Rain Garden Design
(Rooftop and Driveway/Parking Lot)
Rain Garden Design Checklist

- Determine drainage area (rooftop or driveway/parking lot)
- Measure drainage area
- Measure percent slope
- Correspond percent slope to rain garden depth
- Correspond drainage area to rain garden size using New Jersey’s Water Quality Design Storm (1.25” rain over 2 hours)
- Analyze soil (soil texture, percolation test, soil compaction)
- Determine soil amendments, if necessary
- Determine rain garden inlet
- Determine erosion potential
- Determine rain garden overflow
- Determine mulch quantity
- Determine plant quantity
- Summarize rain garden design
Rooftop Scenario

Determine Drainage Area & Measure Drainage Area

Possible Rain Garden

Hockman Farm, Winchester, Virginia
Determine Drainage Area & Measure Drainage Area

Driveway/ Parking Lot Scenarios

Possible Rain Garden

Drainage Area

Base

Height

Width

Length

Possible Rain Garden

Drainage Area

Width

Length
Area of Square/Rectangle = Length x Width

Width = 10’

Length = 15’

Area = 15’ x 10’

= 150 ft²

Area of Triangle = (Base x Height) / 2

Base = 20’

Height = 12’

Area = (20’ x 12’) / 2

= (240 ft²) / 2

= 120 ft²
Measure Percent Slope

\[
\frac{\text{Height}}{\text{Width}} \times 100 = \% \text{ Slope}
\]

Figure 3: The string should be tied to the base of the uphill stake, then tied to the downhill stake at the same level.
### Correspond Percent Slope to Rain Garden Depth

<table>
<thead>
<tr>
<th>Percent Slope</th>
<th>Typical Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 4%</td>
<td>3”-5”</td>
</tr>
<tr>
<td>5% - 7%</td>
<td>6”-7”</td>
</tr>
<tr>
<td>8% - 12%</td>
<td>8” maximum depth</td>
</tr>
<tr>
<td>&gt; 12%</td>
<td>Consider another location</td>
</tr>
</tbody>
</table>

**Exception:** Sites with poor percolation or high percentage of clay soils will be shallower with a larger surface area since they percolate slowly (see Tips for Rain Gardens in Clay Soils worksheet)
## Rain Garden Sizing Table
Based on New Jersey’s Water Quality Design Storm

<table>
<thead>
<tr>
<th>Drainage Area (ft²)</th>
<th>Size of 3” Deep Rain Garden (ft²)</th>
<th>Size of 6” Deep Rain Garden (ft²)</th>
<th>Size of 8” Deep Rain Garden (ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>200</td>
<td>100</td>
<td>75</td>
</tr>
<tr>
<td>750</td>
<td>300</td>
<td>150</td>
<td>112</td>
</tr>
<tr>
<td>1000</td>
<td>400</td>
<td>200</td>
<td>149</td>
</tr>
<tr>
<td>1500</td>
<td>600</td>
<td>300</td>
<td>224</td>
</tr>
<tr>
<td>2000</td>
<td>800</td>
<td>400</td>
<td>299</td>
</tr>
</tbody>
</table>
Correspond Drainage Area to Rain Garden Size using NJ’s Water Quality Design Storm

How did we do this?

\[
\text{Size of Rain Garden (square feet)} = \frac{\text{Drainage Area (square feet) \times NJ’s Water Quality Design Storm (feet)}}{\text{Depth (feet)}}
\]

Rooftop Example:

Rooftop #1:
- Length = 10’
- Width = 20’
- Drainage Area = Length \times Width
  \[= 10’ \times 20’ = 200 \text{ ft}^2\]

Rooftop #2:
- Length = 10’
- Width = 10’
- Drainage Area = Length \times Width
  \[= 10’ \times 10’ = 100 \text{ ft}^2\]

Total Drainage Area = DA of Rooftop #1 + DA of Rooftop #2
\[= 200 \text{ ft}^2 + 100 \text{ ft}^2 = 300 \text{ ft}^2\]

\[300 \text{ ft}^2 \times 0.1’ \left[\begin{array}{c} 0.50’ \end{array}\right] = 60 \text{ ft}^2 \text{ rain garden 6” deep}\]

Cheat Sheet
- NJ’s Water Quality Design Storm = 1.25” = 0.1’
- 3” = 0.25’
- 6” = 0.50’
- 8” = 0.67’

% Slope = 6%
= 6” deep rain garden
Correspond Drainage Area to Rain Garden Size using NJ’s Water Quality Design Storm

How did we do this?

\[
\text{Size of Rain Garden (square feet)} = \frac{\text{Drainage Area (square feet) \times NJ’s Water Quality Design Storm (feet)}}{\text{Depth (feet)}}
\]

Parking Lot Example:

Length = 20’
Width = 30’
Drainage Area = Length \times Width = 20’ \times 30’ = 600 \text{ ft}^2

\begin{align*}
\text{NJ’s Water Quality Design Storm} &= 1.25” \\
&= 0.1’ \\
\text{3”} &= 0.25’ \\
\text{6”} &= 0.50’ \\
\text{8”} &= 0.67’
\end{align*}

\[
\begin{align*}
[600 \text{ ft}^2 \times 0.1’] &= 240 \text{ ft}^2 \\
[0.25’] &= 3” \text{ deep}
\end{align*}
\]
- **Soil texture**
  
  **Soil Texture Test**
  
  Roll soil into a ball in hand and see how it forms
  
  - Hard ball – Clay/Silt soil
  - Soft ball – Loamy soil
  - No ball – Sandy soil

- **Percolation test**

- **Soil compaction**
  
  **Wire Flag Test**
  
  Poke wire flag in ground
  
  - Easily penetrates 6-8” or more
  - Compacted, difficult to insert

**Optimal sand content for a rain garden is 70%**
General Soil Amendments Amounts for a 100 sq ft Rain Garden that is 6 Inches Deep

<table>
<thead>
<tr>
<th>Soil Amendment</th>
<th>Amount for 100 sq ft Rain Garden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse Sand (Bank Run Sand)</td>
<td>1 cubic yard</td>
</tr>
<tr>
<td>Compost</td>
<td>1 cubic yard</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>Follow Soil Test Result Recommendations</td>
</tr>
<tr>
<td>Lime</td>
<td>Follow Soil Test Result Recommendations</td>
</tr>
</tbody>
</table>

Determine Soil Amendments, if necessary
Where will the excess stormwater runoff go in a heavy storm event?

- Overflow is away from buildings
- Berm higher near building
- Overflow sheets over lawn or garden
- Overflow sheets over driveway or walkway
- Flows onto street - an existing storm drain can be used as an outlet for a rain garden
How did we determine how much coarse sand to add?

<table>
<thead>
<tr>
<th>Class</th>
<th>Texture</th>
<th>Recommended Amendments</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Sandy</td>
<td>Compost helpful, but not required</td>
</tr>
<tr>
<td>B</td>
<td>Silt loam/Loam</td>
<td>Add 1”-2” concrete or bank-run sand</td>
</tr>
<tr>
<td>C</td>
<td>Sandy clay/Loam</td>
<td>Add 2”-4” concrete or bank-run sand</td>
</tr>
<tr>
<td>D</td>
<td>Clayey</td>
<td>Add 2”-4” concrete or bank-run sand</td>
</tr>
</tbody>
</table>

Use sand with a mixture of grain sizes. Do not use mason or ball field sand.

\[
\frac{\text{inches of sand}}{12} \times \frac{\text{Rain garden surface area in square feet}}{27} = \text{Cubic yards}
\]
Determine Rain Garden Inlet

How will the stormwater runoff enter the rain garden?

- Extended downspout/gutter
- Stone or concrete spillway
- Across lawn via a gradual slope
- Vegetated or stone-lined swales
- Diversion berm along the bottom of slope
- Paved surface
Will the velocity and erosion of the stormwater runoff be a problem?

- No
- Yes, erosion is possible. Address with:
  - Grading
  - Rocks or obstructions to slow flow
  - Rocks to stabilize
  - Erosion control blanket

Photo Credit: RCE of Monmouth County
Determine Mulch Quantity

• Triple-shredded hardwood mulch with no dye is used in a rain garden

• Mulch should be maintained at a 3 depth in a rain garden

• The benefits of mulch:
  • Keeps soil moist, which allows for percolation of rain water
  • Protects plants and makes weeding easier
  • Minimizes erosion of the rain garden soil
## Amount of Mulch Required for a Three Inch Thick Layer

<table>
<thead>
<tr>
<th>Size of Rain Garden</th>
<th>Approximate Amount of Mulch</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 square feet</td>
<td>0.25 cubic yard</td>
</tr>
<tr>
<td>50 square feet</td>
<td>0.50 cubic yard</td>
</tr>
<tr>
<td>100 square feet</td>
<td>1.0 cubic yard</td>
</tr>
<tr>
<td>200 square feet</td>
<td>2.0 cubic yards</td>
</tr>
</tbody>
</table>

(Triple-Shredded Hardwood Mulch with No Dye)
## Approximate Amount of Plants Based on Future Mature Size

<table>
<thead>
<tr>
<th>Size of Rain Garden</th>
<th>Approximate Amount of Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 square feet</td>
<td>1 Small Tree (Optional)&lt;br&gt;7 Shrubs&lt;br&gt;24 Herbaceous Species</td>
</tr>
<tr>
<td>200 square feet</td>
<td>1 Small Tree (Optional)&lt;br&gt;14 Shrubs&lt;br&gt;48 Herbaceous Species</td>
</tr>
</tbody>
</table>

Leonard Park, Morris County
Summarize Rain Garden Design

• Determine rain garden size and depth, what soil amendments are needed (if necessary), mulch quantity, plant quantity, and other materials (river rock, deer fencing, soaker hose, etc.)

• Use the Rain Garden Site Visit Worksheet (Pre-Installation) for assistance!