TURTLE CREEK WATERSHED ASSOCIATION

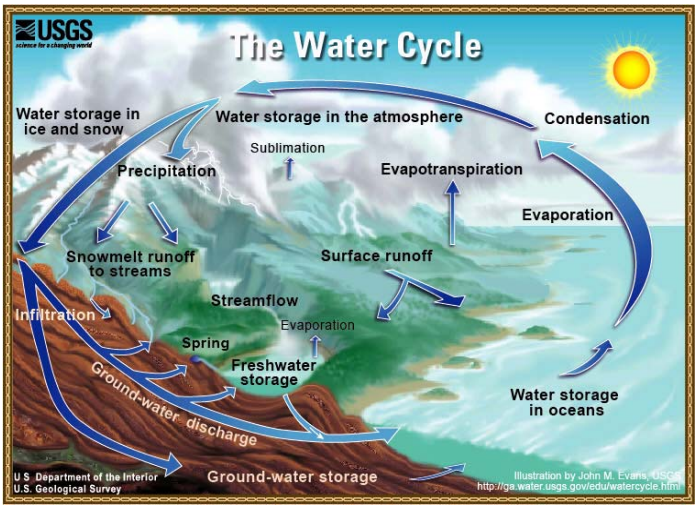
RAIN GARDEN INFORMATION

Water, Water Everywhere:

More than 70% of Earth's surface is covered by water. Of that, a little less than 3% is fresh water, with most of that in glacial ice sheets (that figure is changing). Approximately 0.3% is available as surface and ground water – the source of our drinking water. This means rainfall is quite a valuable commodity in most places in the world.

Here in southwestern Pennsylvania we receive approximately 44 inches of precipitation annually. In combination with our rather high humidity levels, this amount has been ample to support our natural vegetation, our streams, lakes and rivers, and our drinking water needs for many years. In fact, we live in what has historically been one of the best functioning watersheds in the nation. If you have been in the West over the last few years, you have seen the savage effects of drought, fires, and mudslides; you know how lucky we are.

We all learned about the water cycle in the sixth grade, but most of us never understood the significance of it. However, when this cycle works optimally – as it does in our region – then it works to our advantage, providing us with a dependable supply of water.



Unfortunately, our development practices and traditional stormwater management techniques have destroyed this cycle in many locations. There is too much runoff and too little infiltration. Too much runoff means flooding and all its related damages and expensive problems. Too little infiltration means low water tables and stream levels, compromised vegetation, and reduced drinking water supplies.

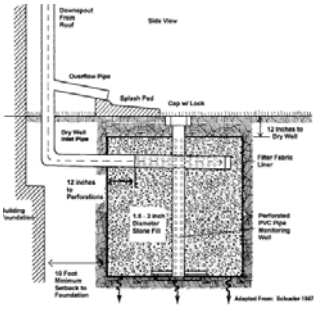
The good news is that we can take steps to improve the situation.

How Can I Make a Difference?

As explained in our "Rain Barrel Information" section, people who wish to reduce the stormwater runoff volume coming from their homes, schools, or businesses have several basic on-lot options with many variations. These can be used in new construction as well as retro-fitted to existing structures and systems.

Rain barrels and cisterns collect and store water for future use. With a soaker hose attached, rain barrels can automatically empty very slowly into nearby landscaping or gardens. Dry wells accept roof runoff in an underground chamber, slowly letting it infiltrate back into the water table. There are also spreaders that can be attached to downspout ends that distribute rainwater across a wide lawn area where it can infiltrate.

www.rainguardusa.com



www.seagrant.sunysb.edu

www.cement.org

www.gotoreviews.com

Direct infiltration without collection can be accomplished via several methods. Pervious paving allows rainfall from walkways, patios, and driveways to penetrate rather than runoff. Both asphalt and concrete can be mixed so that air spaces are formed within them. These spaces then provide a route to the subsurface medium which promotes water infiltration. There are also systems of concrete paving bricks incorporating cutouts which are filled with small gravel or sturdy plants so water can flow down into the permeable subsurface.

Rain gardens employ downspout and/or paving runoff and a permeable subsurface, along with flowering vegetation, as the means to create damp conditions that certain plants love. These gardens are sometimes referred to as bio-retention cells, especially when used in parking lots or road medians. When properly planned, these gardens will not allow water to end up in basements or to pool around foundations.

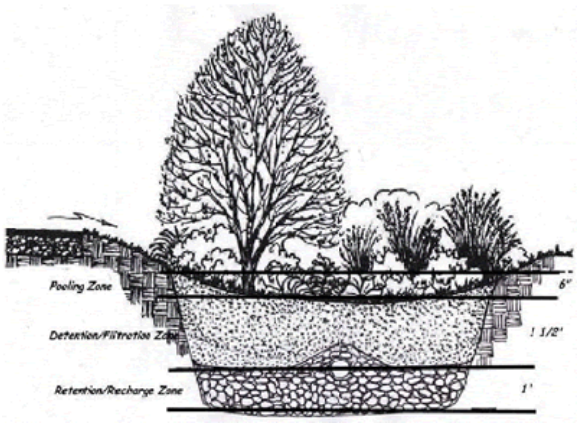
www.ohiowatersheds.osu.edu

What is the Best Spot for a Rain Garden?

Good planning for a rain garden considers the following factors:

- avoid areas where the highest level of the water table is 18 inches or less from the surface
- be sure there are no buried utility lines, pipes, conduits, or cables at the chosen site (especially if you intend to use equipment rather than hand tools to dig, contact PA One Call at 800-242-1776 several days in advance to be sure)
- a sunny location is best, partially sunny sites may work with the proper plant materials and good air circulation, shady locations do not promote the high levels of transpiration and infiltration necessary for success
- be careful when choosing sites near large trees –
    - their roots may soak up much of the water (mature trees themselves can be a great water cycle-friendly method to use runoff – depending upon weather conditions, they transpire between 35 and 100+ gallons of water per day)
    - extensive digging may damage their root systems enough to compromise or kill the trees
    - their roots may not be able to tolerate the damp rain garden conditions
- as with any garden, avoid sites near walnut trees whose roots secrete a plant toxin to eliminate competing vegetation
- if you are using driveway runoff, locate the garden along the downhill sloping edge
- if you are using roof runoff, locate the garden at least ten feet downgrade from a building

- in either case, locate the garden at least twenty five feet from a septic field
- look at the existing drainage patterns to make sure no water from a garden will drain toward a building (this may be a good time to make sure the yard is sloped away from your house, recontouring the yard if needed)
- the means to get the water from the downspout to the rain garden could be utilitarian (a pipe extension), concealed (an underground means), or part of the landscape (a stone lined "streambed") – be sure the water will be distributed evenly across the garden, not just dumped at a single spot



www.ci.des-moines.ia.us

www.urbanwaterquality.org

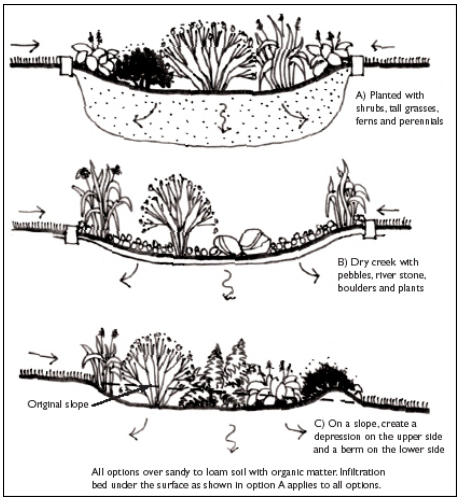
Once My Site is Chosen, What Comes Next?

Check the existing soil percolation ability by digging at test hole at least nine inches deep and six inches wide. Fill it with water and check it every few hours. The sooner it drains dry, the better. If after 24 hours there is still standing water, the soil is compacted and the garden base must be deeper than usual. Here in southwestern Pennsylvania, development practices usually involve completely re-grading a site, destroying its natural infiltration capabilities. Be prepared to do some extra digging and build a better subsurface.

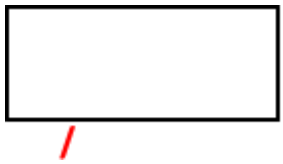
The rain garden will use some of your existing topsoil mixed with some other materials. If you are uncertain of your soil conditions, get it tested to see what minerals it may be lacking and what pH adjustments might be necessary depending upon the plants you choose.

www.cmhc-schl.gc.ca

Typically recommended is a planting medium of 50% sand, 25% compost, and 25% good topsoil. (Clay soils are not advised.) Plan to use a heavy organic mulch one inch thick. Typically recommended for the subsurface is gravel covered with heavy filter fabric to keep fine soil particles from clogging the spaces among the gravel. If your soils do not drain well at all, then you may choose to build an overflow dry well at the low end of the garden to handle any excess water.



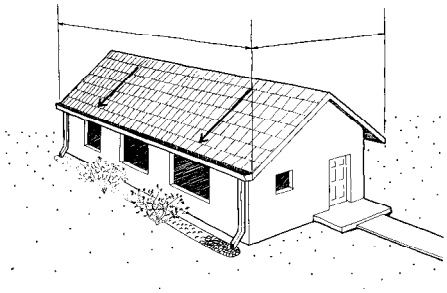
In this region, you will want to dig to a depth of at least twelve inches, more if your soils don't drain well. The bottom of the garden bed should be flat to best distribute the water or only slightly bowed in the middle. The top of the bed should be somewhat concave to maximize its ability to capture water.



length x width = surface area

www.math.about.com

www.ag.arizona.edu



How Big Should My Garden Be?

To determine the proper size, some basic math is needed. We have simplified this process, so that all you need is a tape measure and a calculator. (You can get a good estimate by measuring the outside of your house and adding a few feet for overhang and for roof pitch.) Starting with the example of a 30'x20' roof – as the diagram shows this is one side, we show the arithmetic, then we show where to plug in your numbers to find the optimal size of your garden and the amounts of materials you will need for it.

Example – 30'x 20'Roof Step 1

The rule of thumb states that you determine the roof or driveway surface area that will drain into the garden, then multiply by 25% (shown below as .25) to get the surface area of the rain garden. For example, if the side of your roof that will drain into the garden is thirty feet long and twenty feet wide, the calculation be:

30 feet x 20 feet = 600 square feet

600 square feet x .25 = 150 square feet

If you are using the recommended sand/compost/ topsoil mixture, you will need a garden bed that is 150 square feet.

Your House – Your Numbers Step 1

Plugging in your numbers, use:

_____ roof length in feet x _____ roof width in feet = _____ square feet of roof

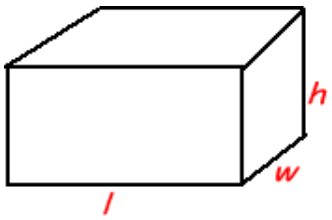
_____ square feet of roof x .25 = _____ square feet of rain garden

Our example of a roof 30 feet long and 20 feet wide translates into a garden bed 10 feet x 15 feet, or 8 feet x 18.5 feet, or any other configuration that totals 150 square feet.

*** If you have compacted soils and do not intend to use a mixture of at least 50% sand with a gravel bed underneath, then you will need a bigger garden. Your multiplication factor will be 60% (.60) of the roof drainage surface, not 25% (.25). ***

The garden's shape will depend upon the space available, but planning the best way to get the water evenly distributed into the bed will help determine the optimal shape. Many people find curved edges most pleasing to the eye, but others prefer straight ones.

If you have heavily compacted soils that do not drain much at all, then count on digging to a depth of two feet to give one foot of gravel base and one foot of soil mixture. For moderately compacted soils, dig to eighteen inches to make room for a six inch gravel base. For loose soils, dig one foot for the soil mixture with no gravel base.



length x width x depth (height) = volume

www.math.about.com

How Much Sand, Compost, Topsoil, and Gravel Will I Need?

This time the calculations will use the garden surface area and depth (can be labeled as "height") to determine the garden's total volume in cubic feet and cubic yards. This will let us determine the volumes of the necessary planting mixture materials.

Example – 30'x 20' Roof Step 2

Staying with our example of 150 square feet, if your garden is 15 feet long by 10 feet wide and 2 feet deep, then the calculations for cubic feet will be:

15 feet long x 10 feet wide = 150 square feet of garden surface area
150 square feet x 2 feet deep = 300 cubic feet

Materials are sold in quantities of cubic yards, so we need to convert cubic feet to cubic yards. There are 27 cubic feet in one cubic yard, so we divide by 27 to get the correct amounts.

300 cubic feet ÷ 27 cubic feet/cubic yard = 11.33 cubic yards

Your House – Your Numbers Step 2

After following Step 1, plug in your garden's length and width numbers:

_____ garden length in feet x _____ garden width in feet = garden surface area
_____ garden surface area x _____ garden depth in feet = _____ cubic feet
_____ cubic feet ÷ 27 cubic feet/cubic yard = _____ cubic yards of garden

Example – 30'x 20' Roof Step 3a

Now you can calculate the amounts of materials needed for this example. We will start with gravel. Because our example bed is two feet deep, it will have a gravel base one foot deep. That one foot of gravel will total 50% (one half) of the total volume or:

11.33 cubic yards x .50 = 5.66 cubic yards of gravel

If you are using a six inch gravel base in an eighteen inch deep garden, then that base will be 34% (one third) of your total volume. Therefore, you will use a factor of .34, not .50, to determine how much gravel you will need:

11.33 cubic yards x .34 = 3.85 cubic yards of gravel

(If you are not using a gravel base, then skip this step. You will simply use the total cubic yardage to determine the amounts of sand, compost, and topsoil you will need.)

Example – 30'x 20' Roof Step 3b

Next, you will need to determine the amounts of sand, compost, and topsoil for this example.

The remaining 5.66 cubic yards will be made up of:

50% (one half) sand at: 5.66 cubic yards x .50 = 2.80 cubic yards
25% (one quarter) compost at: 5.66 cubic yards x .25 = 1.40 cubic yards
25% (one quarter) topsoil at: 5.66 cubic yards x .25 = 1.40 cubic yards

Your House – Your Numbers Step 3a

Starting with your garden's cubic yards from Step 2, for a one foot deep gravel base (half of your two foot depth) your calculations will look like this:

_____ cubic yards of garden x .50 = _____ cubic yards of gravel

For a six inch gravel base (one-third of your eighteen inch depth), your calculation will look like this:

_____ cubic yards of garden x .34 = _____ cubic yards of gravel

(If you are not using a gravel base, then skip this step. You will simply use the total cubic yardage to determine the amounts of sand, compost, and topsoil you will need.)

Your House – Your Numbers Step 3b

For a two foot deep garden with a twelve inch gravel base, your sand, compost, and topsoil amounts will be based upon ***half*** of your garden's total cubic yards. This number will be equal to the cubic yards of gravel found in Step 3a, and your calculations will be:

50% (one half) sand: _____ cubic yards of garden x .50 = _____ cubic yards sand
25% (one quarter) compost: _____ cu. yd. garden x .25 = _____ cubic yards compost
25% (one quarter) topsoil: _____ cu. yd. garden x .25 = _____ cubic yards topsoil

For an eighteen inch deep garden with a six inch gravel base, your sand, compost, and topsoil amounts will be based upon ***two-thirds*** of your garden's total cubic yards. This number will be equal to the cubic yards from Step 2 multiplied by two-thirds (shown as .66):

_____ cubic yards of garden x .66 = _____ cubic yards of soil mixture

Using this number, your calculations will be:

50% (one half) sand: _____ cubic yards of mixture x .50 = _____ cubic yards sand
25% (one quarter) compost: _____ cu. yd. mixture x .25 = _____ cubic yards compost
25% (one quarter) topsoil: _____ cu. yd. mixture x .25 = _____ cubic yards topsoil

For a one foot deep garden with no gravel base, your sand, compost, and topsoil amounts will be based upon ***all*** of your garden's total cubic yards. This number will be equal to the cubic yards of garden found in Step 2, and your calculations will be:

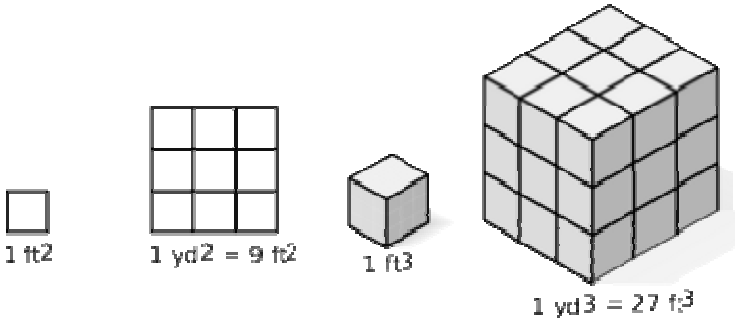
50% (one half) sand: _____ cubic yards of garden x .50 = _____ cubic yards sand
25% (one quarter) compost: _____ cu. yd. garden x .25 = _____ cubic yards compost
25% (one quarter) topsoil: _____ cu. yd. garden x .25 = _____ cubic yards topsoil

one square foot is 12 inches on each side

one square yard is 3 feet (36”) on each side; it contains 9 square feet

one cubic foot is 12 inches on each edge

one cubic yard is 3 feet (36”) on each edge; it contains 27 cubic feet



www.heatandlight.com

Example – 30′x 20′ Roof Step 4

To complete the calculations for this example, we must determine the amount of mulch needed. For one inch of mulch, take the surface area from Step 1, in this case 150 square feet, and multiply by one inch.

(to keep the units the same, this must be stated in terms of feet: 1 inch = 0.09 feet)

150 square feet x 0.09 feet = 13.50 cubic feet of mulch

13.50 cubic feet ÷ 27 cubic feet/cubic yard = 0.50 cubic yards

Your House – Your Numbers Step 4

To determine the amount of mulch you will need, start with the square feet of garden found in Step 1 and multiply that by one inch (0.09 feet) to find the cubic feet. Then find the number of cubic yards by dividing by 27. Your calculations will look like this:

_____ square feet of garden x 0.09 feet = _____ cubic feet

_____ cubic feet ÷ 27 cubic feet/cubic yard = _____ cubic yards of mulch

Digging the Rain Garden:

Good preparation means the difference between success and failure. Having gone through the planning process to locate the best site and choose good plants, mark the garden outlines with turf paint, agricultural lime, or a hose. Look at it for a few days and think about the details of living with it – be sure this design feels right to you. Make any changes now.

Assuming that your site is covered with sod, you will need to remove it. Lifted carefully, with roots intact, it can be used to patch other sections of your yard or a friend’s. If you have a compost pile, the sod will make a good addition to it. Some people prefer to use an herbicide on the sod a week before they dig.

Depending upon the outcome of your percolation test, dig to a depth of twelve, eighteen, or twenty-four inches. Save the best topsoil for the soil mixture. (You want lots of spongy organic matter in that topsoil, no clay. Remember – if your soil contains a lot of clay, by mixing it with sand you will create a substance that rivals concrete when dry.) In addition to re-using the sod, you will also need to consider where the excess soil material will go.

Keep the sides of the garden straight, not sloped. The bottom of the garden should be flat or very slightly sloped so that the water is evenly distributed across the maximum infiltration area and not pooled at the low point.

Preparing the Gravel Base and the Soil Mixture:

http://dnr.wi.gov/

Putting one or more heavy tarps beside the bed provides protection for your lawn while you work and simplifies clean up later. If you are using a gravel base, the gravel can be dumped on the tarp or a delivery truck can rest on it while unloading. Plywood sheets also work well to protect your yard from compression, ruts, etc.

Level the gravel without compacting it, then cover with a thick, non-woven filter fabric.

Once the base is in place, or if you do not need a base, then place proportional amounts of the sand, compost, and topsoil (in a 2:1:1 ratio) on a tarp. (Trying to mix the entire supply at one time is a daunting task – divide the job into smaller quantities.) Mix thoroughly, then add to the bed without compacting the mixture (**not** by standing on the material as the man in the photo is doing). The goal is to create a bedding material that will absorb lots of water, but let the excess drain through to the bottom of the bed to be infiltrated to the water table.

Some people prefer to make a distinct berm on their garden's perimeter or to use some type of edging. The finished contour of the garden's surface should be slightly concave so that it can capture and hold the rainwater entering it.

Planting the Rain Garden:

Check with knowledgeable people at your favorite garden center or review the plant list at the end of this section to see which plants appeal to you and what fit into your budget. When designing, allow one plant for each square foot as a guide. You also want to consider mature sizes – especially if you are using trees and shrubs. Consider bloom times, foliage colors and textures, and flower colors when planning. If you have gardening friends, see if they have any useful perennial plants that need to be divided. If, once your garden is established, you do not intend to water it, then choose hardy species able to withstand both dampness and drought. Natives are best.

http://dnr.wi.gov/

Remember – even the most carefully chosen plants may not be adapted to your specific site's conditions. A certain amount of trial and error occurs in any gardening venture.

Decide if you want a formal look, a cottage garden feel, or a miniature wild meadow. Do you want to include plants that provide food or cover for wildlife? Many people enjoy the butterflies and birds attracted by some rain garden species.

If your garden will be viewed from all sides, then putting the taller species towards the center is best. If it will be viewed from one or two sides, then put the taller species to the back.

If you cannot reach in from the sides of your garden to plant it, then use plywood sheets to walk on. These will distribute your weight over a wide area, and you will not compact the soil mixture.

As you plant, take care not to disturb your plants' roots systems. Damage will threaten survival. Firm the soil mixture around the roots, but do not apply excess pressure. You may wish to use timed-release fertilizer pellets as you plant. Mulch carefully with shredded hardwood chips or other heavy material that will not wash away. The mulch will help to reduce weeds and will prevent excess evaporation during dry periods.

Depending upon your preferences and the space available, some people enhance their gardens with nearby sculptures, benches, bird houses, or bird feeders. When placing a feeder, keep it far enough away so that few seeds land in the garden and grow as weeds.

http://sueellington.com

Rain Garden Maintenance:

For the first few months, you will need to make sure your plants have the best chance to become well established. Make sure that the water from your downspout, driveway, or other source is entering the garden without causing erosion or disturbing the mulch. Make sure the water is evenly distributed so all parts of the garden are evenly saturated. Using spreaders or perforated pipe can achieve this goal. Do not let sediments build up, choking the plants.

Water regularly if no rain falls. Remember, this is not a pond with pond plants, so you do not need to flood the garden – just keep it moist. Weed weekly before unwanted plants have a chance to take hold or reseed themselves.

www.raingardens.org

Some plants species may not be adapted to your site. As these plants fail, you can try again with the same species. However, replacing them with a different species that may be better adapted is often the most cost-effective and least frustrating approach.

Once your garden is established, regular weeding is still important, as is watering during dry periods. With mulch, the garden should be ready for winter. Many plant species, especially the perennials, are adapted to being cut down (or burned) in the spring. Unless you have a species that can harbor plant diseases if left to over-winter, wait until spring to cut the plants back. Letting the garden remain in its natural state during the winter also allows wildlife to benefit from eating the seeds and provides valuable cover for them.

How Much Will This Cost, and What Will I Gain?

Costs depend upon a variety of factors. If you are hiring someone the costs will be greater than if you are doing all the work yourself. Purchasing bulk materials such as gravel, sand, compost, and mulch will be cheaper than purchasing these by the bag. Shop around to find the best prices, the lowest delivery charges, and the best delivery schedules for your timetable.

Plant material costs vary widely. The larger the specimens, the more expensive they are. The rarer the species, the more expensive they are. Comparison shopping can help here too, as can networking. Often people with perennial gardens must divide their plants and are looking for someone to give them a good home. Check with local gardening clubs.

One of the advantages of going through the planning steps is that you will know what bed and plant materials you will need to purchase and in what quantities. Now you can put together a list and get quotes from different suppliers.

Using our example size of a 150 square foot garden, people who do the work themselves find their costs total between $1.50 and $2.50 per square foot.

When properly planned, executed, and cared for, your garden will be an important part of your home's landscaping design. Realtors know that good landscaping can add 10% to 15% to a home's overall value. So, in addition to reducing the overall volume of stormwater runoff and increasing the volume of infiltration – thus protecting others downstream, you are also adding market value to your property.

Be sure to e-mail us a photo of your rain garden and send us tips you learned while building it. We will post those on our website.

www.epa.gov/

www.zieglerdesignassociates.com

Other Resources:

There are many websites offering rain garden information. Use you favorite search engine to look through them to get ideas. These sites are among the best:

http://dnr.wi.gov/org/water/wm/nps/rg/rgmanual.pdf

www.dof.virginia.gov/rfb/rain-gardens.shtml

http://www.raingardens.org/Index.php

http://www.saludareedy.org/outreach/rain_gardens/raingardens_presentation.pdf

There are also many websites offering native plant information. The following sites are among the best:

http://wildflower.utexas.edu/plants/

http://www.enature.com/native_invasive/

http://www.ces.ncsu.edu/depts/hort/consumer/factsheets/native/common_namea-e.html

Rain Garden Plant List for Pennsylvania

Trees and Shrubs:

- *Amelanchier laevis* Shadbush *
- *Asimina triloba* Pawpaw *
- *Betula nigra* River birch *
- *Cephalanthus occidentalis* Buttonbush
- *Clethra alnifolia* Sweet pepperbush *
- *Cornus amomum* Silky dogwood
- *Fothergilla gardenii* Dwarf fothergilla
- *Hamamelis virginiana* Witch hazel
- *Ilex verticillata* Winterberry holly
- *Lindera benzoin* Spicebush
- *Liquidambar styraciflua* Sweet gum
- *Sambucus canadensis* American elderberry *
- *Viburnum dentatum* Arrowwood *

Wildflowers:

- *Asclepias incarnata* Swamp milkweed *
- *Aquilegia canadensis* Wild columbine
- *Aquilegia vulgaris* Common columbine
- *Aster lateriflorus* Side flowering aster *
- *Aster novai-angilae* New England aster *
- *Baptisa australis* Wild false indigo
- *Caltha palustrus* Marsh marigold (toxic in large quantity)
- *Chelone glabra* White turtlehead
- *Echinacea augustafolia* Purple coneflower *
- *Eupatorium purpureum* Joe-pye weed *
- *Eupatorium perfoliatum* Boneset
- *Gentiana clausa* Closed gentian
- *Gentiana saponica* Soapwort gentian
- *Iris versicolor* Wild iris or blue flag
- *Liatris pychnostachya* Prairie blazing star *
- *Lobelia cardinalis* Cardinal flower *
- *Lobelia syphilitica* Blue lobelia *
- *Monarda didyma* Bee balm or bergamot *
- *Monarda fistulosa* Wild bee balm or bergamot *
- *Penstemon digitalis* Smooth beardtongue
- *Polymonium reptans* Jacob's ladder
- *Rudbeckia subtomentosa* Brown-eyed susan *
- *Sagittaria latifolia* Arrowhead
- *Stylophorum diphyllum* Celandine poppy
- *Talictrum polygonum* Tall meadow rue
- *Typha augustofolia* Narrow-leafed cattail
- *Typha latifolia* Common cattail
- *Veronicastrum virginianicum* Culver's root
- *Vernonia* noveboracensis Common ironweed *

Ferns:

- *Athyrium filix-femina* Lady fern
- *Equisetum hyemale* Horsetail
- *Onoclea sensibilis* Sensitive fern
- *Osmunda regalis* Royal fern
- *Osmunda cinnamomea* Cinnamon fern

Grasses:

- *Briza media* Quaking grass
- *Chasmanthium latifolium* Northern sea oats
- *Elymus villosis* Silky wild rye
- *Panicum vergatum* Lowland switchgrass
- *Phalaris arundinacea* Ribbon grass
- *Polypogon monspeliensis* Rabbitfoot grass
- *Schizachyruim scoparium* Little bluestem

Sedges:

- *Carex pendula* Drooping sedge
- *Carex bromoides* Brome hummock sedge
- *Carex pennsylvanica* Pennsylvania sedge
- *Carex stipata* Tussock sedge

* These are either nectar plants or host plants that attract butterflies.

Please note: All plants will not grow in all locations. Success depends upon light conditions, soil components and substrate, soil pH, soil nutrients, total water, winter conditions, animal activities, and proximity to roads (and road salt), among other factors. Deer damage can be substantial in our area – even to supposedly "resistant" species. Determine conditions in your garden, then choose the plants best suited to your site.

As avid gardeners know, things don't always go as planned – anticipate some experimentation.