
JE	Juncus effuses	Soft Rush	#1	4	◆	◆	
LM	Liatris microcephela	Gayfeather	#1	6		◆	
LC	Lobelia cardinalis	Cardinal Flower	QT	24	◆	◆	
RF	Rudbeckia fulgida	Black Eyed Susan	#1	12		◆	◆
SL	Sisyrychium ang. 'Lucerne'	Blue Eyed Grass	QT	6	◆	◆	
[1] Refers to the size of the container: gallon (#1) or quart							



Option 2: Planting Plan for a Sunny Rain Garden with Perennials, Shrubs and Trees

Option 2: Plant List for a Sunny Rain Garden with Perennials, Shrubs and Trees							
LABEL	LATIN NAME	COMMON NAME	SIZE[1]	QTY	PLANTING ZONE		
					1	2	3
TREE							
MV	Magnolia virginiana	Sweetbay Magnolia	8-10'	1	◆	◆	◆
SHRUBS							
CS	Cornus sericea	Red Osier Dogwood	5 gal	3	◆	◆	◆
PERENNIALS, SEDGES + GRASSES							
AN	Aster novae-angliae	New England Aster	QT	3			◆
CG	Chelone glabra	White Turtlehead	QT	18	◆	◆	
CL	Chelone llyoni	Pink Turtlehead	QT	9	◆	◆	
CZ	Coreopsis 'Zagreb'	Tickseed Coreopsis	QT	3			◆
HM	Hibiscus coccineus	Rose Mallow	#1	3	◆	◆	
IV	Iris versicolor	Blue Flag Iris	#1	5	◆	◆	
JE	Juncus effuses	Soft Rush	#1	1	◆	◆	
LC	Lobelia cardinalis	Cardinal Flower	QT	12	◆	◆	
LS	Liatris spicata	Gayfeather	#1	6	◆	◆	
RF	Rudbeckia fulgida	Black Eyed Susan	#1	9	◆	◆	◆
[1] Refers to the size of the container: gallon (#1) or quart							

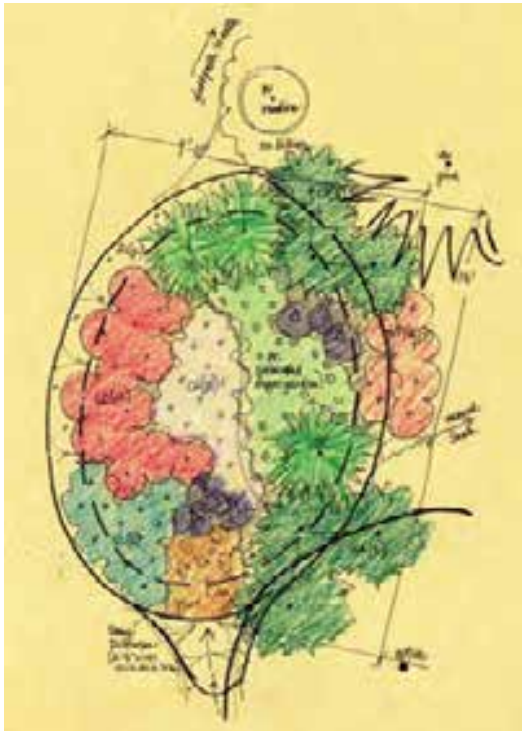
Partial Shade Rain Gardens



Planting Plan for a Partially Shaded Rain Garden with Perennials, Shrubs and Trees

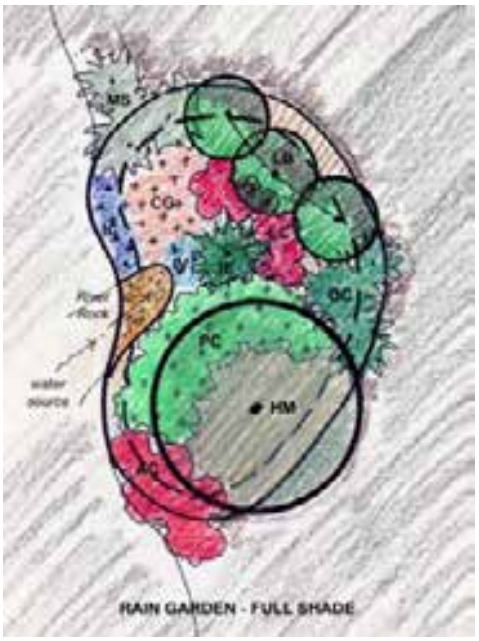
Plant List for a Partially Shaded Rain Garden with Perennials, Shrubs and Trees							
LABEL	**LATIN NAME**	**COMMON NAME**	**SIZE[1]**	**QTY**	**PLANTING ZONE**		
					1	**2**	**3**
TREE							
AA	Amelanchier arborea	Downy Serviceberry	8-10'	1	◆	◆	◆
SHRUBS							
CO	Cephalanthus occidentalis	Buttonbush	5 gal	1	◆	◆	◆
RP	Rhododendron periclymenoides	Pinxterbloom Azalea	5 gal	3	◆	◆	◆
PERENNIALS, SEDGES + GRASSES							
AC	Aquilegia Canadensis	Columbine	QT	3	◆	◆	◆
AN	Aster novae-angliae	New England Aster	QT	7			◆
CG	Chelone glabra	White Turtlehead	QT	12	◆	◆	
CP	Comptonia peregrina	Sweet Fern	#1	5		◆	
HM	Hibiscus coccineus	Rose Mallow	#1	3	◆	◆	
IV	Iris versicolor	Blue Flag Iris	#1	3	◆	◆	
JE	Juncus effuses	Soft Rush	#1	1	◆	◆	
LC	Lobelia cardinalis	Cardinal Flower	QT	12	◆	◆	
PC	Polygonatum commutum	Solomon's Seal	#1	18	◆	◆	
RF	Rudbeckia fulgida	Black Eyed Susan	#1	9	◆	◆	◆
[1] Refers to the size of the container: gallon (#1) or quart							

Full Shade Rain Gardens



Option 1: Planting Plan for a Shaded Rain Garden with Perennials

Option 1: Plant List for a Shaded Rain Garden with Perennials							
LABEL	LATIN NAME	COMMON NAME	SIZE[1]	QTY	PLANTING ZONE		
					1	2	3
PERENNIALS, SEDGES + GRASSES							
CG	Chelone glabra	White Turtlehead	QT	18	◆	◆	
CP	Comptonia peregrina	Sweet Fern	#1	3		◆	
IC	Iris cristata	Crested Iris	QT	12	◆	◆	
IV	Iris versicolor	Blue Flag Iris	#1	6	◆	◆	
JE	Juncus effuses	Soft Rush	#1	3	◆	◆	
LC	Lobelia cardinalis	Cardinal Flower	QT	12	◆	◆	
PHR	Penstemon 'Husker Red'	Beardtongue	#1	7			◆
PC	Polygonatum commutum	Solomon's Seal	#1	18*	◆	◆	
SL	Sisyrychium ang. 'Lucerne'	Blue Eyed Grass	QT	12	◆	◆	
WA	Woodwardia areolata	Netted Chain Fern	#1	3		◆	◆
[1] Refers to the size of the container: gallon (#1) or quart							



Option 2: Planting Plan for a Full Shade Rain Garden with Perennials, Shrubs and Trees

Plant List for a Shaded Rain Garden							
LABEL	**LATIN NAME**	**COMMON NAME**	**SIZE[1]**	**QTY**	**PLANTING ZONE**		
					1	**2**	**3**
TREE							
HM	Hamamelis virginiana	Witchhazel	7 gal	1	◆	◆	◆
SHRUBS							
LB	Lindera benzoin	Spicebush	5 gal	3	◆	◆	◆
PERENNIALS, SEDGES + GRASSES							
AC	Aquilegia Canadensis	Columbine	QT	5	◆	◆	◆
CG	Chelone glabra	White Turtlehead	QT	12	◆	◆	
MS	Matteuccia struthiopteris	Ostrich Fern	#1	3	◆	◆	◆
IC	Iris cristata	Crested Iris	QT	7	◆	◆	
IV	Iris versicolor	Blue Flag Iris	#1	3	◆	◆	
JE	Juncus effuses	Soft Rush	#1	1	◆	◆	
LC	Lobelia cardinalis	Cardinal Flower	QT	12	◆	◆	
OS	Osmunda cinnamomea	Cinnamon Fern	#1	3		◆	◆
PC	Polygonatum commutum	Solomon's Seal	#1	18	◆	◆	
SL	Sisyrychium ang. 'Lucerne'	Blue Eyed Grass	QT	6	◆	◆	◆
[1] Refers to the size of the container: gallon (#1) or quart							

Rain Garden Upkeep Over Time

Right now, you have a fine mulch pit with a few puny plants. That's OK, as it takes a few years before your rain garden fills in and becomes the envy of your neighborhood. The following tips are offered to keep your rain garden healthy and functional as the years go by.

First Growing Season

You will need to water your rain garden after it has been planted if it has been more than a week since it last rained. Give your rain garden a good soaking from your sprinkler in the evening (so as to conserve water and prevent your neighbors from laughing at you).

Although the mulch should suppress most weeds, expect to have to do a bit of spot weeding in the first year.

Otherwise you can pretty much leave it alone (Photo credit: Kara Crissey, Good Earth Gardeners).

First Winter and Start of Second Growing Season

You may want to cut back your perennials, although some folks choose to wait until later in the winter so that birds can eat the seeds.

Come Spring time, you may want to rake the existing mulch evenly over the bed, and make sure any mulch or debris is removed from the inlet and outlet of the rain garden.

Once you see which plants have survived, you may want to think about adding some more plants to fill out the rain garden (Photo credit: Kara Crissey, Good Earth Gardeners).

Another planting strategy is to divide your perennials and replant them to get more surface cover.

Your mulch will be decomposing a bit, and should be good for the year, but you may have to do a bit more weeding.

Also, remember to check your gutters and downspouts at least twice a year to make they are not clogged by sticks, decomposing organic matter or bird nests. Clogged gutters may prevent runoff from getting into your rain garden, and are common if you have tree canopy over your roof.

Start of Third Growing Season

By now your rain garden should be looking fine, although your mulch layer will be getting thin, and may need to be replaced (although you will have a lot more plant cover and will therefore need to buy less mulch).

You will still need to do the normal rain garden upkeep during the spring and the rest of the growing season.

Thereafter

As the years go by, many rain gardens get a bit bushy, so expect to add more weeding, thinning and pruning to your upkeep list.

Photo credit: Kara Crissey, Good Earth Gardeners

Troubleshooting for Rain Gardens

Most rain gardens work real well, as long as you keep up with the plant maintenance. Most of the common problems encountered with rain gardens are easy to remedy, as shown in Box J.

Box J. Troubleshooting for Rain Gardens	
Problem: Too bushy or overgrown **Solution**: Trim and prune the trees and shrubs or learn to love it as a privacy barrier and source of habitat	
Problem: Wetter conditions than anticipated so plants don't grow **Solution**: Re-plant with more wet-footed plants like ferns, sedges and rushes (see Table X for a guide. If surface ponding persists for more than a day, you should construct a surface overflow so the rain garden can drain faster	
Problem: Standing water or really soggy soils present several days after a storm **Solution**: Dig a test hole with your post hole digger to see if soils are saturated all the way to the bottom of the rain garden. If so, install a perforated underdrain on the bottom and daylight the pipe so it drains better (Photo credit: Abbey Associates Inc.)	

Problem: Plants die: Drier conditions than anticipated **Solution**: First, check rain gutters and downspout to make sure water is getting to the rain garden. Re-plant with more dry-footed plant species.	
Problem: Over-mulching in the rain garden **Solution**: Remove excess mulch so that the rain garden has a much layer no deeper than 2 inches. Spread excess mulch elsewhere on your yard	
Problem: Mulch shifts or floats away after a big storm **Solution:** Simply rake the mulch back to the original depth of two inches. Place more river-stone near the inlet to reduce flow velocity into the rain garden	

Problem: Sediment caking or erosion within the rain garden (usually near the inflow) **Solution:** Rake or shovel out the surface sediment layer and dispose of in a planting bed. Back-fill any gullies with top-soil, re-mulch and provide some stone protection near the downspout to reduce flows.	
Problem: Deer and wildlife eating your rain garden plants **Solution:** Buy deer repellent or install guard flamingos	
Problem: Overflow channel is plugged or obstructed **Solution:** Cleanout the sediment, debris and mulch that are blocking the overflow channel	

Conservation Landscaping

Most yards have beds that contain plantings of perennial herbaceous plants, shrubs and small trees to provide landscape interest. With a little shovel work, you can transform them into conservation landscapes that retain rainfall and adsorb runoff generated from adjacent turf or hard surfaces.

Once again, you will want to look at the flow paths to your bed, and make sure the bed is a few inches lower than the rest of the lawn, and use any extra soil to form a small berm on the opposite side to make sure water is retained during a storm.

Have you ever thought about removing some of your turf grass and installing landscape beds with flowering shrubs, grasses, perennials and ground covers? Have you considered installing a butterfly garden or a garden with gracious flowers and berries which act as a wildlife habitat for our critter friends? Or have you thought of planting a fruit or vegetable garden? If so, you may be an ideal candidate for Conservation Landscaping.

Conservation Landscaping is the replacement of turf grass with vegetation which is native to the Chesapeake Bay region. It so happens that while you are improving the aesthetics of your yard by creating a dynamic and changing seasonal landscape that you are also improving the quality of your closest stream and the Bay by increasing rainwater infiltration on your property. This practice is sometimes referred to as Bayscaping.

Conservation Landscaping also plays an important role in ensuring the region's biological diversity and the viability of native plant and animal communities. Many of the plants you could select have the ability to host wildlife and support valuable beneficial insects and pollinators. Did you know that there are a lot of endangered native plants? Interestingly enough native plant growers have been working to ensure that some endangered species continue to survive. Pink Muhly Grass (Muhlengergia capillaris) is still on the endangered list however has become more readily available in local nurseries.

Getting Started

Step 1: Choose Your Landscape Objectives

You have a lot of choices as to the planting objective for your new conservation landscape. For example, you may want to choose plants that:

- Attract pollinators such as butterflies and bees, and the occasional hummingbird
- Provide berries and seeds and nesting habitat for song birds
- Create seasonal color throughout the year by selecting different wildflowers, grasses and shrubs
- Create ideal growing conditions for some tasty heirloom tomatoes, melons, squash or that monster pumpkin you have been dreaming about
- Provide wetland habitat or a fern garden
- Screen your yard from your prying neighbors

Conservation landscapes are an especially good idea for:

- "fertilizer-free" buffers around water features or shoreline on your property
- lawn areas that can capture runoff from small areas of hard surfaces (e.g., sidewalks)
- Any roof downspouts that are not treatable by a rain garden

In general, native plant species are preferred, but ornamental or garden plants are acceptable if they are adapted to regional climates. More resources on choosing the right plants for you and your conservation landscape can be found in Appendix C.

It is important to decide how much care you want to give this new landscape bed. Some people believe that Conservation Landscaping requires less maintenance than turf grass. Turf grass does require weekly/bi-weekly cutting, but conservation landscapes require more weeding. A more maintenance-free approach may be with primarily shrubs and grasses.

NOTE: If you already have a landscape contractor, make sure your contractor understands the new planting plan. Many contractors are still unfamiliar with native plant material and you don't want them to pull your new plants out thinking they are weeds.

Step 2: Locate Your Conservation Landscaping

There are several things to consider when deciding where to locate your conservation landscaping.

Where would you like to locate your new Conservation Landscaping? Is it an extension of your "structural planting" around the house? Is it an extension of the neighbor's landscape? If so, very cool as you are creating a "Habitat Corridor" which is the linking together of landscapes which support wildlife! You get extra eco-points for that!

It is recommended that your practice "connects" to a bed or a tree already planted in the landscape rather than be arbitrarily located on the site.

Select a location which does not conflict with another use of your property, such as play and pet roaming areas.

You should go back to your property assessment and determine your solar exposure. How many hours of sun/part shade/shade in the particular area to choose the right plants?

Make note of windy areas as some plants are less tolerant of exposure to wind. Also, if you are interested in a 'Wind Break' or a 'Sound Break', your conservation landscape can be designed as a vegetative screen to block wind and absorb noise.

Also look for the viewsheds on your property. You may drink coffee every morning from a particular room, and look for the views you are fond of or would like to screen.

Do deer, rabbits, voles, moles frequent your site? This will affect the type of vegetation you plant.

Many people do not think of their property as a wildlife habitat, however many animals have adapted to living in your realm, whether urban or rural.

Do cats frequently roam your property? If so, you may want to reconsider drawing birds and/or hummingbirds.

Do not locate over infrastructure (light poles, pipes, cables, FIOS, etc.) and do not hinder access to fuel tanks, well heads, or septic tanks or septic fields. If you site a bed in the Right of Way, be aware that the County/City owns that property and can tear it up for maintenance without prior permission.

Make sure there is an accessible water source. Your plants will need to be watered until they are established in the first several months after installation. That is the case for native plants as well. Once established they should do fine with what Nature gives them,

except in case of extreme drought. Conservation landscaping can be used in concert with other practices such rain barrels that can water your conservation landscaping bed.

If you are working under any existing trees be sure to protect root zones. Many trees have shallow root systems which extend out to their canopy or beyond. It is best to stay out of the "drip line" of the tree.

Step 3: Create a Design Plan

In this step you need to choose whether you want to handle the design or will hire a professional landscape designer, landscape architect, or a Master Gardener. A professional will have the expertise to consider all of the factors mentioned above and will be able to develop a Design Plan which has seasonal variety and dimension and most importantly meets your objectives. In some areas of the Bay, a Watershed Steward may be available who also possesses this expertise.

Some owners may want to have the project designed and constructed, while others may want to the job themselves.

If you plan to do the job yourself start out by retrieving the basemap of your property you developed earlier.

Sketch out a design plan. Remember that in addition to trees and shrubs consider perennials to provide ground cover (ferns, forbs, grasses, sedges, rushes). A few things to remember are that a 'perennial' comes back every year; An "annual" lives only one year so you will have to replant every year; 'Deciduous' means a shrub or tree loses its leaves; and of course 'Evergreen' means a plant is ever green.

Research plant materials by visiting your local nursery to see what vegetation is available to purchase. As a note, nurseries sometimes do not have an extensive native plant selection; however a lot of native material is available. Refer to the Resource List in Appendix C for nurseries in your area. A designer and contractor will have access to more varieties of native plant material.

Avoid "invasive spreaders" that cross the border of my yard and take jobs away from native plants in the rest of the neighborhood. Examples of invasive spreaders include english ivy, bamboo, and lesser celandine. For a good guide on how to identify and remove these invasive spreaders, consult the link to *Plant Invaders of Mid-Atlantic Natural Areas* http://www.nps.gov/plants/alien/pubs/midatlantic/toc.htm

If you hire a designer and contractor, make sure they utilize eco-practices. Not all designers and contractors are skilled in this area of work although many claim to have the expertise. Get recommendations. Call your local watershed organization as they have a list of professionals with extensive experience.

Some things you will want designers and contractors to understand: a) the use organic soil amendments in lieu of fertilizer; b) knowledge of native plants to include the wildlife benefits; c) ability to purchase native plant material; and d) whether you can add a cistern/rain barrel to reuse rainwater from your roof in your conservation landscape.

Upkeep of Your Conservation Landscape

Once your Conservation Landscape has been installed, you will need to maintain it over the year. Some common tasks are:

Weeding
Your new planting will need to be weeded from time to time. You will find that after plants fill in after a few years that you will have less weeding to do. The plants will spread and shade the weeds.

Use of Herbicides and Pesticides
Assess go see if you can transfer over to natural pesticides and herbicides (praying mantus, lady bugs, bat houses, homemade chemical free pesticides). If you need to use pesticides, use them wisely as pesticides can harm beneficial organisms in your landscape. One of the side benefits of creating wildlife habitat is that you create and introduce more species resulting in a more balanced ecosystem on your property.

Mulch
Mulch helps to retain moisture, helps to prevent weeds and erosion however used too much can rob plants of water. Be sure to use three inches or less. Always used aged leaf compost. Do not pile around tree roots as it encourages shallow root structure. Trees should not be mulched with high "tree volcanos" however should be flush with the landscape as in nature.

Fall Maintenance
Ground up leaves are a great fertilizer. Rather than bagging up leaves in bags, mow over them two times and let the leaves sit on the lawn over the winter. Excess leaves can be put into your compost pile to be used later in your gardens.

Resources

- BayScapes program (Alliance for the Chesapeake Bay) http://allianceforthebay.org/resources/publications/bayscapes/
- Bay-Wise Certification Program (University of Maryland Extension) http://extension.umd.edu/baywise
- "Gardener for the Bay" program (Chesapeake Bay Foundation) http://www.cbf.org/join-us/more-things-you-can-do/gardeners-for-the-bay

Tree Planting

Planting native trees and shrubs to restore a portion of your property to forested conditions is good for your property values, good for native wildlife, good for your local watershed and good for the Bay.

- Landscaping can add 10 to 20 percent more value to a property – especially landscaping that incorporates mature trees[1]
- Using native plant material is ideal because they grow commonly throughout the state and tend to thrive when planted in our home gardens.
- Plants are not optional — we can't live without them. By gardening with native plants — no matter where you live or how small or large your space is — you can help sustain wildlife.[2]
- Trees and shrubs increase infiltration and evapotranspiration of stormwater and remove pollutants which improves water quality.
- One tree planted in an urban area can reduce the nitrogen coming off the property by up to 66%!

Small trees and shrubs cost a matter of a few dollars apiece and can be installed by the home-owner by hand. Large ones, such as the 2 inch caliper oak being planted in the picture, may cost $150 - $200 and may require some heavy equipment and the help of experts.

Where should I plant my tree?

a. Choose an area that will have adequate space for the tree to grow.
b. Consider soil conditions.
c. Choose native plant material.
d. Select your tree size
e. Determine sun and wind conditions on your property
f. Avoid planting above underground utilities
g. Avoid planting large trees below transmission lines

[1] www.realty101.com/value-of-a-tree-in-your-yard; www.arborday.org/trees/benefits.cfm

[2] Doug Tallamy, Bringing Nature Home www.plantanative.com/

Proper Places for Trees around Homes

Not everywhere in your yard is appropriate for planting a tree. Save yourself time and money by planting your tree in the right location. The following illustration indicates approximately what types of trees should be planted in relation to your home and utility lines.

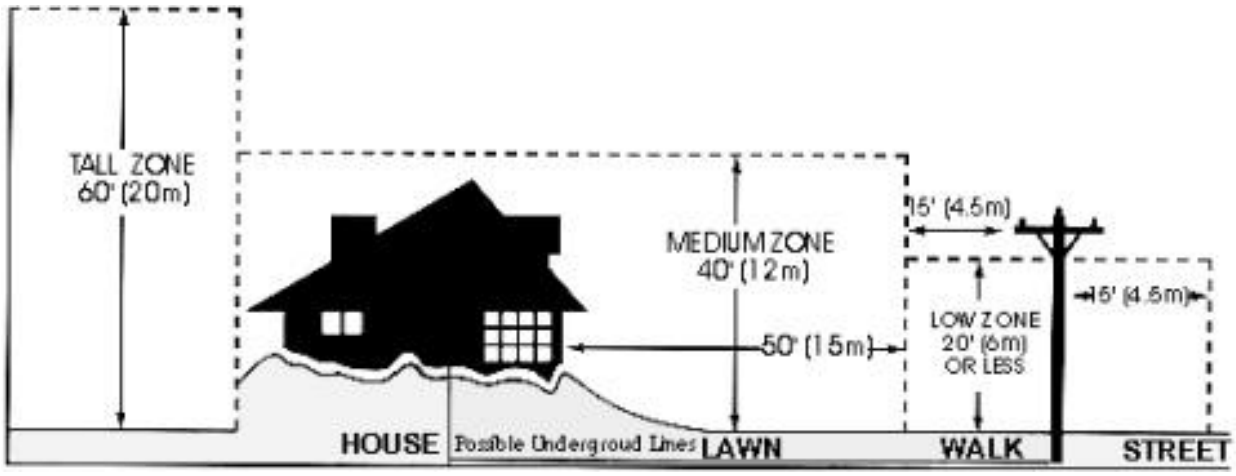


Photo Source: www.treesaregood.com/treecare/avoiding_conflicts.aspx

Which kind of trees should I plant?

Tree selection is one of the most important investment decisions a home owner makes when landscaping a home or replacing a tree lost to damage or disease. Considering that most trees have the potential to outlive the people who plant them, the impact of this decision is one that can influence a lifetime. Match the tree to the site, and both lives will benefit.

When choosing the type of tree you are going to plant, think about the following questions:

- Why is the tree being planted?
- What is the size and location of the planting site?
- Which type of soil conditions exist?
- Which type of maintenance are you willing to provide?

Asking and answering these and other questions before selecting a tree will help you choose the "right tree for the right place."

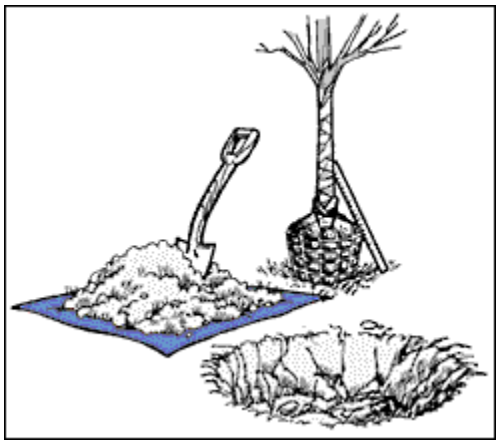
How do I plant my tree?

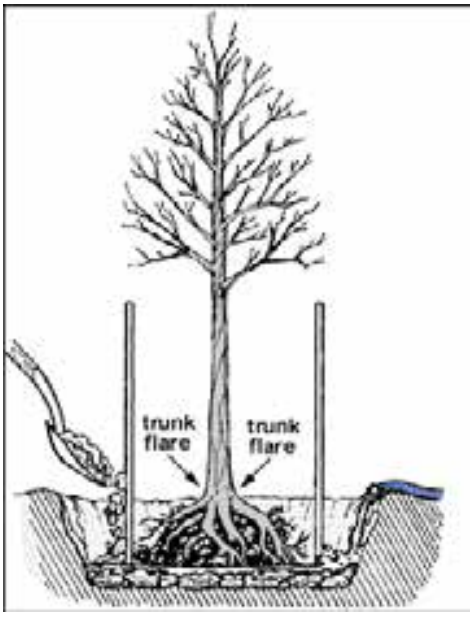
Step 1: Space trees to be planted

Mark each location where a tree will be planted ahead of time. This certainly makes the planting easier if multiple people are working together on getting the trees in the ground.

Step 2: Planting

- Size the hole according to the dimensions of the root ball and the type of container (bare root, containerized or balled & burlapped)
- Position the tree such that the basal trunk flare is just above ground level
- Backfill with native soil
- Apply 2-3 ins of mulch, keeping away from the trunk
- Stake for support, using hose to protect the trunk
- Protect with tree tubes or fencing
- Water generously





How do I care for my tree?

- Water is the critical factor for tree survival after planting. Deep water regularly throughout the first growing season. Allow water to run slowly, soaking the soil, once or twice a week. Do not over water. Water at the perimeter or edge of planting site.
- Keep lawn mowers and string trimmers away from tree to avoid wounding trunk. Reduce herbicide use near tree and in surrounding lawn.
- Never fertilize stressed trees. Fertilizer is not tree food. It should be applied (if absolutely necessary) only after first year. When used, fertilizer should be applied at the perimeter edge of the planting site.
- Start an annual tree inspection program while tree is young to head off problems early.
- Replace mulch as needed. Keep grass and weeds out of mulched area. They compete for the same water and elements as tree.
- Remove stakes and strapping after one year unless site is extremely windy. Do not stake longer than two years.
- Prune dead or injured branches immediately
- Prune while young to maintain size and shape beginning in the second growing season.
- Do not top trees to reduce height (remove large branches from a tree's canopy)
- Call an insured tree care professional for advice on large pruning jobs, hazard trees, and insect or disease problems. Nonprofessionals should never prune near utility wires
- Do not plant flowers under a tree. Do not cultivate soil under the tree.
- Continue deep watering for five years after planting.

Resources

There are a lot of on-line resources available which provide a lot of detail about planting trees. For this overview, we have drawn upon the following websites:

- *For Design, Installation and Maintenance:* *http://pubs.cas.psu.edu/freepubs/pdfs/uh143.pdf*
- *For Selection, Purchasing and Avoiding Tree & Utility Conflicts:* *www.treesaregood.com/treecare/treecareinfo.aspx*
- *Aftercare, plus great set of checklists:* *http://na.fs.fed.us/spfo/pubs/uf/plant_trees/planting_trees.htm*

IF YOU PLANT A TREE – REGISTER IT!!

- "Marylanders Plant Trees" program http://www.trees.maryland.gov/register.asp

Rain Water Harvesting Devices
(Rain Barrels, Cisterns, Tanks)

A rain barrel/cistern is a water holding device which is placed at the base of a roof downspout with the purpose of collecting rainwater for a specific use. The reuse of rainwater can be either active or passive.

Active Reuse: This is the reuse of rain barrel water for either non-potable (cannot drink) or potable (for drinking) uses.

Non-Potable Uses include:

- Irrigating your landscape (typically using a filter and pump system);
- Car washing;
- Cleaning off a deck or patio;
- Flushing toilets (filtration, pump and secondary plumbing required).

Potable reuse or the use of the rain barrel water for drinking requires filtration, disinfection and permits.

Passive Reuse: Watering plants in the landscape utilizing natural slope and/or gravity. This system is typically designed to release rainwater slowly into a landscape bed or the landscape via a soaker hose.

Finally, the reuse of rainwater can be used to meet Stormwater Management Requirements in your state *(i.e., permitting for New Construction or Redevelopment).* Contact a Rainwater Harvesting professional, Landscape Architect, Civil Engineer, Low Impact Development (LID) specialist, Watershed Steward, or Master Gardener for information.

Sizing Your Rain Water Harvesting Device

A rain barrel should be sized according to the drainage area of the roof.

During a 1-inch rain a house which is 1,000 sf will yield approximately 600 gallons of runoff. The average storm in Maryland is ½ inch (per NOAA rainfall data). Typically a 1,000 square foot house has four (4) downspouts where each downspout serves roughly 250 square feet of surface area. Thus one downspout yields approximately 150 gallons of rainfall in a ½ inch rain.

So if you desire to reduce your stormwater utility fee it is imperative to size your device to handle at least the 1/2 –inch storm in order to get credit (you will need to check with your locality to see if a stormwater utility fee credit is available).

The 55 gallon rain barrels fill up fast! However you can "daisy chain" barrels together or purchase a larger rain barrel or cistern. (Photo source: Aaron's Rain Barrels, http://www.ne-design.net/)

DESIGN CONSIDERATIONS

The following are some things to consider before settling on your rain barrel or cistern.

- Use a water meter to accurately measure how much water you want to capture and reuse (attached to spigot).
- Tanks or cisterns should not be installed over utilities, easements, or other infrastructure. Also do not install them over septic systems, sand filters or other underground structures. Rain barrels can be installed in any location as they are more temporary devices.
- Ensure that area is level (flat)
- Stabilize foundation with pavers, flagstone or gravel
- The device must be at a higher elevation if utilizing gravity to drain the water.

DESIGN VARIATIONS

Not all rain barrels and cisterns are created equal. There are design variations depending on the type of practice you want to use and the look you are going for.

Above Ground

- A rain barrel/cistern placed at the base of the downspout (gutter cut off and overflow pipe to safe location);
- A rain barrel/cistern placed around the corner (gutter cut off, an elbow attached; overflow pipe to safe location);
- A rain barrel/cistern placed under a deck; (Photo source: Garden Water Saver, http://gardenwatersaver.com/)

Below Ground

A cistern/tank buried below the ground. Be sure to purchase a device which is designed to not heave out of the ground (a very natural occurrence) or is able to be strapped down. These systems typically require a filtration and pump system. Typically you will want to engage a Rainwater Harvesting professional if you are burying a cistern or tank. You can find certified designers and installers at the American Rainwater Catchment Systems Association (ARCSA.org).

INSTALLING YOUR ABOVE GROUND DEVICE

Follow the rain barrel or cistern manufacturer's installation guidelines. A typical installation requires that you:

1) Shorten the downspout and direct into opening of the barrel.
2) Make sure the device is level.
3) Make sure the screen is in place.
4) Secure the downspout to the device with screws, if appropriate.
5) Attach overflow pipes and be sure that the overflow can drain safely away from your house or downhill to a landscape bed. Be sure not to direct the overflow towards a neighbor's house or to a sidewalk.
6) Connect the hoses to your device and you are ready to go.

MATERIALS TO HAVE ON HAND DURING INSTALLATION

- Extra Gutter (Straight, Elbows)
- Filter (Level One)
- Overflow Pipe
- Handsaw
- Screws
- Line level

MAINTENANCE

Empty your device during the winter by disconnecting the hose or opening all of the spigots to let water run freely through the barrel. There is no need to disassemble it from the downspout. This will prevent water freezing in the device over the winter.

TIPS

- Sometimes there is not an opportunity to reuse rainwater. It is recommended to capture water only if you intend to reuse it!
- Raise the height of the barrel so that there is sufficient water pressure to use a hose. Unsightly cinder blocks can be camouflaged with flagstone or rocks.
- Keep the faucet on "open" so that the water drains out slowly so that there is room for the next rain. This is also easier to manage.
- Always have the overflow going to a safe place in the event that the barrel/cistern fills up – make sure it will not deliver water too close to the house.
- Always use some kind of filtration so that "organics" do not enter the barrel/tank/ cistern. Options include: on the gutter (i.e., Gutter Guard, LeafGuard); on the downspout itself, or directly at the input of the barrel/cistern.
- Put a brick or a large rock in the bottom of the rain barrel so that it does not blow around on a windy day.
- One gallon of water weighs approximately 8.35 lbs, so make sure your device is level and stable. A 55 gallon barrel can weigh upwards of 459 lbs when it is full!
- It is recommended to purchase brass fittings at the outset of installation as they will last longer.

RESOURCES

- American Rainwater Catchment Systems Association (ARCSA) www.arcsa.org

Permeable Hardscapes

Permeable Hardscapes are alternative paving surfaces that capture and temporarily store stormwater by filtering runoff through holes in the pavement surface into an underlying stone reservoir. Filtered runoff may be collected and returned to the storm water system, or allowed to partially soak into the soil. *"Permeable Hardscapes" refers to Pervious Concrete, Porous Asphalt, Concrete Grid Pavers, Permeable Interlocking Concrete Pavers and other products and configurations that are designed to infiltrate water.*

- Permeable hardscapes will reduce runoff volumes when they replace existing hard surfaces. (i.e. an existing patio or driveway).
- If the permeable hardscape is a NEW hard surface, it will help prevent the site from increasing stormwater runoff but does not reduce stormwater runoff from the prior condition.
- Permeable hardscapes allow homeowners to reduce overall imperviousness and stormwater runoff while continuing to maintain hardened areas such as driveways, sidewalks, and patios.

Practice Considerations	
Cost	High
Installation Difficulty	High
Effectiveness for reducing runoff	Medium

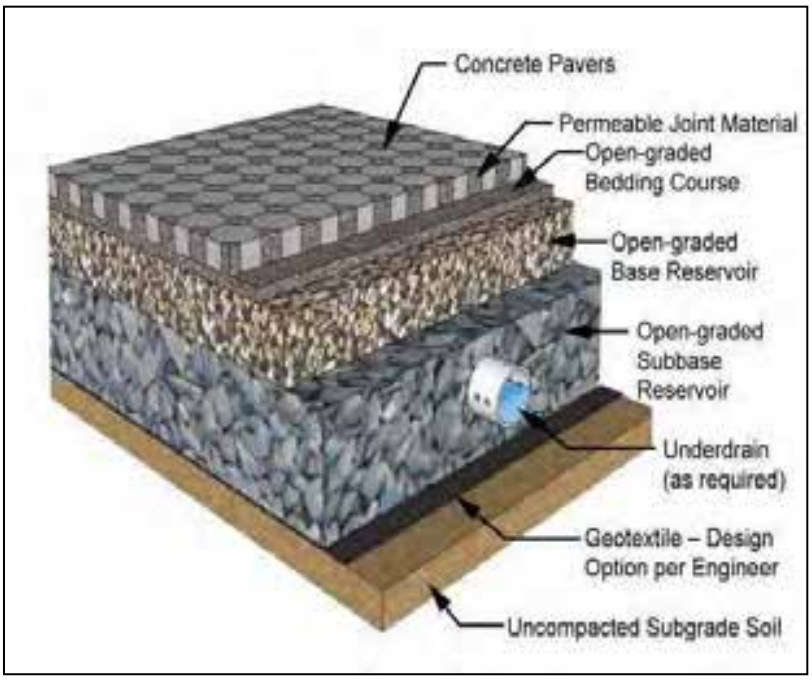


Figure 1: Schematic Profile for Typical Permeable Pavement Section (Source: David Smith, ICPI).

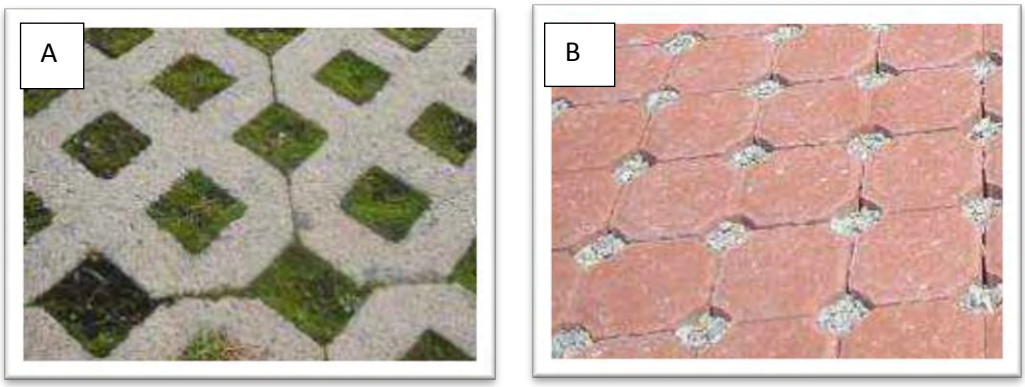


Figure 2: Example A- Concrete Grid Pavers Example B- Permeable Interlocking Concrete Pavers

Where should I put my permeable hardscape?

The following table discusses several site conditions that need to be considered prior for determining whether a particular location is suitable for a permeable hardscape.

Site Considerations		
Site Condition	**Feasible**	**Notes**
Steep Slopes	No	Steep pavement surface slopes may cause shifting of the pavement surface and base materials.
External Drainage	Yes	The area of pavement or rooftop draining onto ("run-on") should be no more than 2 times the area of permeable hardscape. *
High Water Table	No	The bottom of the permeable hardscape installation (i.e., the bottom of the excavated area) must be at least 2 ft. above and the seasonal high water table.
Poor Soil Condition	Yes	Soil conditions do not typically constrain the use of permeable hardscape although they do determine whether an underdrain is needed. This practice is best if the soil has good drainage.
Floodplain	No	Permeable hardscape should not be constructed within the 100-year floodplain
Adjacent Structures	Yes	To avoid the risk of seepage, permeable hardscapes should not be connected to structures so that water cannot seep into basements or damage foundations.
Utilities	Yes/No	Interference with underground utilities should be avoided whenever possible. Approval from the applicable utility company or agency is required if utility lines will run below or immediately adjacent to a permeable hardscape.

**Only paved or stable impervious surfaces should be allowed to drain onto ("run-on") pervious hardscape. Turf, mulch, and other non-paved areas contribute large amounts of sediment to the pervious hardscape which can increase the likelihood of clogging and the need for vacuum maintenance.*

How do I install (or use) my permeable hardscape?

Due to the increased complexity of porous hardscape and the need for some specialty equipment **it is strongly recommended that homeowners work with a trained and certified contractor** (Pervious Concrete Contractor Certification Program or PICP Installer Technician training program, etc.) to implement this type of project.

Step 1. Construction of the permeable hardscape shall only begin after the area surrounding the pervious hardscape has been stabilized. The proposed site should be checked for existing utilities prior to any excavation. Do not install the system in rain or snow, and do not install frozen aggregate materials.

Step 2. Temporary erosion and sediment controls are needed during installation to divert stormwater away from the permeable hardscape area until it is completed. The proposed permeable hardscape area must be kept free from sediment during the entire construction process. Construction materials contaminated by sediments must be removed and replaced with clean materials.

Step 3. Compaction of the bottom of the permeable hardscape area should be avoided to the extent possible. Excavators or backhoes should work from the sides to excavate to the appropriate design depth and dimensions.

Step 4. The native soils along the bottom of the permeable hardscape system should be scarified or tilled to a depth of 3 to 4 inches prior to the placement of stone.

Step 5. Filter fabric should be placed only as required by the design.

Step 6. Moisten and spread the appropriate clean, washed stone aggregate (usually No. 2 or No. 57 stone) 6-inches at a time to the desired depth. Place at least 2 inches of additional aggregate above the underdrain, and then compact it.

Step 7. Paving materials shall be installed in accordance with manufacturer or industry specifications for the particular type of pavement.

- Pavers may be placed by hand or with mechanical installers.
- Fill gaps at the edge of the paved areas with cut pavers or edge units.
- Fill the joints and openings with stone. Joint openings must be filled per the paver manufacturer's recommendation.
- Compact and seat the pavers into the bedding course.
- Thoroughly sweep the surface after construction to remove all excess aggregate.

Step 8. Inspect the area for settlement. Any pavers that settle or are not level must be inspected and reinstalled.

Step 9. Within 6 months, top up the paver joints with stones.

How do I care for my permeable hardscape?

Maintenance is a crucial element to ensure the long-term performance of permeable hardscape. The most frequently cited maintenance problem is surface clogging caused by organic matter (leaves, grass clippings, etc.) and sediment. Periodic sweeping will remove accumulated sediment and help prevent clogging; however, it is also critical to ensure that surrounding land areas remain stabilized.

The following tasks must be avoided on ALL Permeable Hardscapes:

- Sanding
- Re-sealing
- Re-surfacing
- Power washing
- Storage of snow piles containing sand
- Storage of mulch or soil materials

Maintenance Frequency of Permeable Hardscapes Based on Type of Application and Maintenance Method		
Maintenance Task	**Type of Application**	**Frequency**
Dry Sweeping	Patio	Seasonally (4 X per year)
Dry Sweeping	Driveway	Monthly
Vacuum	Patio	Every 2 years
Vacuum	Driveway	Once per year
**This table is intended as guidance only; the frequency should be adjusted based on conditions and the surrounding land cover (e.g. pavement, turf, trees) and level of detritus and sediment on the pavement surface.*		

The frequency of maintenance will depend largely on the pavement use (patio vs. driveway) and traffic loads (foot vs. vehicle). Dry-weather sweeping in the spring and fall months is important. For peak performance, every few years sweep with a dry vacuum sweeper. Do not use a pressure washer or high pressure water spray, since spraying may lead to subsurface clogging.

Resources

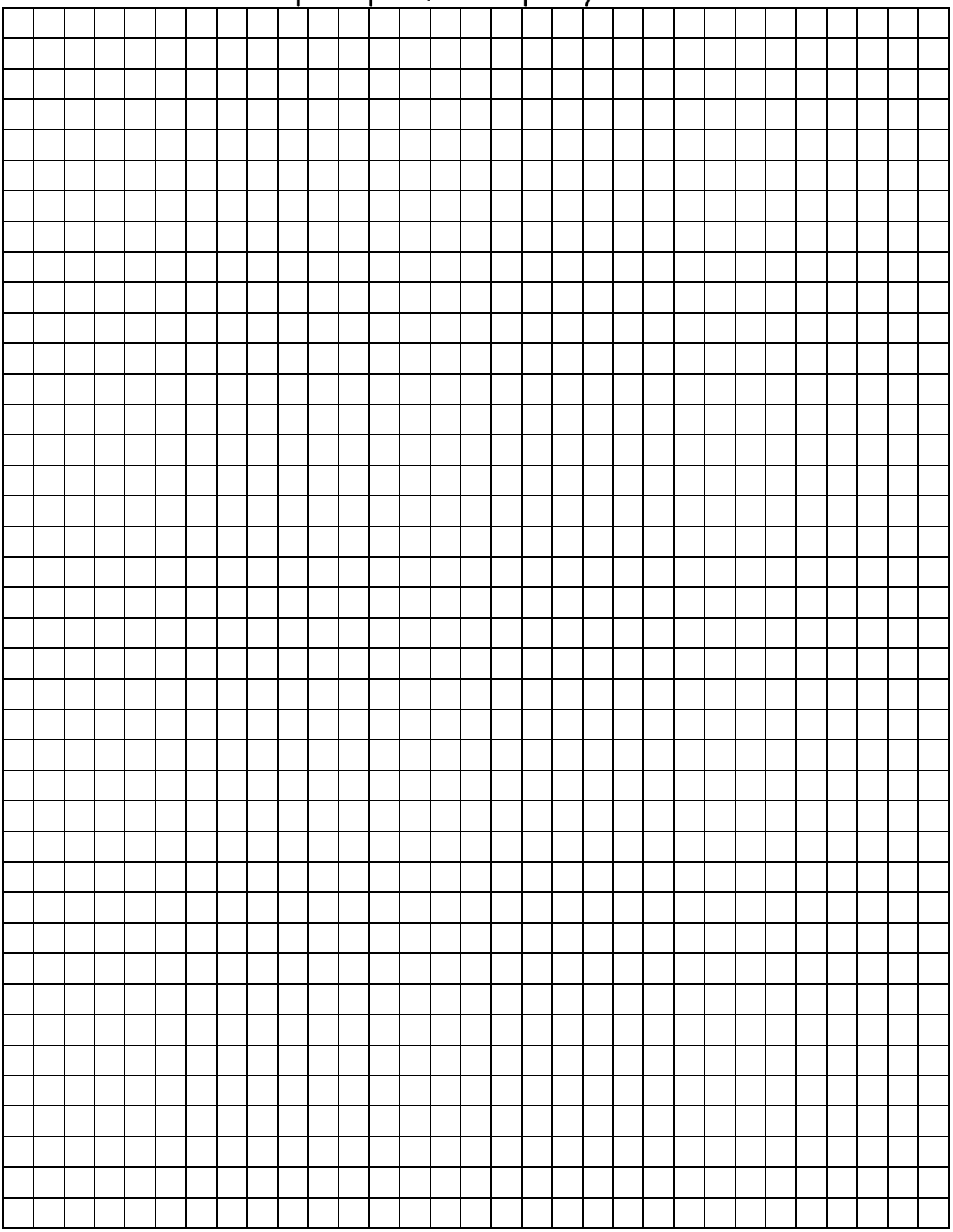
The following are several permeable hardscape resources for homeowners.

- NRMCA Certified Professional Pervious Concrete Contractor Database: http://nrmca.org/Education/Certifications/Certs_DB_Disclaimer.htm

- Interlocking Concrete Pavement Institute Certified Contractor Member Search: http://www.icpi.org/directory-search?search=contractor

Appendix A

Graph Paper for Property Sketch



Appendix B

Quantity Calculator Worksheet for Rain Garden Bulk Materials

Calculator to Estimate Excess Fill and Materials to Buy		
Design Factor	Example	Your Calculation
EXCESS FILL		
Max Digging Depth	24 inches	
Ponding Depth	6 inches	
Top Soil Depth	6 inches	
Subsoil Depth	12 inches	
Divide Subsoil Depth by 2, and then divide this by 12	[12inches/2]/12 X = 0.5 feet	
Garden Surface Area	64 square feet = Y	
Z = Multiply X and Y and divide the product by 27	[(64)(0.5)]/27 = 1.2 cubic yards	
Note: About 6 Wheelbarrow loads per cubic yard	**About 7 loads of subsoil to dispose of elsewhere on your lawn**	
MULCH CALCULATOR		
Garden Surface Area	64 square feet	
1 cubic yard for each 64 square feet of garden area	1 cubic yard of mulch to order [1]	
SAND CALCULATOR		
Take Z and multiply by 1.4	= 1.7 tons of sand to order (round up to 2 tons)	
RIVER STONE CALCULATOR		
Assume 0.2 tons per inlet	0.2 tons (400 pounds) [1]	

[1] Most bulk orders must be done in one cubic yard or ton increments. Last time I checked, the delivered price of sand is about $45, double shredded hardwood mulch costs around $35 a cubic yard and river stone runs $100/ton. You may want to budget about $250 for plants, the connector pipe and other stuff.

Appendix C

List of Plant Resources

Here we have compiled a list of helpful resources within the Chesapeake Bay Watershed for planting your rain garden. You will find that the resources have been listed by type of resource and jurisdiction.

NATIVE PLANT VENDORS (RETAIL AND WHOLESALE)

- U.S. Fish and Wildlife, list of native plant suppliers in the Chesapeake Bay Region, www.fws.gov/chesapeakebay/bayscapes.htm

Maryland

- American Natives Plants (Maryland Natives Nursery, Inc.), (Perry Hall, MD) www.americannativeplants.net
- Ayton State Tree Nursery (Maryland) www.dnr.state.md.us/forests/nursery
- Babikow Greenhouses (Baltimore, MD) www.babikow.com/ Wholesale
- Bay Ridge Nursery (Annapolis, MD) www.BayRidgeNursery.com
- Cavano's Perennials, Inc., (Kingsville, MD) www.cavanos.com Primarily wholesale, open to the public on Saturdays during the planting season
- Chesapeake Natives (Silver Spring, MD) www.chesapeakenatives.org Limited supply of native plants propagated from indigenous seed sources. Seeds, bare root plants, plugs, and pots available
- Classic Groundcovers www.classic-groundcovers.com (Wholesale only)
- Clear Ridge Nursery (Union Bridge, MD) www.gonative.us native trees and shrubs for conservation
- Davidsonville Nursery (Davidsonville, MD) www.davidsonvillenursery.com
- Environmental Concern (St. Michaels, MD) www.wetland.org Retail nursery (open by appointment) for riparian trees and wetland shrubs, education and research facility
- Greenstreet Gardens (Lothian, MD) www.greenstreetgardens.com/
- Herring Run Nursery (Baltimore, MD) www.bluewaterbaltimore.org/herring-run-nursery/
- Homestead Gardens (Davidsonville, MD) www.homesteadgardens.com Limited natives available
- Lower Marlboro Nursery (Owings, MD) www.lowermarlboronursery.com Native perennials, wildflowers, shrubs. The nursery is open to visitors by appointment during the spring and fall planting seasons.
- Patuxent Nursery (Bowie, MD) www.patuxentnursery.com/

- Signature Horticultural Services (Freeland, MD) www.signaturehort.com/ Specializes in Northeastern native herbaceous plants for wetland mitigation, landscape design, restoration, and wildlife habitat enhancement
- Tidewater Growers: wholesale suppliers of trees and shrubs, 757-787-4079, TidewaterGrowers@comcast.net, http://www.tidewatergrowers.com/
- Treessentials (Roseville, MN) www.tubexusa.com/ Tree tubes and deer repellent for tree seedlings,

New Jersey

- New Moon Nursery (Bridgeton, NJ) www.newmoonnursery.com Native perennials (deep plugs), (Wholesale only)
- Pinelands Nursery, Inc. (Columbus, NJ) www.pinelandsnursery.com (wholesale only) Wetland trees, shrubs, herbaceous plants

Pennsylvania

- Appalachian Nursery (Chambersberg, PA) www.appnursery.com
- Keystone Wildflowers (Robesonia, PA) www.keystonewildflowers.com/ Native herbaceous perennial flowers and grasses for wildlife, habitat, naturalistic landscaping and restoration work
- North Creek Nurseries (Landenberg, PA) www.northcreeknurseries.com Native perennials (deep plugs) (Wholesale only)
- Octoraro Native Plant Nursery(Kirkwood, PA) www.octoraro.com Native trees, shrubs and herbaceous plants for reforestation and streambank restoration (Wholesale only)
- Redbud Native Plant Nursery (Glen Mills, PA) www.redbudnativeplantnursery.com
- Sylva Native Nursery and Seed Co., (Glen Rock, PA) www.sylvanative.com Native trees and shrubs

Virginia

- Lancaster Farms, Inc. (Suffolk, VA) www.lancasterfarms.com
- Nature by Design (Alexandria, VA) www.nature-by-design.com

West Virginia

- Enchanter's Garden (Hinton, WV) www.enchantersgarden.com
- Sunshine Farm and Gardens (Renick, WV) www.sunfarm.com

OTHER PLANT PROGRAMS AND RESOURCES

Anne Arundel County Planning and Zoning (Annapolis, MD) Will provide free marsh grasses (*Spartina alterniflora*) to AACO residents 410-222-7441.

SEEDS

- Ernst Conservation Seeds, 800-873-3321. 9006 Mercer Pike, Meadville, PA 16335, seeds of native grasses, wildflowers, wetland plants and shrubs; live stakes for streambank restoration, www.ernstseed.com
- Sylva Native Nursery and Seed Co., (Glen Rock, PA) www.sylvanative.com Native trees and shrubs

REGIONAL PLANT GUIDES

- National Wildlife Federation, searchable database by plant types and by state, with photos and detailed plant descriptions: http://enature.com/native_invasive/natives.asp
- Chesapeake Ecology Center, *Ecoscaping Back to the Future: Restoring Chesapeake Landscapes* (with examples of native plant gardens, rain gardens, xeriscapes), found under "EcoScaping:" www.chesapeakeecologycenter.org.
- U.S. Fish and Wildlife Service, Maryland native plant lists to download: www.nps.gov/plants/pubs/nativesMD/
- *"Native Plants for Wildlife Habitat and Conservation Landscaping: Chesapeake Bay Watershed". On-line PDF* http://www.nps.gov/plants/pubs/chesapeake/
- Society for Ecological Restoration (Mid Atlantic Chapter) http://chapter.ser.org/midatlantic/

NATIONAL PLANT GUIDES

- Lady Bird Johnson Wildflower Center http://www.wildflower.org/ladybird/
- USDA Natural Resources Conservation Service, http://plant-materials.nrcs.usda.gov
- USDA PLANTS Database, (searchable), http://plants.usda.gov/index.html
- Society for Ecological Restoration http://www.ser.org/home

STATE AND COUNTY GUIDES

District of Columbia

- The Botanical Society of Washington http://www.wvnps.org/
- Smithsonian National Museum of Natural History, Department of Botany http://apsdev.org/welcome.html
- National Arboretum, 3501 New York Avenue, NE, Washington, DC 20002, (202) 245-2726
- *Native Plants*: www.usna.usda.gov/Gardens/faqs/nativefaq2.html

Delaware

- Delaware Native Plant Society www.delawarenativeplants.org

- University of Delaware, "Plants for a Livable Delaware" http://ag.udel.edu/extension/horticulture/pdf/PLD.pdf

Maryland

- Maryland Native Plant Society, P.O. Box 4877, Silver Spring, MD 20914, www.mdflora.org
- *Native Plant Sources:* http://www.mdflora.org/publications/nurseries.html
- Anne Arundel County Native Plant Guide: http://www.aacounty.org/IP/Resources/AANativePlants.pdf
- *Native Plants of Maryland: What, When, and Where:* http://hgic.umd.edu/_media/documents/NativePlantsofMD.pdf
- Calvert County (Maryland) Native Plant Guide: www.co.cal.md.us/assets/Planning_Zoning/Environmental/NativePlantGuideOct07.pdf
- Maryland Department of National Resources, State Forest Tree Nursery, 1-800-TREESMD www.dnr.state.md.us/forests/nursery
- Home and Garden Information Center, University of Maryland Extension, 800-342-2507, Available online, http://www.hgic.umd.edu/

New York

- New York Flora Association http://www.nyflora.org/
- Torrey Botanical Society http://www.torreybotanical.org/
- The Finger Lakes Native Plant Society of Ithaca http://flnps.org/
- The Native Plant Center at Westchester Community College www.naiveplantcenter.org

Pennsylvania

- Pennsylvania Native Plant Society (State College, PA) www.pawildflower.org
- Botanical Society of Western Pennsylvania http://www.botsocwpa.org/
- Delaware Valley Fern & Wildflower Society http://www.dvfws.org/

Virginia

- Virginia Native Plant Society (Boyce, VA) www.vnps.org/

West Virginia

- West Virginia Native Plant Society www.wvnps.org

NON-NATIVE / INVASIVE PLANT RESOURCES

- National Park Service, "Plant Invaders of Mid-Atlantic Natural Areas:" http://www.nps.gov/plants/alien/pubs/midatlantic/toc.htm

- Ecology and Management of Invasive Plants Program, Cornell University, website with information on invasive plants, their impact on native species, and their control (particularly biological control) www.invasiveplants.net
- "*Invasive Species of Concern in Maryland:*" (Home and Garden Information Center, University of Maryland Extension) www.hgic.umd.edu/_media/documents/publications/invasive_species_list.pdf
- Maryland Native Plant Society - Information on controlling non-natives, with lists of native plant alternatives, http://www.mdflora.org/publications/invasiveshandbook.html
- The Nature Conservancy (Maryland Chapter) Information on the removal of specific non-native invasive plants, http://www.imapinvasives.org/GIST/ESA/index.html

Appendix D

Directory of Local Programs in the Chesapeake Bay Watershed that Provide Technical and Financial Assistance to Homeowners

The following is a list of programs in the Chesapeake Bay Watershed that provide technical (T), financial (F) or other (O) types of assistance to homeowners installing stewardship practices on their residential property.

Organization	Name of Program	Website	Type of Assistance		
			F	T	O
MARYLAND					
Blue Water Baltimore	Blue Water Audit	http://www.bluewaterbaltimore.org/programs/clean-waterways/waterauditprogram/		x	x
Baltimore County Environmental Protection and Sustainability	Stormwater Retrofit Management Program	http://www.baltimorecountymd.gov/Agencies/environment/watershedrestoration/retrofits.html			
Gunpowder Conservancy	Clear Creeks Project	http://www.gunpowderfalls.org/bay-wise-practices.html			x
Pretty Boy Watershed Alliance		http://www.prettyboywatershed.org/educational-materials			x
Frederick County Office of Sustainability and Environmental Resources	Green Homes Challenge , Green Leader	https://www.frederickgreenchallenge.org/		x	x
Monocacy and Catoctin Watershed Alliance		http://www.watershed-alliance.com/mcwa_restore.html			x
City of Gaithersburg	RainScapes Rewards	http://www.gaithersburgmd.gov/poi/default.asp?POI_ID=1758&TOC=107;81;388;1758;	x	x	x
City of Rockville	RainScapes Rewards	http://www.rockvillemd.gov/environment/watersheds/rainscapes.html	x	x	x

Organization	Name of Program	Website	Type of Assistance		
			F	T	O
Montgomery County Department of Environmental Protection	RainScapes Rewards	http://www6.montgomerycountymd.gov/dectmpl.asp?url=/content/dep/water/rainscapes.asp	x	x	x
Anacostia Watershed Society		http://www.anacostiaws.org/			x
National Capital Region Watershed Stewards Academy		http://www.anacostiaws.org/programs/education/watershed-stewards-academy		x	x
Prince George's County Dept. of Environmental Resources		http://www.princegeorgescountymd.gov/Government/AgencyIndex/DER/index.asp	x		x
Howard County Government	Clean Water Howard	www.cleanwaterhoward.com	x	x	
Howard County Watershed Stewards Academy		http://wsahoco.weebly.com/		x	x
Midshore RiverKeeper Conservancy		http://midshoreriverkeeper.org/		x	
Chester River Association		http://www.chesterriverassociation.org/			
Corsica River Conservancy		http://www.corsicariverconservancy.org/activities		x	x
Sassafras River Association		http://www.sassafrasriver.org/			x
Anne Arundel Watershed Stewards Academy		http://www.aawsa.org/		x	x

Organization	Name of Program	Website	Type of Assistance		
			F	T	O
Anne Arundel County Watershed Ecosystem and Restoration Services		www.aacounty.org/DPW/Highways/RainGarden.cfm	x		x
South River Federation		www.southriverfederation.net	x		x
Severn River Association		www.severnriver.org/	x		x
West Rhode RiverKeeper		www.westrhoderiverkeeper.org/			x
RainScaping Campaign		http://www.rainscaping.org/			x
University of Maryland SeaGrant Extension	Watershed Restoration Specialists	http://www.mdsg.umd.edu/programs/extension/communities/watershed/specialists/		x	x
University of Maryland Extension	Bay-Wise Certification Program	http://extension.umd.edu/baywise		x	
Bay-wise Master Gardeners	Bay-wise Yard Visits	http://extension.umd.edu/baywise/program-certification		x	x
Local Watershed Groups		http://www6.montgomerycountymd.gov/dectmpl.asp?url=/Content/dep/water/localgroups.asp			x
DISTRICT OF COLUMBIA					
National Capital Region Watershed Stewards Academy		http://www.anacostiaws.org/programs/education/watershed-stewards-academy		x	x
District Department of the Environment	RiverSmart Homes	http://green.dc.gov/riversmarthomes			
PENNSYLVANIA					
Conewago Creek Watershed	Conewago Creek Initiative	http://www.conewagoinitiative.net/			

Organization	Name of Program	Website	Type of Assistance		
			F	T	O
Little Conestoga Partnership		http://www.littleconestoga.org/			
Blair Conservation District		http://www.blairconservationdistrict.org			
Altoona, PA		http://www.altoonapa.gov/Pages/StormwaterInformation.aspx			
VIRGINIA					
Lynchburg, VA	Residential Credit Program	http://www.lynchburgva.gov/stormwater-credit-program	x	x	
James River Association	River Hero Homes	http://www.jrava.org/what-we-do/river-hero/			
Elizabeth River Project	River Star Homes	http://www.elizabethriver.org/RiverStars/default.aspx			
Richmond, VA	Residential Credit	http://www.richmondgov.com/PublicUtilities/documents/SWcreditmanual.pdf	x		
Arlington, VA	StormwaterWise	http://www.arlingtonva.us/departments/EnvironmentalServices/Sustainability/page87833.aspx	x	x	
Lynnhaven River Now	Pearl Homes	http://www.lynnhavenrivernow.org/gardening.aspx			
Friends of the Rappahannock	Rainscape Retrofits	http://www.riverfriends.org/OurPrograms/MiddleandUpperWatershed/tabid/607/Default.aspx#LiveTabsContent171922-lt			
James City County	PRIDE	http://www.jamescitycountyva.gov/jccpride/			
Reedy Creek Coalition		http://reedycreekcoalition.org/financial-incentive-program/	x		
City of Fredericksburg		http://www.riverfriendlyyard.com/			x
Chesterfield County		http://www.chesterfield.gov/content2.aspx?id=8589944309			x
Hanover-Caroline Soil and Water Conservation District		http://www.co.hanover.va.us/soilandwater/urban.htm			x

Appendix E

List of Bay-Friendly Lawn Care Experts

The following is a list places within the watershed where you can get a soil test analysis to see what if any fertilizer is required for your lawn.

Maryland	http://extension.umd.edu/hgic
Pennsylvania	http://www.aasl.psu.edu/ssft.htm
Virginia	http://pubs.ext.vt.edu/452/452-129/452-129.html http://www.soiltest.vt.edu/
West Virginia	http://www.caf.wvu.edu/~forage/Sampling_Soils.htm