RI Site Specific Soil Mapping Standards and Procedures

Understanding Hydrologic Soil Groups and Site Specific Mapping

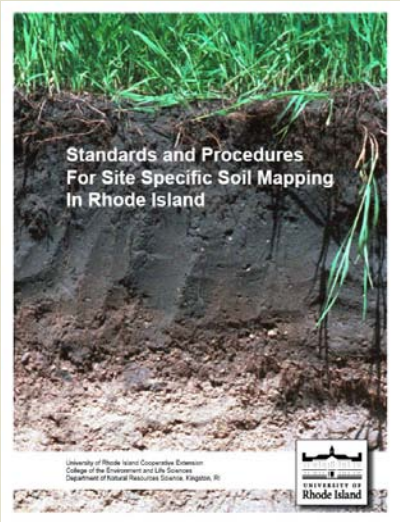
URI Coastal Institute, Kingston

June 28th 2012

Jillian Phillips URI Cooperative Extension NEMO

THE UNIVERSITY OF RHODE ISLAND
COOPERATIVE EXTENSION RI NEMO

Acknowledgments



2007 Site Specific Soil Mapping (SSSM) Standards

Author: Mark Stolt, URI Natural Resources Science Dept.

Reviewers: Peter Fletcher, Jim Turenne, George Loomis, David Kalen, Tom Peragallo.

2012 Update scheduled for August, 2012

2012 Update to include Hydrologic Soil Groups

Authors: Mark Stolt and Jillian Philips, URI NRS Dept.

Reviewers: J.Turenne, L. Joubert.

Funded by RI HEALTH, Office of Drinking Water Quality, to support local protection of drinking water sources.

Produced by URI Cooperative Extension, NEMO

RHODE ISLAND DEPARTMENT OF HEALTH

THE UNIVERSITY OF RHODE ISLAND
COOPERATIVE EXTENSION
RI NEMO

Topics

- Method for adding hydrologic soil groups (HSG)
- Site Specific Soil Manual (SSSM) walk-through
- Where/when to use SSSM
- Interpretation maps

Methods for Determining Hydrologic Soil Groups

- Considered using pre-existing methods
  - Plymouth County, MA
    - Calculated in NASIS, not manually entered
  - National Engineering Handbook
    - Based off of soil map units, not field texture/data
    - Considered a function for engineers, not soil scientists
  - Rhode Island Soil Survey
    - HSG data has not yet been updated

Overall: Existing methods were confusing, out-dated, or both.

New task: Develop a procedure based on field measurements and soils on site, not a large map unit or old data.

Terminology Clarification

(from OWTS Rules, April 2010)

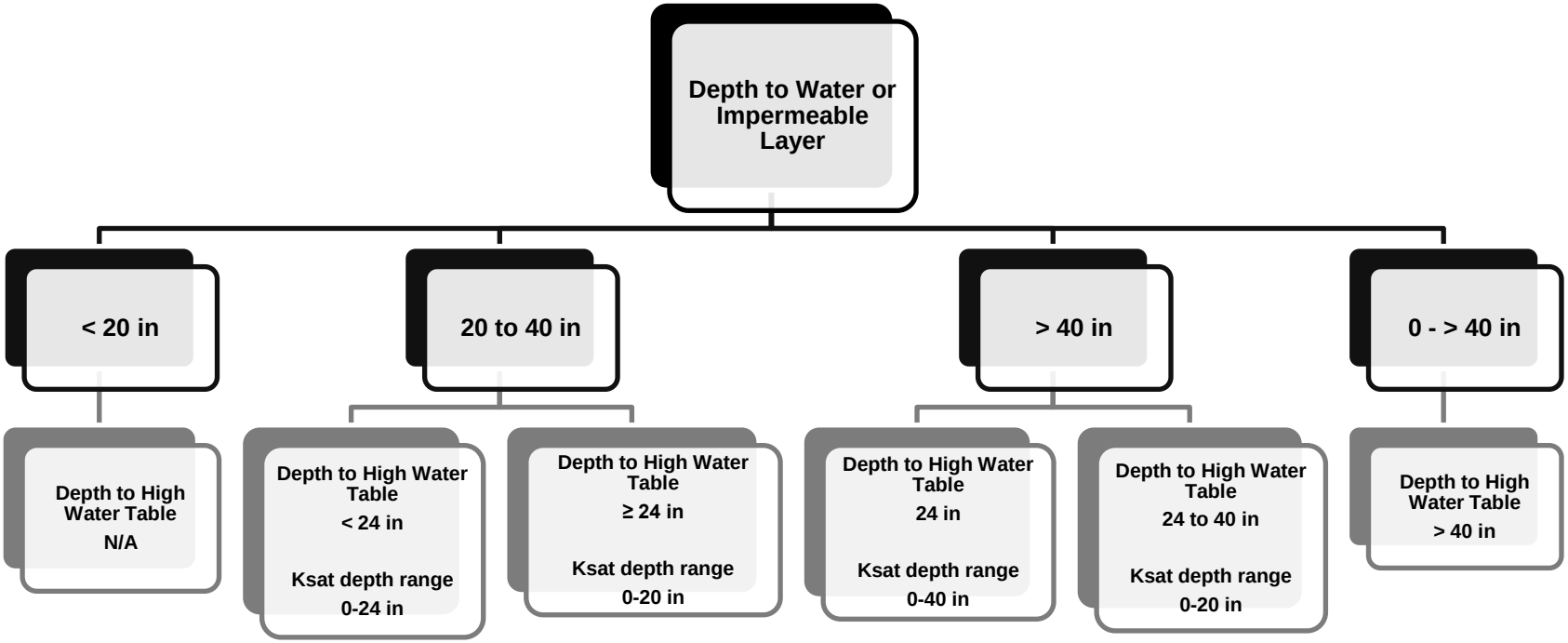
- Infiltration- Entry of water into the soil. Dependant on starting soil water content.
- Permeability- The quality of the soil that enables water or air to move through it
- Saturated Hydraulic Conductivity (Ksat)- actual values measured on soil in situ. Typically measured in units of in/hr or cm/hr.

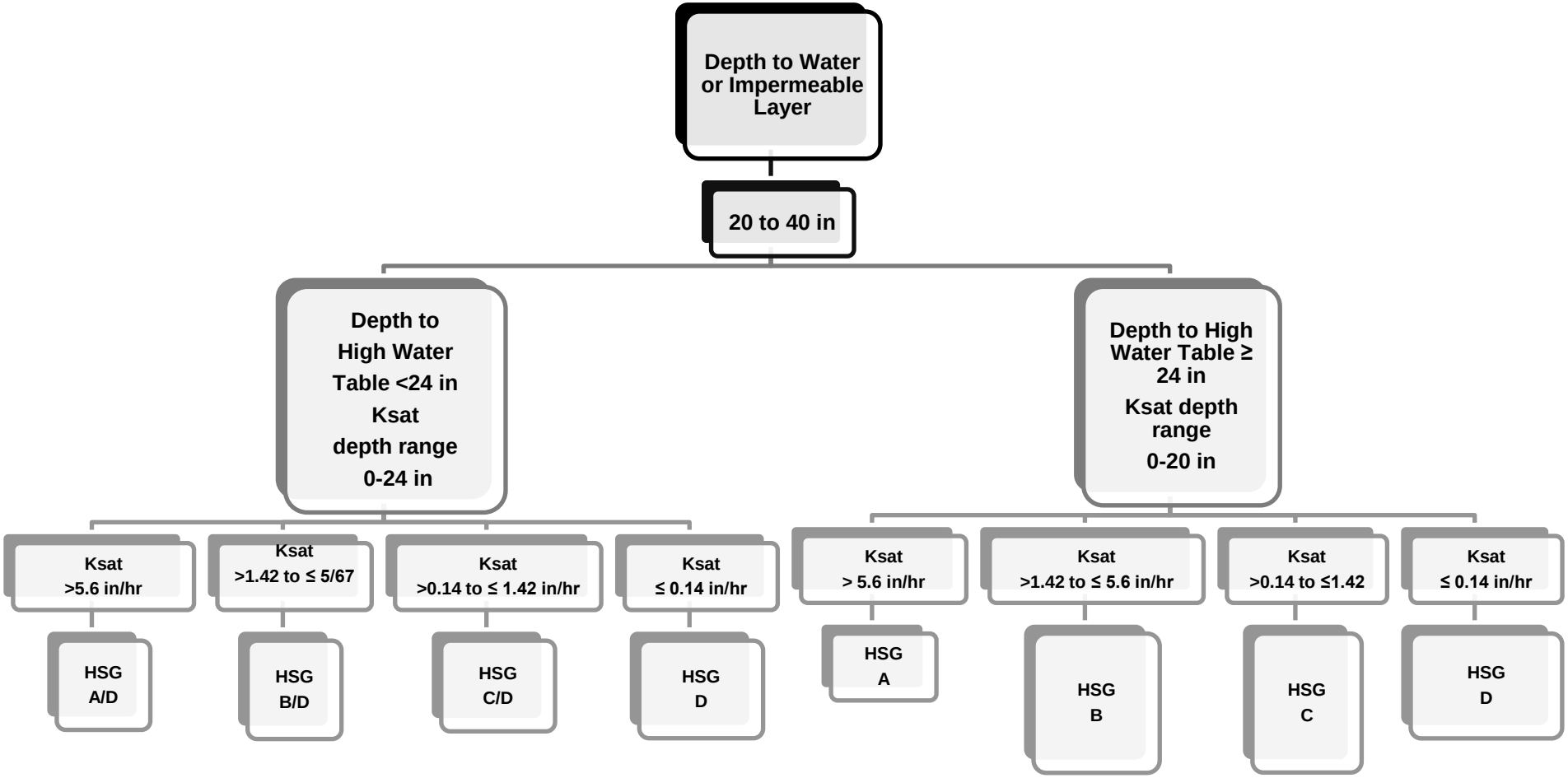
- Because Ksat is a physical value obtained through field measurements, I chose to use Ksat classes and rates to assign HSGs.

Mapping HSG in the RI Site Specific Soil Manual

- 4 Main Components
  1. Depth to impermeable or restrictive layer (field data)
  2. Depth to high water table (field data)
  3. Soil texture (field data)
  4. Saturated Hydraulic Conductivity or Ksat (found using texture classes)

- Useful tools
  - Hydrologic Soil Group Flow Chart
  - NRCS Textural Classes and associated Ksat 'cheat sheet'


Depth to Water or Impermeable Layer
< 20 in
20 to 40 in
> 40 in
0 - > 40 in
Depth to High Water Table
N/A
Depth to High Water Table
< 24 in
Ksat depth range
0-24 in
Depth to High Water Table
≥ 24 in
Ksat depth range
0-20 in
Depth to High Water Table
24 in
Ksat depth range
0-40 in
Depth to High Water Table
24 to 40 in
Ksat depth range
0-20 in
Depth to High Water Table
> 40 in


Depth to Water or Impermeable Layer
20 to 40 in
Depth to High Water Table <24 in
Ksat depth range 0-24 in
Depth to High Water Table ≥ 24 in
Ksat depth range 0-20 in
Ksat >5.6 in/hr
Ksat >1.42 to ≤ 5/67
Ksat >0.14 to ≤ 1.42 in/hr
Ksat ≤ 0.14 in/hr
Ksat > 5.6 in/hr
Ksat >1.42 to ≤ 5.6 in/hr
Ksat >0.14 to ≤1.42
Ksat ≤ 0.14 in/hr
HSG A/D
HSG B/D
HSG C/D
HSG D
HSG A
HSG B
HSG C
HSG D

- Texture can be related to Ksat using this Rhode Island NRCS-USDA ‘cheat sheet’

- Because texture is easily determined in the field, it is using this chart that the values for Ksat were determined and entered into the following flow chart

*This is a general guide. Bulk density of the soil may alter the defined rates

Texture	Textural Class	Permeability Class	Saturated Hydraulic Conductivity (Ksat) in/hr	Saturated Hydraulic Conductivity (Ksat) µm/sec
Gravel	N/A	Very Rapid	>20.0	>141.14
Coarse Sand				
Loamy Sand	Coarse	Rapid	6.0-20.0	42.34-141.14
Loamy Fine Sand				
Loamy Coarse Sand				
Sand				
Fine Sand				
Coarse Sand				
Coarse Sandy Loam	Moderately Course	Moderately Rapid	2.0-6.0	14.11-42.34
Sandy Loam				
Find Sandy Loam				
Very fine sandy loam	Medium	Moderate	0.6-2.0	4.23-14.11
Loam				
Silt Loam				
Silt				
Clay Loam	Moderate Fine	Moderate Slow	0.2-0.6	1.41-4.23
Sandy Clay Loam				
Silty Clay Loam				
Sandy Clay Loam	Fine	Slow	0.06-0.2	0.42-1.41
Silty Clay				
Clay <60%				
Clay >60%	Fine Very Fine	Very Slow	<0.06	<0.42
Claypan				

Depth to Seasonal High Water Table (Wetness Class)		Depth to Restrictive Layer (Bedrock or Densic Material)		Parent Material Texture	
0	0”-12”	1	< 24”	1	Silt loam
1	≥ 12”-24”	2	24”-48”	2	Loam
2	> 24”-36”	3	> 48”	3	Sandy loam
3	> 36”-48”			4	Fine sandy loam
4	> 48”			5	Coarse sandy loam
				6	Loamy sand
				7	Loamy fine sand
				8	Loamy coarse sand
				9	Sand
				10	Fine sand
				11	Coarse sand
				12	Clay loam
				13	Silty clay loam
				gr	Gravelly

Map Units	*HSG*
G33/1A1	*C*
C(G)43/3A1	*A*
C43/6A3	*A*
G23/1A1	*C*
B02/gr4B3	*A/D*
F13/12A3	*B/D*

The Key to Determining Hydrologic Soil Groups Based on Soil Properties Used in Site Specific Soil Mapping

It is the same key used in the Standards and Procedures for Site Specific Soil Mapping.

Depth to SHWT		*Depth to Restrictive Layer*		*Parent Material Texture*		*HSG*
0 or 1		*1 or 2*		*gr, 6, 8, 9, 10, 11*		***A/D***
0 or 1		*1 or 2*		*3, 5, 7*		***B/D***
0 or 1		*1 or 2*		*1, 2, 4, 12, 13, Silt*		***C/D***
2, 3, 4		*1 or 2*		*gr, 6, 8, 9, 10, 11*		***A***
2, 3, 4		*1 or 2*		*3, 5, 7*		***B***
2, 3, 4		*1 or 2*		*1, 2, 4, 12, 13, Silt*		***C***
0 or 1		*3*		*gr, 3, 5, 6, 7, 8, 9, 10 11,*		***A/D***
0 or 1		*3*		*1, 2, 4, 12, 13, Silt*		***B/D***
2 or 3		*3*		*gr, 6, 8, 9, 10, 11*		***A***
2 or 3		*3*		*3, 5, 7*		***B***
2 or 3		*3*		*1, 2, 4, 12, 13, Silt*		***C***
4		*N/A*		*gr, 3, 5, 6, 7, 8, 9, 10 11,*		***A***
4		*N/A*		*1, 2, 4, 12, 13, Silt*		***B***

Below is the final map unit symbol derived from the field data collected

Added to it is the HSG as an upper-case letter at the end of the map unit.

An **example** of a map unit would be: **A22D/gr5C4 A**

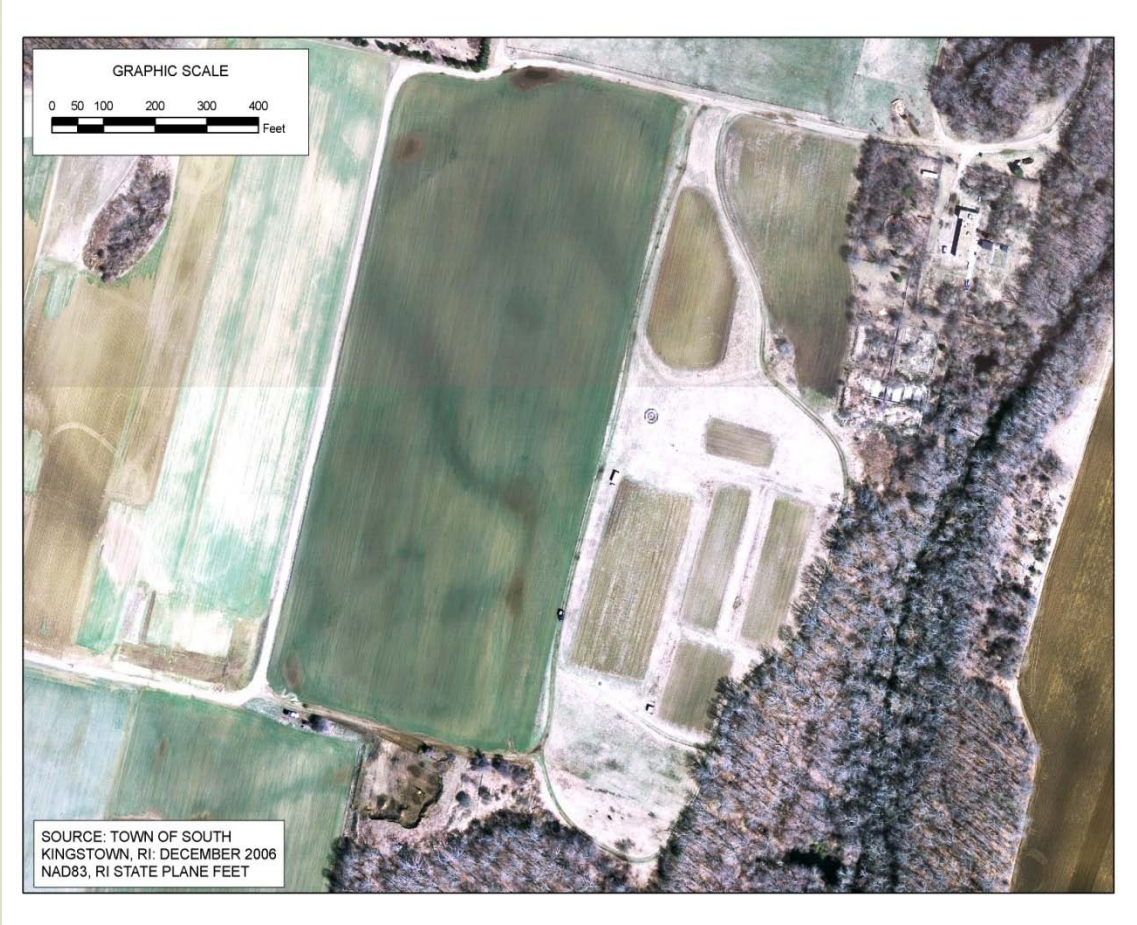
Map unit symbol	A	2	2	D	/	gr	5	C	4	A
Description	**Dense Till**	**> 24 – 36”**	**>24 – 48”**	**Densic**		**gravelly**	**Coarse sandy loam**	**>8 – 15%**	**Fine sandy loam**	**High infiltration rate**
Soil feature	Parent material	Depth to seasonal high water table	Depth to restrictive layer	Bedrock or densic		Coarse fragment modifier	Parent material texture	Slope class	Surface texture	HSG

Topics

- Method for adding hydrologic soil groups (HSG)
- Site Specific Soil Manual (SSSM) walk-through
- Where/when to use SSSM
- Interpretation maps

Procedure for Site Specific Soil Mapping

- Start with a base map of your site area
- LIDAR is now available statewide

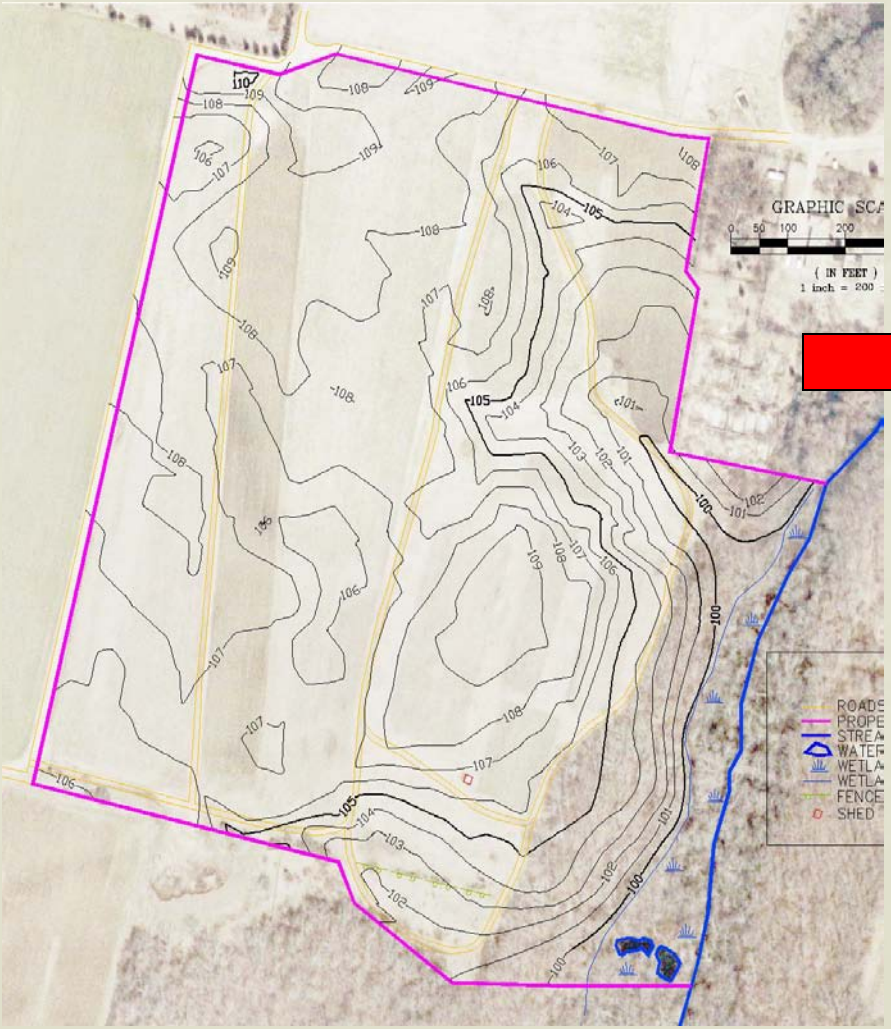


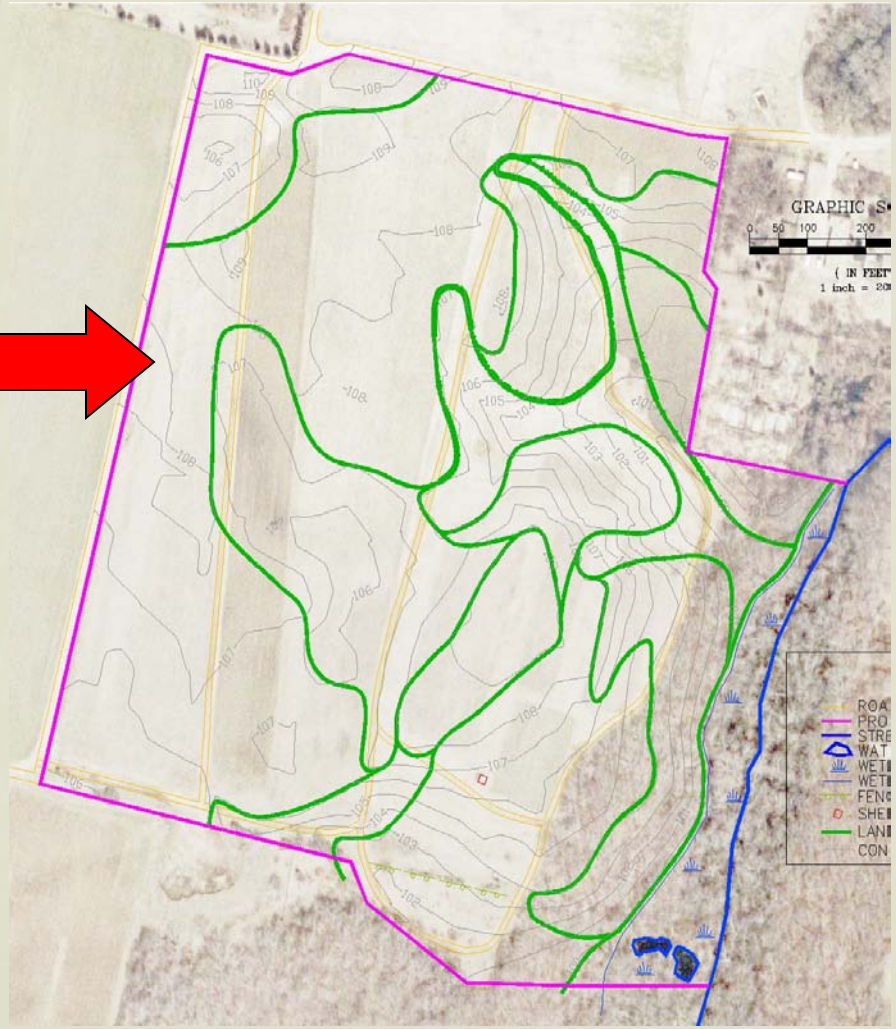
Determine Mapping Scale

- Soil survey maps created to plan for lot locations, roads, sediment control structures, and potential placement of OWTS for large developments are mapped at 1:2400.
- Individual lots less than 1/2 acre should be mapped at a scale of 1:600 or greater (i.e. 1:240).
- Lands with considerable soil variability should be mapped at finer scales to meet map unit variability standards.

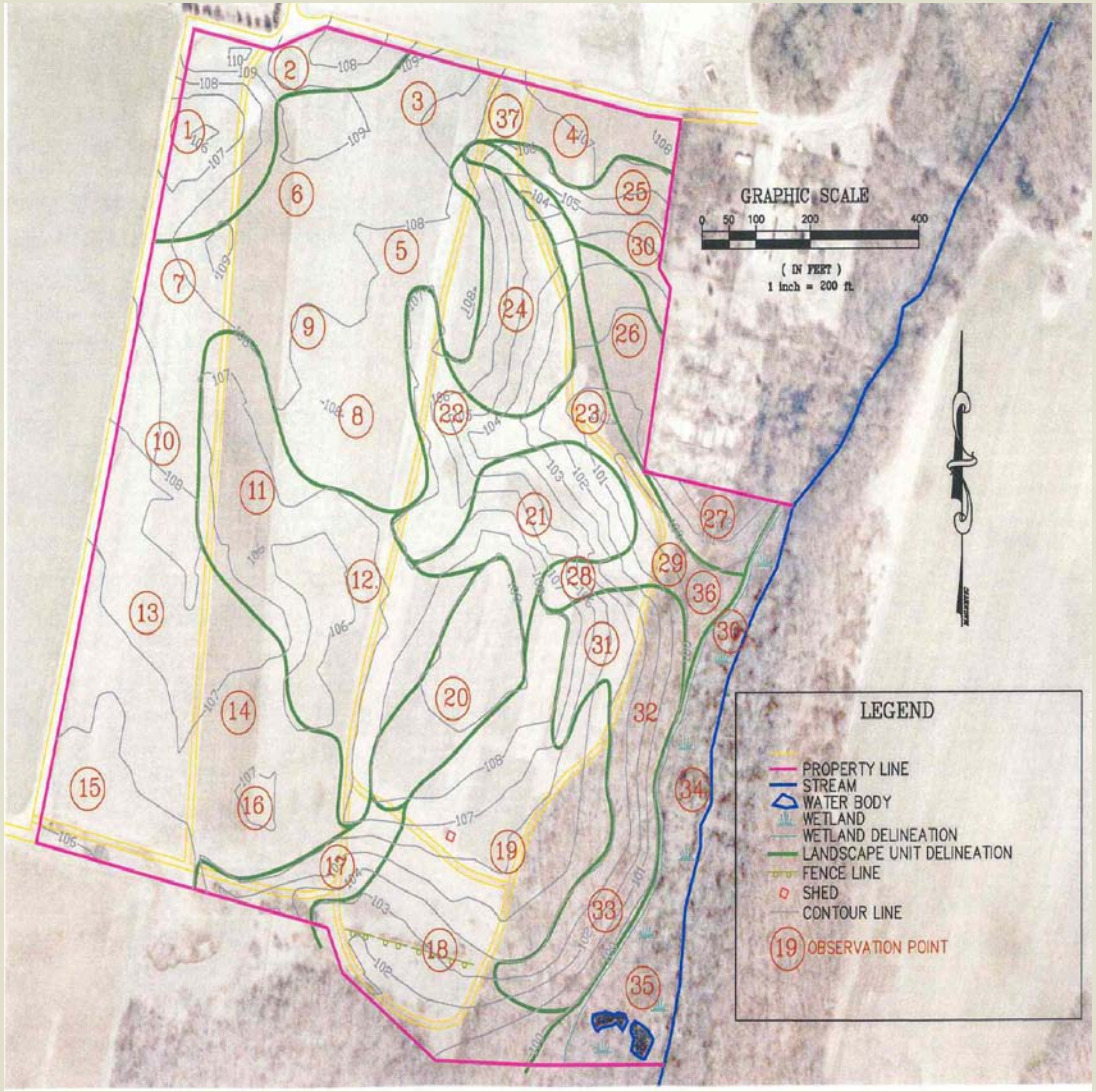
Mapping Scale	1:6000	1:2400	1:1200	1:600	1:480	1:240
Plan Scale Equivalent	1”= 500’	1” = 200’	1” = 100’	1” = 50’	1” = 40’	1” = 20’
Maximum distance between observations	500’	200’	100’	50’	40’	20’

Use a Contour Map to Delineate Landscape Units





Choose Observation Points



Landscape units are delineated in the field on the base map.

Delineations are based on landscape attributes such as slope class and surface water flow-paths.

Differences are recognized by variations in the photos that ID differences in wetness or veg.

Soils within representative areas of each delineation are described to a depth of 48”

Each observation should be located on a separate map.

Data Collection

Observation I.D and Date	Landscape position	Slope %	Parent Material	Surface Texture	Parent Material Texture	Stoniness Class	Depth to Bedrock or Densic Materials *inches*	Depth to Fe Concentrations *inches*	Depth to Depletions *inches*	Wetness Class	HSG	Mapping Unit
1	SUM	3	LS	SIL	SIL	NS	>48	38	38	3	C	G33/1A1
2	BS	4	LS	SIL	SIL	NS	>48	40	40	3	C	G33/1A1
3	N/A	1	LS/OW	SIL	SL	NS	>48	-	--	4	A	C(G)43/3A1
4	N/A	3	OW	SL	LS	NS	>48	-	-	4	A	C43/6A3
5	N/A	2	OW	SL	SL	NS	>48	-	-	4	A	C43/3A3
6	N/A	0	LS/OW	SIL	LS	NS	>48	46	-	4	A	C(G)33/6A1
7	N/A	2	LS/OW	SIL	SL	NS	>48	-	-	4	A	C(G)43/3A1
8	N/A	0	OW	SL	LS	NS	>48	-	-	4	A	C43/6A3
9	N/A	1	OW	SL	LS	NS	>48	-	-	4	A	C43/6A3
10	N/A	2	OW	SL	SL	NS	>48	-	-	4	A	C43/3A3
11	N/A	3	OW	SL	LS	NS	>48	40	-	3	A	C33/6B3
12	SH	4	OW	SL	LS	NS	>48	42	-	3	A	C33/6B3
13	N/A	1	OW	SL	LS	NS	>48	-	-	4	A	C43/6A3
14	N/A	0	OW	SL	SL	NS	>48	46	-	4	A	C43/3A3

Data Collection

Observation I.D and Date	Landscape position	Slope %	Parent Material	Surface Texture	Parent Material Texture	Stoniness Class	Depth to Bedrock or Densic Materials *inches*	Depth to Fe Concentrations *inches*	Depth to Depletions *inches*	Wetness Class	HSG	Mapping Unit
1	SUM	3	LS	SIL	SIL	NS	>48	38	38	3	C	G33/1A1
2	BS	4	LS	SIL	SIL	NS	>48	40	40	3	C	G33/1A1
3	N/A	1	LS/OW	SIL	SL	NS	>48	-	--	4	A	C(G)43/3A1
4	N/A	3	OW	SL	LS	NS	>48	-	-	4	A	C43/6A3
5	N/A	2	OW	SL	SL	NS	>48	-	-	4	A	C43/3A3

- Soils field data circled in red is data that is also required by the DEM Soil Evaluation.
- Similarity in field data required makes use easier because of familiarity.

Key to Determining Hydrologic Soil Groups Based on Soil Properties Used in Site Specific Soil Mapping

Depth to Seasonal High Water Table		Depth to Restrictive Layer		Parent Material Texture		HSG
0 or 1		1 or 2		gr, 6, 8, 9, 10, 11		A/D
0 or 1		1 or 2		3, 5, 7		B/D
0 or 1		1 or 2		1, 2, 4, 12, 13		C/D
2, 3, 4		1 or 2		gr, 6, 8, 9, 10, 11		A
2, 3, 4		1 or 2		3, 5, 7		B
2, 3, 4		1 or 2		1, 2, 4, 12, 13		C
0 or 1		3		gr, 3, 5, 6, 7, 8, 9, 10 11		A/D
0 or 1		3		1, 2, 4, 12, 13		B/D
2 or 3		3		gr, 6, 8, 9, 10, 11		A
2 or 3		3		3, 5, 7		B
2 or 3		3		1, 2, 4, 12, 13		C
4		N/A		gr, 3, 5, 6, 7, 8, 9, 10 11,		A
4		N/A		1, 2, 4, 12, 13		B

Examples of Map Units and their associated HSGs.

- If a combination HSG is keyed out, use restrictions for the most limiting HSG.
  - E.g. Treat an A/D soil as a D soil.
- The symbols that correspond to the table above have been color coded to help illustrate the examples.
- The HSG symbol has been added to the map unit symbol in the complete site specific soil survey map.

Map Units		HSG
G33/1A1		C
C(G)43/3A1		A
C43/6A3		A
G23/1A1		C
B02/gr4B3		A/D
F13/12A3		B/D

Detailed Breakdown of Map Unit Symbol

Parent Material	Depth to Seasonal High Water Table (Wetness Class)	Depth to Restrictive Layer	Bedrock or Densic Material*	/	Coarse fragment modifier	Parent material texture	Slope class	Surface texture	Hydrologic Soil Group
L	#	#	L		I	#	L	#	L
A - De Till B - Loc Till C - Outwas D - Ice Contac Stratified Deposit E - Eol Sands F - Allu G - Lo H - Hu Transp Materia (HTM) I - Orga Soil Materia J - Residuum	4 - >48”				gravelly very elly extremely elly cobbly - very bly xcb - extremely cobbly - stony - very stony - emely stony bouldery - very dery - extremely dery	1 - Silt loam 2 - Loam 3 - Sandy loam 4 - Fine sandy loam 5 - Coarse sandy loam 6 - Loamy sand 7 - Loamy fine sand 8 - Loamy coarse sand 9 - Sand 10 - Fine sand 11 - Coarse sand 12 - Clay loam 13 - Silty clay loam	A - 0 – 3% B - >3 – 8% C - >8 – 15% D - >15 – 25% E - > 25%	1 - Silt loam 2 - Loam 3 - Sandy loam 4 - Fine sandy loam 5 - Coarse sandy loam 6 - Loamy sand 7 - Loamy fine sand 8 - Loamy coarse sand 9 - Sand 10 - Fine sand 11 - Coarse sand 12 - Clay loam 13 - Silty clay loam	A - high infiltration B - moderate infiltration C - slow infiltration D - very slow infiltration A/D –high/very slow B/D -moderate/ very slow C/D- slow/very slow

The “D” and “R” symbols for densic materials and bedrock correspond to DEM Soil Types 9 and 10 respectively.

Letters used for Parent Material correspond to the DEM Parent Material Classes. Additional letters are used because other parent materials are identified using SSSM.

An **example** of a map unit would be: **A22D/gr5C4 A**

Below is the final map unit symbol derived from the field data collected

Added to it is the HSG as an upper-case letter at the end of the map unit.

An **example** of a map unit would be: **A22D/gr5C4 A** (Based off of the symbols used for NH Site Specific Soil Survey)

Map unit symbol	A	2	2	D	/	gr	5	C	4	A
Description	**Dense Till**	**> 24 – 36”**	**>24 – 48”**	**Densic**		**gravelly**	**Coarse sandy loam**	**>8 – 15%**	**Fine sandy loam**	**High infiltration rate**
Soil feature	Parent material	Depth to seasonal high water table	Depth to restrictive layer	Bedrock or densic		Coarse fragment modifier	Parent material texture	Slope class	Surface texture	HSG

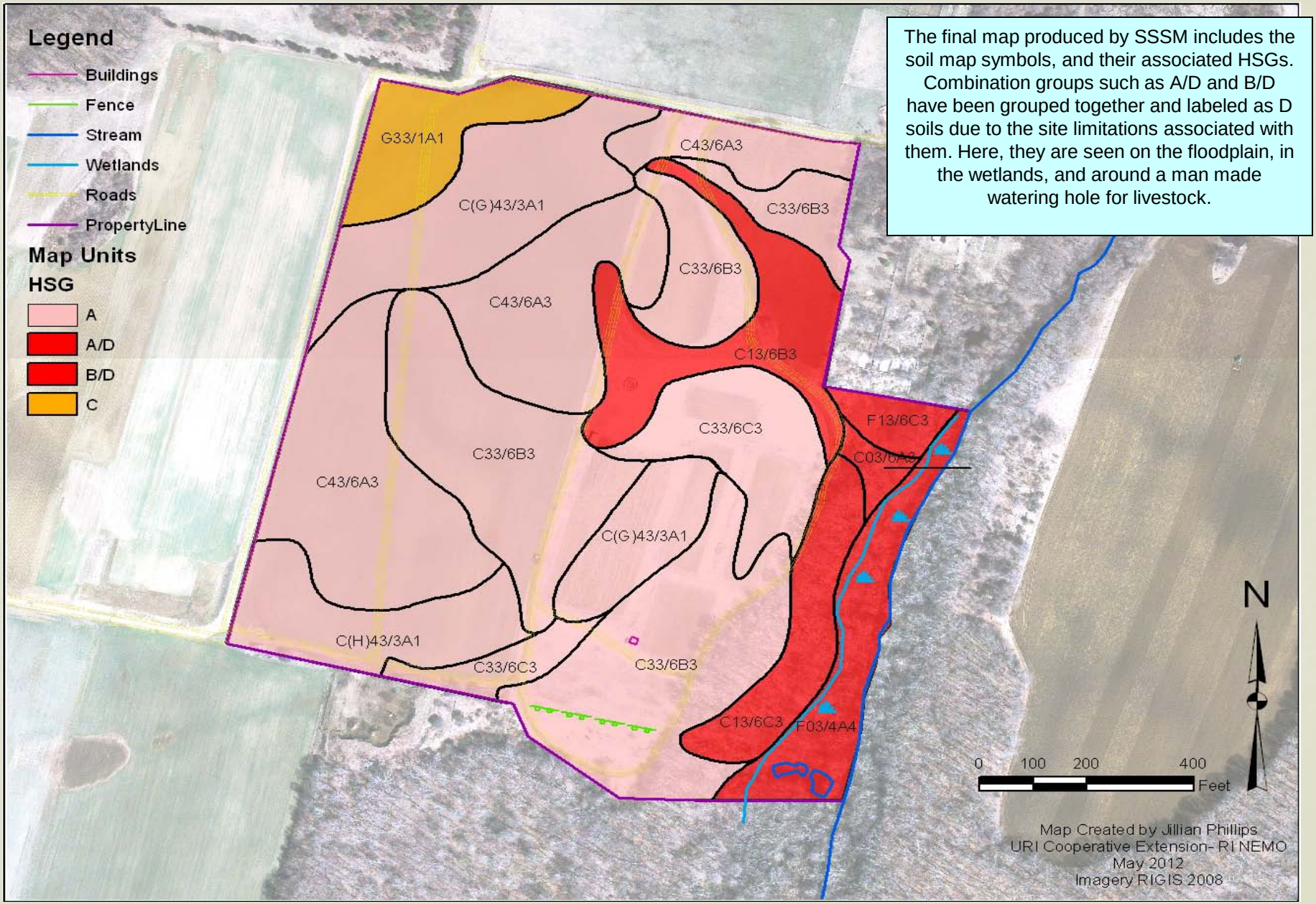
•All of the letters and numbers used are merely field symbols.

•They represent the field data from the data sheet in the same way a soil series symbol is used (Ef = Enfield silt loam etc)

•This allows the maps created to show useful data.

•Once one becomes accustomed to reading the map unit symbols, the vast majority of field data can be known at a simple glance of the map unit symbol.

Final Map of the Study Area



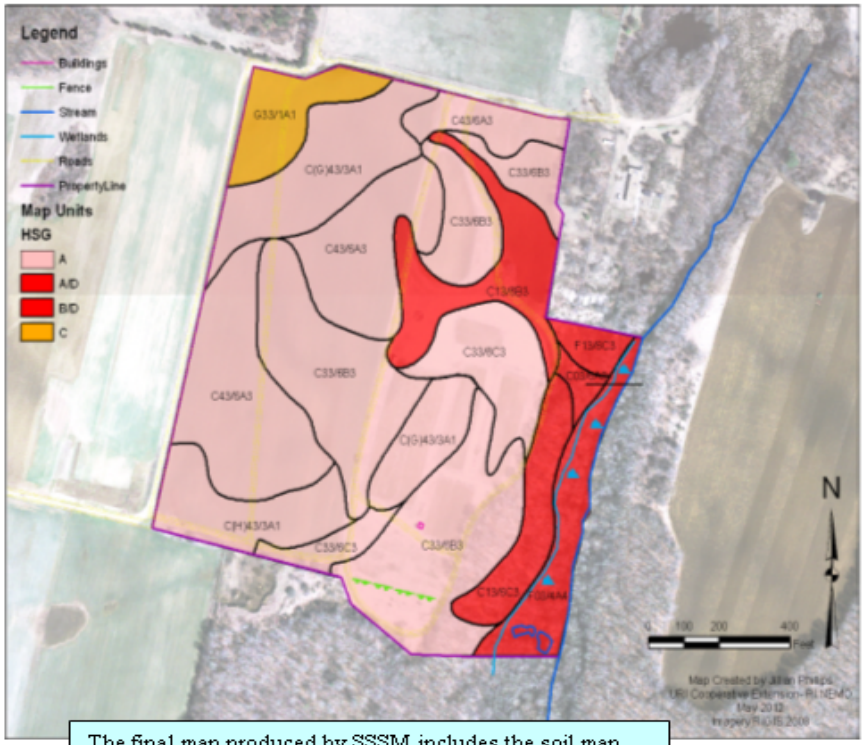
The final map produced by SSSM includes the soil map symbols, and their associated HSGs. Combination groups such as A/D and B/D have been grouped together and labeled as D soils due to the site limitations associated with them. Here, they are seen on the floodplain, in the wetlands, and around a man made watering hole for livestock.

SSSM v. RI Soil Survey

Completed Maps

All maps shown here use the same demonstration area as shown in Standards and Procedures for Site Specific Soil Mapping.

Final Map of Demonstration Area Using SSSM

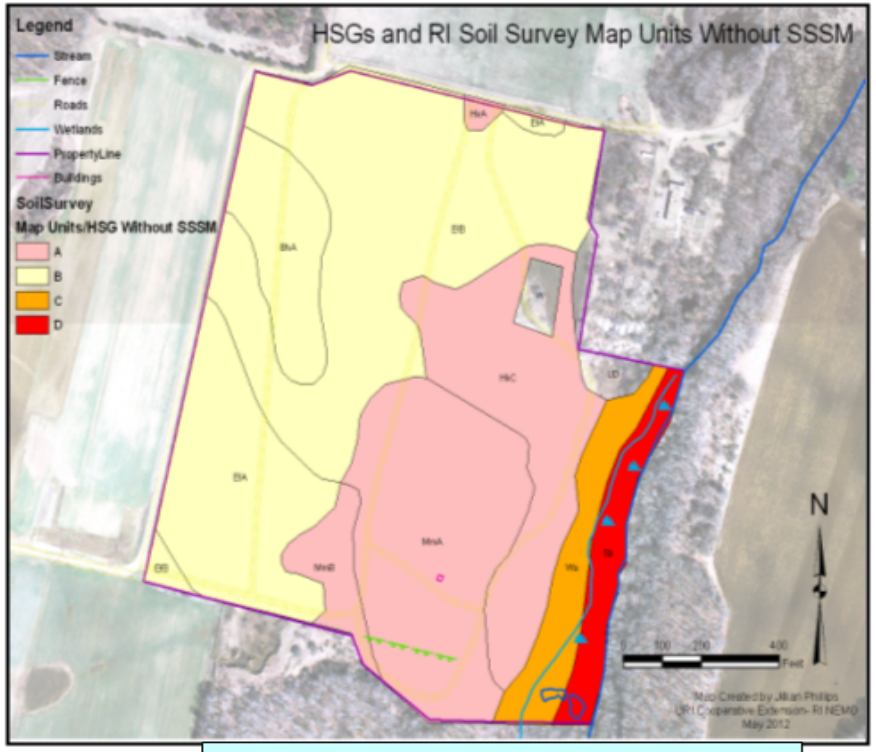


The final map produced by SSSM includes the soil map symbols, and their associated HSGs. Combination groups such as A/D and B/D have been grouped together and labeled as D soils due to the site limitations associated with them. Here, they are seen on the floodplain, in the wetlands, and around a man made watering hole for livestock. Because not all HSG are shown on this site, the key to the right shows all possible HSGs and their associated symbols

HSG

- A
- B
- C
- D, /D

Final Map of Demonstration Area Using RI Soil Survey



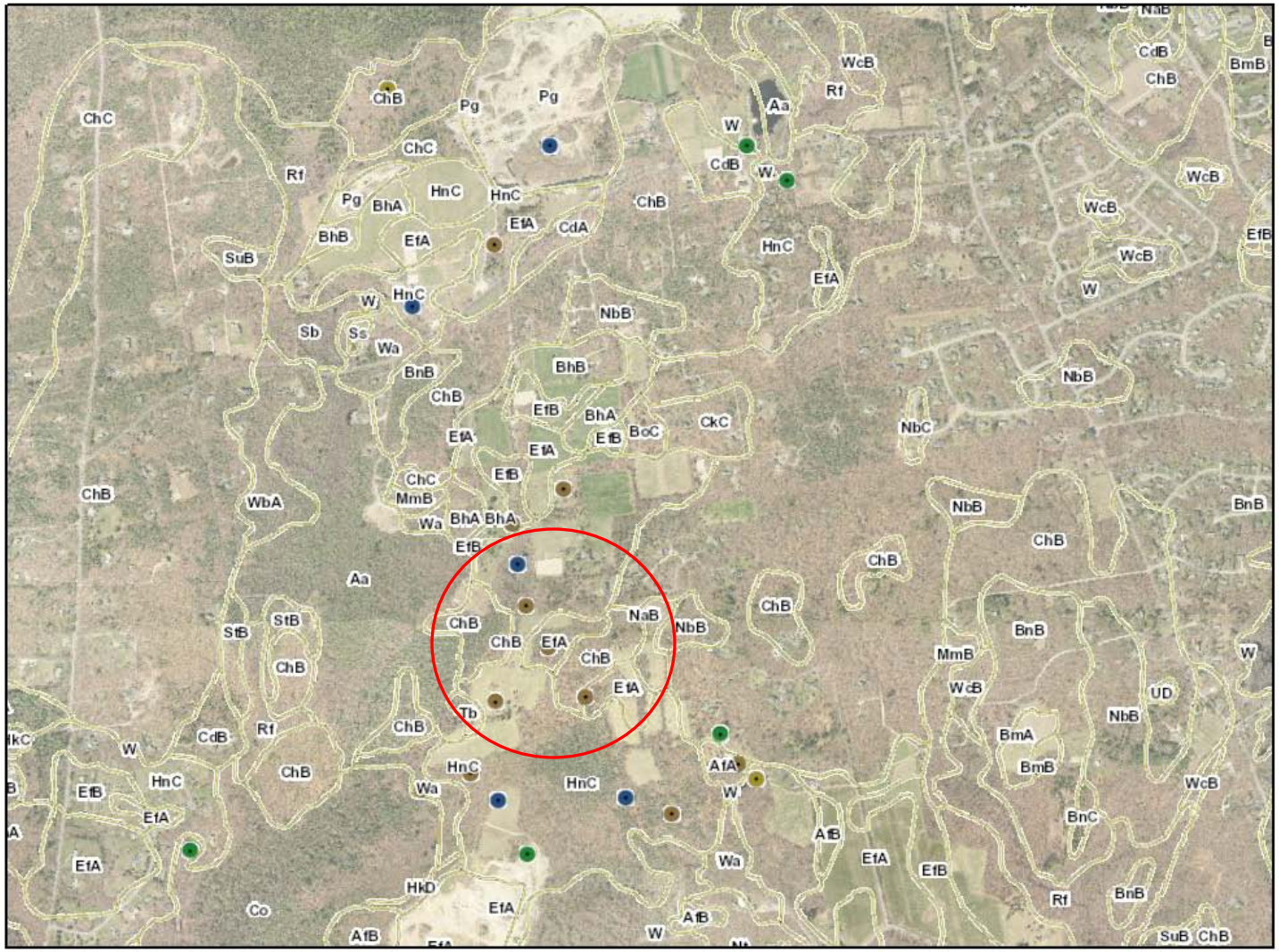
Using only the RI Soil Survey produces a very different final map of HSGs found on this land. It is broader, less accurate, and does not show combination HSGs. It is a prime example of why SSSM is essential to understanding the hydrology of a site. It also has very few map units and excludes portions of the site that are fill or have a permanent water body.

Topics

- Method for adding hydrologic soil groups (HSG)
- Site Specific Soil Manual (SSSM) walk-through
- Where/when to use SSSM
- Interpretation maps

Where to Use SSSM?

- Areas with shallow or limiting soils to determine build-able land
- Areas with high soil variability
- Critical areas: wetland buffers, watersheds, coastal ponds, drinking water supply sheds
- Low Impact Development
- Used to delineate wetlands



Legend

Spot Symbols

NAME

- Bedrock Outcrop
- Bouldery Spot
- Dry Spot
- Fluid Soil Spot
- Gravel Pit
- Gravelly Spot
- Intermittent Open Water
- Marsh
- Quarry Pit
- Sandy Spot
- Shelly Spot
- Very Stony Spot
- Water
- Wet Spot

N

0 500 1,000 2,000 Feet

RIGIS

Jillian Phillips RI NEMO
RIGIS 2008 Imagery
May 2012

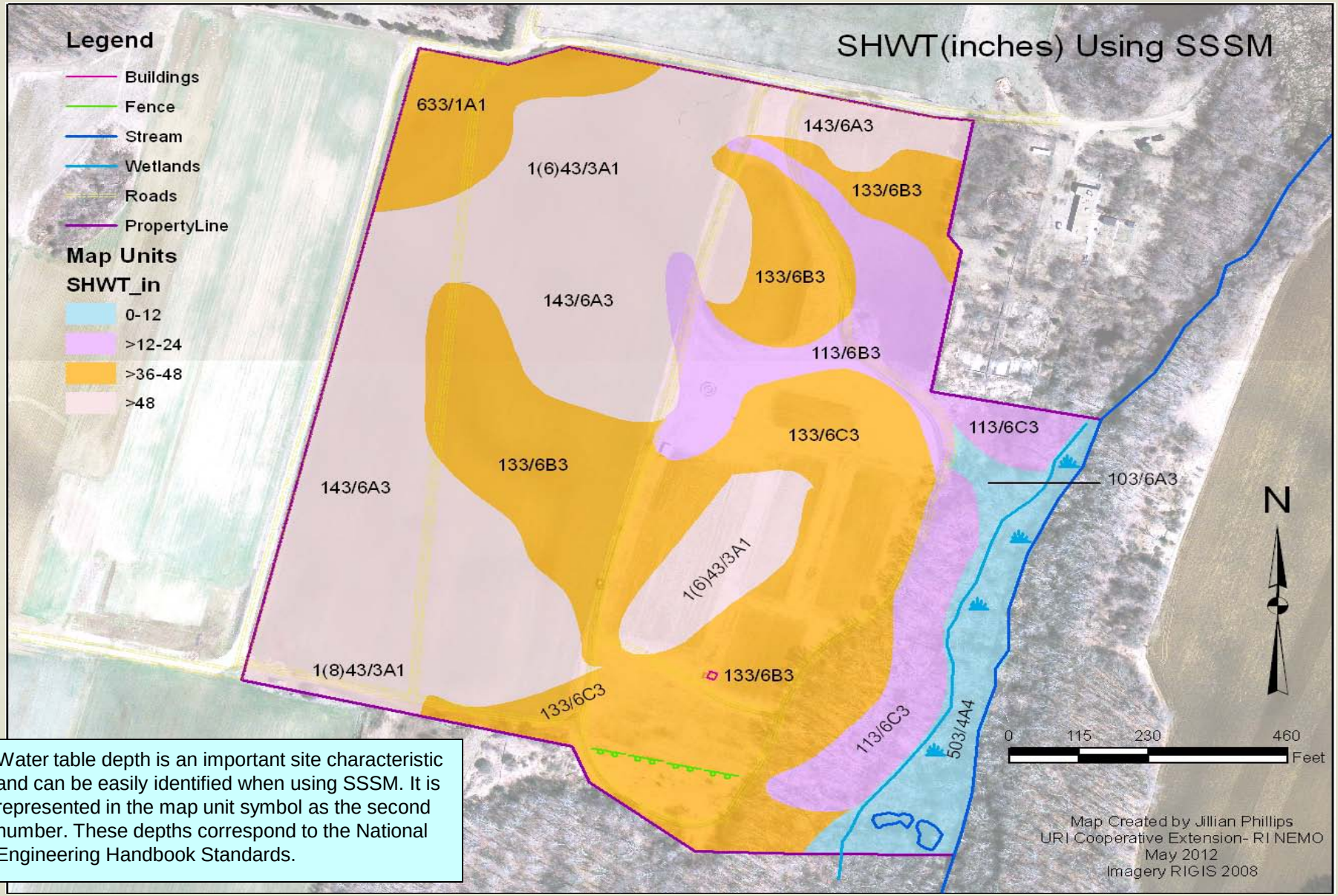
RI Soil Survey Spot Symbol Map

The RI Soil Survey is mapped at a scale of 1:15840 (shown above).
At this scale, map units smaller than 1 acre are not included,
and map units smaller than 2 acres are often mapped as inclusions.
To rememdy this, the RIGIS data includes "spot symbols"
which indicate site limitations not found at the mapping scale.
However, these spot symbols are not included in the paper version of the RI Soil Survey,
which is still widely used by developers and site planners.

Topics

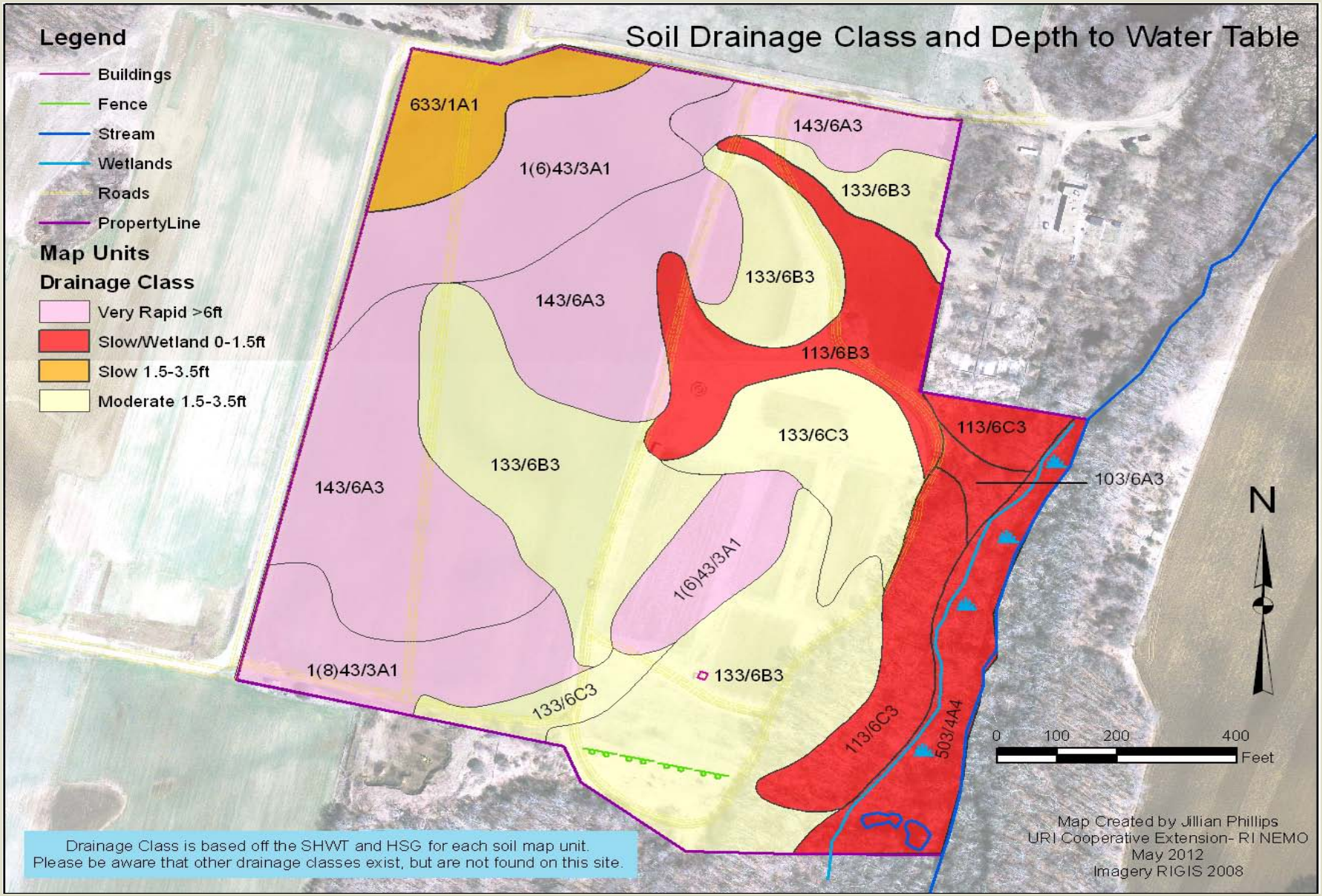
- Method for adding hydrologic soil groups (HSG)
- Site Specific Soil Manual (SSSM) walk-through
- Where/when to use SSSM
- Interpretation maps

Water Table Depths

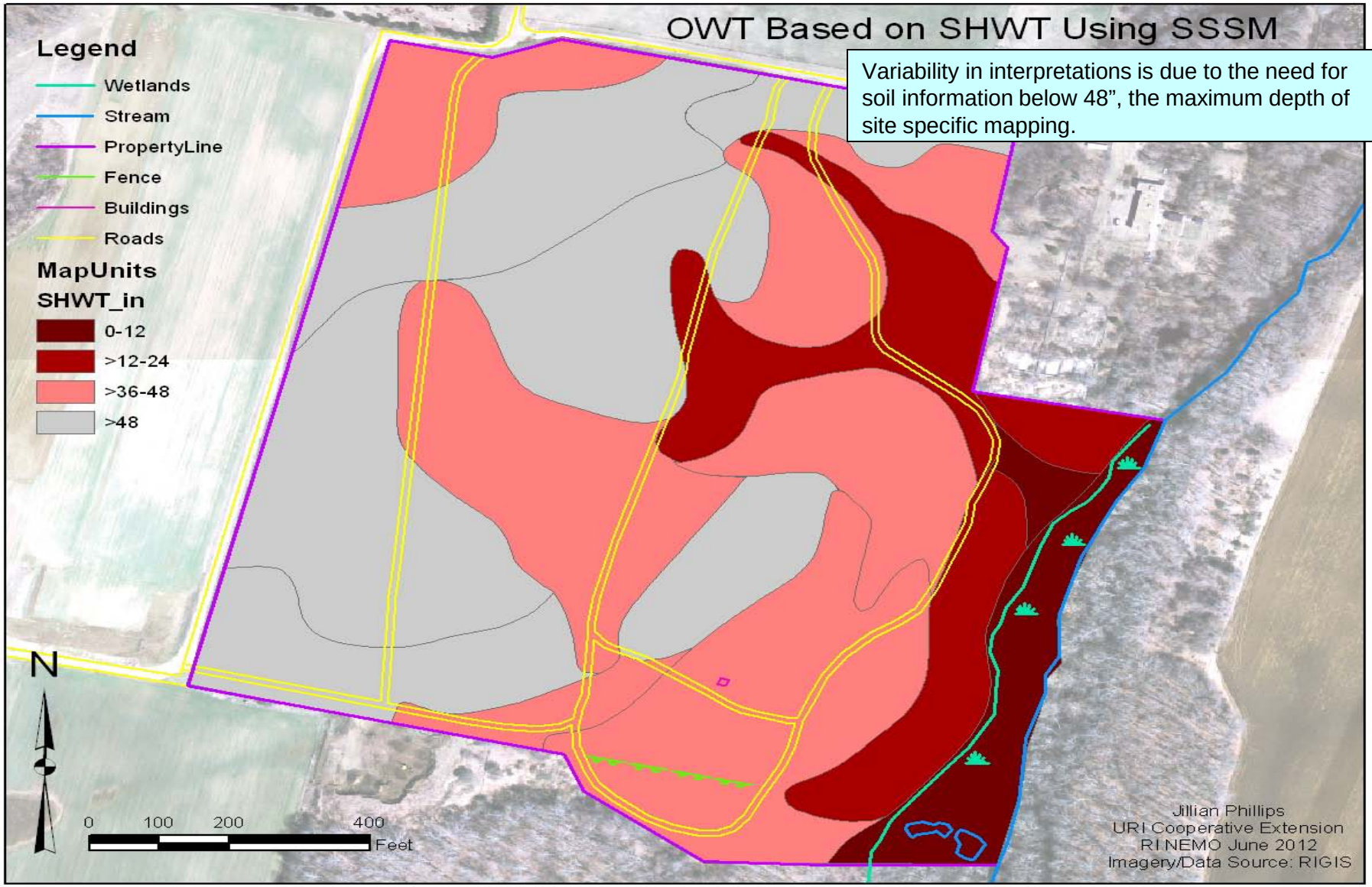


Water table depth is an important site characteristic and can be easily identified when using SSSM. It is represented in the map unit symbol as the second number. These depths correspond to the National Engineering Handbook Standards.

Water Table Depth and Hydrologic Soil Groups



Onsite Wastewater Treatment Suitability



Variability in interpretations is due to the need for soil information below 48", the maximum depth of site specific mapping.

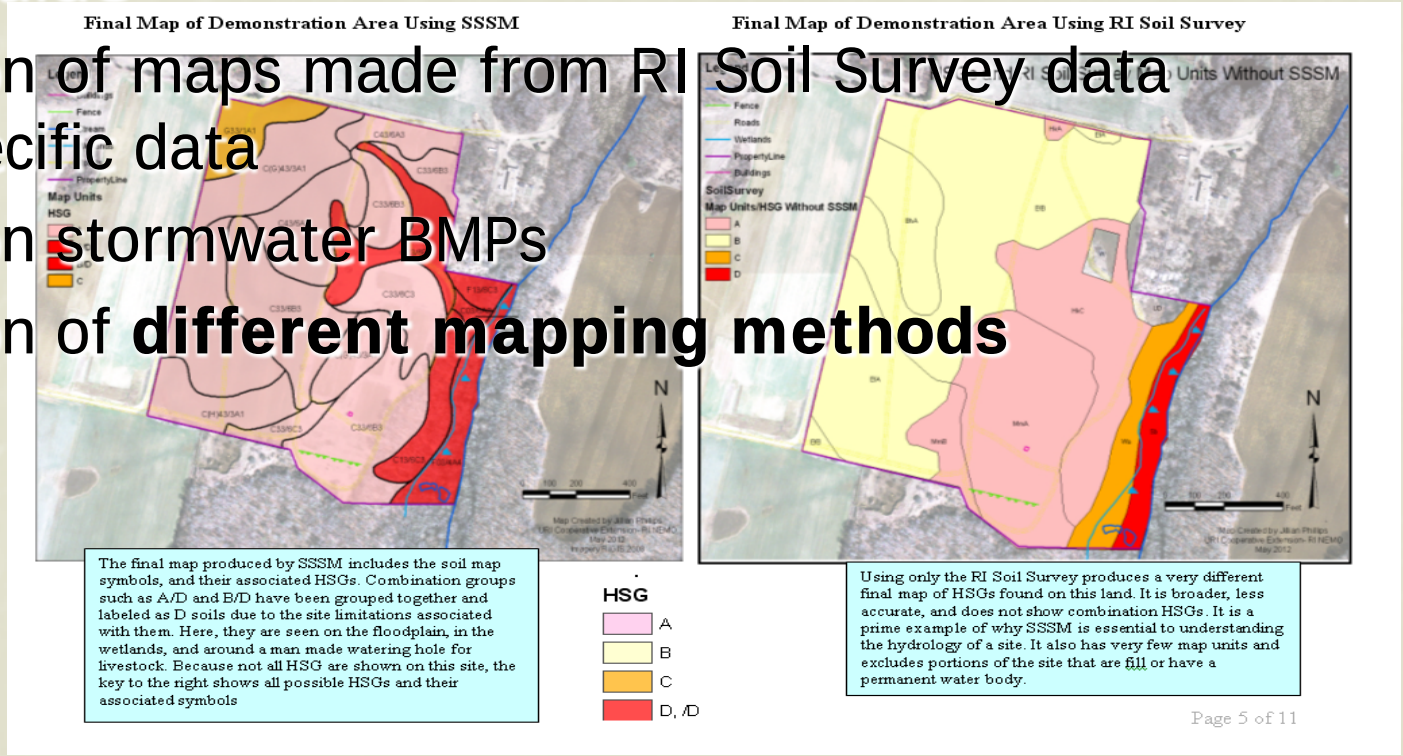
Details on OWTS and Drainfield Options

SHWT Depth	Limitation	Details
0-12”	Unsuitable	Unsuitable but DEM may allow repair; Advanced treatment with Bottomless Sand filter (BSF)required.
12-24”	Unsuitable	Unsuitable but DEM may allow repair or grant variance to 18”; Advanced treatment with BSF is required.
24-36”	Extreme	Advanced treatment required with BSF at < 30”; other drainfields: 30” or deeper - Geomat may be used (modular version of PSND) 32 -40” or deeper– pressurized shallow narrow drainfield (PSND)
36-48”	Severe	Advanced treatment with either drainfield options above or raised shallow conventional drainfield (pipe & stone or Indrain).
> 48”	Variable	SSSM data not available at > 48” Advanced treatment at < 60” with drainfield options above; or Conventional treatment with drip irrigation at ≥ 48”; or Conventional treatment with at-grade shallow drainfield at ≥ 60” or flow diffuser at ≥ 72”

Note: Separation distance from SHWT is greater for certain soils and critical areas (1 ft.) and bedrock (2 ft.).

Next Steps

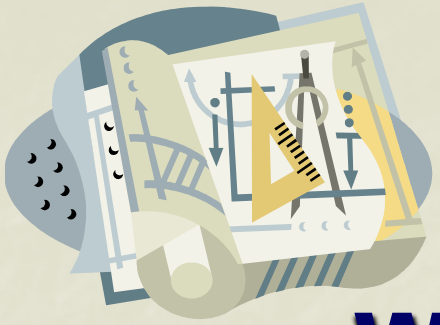
- Final update to the SSSM Standards
- Final technical guide (The Addition of HSG)
- Planner's Guide
  - Comparison of maps made from RI Soil Survey data v. Site Specific data
  - Specifics on stormwater BMPs
  - Comparison of **different mapping methods**



In Summary…

- Hydrologic Soil Groups now an integral part of SSSM
- Method of adding HSG was difficult to develop due to lack of current data and lack of field data
- SSSM has been updated to reflect current methods used by DEM.
- Important for site planning, OWTS, stormwater interpretations

Thank you for your attention!



Questions?

www.uri.edu/ce/wq/

Contacts:

Jillian Phillips	401-874-5178	phillipsjm@g.cofc.edu
Lorraine Joubert	401-874-2138	ljoubert@uri.edu
Mark Stolt	401-874-2914	mstolt@uri.edu

University of Rhode Island, Cooperative Extension
Natural Resources Science, Coastal Institute in Kingston
1 Greenhouse Road, Kingston, RI 02881

THE UNIVERSITY OF RHODE ISLAND
COOPERATIVE EXTENSION
RI NEMO