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Rainwater Harvesting | Raingardens

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A raingarden is an artificial depression in the landscape that collects and stores stormwater runoff until it can infiltrate the soil. Raingardens are not ponds. They are usually planted with native vegetation that is hardy and attractive. Plants in a raingarden can give color to the landscape at all times of the year.

Raingardens can be designed for an individual yard or a neighborhood. They provide a habitat for many animals including birds, butterflies and other insects. The design of a raingarden can be asymmetrical or symmetrical, as shown in Figure 1.

Conserving and Protecting Water

In its natural state, the land can absorb much of the rain that falls. Water absorbed into the soil helps recharge groundwater supplies. Growing urban populations are straining groundwater supplies by using water faster than it can be replenished.

As more land is developed for new houses and businesses, the problem becomes worse because development covers much of the land with impervious surfaces. Rainwater that falls on parking lots, buildings, driveways and roads is not absorbed by the soil. Instead, it runs off into storm drains, streams and rivers. Stormwater runoff increases urban flooding and erodes the banks of rivers and streams. Table 1 shows just how much runoff is generated from impervious surfaces during common storms.

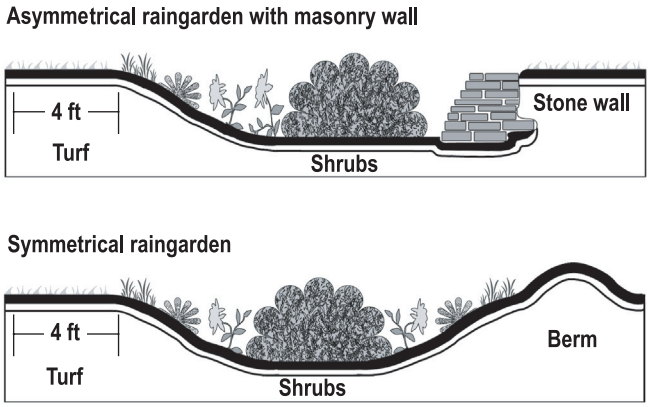

Figure 1. Typical asymmetrical and symmetrical raingardens (adapted from Barr Engineering Company, 2001).

An average-size house has a 1,500- to 4,000-square-foot impervious roof. Thus, the amount of water a typical roof will shed is at least 15 times the volumes shown in Table 1.

Table 1. Volume of rainwater captured in a 100-square-foot area (assuming 100 percent collection).

Rainfall amount (inches)	Volume (ft^3)	Volume (gallons)
0.5	4.2	31
1.0	8.3	62
1.5	12.5	94
2.0	16.7	125
2.5	20.8	156
3.0	25.0	187

In addition to the flooding it can cause, excess rainfall runoff has properties that can harm the environment. Rainwater is heated by the pavement and roofs on which it falls. When this heated water enters a stream or river it raises the temperature of the water in the stream and speeds the growth of bacteria. This, in turn, depletes the amount of dissolved oxygen in the water. Oxygen depletion can kill some fish and other aquatic organisms.

Urban runoff also carries many pollutants into streams and rivers. Water flowing over roads and parking lots picks up oils, heavy metals and other chemicals that leak from vehicles. Water flowing over yards picks up excess fertilizers, chemicals, animal wastes and grass clippings. These pollutants also harm aquatic life.

Water is a valuable resource and every effort should be made to conserve and protect it. Installing a raingarden is one way to do that.

Planning a Raingarden

Besides being functional, a raingarden can be a beautiful and creative addition to a new or existing landscape. Some careful planning is required.

Location

When choosing a location, consider the proximity of the raingarden to foundations, the placement relative to downspouts, the slope of the ground, existing vegetation, views from the house, and views from the road. A raingarden should be at least 10 feet from any foundation or structure to ensure that water does not seep under the foundation and cause it to shift (Bannerman et al., 2003).

Notice where downspouts are located and determine how much of the roof is draining to each individual downspout. Remember that for each inch of rain, about 0.62 gallons can be collected for each square foot of roof area.

It is helpful to create a to-scale drawing of the desired garden location, the catchment area (roof and paved areas from which water will drain), and the surrounding landscape. On the drawing, note any high or low areas and map the flow of water from the downspout. If the path of water from the downspout cannot be determined by looking at the contours of the land, run water from a hose through the downspout and watch where the water flows. Figure 2 shows recommended raingarden placement and orientation.

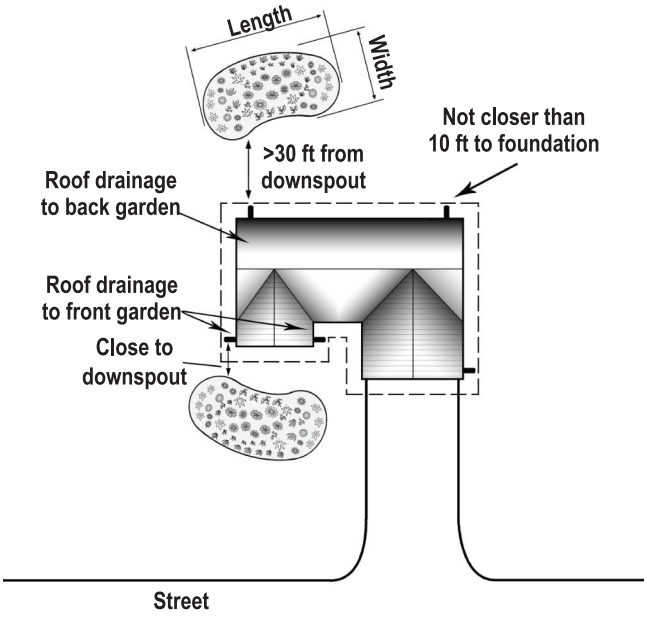

Figure 2. Raingarden placement and orientation in relation to a house (from Bannerman et al., 2003).

The best location for a raingarden is in full to partial sun. This allows plants to fully use the water and speeds evaporation and infiltration. Locating the raingarden under a tree would not be practical.

It is best to have at least 4 feet of turfgrass just before the entrance to the raingarden. This vegetation traps sediment and debris in the water before it enters the garden.

Raingardens should be built on land that slopes no more than 12 percent and no less than 4 percent (Bannerman et al., 2003). Slope influences the depth of the raingarden. The best depth for a raingarden is 4 to 8 inches. A raingarden on steeply sloping land would have to be deeper and the water would, thus, infiltrate more slowly, leaving standing water for a longer time. On a site with little slope the raingarden would be shallow, so it would have to be quite large to contain the runoff from average storms.

Table 2. Recommended design depths for various slopes (Bannerman et al., 2003).

Slope	Depth
4 % or less	3 to 5 inches
5 to 7 %	6 to 7 inches
8 to 12 %	8 inches

Finally, consider views from inside and outside the house. The garden should function not only to help rainwater infiltration but also as a visually pleasing garden. Select plants carefully so that at least some of them will be blooming at most times of the year. Be aware of the heights the plants will be when mature. Depending on the location and orientation of the garden, it might be advantageous to have plants of many different heights.

There is no reason to worry that having a raingarden will lead to mosquito problems. Seven to 12 days are required for mosquito eggs laid in standing water to hatch and mature to adults. A properly designed raingarden will contain standing water for only a few hours after most storms.

Size

Other factors besides slope that determine the right size for a raingarden are the soil texture, rainfall amounts, the size of the catchment area, and the distance from the downspout to the garden.

The texture of the soil affects its permeability and the speed with which water will infiltrate. A soil's textural class is determined by the sizes of the inorganic particles (sand, silt and clay) it contains and the percentage of each size particle.

Table 3. Soil particle sizes (USDA, 1993).

Soil particle	Particle diameter
Gravel	>2.0 mm
Sand	0.05 – 2.0 mm
Silt	0.002 – 0.05 mm
Clay	< 0.002 mm

Figure 3 shows the soil texture triangle with the different soil classifications. Sands have very coarse particles, while silty or clayey soils have very fine particles. Sands are quite permeable and water passes through them rapidly. Soils with lots of clay or silt restrict the movement of water.

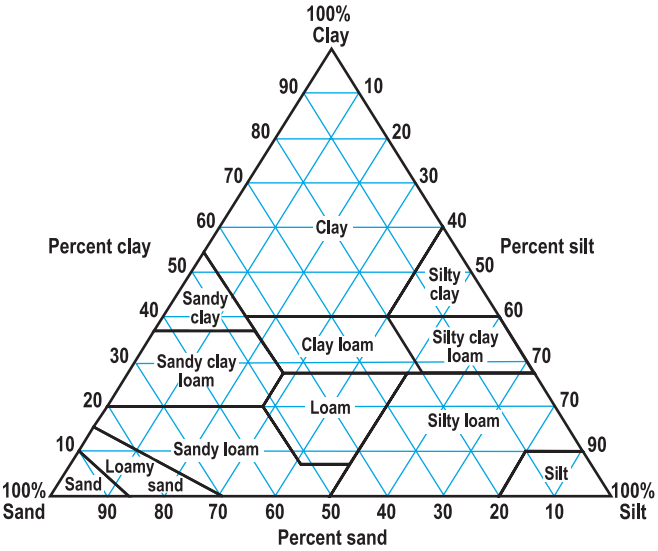

Figure 3. Soil texture triangle (USDA, 1993).

To determine the texture of the soil, look it up in the Natural Resource Conservation Service (NRCS) Soil Survey Reports (available at your county Extension office). Or, ask your county Extension agent to recommend someone with advanced knowledge of soils who can help you. Once the soil texture class is known, use Table 4 or 5 to determine the raingarden's surface area.

Table 4. Size factors for raingardens less than 30 feet from a downspout (Bannerman et al, 2003).

	3 to 5 inches deep	6 to 7 inches deep	8 inches deep
Sandy soil	0.19	0.15	0.08
Silty soil	0.34	0.25	0.16
Clayey soil	0.43	0.32	0.20

Table 5. Size factors for raingardens more than 30 feet from a downspout (Bannerman et al., 2003).

	All depths
Sandy soil	0.03
Silty soil	0.06
Clayey soil	0.10

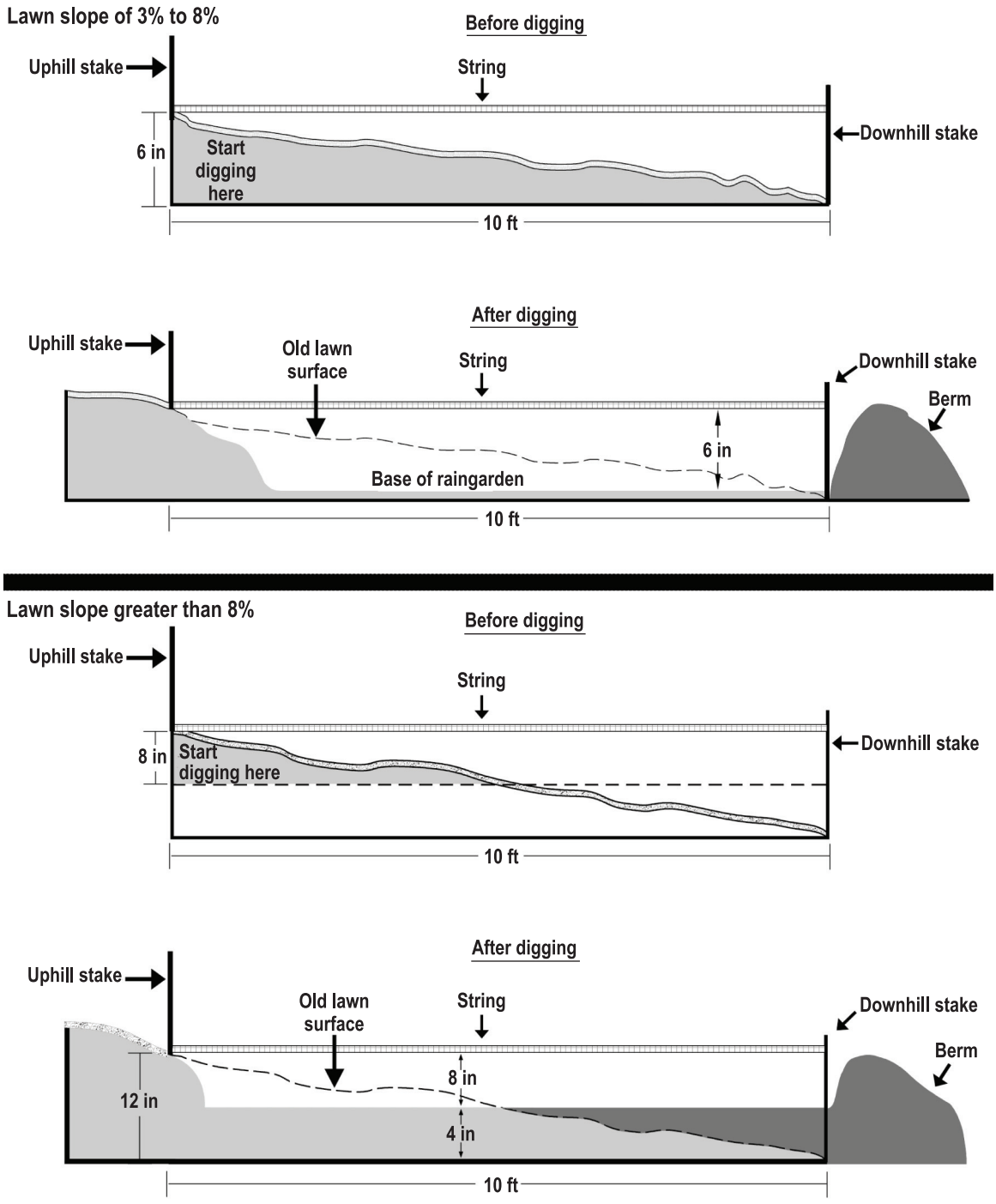

Figure 4. Suggested raingarden cut and fill patterns for different lawn slopes (from Bannerman, et al., 2003).

Use Table 4 if the raingarden will be less than 30 feet from a downspout, and Table 5 if it will be more than 30 feet from a downspout.

After finding the size factor based on the soil type and raingarden depth, multiply the size factor by the catchment area (the roof area that drains into the downspout plus the lawn area between the downspout and the raingarden).

The number obtained is the recommended surface area for the raingarden. If these calculations show that the raingarden area should be more than 300 square feet, it would be best to create several smaller gardens (Bannerman et al., 2003).

Example 1. A 2,000-square-foot house has four downspouts. Two downspouts (1,000 square feet of roof area) will drain into the raingarden. The raingarden will be placed 32 feet from the house. A strip of grass 25 feet wide and 32 feet long between the house and raingarden will drain into the raingarden. The soil is classified as sandy and the site has a slope of 8 percent. The raingarden surface area (RGSA) for this site would be 54 square feet.

RGSA = (roof area + grass drainage area) x 0.03 (from Table 5—>30 feet from downspout, sandy soil)

RGSA = [1,000 ft^2 (25 ft x 32 ft)] x 0.03

RGSA = (1,000 ft^2 + 800 ft^2) x 0.03

RGSA = 54 ft^2

The raingarden will be constructed with about a 2:1 length-to-width ratio, so the garden will be 10 feet along the contour and 5 feet wide.

Example 2. A 2,400-square-foot house has four downspouts (600 square feet of roof per downspout). The raingarden is 15 feet from the downspout. The soil is silty and the yard has a slope of 6 percent. A raingarden depth of 6 inches is chosen (Table 2) for the site. The raingarden surface area will be 150 square feet for one downspout.

RGSA = roof area for downspout(s) x 0.25 (Table 4—6 inches deep, silty soil)

RGSA = 600 x 0.25

RGSA = 150 ft^2

The raingarden will be constructed with about a 2:1 length-to-width ratio so the garden will be 17 feet along the contour and 9 feet wide.

Construction and Maintenance

Proper construction and maintenance will ensure that a raingarden is functional and enjoyable for years.

Raingardens are usually twice as long as they are wide, with the length being placed on the contour of the land or along the slope (Bannerman et al, 2003). The exact orientation can be based on what looks best at the site. It is important to make sure the bottom of the garden is level because high spots will cause water to puddle and not allow uniform infiltration.

It is important to keep from compacting the soil in the garden during construction. Compacted soil is less permeable and decreases the infiltration rate of the water. If the soil in the garden does become compacted during construction, loosen it with an aerator or tiller.

If the raingarden is located in a predominantly clay soil, adding some type of organic matter (such as compost, pine straw or leaf litter) will loosen the soil and make it more permeable. Till the organic material into the soil to a depth of 4 to 8 inches.

Berm

When creating the berm on the downhill side of the garden, use as much of the soil taken from the garden as possible. This will decrease the need for additional soil. Construct the berm with gentle side slopes so the garden blends into the surroundings. Note where the lowest point of the berm is and make sure it is protected from erosion. As the raingarden fills with rainwater, it is at this lowest point where the water will overflow.

Unlike the interior of the raingarden, the soil that forms the berm should be compacted as much as possible to create a sturdy barrier. As soon as possible, cover it with vegetation or mulch to prevent erosion.

A suggested berm orientation is shown in Figure 5.

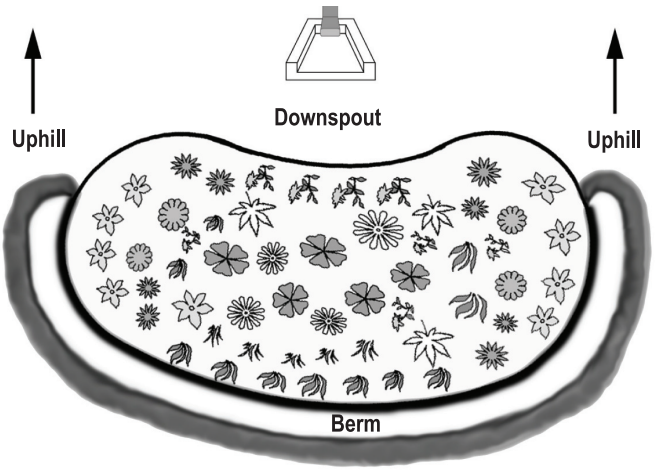

Figure 5. Placement and orientation of a raingarden berm (from Bannerman et al., 2003).

Plants

Do not use seeds to plant the interior of the raingarden because seeds can be washed away during the first rain. Instead, use 1- to 2-year-old plants that have established root systems. The roots will hold the soil in place and give the plants a good chance of surviving. Select plants with different heights, fragrances, bloom times and colors.

Weed the garden whenever weeds appear, especially during the first 2 years. After the first 2 years the garden plants should choke out most weeds, though occasional weeding will still be necessary. During dry periods the raingarden plants may need to be watered.

Each spring, cut the plants back to a height of 6 to 8 inches. The cut material can be left in the garden as mulch or removed. A raingarden will continue to function as long as it is properly maintained.

References

Applied Ecological Services, Inc. 2002. *Fulton Neighborhood Rainwater Management Fact Sheets*. *www.fultonneighborhood.org/lfrwm4.htm*

Bannerman, R. and Ellen Considine. 2003. *Rain Gardens: A how-to manual for homeowners.* Publication GWQ037. University of Wisconsin Extension.

Barr Engineering Company. 2001. *Minnesota Urban Small Sites BMP Manual: Stormwater Best Management Practices for Cold Climates.* Metropolitan Council Environmental Services. St. Paul, MN.

United States Department of Agriculture. 1993. *Soil Survey Manual.* Handbook No. 18. Washington, D.C.

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