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Rain Garden Overview and Design

LOUTTIT LIBRARY

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RI Residential Rain Garden Training

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Presentation Outline

- What are rain gardens?
- Siting Applications
- Siting Checklist
- Site Assessment Considerations
- Rain Garden Elements
- Bioretention 101

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What is a rain garden?

- Short answer:
  - *A depression in the landscape designed to collect and infiltrate stormwater*

- Besides performing this function, they also look really nice…

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What's going on in there?

- **Reduction in stormwater volume**
  - Infiltration and evapotranspiration
- **Filtration of coarse particles**
  - Sediment and bacteria
- **Pollutants retained**
  - Taken up by plants (nitrogen, phosphorus)
  - Adsorbed to mulch, soils, or organic matter (metals)
  - Broken down by microorganisms and sunlight (hydrocarbons, bacteria)
  - Converted to gaseous form

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A Word on Terminology…

- **BIORETENTION**: Commercial applications-engineered design, modified soils, usually have underdrains
  - RI DEM Stormwater Design and Installation Standards Manual
  - Prince George's County, MD
- **RAIN GARDENS**: Home-scale, not typically engineered, use existing soils
  - CRMC and RIDEM small site guidance
  - Wisconsin design manual
  - UConn design manual
  - Rutgers design manual

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Different siting applications

- Take water from:
  - Roof
  - Parking lot/road
  - Turf/mixed use

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Siting Applications: Roof

- Typically intercept gutter downspout leader
  - Can pipe directly to rain garden or run over pervious area first
- Drains to turf, sloped to garden

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Siting Applications: Parking lots/roads

- Either curbless or use curb cuts

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Siting Applications: Parking lots/roads

- Curbless

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Siting Applications: Parking lots/roads

- Provide forebay or turf filter area for sediment accumulation and cleanout
  - Preserves integrity of garden
  - Easier to maintain

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Siting Applications: Alternate cul-de-sac

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Rain Garden Siting

Residential Rain Garden Training – West Greenwich Installation Site Checklist

FACTOR	PREFERRED	West Greenwich Library
Distance from well > 25'	Yes	Yes
Distance from septic system > 15'	Yes	Yes
Distance from foundation > 10'	Yes	Yes
Predominant Soil Texture	Sandy loam or loam	Loam
Infiltration Rate of Native Soil	2 inches/hour	4 inches/hour
Slope – less than 8%?	Less than 8%	~12" rise / 180" run = 6.6%
Proximity to drainage area	Within 30 feet	Within 30 feet
Solves existing stormwater problem (i.e. flooding, downspout into drain)?	Yes	Yes; downspout into drain
Location within drinking water supply, TMDL or SRPW area?	Yes	No
Visibility of location	High	High; in front of town library
Opportunity to use in education programs (i.e. school location)	Yes	Yes
Municipal support (labor, $$)	Yes	Yes; DPW in-kind labor, plant and materials $$
Overflow area	Yes	Yes (existing planting bed)
Full sun to partial sun	Yes	Yes

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Rain Garden Siting

CHECKLIST:

- At least **10 feet from foundation** with basement or where top of foundation is below ponding level
- At least **15 feet from septic system**
- At least **25 feet from private drinking well**
- **Within 30 feet of drainage area**
- **Within area with Full to partial sun**

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Rain Garden Siting

CHECKLIST:

- Predominant Soil texture = **Sandy loam or loam**
- **Infiltration rate = at least 1.5 inches/hour**
- **Slope is less than 8%** (rise/run)
- **Sited to most effectively catch storm runoff** from roof, parking lot/driveway or slope
- **Overflow area present**

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Rain Garden Siting

CHECKLIST:

- Avoid areas with:
  - Shallow (<3 feet) depth to bedrock
  - Seasonal high water table (<2ft from bottom)
  - Ponding water
- Be aware of the infiltration capacity of native soils

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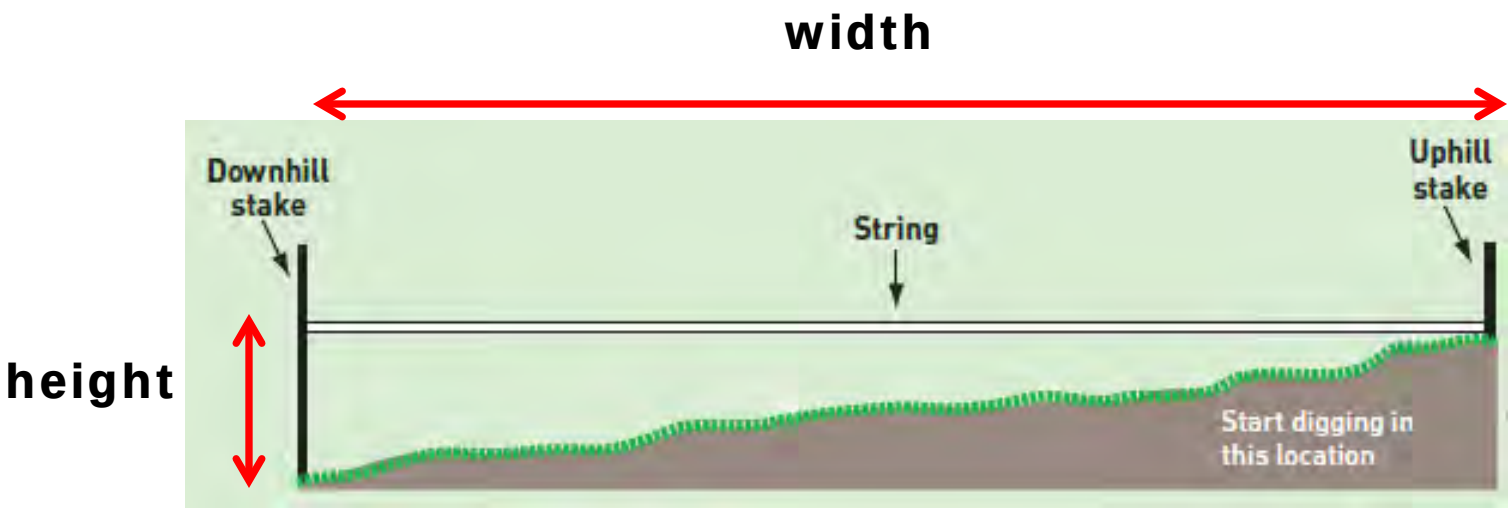
Site Assessment Considerations: Slope



Height / Width x 100 = % Slope

- For flat areas, no berm needed
- Moderate slopes, use berm
- Heavier slopes, use retaining wall design
- **More than 12% slope, look for another location**

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Site Assessment Considerations: Soils

- **Simple Percolation Test**
  - Dig hole 12” deep by 6” wide and fill with water.
  - If there is still water in the hole after 24 hours, the site is **not suitable** for a rain garden
  - 1.5” water draining per hour is ideal

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Site Assessment Considerations: Soils

- My infiltration rate is only 0.8 inches per hour…will it still work?
  - **YES, with some simple amendments or sizing adjustments**
- My infiltration rate is only 0.5 inches per hour…will it still work?
  - Perhaps…but find out why

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Site Assessment Considerations: Soils

<u>Ball Test:</u> Squeeze a moistened ball of soil in the hand

- **Soils break with slight pressure -** Sand or sandy loam
- **Stay together but change shape easily -** Sandy loams and silt loams
- **Soils resist breaking -** clayey or clayey loam

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Site Assessment Considerations: Soils

- **Ribbons less than 1”**
  - Feels gritty = coarse texture (sandy) soil
  - Not gritty feeling = medium texture soil high in silt
- **Ribbons 1-2”**
  - Feels gritty = medium texture soil
  - Not gritty feeling = fine texture soil
- **Ribbons greater than 2” = fine texture (clayey) soil**

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Site Assessment Considerations: Soils

- Send sample to UMass or Uconn Extension Office for sand/silt/clay and/or nutrient analysis
- **Sandy or loamy soils best, but others can be used with amendments**

University of Connecticut College of Agriculture and Natural Resources

UMASS EXTENSION

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Site Assessment Considerations: Soils

- **What if the texture is OK, but the soil doesn't drain?**
  - **Might mean High water table**
    - Pick a different site or see difficult sites information
  - **Compaction-the silent killer of rain gardens…**
    - New construction especially prone

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Site Assessment Considerations: Compaction

- AVOID COMPACTION!!!
  - Compacted soil **will cause** a rain garden to fail
- If it is highly compacted, need to remove, or loosen and aerate
- SOIL COMPACTION before and during construction

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Site Assessment Considerations: Soil Amendments for Compaction

- For compaction, loosen up and remove some of the compacted soil, and replace with sand/compost mixture
- For clay soils (rare in RI):
  - Make garden larger (based on soil sizing coefficient) and shallower, and amend with sand and some compost
- For very sandy soils:
  - Amend with compost to slow down the infiltration
- For urban fill soils, other adjustments may be needed

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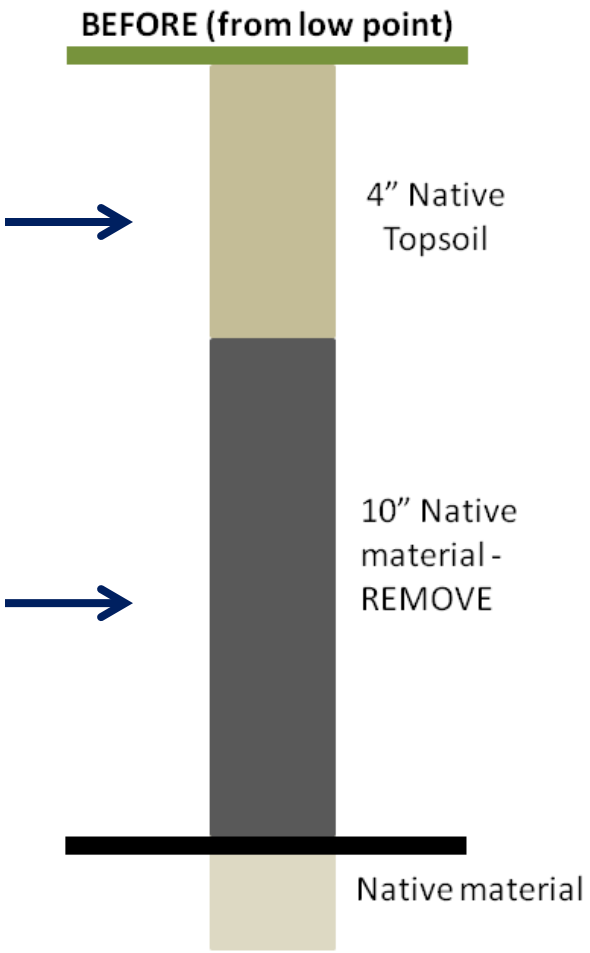
Louttit Library Soil Considerations

Well-drained
High organic matter
Retain onsite

Not-so-well drained
Low organic matter
Remove offsite



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Louttit Library Site Specific Limitations

- Part shade
- Separate gutters
- Slope
- Adjacent planting bed
- Bench

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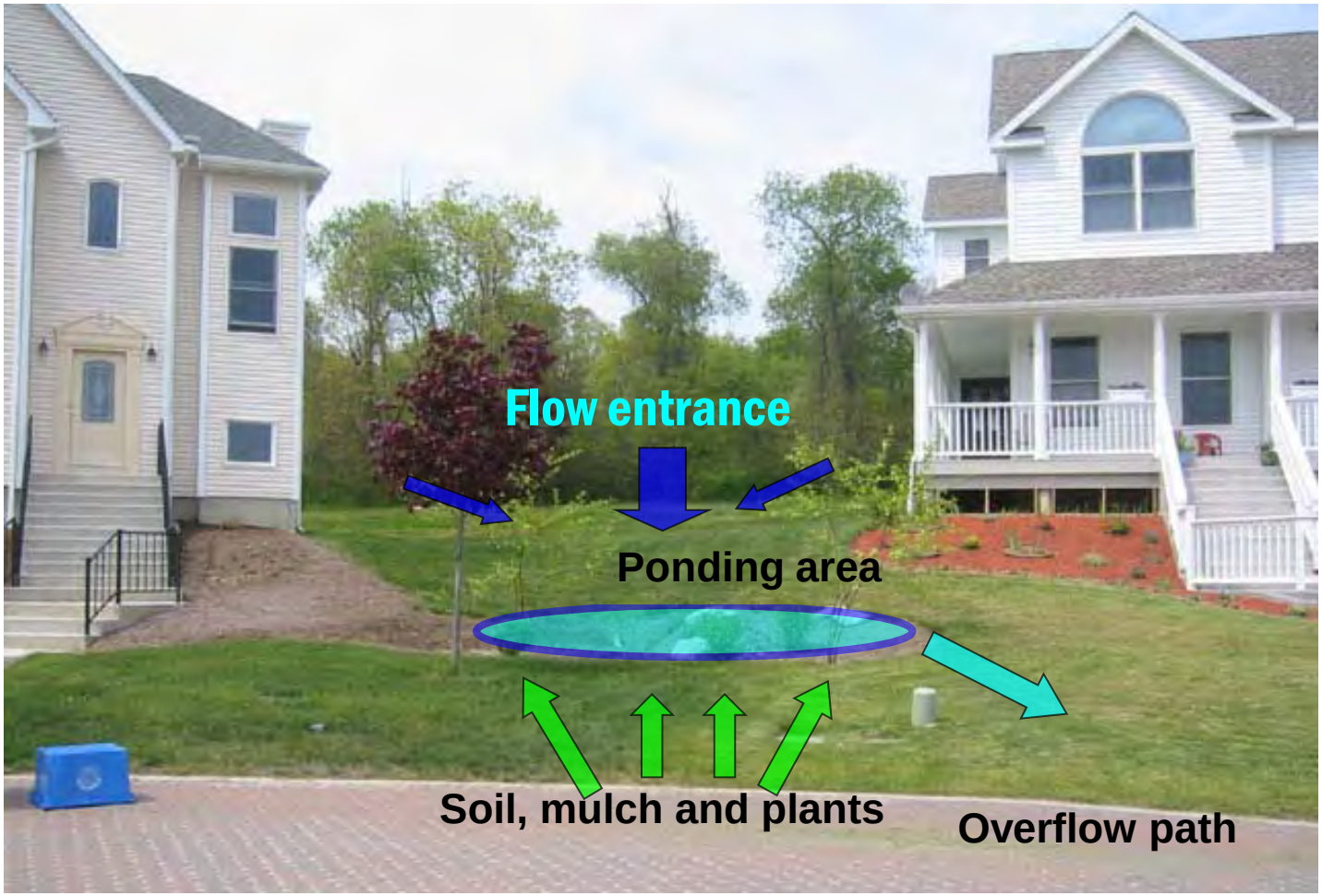
Rain Garden Elements

Vegetated areas designed to infiltrate and process stormwater



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Rain Garden Elements

- **Berm**
  - Not necessary on flat slopes
  - Necessary on moderate slopes (3-11%)
- **Depression**
  - Must be flat, always!
- **Ponding Area**
  - Must be flat
  - Ponding is good, but not for more than 24 hours
- **Flow Path / Forebay**
  - Prepared with gravel to slow down inflow of runoff

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Ponding area

- Ponding is good, but not for more than 24 hours

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Flow Path / Forebay

- **Where flow is concentrated or coming out of a pipe, provide something to break up the energy**
  - Reduces erosion potential

Gravel forebay

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Overflow

- **Overflow consideration**
  - Identify lawn or wooded area adjacent to rain garden to act as overflow when runoff volume exceeds rain garden capacity

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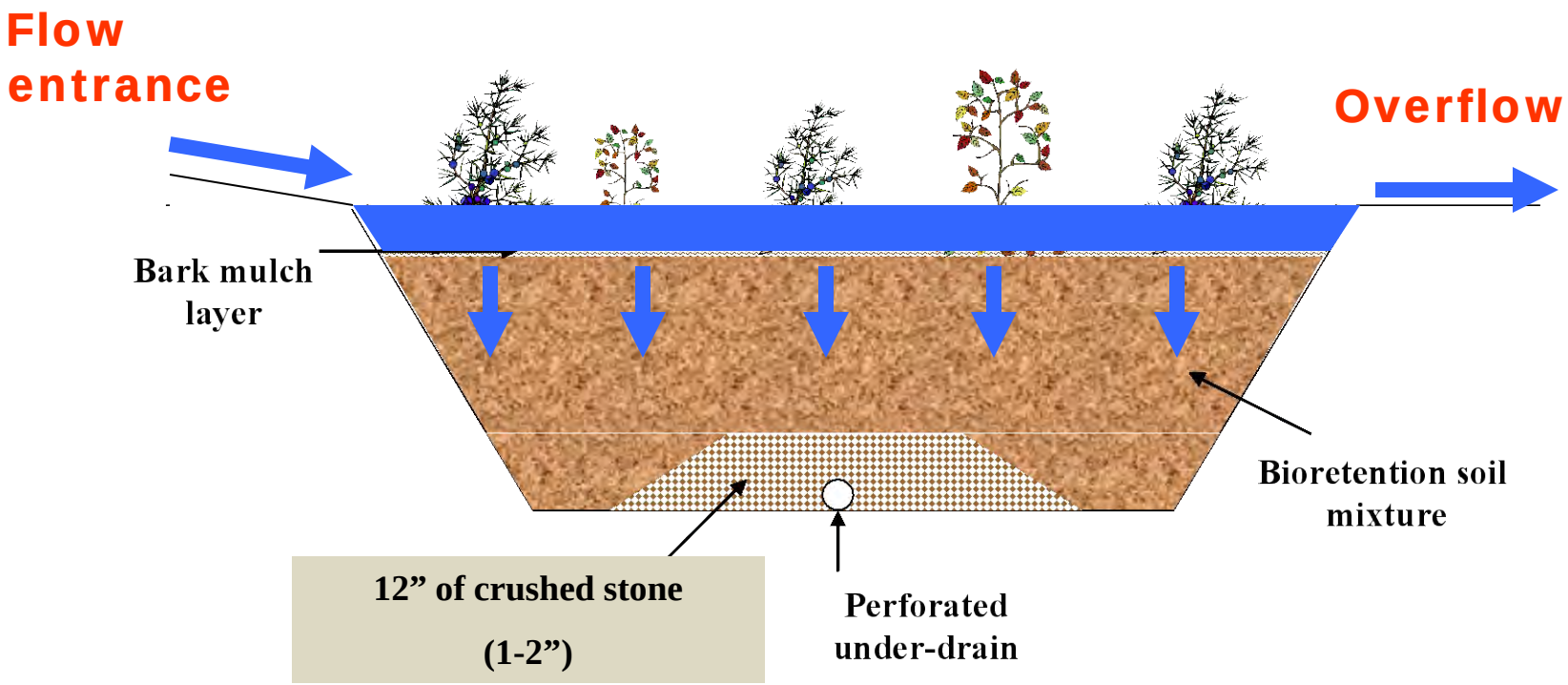
Bioretention Specifics



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Bioretention Specifics

- RI Design and Installation Standards Manual defines bioretention soil mix as:
  - **85-88% sand + 8-12% silt + 3-5% leaf compost + 2% clay**
    - Addition of 20% volume leaf compost required only with soil depth < 4 ft, or more if soil fine content is < 12%.

- Rain garden soil mix = Native soils amended with compost and mulch layer is recommended

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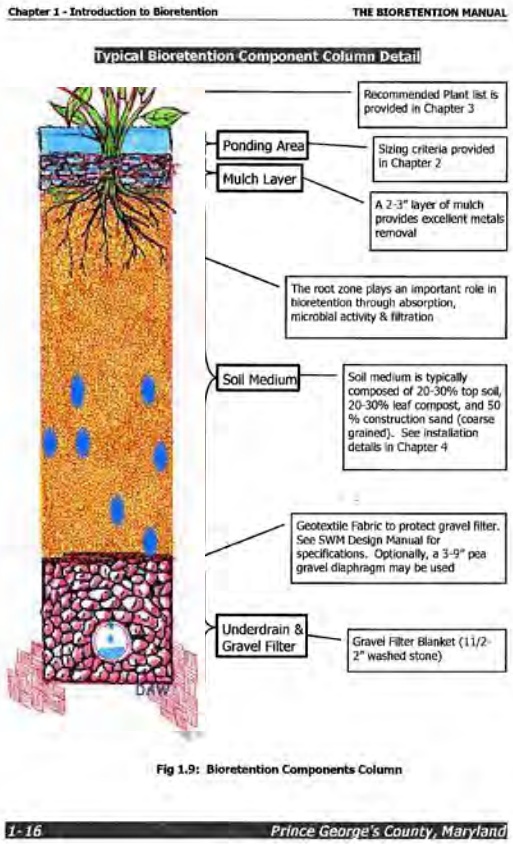
Bioretention Materials

- Soil mix, plants, mulch (underdrain, crushed stone)
- Filter fabric only placed above underdrain
  - Not needed for residential sites
  - Don't line bioretention, don't wrap underdrain pipe
  - Non-woven geotextile



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Bioretention: What about a liner?

- Lining is only needed in very specific applications
- Partial lining where you don't want water to go
- Full lining in "hot spots"
  - Gas stations, industrial facilities, brownfield sites
  - Bioretention is just a filter in these cases

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Bioretention: Underdrains

- Purpose is to reduce potential for extensive surface ponding
- RI Stormwater Design and Installation Standards Manual recommends underdrains to assist in dewatering
- Highly recommended for commercial/urban bioretention
- Slotted (ADS) or perforated (PVC) pipe at bottom or just above bottom of bioretention, surrounded by crushed stone/gravel blanket

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Bioretention: Crushed stone

- 1-2 inch washed crushed stone around pipe, then a pea-stone gravel "blanket" on top, before soil mix gets applied.

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References of Interest

RI NEMO

- http://www.ristormwatersolutions.org

UCONN NEMO

- http://nemo.uconn.edu/

Low Impact Development

- http://epa.gov/region01/topics/water/lid.html
- http://www.lowimpactdevelopment.org/

GreenScapes New England

- http://epa.gov/region01/topics/waste/greenscapes.html

Rain Gardens

- http://www.raingardennetwork.com/
- http://www.raingardens.org/Index.php
- http://www.dnr.state.wi.us/runoff/rg/