Brought to you by WaterRICH: A RiverLink Initiative

Rain Gardens

Rain gardens are small vegetated depressions used to promote infiltration of rainfall runoff from roofs, driveways, and sidewalks. Rain gardens combine grasses, shrubs, and perennials with mulch and soil to filter pollutants in the water runoff. Vegetation is critical to the proper function of a rain garden and proper plant selection is important.

The following pages will assist you in designing, sizing and constructing a rain garden.

THINGS TO CONSIDER ABOUT YOUR RAIN GARDEN

- **Do not design within 10 feet of foundation**
- **Do not back water up against buildings or foundations**
- **Rain Gardens are an amenity**
- **Make sure to do a percolation test to determine the permeability of your location**
- **Be creative**

Evergreen Charter School

For more information contact:

RiverLink

170 Lyman Street
P.O. Box 15488
Asheville, NC 28813-0488

Phone: 828-252-8474
Fax: 828-253-6846
E-mail:
information@riverlink.org

WWW.RIVERLINK.ORG

Design

Rain gardens are best suited for well-drained sandy soils, but can be installed in areas with less permeable soils, such as clay. In Western North Carolina you can design the rain garden more as a constructed wetland, or as this guide suggests, by excavating soil material and replacing it with a more permeable soil mix. Rain gardens in impermeable soils shall be designed as a constructed wetland.

Advantages:

- Can be integrated into existing site easily
- Can be large or small, dependent on drainage area (max drainage area is 1 acre)
- Provide an aesthetically pleasing amenity
- Used at sites where storm sewers are not available
- Can provide groundwater recharge

Evergreen Charter School

Disadvantages:

- Ponding water may take 24 to 48 hours to drain
- Some maintenance, plant maintenance and keeping the basin clean, clean out overflow
- Should not be used for lots with high sediment loading, especially clay deposits

Design Considerations:

- Depression can be 6 to 18 inches in depth.
- Pre-treat runoff through overland sheet flow, for at least 4 feet at no more than 10% slope (i.e. 4' grass strip).
- Locate your Rain Garden in natural depressions or appropriately for water to drain into the depression through overland or gravitational flow.
- Rain Garden should not be within 10 feet of a building foundation.
- Locate at least 25 feet from septic tank or well head.
- Locate where the water table is at least 3 feet below the surface at the lowest point in the depression.

Sizing Rain Gardens

Sizing your Rain Garden:

The size of the rain garden is dependent on the area of impervious surface and the volume of water. In NC we try to capture runoff from the first inch of rain fall. To determine the size of your rain garden you need to determine to sources of runoff and the square footage of impervious surface.

If you take the total impervious area draining into the garden and divide that area by 20 you will get a rough estimate of the garden's area, at a depth of 6 inches. NCSU has developed a sizing chart for 6" and 3" depths.
http://www.bae.ncsu.edu/topic/raingarden/sizing.htm

Example: *5000 square foot impervious surface*
5000/20 = 250 sq. ft. at 6" depth

The State of Maryland, where original rain garden designs emerged, suggests the rain garden be 5 to 7% of the impervious area draining into the garden.
Example: *5000 square foot impervious surface*
5000x.05= 250 sq. ft or 5000x.07= 350 sq. ft.

Helpful Conversions

0.083 feet = 1 inch
0.01 meter = 1 cm
1 cubic foot = 7.48 gallons
1 cubic meter = 264.12 gallons

Calculate Runoff Volume Yourself:
Another easy way to calculate runoff is by multiplying the surface area by a coefficient (Table 1 on next page) that estimates the conditions of the particular conditions. This is then multiplied by the depth of rainfall to obtain a volume of runoff. To make the calculation easier you can assume that rainfall depth comes in units of 1 (1in or 1cm etc.), that way you'll know, for instance, how much runoff you'll have per inch of rainfall.

Here's the equation:
Volume Runoff = Surface Area x Runoff Coefficient x Rainfall Depth

Here's an example of how it works:
Step 1: Assess Site Conditions
In this example we will use a 2500 ft^2 lawn in poor condition that is covered only with approximately 45% grass

Step 2: Obtain Runoff Coefficient
Using the provided table (Table 1), look up the runoff coefficient that most closely resembles your site. In this case it is 0.68.

Step 3: Do the Math
Volume Runoff = Surface Area x Runoff Coefficient x Rainfall Depth
Volume Runoff = $550ft^2$ x 0.68 x 0.083ft = $31ft^3$
Note: Make sure that "Surface Area" and "Rainfall Depth" are in the same units. It doesn't matter what you use just stay consistent — measurements in feet or meters are generally easiest.

Step 4: Convert if Necessary
Most people have trouble thinking about water volume in cubic feet so we will convert to gallons multiplying by $7.48gal/ft^3$.
Volume Runoff = $31ft^3$ x 7.48 gal/ft^3 = 231.9 gallons

SO… In this example, for every inch of rain you can expect to harvest about 232 gallons of water.

Sizing Rain Gardens

Runoff Coefficients

Table 1: Runoff Coefficients

Soil Groups A and B are sandier and Soil Groups C and D are more clayey. These soil classifications would be found in a county soil survey available at any Soil and Water Conservation District office or North Carolina Cooperative Extension center.

Land Use/Cover	Soil Group A Very Sandy	Soil Group B Sandy	Soil Group C Clayey	Soil Group D Very Clayey
100% impervious (parking lots, rooftops, paved sidewalks or patios)	0.98	0.98	0.98	0.98
Open space with grass cover <50%	0.68	0.79	0.86	0.89
Open space with grass cover 50% to 75%	0.49	0.69	0.79	0.84
Open space with grass cover >75%	0.39	0.61	0.74	0.80
Woods in fair hydrologic condition	0.36	0.60	0.73	0.79
Residential lot (1/4 acre)	0.61	0.75	0.83	0.87
Residential lot (1/2 acre)	0.54	0.70	0.80	0.85
Residential lot (1 acre)	0.51	0.68	0.79	0.84

(Table adapted from USDA-NRCS Curve Numbers, 1986)

Implementation

Designing:

1. Begin by reviewing your overall site analysis to determine, based on the design considerations, the advantages and disadvantages of various rain garden placements to determine the best location.
2. Once your location is determined, use the runoff volume calculation to determine the water storage capacity needed for a 1 inch of rain (minimum). Base the size and spacing on your site goals as well. See next page to determine rain garden size.
3. Conduct a percolation test (Chapter One) to determine if the location is suitable for infiltration.
4. Once location and size are determined, lay out rain garden with marking flags or paint.
5. Begin digging out garden, approximately 4-8" deep with a depression in central ponding area.
6. Construct a berm (see Berm and Swale Complexes) with a 6" rise on the downhill edge of the garden.
7. Optional: Adding compost to the top layer of well drained soils will assist in infiltration and plant growth. For clayey or compacted soils, mix sand or gravel to improve infiltration.
8. Plant. See Appendix A for list of native rain garden plants for the Southern Appalachians.
9. Mulch with 2-3 inches of hardwood mulch .

MATERIALS

- Site Analysis
- Site Map
- Site Plan Schematic
- Calculator
- Flagging or Marking materials
- Spade
- Shovel
- Hard Rake
- Mattock
- Mulch
- Plants—Vegetation

OPTIONAL

- Sand/Gravel or Compost (optional) size varies by site

Maintenance:

1. Check berm for stability and possible areas of breaching, specifically after large storms.
2. Keep free of weeds and fine sediment.
3. Maintain mulch base (3" suggested)

Additional Resources

North Carolina Cooperative Extension: Backyard Rain Gardens:
http://www.bea.ncsu.edu/topic/raingarden/

Low Impact Development Center:
http://www.lowimpactdevelopment.org/raingarden_design/whatisaraingarden.htm

North Carolina Department of Environment and Natural Resources:
http://www.enr.state.nc.us/upclose/pages/raingarden.html

NC State University: Urban Waterways—Designing Rain Gardens:
http://www.scribd.com/doc/357/798425/Designing-Rain-Gardens-NC-State-University