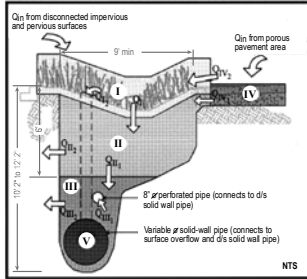


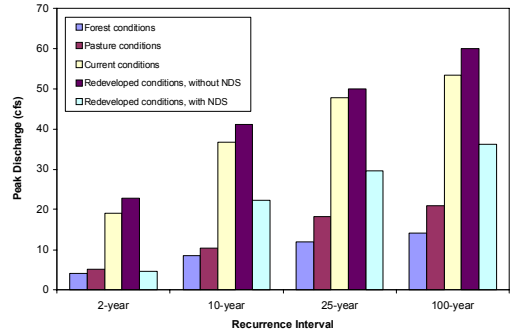
Bioretention Swale Modeling

Description of Modeling Unit

- I Grass-lined or vegetated swale
- II Engineered soil with 20% void volume and 2.0-inch infiltration rate by design
- III Gravel with perforated pipe underdrain
- IV Porous concrete sidewalk
- V Solid-wall pipe

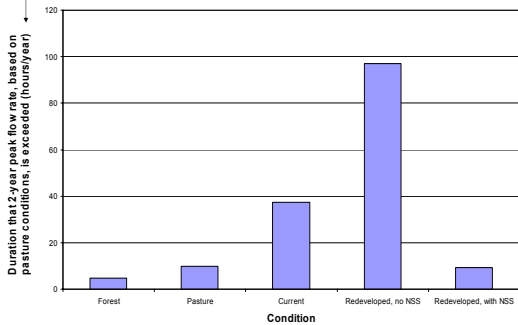


Comparison of Peak Flows



Comparison of Flow Duration

Duration that 2-yr peak flow rate is exceeded (hourly per yr)



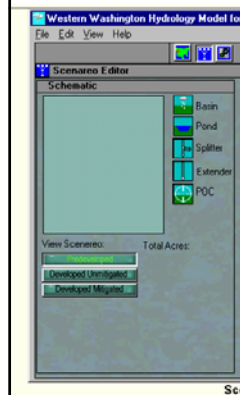
Bioretention Flow Credits

- Represent as a pond with consistent infiltration rate
- Pond equals above ground and soil storage
- Facilities with under-drains: only storage below under-drain considered
- Determine infiltration rate
 - Use the lower of:
 1. the estimated long-term rate for the planting soil mix; or
 2. the initial (short-term) rate of the underlying soil

Bioretention modeling

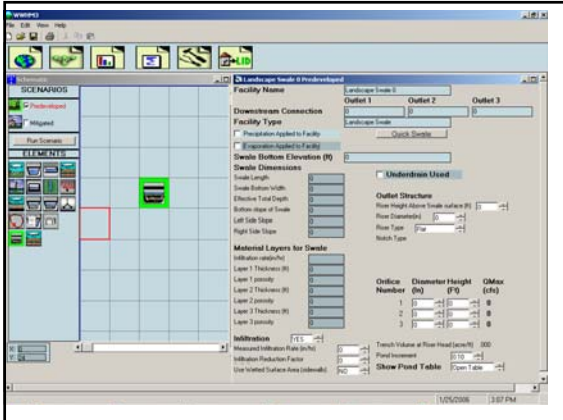
- SBUH Single event methodology- Darcy's law to represent water movement through soils. Numerous spreadsheets!
- Recommend using continuous modeling methodology (HSPF, KCRS, WWHM).
 - Only means of comparing duration in addition to peaks
 - Only mean to represent water storage availability for variety or antecedent conditions

Western Washington Hydrologic Model (WWHM2)



Land Use / Vegetation Cover	Soil Type	
	A/B	C/D Subsoil
Impervious Area (Roof)		
Impervious Area (Paving)		
Landscaped Area		
Forest		
Pasture		
Road		
Developed Residential Land Use		
Grassland		

- Model bioretention as pond
 - A) with native soil as restricting lense. Add voids in bioretention soil as extra ponding depth.
 - B) with bioretention soil as restricting lense. Make sure maximum ponding depth from A not exceeded.



WWHM3 Model Input

- Bioretention Soil Depth: 12 - 48 inches
- Bioretention Infiltration Rate: 1 - 2 in/hr
- Bioretention Porosity: 30 - 40%



Simplified Modeling