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Supporting Sustainable Management of Private Woodlands

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How to Use Soils Information for Woodlot Management

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An understanding of forest soils will help owners manage their woods for improved tree health and more efficient growth of trees. Forest soils should be thought of as a living layer or mantle that allows for trees to be anchored to the earth and obtain necessary minerals and water. The mantle includes layers, called horizons, with the upper most being the organic horizon often called the "duff." Below the organic horizons are the mineral horizons, and usually far below the surface is the parent material or bedrock. The science of soils is as complex as the science of forestry or the science of biology; this article will only scuff the surface of the influence of soils on trees and woodland management.

The characteristics of soils important for woodlands include their texture, organic matter, and pH. Texture is the size of the soil particles that might include some combination of fine clay, medium silt, and coarse sand. Organic matter particles in the mineral horizons help hold or bind the nutrients such as calcium and magnesium that are necessary for tree growth. Micro-organisms and invertebrates (e.g., fungi, bacteria, centipedes) are dispersed throughout the organic layers, and play important roles in decomposition. Texture and organic matter, plus other factors, influence the moisture holding capacity of the soil. The soil's pH describes soil acidity and influences the availability of nutrients. These three characteristics of soils will impact which trees occur in an area, how well they grow, the limitations imposed on certain woodland operations, and the opportunities for other types of woodland operations.

Most forest stewardship plans include a discussion of forest soils. Unfortunately, most of these discussions are of limited utility to the owner, or to anyone lacking a strong background in soil science. These discussions often mention the name of the soil series, the depth of the soil horizons or layers, and perhaps some chemical attributes of the soil. A partial example of such a soil description from a stewardship plan might read:

> *"These loams belong to the Mardin series of soil, and are most commonly found in previously glaciated areas, specifically on broad hilltops and slopes*

Figure 1. The Web Soil Survey is an online tool that provides an abundance of information about the physical and chemical properties of soils, and the impacts of soils on woodland management.

that range between 0% and 50%. They are well-drained soils with a dense fragipan that begins 14 to 26 inches below the soil surface."

This information can easily be found in the county's soil survey (paper copy) or the more widely available Web Soil Survey (WSS, Figure 1) produced by the Natural Resources Conservation Service, www.websoilsurvey.nrcs.usda.gov.

Specific information is also available in the WSS that would be more useful to most landowners. Information is available, for example, to address how different tree species respond to the soil, if soil conditions might limit the building of roads or landings and if the soils are prone to drought or poor drainage of moisture. If a tree species is suited to a particular soil it will have better health, better growth, and recover more quickly after a stressful event than a species that is growing "off-site." One indicator of whether a tree is suited to a particular soil is the tree's site index on that soil. Site index is the expected height of a tree species at a specific age, usually 50 years old. As an illustration, if a tree species growing on a given soil type has a site index of 65, we would expect an upper canopy tree of that species to be approximately 65 feet tall when the tree is 50 years old. To further illustrate, if sugar maple has a site index of 55 on one soil and 70 on another soil, the latter soil is better matched to the needs of sugar maple resulting in a tree that will grow better and have fewer problems with health. WSS provides the full range of information about the physical and chemical properties of soils.

Woodland owners now have access to two complementary and free resources on the Internet they can use to understand the soils on their property. One resource is WSS, as previously mentioned. WSS is a database of soils information for all lands in the US. An owner can create a map of their property and a list of all the soils (Figure 2). WSS allows the owner to generate a table of soils, and the characteristics of each soil type. A second resource is Google Earth Pro (www.google.com/earth). Google Earth Pro (GEP) provides recent and historic satellite images of the earth. GEP also includes tools that allow a woodland owner to draw and save property and stand boundaries, determine the area of mapped units, draw lines,

Map Unit Legend

Tompkins County, New York (NY109)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BgC	Bath and Valois soils, 5 to 15 percent slopes	0.9	4.0%
EbB	Erie channery silt loam, 3 to 8 percent slopes	11.4	49.8%
ErA	Erie-Chippewa channery silt loams, 0 to 3 percent slopes	3.2	14.1%
LaB	Langford channery silt loam, 2 to 8 percent slopes	7.4	32.1%
Totals for Area of Interest		**22.9**	**100.0%**

Figure 2. This figure shows an example of a soil map for a woodlot in Tompkins County, NY. The soil map legend references the map codes and the acreage in the mapped area, known as the Area of Interest (AOI).

measure distance, and more. Better still, WSS can be integrated into GEP with a minimal effort.

A blog about using WSS and GEP is available at www.CornellForestConnect.ning.com and includes several videos on how to use and integrate these resources, and then how to use them. WSS and GEP are powerful tools, and as with all powerful tools plan to spend some time learning how to use them for optimal success.

A simple example of a woodlot in Tompkins County, NY will illustrate some of the ways to use soil information from WSS (Figure 2). This woodlot has four different types of soils, which WSS refers to as soil map units. The two most abundant units based on the area of interest (AOI) are Erie and Langford soils. The WSS tab for "Soil Data Explorer" allows the owner to learn the site index of specific trees (Figure 3). This example for black cherry shows that the Bath and Langford soils have a better site index than the other soils, though all are fairly good. Similarly, the soils are rated for suitability for a log landing (Figure 4) based on slope, soil strength, wetness, and potential for dust.

Tables — Forest Productivity (Tree Site Index): black cherry (Defler 1937 (750)) — Summary By Map Unit

Summary by Map Unit — Tompkins County, New York (NY109)

Map unit symbol	Map unit name	Rating (feet)
BgC	Bath and Valois soils, 5 to 15 percent slopes	75
EbB	Erie channery silt loam, 3 to 8 percent slopes	65
ErA	Erie-Chippewa channery silt loams, 0 to 3 percent slopes	65
LaB	Langford channery silt loam, 2 to 8 percent slopes	75
Totals for Area of Interest		

Figure 3. WSS allows the user to select a tree species to generate a table of site index values for species commonly found on those soils. Site index values are found in WSS under the tab for Soil Data Explorer, and then within vegetative productivity.

Another example illustrates additional information available to woodland owners. After creating the area of interest (AOI), select the tab for "Soil Data Explorer" and the "Forestland" option as the manner to view soils information (Figure 5). Soil Data Explorer includes a tab for "Suitabilities and Limitations" and information on many subjects such as land classification and vegetative productivity. Information about the potential for windthrow is based on an assessment of the depth to a dense layer, depth to bedrock, and depth to a saturated layer (Figure 6). A visualization of the moderate vs. high ratings for potential windthrow allow the owner to modify cutting practices to reduce the exposure of trees on the more vulnerable soils (Figure 7).

Considering again the stewardship plan, what soil characteristics should be included? The simple answer are those that relate to the objectives of the owner.

Tables — Suitability for Log Landings — Summary By Map Unit

Summary by Map Unit — Tompkins County, New York (NY109)

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)
BgC	Bath and Valois soils, 5 to 15 percent slopes	Moderately suited	Bath (40%)	Slope (0.50)
				Low strength (0.50)
				Dusty (0.01)
			Valois (35%)	Slope (0.50)
				Low strength (0.50)
				Dusty (0.01)
			Langford (5%)	Slope (0.50)
				Low strength (0.50)
				Wetness (0.50)
				Dusty (0.01)
			Mardin (5%)	Low strength (0.50)
				Wetness (0.50)
				Dusty (0.01)
EbB	Erie channery silt loam, 3 to 8 percent slopes	Poorly suited	Erie (75%)	Wetness (1.00)
				Low strength (0.50)
				Slope (0.50)
				Dusty (0.02)
ErA	Erie-Chippewa channery silt loams, 0 to 3 percent slopes	Poorly suited	Erie (60%)	Wetness (1.00)
				Low strength (0.50)
				Dusty (0.01)
			Chippewa (30%)	Wetness (1.00)
				Low strength (0.50)
				Dusty (0.01)

Figure 4. One example of how management is influenced by soils are the potential for a soil to serve as a log landing. Log landings need soils that are fairly stable, not overly rocky, and relatively dry. The ratings for log landing suitability take these and other factors into consideration.

Examples of soil characteristics that might be of interest to many owners include the following:

Within "Suitabilities and Limitations"

- Soil rutting
- Potential for windthrow
- Paths and trails (look within recreational development)
- Harvest equipment operability
- Potential for seedling mortality

Within "Soil Properties and Qualities"

- pH and Cation Exchange (within soil chemical)
- Available water (within soil physical)
- Drainage class (within soil qualities and features)

Finally, the tab for "Soils Report" allows owners to inspect integrated summaries of related soil characteristics. For example, information is aggregated for tree planting and harvesting because these often involve machines.

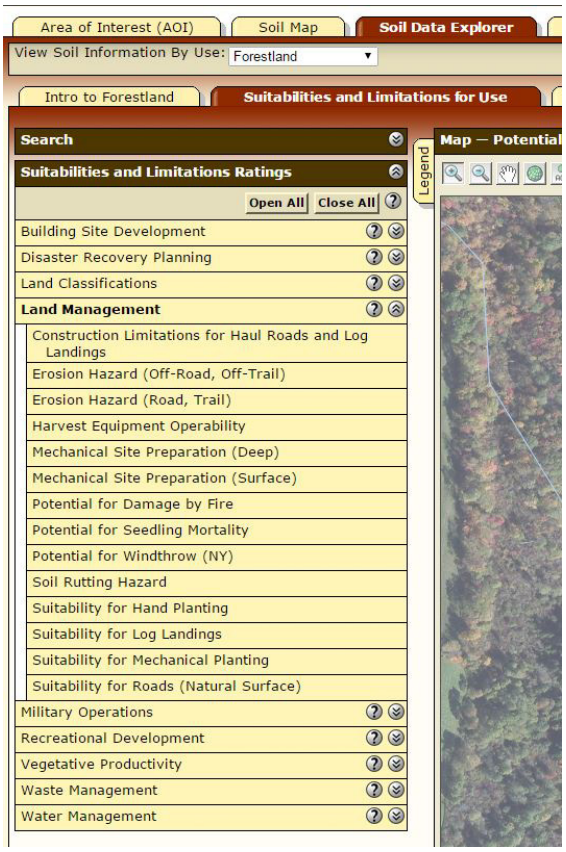

Figure 5. Within an area of interest, forestland soil information is provided for a variety of topics such as potential for windthrow, harvest equipment operability, and rutting hazard.

A couple points are worth noting for the use of the WSS and GEP soils resources in your woodland management. First, the ratings are based on the general properties of a soil type and projected onto a specific owner's property. Although the soil maps are usually accurate, there may be variation between the map and what the owner finds on the ground. It is prudent to spend some time in the woods to verify the maps. Second, understanding the estimates of the soil properties may require a discussion with your forester or staff at the local Soil and Water Conservation District and comparison among different parts of your property. For example, unless you know the significance of a site index of 55 versus 70, the numbers don't mean much. Finally, a soil map unit might have a low rating for some condition, but the location of that unit might be the best option available to an owner. For example an owner may be confronted with a wet rating for a potential log landing; however, there might be management strategies to mitigate this limitation such as summer logging on dry ground or winter logging on frozen ground.

Tables — Potential for Windthrow (NY) — Summary By Map Unit

Summary by Map Unit — Tompkins County, New York (NY109)

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
BgC	Bath and Valois soils, 5 to 15 percent slopes	Moderate	Bath (40%)	Depth to dense layer (0.08)	1.0	4.0%
			Valois (35%)	Depth to dense layer (0.17)		
			Langford (5%)	Depth to dense layer (0.87)		
				Depth to saturated zone (0.20)		
			Mardin (5%)	Depth to dense layer (0.91)		
				Depth to saturated zone (0.20)		
			Lordstown (5%)	Depth to bedrock (0.50)		
EbB	Erie channery silt loam, 3 to 8 percent slopes	High	Erie (75%)	Depth to saturated zone (1.00)	11.0	46.0%
				Depth to dense layer (0.98)		
ErA	Erie-Chippewa channery silt loams, 0 to 3 percent slopes	High	Erie (60%)	Depth to saturated zone (1.00)	3.3	14.0%
				Depth to dense layer (0.98)		
			Chippewa (30%)	Depth to saturated zone (1.00)		
				Depth to dense layer (1.00)		
			Chippewa, very poorly drained (5%)	Depth to saturated zone (1.00)		
				Depth to dense layer (1.00)		
LaB	Langford channery silt loam, 2 to 8 percent slopes	Moderate	Langford (75%)	Depth to dense layer (0.87)	8.6	35.9%
				Depth to saturated zone (0.20)		
Totals for Area of Interest					**23.8**	**100.0%**

Figure 6. The details of the additional information, here windthrow, describes the attributes of the soil that predict a soil to more or less vulnerable. If a soil is vulnerable, the cause of the vulnerability may indicate if and how remediation is possible.

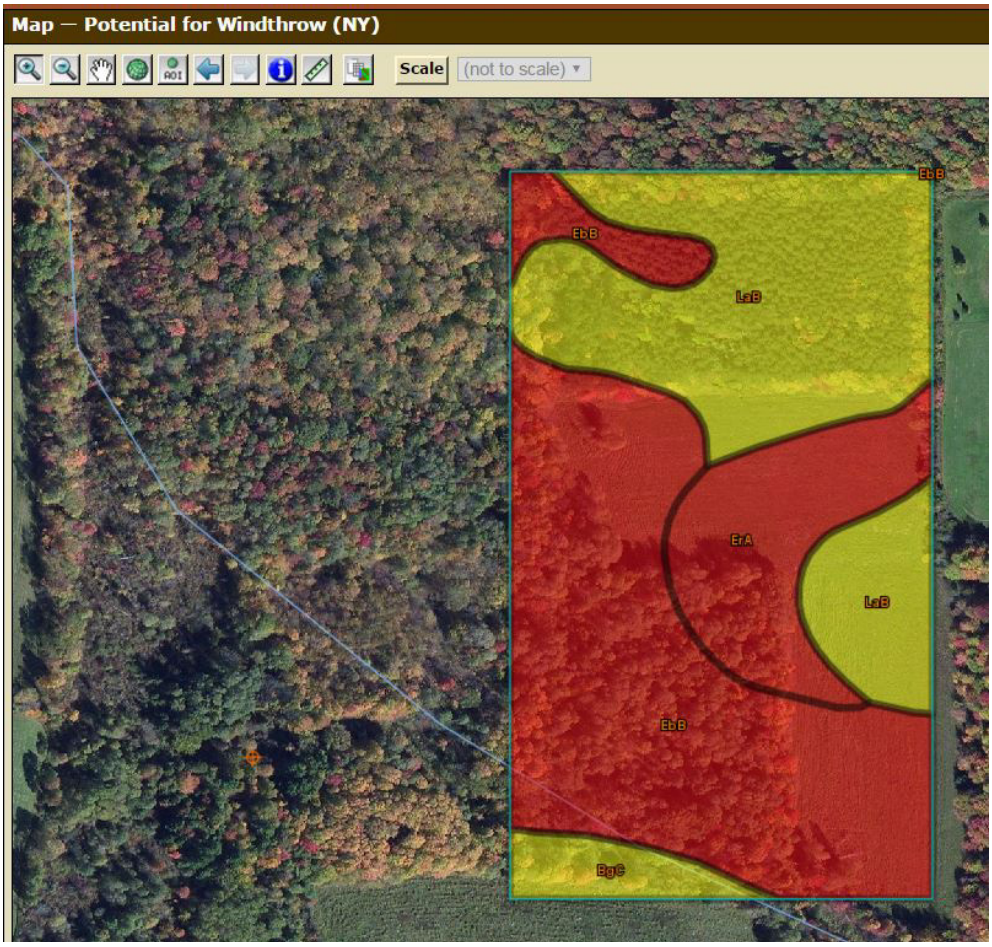

Figure 7. The soil map units illustrate the areas of high windthrow risk such as those in the southwest portion of the Area of Interest.

For additional information on woodland management go to:
www.ForestConnect.com

www.CornellForestConnect.ning.com

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