

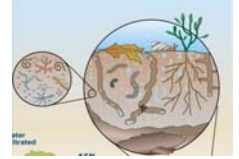
Bioretention Soils: How much can we engineer soils?



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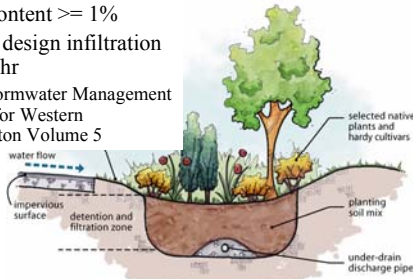
Performance Needs of the Soil

- Provide desired infiltration rate
- Support vegetation and soil biota
- Provide water quality treatment



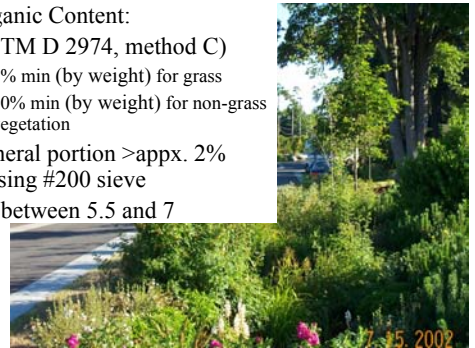
Provide Water Quality Treatment

- Cation Exchange Capacity \geq 5 meq/ 100 gm dry soil
- Organic Content \geq 1%
- Maximum design infiltration rate 2.4 in/hr
 - DOE, Stormwater Management Manual for Western Washington Volume 5



Support Vegetation

- Organic Content: (ASTM D 2974, method C)
 - 5% min (by weight) for grass
 - 10% min (by weight) for non-grass vegetation
- Mineral portion $>$ appx. 2% passing #200 sieve
- pH between 5.5 and 7



Organic Content of Compost does have variability!

Code	Name	T166A	T166B				T166C	
			Sub A	Sub B	Sub C	Sub D	Sub E	Sub F
01	01	100	100	100	100	100	100	
02	02	100	100	100	100	100	100	
03	03	100	100	100	100	100	100	
04	04	100	100	100	100	100	100	
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06	06	100	100	100	100	100	100	
07	07	100	100	100	100	100	100	
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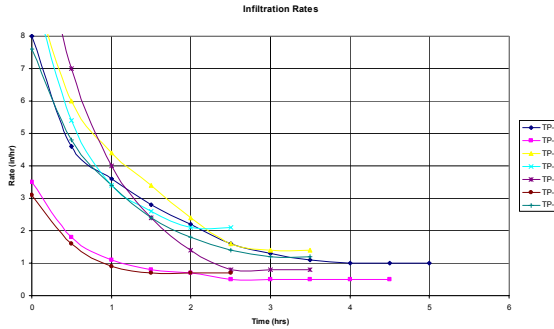
47-59%,
AVG 52%

Provide desired infiltration Rate



- What is the design infiltration rate?
- How can you tell if you have achieved that design rate?

Will it be Saturated?



Will the soil be compacted?

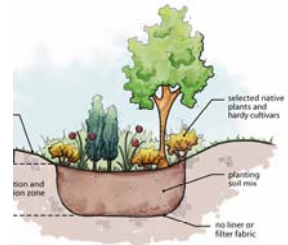


Bioretention Soil Mixes – lets try for regional consistency

- Testing methods
 - Hydraulic conductivity per ASTM D 2434
 - Compaction per ASTM D 1557
- <10% passing # 200 sieve, suggest max of 7.5%
- 100% passing 1-inch sieve

Bioretention Soil Mixes – “Bioretention Soil Mix 1”

- Design infiltration rate of ???
- LID manual p. 181
- Native amended with compost
- **DO NOT RECOMMEND USE FOR LARGE PROJECTS**

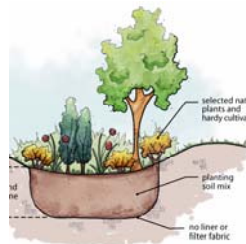


SEA Street #1



“Bioretention Soil Mix 2”

- Design infiltration rate of 1 in/hr at 80% compaction
- LID manual p 182, modified.
- **US No. 200 2 – 7.5**
- approx. 60-65% Loamy sand (USDA textural classification) and 35-40% compost



Broadview Green Grid "Bioretention Soil Mix 2"



Broadview Green Grid Testing

- Bioretention soil mix 2, supplied with modified Vegetable Garden blend from Cedar Grove. 6% passing #200 sieve.
- Densities between 73 pcf to 83 pcf
- Appx. 70 to 83 percent compaction per ASTM D1557
- Dry : 48-54% porosity
- At 15% moisture content: There is apprx. 0.3 feet of water storage available for every 1 foot of soil.

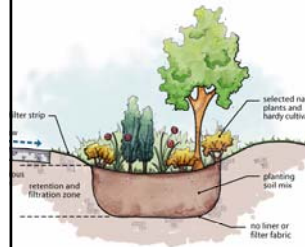
Pinehurst NDS Bioretention Soil Mix 2 ???

Modified Vegetable Garden blend from Cedar Grove, but same ratios as Broadview resulted in 11.9% passing #200 sieve! (hydraulic conductivity <1in/hr). Contractor will be removing and replacing soil.



10/05 19th Avenue btwn NE 115th and NE 117th

Bioretention Soil Mix 3



- 55% -65% clean sand and 35-45% compost.
- Sieve Size Percent Passing

Sieve Size	Percent Passing
1/4-inch	100
US No. 6	54-95
US No. 8	45-92
US No. 50	9 - 35
US No. 200	2 - 7.5
- Design infiltration rate of 1.5 in/hr at **85%** compaction. 2in/hr at 80% compaction

Cascade Design 65% clean sand/ 35% compost



Bioretention Soil Mix 3

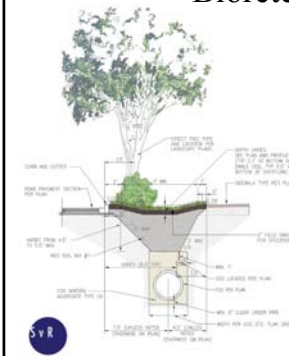


Pinehurst NDS 1/15/06
20th Avenue btwn NE 115th and NE 117th

?Considering using different soil spec on sideslopes?



Bioretention Soil Mixes – “Engineered Soil”



- 65% -70% gravelly sand and 30-35% compost.

• LID manual p. 181

Sieve Size	Percent Passing
2-inch	100
¾-inch	70 - 100
¼-inch	50 - 80
US No. 40	15 - 40
US No. 200	0 - 3

- Design infiltration rate of 2 in/hr

High Point Neighborhood



High Point Neighborhood



High Point Neighborhood



More Project Information:
<http://www.ci.seattle.wa.us/util/naturalsystems/>