Soils, Landscapes, and Storm Water

U.S. Department of Agriculture Natural Resources Conservation Service

CONNECTICUT

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Hydrologic Cycle





Soil Quality: Pre-Development



Reduced Function: Post-Development





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Peak flow pre and post development



Conventional

- "end of pipe" technology
- Large structural practices
- Low end of site
- On "leftover" land

Low Impact Development (LID)

- Uses site design
- Many small scale treatment practices close to source
- Planning phase first optimizes conservation of natural hydrologic functions

LID Principals

- Minimize site disturbance
- Work with site hydrology (and native soils)
- Minimize and disconnect impervious surface
- Apply small scale controls at the source

It's easy to put the right practice in the wrong place!

Understand the soil properties before selecting practice types.



Soil properties that influence Infiltration and runoff

- Infiltration and Saturated hydraulic conductivity (Ksat)
- Slope
- Depth
 - to water table
 - Bedrock
 - Hardpan

Bedrock Controlled Supraglacial Till

Groundwater generally deep
Medium to high surface runoff
Wetlands, vernal pools in depressions

Hydrology in Bedrock Controlled Till



Development Impacts

Increased runoff

• Reduced ground water recharge and base

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Deep Subglacial Till

Medium surface runoff from side slopes
Shallow, perched groundwater flow follows contours of dense till
Wetlands in depressions and seeps

Hydrology in Tills



Development Impacts

Subsurface drainage

• Increased runoff

Decreased base flow to wetlands and watercourses

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Outwash (sand and gravel)

Deep groundwater
Few wetlands or vernal pools
Low runoff
Critical to recharge of larger aquifers

Outwash Hydrology



Development Impacts

• Highest increase in runoff

• Loss of groundwater recharge

• Decreased water levels in wetlands

Floodplain and Riparian

Shallow groundwater
CT wetlands dominate
Maintains stream dynamics
Stores, discharges floodwaters, groundwater

Development Impacts

Decreased storage for flood events

Increased flooding frequency

Wider area impacts

Lacustrine (silt and clay)

 High surface runoff
 Extensive wetlands and many vernal pools, supported by runoff
 Groundwater both shallow and deep

Lacustrine Landscape



Development Impacts

Increased runoff

• Subsurface drainage for homes and roads diverts groundwater

Surface runoff captured and diverted

Other Landscapes

Tidal marsh, estuary
Inland swamp, bog, marsh
Human made

Soil landscape functions in a watershed



LID Principals

- Minimize site disturbance
- Work with site hydrology
 - Existing drainage patterns
 - Native soils
- Minimize and disconnect impervious surface
- Apply small scale controls at the source

Soil properties that influence Infiltration and runoff

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- Depth to
 - water table
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Infiltration

Entry of water into the soil

Permeability Quality of soil that enables water to move through it (cm/hr)

Hydraulic Conductivity

Quantifies ability of soil to transmit water

 $Q = KAi (cm^3/hr)$



Saturated Hydraulic Conductivity (Ksat) With Amoozemeter

Soil Properties That Affect Infiltration and Saturated Hydraulic Conductivity



High Infiltration and permeability



Course textures and loose soil material

Compact till restricts water, movement

Low Infiltration and permeability



Infiltration and Saturated Hydraulic Conductivity Information

• Data

- Practice specifications
 - Pervious pavement: >.5 inches per hour best
- Design considerations:
 - A rain garden on soils with low Ksat may need to be larger
- May need converting to use
- Rating class _
- Interpretations

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Ksat Class (in/hr)
Very High \geq 14.7
High 1.4 – 14.7
Moderately High .14 – 1.40
Moderately Low 0.014 –
0.14
Low 0.0014 - 0.014
Very Low < 0.0014
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Ksat data is used to developVery Low <</th>Hydrologic Soil Group and Runoff class

Sizing a Rain Garden

Step 2: Examine the Soils in Your Proposed Rain Garden

	Indicator	Unfavorable Condition	Favorable Condition	Comments/Modifications			
	Bedrock (ledge)	Exposed bedrock at the proposed site or within one foot of the surface	Can dig a hole at least 2 feet deep without hitting solid bedrock	Consider another location for the rain garden if bedrock is near the surface. Some types of bedrock may allow water to infiltrate through cracks and into groundwater. Other types will not allow infiltration at all and cause overflow.			
	Soil compaction	Wire flag or probe cannot be inserted into the soil at all	Loose soil at least 2 feet deep	If the soil is compacted, follow attached instructions on how to loosen it OP replace with a mix of 50-60% sand			
	Soil texture	Clay, sand					
	http://	www.ct.nrc	s.usda.eov	/eln-site assessment.html			

Soil suitability for LID Practices

- Infiltration
- Retention
- Combo / Detention

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Background Information

- A <u>soil interpretation</u> refers to the behavior of soils in response to human activities. Interpretations are a guide to use and management of soils in a survey area. Soils with similar responses to a particular use or treatment often are grouped together.
- These interpretations are designed to be used with the <u>National Cooperative Soil Survey of Connecticut</u>. The mapping was done at the 1:12000 scale. The minimum delineation is about 3 acres.
- Maps generated from these ratings are for planning purposes and do not replace an on-site evaluation for siting and design.



Infiltration Systems

Soils: Very deep, well drained, permeable

Hydrologic Soil Group A

Practices: Large engineered underground infiltration systems, large bioretention practices, dry wells





Pervious Pavement

Soils: Nearly level, moderate to rapid permeability, adequate depth to water table and bedrock.

Hydrologic soil groups A and B

Practices: Porous asphalt or concrete Reinforced vegetation Other materials like gravel, cobbles, brick, etc. Also OK for dry wells



STORMWATER RUNOFF MANAGEMENT: SOIL SUITABILITY FOR STORM WATER BASINS

Steele Brook Watershed Planning Project 2/20/2009 DRAFT



Storm water Basins:

Soils: Excludes very shallow soils, wetland soils, very steep areas.

Hydrologic soil groups A, B, C

Practices: Wide range of practices, especially small scale, rain gardens, swales, buffers, filter strips

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STORMWATER RUNOFF MANAGEMENT: SOIL SUITABILITY FOR DRY DETENTION BASINS

Steele Brook Watershed Planning Project 2/20/2009 DRAFT



Dry Detention Basins

A subset of stormwater basins

Moderate or low permeability, deep, well drained.

Designed to detain runoff briefly.

Hydrologic soil group B and C

Could be used for a swale or rain garden where short term detention is desired



STORMWATER RUNOFF MANAGEMENT: SOIL SUITABILITY FOR WET EXTENDED DETENTION BASINS

> Steele Brook Watershed Planning Project 2/20/2009





Wet Extended Detention Basins A subset of storm water basins

Low permeability for longest detention (without using wetlands)

Hydrologic soil group C Practices: Storm water basins with longer detention times.

Could be used for a swale or rain garden where extended detention is desired



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Putting it all together / getting info Web soil survey

Area of Interest (AOI) Soil Map Soil Data Explorer Shopping Cart (Free) View Soil Information By Use: All Uses Add to Shopping Cart Printable Version Intro to Suitabilities and Soil Properties Ecological Site Soil Limitations for Use and Qualities Assessment Soils Reports Soil Map Search dend 2 🖑 🥘 🔍 🚽 🚺 🖉 🐚 Scale (not to scale) Properties and Qualities Ratings 昭 🔛 Open All Close All 🔇 2 3 Soil Chemical Properties 2 3 Soil Erosion Factors 2 3 Soil Physical Properties Soil Qualities and Features 28 AASHTO Group Classification (Surface) Depth to a Selected Soil Restrictive Layer Depth to Any Soil Restrictive Layer Drainage Class Frost Action Frost-Free Days Hydrologic Soil Group Map Unit Name Parent Material Name Representative Slope Unified Soil Classification (Surface)

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💐 Unknown Zone



Done

Putting it all together / getting info

A	B	C	D	E	P	G	н	1	1	K	L	
Map Unit 5	Series	Infibration Systems	Limitations	Porous Pavement	Umitationa	Stormwater Basins	Limitations	Wet extended Detention Basins	Limitations	Dry Detention Basins	Limitations	
2	Ridgebury	Least subble	water table	Least subble	water table	Least subable	water table	Least suitable	water table	Least subble	water table	
3	Ridgebury	Least subble	water table	Least suitable	water table	Least subable	water table	Least suitable	water table	Least suitable	water table	
3	Leicester	Least subble	water table	Least subble	water table	Least subable	water table	Least suitable	water table	Least suitable	water table	
3	Whitman	Least subble	water table	Least suitable	water table	Least subable	water table	Least suitable	water table	Least suitable	water table	
4	Leicester	Least subble	water table	Least suitable	water table	Least subble	water table	Least suitable	voter table	Least suitable	water table	
5	Wibrehem	Least subble	water table	Least suitable	water table	Least subable	water table	Least suitable	voter table	Least suitable	water table	
6	Wibraham	Least subble	water table	Least subble	water table	Least suitable	water table	Least suitable	water table	Least subble	water table	
6	Menio	Least subble	water table	Least suitable	water table	Least subable	water table	Least suitable	water table	Least subble	water table	
7	Mudoepond	Least subble	water table	Least subble	water table	Least suitable	water table	Least suitable	water table	Least subble	water table	
8	Mudpepond	Least subble	water table	Least subble	water table	Least subable	water table	Least suitable	voter table	Least suitable	water table	
8	Alden	Least subble	water table	Least suitable	water table	Least subable	water table	Least suitable	voter table	Least suitable	water table	
9	Scitico	Least subble	water table	Least suitable	water table	Least subable	water table	Least suitable	voter table	Least suitable	water table	
9	Shaker	Least subble	water table	Least subble	water table	Least suitable	water table	Least suitable	voter table	Least suitable	water table	
9	Maybid	Least subble	water table	Least suitable	water table	Least suitable	water table	Least suitable	water table	Least suitable	water table	
10	Reynham	Least subble	water table	Least suitable	water table	Least subable	water table	Least suitable	water table	Least subble	water table	
12	Raypol	Least subble	water table	Least suitable	water table	Least suitable	water table	Least suitable	water table	Least suitable	water table	
13	Walcole	Least subshie	water table	Least a itable	water table	Least suitable	water table	Least suitable	water table	Least suitable	water table	
14	Fredon	Least subble	water table	Least suitable	water table	Least subable	water table	Least suitable	water table	Least suitable	water table	
15	Reation	under tehle	water table	Least a dable	water table	Least mitable	under table	Lagest or dischile	unter table	Least suitable	water table	-
18	Halaav	under tehle	water table	Least a dable	and an inclusion	Least autoble	water table	Land or the bla	under tehle	Least subship	water table	⊢
17	Timelow	Loast subship	faceling under table	Laged a dable	fooding under hebig	Least within	Ecodera sector table	Level e deble	Encoding under hable	Land subble	Anodina under helde	⊢
17	Natritary	Least subship	fooding, water table	Least a itable	Roading water table	Least autoble	Fronting, water table	Lager or the bla	Incoding water table	Land subble	fooding, water table	⊢
12	Catrian	Least subship	fooding, water table	Least a dable	Roading water balls	Least subship	Fooding, water table	Level or doble	fooding water table	Least subble	fooding, water table	⊢
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24A	Deerfield	Less subble	water table	Least suitable	water toble	Most subable		Least subble	to permeable	Least suitable	too permeable	⊢
200	Drancroft	Lesit subble	water table / low permeability	Least subscie	water table / low permeability	Most subscie		Most suitable		Nost subscie		⊢
200	Drancron	Least subscie	water table / low permeability	Least subscie	water table / low permeability	MORT BLIDICH		Most suitable		Not subore		—
200	Drancroft	LANK NUTSCIE	water table / low permeability	Least subscie	water table / low permeability	MORT BLIDEDIN		Most suitable		Nost subside		—
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268	Berlin	Less subble	water table / low permeability	Least subble	water table / low permeability	Most subable		Most suitable		Nost subable		⊢
27A	Belgrade	Least subble	water table / low permeability	Least subble	water table	Nost subable		Somewhat subsble	too permeable	Nost subable		⊢
28A	Emridge	Less subble	water table / low permeability	Least subble	weber bebie	Most subable		Most suitable		Nost subable		⊢
255	Limridge	Less subble	water table / low permeability	Least subsble	water table	Nost subable		Most suitable		Nost subable		—
29A	Agawam	Nost suitable		Most suitable		Nost subable		Least subible	to permeable	Least subble	too permeable	⊢
298	Agawam	Somewhat suitable	Nope	Somewhat suitable	Nope	Most subable		Least subible	too permeable	Least suitable	too permeable	<u> </u>
29C	Agawam	Least subble	siope	Least subble	Nope	Nost subable		Least suitable	too permeable	Least suitable	too permeable	⊢
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300	Brantord	Least subble	Biope	Least subable	Nope	Most subable		Least suibible	too permeable	Least subable	too permeable	\vdash
31A	Copake	Most suitable		Most suitable		Most suitable		Least suitable	too permeable	Least subble	too permeable	
318	Copeke	Somewhat suitable	slope	Somewhat suitable	Nope	Most suitable		Least suitable	too permeable	Least suitable	too permeable	
31C	Copeke	Least subble	siope	Least suitable	Nope	Nost subable		Least suitable	bo permeable	Least suitable	too permeable	1
32A	Haven	Most suitable		Most suitable		Most subable		Least suitable	too permeable	Least suitable	too permeable	\vdash
32A	Enteld	Nost suitable		Most suitable		Nost subable		Least suitable	too permeable	Least suitable	too permeable	
328	Haven	Somewhat suitable	slope	Somewhat suitable	Nope	Most subable		Least suitable	too permeable	Least suitable	too permeable	
328	Enteld	Somewhat suitable	siope	Somewhat suitable	Nope	Most subble		Least suitable	too permeable	Least suitable	too permeable	
32C	Haven	Least subble	siope	Least suitable	Nope	Most suitable		Least suibible	too permeable	Least suitable	too permeable	
32C	Enteld	Least subble	siope	Least suitable	siope	Most subsble		Least suitable	too permeable	Least suitable	too permeable	
33A	Hartford	Most suitable		Most suitable		Most suitable		Least suitable	too permeable	Least suitable	too permeable	
338	Hartford	Somewhat suitable	siope	Somewhat suitable	Nope	Most subable		Least suitable	too permeable	Least suitable	too permeable	
34A	Merrimac	Most suitable		Most suitable		Most subable		Least suitable	too permeable	Least suitable	too permeable	

On-site investigation!

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Questions?