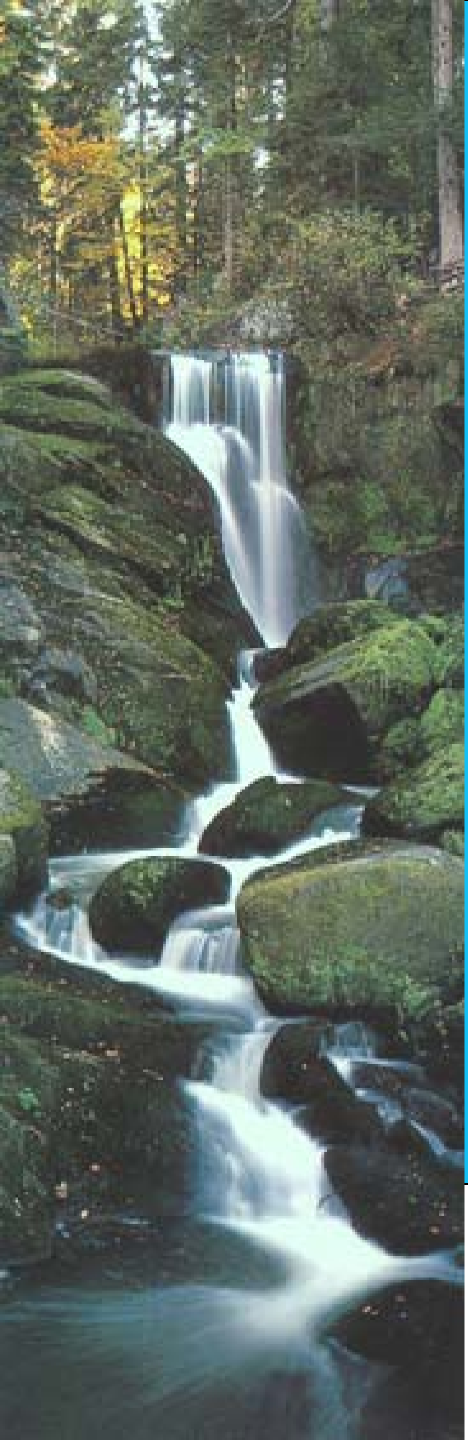


Rain Gardens: Designing your Landscape to Protect Aquatic Resources

Curtis Hinman

WSU Extension Faculty

Watershed Ecologist

chinman@wsu.edu

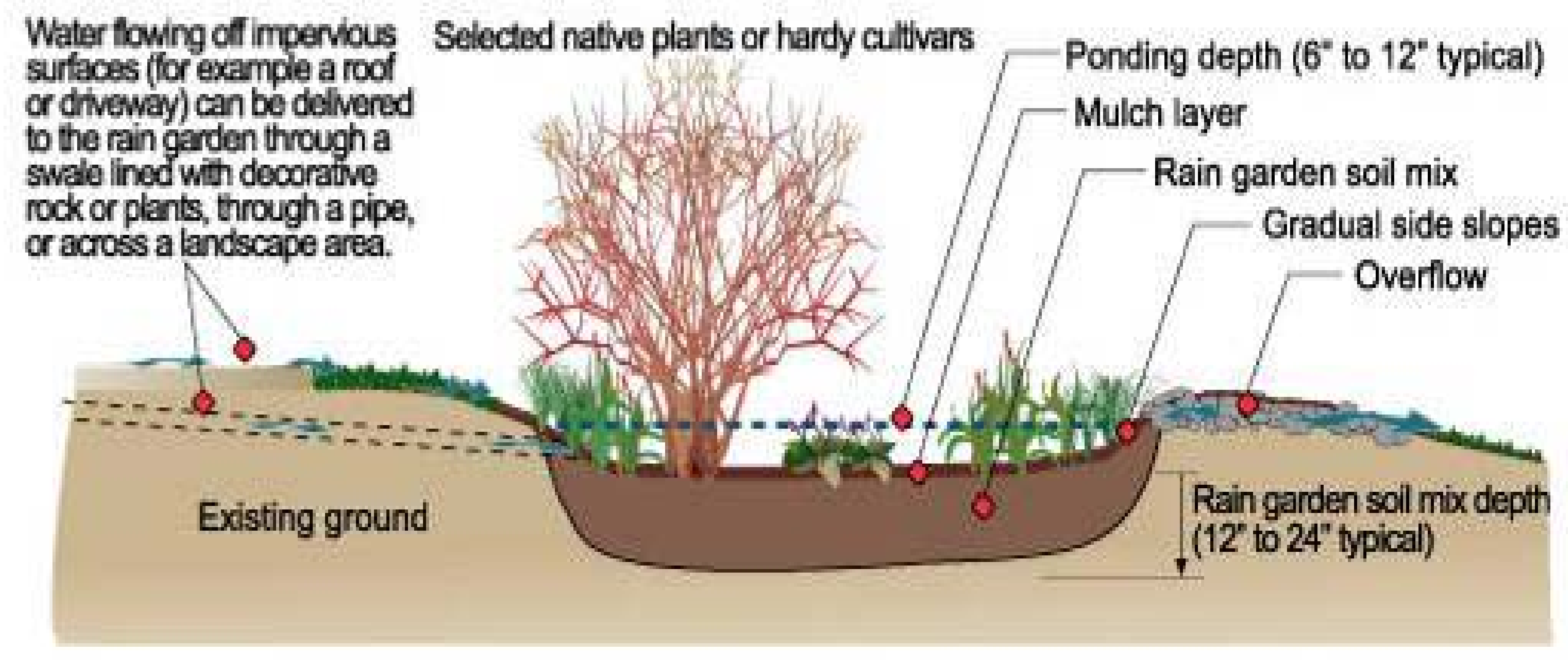
WASHINGTON STATE UNIVERSITY

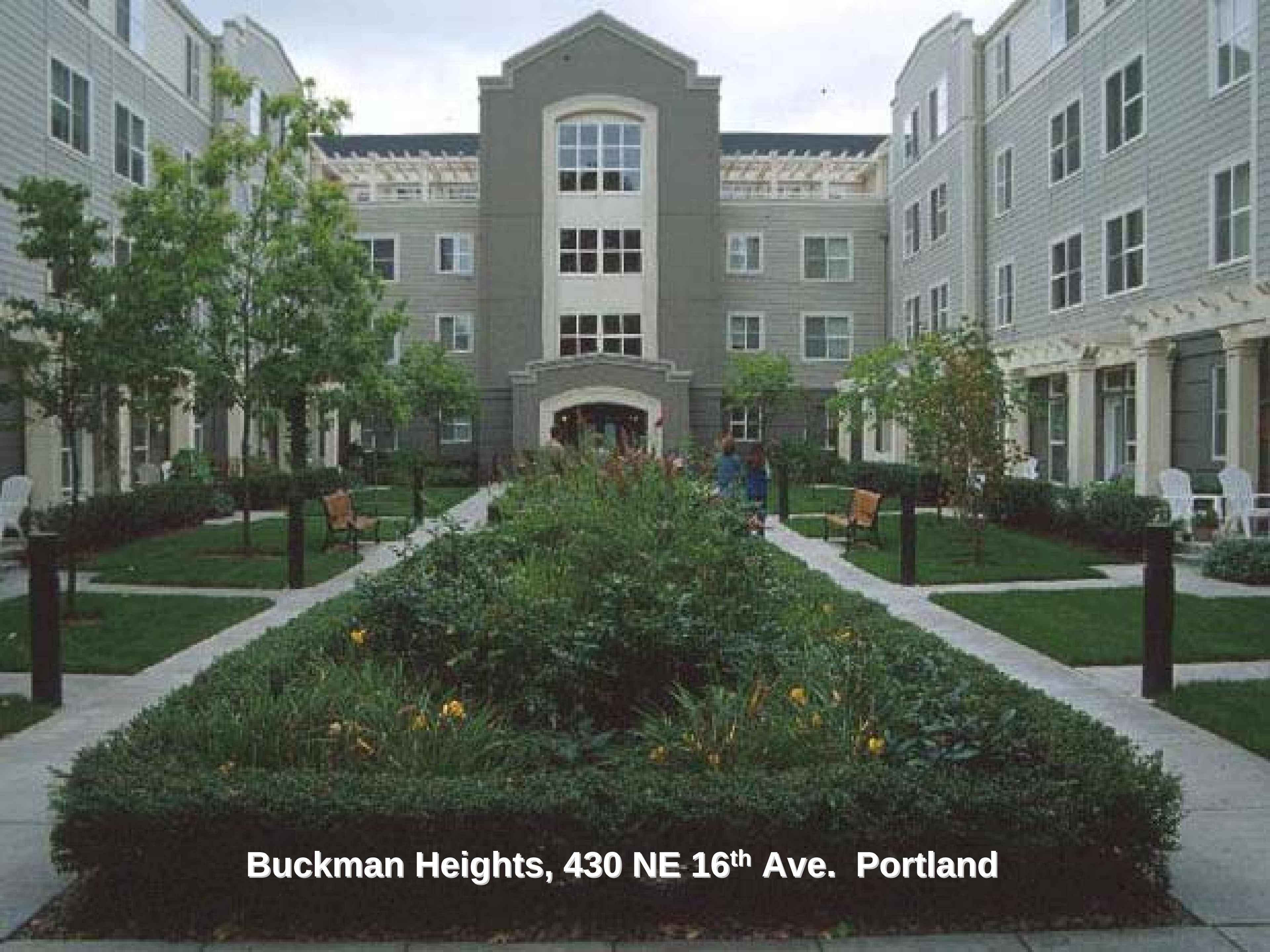
PIERCE COUNTY EXTENSION

Basic Design Characteristics

- **Shallow landscaped depressions that receive stormwater from small contributing areas**
- **Soil mixes and plants selected to more closely mimic native conditions**
- **Small scale, dispersed facilities integrated into the design as a landscape amenity**

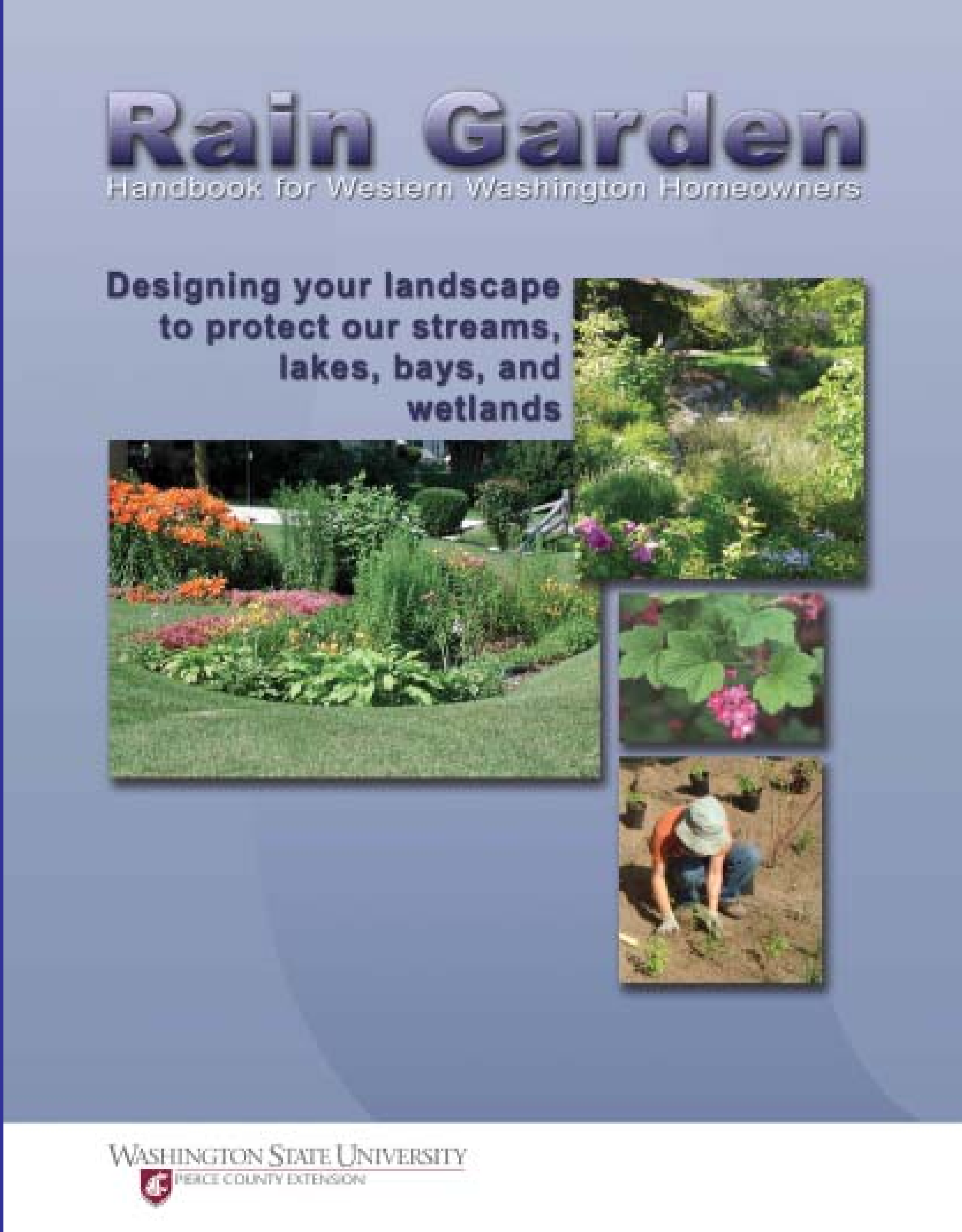
Anatomy of a Rain Garden





Buckman Heights, 430 NE 16th Ave. Portland

Represent in simple language and primarily through graphics, the design and construction of rain gardens on single family lots



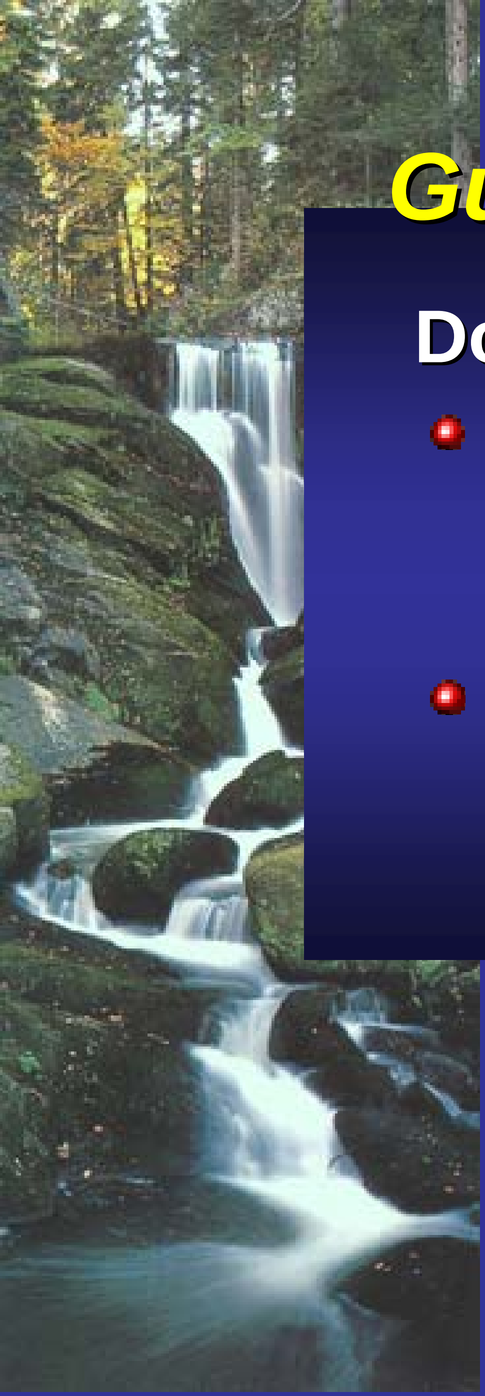
Development

- Funded with a DOE DIF grant
- Approximately 18 months to complete and included:
  - Scoping
  - Extensive modeling
  - Construction of 3 demonstration rain gardens
  - Handbook with design of many original graphics
- Printed 15,000 copies

Guidelines

Don't locate

- Within 10 ft of a building foundation
- Over septic drain field or tank (if uphill > 50ft between rain garden and septic)
- Over shallow utilities…locate and mark
- Near edge of steep slopes…slopes should be < 15% for conventional RG…if within 50ft of 15% slope consult with geotech)
- Where groundwater < 1ft from bottom of finished rain garden



Guidelines

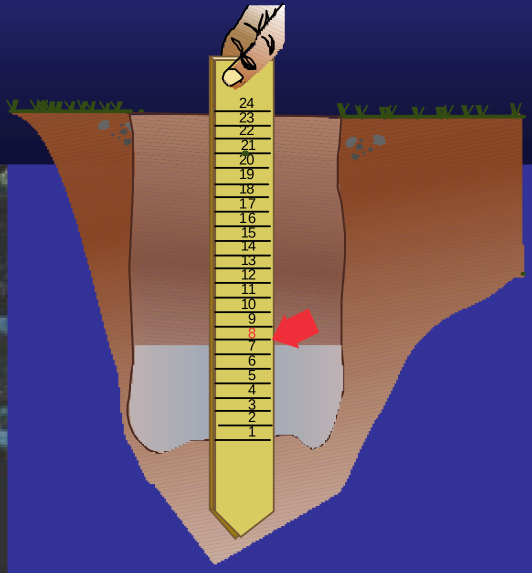
Do locate

- Where overflow can direct water safely away from the home and neighboring property
- Where it enhances the appearance of the home

Guidelines

Soil Assessment

- Dig perk hole (1-2ft diameter x ~2ft deep)
- Look for signs of high groundwater and examine soil texture
- Conduct simple perk test

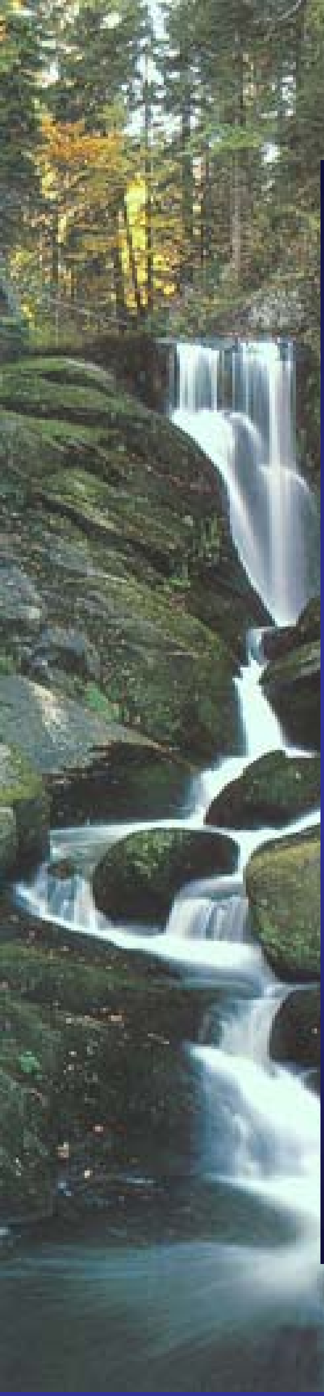


Guidelines

Using the Information From the Soil Drainage Test

- **Drainage or infiltration rate is less than 0.25 inches/hour, but more than 0.1 inches/hour**
- **Infiltration rate is less than 0.1 inches/hour**

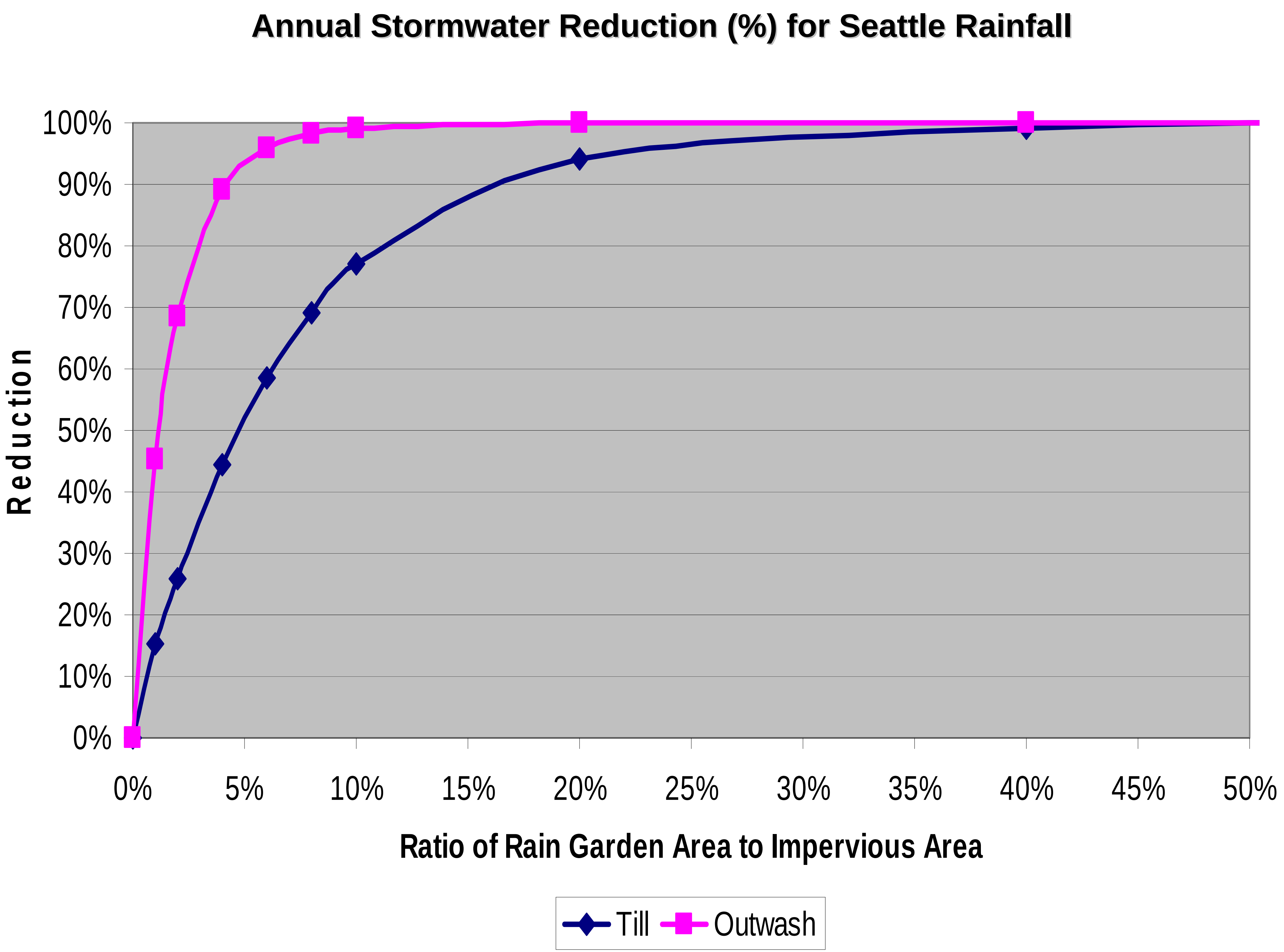
In the handbook, soil that infiltrates at 0.5 inches/hour or more is considered well-draining and less than 0.5 inches/hour poor-draining



Guidelines

Sizing

- Handbook does not provide equations or specific sizing guidelines
- Guidelines provide instructions to properly locate and design considering primary constraints: 1) drainage area; and 2) scale and aesthetics appropriate with lot
- Extensive modeling condensed into table with rain garden annual volume reduction (rain garden size expressed as a percent of contributing area)



Annual Stormwater Reduction (%) for Seattle Rainfall
Reduction
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0%
5%
10%
15%
20%
25%
30%
35%
40%
45%
50%
Ratio of Rain Garden Area to Impervious Area
Till
Outwash

Annual Stormwater Reduction (%) for Olympia Rainfall

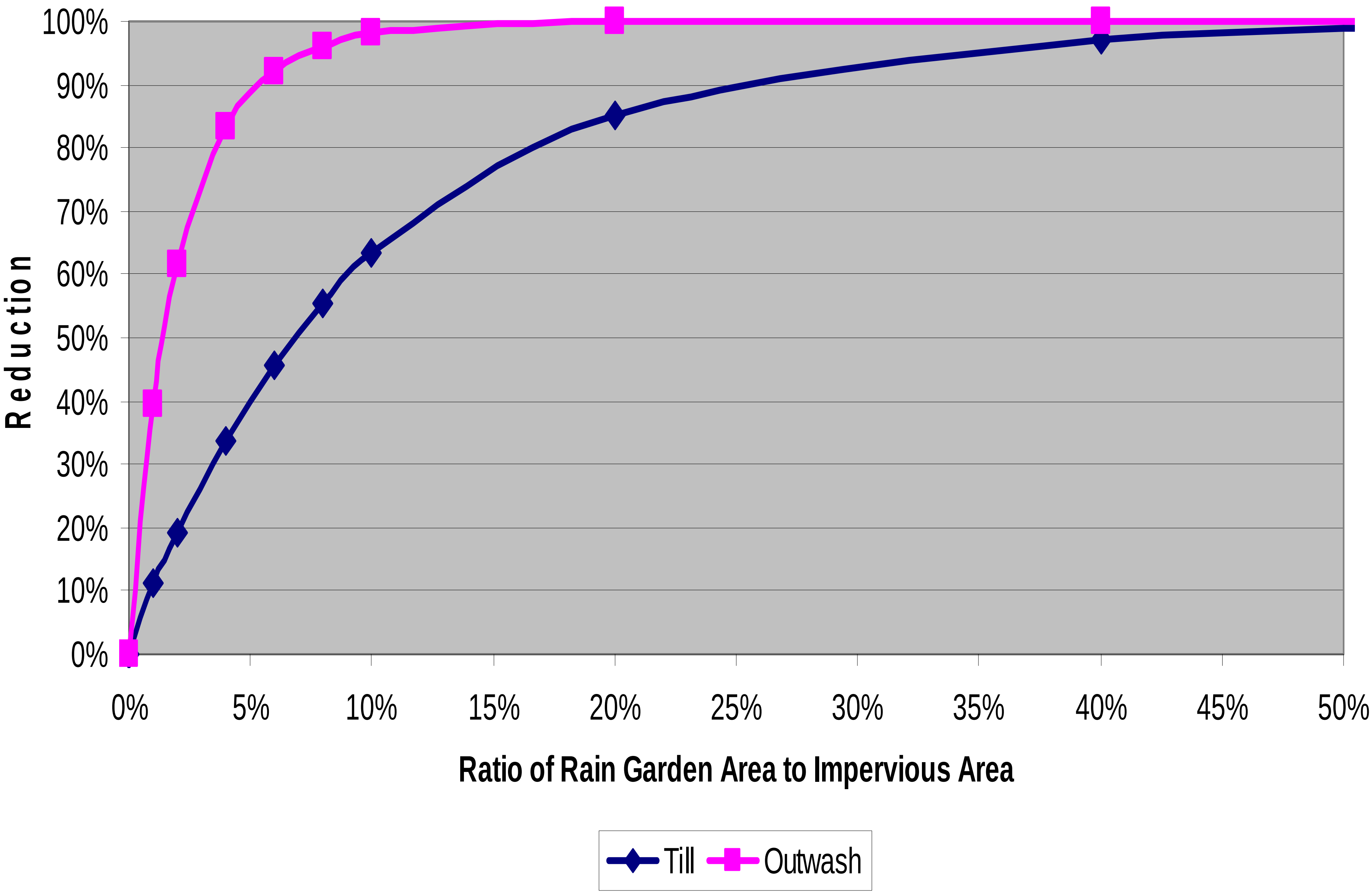


Table 1: Annual volume of water held in a rain garden with 12 inches of rain garden soil mix and a 6-inch ponding depth (18 inches total)

Size of rain garden (as a percent of imprevious area and measured in square feet)	Annual volume of water held in rain garden for poor-draining soils	Annual volume of water held in rain garden for well-draining soils
10%	70%	99%
20%	90%	100%
50%	99%	100%
80%	100%	100%

If the depth of the rain garden is increased to 30 inches* on poor-draining soils, then you can reduce the square foot area by 5% and hold the same amount of water. On well-draining soils depth does not significantly increase how much water the rain garden can hold.

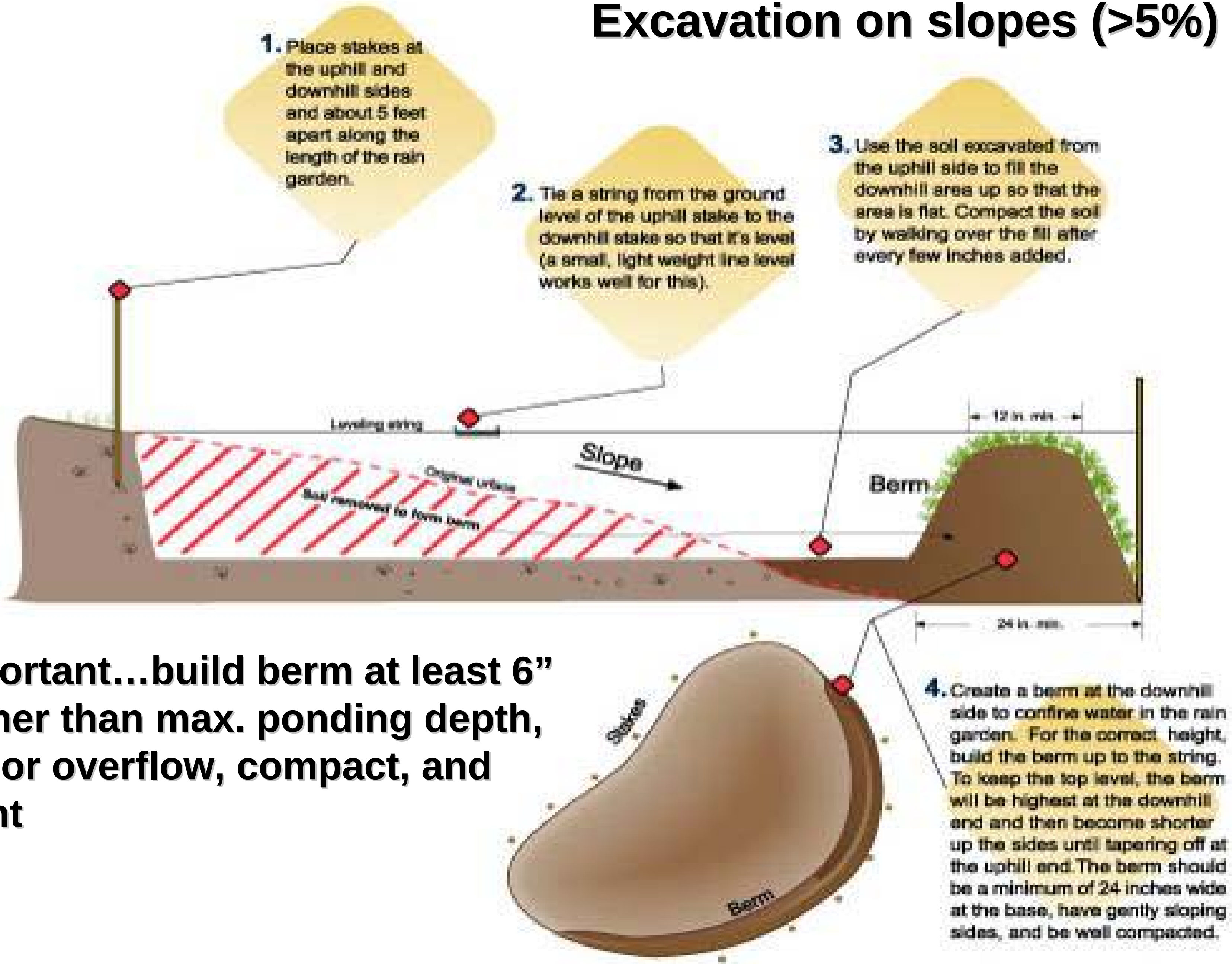
* 24 inches of rain garden soil mix and a 6-inch ponding depth (30 inches total).

Guidelines

Excavation

- Minimal excavation on good quality soils
  - Excavate ~ 9” to create desired ponding depth and incorporate ~3” of compost to 4-5”
- Excavation on fairly flat ground

Excavation on slopes (>5%)



Important…build berm at least 6" higher than max. ponding depth, armor overflow, compact, and plant

Bioretention Soil Mix

- Current Guidelines can be difficult to apply consistently
- Seattle and WSU developing guidelines that use fairly consistent materials and are readily available, affordable and meet necessary criteria

WSU work Funded by the Puget Sound Partnership

WASHINGTON STATE UNIVERSITY
PIERCE COUNTY EXTENSION

Technical Memorandum

Bioretention Soil Mix Review and Recommendations for Western Washington

Prepared for: Puget Sound Action Team
Prepared by: Curtis Hinman WSU Extension Faculty

Date: June 25, 2007

Soil mixes for bioretention areas need to balance three primary design objectives to provide optimum performance. These are:

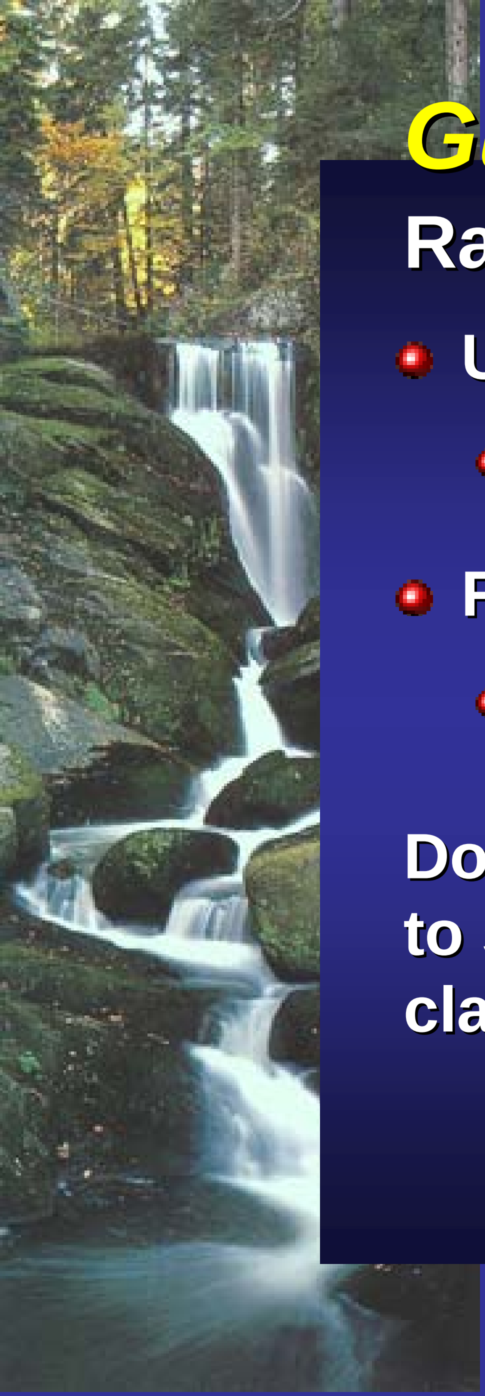
- Provide high enough infiltration rates to meet desired surface water drawdown and system dewatering.
- Provide infiltration rates that are not too high in order to optimize pollutant removal capability.
- Provide a growth media to support long-term plant and soil health.

Draft recommendations from Seattle and WSU similar

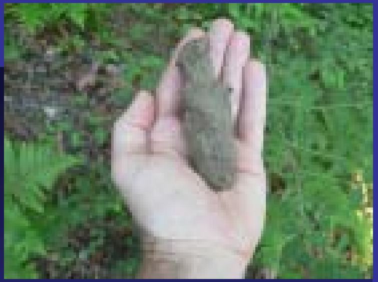
- Aggregate component of both are primarily sand and very little fines
- Seattle uses a type 17 aggregate (primarily sand with some gravel) with compost
- WSU guidelines will likely use a utility or screened sand (very little or no gravel) with compost

Bioretention Soil Mix Data Summary

	Organic Content (%)				Grain Size Summary						
Sample Identification	before perm. test	after perm. test	Percent Compost (volume)	Percent Aggregate (volume)	dlO (mm)	d60 (mm)	d90 (mm)	Coefficient of Uniformity Cu	Percent Fines	Maximum Dry Density (pct)	Average Permeability (in/hour)
Fred Hill Screen Sand + Compost	8.3	6.3	40	60	0.17	0.91	3.1	5.5	4.6	111	1.3
Green Earth C33 Washed Sand + Compost	8.8	6.2	40	60	0.27	1.2	3.5	4.4	1.0	108	27
Green Earth Screen Sand + Compost	9.6	--	40	60	0.19	0.55	1.0	2.9	2.4	102	13
Miles S&G Utility Sand + Compost	8.9	--	40	60	0.13	0.73	2.7	5.7	3.7	104	5.6



Guidelines



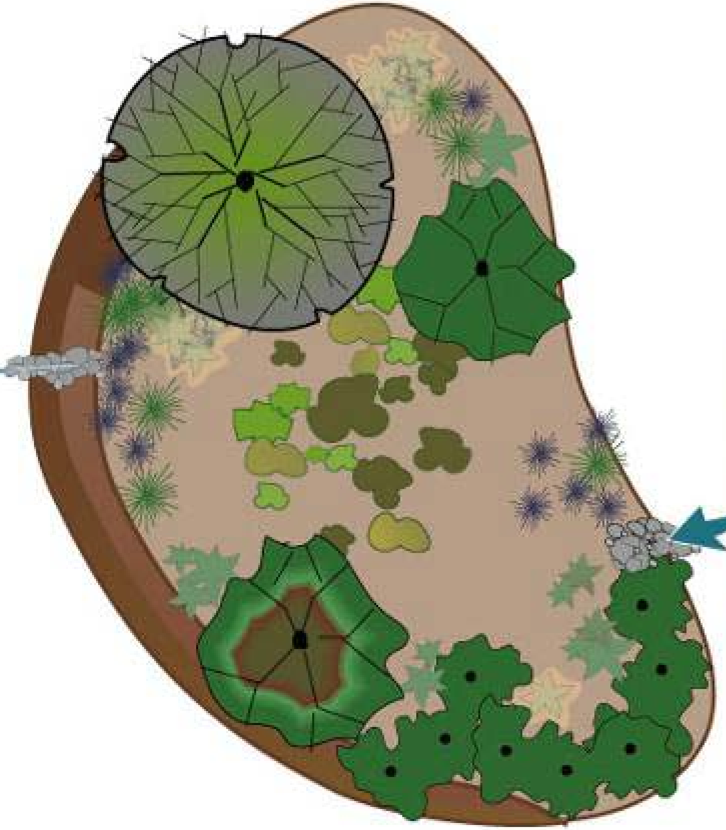
Rain Garden Soil Mix

- **Using excavated soils**
  - **~ 65% excavated soil with 35% compost**
- **Replacing excavated soil**
  - **~ 60% screened sand and 40% compost**

Don’t add sand to soil with high clay content

Armor inflow and outflow channels

Rock lined overflow

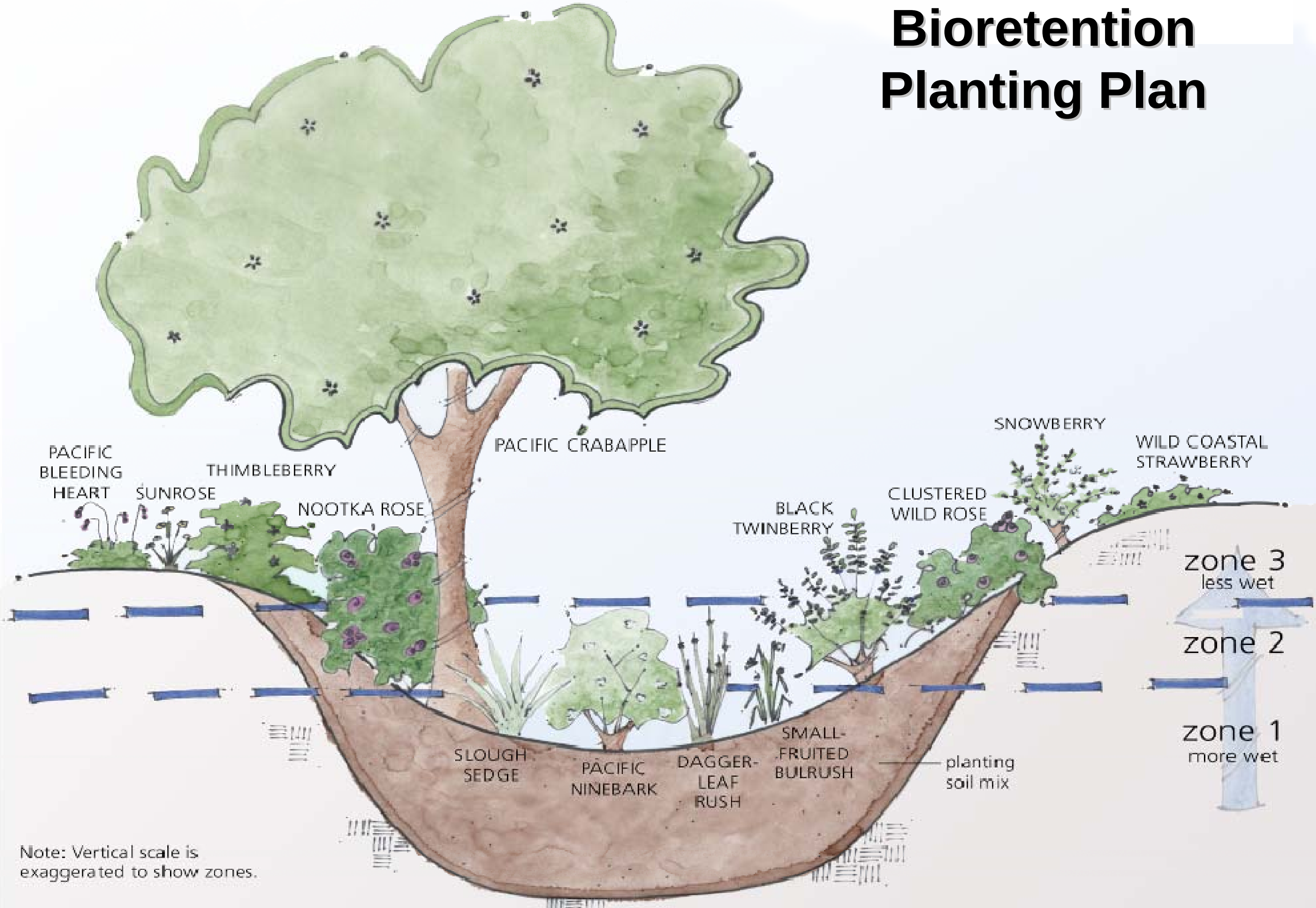


Rock lined inlet.
Rock should be free of
sediment, so order
"washed."

Plant Requirements

- **Tolerate inundation & summer drought**
- **Tolerate expected pollutant loads**
- **Position on soil moisture gradient to tolerate ponding and water fluctuations**
- **Underground infrastructure and rooting depth**
- **Some examples:**
  - Woody plants in wet zone: twinberry, nine bark, willow, red-twig dogwood, salmonberry
  - Emergents in wet zone: rushes & sedges
  - Drier zone: currants, manzanita, grasses

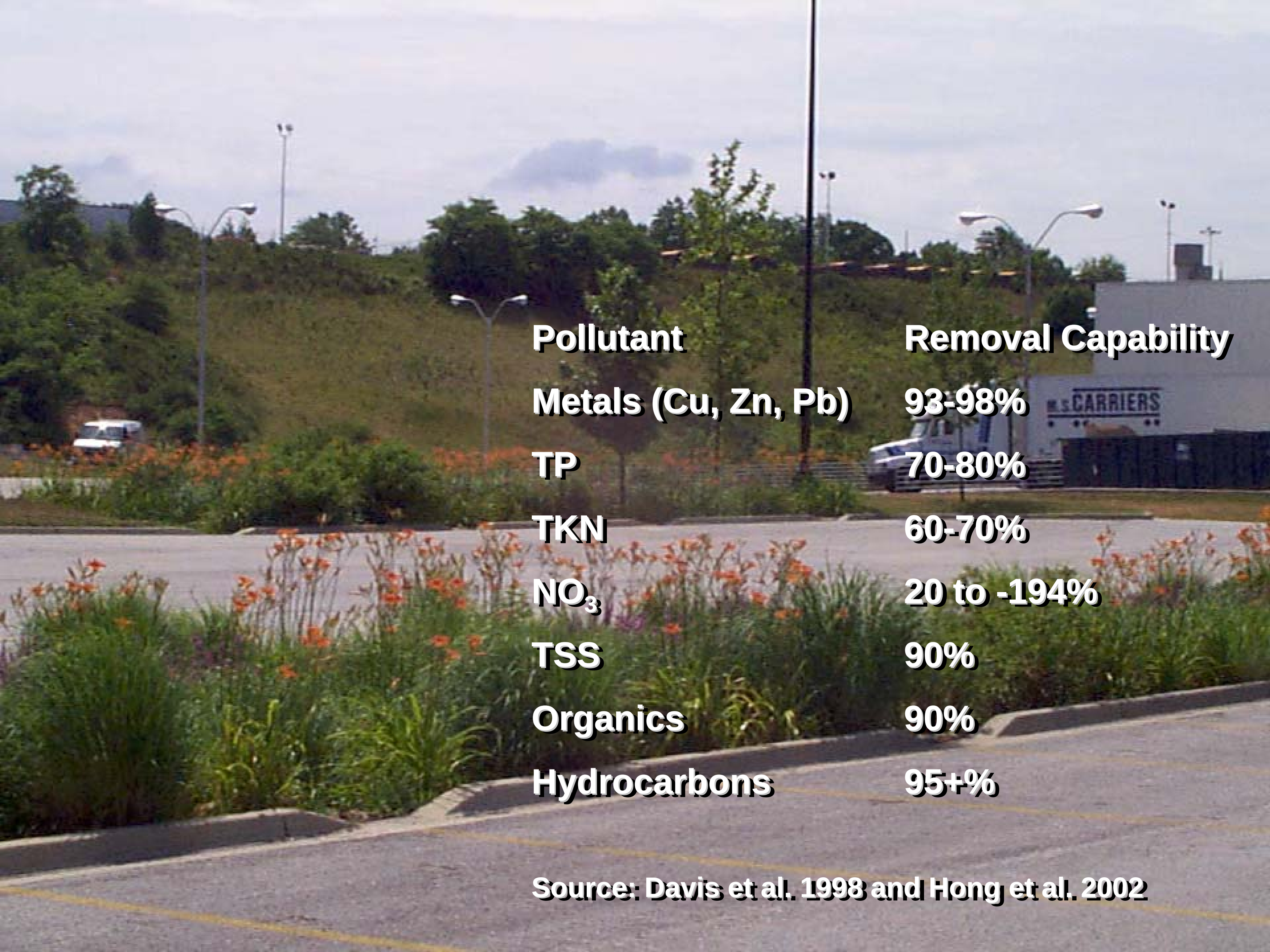
Bioretention Planting Plan



Guidelines

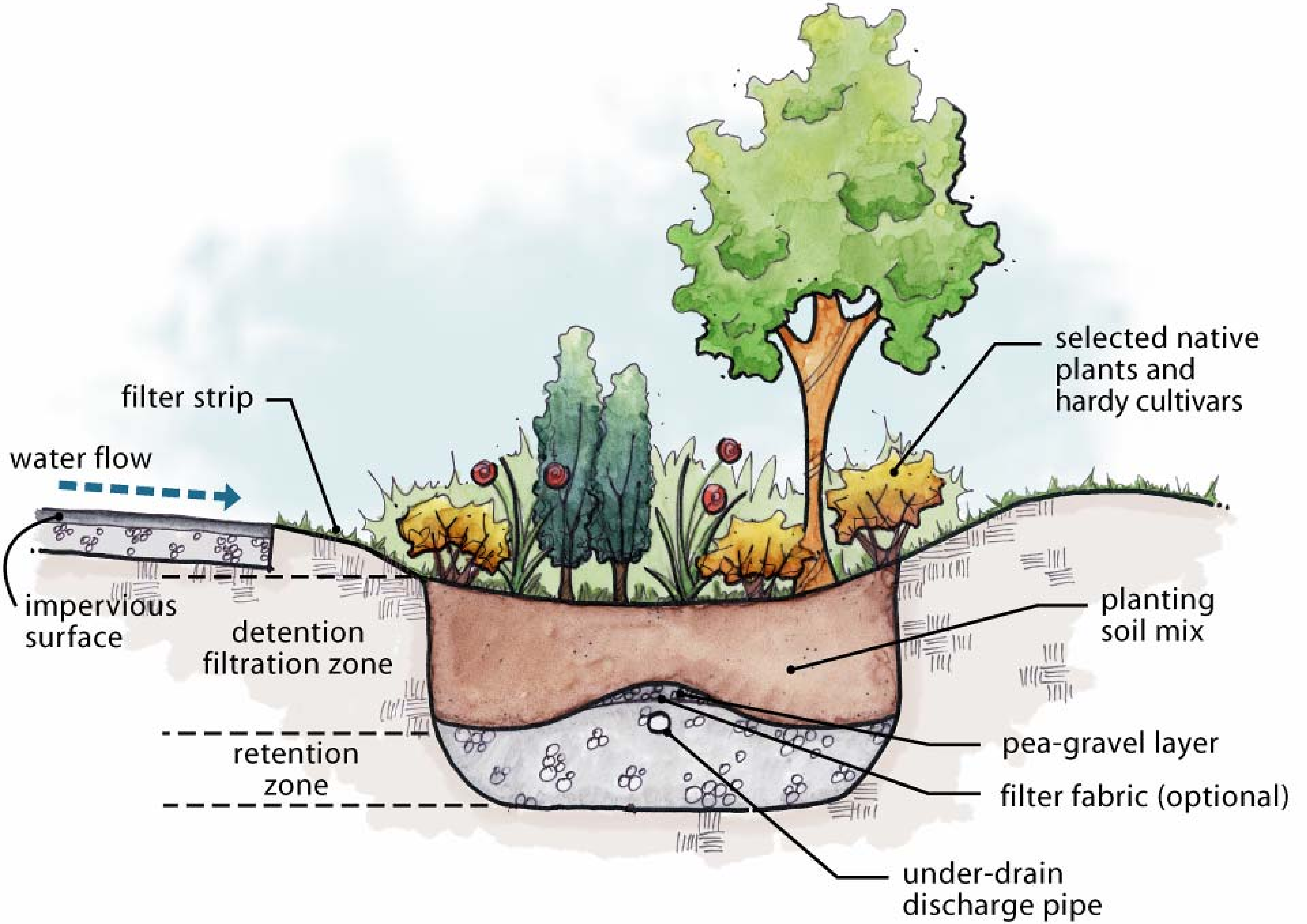
Mulch

- Coarse compost best for bottom of ponding area
- Shredded or chipped hardwood or softwood floats—good for perimeter
- Dense groundcover beneficial—may need access to maintain mulch if pollutant hotspot



Pollutant	Removal Capability
Metals (Cu, Zn, Pb)	93-98%
TP	70-80%
TKN	60-70%
NO_3	20 to -194%
TSS	90%
Organics	90%
Hydrocarbons	95+%

Source: Davis et al. 1998 and Hong et al. 2002


water flow
filter strip
selected native plants and hardy cultivars
impervious surface
detention filtration zone
planting soil mix
retention zone
pea-gravel layer
filter fabric (optional)
under-drain discharge pipe

Links to Bioretention Guidelines:

Puget Sound Action Team, WSU
LID Technical Guidance Manual
www.psp.wa.gov/LID

Seattle "Natural Drainage Systems" specs
www.seattle.gov/util/NaturalSystems

Rain Garden Handbook for Western Washington Homeowners
www.pierce.wsu.edu/Water_Quality/LID

Bioretention Soil Mix Review and Recommendations for Western Washington
www.pierce.wsu.edu/Water_Quality/LID