



Start-to-Finish

Rain Garden Design

A Workbook for Homeowners



Your Contact Information

Name _____

Phone or E-mail _____

Address _____



Why Rain Gardens?

What is Stormwater?

Stormwater is a term that is used to describe the water that does not soak into the ground after a rainfall or snowmelt. It is the water that runs into storm drains, flows over the land's surface, and causes puddles to occur. In a natural landscape like a forest or grassland, rain-water soaks into the ground and only after the soil is saturated will runoff as stormwater. In urban hours however, most of the land has been paved over, shingled, or compacted so that water can no longer soak into the ground.

Stormwater causes trouble for individuals, municipalities, and the environment. You or your neighbor may experience water in your basement as a result of stormwater. Municipalities might encounter problems with parks flooding or puddling in roadways. The quality of our waters is degraded by all of the chemicals, sand, grass clippings, and other debris that rides with stormwater down storm drains and into local lakes, rivers, ditches, and streams.

What is a Rain Garden?

A rain garden is a shallow dish-like depression in the ground that is planted with water-tolerant vegetation. The primary purpose of a rain garden is to soak up stormwater and infiltrate it into the ground; however, rain gardens also provide many other benefits as well.

- Beautifies the landscape
- Soaks up Puddles within 48 hours (to avoid mosquito-breeding environments)
- Provides an Outlet for Roof and Sump Pump Water
- Improvements to Water Quality
- Reduces Pressure on Existing Storm Sewer Infrastructure
- Provides Habitat

Who Should Have a Rain Garden?

EVERYONE! Rain gardens are a great way to reduce stormwater volume and improve water quality - The more rain gardens there are, the more volume is decreased and quality improves. Rain gardens are relatively cheap and are simple to design and install. If you decide to go ahead and plan a rain garden of your own, use this guide to take you through the design process.

About this Guide...

This guide is a set of worksheets meant to take homeowners like you through the process of planning a rain garden. It is a comprehensive guide compiled from a number of rain garden sources from around the country. A rain garden is a simple concept that can be as straightforward as digging a shallow depression in the ground and planting it. However, working through this guide will help ensure the maximum functionality and success of your rain garden. Use this workbook to fill in your answers, do the calculations, and complete your sketches. Once the workbook is complete, you should be ready to install your rain garden!

Soil Tests

Water Table

If there is often standing water on the site where you would like to establish the rain garden and the water pools there for long periods of time, it may be because the water table is very close to the surface here.

- The water table is more than 2 feet from the surface all year round; you have a good site for a rain garden
- The water table is closer than 2 feet from the surface for all or some of the year; you'll have to be creative when planning your garden. You may want to look for an alternative site

Soil Type

Collect a few teaspoons of soil from 4-6 inches beneath the surface. Place about 2 teaspoons of soil in the palm of your hand and add drops of water until the soil has reached a consistency that makes it moldable, like moist putty. Knead the soil as you add the water drops.

Form the soil into a ball and place the ball between your thumb and forefinger. While gently pushing the soil with your thumb, squeeze the soil upward into a ribbon of uniform thickness and width. Allow the ribbon to emerge and extend over your forefinger until it breaks from its own weight.

- The soil could not remain in a ball form; you have sandy soil
- The soil formed a ribbon less than 1 inch long before it broke; you have silty soil
- The soil formed a ribbon 1-2 inches long before it broke; you have clayey soil

* If the soil makes a ribbon greater than 2 inches before it breaks, this is probably not a suitable site for a rain garden.

Soil Compaction

Poke a wire flag into the ground.

- The wire easily penetrates 6-8 inches into the ground; your soils are not too compacted
- The wire is difficult to push into the ground; be sure to rip up the bottom of the rain garden before adding soil amendments

Infiltration Rate

Dig a hole about 6-12 inches deep and at least 4 inches in diameter in the rain garden site. Fill the hole with water and let it sit for an hour or two to pre-soak the soils for your test. Then refill the hole with water and push a popsicle stick into the side of the hole to mark the water level. After an hour, measure and record the depth of the water again. You may want to continue taking measurements at hourly increments for a few more hours.

- The water level dropped one-half inch or more; this is a perfect site for a rain garden but you might still want to consider soil amendments (*see page 7*)
- The water level dropped less than one-quarter of an inch; you will have to amend your soils (*see page 7*). You may also want to try another site or leave the garden "off-line" until the vegetation has improved the infiltration capability of the soils.

Design Calculations

Calculating the Depth of Depression

Using the results of the *infiltration* rate test, calculate the depression depth of your garden.

Inches of water level drop in one hour x 24 hours = depth of depression

My infiltration rate test showed:

_____ inches in one hour x 24 hours = _____ inches/day

Make your rain garden depression this deep!

Slope of the Site

Find the slope of your lawn using two stakes and a piece of string:

1. Pound one stake in the ground at the uphill end of your rain garden site and one at the downhill end. The two stakes should be about 15 feet apart.
2. Tie the string to the bottom of the uphill stake and bring the other end to the downhill stake.
3. Tie the string on the downhill stake at a height where the string will be in a horizontal position (you may want to use a level).
4. Take the necessary measurements to fill in the boxes below.

	÷		x	100 =	
Distance between string and ground on the downhill stake (inches)	÷	Distance between the two stakes (inches)	x	100 =	Percent slope of rain garden site

A slope of 12% or less is best for a rain garden.

Garden Location

Where is the best place for your garden? Make sure the site meets the following criteria*:

- The site does not have *heavy* clay soils
- The site infiltrates one-half inch per hour or more
- The water table is at least 2 feet from the surface at its shallowest
- The slope of the site is not more than 12%
- The site is at least 12 feet from buildings with basements
- The site is not over any utilities (call Gopher One to be sure)
- The site is not near a septic tank or drainfield
- The site does not interfere with any trees. If there are trees in the area, they are species that can handle wet soil conditions for lengthy periods of time.

*If the site that you have chosen does not meet all of the criteria it does not necessarily mean that a rain garden cannot be established there. Talk to a professional to review your options.

Drainage Area

In order to determine what size you should make your rain garden, you need to know the size of the area that will be draining to the garden.

Drainage Area	Area (Square Feet)
<input type="checkbox"/> Roof downspout*	
<input type="checkbox"/> 2nd roof downspout*	
<input type="checkbox"/> Driveway	
<input type="checkbox"/> Sidewalk	
<input type="checkbox"/> Lawn	
<input type="checkbox"/> Other	
TOTAL DRAINAGE AREA =	

* Many homes have more than one downspout. Do your best to estimate the area of roof draining to the downspout you would like to use for your rain garden.

Sizing your Rain Garden

Divide the total drainage area (above) by the depth of the depression (see *Calculating the Depth of the Depression* on page 3) to calculate what the square footage of your rain garden should be:

$$\frac{\text{Drainage Area (in Square feet)}}{\text{Depth of Depression (in inches)}} = \text{Size of Rain Garden (in square feet)}$$

The size of my rain garden should be:

$$\frac{\text{My drainage area is } \underline{\hspace{2cm}} \text{ square feet}}{\text{The depth of my depression is } \underline{\hspace{2cm}} \text{ inches}} = \underline{\hspace{2cm}} \text{ square feet}$$

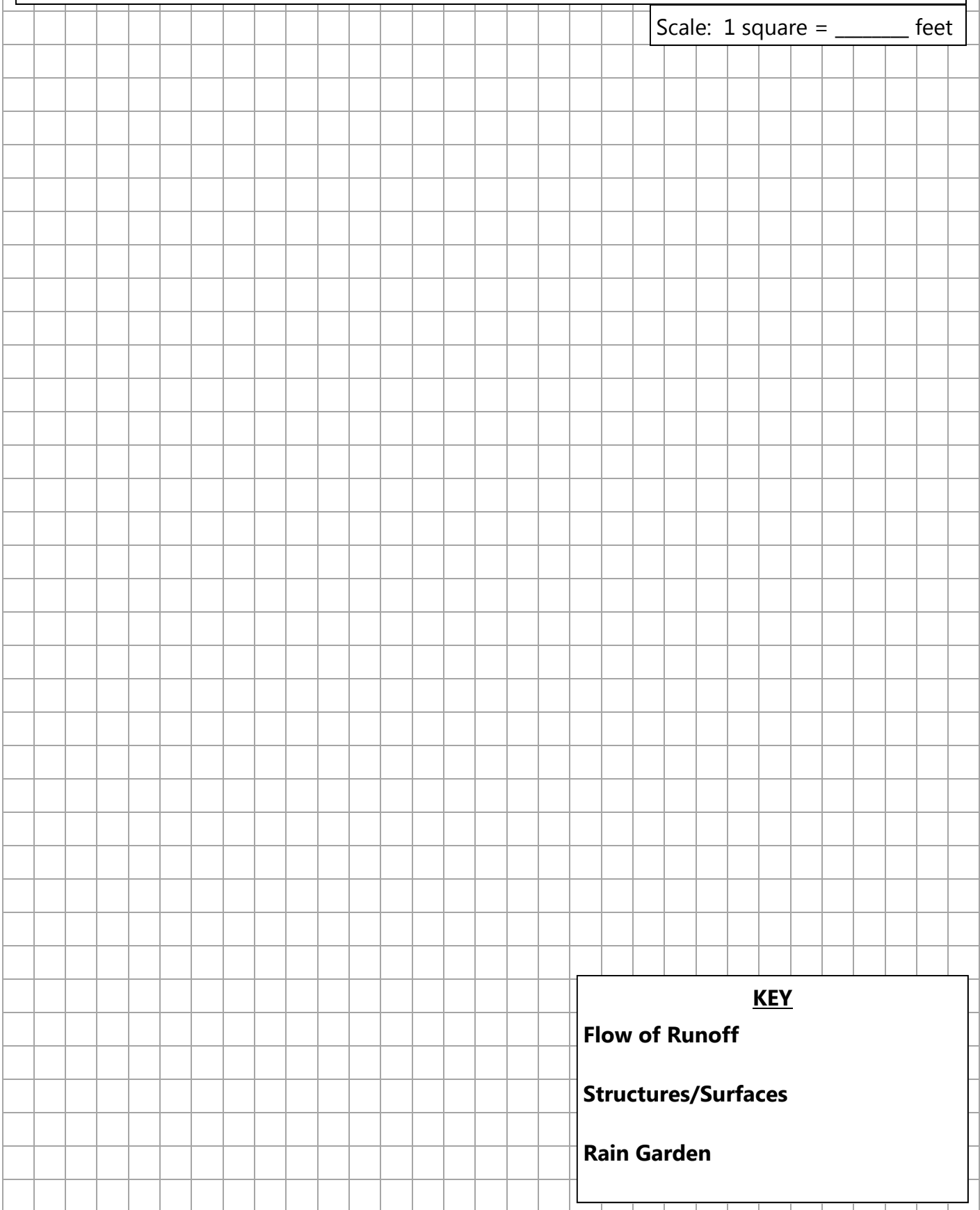
This calculation gives the area of a garden that will infiltrate the first inch of rainfall. If you want your garden to infiltrate 2 inches, simply double the drainage area number!

Once you know the total square footage that your rain garden needs to be, you can make it whatever length and width combination you want!

Aerial Site Sketch

Draw a bird's-eye-view of your property including all impervious surfaces and existing structures. Draw arrows depicting the flow of water on the property and the proposed site of the rain garden.

Scale: 1 square = _____ feet



KEY

Flow of Runoff

Structures/Surfaces

Rain Garden

Design Elements

Inlet

The inlet is where water enters the garden.

How will water get to the garden?

- Extended downspout
- Buried downspout or drain tile (Your site needs to have enough slope to ensure the tile flows downhill towards the garden and still surfaces in the garden.)
- Overland flow across lawn
- Vegetated or rock pathway
- Other:

What will you use to stabilize (reduce erosion) the inlet?

- River Rock
- An Erosion Control Blanket
- A rock splash block
- Sod

Overflow

The overflow is how excess water gets out of the garden once it is full.


Will the overflow:

- Flow over the lawn?
- Flow over the driveway or sidewalk?
- Flow into the street?
- Other

It is important to make sure that your outlet is at a height that will allow water to pool in the garden to the desired depth. In my rain garden, **the desired depth of the depression is _____ inches deep** (see *Calculating the Depth of Depression* on page 3).

- The rain garden is located on a slope; you will need to build up the downhill side of the rain garden with a wall or a berm (see below)
- The rain garden is located on a flat site; no berm or wall is needed here.

Will you need to put rocks at the outlet to slow the water flow going out of the garden and reduce erosion potential? _____

 Make sure that the overflow is directed away from your home and other buildings!

A note on berms and walls:

A berm is a simple mound of soil that should be covered with a erosion control blanket or other erosion-control device to keep it from washing away. The berm can then be planted with dry-tolerant plants. A wall is a more formal-looking choice for leveling the rain garden. Landscaping blocks are a good rain garden wall-making material. To ensure that water and soil won't escape from the garden through cracks in the wall, line the inside of the wall with landscape fabric.

Border

When designing a rain garden, it is a good idea to keep the border of the garden nice and neat to make it easier for you to mow and to keep it looking good for the neighbors. Landscape edging, brick, or rock borders do a fine job. A neatly-mown turf grass edge would work as well and will also filter out fine sediment particles before water gets into the garden.

Materials

Soil Amendments

If your soil percolated well when you did your infiltration rate test (for example, you got 8 inches of infiltration per day) and there is some soil at the site that is suitable for growing plants in, then you really don't need to add soil amendments. If you had mostly clay or sand and your infiltration test didn't show an outstanding percolation rate, then you should amend the soils under the depression using the following method:

1. Shape the garden and dig the depression roughly to the desired depth (see *Calculating Depth of Depression* on page 3)
2. Now dig 4-6 inches deeper (8 inches if you have heavy clay soils) and remove that soil.
3. Break up the soils on the bottom of the bed with a rototiller, shovel, or pitchfork. Break up the bed about 6 inches down.
4. Add some compost (and sand if you had clay soils) and work it into the bed, mixing it with the broken up native soils. Repeat this process until the depth of the garden is back up to the desired depth of the depression.

To determine how much sand and compost you will need, you must calculate the cubic feet of your garden. The simplest way to do this (and ensure that you don't under-calculate what you will need), is to multiply the square footage of your garden (see *Sizing your Rain Garden* on page 4) by the depth that you need to amend to (see above). So,

$$\frac{\text{Square feet of my rain garden}}{\text{Square feet of my rain garden}} \times \left(\frac{\text{Depth of soil amendment divided by 12 inches}}{\text{Depth of soil amendment divided by 12 inches}} \right) = \frac{\text{Total cubic feet of my rain garden}}{\text{Total cubic feet of my rain garden}}$$

There are many blends of sand, compost and native soils that are recommended for rain gardens, the following calculations are for a 40% sand, 40% compost, 20% existing soil blend. The sand used in rain gardens should be a clean sand, and the compost should be well-aged organic compost (preferably leaf compost). To adjust for the breaking up of the bottom of the bed (step 3 above) the below equation calculates for 50% sand and 50% compost.

To amend my soils I will need:

$$\frac{\text{cubic feet of my rain garden}}{\text{cubic feet of my rain garden}} \times 0.50 = \boxed{\text{cubic feet of sand}}$$

$$\frac{\text{cubic feet of my rain garden}}{\text{cubic feet of my rain garden}} \times 0.50 = \boxed{\text{cubic feet of compost}}$$

Mulching

In order to keep moisture in your garden and suppress weeds, spread 2-3" of shredded or double-shredded hardwood mulch over the whole garden bed before planting.

To calculate how much mulch you will need for your garden, multiply the square footage of your rain garden by 0.25 feet (0.25 feet comes from dividing 3 inches by 12 inches).


For my garden I will need:

$$\underline{\hspace{2cm}} \times 0.25 \text{ feet} = \boxed{\underline{\hspace{2cm}}} \text{ cubic feet of mulch}$$

(square feet of my rain garden)

General Rule:

One cubic yard (27 cubic feet) will cover 100 square feet at 3 inches thick.

 Why "double-shredded hardwood" mulch? Because shredded mulch binds together and forms a semi-solid mat whereas wood chips simply float away!

Materials I Need for My Rain Garden

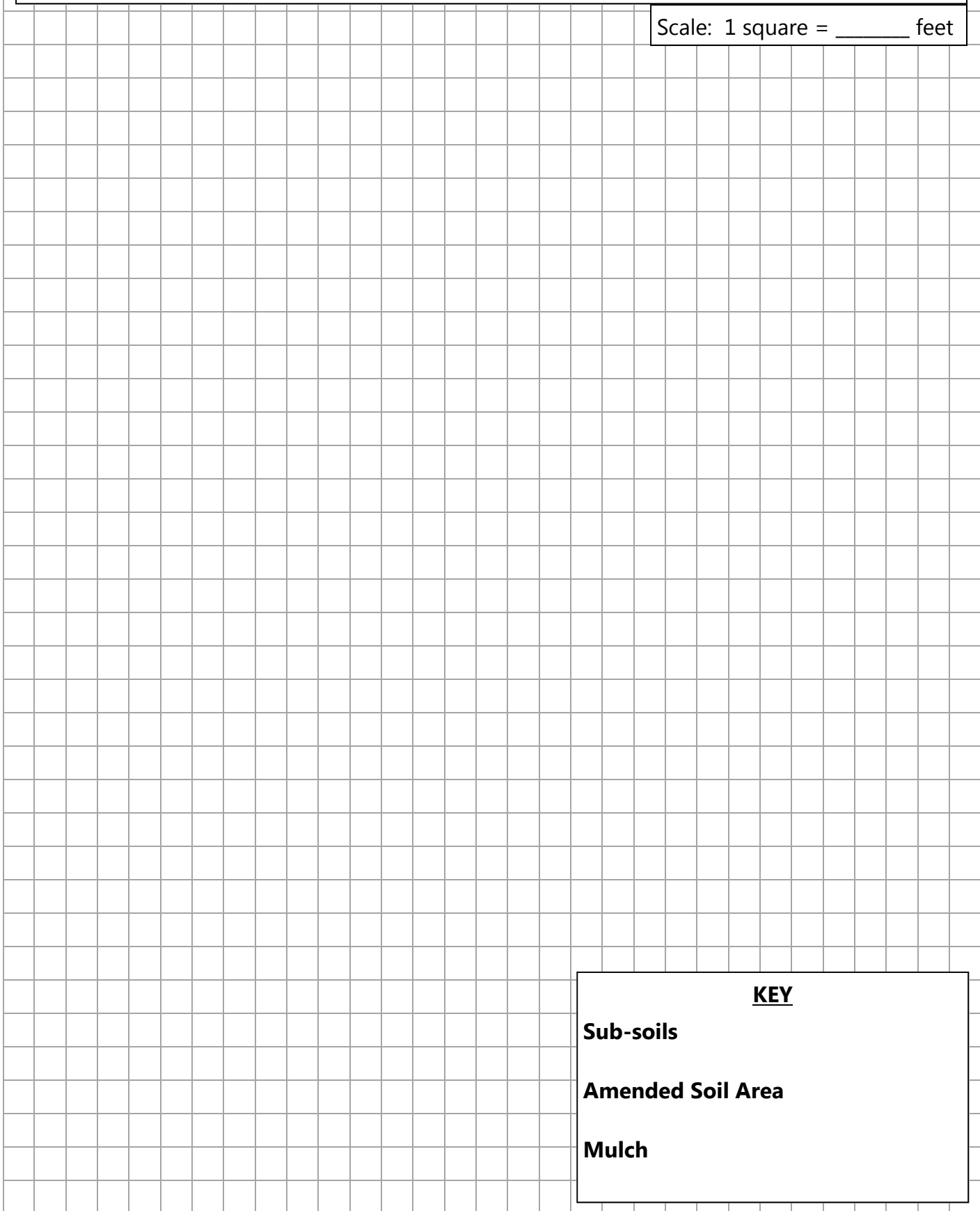
<i>Materials Needed</i>	<i>Quantity</i>
<input type="checkbox"/> Sand	cubic feet*
<input type="checkbox"/> Compost	cubic feet*
<input type="checkbox"/> Mulch	cubic feet*
<input type="checkbox"/> Downspout extension	
<input type="checkbox"/> Drain tile	
<input type="checkbox"/> Large rock	
<input type="checkbox"/> Small Rock	
<input type="checkbox"/> Border/Edging Material	
<input type="checkbox"/> Wall material	
<input type="checkbox"/> Erosion control blanket	
<input type="checkbox"/> Splash block	
<input type="checkbox"/> Other	

* Some suppliers sell sand and compost in cubic yards instead of cubic feet. To convert cubic feet into cubic yards, divide the cubic feet by 27 (since there are 27 cubic feet in 1 cubic yard).

Cross-Section

Draw the cross-section of the garden including the sub-soils under the rain garden, the amended soil area, and the mulched depression.

Scale: 1 square = _____ feet



KEY

Sub-soils

Amended Soil Area

Mulch

Plants

Choosing Plants

The site is:

- Sunny for 4 hours or less
- Sunny for more than 4 hours
- Mostly sunny in the morning
- Mostly sunny in the afternoon

What type of plants would you prefer to have in your garden?

- All Native
 - well-adapted to our local soil conditions
 - tolerant of drought-like conditions
 - somewhat "wild" in appearance
 - require little maintenance once established
- A mix of Native and Non-native
 - medium maintenance burden
 - needs to be watered in drought-like conditions

To fill your rain garden, you will need to choose a variety of plants that includes different *moisture tolerances*, different *heights*, and different *blooming times*.

- Remember that a rain garden is like a shallow dish, so water will be in the middle/bottom of the garden for longer periods of time than it will be on the edges/top of the garden. You will need to choose plants for the bottom of the garden that can handle a lot of moisture, plants for the inside slopes that can handle medium moisture, and plants for the top of the garden that can handle drier conditions.
- To ensure that all of the plants in your rain garden are visible you will want to plant taller plants behind shorter plants. If your garden will not be viewed from the back as much, then you should plant the tallest plants at the back of the garden and work your way forward with progressively shorter plants. If the garden will be viewed from all sides, you should plant the tallest plants in the middle and radiate outward with progressively shorter plants.
- You will also want to ensure that something in your rain garden is blooming from spring until fall. This means making note of the blooming times of your plant choices and coordinating your choices to ensure that you will have beautiful blooms throughout the growing season! Your garden will also be seen during the winter months, so try and choose some plants that will make your garden interesting all year round (grasses and woody plants are good choices for winter interest).

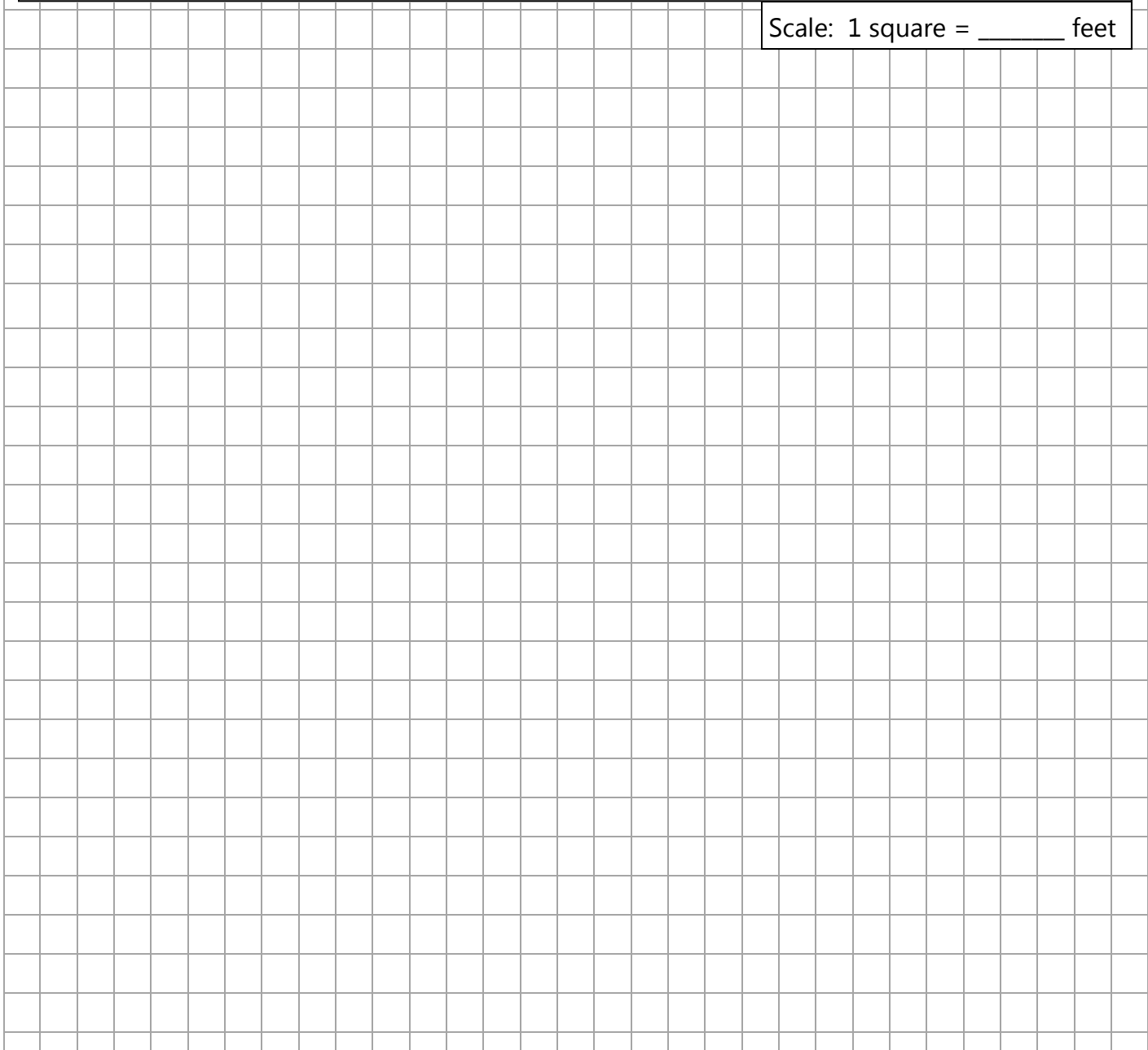
Design Tip:

- Plant same plants in groups of 3 or 5 (or higher odd-numbers if your garden is large). This will make identifying weeds easier and make a big impact when each type of plant blooms!

Planting Plan

Draw the outline of your garden. Now draw in what plants you would like to place where. This will be your guide when it is time to plant your garden.

Scale: 1 square = _____ feet



KEY

Bottom (wettest zone)

Side Slopes (medium wetness)

Outside Edges (pretty dry)

How many Plants?

When deciding how many plants to get for your rain garden a good estimate is that you will need one-plant-per-square-foot. But, keep in mind how large the plants that you chose will be at maturity. Many plants have their own spacing recommendations so check these out and plant accordingly. If a plant needs more than a square foot then give it more room, and if one requires less space then don't leave it as much room.

If I assume that the plants I choose that need more than a square foot and the plants I choose that need less average out then I should use the one-plant-per-square-foot rule as my guide.* This means I will need the same quantity of plants as the square footage of my garden. So;

square feet of my garden = number of plants I will need

My rain garden is _____ square feet, so I will need _____ plants.

* If you will be planting trees or shrubs in your rain garden then do not use the one-plant-per-square-foot rule. Instead go by the spacing recommendations for each plant.

Note to first-time gardeners:

Your garden will probably look kind of sparse at first, but give it time and it will fill in nicely - all gardens take a few years to mature and look their best. You can also add more plants and replace plants that do not survive or that you decide you don't like later.

Buying Plants

Three common forms that grasses and flowers are sold in are seeds, plugs, and pots.

- Seeds are cheap and widely available, but not recommended for rain gardens because of their tendency to float away and they sometimes take a few years to become established.
- Using potted plants in a garden gives it a full look instantly, but can often be quite an expensive option. Potted plants may also take a while to adjust to their new garden home because they have been pampered and fussed over at garden centers for so long.
- Plugs are a relatively cheap and effective way to establish plants in a rain garden. Plugs are very small plants about 1-2 inches wide and 4-6 inches long and generally come in 6 or 9-packs. They look pretty scrawny compared to big potted plants, but they establish quickly and catch up to their larger counterparts usually within a year's time.

Buying Tip:

If you are planting in the springtime, you may want to consider planting 25% potted plants and 75% plugs so that your garden has a fuller look throughout the first summer. If planting in the fall you will only see the garden for a short time so 100% plugs would be the most economical choice.

Transplanting:

Using portions of mature plants from other places in your yard or a friend's yard can save you money on the cost of plants. Also, check out local plant sales and exchanges!

Be aware of invasive plant species and never plant them!

Notes

Sources and Credits:

Board of Regents of the University of Wisconsin System. Rain Gardens: A how-to manual for homeowners. UWEX Publication, 2003.

City of Maplewood. Rain Garden Design and Construction Worksheet. Maplewood: City of Maplewood, 2007.

Rusty Schmidt, Dan Shaw, and David Dods. The Blue Thumb Guide to Raingardens. Waterdrop Innovations, LLC, 2007.



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