Iowa Rain Garden
Design & Installation Guide

Third Edition

Developed by **The Iowa Stormwater Education Partnership**

Iowa Rain Garden Design & Installation Guide

This document is a publication of the Iowa Stormwater Education Partnership (ISWEP) and is made possible through partnerships with Iowa communities and organizations that are committed to improving the quality of Iowa's water resources through local education and outreach. Learn more at www.IowaStormwater.org.

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- **Ben Curtis,** Iowa Stormwater Education Partnership
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- **Josh Balk,** Black Hawk Soil and Water Conservation District
- **Sean Pearl,** Sustainable Landscape Solutions
- **Julie Perreault,** Polk Soil and Water Conservation District
- **Johnathan Swanson,** Polk County Public Works

Table of Contents

Chapter 8: Maintaining a Rain Garden

References

Appendix

The *Iowa Rain Garden Design and Installation Guide* was developed by ISWEP in cooperation with the following partners:

Smooth Blue Aster

Symphyotrichum laeve

PLANT NOTES

Common throughout Iowa. Blooms in the fall. Stems are usually 20"-60" long. Flowers are about 1" across with 15 to 30 petals. Yellow center that turns reddish with age. A beautiful addition to any rain garden and landscape.

Photos: Shutterstock

Introduction

What is a Rain Garden?

Capturing Stormwater Runoff

A rain garden is a type of ***stormwater best management practice (BMP)*** used to capture ***stormwater runoff***. Stormwater runoff is generated from ***impervious*** surfaces such as rooftops and driveways. Stormwater BMPs collect rain and snow melt. They remove pollutants that accumulate on impervious surfaces and lawns.

Rain gardens and other stormwater BMPs such as rain barrels, soil quality restoration, and native landscaping are also referred to as ***Rainscaping*** practices. These practices are landscaping features used to manage stormwater runoff on residential and commercial properties.

Rain gardens are designed as shallow, landscaped depressions. They promote infiltration of rainwater into the landscape, rather than it running off into a storm drain. Runoff that enters the rain garden is temporarily ponded so that the rain can soak into underlying soils and be cleansed.

Homeowners can add value to their property and improve local water quality through the installation of a rain garden. Many rain gardens utilize native plants, which provide excellent habitat for birds, bees, and butterflies. Native plants provide added benefit because once they are established, they require less maintenance over the long term.

Terms to Know

Stormwater BMP: Landscaping practice that is designed to temporarily impound and treat stormwater runoff.

Stormwater Runoff: Rainfall and snow melt that drains off impervious surfaces and is not absorbed into the landscape.

Rainscaping: Landscaping method that promotes the use of infiltration-based stormwater management practices in Iowa.

Impervious: Surfaces (such as roofs, driveways, and streets) that are unable to absorb rainfall and thus contribute to stormwater runoff.

Photo: Sustainable Landscape Solutions

Residential rain garden in eastern Iowa.

Why Install a Rain Garden?

When Iowa was covered by prairie and forests in the early 1900s, rainfall was able to slowly infiltrate into soils. This allowed streams to be recharged naturally via groundwater flow. Before these ecosystems were altered and eliminated, waterways had clean water, stable levels, and minimal flooding.

Photo: USFWS

Native prairie at Neal Smith Wildlife Refuge in Iowa.

The tallgrass prairie ecosystem was dominated by grasses and flowering plants, or forbs, that had deep, fibrous root systems. Annually, as a part of the root system died off and decayed, organic matter was formed to create deep, rich, and porous soils.

These two features – high ***organic matter*** and high ***porosity*** – gave prairie landscapes the ability to infiltrate most rainfall into the soil. Forests also had deep-rooted trees and plants that helped build healthy soils that could intercept and infiltrate rainfall.

As Iowa landscapes became more altered, soils were either replaced by impervious surfaces or were so heavily disturbed that they lost significant amounts of organic matter and pore space. The result is increased stormwater runoff.

Rain gardens are attractive landscape features that homeowners can use to restore the natural function of landscapes. Homeowners that manage stormwater on their property help reduce the amount of stormwater runoff that can degrade local streams.

Terms to Know

Organic Matter: Fraction of soil that consists of decomposed plant or animal material that acts like a sponge to hold water and provide nutrients to plants.

Porosity: The amount of pores or open space in soil, expressed as a percentage of the total volume of the soil material.

Did you know? You can get money to help build your rain garden!

Some communities and Soil and Water Conservation Districts (SWCDs) in Iowa have cost share programs to help homeowners pay for installing a rain garden. The goal of cost share programs is to encourage homeowners to incorporate stormwater practices on their property. This helps to improve local water quality and reduce localized flash flooding. Learn more at www.bit.ly/IowaCostShare.

Overview of the Design to Install Process

This guide will assist homeowners and contractors with the design and installation of rain gardens. The following is an overview of the step-by-step process that will be detailed in subsequent chapters.

CHAPTER 1

Locating a Rain Garden

This chapter will address the best locations for rain gardens. Factors include direction of rainwater drainage across the landscape, locations of utilities and trees, clay content of soils, natural and hardscape features, and personal preferences. Rain gardens will perform well when located properly.

CHAPTER 2

Evaluating Soil Conditions

Conduct soil color, ribbon, and percolation tests to determine how the soils drain at the project site. Adequate drainage is a crucial component when designing an effective rain garden. This is perhaps the most important step in the process!

CHAPTER 3

Choosing the Type of Rain Garden

In this step, the type of rain garden will be chosen. This guide details two types, basic and enhanced rain gardens. Simple soil tests and site conditions play a role in the type of rain garden installed. Basic rain gardens can be used in areas with good percolation rates while enhanced rain gardens, which feature a subdrain, are recommended where soils drain slower.

CHAPTER 4

Designing a Rain Garden

This guide provides instructions for determining the appropriate size, depth, and layout of basic and enhanced rain gardens. Rain garden design also includes considerations for subsurface drainage, overflow devices, inlets and outlets, berms, and retaining walls. It also includes methods for directing rainwater to the rain garden.

Photo: Pixabay

Most rain gardens receive rainwater from roof gutters.

CHAPTER 5

Estimating Materials

Once the size and depth of the garden are determined, an estimate of the amount of materials required for the project can be made. This might include sand, topsoil, compost, mulch, rock aggregate, a subdrain, or hardscape features. Instructions are provided in this chapter for purchasing by the bag or in bulk.

CHAPTER 6

Constructing a Rain Garden

When weather permits, the site will need to be prepped, excavated, and graded before any plants can be put into the ground. This step also calls for excavation of the depression, installation of inlets and outlets, overflow features, and construction of berms and retaining walls. If constructing an enhanced rain garden, an aggregate layer and subdrain are also installed at this time. Soil amendments and mulching are completed prior to planting.

Photo: Polk SWCD

Rain garden under construction.

CHAPTER 7

Planting Vegetation

Add some color! Select plants from sample layouts or design your own. Select plants suited to sunlight availability, soil conditions, and homeowner preferences. Clumping species and simplifying the design can make weeding easier. Need some inspiration? Check out the following page for examples of beautiful rain gardens.

Photo: Shutterstock

Harebell is a plant native to Iowa.

CHAPTER 8

Maintaining a Rain Garden

Keep an eye on your rain garden and periodically inspect it using the checklist included in this guide. Routine inspections and subsequent maintenance prevent additional costs and protect the landscaping investment. Taking good care of a rain garden ensures that it functions properly and looks great.

Photo: ISWEP

Pruning mature vegetation in the fall.

1. A basic rain garden in a residential backyard after a rain storm. *Photo: Polk SWCD*

2. Rainwater temporarily ponded in a residential rain garden located downslope from the home. *Photo: Polk SWCD*

3. Rainfall is moved to this small, circular rain garden through a rocked channel connected to one of the home's downspouts. *Photo: Blackhawk SWCD*

4. A large, oblong rain garden is carved into a steep hill featuring boulders for soil stabilization. The newly established garden has young native plant plugs. *Photo: Polk SWCD*

5. This multi-cell rain garden captures stormwater runoff from a nearby street. *Photo: Forever Green Garden Center*

CHAPTER 1

Woodland Phlox

Phlox divaricata

PLANT NOTES

Prefers shady areas and spreads over time; "divaricata" means "with a spreading and straggling habitat." Drought tolerant once established, but does best in medium moisture and well-drained soils. Violet-blue to pink flowers bloom in late May and stand between 1 and 2 feet tall.

Photos: Shutterstock

Chapter 1
Locating a Rain Garden

Location is Critical

The first step in planning a rain garden is to determine sources generating runoff (like a rooftop) and then determining how rainfall is flowing across the property. This can be done by walking the site during a rainfall event. A rain garden must be located so that runoff moves to it.

Start by using a grid sheet to create a sketch of the site. First draw existing buildings, driveways, sidewalks, trees, and other ***hardscape*** and natural features. Next, identify locations of utilities. Last, identify downspouts and draw in lines where water flows across the property. Mark where water ponds, if applicable. A blank grid sheet can be found in Appendix I. Keep these tips in mind when locating the site of a rain garden:

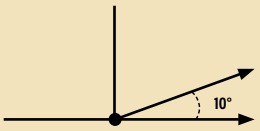
- **Digging to depths where public and private utilities are buried may occur during the installation of a rain garden.** Contact Iowa One Call to locate buried utility lines on a property. Avoid locating a rain garden above or directly adjacent to marked utilities.
- **Identify all drainage to the proposed rain garden area.** Rain gardens are designed to manage runoff generated from small areas, usually a rooftop downspout and some lawn area. They are not meant to manage runoff from multiple buildings or large drainage areas. A general rule of thumb is to limit the drainage area to no more than 11,000 square feet (or about 1/4 acre).
- **Identify drainage easements.** Rain gardens placed in a ***drainage easement*** or backyard swale may easily become overwhelmed, even if designed correctly. These locations are not ideal because the drainage area is typically too large for stormwater to be effectively managed by a rain garden.

Terms to Know

Hardscape: Landscaping features built with "hard" materials, such as paved roads, patios, and driveways. Hardscapes typically increase impervious surface area and stormwater runoff.

Drainage Easement: Land areas used to control stormwater runoff. Easement allows another party to access land in emergency situations. Rain gardens may be prohibited within drainage easements.

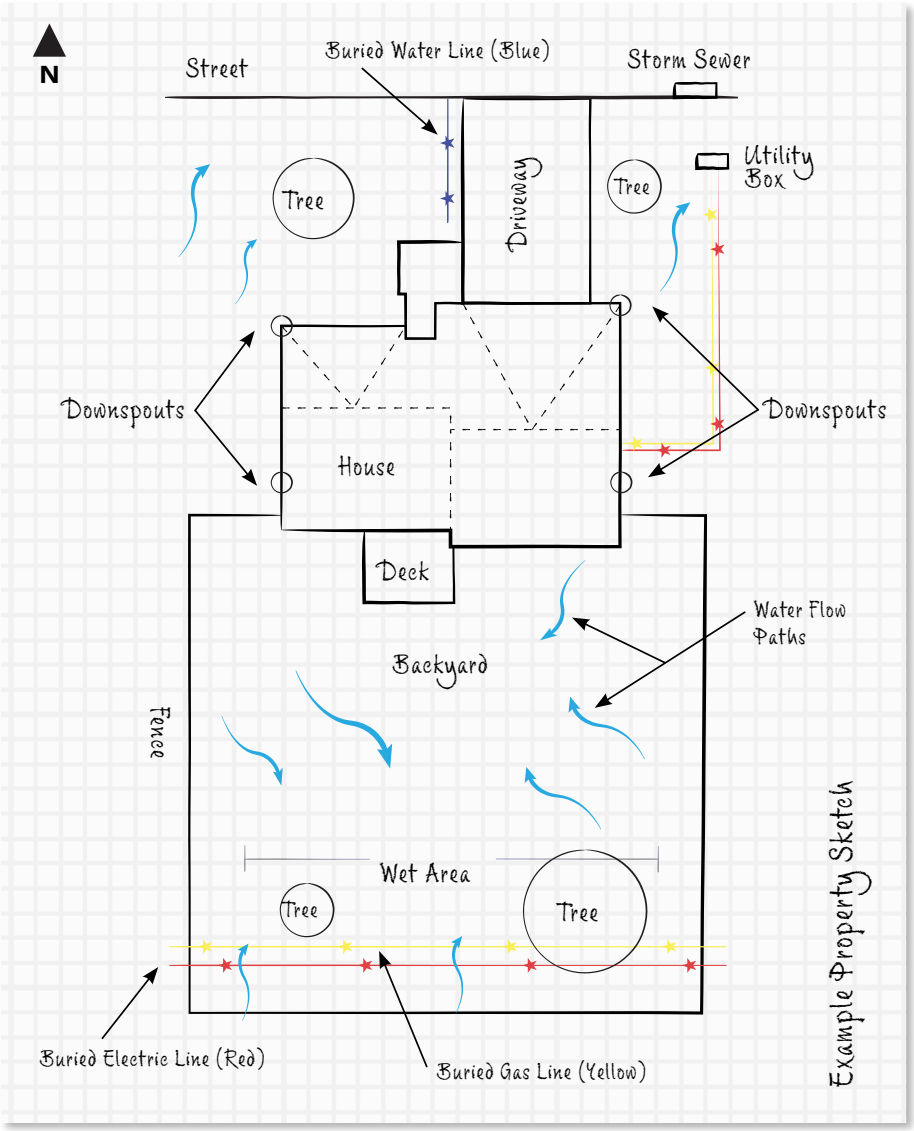
Steep Slopes: A steep slope is defined as greater than 10 percent.



- **Locate the rain garden downslope from structures.** Runoff going into the rain garden must be at an elevation higher than where water would be leaving the garden. However, avoid siting a rain garden near ***steep slopes***. Stormwater should always move away from structures.

- **Look for low spots.** Where does water flow on the property? Are there areas where water typically ponds? Rain gardens can be used in some situations to address drainage issues. Use caution in placing rain gardens in low spots. There may be poorly drained soils or too much drainage for a basic rain garden to handle. An enhanced rain garden may be needed in some of these situations.

- **Rain gardens can be easily incorporated into existing landscaping or new projects.** As long as soils are suitable, rain gardens work great in areas where there might be traditional landscaping. They can be used along property or fence lines, near a driveway or walkway leading to a front door, or around the perimeter of a fire pit or patio area.



Runoff, Structures, and Drainage Considerations

Stormwater runoff needs to reach the rain garden. It is often easiest to locate a rain garden close to downspouts. Runoff can be directed to a downslope location using ***subsurface drainage*** or a ***vegetated swale***. In some cases, downspouts can be rehung or redirected.

Rain gardens should be sited in flat areas. Installing a rain garden will be more challenging if steep slopes exist. To minimize erosion or scouring, avoid placing rain gardens on slopes steeper than ten percent. ***Saturated soils*** on steep slopes can also become very unstable. Retaining walls are usually needed to create a level depression for a rain garden on steep slopes. Work with a landscaping professional in this case.

During large rainfall events, rain gardens may overflow because the soils become temporarily saturated. It is important to route the overflow to a ***stabilized area***. Overflow drainage should always be directed away from structures and neighboring properties.

To prevent adverse impacts to your property or other structures, maintain the following minimum distances:

- 10 feet downslope from a basement, 30-40 feet is preferred
- 10 feet from a foundation/slab
- 2 feet from a sidewalk
- 100 feet downslope from a septic system drain field or private well
- 200 feet downslope from a public well
- Near public and private utilities (refer to page 15)

Check with the local jurisdiction to confirm any additional requirements such as minimum separation distances between neighboring properties and if a rain garden can be placed in the right-of-way space between the street curb and sidewalk (see photo to the right).

Terms to Know

Subsurface Drainage: Method of moving excess rainwater via a buried pipe, either to remove excess rainwater or transfer rainwater to the rain garden.

Vegetated Swale: Sloped depressions used for above-ground rainwater conveyance. May feature a rock bed with vegetation.

Saturated Soils: A soil condition in which the pore space between soil particles is completely filled with water.

Stabilized Area: Any area of land (i.e. garden, lawn) that is fully vegetated and bare soil is absent.

Photo: Linn SWCD

Grassed right-of-way space between the street curb and sidewalk.

Locating a rain garden also depends on various natural conditions that determine drainage patterns. To ensure adequate drainage, avoid the following areas:

- **Areas where seasonal groundwater is less than two feet from the bottom of the proposed rain garden.** Shallow groundwater may potentially be discovered during excavation or a soil percolation test. Be aware that if a percolation test is completed during drought conditions, groundwater may not be visible. Shallow groundwater may also be verified by looking at the color of the soil. Gray soil and soil with orange stains may be too wet.

- **Wet areas discovered during a site assessment.** Unless an enhanced rain garden is used, rain gardens should be sited away from areas where soils take longer than 24 hours to drain. Heavy soil compaction and/or shallow groundwater may prohibit adequate infiltration and percolation.

Photo: Shutterstock

Wet areas likely will not have adequate drainage to support a rain garden.

- **Areas where bedrock is less than two feet from the bottom of the proposed rain garden.** Soil survey information from the United States Department of Agriculture's (USDA) online Web Soil Survey may indicate whether high water tables exist or where shallow bedrock might exist. Probing the soil can confirm the existence of both.

- **Areas that have been contaminated by heavy metals or other pollutants.** Do not install a rain garden on a contaminated site. These soils are typically found in ultra-urban areas.

- **Be cautious of tree locations.** Avoid locations near or under trees to prevent harming the root structure of trees.

Be Careful With Sump Pump Discharges

In some situations, it may be possible to utilize a rain garden to manage discharge from a sump pump. To prevent continuous recycling of groundwater between the rain garden and a home's foundation, consider the following recommendation:

Never permanently "connect" your sump pump to the rain garden. Continuously saturated soils, the presence of algae, and dead plants are indications that the sump pump is providing too much water to the rain garden. Disconnect the sump pump connection if this is the case and reroute the discharge to a stabilized area. Contact local officials for more guidance.

Working Within Existing Site Conditions

Avoid areas where utilities are located. Call "Iowa One Call" at 811 or (800) 292-8989 to locate utilities before any digging begins. Iowa One Call requests can also be completed online. Be sure there are no phone lines, gas lines, or other infrastructure where digging will occur. Call at least 48 hours in advance of digging. Be aware that Iowa One Call will not mark utilities such as electric dog fences, water lines, and electric or gas lines that were installed privately.

Rain gardens should only be installed when surrounding landscapes are stabilized and not subject to erosion. If a rain garden will be installed in conjunction with other landscaping or as part of new home construction, install the rain garden after construction is completed and the surrounding area is fully vegetated. Sediment entering a rain garden will create a plugged surface that will limit the infiltration of rainwater.

Photo: Iowa One Call / Facebook

Dial 8-1-1 before any digging begins.

Finally, avoid locating rain gardens under trees. Excavation under the drip line of a tree canopy will cause damage to the tree's roots. There is a much wider selection of plant species suitable for sunny conditions as well.

Understanding Utility Markings

The following colors are used nationwide to mark the locations of buried utilities. Homeowners typically use white flags or white spray paint to denote the proposed area of excavation.

Electric Power Lines, Cables, Conduit, and Lighting Cables	
Gas, Oil, Steam, Petroleum, or Gaseous Material	
Communication, Alarm or Signal Lines, Cables, or Conduit	
Potable Water	
Sewers and Drain Lines	

CHAPTER 2

Purple Coneflower

Echinacea purpurea

PLANT NOTES

A variety of bees, butterflies, and birds (including the American Goldfinch) utilize the coneflower's nectar. Larvae of the silvery checkerspot feed on the leaves and larvae of several moths feed on flowers. Petals tend to droop downward as the flower matures. Flowering stalks, up to 8" long; daisy-like flowerheads with 10 to 20 petals. Blooms in the mid to late summer months.

Photos: Shutterstock

Chapter 2
Evaluating Soil Conditions

The Importance of Good Soils

Healthy soils have good pore space, minimal compaction, high organic matter and microbial activity, and a sufficient supply of nutrients. These characteristics factor into a soil's ability to drain water. Rain gardens rely on good soils for this reason.

Rain gardens typically hold water for 12 hours or less. For example, if it rains in the afternoon, a rain garden should not have standing water by morning. Standing water for a long period of time in a rain garden can create low oxygen conditions in the subsurface soils. This can lead to a variety of issues, including plant death and odor problems.

There are three soil tests that should be done at the proposed rain garden location. The first test is simply to view the color of the subsurface soils. The second test is a soil ribbon test and the third is a ***percolation*** test. These three tests help determine if soils have adequate drainage for the installation of a rain garden.

While the soil tests may appear conclusive regarding the soil type and drainage patterns of an area, seasonal variations such as soil moisture content and temperature can change the testing outcomes. Seek technical assistance from a local Soil and Water Conservation District (SWCD) office if there are questions about the suitability of the soil at a proposed rain garden site.

Terms to Know

Percolation: The movement of water through the soil. Percolation rate is the rate that water moves downward through the pores in the soil profile, and is measured in inches per hour. Sandy soils tend to have high percolation rates and clay soils tend to have slower rates.

Water Table: In subsurface soils, it is the top level below which the pore spaces in soil are saturated with water.

Photo: Polk SWCD

Healthy soils allowed for a basic rain garden to be installed at this residence.

Soil Color Test

Various soil colors are indicators of drainage conditions. Soils that are too wet can have a gray color. Reddish dots of color indicate that there may be a seasonally high ***water table***. This typically is an unsuitable location for a rain garden. The soil color test can be completed when excavating soils for the soil ribbon and percolation tests.

Photo: MN Pollution Control Agency

Gray color indicating high levels of moisture in the soil.

Soil Ribbon Test

The soil ribbon test estimates the amount of clay in the soil, which indicates how quickly rainfall will percolate through the soil. Follow these steps to complete a soil ribbon test:

Photo: ISWEP

Accessing subsoils using a soil probe.

1. Select three locations within the proposed rain garden area. Try to pick the center of the rain garden and upslope and downslope locations. These holes will also be used for the soil percolation test.

2. Once all underground utilities have been marked, use a soil probe, shovel, or clamshell posthole digger to dig three holes within the proposed rain garden location. The upslope hole should be about three feet deep, the downslope hole about 1.5 feet deep, and the center hole in between those depths. You may have to pre-wet the area if the soil is dry by slowly pouring a bucketful of water on the area and allowing the water to soak into the soil.

3. At every half foot increment in depth, grab a handful of soil and roll it into the shape of a cigar with your hands.

4. Squeeze the soil between your thumb and forefinger into a flat ribbon. Measure the approximate length of soil that ribbons out before breaking.

5. Refer to "How to Interpret Soil Ribbon Test Results" on the following page.

How To Interpret Soil Ribbon Test Results

✓	If the soil won't ribbon outward and breaks off as you squeeze it, the soils have a low clay content and good percolation rates.
✓	If the soil extends out between one and two inches before breaking off, the clay content should still be low enough for adequate percolation rates.
✗	If the soil ribbons out two inches or more before breaking off, the clay content is too high. Percolation rates will likely be too slow for a rain garden to adequately drain.

How To Determine Soil Type With a Soil Ribbon Test

Low Clay Content	If the soil does not form a ribbon or forms a ribbon less than one inch, the soil is **sandy** or **loamy**. These types of soils are best suited for rain gardens because they have high percolation rates.
Medium Clay Content	If you are able to form a ribbon that is between one and two inches before it breaks off, you likely have a **clay loam** type soil. These soils have moderate percolation rates and may still work for rain gardens.
High Clay Content	If you are able to form a ribbon that is longer than two inches before it breaks off, the soil has a high **clay** content. These types of soils have slow percolation rates. Select an alternative site or consider installing a bioretention cell.

Photo: Polk SWCD

Photo: Design With Natives

Photo: Rainscapinglowa

Refer to Appendix C for more information on infiltration rates in natural soil types that mimic percolation rates.

While medium to high clay content is not preferable for rain gardens, it is not impossible to overcome. Native plants, once established, grow deep roots that have the ability to open pore space. The rain garden may need to be designed with additional amounts of amended soils and a subsurface perforated subdrain to ensure adequate drainage and for vegetation to succeed.

Soil Percolation Test

A percolation test indicates whether water will drain fast enough through the soils beneath the rain garden. Follow these steps to conduct the percolation test:

1. Use the same areas where you did the ribbon test to conduct the percolation test. If you used a soil probe to do the ribbon test, you will need to dig the holes larger with a shovel or clamshell posthole digger.

2. If dry soil conditions exist, slowly pre-wet (pour water) the areas with a pail of water. Wait a couple of hours for the water to drain through the soil.

Photo: ISWEP

Using a clamshell posthole digger to create a hole for the perc test.

3. Have a tape measure on hand for measuring water depths. Fill each hole with 12 inches of water.

4. Measure how far the water drops in height (inches) after 12 and 24 hours.

5. Calculate how many inches of water have percolated after 12 and 24 hours.

6. Calculate the average percolation rate by adding the rates together and dividing by two.

7. After 24 hours, fill each hole with another 12 inches of water and repeat the percolation test to validate the results from the first test.

Use the "How To Interpret Percolation Test Results" table on the following page to determine if there is adequate drainage for a rain garden. Generally, a basic rain garden can be installed when percolation rates are greater than one-half inch per hour. Ideally, rain gardens are most suitable where soils percolate water at a rate greater than 1 inch per hour. Jot down the measured percolation rate as it will be utilized when designing the size and depth of your rain garden in Chapter 4.

How To Interpret Percolation Test Results

✓	If water drains completely from the hole within 12 hours for both tests, percolation rates should be ***greater than 1 inch per hour***. This is a good percolation rate for a basic rain garden installation.
✓	If water drains completely from the hole within 24 hours for both tests, percolation rates should be ***between 0.5 and 1.0 inches per hour***. This is an acceptable percolation rate for both basic and enhanced rain garden installations.
✗	If water does not completely drain from the hole within 24 hours for either test, percolation rates are ***less than 0.5 inches per hour***. This percolation rate is too slow for a basic rain garden and likely an enhanced rain garden as well. Consider installing a bioretention cell or other stormwater practice, such as a native plant garden or soil quality restoration.

Example Percolation Test

In this example, water height was measured at 4 inches (8 inches drained) after 12 hours and at 1 inch (11 inches drained) after 24 hours. The average percolation rate among the measured rates is 0.57 inches per hour. This site is suitable for a basic rain garden.

8" / 12 hours = 0.67"/ hour

11" / 24 hours = 0.46"/ hour

(0.66" + 0.46") / 2

= 0.57"/ hour

Photo: Polk SWCD

Photo: Polk SWCD

CHAPTER 3

Butterfly Milkweed

Asclepias tuberosa

PLANT NOTES

Late summer bloomer that commonly occurs throughout Iowa. Provides nectar for many insects and hummingbirds and larval food for monarchs. The plant can take on a bushy appearance from multiple stems and branches. Single stem when young, multiple stems when mature. Dome-shaped with 8 to 25 flowers, 2" to 5" across.

Photos: Shutterstock

Chapter 3
Choosing a Rain Garden Type

Two Types of Rain Gardens

There are two types of rain gardens covered in this guide, a basic rain garden and an enhanced rain garden. Selecting the type of rain garden suitable for your property will depend on a variety of factors such as soil type, percolation rate, compaction, age of home, and space constraints.

Basic rain gardens are suitable for well drained soils that can percolate water at a rate greater than one-half inch per hour. Many homes built in the 1970s or earlier will have yards that can support a basic rain garden. Basic rain gardens also provide more flexibility in their design when there is no place to outlet a subdrain. A subdrain is a feature of an enhanced rain garden.

Photo: Polk SWCD

Native and non-native plants in a basic rain garden.

Photo: Polk SWCD

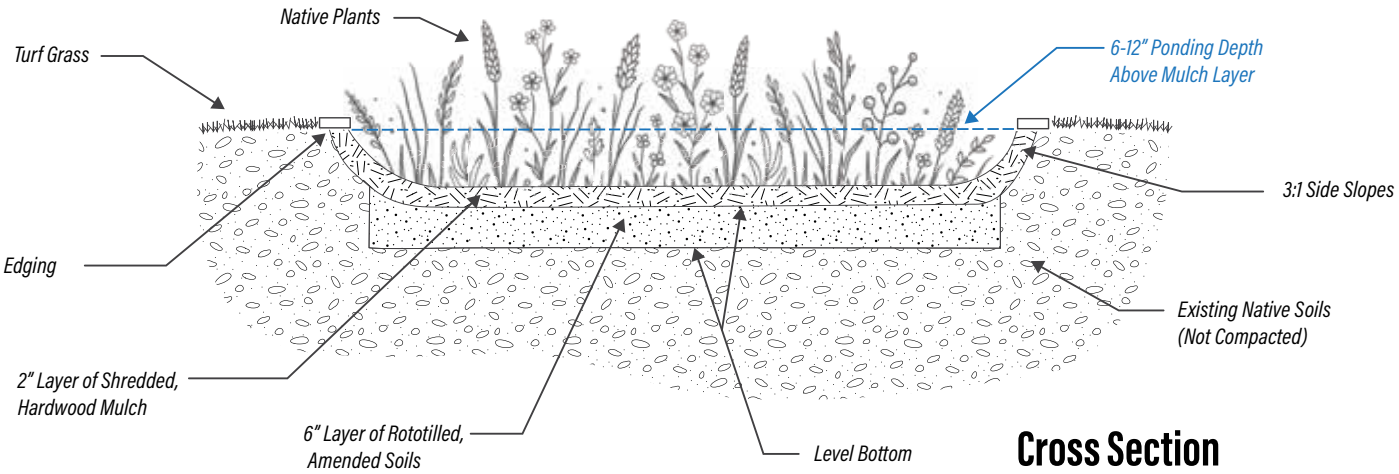
Enhanced rain garden with a vertical overflow structure.

Enhanced rain gardens are often suitable for sites in newer developments where soils are compacted and have poor drainage. Some homeowners opt for an enhanced rain garden when space is limited, or a smaller footprint is desired.

Although basic rain gardens and enhanced rain gardens may appear similar above ground, they are designed differently underground. Enhanced rain gardens are used in poorly drained soils and feature a subsurface perforated subdrain buried in aggregate. They also have an overflow structure for large rainfall events.

Basic Rain Gardens

If site conditions and percolation rates are suitable, a basic rain garden is a simple solution for treating and managing stormwater runoff. Basic rain gardens feature four major components as detailed below. Both basic and enhanced rain gardens are designed to impound a specified amount of rainfall. This is known as the ponding depth and is typically between 6 and 12 inches above the mulch layer.



Cross Section

Not To Scale, Source: ISWEP

Basic Rain Garden Components

1. **Amended Soils.** Many rain gardens have amended soils in the base of the garden, especially if percolation rates range from ½ - 1.0 inch per hour. A recommended starting point is to amend with 2 inches of purchased topsoil, 3½ inches of washed concrete sand, and ½ inch of compost for a total depth of 6 inches. If you have healthy soils, topsoil that is loose and uncompacted with good percolation rates, it may not be necessary to amend the soils.

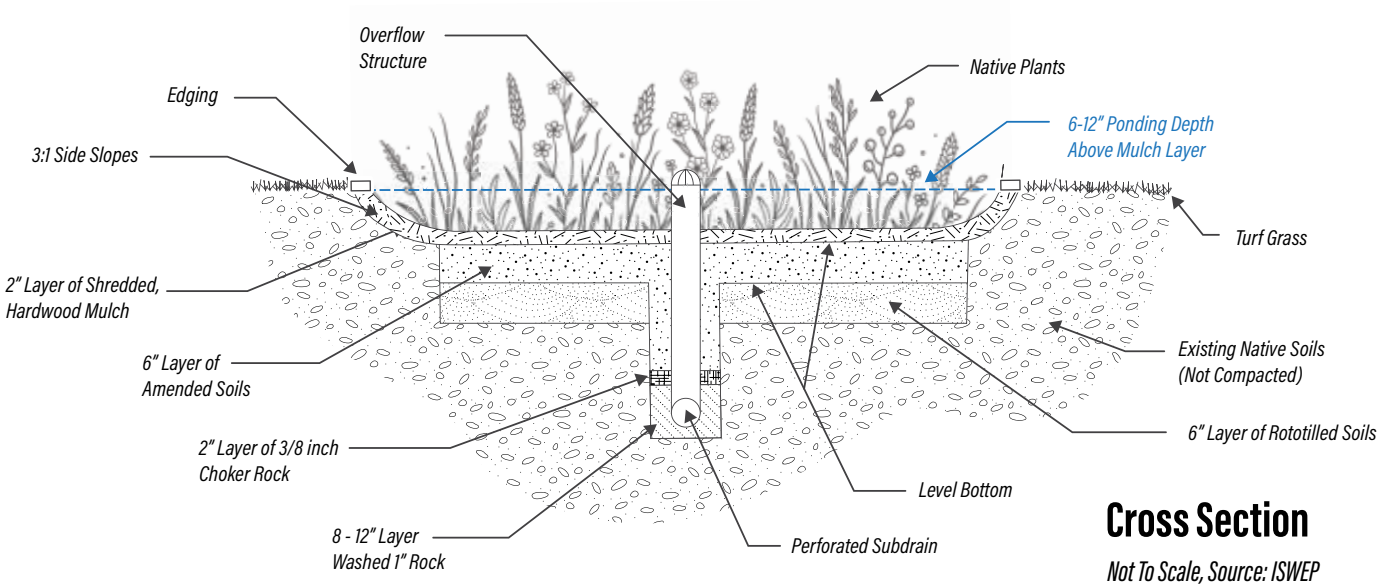
2. **Shredded Hardwood Mulch.** A two-inch layer of shredded hardwood mulch is added above the amended soils for weed suppression and moisture retention. Shredded hardwood is used since it is less likely to float when the rain garden has ponded water.

3. **Native and/or Non-Native Plants.** The use of native Iowa plants in rain gardens is recommended. Native plants are hardy and adapted to Iowa's fluctuations in seasonal temperatures, rainfall, and soils.

4. **Edging.** Many rain gardens have defined edges using paver blocks, landscape edging, or mulched trenches. This makes mowing around the rain garden easier and prevents encroachment from roots of the surrounding turf grass.

Enhanced Rain Gardens

An enhanced rain garden can be installed in areas where soils drain slowly or where space is limited. The use of a subdrain, overflow structure, amended soil, and rock layers are the primary differences between the two types of rain gardens. Due to a more complicated installation, most homeowners hire a landscaping contractor to install this type of rain garden. A detailed cross section can be found in Appendix G.



Cross Section

Not To Scale, Source: ISWEP

Enhanced Rain Garden Components

1. **Amended Soils.** Amended soils consist of a mixture of washed concrete sand (75-90%), topsoil (0-25%), and compost (0-10%). They promote rainwater percolation and create a suitable planting bed for young plants. After rototilling, a six-inch layer is placed in the excavated depression.

2. **Perforated Subdrain.** The subdrain is placed horizontally within a trench filled with 8 to 12-inches of washed rock. There are typically two inches of rock below the subdrain.

3. **Overflow Structure.** The overflow riser is a solid pipe that extends vertically above the ponding depth. There are openings on the cap of the riser that are used for drainage overflow generated from large rainfall events.

4. **Washed Rock.** An 8 to 12 inch layer of washed one-inch rock surrounds the perforated subdrain pipe.

5. **Choker Rock.** A two-inch layer of 3/8-inch washed rock is placed above the washed rock layer to prevent the amended soil from entering the subsurface rock and subdrain.

CHAPTER 4

Wild Geranium

Geranium maculatum

PLANT NOTES

Common throughout Iowa, but more prevalent in eastern counties. Prefers partial shade and slightly damp sandy or loamy soils. When not flowering, Wild Geranium leaves may be mistaken for Canada Anemone. Flower is 1 1/4" diameter with upward facing saucer-shaped petals with rounded tips. Foliage remains all season. Blooms in the summer to early fall.

Photos: Shutterstock

Chapter 4
Designing a Rain Garden

Determining Drainage Areas

The first step in designing a rain garden is to determine what areas flow to the rain garden. Typically, rain gardens manage rainfall from roofs and lawns. The plan is to direct one or several of the home's downspouts to the rain garden and determine the specific area of the roof that drains to each downspout.

An easy way to determine the ***surface area*** of a roof is to place a tape measure on the ground and mimic the outline of the roof. Measure the length and width of the roof. Another option is to use Google Maps on the Internet. Locate the property and use the "Measure Distance" tool by right-clicking on the map. Draw the outline of each roof section and note the area. Add the roof sections together to find the ***impervious drainage area*** in square feet.

All surface area calculations should be measured in "plan view", which is the two-dimensional area of the roof. When measuring the roof, be sure to include overhangs, eaves, and all roof areas contributing to each gutter.

Next, measure the approximate lawn area that will contribute runoff to the rain garden. This area is known as the ***pervious drainage area***. Some rainfall that falls on pervious areas will soak into the ground and not contribute runoff to the rain garden. Therefore, the entire pervious area may not need to be included in the ***total drainage area***. The pervious area can be entirely eliminated from the total drainage area if soil quality restoration (SQR) has been completed. SQR is a combination

Terms to Know

Surface Area: Measure of the total area occupied by the surface of an object.

Impervious Drainage Area: Part of the drainage area that includes roofs, pavement, and other hardscapes.

Pervious Drainage Area: Part of the drainage area that includes lawn areas, planting beds, and other natural features.

Total Drainage Area: The sum of all impervious and pervious areas draining to the rain garden.

Photo: Google Maps

Plan view of a roof section and calculated surface area in Google Maps.

of deep tine aeration and the addition of compost to the lawn surface. If SQR has not been performed on the lawn, the pervious drainage area is divided in half to account for some of the runoff being infiltrated into the lawn.

Calculating Size and Selecting a Shape

The majority, 90 percent, of rainfall events in Iowa generate less than 1.25 inches of rainfall in 24 hours. Design calculations will ensure that rain gardens handle runoff from 1.25 inches of rain. This amount of rainfall is called the Water Quality Volume (WQv). In order to effectively manage the WQv, a rain garden must have enough surface area and be deep enough for stormwater to be stored without overtopping. Follow the instructions on page 30 to determine the appropriate size and depth for the rain garden. The instructions will yield the square feet of rain garden surface area needed to impound the WQv. Rain gardens can be built with a surface area greater than what is required by the WQv to manage more rainfall.

Photo: Polk SWCD

This rain garden was built below the yard surface with no berms. The water overflows onto the existing grass and flows away from the house.

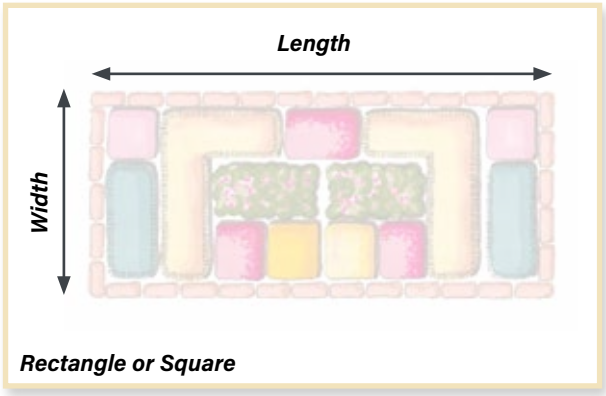
Next, determine the appropriate depth for the rain garden. This guide offers three options: six, nine, and 12 inches. Most residential rain gardens in Iowa have a six-inch or nine-inch depth. The 12-inch option is only recommended for large sites, such as commercial areas or parks, as it may be too deep for a small residential application. A common rule of thumb is to use a six-inch ponding depth if the rain garden is estimated to be less than 200 square feet.

Photo: Polk SWCD

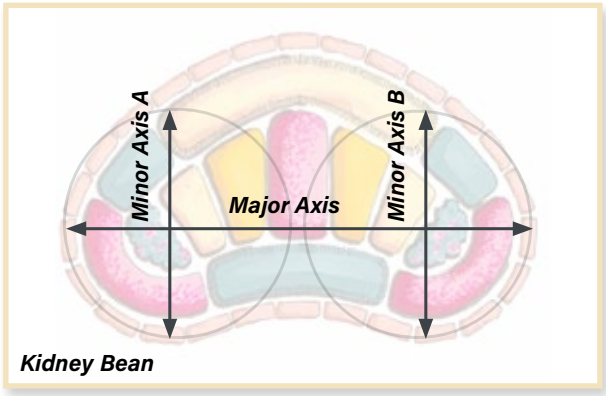
In order to achieve a ponding depth in the rain garden, this sloped site requires berms and/or retaining walls.

A key design and installation decision is determining the rain garden's correct elevation in the landscape. Rain gardens in flat areas can be created with a ponding depth below the surrounding area that overflows into the yard. Selecting a shape that conforms to the existing landscape, and at the ideal elevation, can help avoid unnecessary labor and material costs. An ideal elevation for a rain garden is where either the upslope or downslope side of the rain garden is level with the nearby landscape. A rain garden may require the use of a berm to create ponding depth. Retaining walls can be used on steeper slopes.

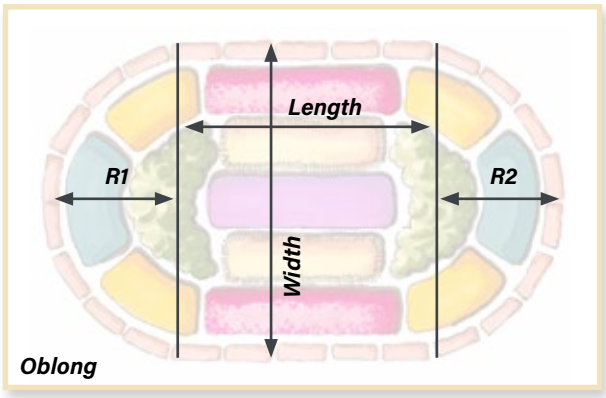
Once the surface area is determined, consider various dimensions (lengths and widths) that yield the required square footage. Long and narrow rain gardens are often preferred so installation and maintenance can be done from the side of the garden. Common rain garden shapes are rectangular, kidney, oblong, and L-shaped.



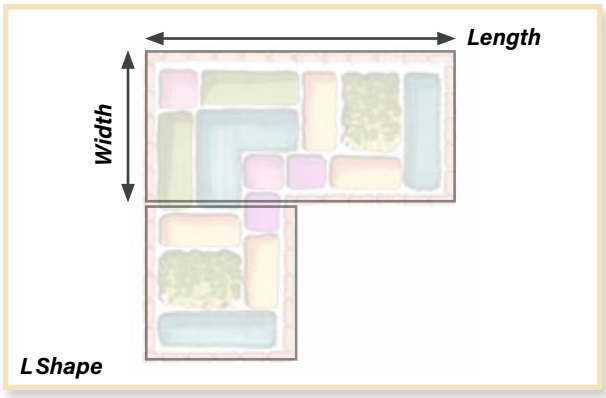
Area = Length x Width



Area = (Minor Axis A + Minor Axis B) x Major Axis x 0.45



Area = R1 x R2 x 3.14 + (Length x Width)



Area = Length x Width of Square + Length x Width of Rectangle

Directing Rainwater to the Rain Garden

After calculating the depth and dimensions of the rain garden, the next step is to determine a method or combination of methods for getting rainwater to the rain garden. Consider the options shown below. Whichever method(s) is selected, ensure there is an adequate slope to allow gravity to move rainwater to the rain garden.

Photo: ISWEP

Gutter extension added to downspout to move rainwater to rain garden.

Photo: Polk SWCD

Buried drain pipe connected to downspout that discharges to the surface of a garden.

How To Calculate the Size of Basic and Enhanced Rain Gardens

Step 1: **Estimate Impervious Drainage Area**	Estimate the impervious drainage area in square feet of the contributing roof section(s). If applicable, add the total area of other impervious surfaces that would contribute runoff (e.g. driveway, sidewalk, patio). *The result of this step is total impervious surface area in square feet.*
Step 2: **Estimate Pervious Drainage Area**	Estimate the pervious drainage area of lawn that would contribute runoff to the rain garden. Refer to the site drawing to determine the areas of the lawn that will shed runoff to the rain garden. *The result of this step is total pervious surface area in square feet.*
Step 3: **Calculate the Total Drainage Area**	On lawns that have not had SQR completed: **Total Drainage Area = Impervious Drainage Area + ½ the Pervious Drainage Area.** For lawns that have completed SQR: **Total Drainage Area = Impervious Drainage Area.** *The result of this step is the total drainage area required for the rain garden to manage the Water Quality Volume (WQv).*
Step 4: **Select Footprint Area Percentage**	Select desired ponding depth of 6, 9, or 12 inches. Refer to the Rain Garden Sizing Guidelines table on page 31 to determine the required footprint area percentage, which is based on the selected ponding depth and the calculated percolation rate in Chapter 2.
Step 5: **Calculate Footprint of Rain Garden Area**	Using the following formula, calculate the required footprint of the rain garden: **Rain Garden Footprint = (Total Drainage Area) x (Footprint Area Percentage from the table on page 31).** *The result of this step is the surface area of the proposed rain garden in square feet.*
Step 6: **Select Shape and Calculate Surface Area Dimensions**	Select a basic shape for the rain garden based on site constraints and preferences. Determine the length(s) and width(s) of the rain garden that is roughly equal to or slightly larger than the area calculated in Step 5.

Rain Garden Sizing Guidelines

Percolation Rate	Appropriate BMP for Site and Ponding Depths for Rain Gardens	Footprint Area Percentage
> 0.5 inches per hour	Enhanced Rain Garden	5%
>= 1.0 inch per hour	Basic Rain Garden with 6" Ponding Depth [1]	10%
	Basic Rain Garden with 9" Ponding Depth [1]	7%
	Basic Rain Garden with 12" Ponding Depth [2]	5%
0.5 - 0.99 inch per hour	Basic Rain Garden with 6" Ponding Depth [1]	21%
	Basic Rain Garden with 9" Ponding Depth [1]	14%
	Basic Rain Garden with 12" Ponding Depth [2]	10%
< 0.5 inch per hour	Bioretention Cell [3]	~3% - 4% [4]

[1] *Appropriate for drainage from one home. Not applicable for managing runoff from numerous sites.*

[2] *For use on large sites only.*

[3] *Where soils drain less than 0.5 inches per hour, it is recommended that a bioretention cell be installed rather than an enhanced rain garden. Bioretention cells are typically installed in parking lots or along roadways. They typically treat runoff from large watershed areas and are often used in tandem with pre-treatment practices to provide added sediment capture. Refer to Chapter 5, Section 4 of the Iowa Stormwater Management Manual (ISWMM) for full design guidelines. The ISWMM can be accessed online via the Iowa DNR's website.*

[4] *General rule of thumb. Actual square footage must be calculated using the bioretention cell calculation in the ISWMM.*

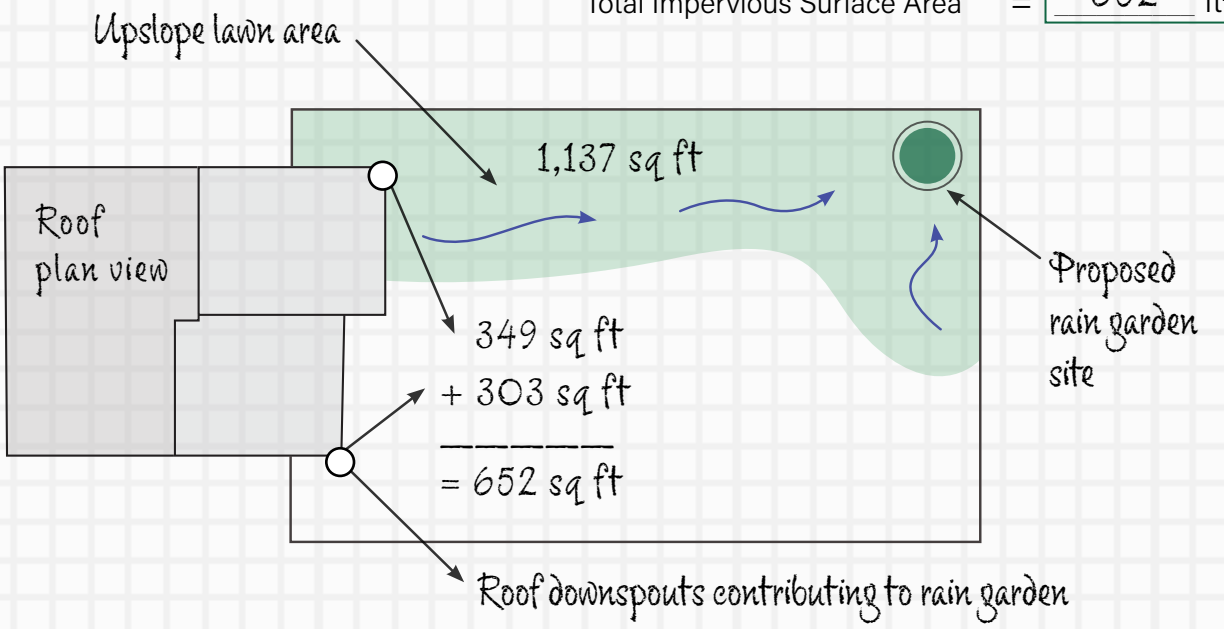
Rain Garden Sizing Example

Step 1: Estimate Impervious Drainage Area

What is the total surface area of the contributing roof section(s)? 652 ft²

What is the total surface area of the contributing driveway, sidewalk, patio, or other impervious area? + 0 ft²

Total Impervious Surface Area = 652 ft²



Step 2: Estimate Pervious Drainage Area

What is the contributing area of lawn upslope of the rain garden?

Total Pervious Surface Area = 1,137 ft²

Step 3: Calculate the Total Drainage Area

In this example, soil quality restoration (SQR) has not been completed. Soil organic matter content of site soils is less than 5 percent.

Impervious Drainage Area + (0.5 x Pervious Drainage Area) = Total Drainage Area

652 ft² (Step 1) + (0.5 x 1,137 ft² (Step 2)) = 1,221 ft²

Step 4: Select Ponding Depth

Previous percolation tests determined an average percolation rate of 0.8 inches per hour. The homeowner selects a ponding depth of 6 inches. This allows them to build a rain garden that has a larger footprint that doesn't appear too deep and provides more space to plant grasses and flowers.

Percolation Rate = 0.8 inches /hour

Desired Ponding Depth = (6") or 9" or 12"

Percent of Total Drainage Area (Per Sizing Guidelines Table on Page 31) = 21%

Step 5: Calculate Footprint of Rain Garden Area

(1,221 ft²) x (0.21) = 256 ft²

(Total Drainage Area) x (% of Total Drainage Area) = Footprint of Rain Garden

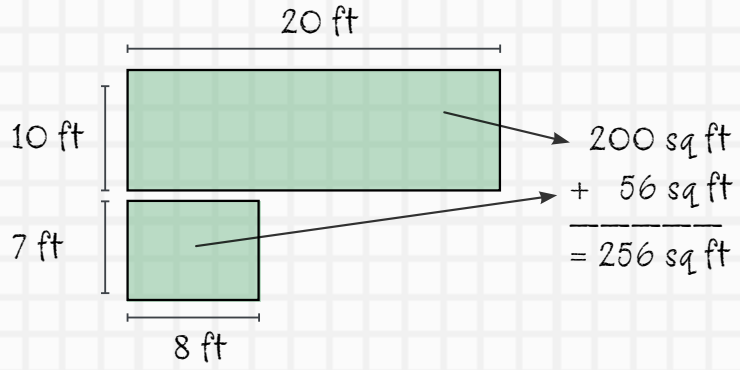
Step 3 *Step 4*

Step 6: Select Shape and Calculate Surface Area Dimensions

The homeowner selected an "L"-shaped rain garden, which was based on site constraints and preference. The total surface area of the "L"-shape should be approximately 256 square feet.

(8 ft x 7 ft of Square) + (20 ft x 10 ft of Rectangle) = 256 ft²

(Length x Width of Square) + (Length x Width of Rectangle) = Surface Area of "L"-shaped Rain Garden



Disconnecting Downspouts from the Storm Sewer

In some cases, a home's gutter system and downspouts will be directly connected to the storm sewer system. If rainwater will discharge directly to a rain garden via one or multiple downspouts and the home's system is tied directly to the storm sewer, check with the local community to find out if there are any disconnection requirements.

Inlets and Outlets

Rainwater typically enters the rain garden from a downspout, subdrain, or swale. The inlet is the opening where most of the rainwater enters the rain garden. Keep in mind that water comes from impervious and pervious areas and may enter the rain garden from a variety of places.

Photo: ISWEP

Rainwater enters the rain garden through a rock channel.

To prevent scour and erosion of soil in the bottom of the rain garden, armor the inlets and outlets with washed, three to four-inch diameter rocks, flagstones, or other protective products. Optionally, place landscaping fabric over the soil before placing rock so erosion does not occur right below the rocks. *This is the only location in the rain garden where limited use of landscaping fabric may be used.*

Photo: ISWEP

An outlet from a rain garden reinforced with rock.

Rain gardens also need a designated outlet to allow excess water to leave the rain garden safely without causing damage to the garden. Outlets typically are notched out areas in a berm where excess rainwater can pass through. They should be reinforced with vegetation or rock. The outlet should be level to prevent scour at the discharge point.

If installing an enhanced rain garden, an overflow pipe is often used in combination with the notched out area in a berm. The height of the overflow pipe is set at six, nine, or 12 inches (the ponding depth) above the base of the rain garden. The notch in the berm can be set at the same elevation as the overflow pipe or a little higher as a backup in case the overflow cannot handle all the water. Make sure that where the base of the overflow pipe daylights back onto the lawn, water is conveyed in a manner that does not damage downslope property or infrastructure.

Berms and Retaining Walls

Rain gardens must be level from end to end and side to side. One option to create a level bottom in sloped areas is to use berms and/or retaining walls. Berms can provide a natural edge for the rain garden and allow for rainwater to pond and soak into the soil.

If berms are used, ensure that the berm located on the downslope edge of the rain garden is higher than the upslope berm. The back slope of the berm should be gradual. A 5:1 slope is recommended and means that for every one foot of vertical height, the berm should extend out five feet horizontally. This will allow water during larger rainfall events to flow slowly to an area stabilized with vegetation, rocks, or other types of stabilization. If the site is flat, berms are not always necessary. Simply excavate to get to the designed ponding depth.

Photo: Central Ohio Rain Gardens

Upslope retaining wall around an oblong rain garden with a mulch berm on the downslope side.

If steep slopes exist at the site of a proposed rain garden, a retaining wall may be needed. A retaining wall can be built up to create a level depression on a sloping site. An alternative is to cut into a slope to create a level depression and have the retaining wall as a backdrop that holds the cut slope soil in place. Retaining walls can be used for decorative purposes even if there are no steep slopes.

Photo: Ramsey Wash. Metro Watershed

Rock retaining wall is cut into the slope to create a level bottom.

Pre-Treatment Areas

Some rain gardens, primarily enhanced rain gardens designed to manage larger drainage areas, feature pre-treatment areas. These areas are used to filter out debris and sediment before stormwater runoff reaches the rain garden. Pre-treatment areas can extend the longevity of the stormwater BMP and reduce annual maintenance. Rain gardens located along streets or driveways typically include a curb cut to allow stormwater runoff to enter into the rain garden. A grass filter strip between the curb and rain garden is a simple pre-treatment practice that could be used in this scenario. Sod should be placed two inches lower than the inlet to accommodate sediment deposition. Another option for pre-treatment could be stone steps.

Photo: Wayne Petersen

Pre-treatment grass filter strip used for a rain garden receiving street runoff.

CHAPTER 5

Little Bluestem

Schizachyrium scoparium

PLANT NOTES

Perennial bunchgrass that forms dense mounds up to 2 feet tall. Vegetation color remains year-round and turns from greenish-blue to reddish-white in the fall. Is drought tolerant and thrives in full to partial sun. Hearty grass commonly used in rain gardens.

Photos: Shutterstock

Chapter 5
Estimating Materials

Creating a Materials List

Once the rain garden has been designed, the next step is to create a materials list and determine the approximate amount of materials needed for installation.

- **Concrete Sand.** Ensure the sand is washed and graded. Many commercial concrete sands may simply say "All Purpose Sand". Do not use masonry sand. In enhanced rain gardens, concrete sand and should account for between 75 and 90 percent of the amended soil mixture. Read more about amended soils in Appendix D.

- **Compost.** Compost is typically composed of decayed plant and tree materials. High-quality compost should be black to dark brown in color, be loose, and have a musty or earthy smell. Look for STA (Seal of Testing Assurance) certification by the US Composting Council. In enhanced rain gardens, compost should account for up to ten percent of the amended soil mixture.

- **Topsoil.** Ensure excavated or purchased topsoil is free of small rocks, roots, and debris. It should have a dark brown to black color, be loose (not sticky), and granular. In enhanced rain gardens, topsoil should account for up to 25 percent of the amended soil mixture.

Photo: ISWEP

Concrete sand is added to rain gardens to enhance percolation.

Photo: ISWEP

Compost is added to increase organic matter.

Photo: ISWEP

Topsoil provides nutrients needed for plants to survive.

- **Shredded Hardwood Mulch.** Long strand, shredded hardwood mulch is used to retain soil moisture for plants. It also helps suppress weeds. Shredded hardwood mulch is recommended because it is less likely to float or wash away when the rain garden has ponded water.

- **Potted Plants and Plugs.** Vegetation can be purchased as potted plants, typically in quart or gallon pots, or as plugs, which are seedlings sold in trays. Plugs are more economical but potted plants provide more immediate aesthetics. Once plants for the rain garden are selected (see Chapter 7), jot down the spacing recommendations for each plant species. Calculate the average spacing recommendations from your plant list. Most plants are placed at one plant per square foot for an average spacing of 12 inches. Spacing recommendations are measured "on-center", or from the center of one plant to the center of the neighboring plant.

- **Inlet and Outlet Rock.** Two-inch to five-inch river rock can be used to prevent scouring at the inlets and outlets of a rain garden. Larger decorative flagstones can be used alone or in combination with the rock at these locations.

- **Edging.** Edging is used around the perimeter of the rain garden. It prevents turfgrass encroachment and makes mowing around the rain garden easier. Landscaping pavers, a mulch trench, cedar wood, and plastic or metal edging can be used.

Photo: ISWEP

Long-strand, shredded hardwood mulch.

Photo: ISWEP

Plant plugs ready to be planted in a rain garden.

Photo: ISWEP

Two to five-inch rock provides scour protection at inlets and outlets.

Photo: ISWEP

Plastic landscape edging along the perimeter of a rain garden.

In addition to the previous materials, the following items are needed for *enhanced rain gardens*.

- **1-inch Rock.** One-inch clean field rock or limestone surrounds the subdrain in an enhanced rain garden. The rock should be washed and adhere to DOT Section 4115, Gradation No. 3, Class 2, or ASTM D 448, #57.

- **3/8-inch Aggregate.** 3/8-inch aggregate is used in enhanced rain gardens as a choker layer that separates the amended soil from the 1-inch rock above the subdrain. Ensure aggregate selection is washed and does not have a wide range of particle sizes. Seek aggregate meeting ASTM #8 specifications and avoid road stone.

- **Subdrain Pipe.** It is recommended that a 4- or 6-inch high-density polyethylene (HDPE) perforated drainpipe be used as the subdrain in enhanced rain gardens. HDPE is resistant to corrosion, durable, and lightweight for easier installation. Pipe is typically sold in lengths of 10, 50, or 100 feet. Measure from the outlet of the pipe to the edge of the enhanced rain garden farthest away from the outlet. Add 10 percent extra to the rain garden length to ensure enough pipe is purchased. If you plan to route rainwater underground from a downspout, the same type of HDPE pipe can be used. However, it should be solid pipe and not perforated. Do not buy pipe that is smaller in diameter than the downspout. This can back water up the downspout. Ensure a water-tight seal, which may require an adapter. The outlet of the subdrain into the rain garden should be capped with a grate to prevent animals from nesting inside the pipe.

- **Overflow Structure and Grate Cover.** A solid, four or six-inch PVC pipe can be used for the riser overflow structure. PVC provides a more rigid, firm pipe that will not bend over

Photo: ISWEP / Gravelshop

1-inch washed field rock and crushed limestone rock.

Photo: ISWEP

3/8-inch aggregate.

Photo: Fairfield Elementary School

HDPE subdrain pipe in an enhanced rain garden.

Photo: Polk SWCD

Overflow structure extending to the top of the ponding depth.

time and will stay vertical at the correct angle. Make a plan on how you will connect the overflow structure to the subdrain. This step may require an adapter or coupler to create a water-tight seal. A grated inlet cover rests on top of this pipe. The grated device is located at the height of the ponding depth to drain ponded water that exceeds the design depth. Beehive (dome-shaped), square, or circular grates are common and can be purchased at a local home improvement retailer. Ensure that the diameter of the overflow pipe matches the diameter of the grate opening.

Creating a Budget

The cost of installing a rain garden will vary based upon the footprint area, ponding depth, amount of plants, type of edging, and if subsurface drainage is used. Enhanced rain gardens will be more expensive than basic rain gardens and are typically designed and installed by a contractor. The following are simple cost ranges for estimating the total project cost of a "Do-It-Yourself" installation. Estimated ranges reflect material costs in 2021.

Photo: Shutterstock

Individual bags of long-strand, shredded hardwood mulch.

Basic Rain Gardens = $4 - $10 per square foot (assumes a rain garden less than 400 square feet, 6" ponding depth, 12" plant spacing, edging)

Enhanced Rain Gardens = $10 - $20 per square foot (assumes an enhanced rain garden less than 400 square feet, 6" ponding depth, 12" plant spacing, subdrain infrastructure, and edging)

Use the tables on pages 41 and 42 to develop a more accurate estimate of the materials needed and potential costs.

Photo: Shutterstock

Bulk delivery of long-strand, shredded hardwood mulch.

Depending on the size of your rain garden, buying materials in bulk may be more cost-effective than purchasing individual bags. Bulk delivery of materials typically includes a delivery fee.

In addition to buying in bulk, out-of-pocket costs can be reduced by utilizing a local stormwater BMP cost-share program. Cost-share programs are offered by many cities and SWCDs in Iowa. Common programs fund fifty percent of the project cost, usually up to a specified dollar amount. Cities encourage residents to adopt stormwater practices on their property to help improve local water quality and reduce flash flooding. A complete list of participating communities and organizations can be found at www.bit.ly/IowaCostShare.

Estimated Cost Ranges for Rain Garden Materials

Item	Purchased in Bulk	Bulk Cost Range	Purchased as Individual Bags	Cost Range
Topsoil	1 Cubic Yard	$20 - $55	0.75 Cubic Ft.	$2 - $5
Compost	1 Cubic Yard	$15 - $45	0.75 Cubic Ft.	$2 - $5
Concrete Sand	1 Cubic Yard	$30 - $40	0.5 Cubic Ft.	$3 - $8
Shredded Hardwood Mulch	1 Cubic Yard	$18 - $35	2.0 Cubic Ft.	$3 - $6
1" Rock	1 Cubic Yard	$30 - $40	0.5 Cubic Ft.	$3 - $6
3/8" Aggregate	1 Cubic Yard	$40 - $55	50 Lbs. Bag	$4 - $8

Refer to Appendix H for calculating material quantities.

List of Communities that Sell Compost, Topsoil, or Mulch

Some municipalities in Iowa have facilities that convert yard waste to mulch or compost. This is an environmentally friendly way of diverting biomass from the landfill and reusing organic materials. It's also a more cost-effective solution for homeowners and contractors, materials are typically cheaper than buying commercially. Some cities even offer free materials to residents. The following is a list of facilities in Iowa that are STA certified by the US Composting Council.

Region	Location	Agency	Materials
Eastern	Cedar Rapids	Solid Waste Agency	Compost, Mulch
Eastern	Davenport	City of Davenport	Compost, Garden Soil, Potting Soil, Mulch
Central	Des Moines	Metro Waste Authority	Compost

Are amended soils always necessary?

Basic Rain Gardens

Soils in newer developments are often heavily disturbed. Typically, it is desirable to amend the soils in the base of the garden, especially if percolation rates range from ½ - 1.0 inch per hour. Amendments include topsoil, washed concrete sand, and compost. A recommended starting point is to amend with 2 inches of purchased topsoil, 3½ inches of washed concrete sand, and ½ inch of compost for a total depth of 6 inches of amended soils. Compost is naturally high in nutrients such as nitrogen and phosphorus. Use no more than a ½ inch of compost at any time to prevent contamination of groundwater from excess nutrients. The amount of sand can be adjusted based on native soils. If there is more clay present, use more sand. Over excavate the bottom of the rain garden to account for the soil amendments to make sure that the design ponding depth is achieved. Rototill to create a uniform blend of topsoil, sand, and compost. If you have healthy soils, topsoil that is loose and uncompacted with good percolation rates, it may not be necessary to amend the soils in the base of the rain garden.

Enhanced Rain Gardens

Amended soils are used in enhanced rain gardens. Follow recommendations in the Iowa Stormwater Management Manual (ISWMM) for bioretention cells. The amended soils (or modified soils) consist of a mixture of washed concrete sand (75-90%), topsoil (0-25%), and compost (0-10%). The trench above the choker layer and rock-embedded subdrain may be filled with amended soils or choker rock.

Other Estimated Costs for Basic and Enhanced Rain Gardens

Item	Details	Cost Range
Plant Plugs	Native/Non-Native Species, Sold as Flats	$1 - $5 per plant
Potted Plants (Quart)	Native/Non-Native Species, Sold Individually	$3 - $10
Potted Plants (Gallon)	Native/Non-Native Species, Sold Individually	$5 - $45
HDPE Perforated Pipe	4-inch Diameter by 100 foot Length	$35 - $45
PVC Non-Perforated Pipe	4-inch Diameter by 10 foot Length	$8 - $15
Drain Grate	4-inch Round, Square, Beehive, or Atrium	$5 - $15
Pipe Adapters	Varies by Brand and Material	$5 - $15

Example Materials List

Continuing with the example provided in Chapter 4, the homeowner intends to install a basic rain garden with a footprint of 256 square feet and a ponding depth of 6 inches. The homeowner has chosen to amend the soils based on the recommendations on page 42. Always round up to make sure you purchase enough materials. See Appendix H for a blank worksheet.

Topsoil *(Suggested **0.5** ft [6 in.] Amended Soil Layer = **0.33** [33%] of Mixture = 2 in. Layer of Topsoil)*

256 ft² (rain garden SF) x 0.5 ft = 128 ft³ x 0.33 % Mix (decimal) = 42 ft³ / 27 = 1.56 cu yd

1.56 cu yd x 2,400 lbs. = 3,755 lbs. / 2,000 = 1.88 tons

Compost *(Suggested **0.5** ft [6 in.] Amended Soil Layer = **0.08** [8%] of Mixture = ½ in. Layer of Compost)*

256 ft² (rain garden SF) x 0.5 ft = 128 ft³ x 0.08 % Mix (decimal) = 10 ft³ / 27 = 0.38 cu yd

0.39 cu yd x 1,200 lbs. = 455 lbs. / 2,000 = 0.23 tons

Concrete Sand *(Suggested **0.5** ft [6 in.] Amended Soils = **0.58** [58%] of Mixture = 3 ½ in. Layer of Sand)*

256 ft² (rain garden SF) x 0.5 ft = 128 ft³ x 0.58 % Mix (decimal) = 74 ft³ / 27 = 2.75 cu yd

2.75 cu yd x 3,000 lbs. = 8,249 lbs. / 2,000 = 04.12 tons

Shredded Hardwood Mulch *(Suggested **0.17** ft [2 in.] Depth)*

256 ft² (rain garden SF) x 0.17 ft (mulch depth) = 44 ft³ / 27 = 1.61 cu yd

256 ft² (SF of berm & slopes, if applicable) x 0.17 ft (mulch depth) = 34 ft³ / 27 = 1.26 cu yd

TOTAL MULCH: 1.61 cu yd (base) + 1.26 cu yd (berm/slopes) = 2.87 **total cubic yards (cu yd)**

Edging Type of Edging Trench edging with mulch Approximate Linear Feet 67

Vegetation The rain garden square footage only accounts for the flat bottom of the rain garden. If plants are desired for the side slopes and berms, measure the total square footage of the area to calculate needed plants. Spacing options include 1 plant per square foot, 1 plant per 1.5 square foot, and 1 plant per 2 square feet.

256 ft² (basic rain garden SF) / 1.00 ft² (average plant spacing) = 256 total plants

200 ft² (SF of berms & slopes, if applicable) / 1.50 ft² (average plant spacing) = 134 total plants

CHAPTER 6

Jacob's Ladder

Polemonium reptans

PLANT NOTES

A shorter (up to 1 foot tall) perennial providing vibrant shades of blue in April to May. Jacob's Ladder prefers shady areas but can withstand full sun if moisture conditions are sufficient. Cup-shaped blooms provide nectar to a host of pollinators. "Reptans", meaning "creeping", gives this spring ephemeral a sprawling aesthetic.

Photos: Shutterstock

Chapter 6
Constructing a Rain Garden

"Do-It-Yourself" Installation

Be aware that rain gardens require a significant amount of excavation. For rain gardens with a ponding depth of six inches, be prepared to excavate at least 14 inches (six-inch ponding depth, two-inch mulch layer, six inches of amended soils) for the entire footprint. Increasing the ponding depth will add more excavation.

The first construction step is to remove or kill-off existing turfgrass or other vegetation at the site. If turfgrass is not removed properly, it will compete with rain garden plants. Turfgrass removal can be completed in one of three ways after mowing the grass as short as possible.

- Place plastic sheeting or cardboard to cover the rain garden area and weigh it down with rocks or other heavy items. This method should suppress existing vegetation within a few weeks.
- Rent a sod cutter or remove it using a shovel. The sod could be used to fill in bare areas outside of the rain garden or elsewhere on the property.
- An herbicide like Roundup® can be used to kill off existing vegetation. Grass should be killed off within a few weeks of application.

Use a garden hose, rope, or spray paint to layout the rain garden area. Don't forget to include additional space to achieve a minimum of 3:1 side slopes on the rain garden. See "Ensuring 3:1 Slopes" above for guidance on how much space to include based on the ponding depth. Additional space will be needed if the rain garden side slopes are flatter than 3:1. If the subsoil is not being re purposed for a berm or elsewhere on the property, create a plan for disposal.

Equipment List

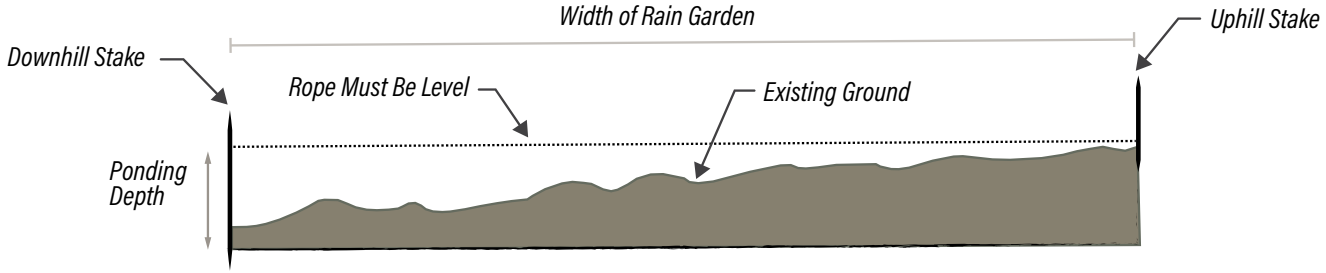
- Carpenter's Level
- 2" x 4" Board, 6' Length
- Rubber Mallet
- Shovel
- Spade
- 2-4 Wooden Stakes
- Rope, Garden Hose, Flags
- Wheelbarrow
- Tape Measure
- Rake
- Rototiller
- Spray Paint (optional)

Ensuring 3:1 Slopes

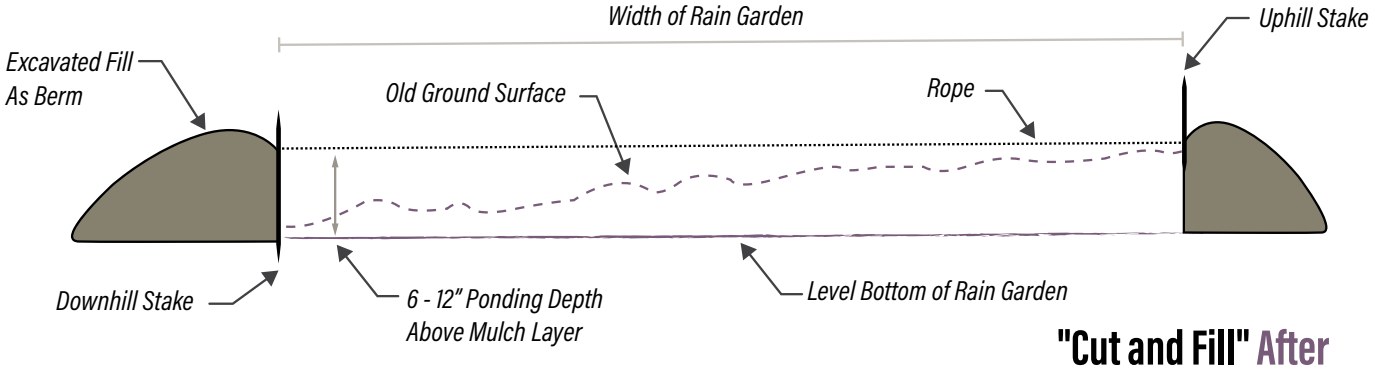
Add the following distances to the perimeter of the calculated rain garden area.

1.5' for 6" ponding depth
2.25' for 9" ponding depth
3' for 12" ponding depth

The most common installation approach for rain gardens is the "cut and fill" technique. This is because most rain garden sites have some degree of slope and rain gardens require a level bottom. With "cut and fill", a small berm is built on the downslope side of the rain garden using material excavated from the upper side of the rain garden. Once the rain garden has been excavated, refer to "Place Soil Amendments" on page 49 to continue basic rain garden installation.



"Cut and Fill" Before



"Cut and Fill" After

"Cut and Fill" Instructions

1. Layout the shape of the rain garden with a rope, garden hose, flags, or spray paint. Adjust the layout to make sure the rain garden fits into the landscape nicely and provides an aesthetic addition to the yard. If you adjust the layout in this step, make sure the footprint of the area is equal to the footprint area calculated in Chapter 4.

Photo: Polk SWCD

2. Place stakes at the upper edge of the rain garden and stakes at perpendicular angles on the lower edge of the rain garden. Tie a rope at the base of the upper stake. Then tie the rope to the top of the lower stake. Use a carpenter's level and 2"x4" board to ensure the rope is level.

"Cut and Fill" Instructions (Continued)

3. Measure the distance from the ground at the lower stake to the rope. Depending on the ponding depth selected in Chapter 4, raise or lower the rope to meet the desired depth. Adjust the upper stake to ensure the rope is level using a carpenter's level and a 2"x4" board.

4. If it is necessary to raise the rope to get the correct ponding depth, the area around the lower stake will need to be backfilled. Likewise, if you need to lower the rope to meet the correct ponding depth, excavate the area at the upper stake.

5. Once the rope is level and the lower stake is located at the correct ponding depth, excavate 8 inches deeper than the lower stake. If amended soil is used, fill 6 inches up to the bottom of the lower stake. A rototiller can be used to loosen the soil that can then be removed using a shovel. Fill the area with amended soil. Ensure a level bottom is achieved throughout.

6. Level the berm by raising or flattening the soil using the 2"x4" board. Place the carpenter's level on top of the board to verify levelness. For basic and enhanced rain gardens, notch out a designated outlet area on the berm to accommodate overflow from storms that exceed the capacity of the rain garden. Make sure the notch is set at or just above the ponding depth. Decorative rocks or stones can be placed on this area to prevent scour. The area beneath the berm where overflow will be discharged should be protected with vegetation (turf grass) or rock.

7. The upper edge of the rain garden, where rainwater from turf or other areas will flow into the rain garden, should be gently sloped backward (3:1 or flatter). It is recommended that for every 1 foot of height (depth of the cut slope), the slope should step back 3 feet. Place a layer of straw mulch or an erosion control blanket along this slope to protect it until vegetation is established (if seed is used). Sod can provide immediate protection.


Photo: Polk SWCD


Photo: Polk SWCD


Photo: Polk SWCD


Photo: Polk SWCD


Photo: Polk SWCD

Installation for Contractors

Contractors can be hired to construct both basic and enhanced rain gardens. The following instructions are provided to ensure that rain gardens are constructed properly, and soil compaction is avoided throughout the installation process.

Equipment List

- Spray Paint and/or Flags
- Laser Survey Equipment
- Excavator
- Rototiller
- Shovel
- Rake
- 2" x 4" Board, 6' Length
- Rubber Mallet
- 2-4 Wooden Stakes, Rope
- Wheelbarrow
- Rake
- Tape Measure

Step 1 - Layout. Use spray paint or place flags to layout the rain garden area. Extend the layout to accommodate for 3:1 side slopes (see page 45). If vertical sides are being used for the perimeter, there is no need to extend the layout. Ensure that the area surrounding the rain garden is stabilized prior to excavation of the garden area. Install erosion and sediment control practices upslope to protect the rain garden from eroded sediment.

Step 2 - Survey. Use survey equipment throughout the construction process to ensure that the base of the rain garden is level from front to back and side to side and to ensure downslope berms are high enough. Refer to "cut and fill" instructions (pages 46-47) for sloped areas.

Step 3 - Excavation. Excavate the rain garden area to the length, width, and depth specified in the contract design documents. Keep all equipment out of the garden by working from the sides of the garden. This will prevent compaction of the soils. Use tooth buckets on small excavators that will not smear soils. Final grading may require using hand shovels to avoid compaction.

Step 4 - Construct Berm(s). Place excavated subsoil on the downslope side of the rain garden site. Use this to create a berm on the lower edge of the rain garden. Soil compaction is needed on the berm to prevent it from collapsing when water is ponded. Use a tamper to compact soil after each two-inch lift. This is the only soil material that should be compacted during construction. If installing an enhanced rain garden, drainage infrastructure will need to be installed before backfilling with amended soils. This step is not required for basic rain gardens.

Photo: Polk SWCD

Rain garden berms under construction.

Step 5 - Place the Subdrain (Enhanced Rain Gardens Only). Excavate the trench for the subdrain according to depths recommended for enhanced rain gardens (see page 25). Place first lift of aggregate then the perforated pipe at the elevation specified. The subdrain should extend the entire width of the longest side of the enhanced rain garden. Confirm local requirements if the subdrain

will be connected to the storm sewer system. If the subdrain is daylighted downslope of the rain garden, ensure the area is protected from scouring using rock, sod, or other erosion control products.

Photo: Fairfield Elementary School

Placement of perforated subdrain.

Step 6 - Add Overflow Pipe (Enhanced Rain Gardens Only). Install the vertical overflow pipe at this time. Use a carpenter's level to make sure the pipe is standing at a 90-degree angle. Ensure all joints and connections are sealed tight. Backfill the trench with enough of the one-inch rock to cover the subdrain completely and to a depth of at least two inches above the subdrain. Next, place a two-inch layer of 3/8-inch aggregate rock into the trench. This creates a "choker" layer to prevent sediment from moving into the aggregate layer and subdrain.

Step 7 - Place Soil Amendments. Soil amendments are required for enhanced rain gardens. Depending on the native soils at the project site, soil amendments may also be used in basic rain gardens.

Add amended soil in two to three-inch lifts to the elevation specified in the contract documents. Overfill area with amended soil by five percent of the specified depth to allow for natural settlement. Avoid compaction by allowing time for natural settlement. If the project schedule does not allow for natural settlement of soil, enhance the settlement of the amended soil by soaking. Apply water to uniformly saturate the entire rain garden surface by spraying or sprinkling. Add amended soil as required to restore settled surface to finished elevation. Uniformly grade and rake the top of the amended soil layer to a flat and smooth surface.

Do not use landscaping fabric in a basic or enhanced rain garden for controlling weeds. Landscaping fabric will significantly limit rainwater infiltration. This will not allow the rain garden to function properly. Mulch is used to help control weeds.

Step 8 - Add Mulch. Place a two to three-inch layer of long-strand, hardwood mulch over the base and side slopes. If using plugs for vegetation, place the mulch then plant. Larger plants can be installed prior to placing mulch. Mulch should be level so that water infiltrates uniformly across the base of the rain garden.

Step 9 - Install Edging. The final step for both basic and enhanced rain gardens is to install edging if it is being used. Edging provides a barrier that prevents the roots of surrounding sod from creeping into the rain garden. It also makes mowing around the rain garden easier. Make sure that water can still flow into the rain garden over the edging. Mulch located in the rain garden along the perimeter should be lower than the installed edging. Common edging products include plastic, wood, or composite landscape edging, retaining wall blocks, and edging pavers.

CHAPTER 7

Prairie Coreopsis

Coreopsis palmata

PLANT NOTES

Prairie coreopsis prefers full sun to partial shade in mesic to dry soils. Flowers are 1 1/2" - 2" across with 8 to 12 petals with rounded tips looking a bit ragged. Flowers earlier in the summer and blooms before the warm-season prairie grasses develop rapidly in response to hot summer weather.

Photos: Shutterstock

Chapter 7
Planting Vegetation

Selecting Species

Native plants are recommended for rain gardens for many reasons. They are adapted to the region's climate, soil, and moisture conditions. As native plants get established, their deep roots help break up the soil. This creates pore space that helps infiltrate and percolate water. Additionally, some of the native plant's roots decay adding more pore space and organic matter to the soils. Healthy plants with excellent root systems can make rain gardens more functional over time. Plants with deep roots also have the ability to reach further into the ground to find water during dry periods.

Photo: Katy Chayka, Bugwood.org

Prairie Blazing Star is a native prairie plant in Iowa.

Photo: Dow Gardens

Autumn Joy Sedum is a non-native plant suitable for rain gardens in Iowa.

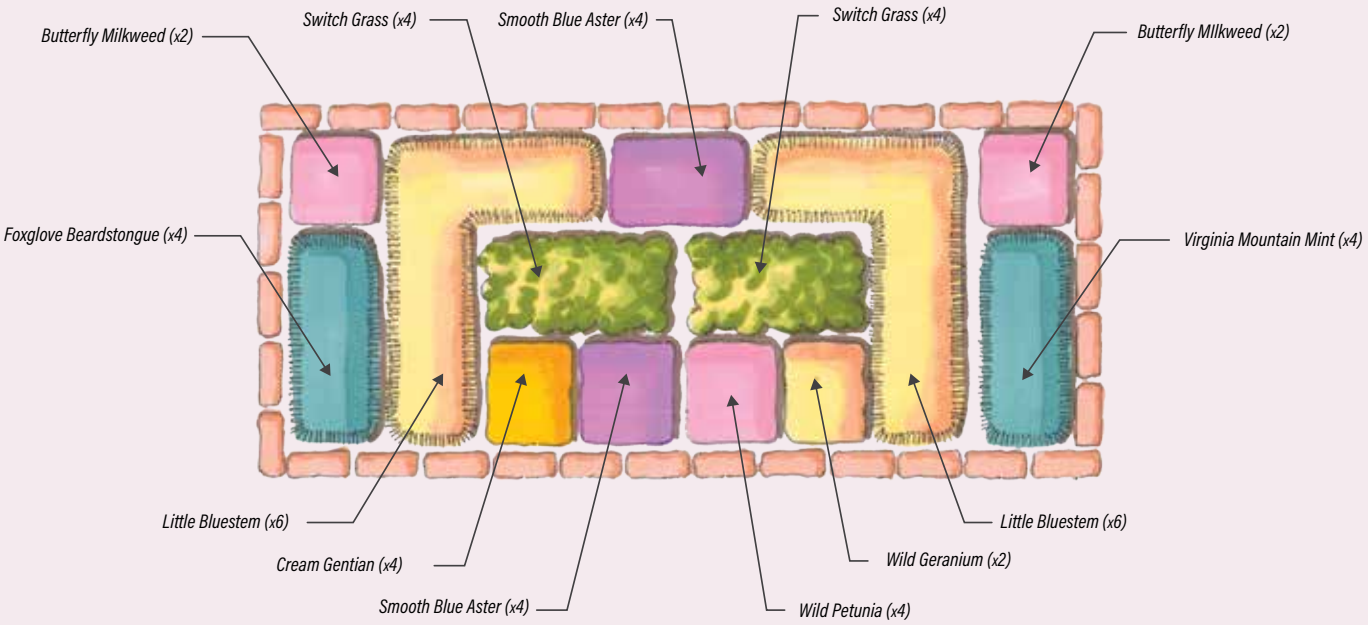
Many native plant species can tolerate temporary impoundment of water, which is the function of a rain garden. Native species are disease resistant and require less watering once established. They also don't require fertilization. Native species provide excellent habitat for pollinators, birds, and other wildlife.

Some rain gardens also feature species that are non-native to Iowa. While natives are recommended, some people may want to blend in their favorite horticultural cultivars. Select plants that meet your aesthetic values but consider the amount of inputs needed to keep non-native plants alive. This could include more water during periods of drought and the use of fertilizer.

Plant selection should be based on sunlight, soil moisture, plant characteristics, and other site conditions. This guide provides a variety of plant layouts to assist in species selection. Layouts are based on sun conditions and the use of native and non-native plants. Refer to Appendix B for more information.

Example Plant Layout

In this example, a 5 foot by 10 foot (50 square foot) rain garden will be constructed. Native plants for full sun conditions will be planted in the garden. The desired plant spacing is 1 plant for every 1.0 square feet. Fifty plants will be planted. Species selected provide a variety of bloom colors and mature heights. More layouts are available in Appendix B.



Planting Process

First, gather the appropriate tools: a shovel, small hand tools, a rake, and a wheelbarrow. Try to minimize foot traffic within the rain garden when planting to minimize compaction of amended soils. Work from the side of the rain garden if possible. On larger, wider rain gardens a small bridge can be built by using two by four boards or an extension ladder and laying plywood over the top of the support boards.

Photo: Polk SWCD

Plants placed into position before installation.

Place a two to three-inch layer of shredded hardwood mulch across the entire surface area. Mulch suppresses weeds and helps conserve moisture needed especially for young plants during the first year. Mulch protects the rain garden from erosion.

Keep the soil in potted plants, shrubs, and trees moist before planting and keep them out of direct

sunlight until planting. When planting plugs, first place mulch. Then push aside mulch, dig a hole, bury the plant roots, and replace mulch. A dibble makes it easy to plant plugs. Push a hole into the ground with the dibble, plant then replace surrounding soil.

Depending on weather conditions, gently water plants every other day for the first few months after planting. As a rule of thumb, one inch of water per week is recommended. Watering in the early morning or evening hours will avoid water loss from evaporation. Target the base of plants rather than spraying broadly over the entire rain garden. New growth indicates that watering can be reduced to once weekly. Watering requirements will lessen as plants become fully established after the first year.

Photo: Polk SWCD

Using a soaker hose for watering in a new rain garden.

Soaker hoses or drip irrigation systems can be installed to provide water to the rain garden at set rates and times. A dedicated spigot is required for this option. Rain gardens can also be irrigated with a garden hose or watering can. Consider installing a rain barrel on your property to collect rainwater for watering plants. Rain barrels can also discharge water to rain gardens if they overflow.

Plant Selection Tips and Considerations

- Wetland plants will not survive in rain gardens. Since rain gardens drain down readily after a rain event, selected species must be adapted to drained soil conditions.
- Clump species together to express more dense natural plant communities. This makes the planting pattern more obvious.
- When shrubs and trees are used in enhanced rain gardens, the amended soil mix will likely need to be adjusted. Shrubs and trees will require more topsoil than sand.
- Use a layer of low-growing plants around the circumference to frame the plant palette. An example would be the use of some of the shorter native grasses such as blue grama and June grass.
- Consider a more natural approach that mimics a dense, layered plant arrangement that occurs in natural settings. This might include layers of low-growing ground cover, clumped species of taller plants, and at the tallest layer, shrubs and/or trees. A thick layer of more shade tolerant, low growing species can be grown under shrubs, trees, and taller plants. This ground cover can be thought of as a living mulch that protects soils from erosion, promotes vital soil microbes, and reduces weed pressure. Potential species might include sedges, short grasses, and flowers that spread easily. Non-native cultivars can be used if native plants are not available.

CHAPTER 8

Prairie Blazing Star

Liatris pychnostachya

PLANT NOTES

A variety of bees, butterflies, moths, and skippers utilize the nectar. Upright, clump-forming plant. Distinct flowers open top to bottom on the spikes. 3/4" wide flower heads, typically numbering 5 to 60 appear on a dense spike. Blooms late summer to early fall months.

Photos: Shutterstock

Chapter 8
Maintaining a Rain Garden

Make a Plan for Maintenance

Routine inspection and maintenance are crucial for the lasting function and appearance of a rain garden. Maintenance protects the owner's financial investment of installing a rain garden and prevents costly rehabilitation.

Typical maintenance includes pulling weeds, pruning plants, replanting, mulching, and removing sediment and debris. This chapter includes guidance for important points of inspection and maintenance tasks that will need to be performed in order to keep the rain garden functioning properly and looking great. A maintenance checklist is provided in Appendix J of this guide. Consider the following quick tips:

Photo: Elizabeth Bella, AECOM

Quackgrass is a weed that can appear in rain gardens.

- **Get familiarized with your rain garden plants.** When plants are young, take photos and make your own plant ID book for your garden. Throughout the year, take photos at different points of maturity for reference so that you can easily distinguish your rain garden plants from weeds.
- **Monitor the rain garden for standing water after 24 hours of a rainfall event.** If rainwater is still standing after 24 hours, it may be an indicator that the rain garden is not functioning properly.
- **Supplement plantings as needed.** Be prepared to replant or replace some plants over the course of the first two to three years. Some species may not survive due to extreme weather conditions or may spread too rapidly.
- **Be prepared to manage leaves.** Excess leaves could clog the delivery of rainfall runoff to the garden, smother plants, and impact infiltration.
- **Gutters should be cleaned out regularly.** Any downspouts or drainpipes that deliver rainwater to the rain garden should be cleaned out to avoid backups.

Protecting Newly Established Plants

Rain gardens are designed to pond water for a short period of time. However, ponded water can be harmful to newly established plants after construction of the rain garden is complete. For that reason, some rain gardens are kept "offline", which means that rainwater is temporarily redirected away from the rain garden. Downspouts designed to direct rainwater to the rain garden are not connected to the rain garden temporarily. If the rain garden is designed to take street runoff, cut curbs after plants are established.

Photo: Polk SWCD

Downspout disconnected to temporarily have rain garden "offline".

Photo: Polk SWCD

This rain garden is online with downspouts connected to underground drain pipe.

Keeping rain gardens "offline" prevents young plants from receiving too much water if heavy rainstorms occur. However, during the first few months be prepared to water a rain garden if timely rainfall does not occur. Water at least once a week if it does not rain at least one inch per week. Monitor rainfall using a simple rain gauge and observe how much rainwater is reaching the rain garden during rainfall events.

In general, rain gardens featuring plants native to Iowa should not require extensive maintenance once plants are fully established. This typically takes three or four years. Reducing long-term maintenance can be minimized if weeds are diligently pulled during the first few years. This is because weeds will not compete well against vigorous, deep-rooted native species.

"Is that a native plant or a weed?"

To assist homeowners with plant and weed identification for rain gardens installed with native species, the Iowa Stormwater Education Partnership (ISWEP) has created a pocket-size field guide for quick reference. Contact ISWEP to inquire about ordering hard copies. A free, complimentary mobile application is also available for download in the Google Play Store and the Apple App Store. Scan the QR code to download today! More detailed information can be found on www.IowaStormwater.org. Other mobile apps are available, too, that can identify a plant by taking a photo of it.

Inspection Points and Maintenance Tasks

Inlet and Pre-Treatment Area (If Installed). Once a month during the growing season and after major storm events, inspect the area for excessive deposition of sediment and debris and signs of erosion and scouring. Checking these areas is especially important during the spring and fall.

- ☐ Remove litter, trash, debris, and sediment to prevent water from bypassing designated inlets and pre-treatment areas.
- ☐ Sod or native pre-vegetated mats can be installed on larger projects to prevent erosion in pre-treatment areas. They can also save on labor for weeding.

Photo: ISWEP

Grass filter strip used for pre-treatment area.

Base of Rain Garden. Check for ponded water 24 hours after a rainfall event. Ponded water for extended periods of time is an indicator that soils may have become plugged with sediment or heavily compacted due to human, animal, or vehicle traffic. This will prevent rainwater from effectively draining.

Photo: Polk SWCD

Rain garden showing temporary ponding after a rainfall event.

Check for fallen leaves and debris during the growing season and after major storms. Inspect distribution of mulch inside the rain garden and along slopes. Mulch and debris can smother plants and restrict growth if it becomes too concentrated.

- ☐ Remove litter, trash, leaves, and debris from the base of the rain garden.
- ☐ Spread shredded hardwood mulch evenly throughout the entire rain garden area. Mulch should be two to three inches thick.
- ☐ Clean out any debris and recheck drainage. If standing water is still present after 24 hours, the soils in the base of the garden may have to be replaced with amended soils. For this process, excavate and remove six or more inches of soil and replace with amended soil. In some cases, punching a few holes in the base of the rain garden with a post hole digger will suffice. Fill the holes with topsoil and cover with mulch.

Photo: Polk SWCD

Ensure rain gardens drain within 24 hours.

Newly Established / Young Plants and Trees. Young plants may be impacted if too much water or not enough water is entering the rain garden. Wilting of leaves is a good indicator of issues.

- [ ] Check for at least 75 percent vegetative cover upon establishment of new plants at the end of the first growing season. A healthy rain garden should have complete vegetative cover after the end of the third growing season.

- [ ] Remove dead vegetation during the spring or fall. Replant as needed to maintain desired vegetative cover in the rain garden. It is recommended during a fall cutback that some plants remain as winter habitat for pollinators. Some plants can also remain over winter based on personal aesthetic preferences.

Photo: Polk SWCD

Plugs recently planted in an enhanced rain garden.

- [ ] Pull weeds monthly during the first three years after installation. Reducing weed competition early and getting plants well established is needed to reduce maintenance over time.

Established / Mature Plants and Trees. Inspect older plants if they appear "leggy" or floppy or portions are dead. Inspect the base of mature plants and trees for undesired saplings.

Photo: Polk SWCD

Well established enhanced rain garden.

- [ ] Mature non-native plants may be "deadheaded", which is the act of cutting off the old flower heads after a plant is done blooming. Deadheading can be used for most flowering plants and some perennials.

- [ ] Pruning of mature trees and shrubs should be completed in the fall or early winter. If plants are getting overgrown, some plants can be easily split and placed elsewhere in the rain garden to fill in bare spots. However, native plants have long roots, so transplanting may not be an option.

Photo: ISWEP

Removing unwanted tree saplings.

- [ ] Replace diseased or dead plants. Remove basal shoots, root suckers, and volunteer trees close to the ground. Herbicide treatment may also be necessary. If volunteer trees are a big problem, stump killer can be put on cut tree stumps to restrict growth.

Overflow Structure (Enhanced Rain Gardens Only). Inspect the overflow structure and grate for obstructions preventing flow into the pipe. Inspect where the structure daylights to ensure the animal guard is in place and clear of debris.

- [ ] Remove debris and trash from the grate or within the overflow pipe as needed.

Berm and Retaining Wall. Check on the notch in the downslope berm for overflow from large events. Look for evidence of scour there as well as on the discharge area. These areas may have to be revegetated or reinforced with rocks. Eroded sections of berms can also allow water to enter or exit the rain garden at unintended points that are not stabilized adequately.

- [ ] Rebuild and compact berms that have sunk from erosion or natural settling.
- [ ] For failing retaining walls, remove bricks or rock and level the trench area. Place bricks on paver sand or pea gravel and re-level. A drainage pipe may be needed behind taller retaining walls to prevent bricks from dislodging, which can be caused by drainage issues.

A Note on Wildlife

Just like a typical flower or vegetable garden, rain gardens can attract birds, deer, and rabbits. Plugs and small plants are especially vulnerable and will need protection until they mature. In the first few years after installation, a fence or other barrier may be needed to keep wildlife out of the rain garden. Where this may be a continuous issue, homeowners should consider selecting plants that aren't preferred by wildlife.

Final Considerations

The most common mistake identified by owners of rain gardens is insufficiently weeding the first year after installation. Annual weeds that are not pulled will re-seed rapidly, creating an unkept looking rain garden. In the end, rain gardens are a functional stormwater practice that also provides aesthetic appeal. If routine maintenance is an obstacle, a rain garden may not be the appropriate practice. Consider other practices such as soil quality restoration that has limited maintenance requirements.

The installation of one rain garden by one homeowner will not have major impacts on reducing hydrologic instability and water quality problems that are present in Iowa. However, the cumulative effect of individual actions can create tangible improvements in local water quality, localized flooding, and streambank stability.

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Appendix

- Appendix A: Native and Non-Native Plants Lists
- Appendix B: Sample Plant Layouts
- Appendix C: Infiltration Rates for Natural Soil Types
- Appendix D: Soil Amendment Basics
- Appendix E: Design Review Checklists
- Appendix F: Sizing Worksheet
- Appendix G: Cross Sections
- Appendix H: Materials Lists
- Appendix I: Project Notes and Grid Sheet
- Appendix J: Maintenance Checklist

If you are planning to construct a basic or enhanced rain garden on your property and are applying for cost-share funding through a local municipality, SWCD, IDNR, or IDALS, a packet of required paperwork (based on the appendices in this guide) can be downloaded at the following link. Most forms are "fillable" and can be completed digitally. Contact your local municipality before completing any forms as they may use their own.

https://iowastormwater.org/rainscaping/rain-gardens/

Native and Non-Native Plants Lists

This appendix provides information on plant species that are well-suited to rain gardens in Iowa. This list is not exhaustive of all native and non-native plants suitable for rain gardens. It is provided to give homeowners and contractors recommendations for plants based on site conditions such as sun exposure and soil moisture.

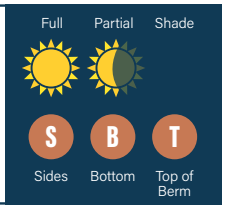
In addition to an image of each plant, the following characteristics are provided:

- **Common and scientific name.** Common names are given to plants regionally and can vary. Scientific names are given to plants in Latin, which is generally agreed upon nationally to avoid confusion with multiple common names for the same plant. A nursery may ask for a plant's scientific name to ensure the correct plant is being ordered.
- **Height.** Predicted height of the fully grown plant.
- **Soil moisture.** Four soil moisture classifications are provided in this guide: wet, moist, mesic, and dry. Soil moisture correlates to both soil type and the plant's location within a rain garden (see below). Mesic soils refer to areas that have average moisture content, neither constantly moist or dry.
- **Bloom period and color.** Average time range when plant provides the majority of blooms and generalized color.
- **Sun exposure.** "Full" exposure is typically considered as at least 6 hours of direct sunlight per day. "Partial" exposure is defined as between 3 and 6 hours of direct sunlight per day, or filtered sunlight all day. "Shade" exposure is less than 3 hours of direct sunlight per day.
- **Location within rain garden.** Placement relates to how much moisture is available to the plant based on its location in the rain garden. Moisture depends on the natural soils at the site and if soil amendments are made. This guide provides 3 locations: in the bottom of the rain garden, along the sides (side slopes or along the perimeter), and on top of the berm (if installed). Plants that can sustain temporary periods of pondings will be more successful in the bottom of the rain garden whereas plants favoring dryer conditions are recommended on top of the rain garden's berm.

Native Iowa Forbs

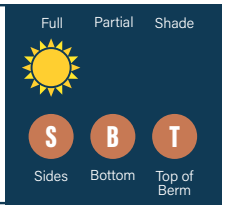
Anemone, Canada *Anemone canadensis*

Height: 6" - 12"
Bloom Period: May - June
Moisture: Moist to Dry
Bloom Color: White
Comments: Will spread easily in the right conditions



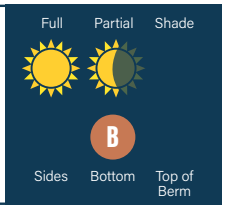
Aster, Smooth Blue *Symphyotrichum laeve*

Height: 24" - 36"
Bloom Period: August - October
Moisture: Moist to Dry
Bloom Color: Purple
Comments: Spreads slowly, will persist for many years



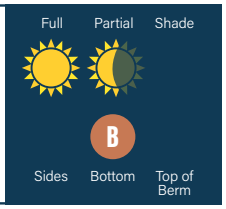
Beardtongue, Foxglove *Penstemon digitalis*

Height: >36"
Bloom Period: May - June
Moisture: Moist to Mesic
Bloom Color: White
Comments: Clump-forming perennial, somewhat aggressive spreader



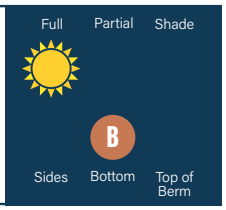
Bergamot, Wild *Monarda fistulosa*

Height: 12" - 36"
Bloom Period: June - August
Moisture: Mesic
Bloom Color: Pink
Comments: Spreads easily; divide every 2-3 years



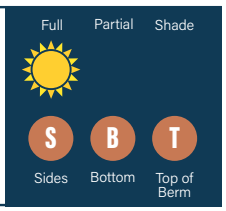
Blazing Star, Button (Rough) *Liatris aspera*

Height: 24" - 36"
Bloom Period: July - September
Moisture: Mesic to Dry
Bloom Color: Purple
Comments: Rounded bracts give "rough" characteristic



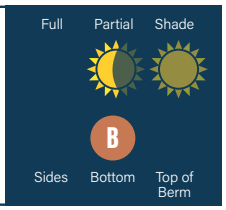
Blazing Star, Prairie *Liatris pycnostachya*

Height: 24" - 36"
Bloom Period: July - September
Moisture: Mesic to Dry
Bloom Color: Purple
Comments: Blooms begin at top and work down



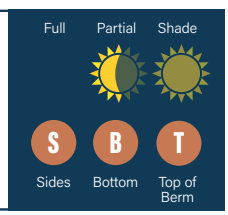
Bloodroot *Sanguinaria canadensis*

Height: 6" - 12"
Bloom Period: March - April
Moisture: Wet to Moist
Bloom Color: White
Comments: Nice groundcover beneath trees



Bluebells, Virginia *Mertensia virginica*

Height: 12" - 24"
Bloom Period: April - May
Moisture: Wet to Moist
Bloom Color: Blue
Comments: Fast growing, flowers start pink then slowly turn blue



Clover, Purple Prairie *Dalea purpurea*

Height: 12" - 24" Bloom Period: July - September
Moisture: Mesic to Dry Bloom Color: Purple
Comments: Long-lived plant tolerant of heat and drought

Columbine, American *Aquilegia canadensis*

Height: 12" - 24" Bloom Period: April - June
Moisture: Moist to Mesic Bloom Color: Red, Yellow
Comments: Suitable in a variety of soils, locations, and sun conditions

Coneflower, Gray-headed Prairie *Ratibida pinnata*

Height: >36" Bloom Period: June - September
Moisture: Moist to Mesic Bloom Color: Yellow
Comments: Showy plant that prefers competition in small areas

Coneflower, Orange *Rudbeckia fulgida*

Height: >36" Bloom Period: July - September
Moisture: Moist to Dry Bloom Color: Orange
Comments: Long blooming season with vibrant color

Coneflower, Pale Purple *Echinacea pallida*

Height: 24" - 36" Bloom Period: July - September
Moisture: Moist to Mesic Bloom Color: Purple
Comments: Regarded as an important prairie forb

Coneflower, Purple *Echinacea purpurea*

Height: 24" - 36"+ Bloom Period: July - Septmber
Moisture: Moist to Mesic Bloom Color: Pink
Comments: Long lasting color, will reseed itself

Coreopsis, Prairie *Coreopsis palmata*

Height: 12" - 36" Bloom Period: June - August
Moisture: Mesic to Dry Bloom Color: Yellow
Comments: Good nectar source for pollinators

Dutchman's Breeches *Dicentra cucullaria*

Height: 6" - 12" Bloom Period: April - May
Moisture: Moist to Mesic Bloom Color: White
Comments: Flowers will wilt immediately upon touch

Gentian, Cream *Gentiana flavida*

Height: 12" - 24" Bloom Period: August - September
Moisture: Moist to Mesic Bloom Color: Yellowish, White
Comments: Distinct "closed mouth", bottle-shaped flowers

Full Partial Shade
S B T
Sides Bottom Top of Berm

Gentian, Bottle *Gentiana andrewsii*

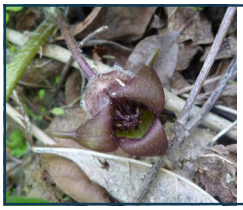
Height: 12" - 24" Bloom Period: August - September
Moisture: Most to Mesic Bloom Color: Blue
Comments: Distinct "closed mouth", bottle-shaped flowers

Full Partial Shade
S B T
Sides Bottom Top of Berm

Geranium, Wild *Geranium maculatum*

Height: 12" - 24" Bloom Period: May - June
Moisture: Moist to Mesic Bloom Color: Pink
Comments: Will spread easily in the right conditions

Full Partial Shade
S B T
Sides Bottom Top of Berm



Ginger, Wild *Asarum canadense*

Height: 6" - 12" Bloom Period: April - May
Moisture: Wet to Mesic Bloom Color: Purple, Brown
Comments: Low growing, spreading plant with heart-shaped leaves

Full Partial Shade
S B T
Sides Bottom Top of Berm

Golden Alexander *Zizia aurea*

Height: 24" - 36" Bloom Period: May - June
Moisture: Moist to Mesic Bloom Color: Yellow
Comments: Long blooming period starting earlier than most forbs

Full Partial Shade
B
Sides Bottom Top of Berm

Iris, Blue Flag *Iris versicolor*

Height: 24" - 36" Bloom Period: May - June
Moisture: Wet to Mesic Bloom Color: Blue, Purple
Comments: Clumps spread slowly by rhizomes (horizontal roots)

Full Partial Shade
S B
Sides Bottom Top of Berm

Jacobs Ladder *Polemonium reptans*

Height: 12" - 24" Bloom Period: April - June
Moisture: Wet to Mesic Bloom Color: Blue
Comments: Will self-seed in optimal conditions

Full Partial Shade
S
Sides Bottom Top of Berm

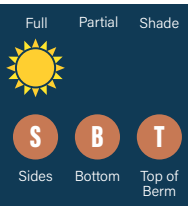
Lobelia, Great Blue *Lobelia siphilitica*

Height: 24" - 36" Bloom Period: July - October
Moisture: Wet to Mesic Bloom Color: Blue
Comments: Clumps can be divided in the spring as desired

Full Partial Shade
S B T
Sides Bottom Top of Berm

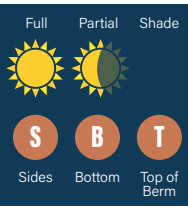
Loosestrife, Prairie *Lysimachia quadriflora*

Height: 12" - 24"
Bloom Period: July - August
Moisture: Wet to Moist
Bloom Color: Yellow
Comments: Prefers consistently moist conditions



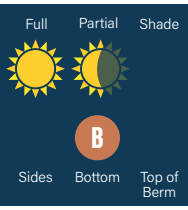
Milkweed, Butterfly *Asclepias tuberosa*

Height: 12" - 24"
Bloom Period: June - September
Moisture: Mesic to Dry
Bloom Color: Orange
Comments: Favorite of the Monarch butterfly



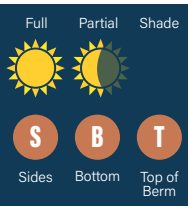
Milkweed, Common *Asclepias syriaca*

Height: >36"
Bloom Period: June - August
Moisture: Wet to Mesic
Bloom Color: Pink
Comments: Fragrant blooms, one of the easiest milkweeds to grow



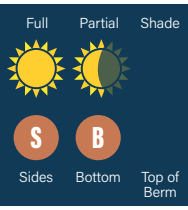
Mint, Virginia Mountain *Pycnanthemum virginianum*

Height: 12" - 24"
Bloom Period: June - August
Moisture: Moist to Dry
Bloom Color: White
Comments: Petals are spotted with purple flecks



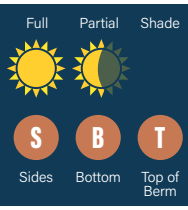
Monkey Flower *Mimulus ringens*

Height: 24" - 24"
Bloom Period: June - August
Moisture: Wet to Moist
Bloom Color: Purple
Comments: Plant size depends heavily on moisture suitability



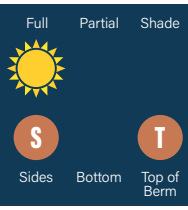
Onion, Nodding *Mertensia virginica*

Height: 6" - 24"
Bloom Period: July - August
Moisture: Mesic
Bloom Color: White, Pink
Comments: Most effectively planted in small groups



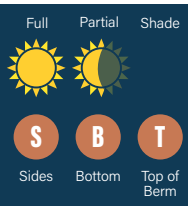
Petunia, Wild *Ruellia humilis*

Height: 12" - 24"
Bloom Period: June - August
Moisture: Mesic to Dry
Bloom Color: Purple
Comments: Nice border plant but watch for aggressive spreading



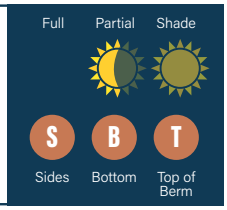
Phlox, Prairie *Phlox pilosa*

Height: 12" - 24"
Bloom Period: May - June
Moisture: Moist to Mesic
Bloom Color: Pink
Comments: Fragrant flower, rounded clusters, and a butterfly favorite



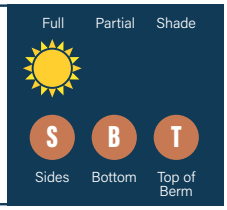
Phlox, Woodland *Phlox divaricata*

Height: 12" - 24" Bloom Period: June - August
Moisture: Moist to Mesic Bloom Color: Purple
Comments: Excellent ground cover in shady areas



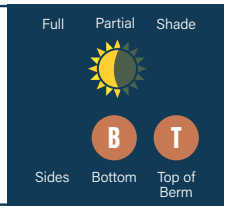
Prairie Smoke *Geum triflorum*

Height: 6" - 12" Bloom Period: April - May
Moisture: Mesic to Dry Bloom Color: Pink
Comments: Nodding flowers arrive early in the spring



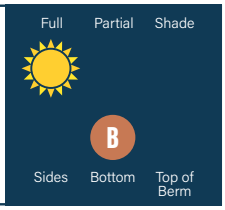
Shooting Star *Dodecatheon meadia*

Height: 6" - 12" Bloom Period: April - June
Moisture: Wet to Mesic Bloom Color: Pink
Comments: Short lived perennial, does not produce flowers in first year



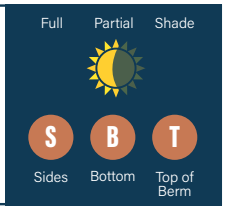
Sneezeweed *Helenium autumnale*

Height: 12" - 36+" Bloom Period: August - October
Moisture: Wet to Moist Bloom Color: Yellow
Comments: Divide every 3-4 years to maintain vigor



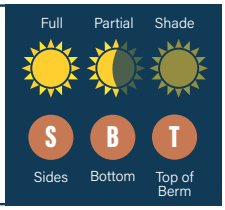
Solomon's Seal *Polygonatum biflorum*

Height: 12" - 24" Bloom Period: April - May
Moisture: Moist to Mesic Bloom Color: White
Comments: Unique flowers that hang from underside of stem



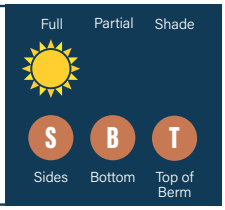
Spiderwort, Ohio *Tradescantia ohioensis*

Height: 24" - 36" Bloom Period: May - July
Moisture: Moist to Mesic Bloom Color: Blue
Comments: Flowers open early morning and will shrivel if touched



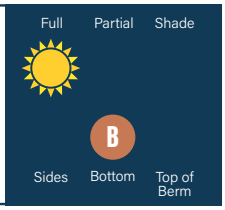
Spiderwort, Prairie *Tradescantia bracteata*

Height: 12" - 24" Bloom Period: May - June
Moisture: Mesic to Dry Bloom Color: Blue, Purple
Comments: Long-bract flowers close by midday and last only one day



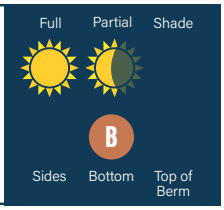
Susan, Black-eyed *Rudbeckia hirta*

Height: 12" - 36" Bloom Period: June - September
Moisture: Mesic to Dry Bloom Color: Yellow
Comments: Short-lived perennial, reseeds itself



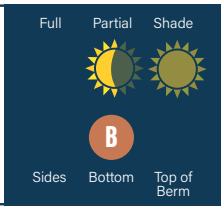
Susan, Brown-eyed *Rudbeckia triloba*

Height: 12" - 36" Bloom Period: June - September
Moisture: Mesic to Dry Bloom Color: Yellow
Comments: Will naturalize by self-seeding, even with die out



Sweet William, Wild *Phlox maculata*

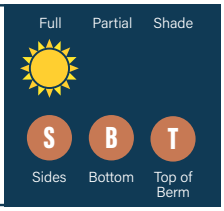
Height: 12" - 36" Bloom Period: May - June
Moisture: Mesic to Dry Bloom Color: Purple, Brown
Comments: Flowers are slightly fragrant, rabbits tend to like it



Native Iowa Grasses, Sedges, and Ferns

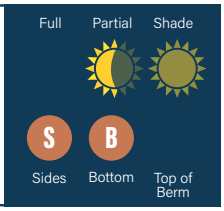
Blue Grama *Bouteloua gracilis*

Height: 6" - 12" Bloom Period: July - September
Moisture: Mesic to Dry Bloom Color: Green, Blue
Comments: Can be planted as turf grass mixed with Buffalograss



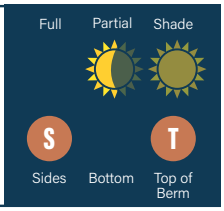
Fern, Lady *Athyrium Filix-femina*

Height: 12" - 36" Bloom Period: N/A
Moisture: Moist to Mesic Bloom Color: Green, Purple (Fronds)
Comments: Deciduous fern will drop its leaves with first frost



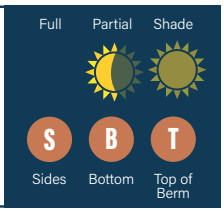
Fern, Interrupted *Osmunda claytoniana*

Height: >36" Bloom Period: June - August
Moisture: Moist to Dry Bloom Color: Brown (Spores)
Comments: Easy to cultivate



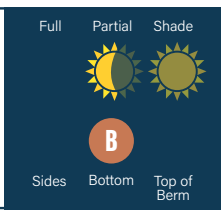
Fern, Maidenhair *Adiantum pedatum*

Height: 6" - 12" Bloom Period: Not Applicable
Moisture: Moist Bloom Color: Green (Fronds)
Comments: Delicate, dark stems



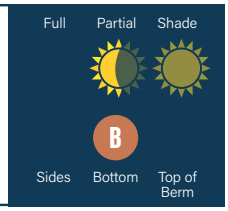
Fern, Ostrich *Matteuccia struthiopteris*

Height: 12" - 24" Bloom Period: June - September
Moisture: Wet to Mesic Bloom Color: Green (Fronds)
Comments: Fronds will persist through the winter



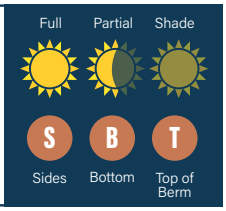
Grass Bottlebrush *Hystrix patula*

Height: 12" - 36" Bloom Period: August - September
Moisture: Mesic to Dry Bloom Color: Green, Brown
Comments: Cool season, clumping grass best in light shade



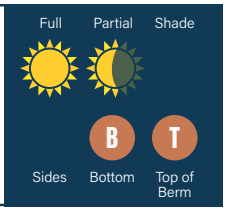
June Grass *Koeleria macrantha*

Height: 12" - 24" Bloom Period: June - July
Moisture: Mesic to Dry Bloom Color: Green
Comments: Requires good drainage conditions



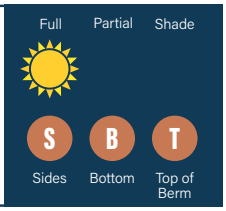
Little Bluestem *Schizachyrium scoparium*

Height: 24" - 36" Bloom Period: July - October
Moisture: Moist to Dry Bloom Color: Green, Blueish
Comments: Forms in dense mounds, colors remain over winter



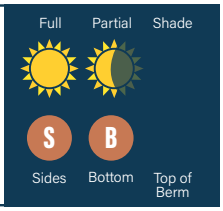
Prairie Dropseed *Sporobolus heterolepis*

Height: 12" - 24" Bloom Period: August - October
Moisture: Moist to Dry Bloom Color: Green, Cream
Comments: Produces good nourishment for seed eating birds



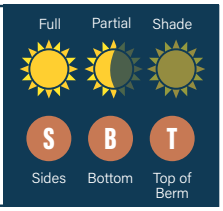
Sedge, Brown Fox *Carex vulpinoidea*

Height: 24" - 36" Bloom Period: June - July
Moisture: Wet to Mesic Bloom Color: Green
Comments: Can spread easily and appear weedy



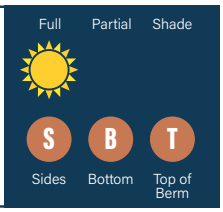
Sedge, Common Wood *Carex blanda*

Height: 12" - 36" Bloom Period: May - June
Moisture: Wet to Mesic Bloom Color: Green
Comments: Versatile and low-profile



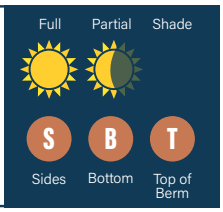
Sideoats Grama *Bouteloua curtipendula*

Height: 12" - 24" Bloom Period: August - September
Moisture: Mesic to Dry Bloom Color: Purple, Green
Comments: Bracts hang from one side of stem



Switchgrass *Panicum virgatum*

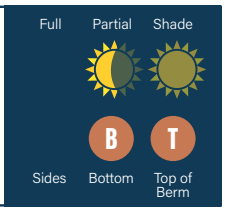
Height: >36" Bloom Period: July - September
Moisture: Moist to Dry Bloom Color: Pinkish
Comments: Can spread easily, take over other plants if not managed



Non-Native Plants

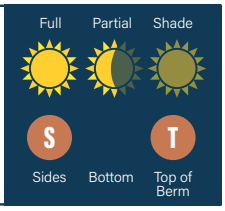
Astilbe, Chinese *Astilbe chinensis 'Pumila'*

Height: 6" - 24"
Bloom Period: July - August
Moisture: Moist to Mesic
Bloom Color: Pink
Comments: Provides ornamental interest even after bloom



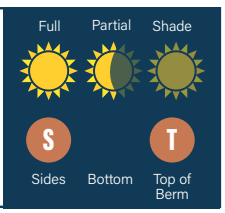
Coralbells, Brandon Pink *Heuchera 'Brandon Pink'*

Height: 6" - 24"
Bloom Period: June - September
Moisture: Moist to Mesic
Bloom Color: Pink
Comments: Bright display of color, attractive to hummingbirds



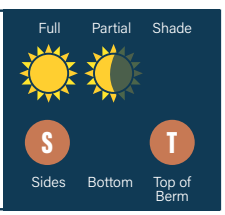
Coralbells, Plum Pudding *Heuchera 'Plum Pudding'*

Height: 12" - 36"
Bloom Period: June - September
Moisture: Moist to Mesic
Bloom Color: White
Comments: Small white flowers arise from deep purple foliage



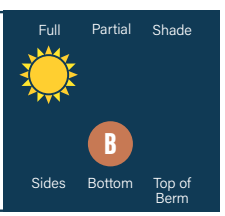
Coreopsis, Threadleaf *Coreopsis verticillata*

Height: 24" - 36"
Bloom Period: May - July
Moisture: Moist to Dry
Bloom Color: Gold, Yellow
Comments: Low maintenance, rapid growth perennial



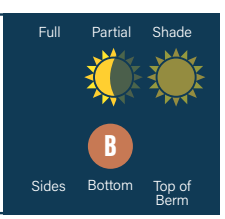
Feather Reed Grass *Calamagrostis acutiflora 'Karl Forester'*

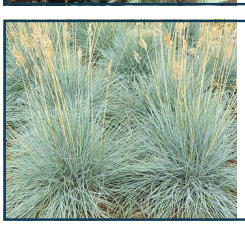
Height: >36"
Bloom Period: May - February
Moisture: Wet to Moist
Bloom Color: Purple, Pinkish
Comments: Nice backdrop to shorter perennials



Fern, Japanese Painted *Athyrium niponicum pictum*

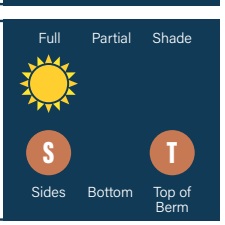
Height: 12" - 24"
Bloom Period: N/A
Moisture: Moist to Mesic
Bloom Color: Gray, Burgundy (Fronds)
Comments: Fronds provide colorful array of ground coverage

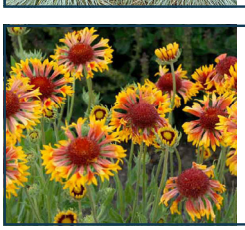




Fescue, Elijah Blue *Festuca glauca 'Elijah Blue'*

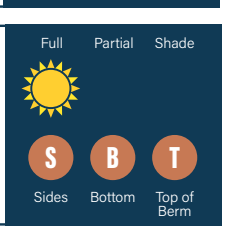
Height: 6" - 12"
Bloom Period: June - July
Moisture: Moist to Mesic
Bloom Color: Light Green, Purple
Comments: Attractive border plant, does not spread outward easily





Gaillardia, Fanfare *Gaillardia x grandiflora 'Fanfare'*

Height: 12" - 24"
Bloom Period: June - September
Moisture: Moist to Mesic
Bloom Color: Orange
Comments: Removing fading flowers can encourage more blooms



Hosta, Everlasting Love *Hosta 'Everlasting Love'*

Height: 6" - 12" Bloom Period: July - August
Moisture: Moist to Mesic Bloom Color: Lavender
Comments: Forms hardy and low-maintenance clumps

Full Partial Shade
S B T
Sides Bottom Top of Berm

Hosta, Shirley Levy *Hosta 'Shirley Levy'*

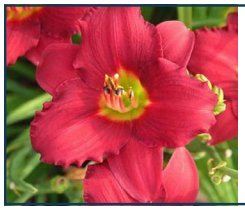
Height: 12" - 24" Bloom Period: July - August
Moisture: Moist to Mesic Bloom Color: Lavender
Comments: Greenish-yellow foliage

Full Partial Shade
S B T
Sides Bottom Top of Berm

Iris, Siberian *Iris sibirica*

Height: 12" - 36" Bloom Period: May - June
Moisture: Moist to Mesic Bloom Color: Purple, Blue
Comments: Long-lasting blooms, foliage remains after blooms die off

Full Partial Shade
B T
Sides Bottom Top of Berm



Lily, Pardon Me *Hemerocallis 'Pardon Me'*

Height: 12" - 24" Bloom Period: July - September
Moisture: Moist to Mesic Bloom Color: Red
Comments: Attractive to butterflies and hummingbirds

Full Partial Shade
B T
Sides Bottom Top of Berm

Lily, Rocket City *Hemerocallis 'Rocket City'*

Height: 12" - 24" Bloom Period: July - September
Moisture: Moist to Mesic Bloom Color: Yellow, Orange
Comments: Extended daily bloom time of 16 or more hours

Full Partial Shade
B T
Sides Bottom Top of Berm

Lily, Stella De Oro Day *Hemerocallis 'Stella de Oro'*

Height: 12" - 24" Bloom Period: June - August
Moisture: Moist to Mesic Bloom Color: Orange
Comments: Spent flowers can be deadheaded daily

Full Partial Shade
B T
Sides Bottom Top of Berm

Salvia, May Night *Salvia nemorosa 'May Night'*

Height: 12" - 24" Bloom Period: May - August
Moisture: Moist to Mesic Bloom Color: Purple, Blue
Comments: Blooms vigorously with routine watering

Full Partial Shade
S T
Sides Bottom Top of Berm

Silver Grass, Variegated *Miscanthus sinensis 'Variegatus'*

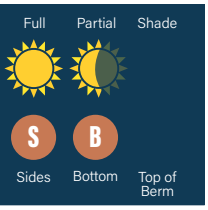
Height: >36" Bloom Period: September - October
Moisture: Moist to Dry Bloom Color: White
Comments: Plumes can extend as tall as 8 feet

Full Partial Shade
S B
Sides Bottom Top of Berm

Native Trees and Shrubs

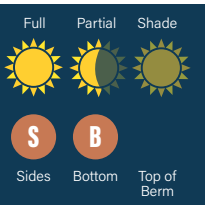
Dogwood, Red Osier *Cornus sericea*

Height: 6' - 12'
Bloom Period: May - June
Moisture: Moist to Mesic
Bloom Color: White
Comments: Very conspicuous red branches in winter



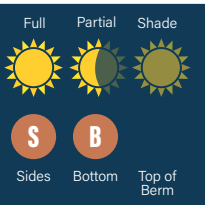
Redbud, Eastern *Cercis canadensis**

Height: 15' - 30'
Bloom Period: March - May
Moisture: Moist to Mesic
Bloom Color: Pink
Comments: Short trunk, spreading branches, umbrella-like crown



Serviceberry, Canadian *Amelanchier canadensis*

Height: 6' - 20'
Bloom Period: April - May
Moisture: Wet to Moist
Bloom Color: White
Comments: Lasting fall foliage is orange to rusty-red

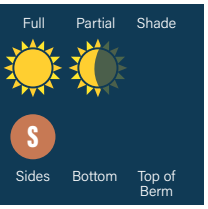


** More winter-hardy strains have been developed in Minnesota. For more information, visit: https://bit.ly/2JHpe7a*

Non-Native Trees and Shrubs

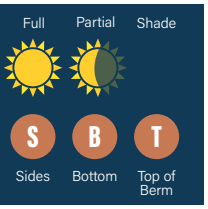
Dogwood, Pagoda *Cornus alternifolia*

Height: 15' - 25'
Bloom Period: May - June
Moisture: Moist to Mesic
Bloom Color: Yellow, White
Comments: Distinctive "layered" horizontal branching



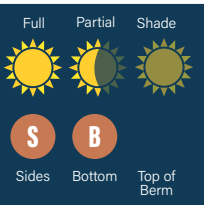
Hydrangea, 'Blushing Bride' *Hydrangea macrophylla*

Height: 3' - 6'
Bloom Period: June - September
Moisture: Moist to Mesic
Bloom Color: White
Comments: Prefers some shade, especially during hot dry spells



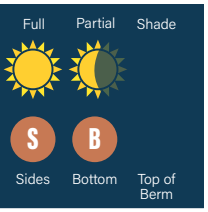
Snowberry, Magic Berry *Symphoricarpos doorenbosii*

Height: 4' - 6'
Bloom Period: March - June
Moisture: Moist to Mesic
Bloom Color: Pink, Red
Comments: Provides nice winter interest



Virburnum, Nannyberry *Viburnum lentago*

Height: 8' -16' (as shrub)
Bloom Period: May - June
Moisture: Moist to Mesic
Bloom Color: White
Comments: Produces edible fruits often used in jams and jellies



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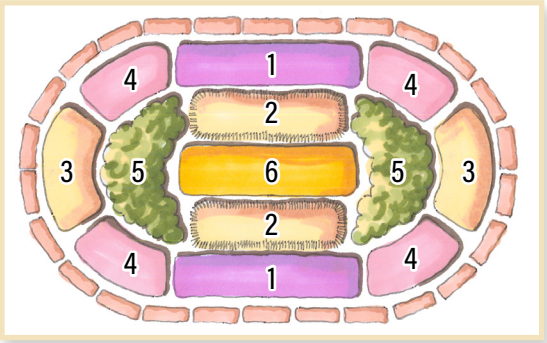
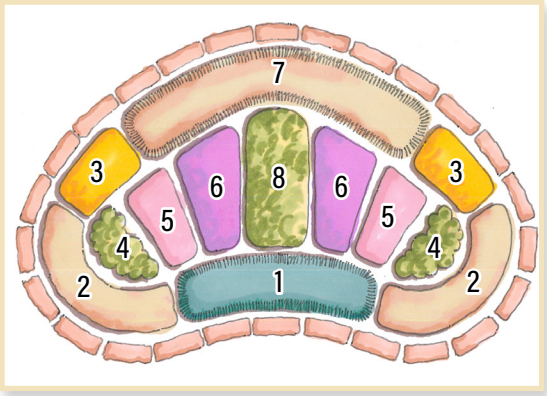
1. Anemone, Canada: Rob Routledge, Sault College, Bugwood.org
2. Aster, Smooth Blue: Katy Chayka, www.minnesotawildflowers.info, Bugwood.org
3. Beardtongue, Foxglove: Jennifer Welch, Polk County Soil and Water Conservation District
4. Bergamot, Wild: Elmer Verhasselt, Bugwood.org
5. Blazing Star, Button (Rough): John D. Byrd, Mississippi State University, Bugwood.org
6. Blazing Star, Prairie: William M. Ciesla, Forest Health Management International, Bugwood.org
7. Bloodroot: Joseph OBrien, USDA Forest Service, Bugwood.org
8. Bluebells, Virginia: Chris Evans, University of Illinois, Bugwood.org
9. Clover, Purple Prairie: Peter Dziuk, Minnesota Department of Agriculture, Bugwood.org
10. Columbine, American: Rob Routledge, Sault College, Bugwood.org
11. Coneflower, Gray-headed Prairie: Derek Namanny, Iowa Department of Agriculture, Bugwood.org
12. Coneflower, Orange: Dow Gardens , Dow Gardens, Bugwood.org
13. Coneflower, Pale Purple: Chris Evans, University of Illinois, Bugwood.org
14. Coneflower, Purple: John Ruter, University of Georgia, Bugwood.org
15. Coreopsis, Prairie: Katy Chayka, www.minnesotawildflowers.info, Bugwood.org
16. Dutchmans Breeches: David Cappaert, Bugwood.org
17. Gentian, Cream: Peter Dziuk, Minnesota Department of Agriculture, Bugwood.org
18. Gentian, Bottle: Steven Katovich, Bugwood.org
19. Geranium, Wild: Ansel Oommen, Bugwood.org
20. Ginger, Wild: Karan A. Rawlins, University of Georgia, Bugwood.org
21. Golden Alexander: Ansel Oommen, Bugwood.org
22. Iris, Blue Flag: Elmer Verhasselt, Bugwood.org
23. Jacobs Ladder: Chris Evans, University of Illinois, Bugwood.org
24. Lobelia, Great Blue: Rob Routledge, Sault College, Bugwood.org
25. Loosestrife, Prairie: Vern Wilkins, Indiana University, Bugwood.org
26. Milkweed, Butterfly: David Cappaert, Bugwood.org
27. Milkweed, Common: Ansel Oommen, Bugwood.org
28. Mint, Virginia Mountain: Katy Chayka, www.minnesotawildflowers.info, Bugwood.org
29. Monkey Flower: Ansel Oommen, Bugwood.org
30. Onion, Nodding: William M. Ciesla, Forest Health Management International, Bugwood.org
31. Petunia, Wild: Rebekah D. Wallace, University of Georgia, Bugwood.org
32. Phlox, Prairie: Katy Chayka, www.minnesotawildflowers.info, Bugwood.org
33. Phlox, Woodland: Chris Evans, University of Illinois, Bugwood.org
34. Prairie Smoke: Dave Powell, USDA Forest Service (retired), Bugwood.org
35. Shooting Star: Jerry A. Payne, USDA Agricultural Research Service, Bugwood.org
36. Sneezeweed: Beverly Turner, Jackson Minnesota, Bugwood.org
37. Solomon's Seed: Charles T. Bryson, USDA Agricultural Research Service, Bugwood.org
38. Spiderwort, Ohio: Elizabeth Moss, West Virginia State University, Bugwood.org
39. Spiderwort, Prairie: Katy Chayka, www.minnesotawildflowers.info, Bugwood.org
40. Susan, Black-eyed: Rob Routledge, Sault College, Bugwood.org
41. Susan, Brown-eyed: Peter Dziuk, Minnesota Department of Agriculture, Bugwood.org
42. Sweet William, Wild: John Ruter, University of Georgia, Bugwood.org
43. Blue Grama: Dave Powell, USDA Forest Service (retired), Bugwood.org
44. Fern, Lady: Chris Evans, University of Illinois, Bugwood.org
45. Fern, Interrupted: Rob Routledge, Sault College, Bugwood.org
46. Fern, Maidenhair: Steven Katovich, Bugwood.org
47. Fern, Ostrich: Ansel Oommen, Bugwood.org
48. Grass Bottlebrush: Rob Routledge, Sault College, Bugwood.org
49. June Grass: Dave Powell, USDA Forest Service (retired), Bugwood.org
50. Little Bluestem: Rob Routledge, Sault College, Bugwood.org
51. Prairie Dropseed: Pat Sauer, Iowa Stormwater Education Partnership, Bugwood.org
52. Sedge, Brown Fox: Rob Routledge, Sault College, Bugwood.org
53. Sedge, Common Wood: Charles T. Bryson, USDA Agricultural Research Service, Bugwood.org
54. Sideoats Grama: Sideoats Grama: Pat Sauer, Iowa Stormwater Education Partnership, Bugwood.org
55. Switchgrass: John Ruter, University of Georgia, Bugwood.org
56. Astilbe, Chinese: http://www.missouribotanicalgarden.org.
57. Coralbells, Brandon Pink: https://vanstonenurseries.com/plants/brandon-pink-coral-bells/
58. Coralbells, Plum Pudding: https://www.gardenia.net/plant/heuchera-plum-pudding-coral-bells
59. Coreopsis, Threadleaf: Rebekah D. Wallace, University of Georgia, Bugwood.org
60. Fern, Japanese Painted: John Ruter, University of Georgia, Bugwood.org
61. Fescue, Elijah Blue: https://www.gardenia.net/plant/festuca-glauca-blue-fescue-grass
62. Gaillardia, Fanfare: https://www.gardenia.net/plant/gaillardia-grandiflora-fanfare
63. Hosta, Everlasting Love: David Husband, http://www.hostalibrary.org/e/everlastinglove.html
64. Hosta, Shirley Levy: Russ O'Hara, http://www.hostaregistrar.org/detail.php?id=4715
65. Iris, Siberian: Dow Gardens , Dow Gardens, Bugwood.org
66. Karl Forester's Feather Reed Grass: John Ruter, University of Georgia, Bugwood.org
67. Lilly, Stella De Oro Day: https://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=d160#AllImages
68. Pardon Me Daylily: https://www.gardenia.net/plant/hemerocallis-pardon-me-daylily
69. Rocket City Daylily: https://www.gardenia.net/plant/hemerocallis-rocket-city-daylily
70. Variegated Silver Grass: John Ruter, University of Georgia, Bugwood.org
71. Chokeberry, Black: John Ruter, University of Georgia, Bugwood.org
72. Dogwood, Redosier: Richard Webb, Bugwood.org
73. Redbud, Eastern: Carl Dennis, Auburn University, Bugwood.org
74. Serviceberry: Dow Gardens , Dow Gardens, Bugwood.org
75. Dogwood, Pagoda: Richard Webb, Bugwood.org
76. Hydrangea, Endless Summer 'Blushing Bride': https://www.whiteflowerfarm.com/63141-product.html
77. Snowberry, Magic Berry:https://landscapeplants.oregonstate.edu/plants/symphoricarpos-doorenbosii-magic-berry
78. Virburnum, Nannyberry: Dow Gardens , Dow Gardens, Bugwood.org

Native Plant Layouts for Sun

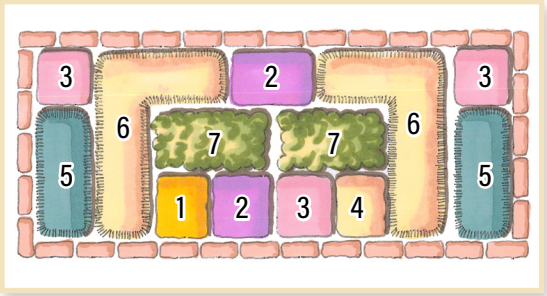
Primary species is provided in bold, followed by a substitution.



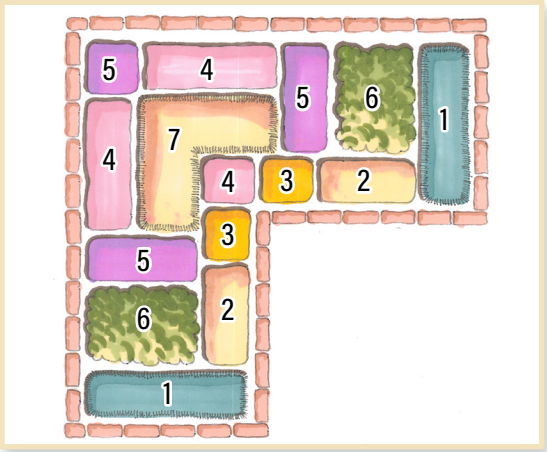
1. **Wild Geranium**, Prairie Smoke
2. **Prairie Dropseed**, Little Bluestem
3. **Bottle Gentian**, Smooth Blue Aster
4. **Foxglove Beardtongue**, Golden Alexander
5. **Monkey Flower**, Black-eyed Susan
6. **Pale Purple Coneflower**, Butterfly Milkweed



1. **Wild Sweet William,** Prairie Smoke
2. **Blue Gramma**, Prairie Dropseed
3. **Mountain Mint**, Purple Coneflower
4. **Black-eyed Susan**, Golden Alexander
5. **Butterfly Milkweed**, Ohio Spiderwort
6. **Prairie Blazing Star**, Grey-headed Coneflower
7. **Culvers Root**, Stiff Goldenrod
8. **Brown-eyed Susan**, Queen-of-the-Prairie



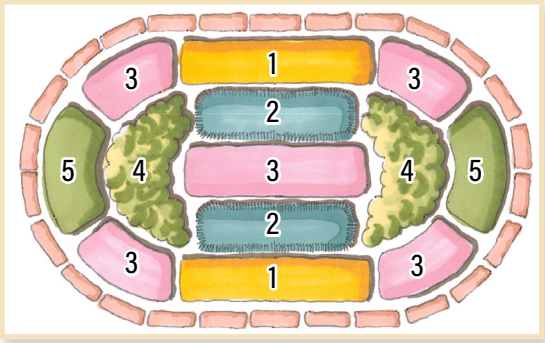
1. **Wild Sweet William**, Prairie Smoke
2. **Smooth Blue Aster**, Bottle Gentian
3. **Brown-eyed Susan**, Black-eyed Susan
4. **Wild Geranium**, Nodding Onion
5. **Foxglove Beardtongue**, Prairie Phlox
6. **Little Bluestem**, Prairie Dropseed
7. **Switchgrass**, Little Bluestem



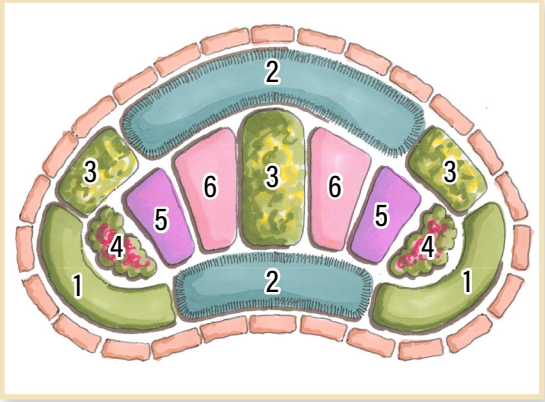
1. **Virginia Bluebells**, Prairie Smoke
2. **Smooth Blue Aster**, Bottle Gentian
3. **Wild Geranium**, Nodding Onion
4. **Monkey Flower**, Black-eyed Susan
5. **Foxglove Beardtongue**, Prairie Phlox
6. **Sideoats Grama**, Butterfly Millweed
7. **Rough Blazing Star**, Prairie Blazing Star

Native Plant Layouts for Shade

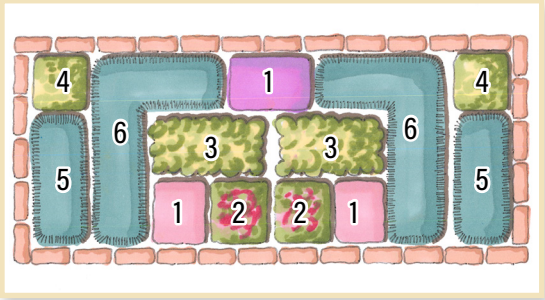
Primary species is provided in bold, followed by a substitution.



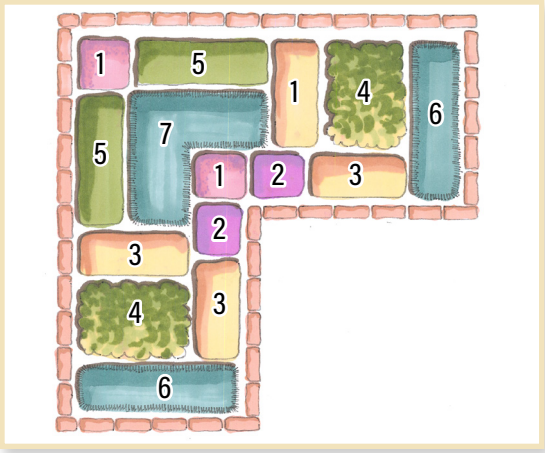
1. **Maidenhair Fern**, Prairie Smoke
2. **Bottlebrush Grass**, Common Wood Sedge
3. **Solomon's Seal**, Interrupted Fern
4. **Wild Geranium**, Jack-in-the-Pulpit
5. **Wild Ginger**, Columbine



1. **Bloodroot**, Wild Ginger
2. **Columbine**, Jacob's Ladder
3. **Fox Sedge**, Common Wood Sedge
4. **Virginia Bluebells**, Wild Geranium
5. **Maidenhair Fern**, Interrupted Fern
6. **Jack-in-the-Pulpit**, Ohio Spiderwort



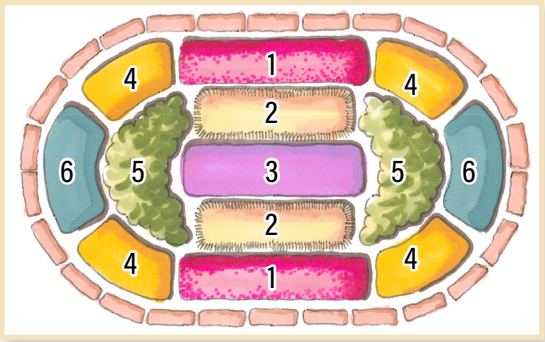
1. **Bloodroot**, Prairie Smoke
2. **Wild Ginger**, Dutchman's Britches
3. **Jacob's Ladder**, Columbine
4. **Lady Fern**, Interrupted Fern
5. **Wild Geranium**, Sweet William
6. **Solomon's Seal**, Jack-in-the-Pulpit



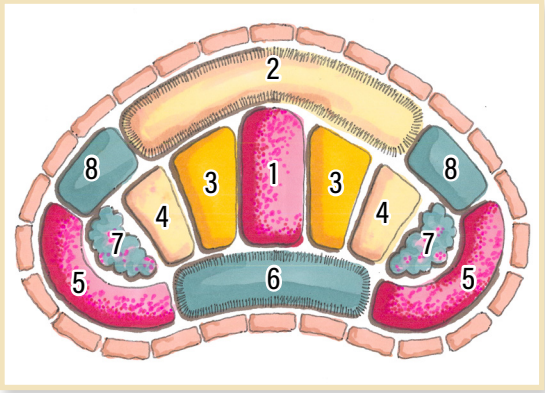
1. **Sweet William**, Ohio Spiderwort
2. **Bloodroot**, Dutchman's Britches
3. **Maidenhair Fern**, Lady Fern
4. **Columbine**, Jacob's Ladder
5. **Wild Geranium**, Virginia Bluebells
6. **Brown Fox Sedge**, Wild Geranium
7. **Solomon's Seal**, Interrupted Fern

Non-Native Plant Layouts for Sun

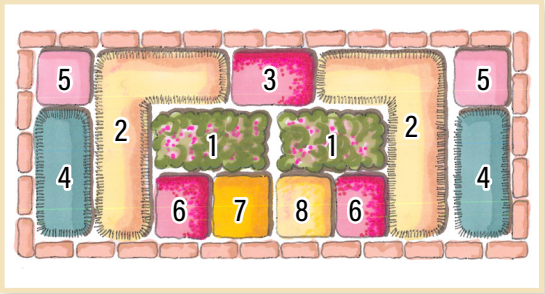
Primary species is provided in bold, followed by a substitution. Native plants and cultivar options can be mixed into non-native plant layouts. Consult your local nursery for additional plant options. Native plants are italicized.



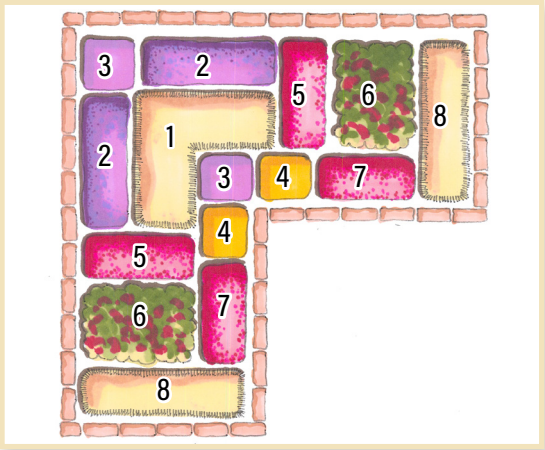
1. Fanfare Gaillardia
2. Variegated Silver Grass
3. *Purple Coneflower*
4. *Butterfly Milkweed, Black-eyed Susan*
5. Asiatic Lily (White)
6. Yellow Trumpet Daffodils



1. **Pardon Me Daylily**, Yellow Trumpet Daffodils
2. Karl Foerster's Feather Reed Grass
3. *Butterfly Milkweed*
4. *Black-eyed Susan*
5. Fanfare Gaillardia
6. Elijah Blue Fescue
7. Brandon Pink Coralbells
8. Triumph Tulips



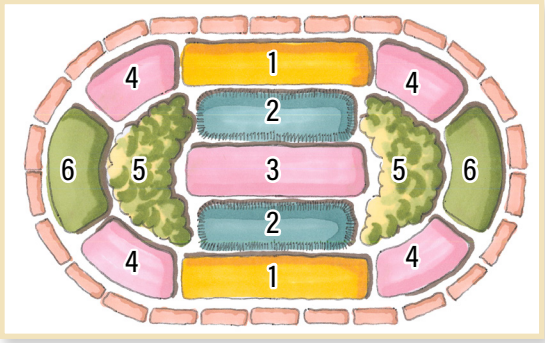
1. Nannyberry Viburnum
2. Karl Foerster's Feather Reed Grass
3. Pardon Me Daylily
4. Elijah Blue Fescue
5. Threadleaf Coreopsis
6. Fanfare Gaillardia
7. ***Black-eyed Susan***, Double Early Tulips, Hibiscus
8. *Butterfly Milkweed*



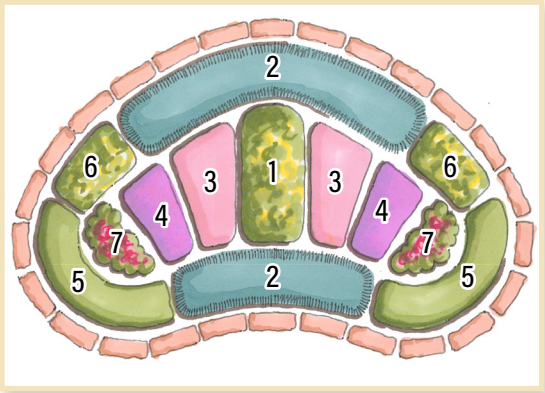
1. Karl Foerster's Feather Reed Grass
2. Threadleaf Coreopsis
3. ***Purple Coneflower***, Triumph Tulips
4. Rocket City Daylily
5. Pardon Me Daylily
6. Plum Pudding Coralbells
7. Fanfare Gaillardia
8. *Prairie Dropseed*

Non-Native Plant Layouts for Shade

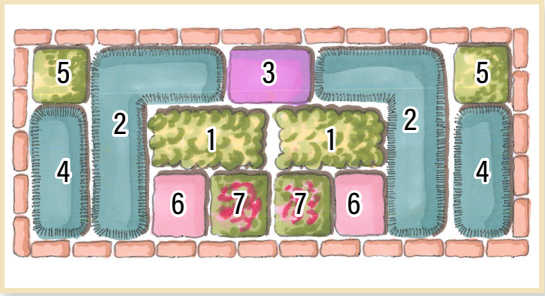
Primary species is provided in bold, followed by a substitution. Native plants and cultivar options can be mixed into non-native plant layouts. Consult your local nusery for additional plant options. Native plants are italicized.



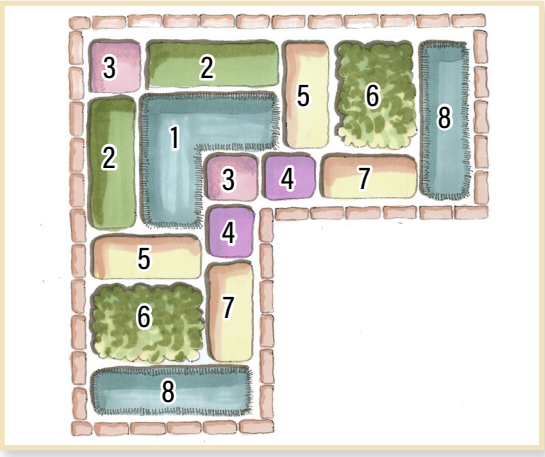
1. *Maidenhair Fern*
2. *Jacob's Ladder*
3. *Solomon's Seal*
4. Chinese Astilbe
5. *American Columbine*
6. Japanese Painted Fern



1. *Brown Fox Sedge*
2. *American Columbine*
3. *Solomon's Seal*
4. Plum Pudding Coralbells
5. Interrupted Fern
6. Shirley Levy Hosta
7. Everlasting Love Hosta



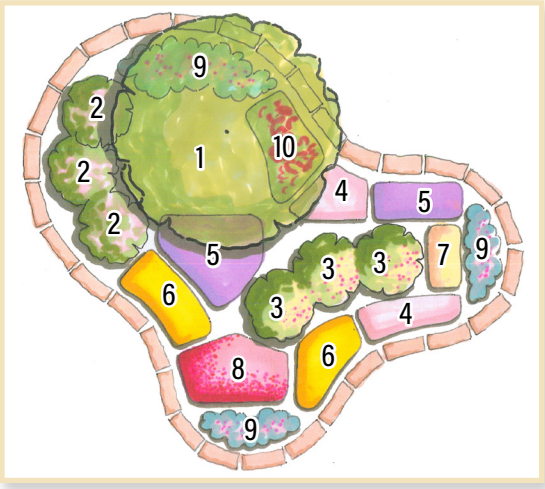
1. Everlasting Love Hosta
2. *Dutchman's Breeches*
3. *Jacob's Ladder*
4. *Lady Fern*
5. Brandon Pink Coralbells
6. Shirley Levy Hosta
7. Chinese Astilbe



1. Everlasting Love Hosta
2. Japanese Painted Fern
3. *Maidenhair Fern*
4. *American Columbine*
5. *Virginia Bluebells*
6. *Jack-in-the-Pulpit*
7. *Dutchman's Breeches*
8. Shirley Levy Hosta

Native Trees, Shrubs, and Plants Layout

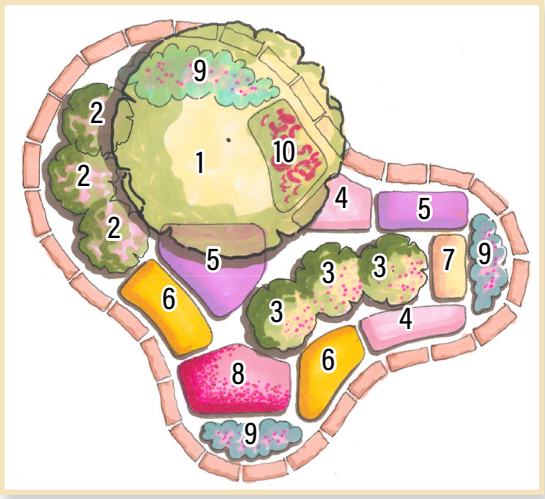
Primary species is provided in bold, followed by a substitution.



1. **Redbud**, Serviceberry
2. Wild Geranium
3. **Red Oster Dogwood**, Black Chokeberry
4. Butterfly Milkweed
5. Jacob's Ladder
6. Wild Petunia
7. Prairie Dropseed
8. Smooth Blue Aster
9. Prairie Smoke
10. Lady Fern

Non-Native Trees, Shrubs, and Plants Layout

Primary species is provided in bold, followed by a substitution. Native plants and cultivar options can be mixed into non-native plant layouts. Consult your local nusery for additional plant options. Native plants are italicized.



1. **Nannyberry Viburnum**, Pagoda Dogwood
2. Magic Berry Snowberry
3. Endless Summer Hydrangea "Blushing Bride"
4. Visons Astilbe
5. May Night Salvia
6. ***Black-eyed Susan***, Double Early Tulips
7. Asiatic Lily (White)
8. Pardon Me Daylily
9. Brandon Pink Coralbells
10. Plum Pudding Coralbells

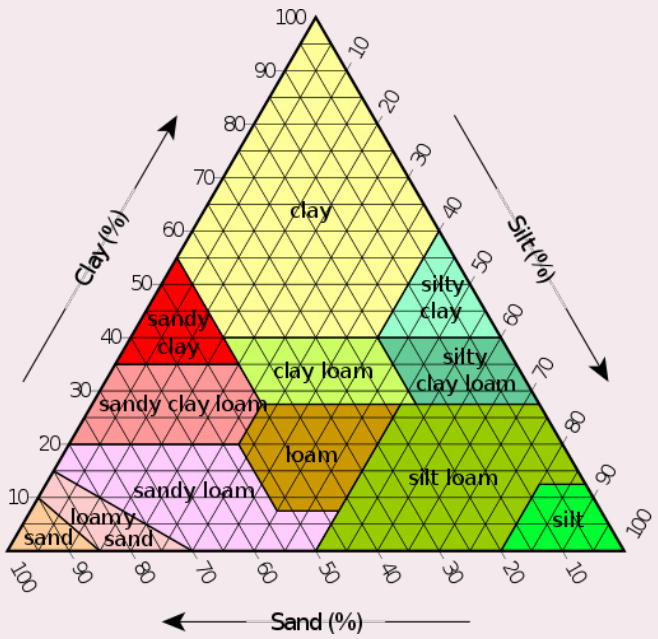
Infiltration Rates for Natural Soil Types

Almost every soil has a certain percentage of sand, silt, and clay. This is referred to as the soil texture. Soil texture plays a role in how fast rain will soak into or percolate through the soil in a rain garden. Water will move through or soak into sandy soils a lot faster than clayey soils. Percolation tests and ribbon tests are used to estimate how fast the water will move through the soils in a rain garden area which influences sizing.

Information is available on estimated infiltration rates and different soil textures. Similar data for percolation rates is not readily available. However, infiltration rates closely mimic percolation rates. The following table relates soil texture to infiltration rates. Sandy soils will have faster infiltration rates in inches per hour and clayey soils will have slower infiltration rates. A textural triangle follows and shows the relationship between the amount of sand, silt, and clay and the soil texture name.

Soil Textures and Minimum Infiltration Rates

Soil Texture	Minimum Infiltration Rates (inches per hour)
Sand	8.27
Sandy Loam	1.02
Loam	0.52
Silt Loam	0.27
Silty Clay Loam	0.06
Clay	0.02



Source: Rawls et al 1982. Infiltration rates provide an estimate of percolation rates.

Soil Amendment Basics

Most rain gardens in Iowa have been constructed with six inches of amended soils. Combining concrete sand, topsoil, and compost enhances rainwater infiltration and percolation and provides an excellent planting media for rain garden plants. These three layers can be placed individually by depth into the rain garden and then tilled together to mix it into an amended soil.

Not all basic rain gardens require the use of amended soils if the native soils have sufficient topsoil and percolation rates. However, a 6-inch layer of amended soils is required for enhanced rain gardens. This guide offers a recommended range for each material placed in an enhanced rain garden. The following table provides a starting point for recommended mixes.

Recommended Amended Soil Mixtures

Material	Basic Rain Gardens		Enhanced Rain Gardens		
	Depth (inches)	Material (feet)	Suggested Range	Depth (inches)	Material (feet)
Concrete Sand	3 ½ (58%)	0.29	75-90%	4 ½ (75%)	0.375
Topsoil	2 (~33%)	0.17	0-25%	1 (17%)	0.083
Compost	½ (8%)	0.04	0-10%	½ (8%)	0.04

Previous editions of this guide have recommended a higher percentage of compost in amended soil mixtures. New research on phosphorus export from rain gardens in the past decade has led rain garden experts to lower the suggested amount of compost. While phosphorus is naturally-occurring, additional nutrient runoff from a rain garden can negatively impact local waterbodies and ecosystems.

Appendix H estimates the total quantity of each material in pounds (lbs.), tons, and cubic yards (cu. yds.). In most circumstances, topsoil and concrete sand are sold as tons while compost and mulch are typically sold in cubic yards. Some materials, depending on the size of the rain garden, can be bought by the bag. If this is the case, divide the weight of the bag by the total weight of the material in pounds generated in Appendix H. This will yield the minimum number of bags that should be purchased for the rain garden installation.

Throughout this guide, a 6-inch layer of amended soils is used for both basic and enhanced rain gardens. While uncommon, some designers may choose to design an amended soil layer greater than 6 inches. If this is the case, 0.5 (half of a foot), will not be used for calculations in Appendix H. For example, if an 8-inch layer is designed, calculations in Appendix H should utilize 0.66 as the depth of the amended soil layer (8/12=0.66). The table shown above assumes a 6-inch layer for both basic and enhanced rain gardens.

Basic Rain Garden Design Review Checklist

RESET FORM

Applicant: _____ **Date:** _____

Submitted By: _____ **Project Location:** _____

1) Complete Appendix **F**, **G**, and **H** - Sizing Worksheet, Cross Section, and Materials List.

2) Attach a map of the drainage area, plan view, planting plan, and plant list.

3) Discuss soils investigation findings (i.e. soil type, texture, structure, depth to water table, etc.).

_____

_____

4) Describe any pretreatment techniques provided (what practice(s) was used, how were things sized, etc.). _____

_____

5) Describe the overflow (i.e. stand pipe, notch in berm, etc.) _____

_____

6) Spacing and size of plants _____

7) If seeding was done, describe type and quantity of seed used and the rate that was applied (i.e. lbs/ac or per 1,000 SF). _____

_____

8) Separation distance from nearest foundation _____. If less than 10 ft, describe water proofing methods. _____

_____

9) Please describe the Erosion and Sediment Control measures employed if the drainage area is not stabilized or the rain garden is not planted and stabilized immediately: _____

_____

_____

FOR REVIEWERS USE ONLY

Design appears to comply with the standards in the Iowa Rain Garden Design and Installation Guide and the Iowa Stormwater Management Manual. ☐ Yes ☐ No

Comments: _____

_____

_____

Reviewer Name: _____ Date: _____ Signature: _____

Enhanced Rain Garden Design Review Checklist

RESET FORM

Applicant: _____ **Date:** _____

Submitted By: _____ **Project Location:** _____

1) Complete Appendix **F**, **G**, and **H** - Sizing Worksheet, Cross Section, and Materials List.

2) Attach a map of the drainage area, plan view, planting plan, and plant list.

3) Discuss soils investigation findings (i.e. texture, degree of compaction, percolation potentials, depth to water table, contamination, etc.). _____

_____

4) Describe any pretreatment techniques provided (what practice(s) was used, how were things sized, etc.). _____

_____

5) Describe where water exits the solid outlet pipe: _____

_____

6) Describe how the water leaves the rain garden when it exceeds ponding depth (i.e. stand pipe, notch in berm, etc.): _____

_____

7) Separation distance from nearest foundation _____. If less than 10 ft, describe water proofing methods. _____

8) Spacing and size of plants _____

9) If seeding was done, describe type and quantity of seed used and the rate that was applied (i.e. lbs/ac or per 1,000 SF). _____

_____

10) Please describe the Erosion and Sediment Control measures employed if the drainage area is not stabilized or the rain garden is not planted and stabilized immediately: _____

_____

FOR REVIEWERS USE ONLY

Design appears to comply with the standards in the Iowa Rain Garden Design and Installation Guide and the Iowa Stormwater Management Manual. ☐ Yes ☐ No

Comments: _____

_____

_____

Reviewer Name: _____ Date: _____ Signature: _____

Rain Garden Sizing Worksheet

RESET FORM

Project Name: _____ **Installation Date:** _____

Step 1: Estimate Impervious Drainage Area	
1a. What is the total surface area of the contributing roof section(s)?	0 ft²
1b. What is the total surface area of the contributing driveway, sidewalk, or other impervious areas?	0 ft²
1c. Total Impervious Surface Area = Step 1a + Step 1b	0 ft²

Step 2: Estimate Pervious Drainage Area	
2a. What is the contributing area of lawn upslope of the rain garden?	0 ft²
2b. Has Soil Quality Restoration (SQR) been completed at the rain garden location?	☐ Yes ☑ No
If "Yes" to step 2b, ignore Step 2 altogether. If SQR has been performed at the project site, then the lawn area will not contribute runoff to the rain garden. If "No" to Step 2b, multiply Step 2a by 0.5.	
2c. Total Pervious Surface Area = Step 2a x 0.5	0 ft²

Step 3: Calculate Total Drainage Area	
3a. Total Impervious Surface Area from Step 1	0 ft²
3b. Total Pervious Surface Area from Step 2	0 ft²
3c. Total Drainage Area = Step 3a + Step 3b	0 ft²

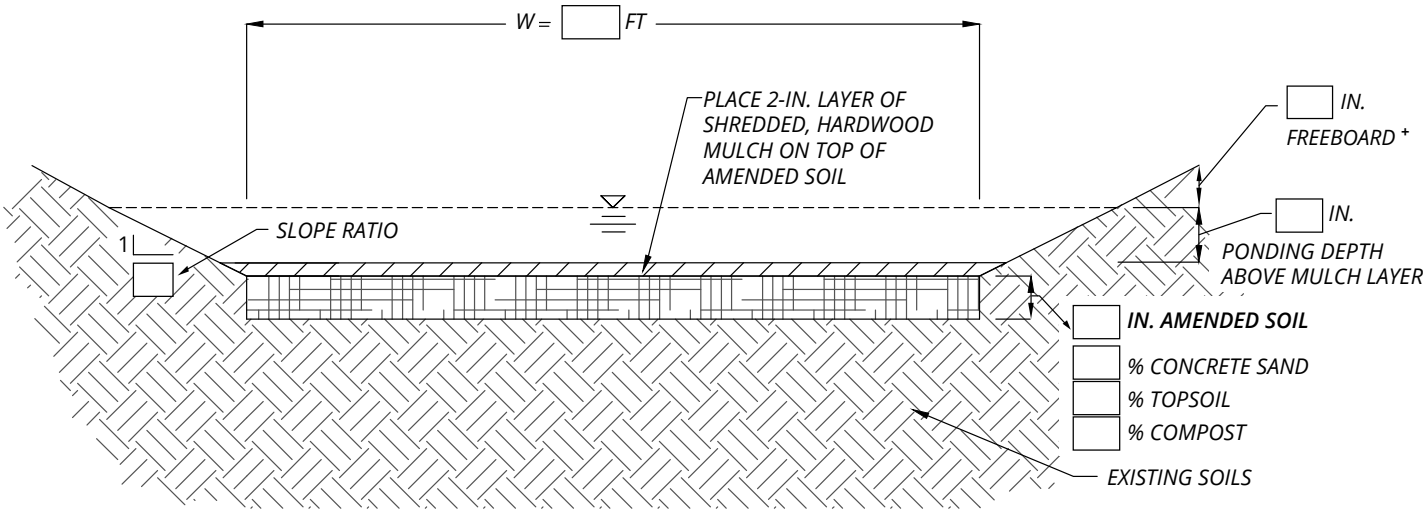
Step 4: Selecting Footprint Area Percentage	
4a. Are you constructing a Basic Rain Garden (BRG) or an Enhanced Rain Garden (ERG)?	☑ BRG ☐ ERG
4b. What was the calculated percolation rate at the rain garden site?	**1.00** inches/hour
4c. What is the desired ponding depth?	☑ 6" ☐ 9" ☐ 12"
4d. Footprint of Rain Garden Area per Sizing Table Recommendation (shown below)	**10** %

Percolation Rate	Ponding Depths	Footprint Area %	Footprint Area Decimal
> 0.5 inches per hour	Enhanced Rain Garden	5%	.05
> 1.0 inches per hour	Basic Rain Garden with 6″ Ponding Depth	10%	.10
	Basic Rain Garden with 9″ Ponding Depth	7%	.07
	Basic Rain Garden with 12″ Ponding Depth	5%	.05
0.5 - 1.0 inches per hour	Basic Rain Garden with 6″ Ponding Depth	21%	.21
	Basic Rain Garden with 9″ Ponding Depth	14%	.14
	Basic Rain Garden with 12″ Ponding Depth	10%	.10
< 0.5 inches per hour	Bioretention Cell (Follow ISWMM Guidance)	~3% - 4%	.03 - .04

Step 5: Calculate Footprint of Rain Garden Area	
5a. Footprint of Rain Garden = (Step 3c Total) x (Step 4d Decimal) *Required surface area of proposed rain garden in order to manage WQv*	**0** ft^2
5b. Temporarily Impounded Water by 1.25" Rainfall Event Total drainage area SF (3c) x 1.25 x 0.623 = gallons _____ gallons x 0.1337 = cubic feet	**0** gallons **0** ft^3

Basic Rain Garden Cross Section

RESET FORM



RAIN GARDEN AREA

L ☐ FT x W ☐ FT = ☐ FT²

*SOILS NOTE

- AMENDED SOIL LAYER WILL BE INSTALLED ☐ (Y/N)

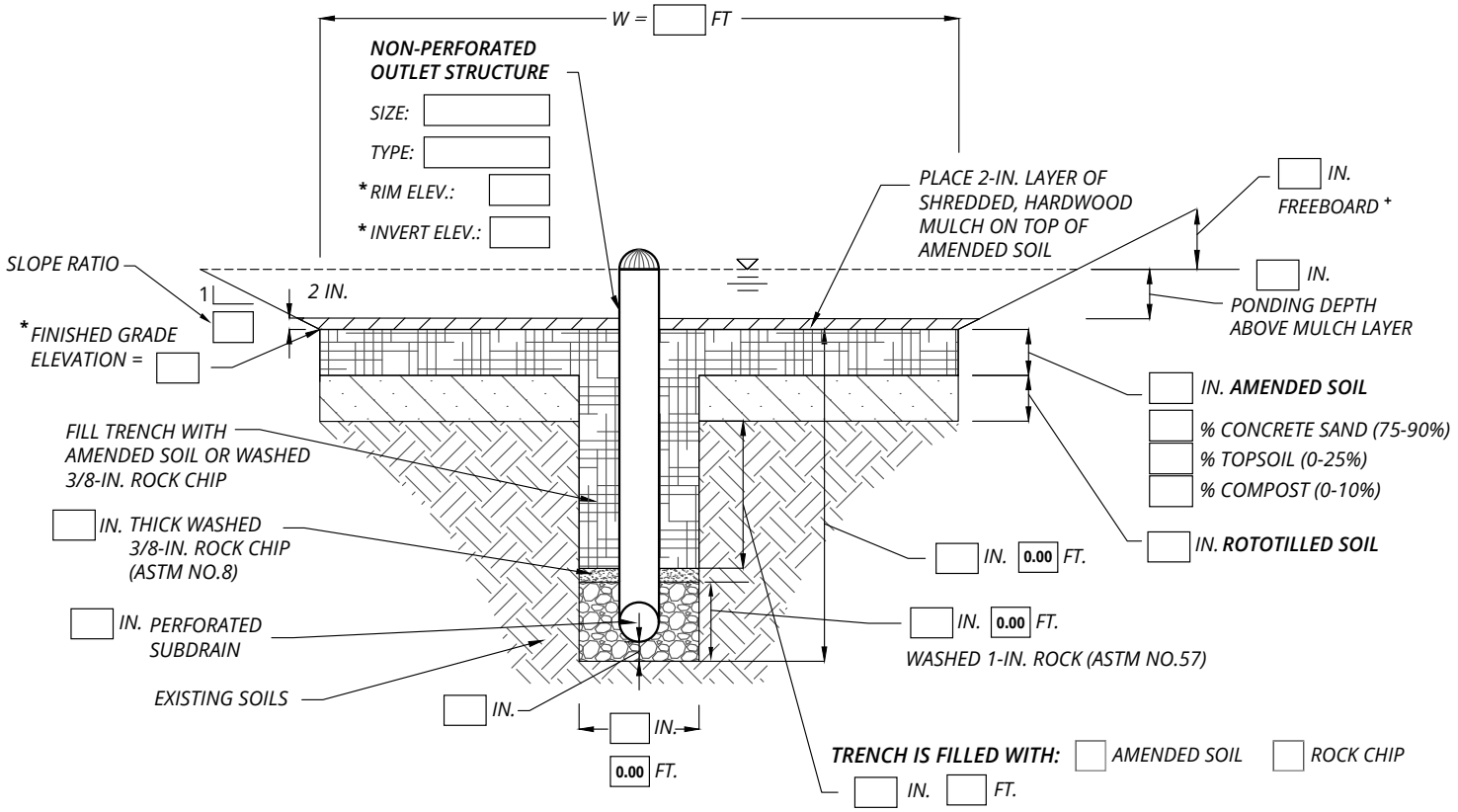
BASIC RAIN GARDEN

NOT TO SCALE

+ FREEBOARD IS THE ELEVATION DIFFERENCE BETWEEN THE OUTLET AND THE TOP OF THE BERM (OR HIGHEST ELEVATION OF THE RAIN GARDEN EDGE).

Enhanced Rain Garden Cross Section

RESET FORM



ENHANCED RAIN GARDEN

NOT TO SCALE

* *IF KNOWN, OTHERWISE LEAVE BLANK*

\+ *FREEBOARD IS THE ELEVATION DIFFERENCE BETWEEN THE OUTLET AND THE TOP OF THE BERM (OR HIGHEST ELEVATION OF THE RAIN GARDEN EDGE).*

RAIN GARDEN AREA

L FT x W FT = FT²

Basic Rain Garden Materials List

RESET FORM

Topsoil *(Suggested **0.5** ft [6 in.] Amended Soil Layer = **0.33** [33%] of Mixture = 2 in. Layer of Topsoil)*

____ ft² (rain garden SF) x ____ ft = 0 ft³ x _____ % Mix (decimal) = 0 ft³ / 27 = 0.00 cubic yards (cu yd)

0.00 cu yd x 2,400 lbs. = 0 lbs. / 2,000 = 0.00 tons

Compost *(Suggested **0.5** ft [6 in.] Amended Soil Layer = **0.08** [8%] of Mixture = ½ in. Layer of Compost)*

____ ft² (rain garden SF) x ____ ft = 0 ft³ x _____ % Mix (decimal) = 0 ft³ / 27 = 0.00 cubic yards (cu yd)

0.00 cu yd x 1,200 lbs. = 0 lbs. / 2,000 = 0.00 tons

Concrete Sand *(Suggested **0.5** ft [6 in.] Amended Soil Layer = **0.58** [58%] of Mixture = 3 ½ in. Layer of Sand)*

____ ft² (rain garden SF) x ____ ft = 0 ft³ x _____ % Mix (decimal) = 0 ft³ / 27 = 0.00 cubic yards (cu yd)

0.00 cu yd x 3,000 lbs. = 0 lbs. / 2,000 = 0.00 tons

Shredded Hardwood Mulch *(Suggested **0.17** ft [2 in.] Depth)*

_____ ft² (rain garden SF) x _____ ft (mulch depth) = 0 ft³ / 27 = 0.00 cubic yards (cu yd)

_____ ft² (SF of berm & slopes, if applicable) x _____ ft (mulch depth) = 0 ft³ / 27 = 0.00 (cu yd)

TOTAL MULCH: 0.00 cu yd (base) + 0.00 cu yd (berm/slopes) = 0.00 **total cubic yards (cu yd)**

Edging

Type of Edging _____ Approximate Linear Feet _____

Vegetation

The rain garden square footage only accounts for the flat bottom of the rain garden. If plants are desired for the side slopes and berms, measure the total square footage of the area to calculate needed plants. Spacing options include 1 plant per square foot, 1 plant per 1.5 square foot, and 1 plant per 2 square feet.

☐ 1 plant per square foot ☐ 1 plant per 1.5 square foot ☐ 1 plant per 2 square feet

_____ ft² (basic rain garden SF) / _____ ft² (average plant spacing) = NaN total plants

_____ ft² (SF of berms & slopes, if applicable) / _____ ft² (average plant spacing) = NaN total plants

Enhanced Rain Garden Materials List

RESET FORM

"Mix" refers to the amended soil mixture used in enhanced rain gardens.

TOPSOIL *(Suggested **0.5** ft [6 in.] Amended Soil Layer = **0.17** [17%] of Mixture = 1 in. Layer of Topsoil)*

Mix: _____ ft² (rain garden SF) x ___ ft = 0 ft³ x _____ % Mix (decimal) = 0 ft³ / 27 = 0.00 cu yd

***Trench:** L ___ ft x W ___ ft x D ___ ft = 0 ft³ x _____ % Mix (decimal) = 0 ft³ / 27 = 0.00 cu yd

** Complete if subdrain trench is filled with amended soils.*

TOTAL TOPSOIL: 0.00 cu yd (mix) + 0.00 cu yd (trench) = 0.00 **total cubic yards (cu yd)**

0.00 total cu yd x 2,400 lbs. = 0 **total lbs.** / 2,000 = 0.00 **total tons**

COMPOST *(Suggested **0.5** ft [6 in.] Amended Soil Layer = **0.08** [8%] of Mixture = ½ in. Layer of Compost)*

Mix: _____ ft² (rain garden SF) x ___ ft = 0 ft³ x _____ % Mix (decimal) = 0 ft³ / 27 = 0.00 cu yd

***Trench:** L ___ ft x W ___ ft x D ___ ft = 0 ft³ x _____ % Mix (decimal) = 0 ft³ / 27 = 0.00 cu yd

** Complete if subdrain trench is filled with amended soils.*

TOTAL COMPOST: 0.00 cu yd (mix) + 0.00 cu yd (trench) = 0.00 **total cubic yards (cu yd)**

0.00 total cu yd x 1,200 lbs. = 0 **total lbs.** / 2,000 = 0.00 **total tons**

CONCRETE SAND *(Suggested: **0.5** ft [6 in.] Amended Soils = **0.75** [75%] of Mixture = 4 ½ in. Sand Layer)*

Mix: _____ ft² (rain garden SF) x ___ ft = 0 ft³ x _____ % Mix (decimal) = 0 ft³ / 27 = 0.00 cu yd

***Trench:** L ___ ft x W ___ ft x D ___ ft = 0 ft³ x _____ % Mix (decimal) = 0 ft³ / 27 = 0.00 cu yd

** Complete if subdrain trench is filled with amended soils.*

TOTAL CONCRETE SAND: 0.00 cu yd (mix) + 0.00 cu yd (trench) = 0.00 **total cubic yards (cu yd)**

0.00 total cu yd x 3,000 lbs. = 0 **total lbs.** / 2,000 = 0.00 **total tons**

CHOKER ROCK *(Suggested Choker Layer: **0.17** ft [2 in.] Depth, Trench Depth from Cross Section in feet)*

Choker Layer: L _____ ft x W _____ ft x D _____ ft (depth) = 0 ft³ / 27 = 0.00 cubic yards

⁺Trench: L _____ ft x W _____ ft x D _____ ft (depth) = 0 ft³ / 27 = 0.00 cubic yards

⁺ Complete if subdrain trench is filled with rock.

TOTAL CHOKER ROCK: 0.00 cu yd (choker layer) + 0.00 cu yd (trench) = 0.00 **total cubic yards (cu yd)**

0.00 total cu yd x 3,000 lbs. = 0 **total lbs.** / 2,000 = 0.00 **total tons**

WASHED ROCK *(Suggested **0.83** ft [10 in.] Depth)*

Trench: L _____ ft x W _____ ft x D _____ ft (depth) = 0 ft³ / 27 = 0.00 cubic yards

TOTAL WASHED ROCK: 0.00 cu yd (trench) = 0.00 **total cubic yards (cu yd)**

0.00 total cubic yards x 3,000 lbs. = 0 **total lbs.** / 2,000 = 0.00 **total tons**

SHREDDED HARDWOOD MULCH *(Suggested **0.17** ft [2 in.] Depth)*

Surface Layer: _____ ft² (rain garden SF) x _____ ft (depth) = 0 ft³ / 27 = 0.00 cubic yards

Berm/Slopes: _____ ft² (SF of berm & slopes, if applicable) x _____ ft (depth) = 0 ft³ / 27 = 0.00 cu yd

TOTAL MULCH: 0.00 cu yd (surface layer) + 0.00 cu yd (berm/slopes) = 0.00 **total cubic yds**

Subdrain and Overflow Structure

Subdrain Material _____ Approximate Linear Feet _____

Overflow Stand Pipe Material _____

Solid Outlet Pipe Material _____ Approximate Linear Feet _____

Animal Guard? ☐ Yes ☐ No

Edging

Type of Edging _____ Approximate Linear Feet _____

Vegetation

The rain garden square footage only accounts for the flat bottom of the rain garden. If plants are desired for the side slopes and berms, measure the total square footage of the area to calculate needed plants. Spacing options include 1 plant per square foot, 1 plant per 1.5 square foot, and 1 plant per 2 square feet.

☐ 1 plant per square foot ☐ 1 plant per 1.5 square foot ☐ 1 plant per 2 square feet

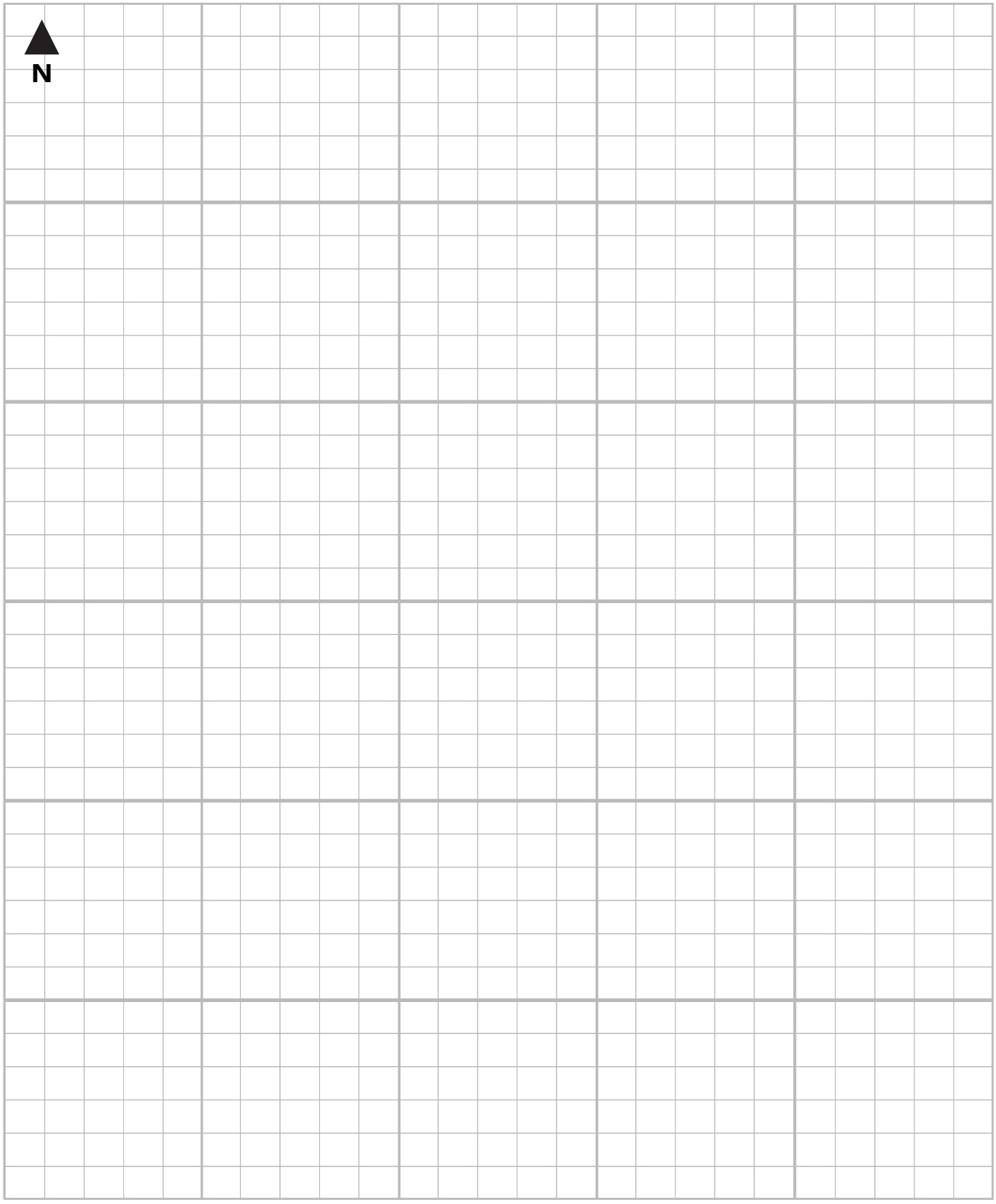
_____ ft² (enhanced rain garden SF) / _____ ft² (average plant spacing) = NaN total plants

_____ ft² (SF of berms & slopes, if applicable) / _____ ft² (average plant spacing) = NaN total plants

Project Notes

RESET FORM

Click in the box below to attach an image or drawing.


N

☐ = _____

Maintenance Checklist

RESET FORM

Project Name: _____ **Installation Date:** _____

Inspection Point	Maintenance Activity	Maintenance Schedule
Inlet, Outlet, Pre-Treatment Area	Remove litter, trash, and accumulated sediment	Annually, spring or fall and after major rainfall events
	Repair, re-armor with rocks, erosion control blankets, or mats, and revegetate area if erosion is present	As needed
	Maintenance Completed: Year 1 ☐ Year 2 ☐ Year 3 ☐ Year 4+ ☐ **Notes:**	
Base of Rain Garden	Remove litter, trash, and debris	Annually, spring or fall and after major rainfall events
	Spread mulch evenly, 2-3" thick throughout	Annually, spring or fall
	If surface is plugged by sediment, find and eliminate source of sediment, then replace amended soils, re-plant and mulch. If the surface has been compacted, till the soils, re-plant and mulch.	As needed
	Maintenance Completed: Year 1 ☐ Year 2 ☐ Year 3 ☐ Year 4+ ☐ **Notes:**	
Berm and/or Retaining Wall	Rebuild and compact berms in areas that have sunk over time or have blown out. Make sure there is a stabilized, notched out area for overflows from large rainfall events.	Inspect annually, repair as needed
	Remove bricks and rebuild retaining wall from lowest level, and level bricks at each course	Inspect annually, repair as needed
	Maintenance Completed: Year 1 ☐ Year 2 ☐ Year 3 ☐ Year 4+ ☐ **Notes:**	

Inspection Point	Maintenance Activity	Maintenance Schedule
Newly Established / Young Plants	Supplement plantings if at less than 75% vegetative cover	Inspect at end of first growing season, replant as needed
	Remove dead vegetation, maintain some winter habitat for pollinators	Annually, spring or fall
	Water young plants regularly until root systems have established, plants should receive around 1" of water per week	As needed depending on weather patterns
	Pull weeds and invasive species, avoid use of herbicides if possible	Monthly during first 3 years after installation
	Maintenance Completed: Year 1 ☐ Year 2 ☐ Year 3 ☐ Year 4+ ☐ **Notes:**	
Established / Mature Plants	"Deadhead" non-native flowering plants at the end of blooming period, cut back perennials several inches above base	Annually, depending on species
	General pruning of healthy plants	Annually, fall or early winter
	Replace diseased or dead plants. Dig out or prune back volunteer trees. Herbicide treatment will be needed if the tree roots are not removed.	As needed
	Maintenance Completed: Year 1 ☐ Year 2 ☐ Year 3 ☐ Year 4+ ☐ **Notes:**	
Overflow Structure (Enhanced Rain Gardens Only)	Remove debris and trash from overflow grate, within pipe, and at the outlet where the enhanced rain garden daylights	Annually, spring or fall and after major rainfall events
	Maintenance Completed: Year 1 ☐ Year 2 ☐ Year 3 ☐ Year 4+ ☐ **Notes:**	