

BMP T5.14A: Rain Gardens

Purpose and Description

Rain gardens are typically small, non-engineered shallow depressions with amended soils and plants adapted to local conditions. Rain gardens remove stormwater that fills the depression via infiltration into the native soil, while excess stormwater overflows into an adjacent drainage system.

Applications, Limitations and Setbacks

Rain Gardens are to be used to the maximum extent feasible for runoff from roofs and other hard surfaces unless a higher priority BMP is feasible.

Rain Gardens are suitable for infiltration if the minimum measured infiltration rate is 0.3 in/hr or greater. See Section 5 for more information on soil assessments and infiltration tests conducted for Rain Gardens.

Setbacks

- 50 feet from the top of slopes greater than 20% or with more than 10 feet of vertical relief.
- 100 feet from a landfill (active or closed).
- 100 feet from a drinking water well or a spring used for drinking water.
- 10 feet from any small on-site sewage disposal drain field, including reserve areas, and grey water reuse systems. For setbacks from a “large on-site sewage disposal system,” see Chapter 246-272B WAC.
- From an underground storage tank and its connecting pipes that is used to store petroleum products, chemicals, or liquid

hazardous waste in which 10% or more of the storage volume of the tank and connecting pipes is beneath the ground:

- 10 feet when the system capacity is 1100 gallons or less.
- 100 feet when the system capacity is greater than 1100 gallons.
- 100 feet from an area with known deep soil contamination.
- 10 feet from any property line or structure unless a qualified professional provides a written document stating that the structure will not be affected by the proposed location.

Because rain gardens can add phosphorus to stormwater from soil amendments and/or plant material:

- Imported compost shall not be used if the site is within 1/4 mile of a phosphorous-sensitive water body.
- An underdrain shall not be used if drainage would be routed to a phosphorous-sensitive waterbody.

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For an alternate format, contact the Clark County ADA Compliance Office.
Phone: (360) 397-2322
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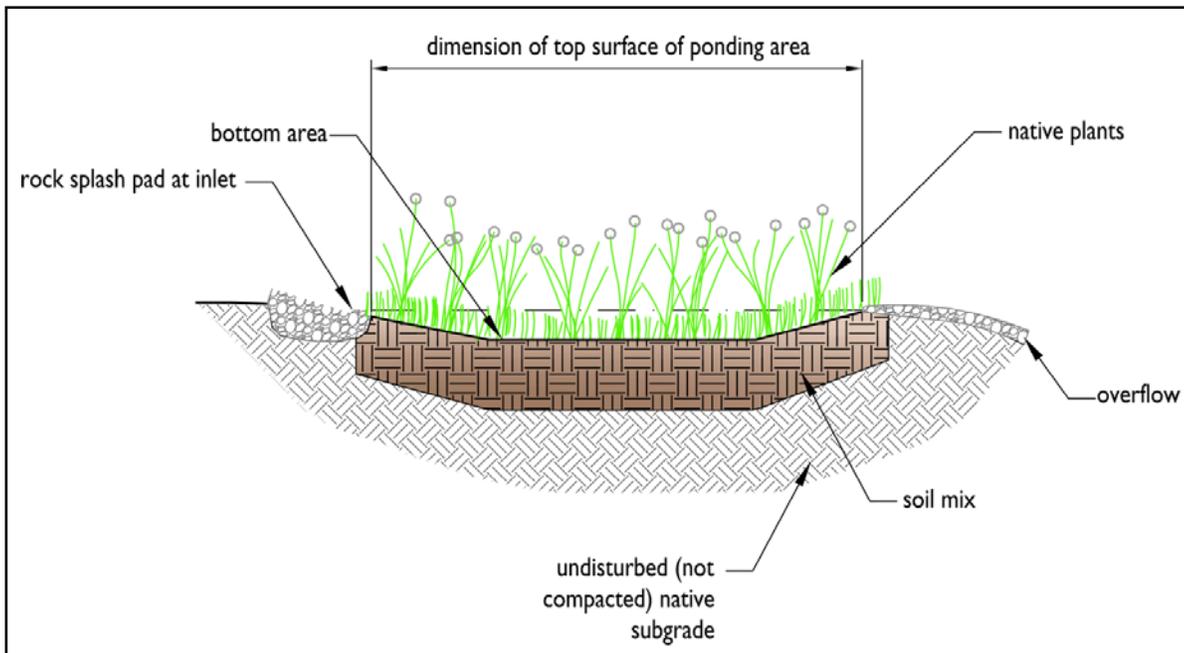


Figure 1: Schematic of Typical Rain Garden

(Source: redrawn from Oregon State University Extension)

Infeasibility

The following criteria describe conditions that make Rain Gardens infeasible to meet Minimum Requirement #5. Citation of any of the infeasibility criteria must be based on an evaluation of site-specific conditions and documented in the LID Feasibility Checklist. Rain Gardens are considered infeasible under the following conditions:

- Where the Responsible Official has determined that the BMP is not compatible with surrounding drainage systems.
- Where the land for the BMP is within an area designated as an erosion hazard or landslide hazard by the geotechnical report or county critical areas mapping.
- Where the site cannot reasonably be designed to locate the BMP on slopes less than 8%.
- On properties with known soil or

groundwater contamination (typically federal Superfund sites or state cleanup sites under the Model Toxics Control Act (MTCA)) and any of the following criteria:

- The proposed BMP is within 100 feet of an area known to have deep soil contamination. [Note: this criterion is also found in Setbacks.]
- The site is in an area where groundwater modeling indicates infiltration will likely increase or change the direction of the migration of pollutants in groundwater.
- The proposed BMP is located in an area where surface soils have been found to be contaminated, and contaminated soils are still in place within 10 horizontal feet of the infiltration area.
- The BMP would be within any area where it would be prohibited by an

- approved cleanup plan under the state Model Toxics Control Act or Federal Superfund Law, or an environmental covenant under Chapter 64.70 RCW.
- Where the minimum vertical separation of one foot to seasonal high water table, bedrock or other impervious layer cannot be achieved below a Rain Garden.
 - Where field testing indicates that soils have a measured (a.k.a. initial) native soil coefficient of permeability less than 0.3 inches per hour. [Note: an LID infiltration BMP may still be feasible with the use of an underdrain to help meet Minimum Requirements #6 or #7, depending on soil and filtration media characteristics.]
 - Where the site cannot reasonably be designed to avoid placing the rain garden within setbacks given above.
 - Where a professional evaluation demonstrates that any condition below is met:
 - Where a professional geotechnical evaluation recommend infiltration not be used due to reasonable concerns about erosion, slope failure or down gradient flooding.
 - Where the site has groundwater that drains into an erosion hazard or landslide hazard area.
 - Where the only area available for siting the BMP threaten the safety or reliability of pre-existing underground utilities, pre-existing underground storage tanks, pre-existing structures and basements, or pre-existing road or parking lot surfaces.
 - Where infiltrating water would threaten existing below grade basements.
 - Where infiltrating water would threaten shoreline structures such as bulkheads.
 - Where the only area available for siting the BMP is one that does not allow for a safe overflow pathway to the municipal separate storm sewer system or to a private storm sewer system.
 - Where the site is a redevelopment project that lacks usable space.
 - Where the site is a public road project that lacks sufficient space within existing public right-of-way.

Design Criteria

The design criteria and procedures in this section are adapted from the [Rain Garden Handbook for Western Washington: A Guide for Design, Installation, and Maintenance \(Ecology, 2013\)](#). Users may reference the handbook for additional design specifications and construction guidance. If information in the handbook conflicts with information in this manual, the information in this manual shall apply.

Site Considerations

Due to the geologic and topographical conditions in Clark County, not all sites are suitable for rain gardens. A rain garden should not:

- Be placed over existing utilities. Contact utility locate services in the early design stages.
- Be located in areas that would require disturbing healthy native soils, trees, and other vegetation—these areas

already do a good job of filtering and storing stormwater.

- Be located where there is high groundwater during the winter. A minimum of one foot of separation is required between the lowest elevation of the rain garden soil or any underlying gravel infiltration layer and the seasonal high groundwater elevation or other impermeable layer.

Pond Area

- The ponding depth must be 6" minimum and 12" maximum.
- The pond must have a flat and level bottom.
- The minimum freeboard measured from the maximum ponding water surface elevation to the top of the facility shall be 2" for drainage areas less than 1,000 square feet and 6" for drainage areas 1,000 square feet or greater.
- If a berm is used to achieve the minimum top elevation, maximum slope on berm shall be 2H:1V and minimum top width of design berm shall be 1 foot. Berm shall be a material which is water tight. Imported soil may be necessary to ensure berm does not fail. Berm shall be tightly packed during construction.

Sizing Requirement and Procedure

Use this sizing procedure to determine the required area of the top surface of the pond. A rain garden built using this procedure will capture approximately 80% of the water that flows to it.

Size the top surface of the pond by applying a sizing factor determined using the steps below to the total contributing area flowing to the rain garden. If meeting Minimum

Requirement #5, in no case shall the sizing factor be less than 5%.

1. Calculate the area of the contributing drainage in square feet.
 - a. Include all types of surfaces draining to the rain garden including, but not limited to, roofs, driveways, patios, landscaping, and lawn.
2. At the location where the rain garden will be installed, find the infiltration rate of the soil following instructions in Book 1, Section 2.3.1.4. (Note: the *Rain Garden Handbook*, cited above, describes a different procedure for determining soil infiltration rate which is not accepted by Clark County.)
3. Determine the mean annual rainfall at the site (see map at Figure 15).
4. Use Table 1, below, and the information from steps 2 and 3, to determine the sizing factor.
5. Multiply the contributing area and the sizing factor to find the top surface area of the pond (see Figure 14 for an illustration of the top surface of the ponding area).

Table 1: Rain Garden Sizing Factors

Average Annual Precipitation (In.)	Soil Infiltration Rate				
	0.10 – 0.24 inches/hour¹	0.25 – 0.49 inches/hour²	0.50 – 0.99 inches/hour	1.00 – 2.49 inches/hour	2.5 or more inches/hour
< 30	8%	7%	7%	6%	6%
30 - 40	14%	10%	8%	6%	6%
40 - 50	16%	11%	8%	7%	6%
50 – 70	19%	12%	10%	7%	6%
70 – 90	23%	15%	11%	9%	6%
> 90	28%	18%	13%	10%	7%

¹ At these low drainage rates, the maximum ponding depth is 6 inches. A 12-inch pond will not drain down quickly enough.

² If meeting Minimum Requirement #5, a rain garden is not required if the infiltration rate is less than 0.30 inches/hour.

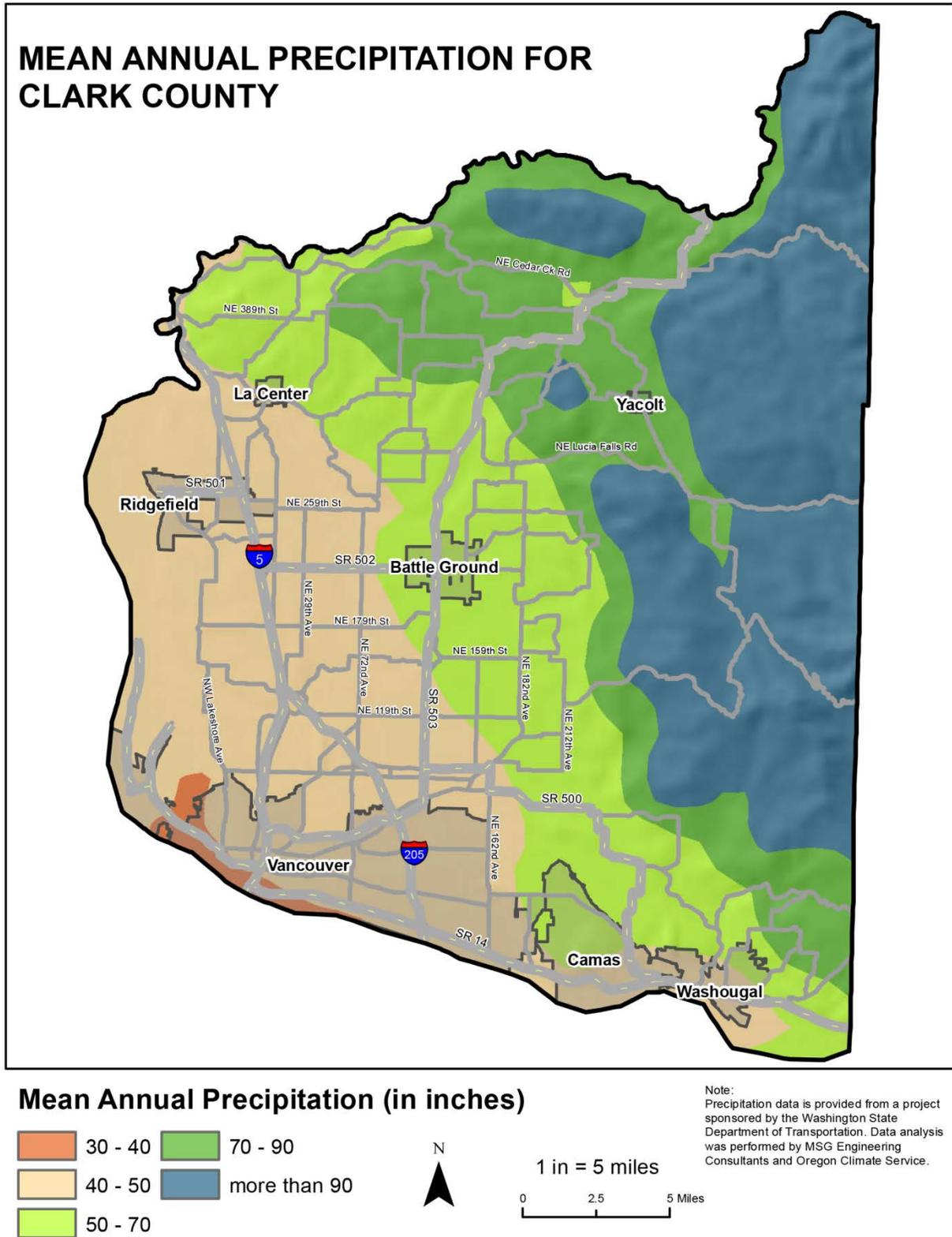


Figure 15: Mean Annual Precipitation in Clark County

Flow Entrances

- Dispersed across a landscaped area. For sheet flow into a rain garden, include at least a 1 inch drop from the edge of the contributing impervious surface. This drop is intended to allow for less frequent maintenance due to sediment/debris buildup.
- Dispersed through an open swale. For slopes greater than 2%, add rock check dams every 5 to 10 feet to slow water flow.
- Pipe flow entrance. Place a rock pad where stormwater enters the rain garden from a swale or pipe. It is recommended to use washed round rock that is a minimum of 2 inches in diameter. Rock pad should be 4" thick and 2 feet wide and extend 2 feet to reduce potential for erosion at the inlet.
- Do not place plants directly in the entrance flow path as they can restrict or concentrate flows.
- Install flow diversion and erosion control measures to protect the rain garden from sedimentation until the upstream area is stabilized.

Overflow

- Provide an overflow pathway lined with a 4" thick washed rock pad. Washed rock shall be a minimum of 2 inches in diameter. Extend overflow 4 feet past rain garden edge.
- Overflow shall not be directed to structures, neighboring properties, or over sidewalks.
- Overflow shall not cause damage to downstream properties or receiving waters.

- The minimum freeboard from the invert of the overflow stand pipe, horizontal drainage pipe or earthen channel shall be 6 inches.

Soil Mix

Rain garden soil mix is the medium that supports plant growth and allows water to infiltrate downward into the undisturbed native subgrade (see Figure 14). Rain garden soil mix is usually a mix of topsoil and compost or sand and compost.

Place rain garden soil mix to a depth of between 12 inches and 24 inches.

There are three methods to achieve a proper rain garden soil mix.

Method 1: Excavate and Replace Soil

Excavate the full depth and replace existing soil with a rain garden soil mix. A rain garden soil mix typically contains about 60% sand and 40% compost by volume.

Use this method if:

- Clay content is greater than 5% (infiltration rate is less than 0.24 inches per hour).
- In gravel soils as plant growth will be inhibited (infiltration rates typically above 2.5 inches per hour).

Method 2: Excavate and Amend Topsoil with Compost

Excavate the rain garden and amend the removed topsoil with compost using 65% excavated soil to 35% compost.

Use this method if soils have a moderate infiltration rate (0.25 to 0.49 inches per hour).

Method 3: Amend Topsoil in Place

Excavate to the ponding depth plus 3 inches. Amend soil in place by spreading 3

inches of compost and tilling to depth of 4 to 5 inches to fully incorporate compost. Use this option only if the infiltration rate is 1 inch per hour or greater in soil that supports plant growth.

Rain garden soil mixes may be available at local landscape suppliers or nurseries.

Compost

Compost used to amend soils should have the following characteristics:

- Be stable and mature (capable of supporting plant growth) and made from organic waste materials.
- Have an earthy, non-sour smell.
- Be brown to black in color.
- Be a crumbly texture with mixed particle sizes.
- Be a stable temperature. Do not use mushroom compost, un-composted manure, pure bark, biosolids, or sawdust.

Planting

In general, the predominant plant material used in rain gardens are species adapted to stresses associated with wet and dry

conditions. Soil moisture conditions will vary within the facility from saturated (bottom of cell) to relatively dry (rim of cell). The minimum requirements associated with the vegetation design include the following:

- The plants must be sited according to sun, soil, wind, and moisture requirements of the plant.
- Plants shall have a maximum mature plant height of 3 feet to minimize the need for extensive pruning that could impact the function of the rain garden in future years.
- Select plants based on suitability for maintenance, including factors such as minimal pruning needs and minimal plant debris (e.g. fruits, bark).
- Minimize plantings around the inlet and outlet to maintain desired water flow.
- At a minimum, provisions must be made for supplemental irrigation during the first two growing seasons following installation.

Table 2: Plant List for Rain Garden*

Moist to Wet Soil Conditions (Facility Bottom to Bottom of Overflow)				
Type	Botanical Name	Common Name	O.C. Spacing	Allowed ROW**
Herbaceous	<i>Carex densa</i>	Dense sedge	12"	Y
Herbaceous	<i>Carex morrowii</i>	Ice Dance	12"	Y
Herbaceous	<i>Carex obnupta</i>	Slough Sedge	12"	N
Herbaceous	<i>Deschampsia cespitosa</i>	Tufted Hair Grass	12"	N
Herbaceous	<i>Juncus patens</i>	Spreading Rush	12"	Y
Shrub	<i>Cornus sericea 'Kelseyii'</i>	Kelsey Dogwood	24"	Y
Shrub	<i>Spiraea betulifolia</i>	Birchleaf Spiraea	24"	N
Shrub	<i>Spiraea densiflora</i>	Sub-alpine Spiraea	24"	Y
Shrub	<i>Spiraea japonica</i>	Japanese spirea cultivars	24"	Y

Groundcover	<i>Rubus calcynoides & pentalobus</i>	Creeping Bramble	12"	N
Accent	<i>Camassia leichtinii</i>	Great Camas	12"	N
Accent	<i>Camassia quamash</i>	Common Camas	12"	N
Tree	<i>Acer campestre 'Evelyn'</i>	Elizabeth Hedge Maple	30'	Y
Tree	<i>Betula jacquemontii</i>	Jacquemontii Birch	60'	N
Tree	<i>Celtis occidentalis</i>	Hackberry	50'	N
Tree	<i>Koelreuteria paniculata</i>	Goldenrain Tree	30'	Y
Tree	<i>Nyssa sylvatica</i>	Black tupelo	50'	Y
Tree	<i>Prunus virginiana 'Canada Red'</i>	Canada Red Chokecherry	25'	Y
Tree	<i>Quercus shumardii</i>	Shumard Oak	70'	Y
Tree	<i>Rhamnus purshiana</i>	Cascara	30'	N

Dry Soil Conditions (Overflow and Above)

Type	Botanical Name	Common Name	O.C. Spacing	Allowed ROW
Herbaceous	<i>Deschampsia cespitosa</i>	Tufted Hair Grass	12"	N
Herbaceous	<i>Helictotrichon sempervirens</i>	Blue Oat Grass	12"	Y
Shrub	<i>Cornus sericea 'Kelseyii'</i>	Kelsey Dogwood	24"	Y
Shrub	<i>Euonymous japonicas 'Microphyllus'</i>	Boxleaf Evergreen	24"	Y
Shrub	<i>Mahonia aquifolium 'Compacta'</i>	Oregon Grape	24"	Y
Shrub	<i>Spiraea betulifolia</i>	Birchleaf Spiraea	24"	N
Shrub	<i>Spiraea densiflora</i>	Sub-alpine Spiraea	24"	Y
Shrub	<i>Spiraea japonica</i>	Japanese spirea cultivars	24"	Y
Groundcover	<i>Arctostaphylos uva-ursi</i>	Kinnickinnick	12"	Y
Groundcover	<i>Fragaria chiloensis</i>	Coastal Strawberry	12"	Y
Groundcover	<i>Mahonia repens</i>	Creeping Oregon Grape	12"	N
Accent	<i>Camassia leichtinii</i>	Great Camas	12"	N
Accent	<i>Camassia quamash</i>	Common Camas	12"	N
Tree	<i>Acer campestre 'Evelyn'</i>	Elizabeth Hedge Maple	30'	Y
Tree	<i>Celtis occidentalis</i>	Hackberry	50'	N
Tree	<i>Koelreuteria paniculata</i>	Goldenrain Tree	30'	Y
Tree	<i>Prunus virginiana 'Canada Red'</i>	Canada Red Chokecherry	25'	Y
Tree	<i>Quercus shumardii</i>	Shumard Oak	70'	Y
Tree	<i>Rhamnus purshiana</i>	Cascara	30'	N

Selected plants shall not include any plants from the State of Washington Noxious Weed List. Refer to clark.wa.gov/weed/ for a current list of noxious weeds.

*Adapted from Portland Bureau of Environmental Services 2014 Stormwater Management Manual, Appendix F.4., Planting Templates and Plant Lists

** Plant species allowed in Clark County street Rights of Way

Mulch Layer

Rain garden facilities should be designed with a mulch layer. Properly selected mulch material reduces weed establishment, regulates soil temperatures and moisture, and adds organic matter to the soil

- Mulch should be free of weed seeds, soil, roots, and other material that is not trunk or branch wood and bark. Mulch shall not include grass clippings, mineral aggregate, pure bark, or beauty bark. Mulch should be coarse mulch.
- Mulch should be wood chip mulch composed of shredded or chipped hardwood or softwood, depth 2-3 inches. Additional rain garden depth will be needed to ensure appropriate ponding and freeboard.
- A dense groundcover can be used as an alternative to mulch although mulch should be used until the dense groundcover is established.

General Construction Criteria

- Do not install media or excavate rain garden during soil saturation periods.
- Excavation and soil placement should be done from equipment operating

adjacent to the facility – no heavy equipment should be operated in the facility to avoid compacting soils

- If equipment must be operated within the facility for excavation, use lightweight, low ground pressure equipment and scarify the base to reduce compaction upon completion. Do not use equipment on top of rain garden soil mix.
- Do not use fully excavated rain garden for erosion and sedimentation control during construction
- Scarify sides and bottom to roughen where equipment may have compacted soil.
- Clogged soil and silt shall be removed during excavation to finished bottom grade prior to installing rain garden soil mix
- Ensure the rain garden is protected from erosion and sedimentation until all contributory areas are fully stabilized.
- If sedimentation occurs within the rain garden, excavate the area a minimum of 12 inches below final grade to remove sediment and replace media, mulch, and plants as necessary.