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NEON Site Level Plot Summary University of Notre Dame Environmental Research Center (UNDE)

Document Information

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Site Background

The University of Notre Dame Environmental Research Center east is located along the state line of Wisconsin (Vilas County) and Michigan (Goegebic County). The entire site encompasses a land area of 6150 acres and 30 lakes and bogs with a surface area of 1350 acres giving total of 7500 acres. The site is in Major Land Resource Area (MLRA) 93B Stony and Rocky Loamy Plains and Hills, Eastern Part.

Site Information

This area is entirely in the Superior Upland Province of the Laurentian Upland. Elevation ranges between 1640 ft (500 m) and 1700 ft (520 m).

The bedrock consists of Precambrian slate, greywacke, and gneiss that is covered by late Wisconsin glacial deposits. The area in and surrounding the site is best characterized as a disintegration moraine with numerous ice block depressions that form lakes or closed depressions. As is common in a disintegration moraine, the parent materials at the UNDE site consist of glacial deposits including supraglacial and subglacial till, and outwash. Organic parent materials formed subsequent to deglaciation in depressions that intersected the water table. The origin and properties of the parent material (predominantly till and outwash) may vary within a small area, depending on the deposition.

Plant Communities at the site are forest and woodland with smaller proportions of woody wetlands.

Soils at this site dominantly classify as Spodosols with lesser proportions classifying as Histosols and Inceptisols. Diagnostic features present or absent in each individual soil determine the finer taxonomic classification and are noted within the soil descriptions for this project. Relevant diagnostic features for this site include albic, argillic, cambic, spodic, and glossic horizons; aquic conditions; fragipans, hemic and sapric soil materials; endosaturation and episaturation. Soil types at this site dominantly have particle size control section textures of Sandy with lesser proportions of Coarse-Loamy, Sandy or Sandy-Skeletal, Coarse-Silty, Coarse-Loamy over Sandy or Sandy-Skeletal, or are organic soils outside of the Terric subgroups. Soil minerology is dominantly Mixed with some soils having Isotic minerology.

Analysis of Plots for Sampling

Plots for the UNDE site were selected to maximize overall soil representation of the site based upon preselected plot locations using the soil mapunits identified in the Soil Survey that the site occurs within. Plots were given greater consideration in our analysis for mapunits that were more extensive within the plot areas, or had limited or no existing data for the named Series. In addition, emphasis was placed on plots where pit excavation sampling could occur; Information obtained from a soil pit can be extrapolated to plots sampled by an auger borehole. Furthermore, many of the mapunits on the UNDE site share the same or similar soil components by named soil series; this means that the overall soil composition within the mapunits has a common suite of soil components but specific quantities of components vary within a given mapunit. We included this relationship in the selection of plots to sample.

The Soil Survey for the area that includes the UNDE site shows of 42 uniquely named mapunits within site boundary; the pre-selected plots occur on 17 of these mapunits. From our analysis, 13 plots were selected to describe, sample, and characterize. The 21 plots not sampled either occurred in non-typical locations, on or near a mapunit delineation line (i.e. within 10 m of a delineation boundary), or duplicated a soil component sampled in a different mapunit.

Approximately 59 percent of the UNDE site total mapunit acres were represented in the plots sampled. Of total mapunit acres, 29 percent did not have a plot available to sample. An additional 14 percent of mapunit acres could have been included in the sampling for a total potential maximum coverage of 73 percent if all 34 plots had been selected.

Soil Mapunits within Sampled Plots		
MUSYM	Mapunit Name	Percent Total Acres (7,500)
41	Lupton-Pleine-Cathro complex, 0 to 1 percent slopes	15
5172C	Gogebic, sandy substratum-Pence-Cathro complex, 0 to 18 percent slopes	7
44C	Karlin-Keweenaw-Sarona, dense substratum, complex, 6 to 25 percent slopes	14
39C	Gogebic silt loam, sandy substratum, 6 to 18 percent slopes, stony	6
44D	Karlin-Keweenaw-Sarona, dense substratum, complex, 25 to 50 percent slopes	5
38C	Gogebic fine sandy loam, sandy substratum, 6 to 18 percent slopes, stony	5
28	Dawson, Greenwood, and Loxley soils, 0 to 1 percent slopes	6
36	Gay-Pleine complex, 0 to 1 percent slopes, stony	1
	Total	59

Soil Mapunits within Plots Not Sampled		
MUSYM	Mapunit Name	Percent Total Acres (7,500)
GoC	Gogebic-Fence-Pence complex, 3 to 15 percent slopes	3
38B	Gogebic fine sandy loam, sandy substratum, 1 to 6 percent slopes, stony	3
47B	Karlin, very deep water table-Noseum-Gay complex, 0 to 6 percent slopes	2
Se	Seelyeville and Markey mucks, 0 to 1 percent slopes	2
GoB	Gogebic-Fence-Pence complex, 0 to 6 percent slopes	1
39B	Gogebic silt loam, sandy substratum, 1 to 6 percent slopes, stony	1
46D	Amasa-Karlin complex, esker, 18 to 35 percent slopes	1
309	Cathro muck, drainageway, 0 to 1 percent slopes	0
43C	Karlin-Pence complex, 6 to 18 percent slopes	0
	Total	14

Plot Findings

The 13 described and sampled pedons represent eight uniquely named soil mapunits. The major components of these mapunits are the Lupton, Pleine, Cathro, Gogebic, Karlin, Keweenaw, Sarona, Pence, Dawson, Greenwood, Loxley, and Gay soils. Upon field description soils that were described at plot locations were the Cathro, Greenwood, McMillan, Newot, Sarona, Sarona-Taxadjunct, Schweitzer, Schweitzer-Taxadjunct, and Worcester-Taxadjunct. A taxadjunct, while described as a recognized, existing soil series for reference has one or more differentiating characteristic(s) outside of taxonomic class limits for the named soil series. Plots were dominated by tree cover and varied from hardwoods, swamp, and intermixed conifers and hardwoods.

Parent material - Plots UNDE_012, 030, and 037 were soils formed in till. Plots UNDE_013 and 044 were soils formed in glaciofluvial deposits over outwash. Plots UNDE_006 and 043 were soils formed in glaciofluvial deposits/loess over till. Plots UNDE_010 and 038 were soils formed in organic material over alluvium. Plot UNDE_001 was a soil formed in glaciofluvial deposits over till. Plot UNDE_019 was a soil formed in glaciofluvial deposits/eolian deposits over till. Plot UNDE_018 was a soil formed in organic, mossy material. Plot UNDE_002 was a soil formed in organic, mossy material over organic, woody material.

Summary of Soils

Half of the soils sampled at the plots had a surface organic horizon (7 of the 13 plots); the remaining six soils had mineral soil at the surface. Organic surface horizons ranged from the relatively thin 3 cm in thickness to as thick as the entire observed soil profile.

Of the 13 samples, no soil in particular dominated the UNDE site more than other soils found.

Two plots (UNDE_010, 038) were identified as Cathro series soil. UNDE_010 was identified within a Dawson, Greenwood, and Loxley soils, 0 to 1 percent slopes mapunit and UNDE_038 was identified within a Lupton-Pleine-Cathro complex, 0 to 1 percent slopes mapunit. Within the mapunit for plot UNDE_038, Cathro series soils was a named major component of the mapunit. However, within the mapunit for plot UNDE_010, Cathro series soils were neither a named major component (Dawson, Greenwood, Loxley) nor currently a minor soil component (Kinross) included within the mapunits composition. The identification of Cathro series soil at plot UNDE_010 would commonly illustrate an unnamed minor component soil, when mapunit composition is drafted components that are not commonly expressed in every delineation of a mapunit, do not add to the overall understanding, add significantly to the reflection of soil properties and qualities and thereby interpretative value and response to use and management are often included conceptually by another similar component serving as a proxy for that soil. Cathro series soil is most reflective of the Dawson series soil named major component with one of the primary differences being that Cathro soils would have at least one or more soil organic layers with a pH of 4.5 or greater within the control section for Histosols or Histels, in this case within 130 cm of the soil surface (Euic). Conversely, Greenwood would have no one soil organic layer within its control section where one would see pH of 4.5 or greater (Dysic). Another difference between Cathro and Dawson series soils is that while both of these soils classify within a Terric taxonomic subgroup and therefore have mineral soil material 30 cm or more thick with its upper boundary within the control section but below the surface tier for Histosols or Histels and require a particle size class, they rank out in differing classes. The Cathro soil has a weighted average particle size control section that classifies as Loamy (i.e. clay 0.0002-0.002 mm content < 35%, fragments 2 mm and greater content < 35%, sand 0.05-2.0 mm content < 70%, and > 10% fine earth < 2.0 mm). The Dawson soil has a weighted average particle size control section that classifies as Sandy or Sandy Skeletal (i.e. > 70% sand 0.05-2.0 mm content of which < 50% would be considered very fine 0.05-0.1 mm sand, and > 10% fine earth < 2.0 mm).

Two plots (UNDE_002, 018) were identified as Greenwood series soil. Both UNDE_002 and UNDE_018 were identified within Lupton-Pleine-Cathro complex, 0 to 1 percent slopes mapunits. Greenwood series soils were neither a named major component (Lupton, Pleine, Cathro) nor currently a minor soil component (Gay) included within the mapunits composition. The identification of Greenwood series soil at both plots would commonly illustrate an unnamed minor component soil. Greenwood series soil is most reflective of the Lupton series soil named major component with one of the primary differences being that Lupton soils would have at least one or more soil organic layers with a pH of 4.5 or greater within the control section for Histosols or Histels, in this case within 160 cm of the soil surface (Euic). Conversely, Greenwood would not have an organic layer within its control section where the pH is 4.5 or greater (Dysic). Another difference between Greenwood and Lupton series soils is that Lupton soils classify in the Saprist suborder (i.e. a greater amount of sapric (highly decomposed) soil material than any type of organic soil material). Sapric soil materials are the most highly decomposed kind of organic soil materials with the smallest quantity of identifiable plant fiber, highest bulk density, lowest dry-weight basis water content, and the highest physical and chemical stability of all organic soil materials. Conversely, Greenwood soils would classify to the Hemist taxonomic suborder and would reflect a dominance of organic soil materials that is at a medium stage of decomposition. rather than any other kind of organic soil material. Hemic soil materials are intermediate in their level of decomposition and ranks between the fibric or less decomposed and the sapric or more decomposed soil materials, as such reflect intermediate values for bulk density, content of fiber, water content and are less stable than sapric soil materials, but more stable than fibric soil materials.

Two plots (UNDE_030, 037) were identified as Sarona series soil, and one plot (UNDE_043) was identified as Sarona-Taxadjunct soils. UNDE_030 was identified within a Gogebic, fine sandy loam, sandy substratum, 6 to 18 percent slopes, stony mapunit. Sarona series soil was neither a named major component (Gogebic) or currently a minor soil component (Tula, Karlin) included within the mapunits composition. UNDE_037 was identified within a Gay-Pleine complex, 0 to 1 percent slopes, stony. Sarona series soils was neither a named major component (Gay, Pleine) or currently a minor soil component (Tonkey, Cathro, Foxpaw) included within the mapunits composition. UNDE_043 was identified within a Gogebic, sandy substratum-Pence-Cathro complex, 0 to 18 percent slopes. Sarona-Taxadjunct soils was neither a named major component (Gogebic, Pence, Cathro) nor currently a minor soil component (Tula, Annalake). The identification of Sarona series soils and Sarona-Taxadjunct soils at these plots would commonly illustrate an unnamed minor component soil , when mapunit composition is drafted, components that are not commonly expressed in every delineation of a mapunit, do not add to the overall understanding, add significantly to the reflection of soil properties and qualities and thereby interpretative value and response to use and management are often included conceptually by another similar component serving as a proxy for that soil. For the Sarona series soil identified at plot UNDE_030, it is most reflective of the Karlin series soil minor component. One of the primary differences being that Sarona soils would have an argillic (subsurface diagnostic horizon with evidence of translocated clay and a higher clay than the layer overlies it (zone of clay loss or the illuviated clay) within 200 cm of the mineral soil surface that also has a base saturation of 35% or more in some part of it (Alfic). Karlin soils however would not have this qualification and would additionally have one of the following qualifications within its Spodic diagnostic horizon; a texture class of very fine sand (> 85% sand 0.05-2.0 mm of which > 50% must be very fine sand 0.05-0.1 mm and < 10% clay 0.0002-0.002 mm), loamy very fine sand (>70% but less than 91% sand 0.05-2.0 mm of which > 50% must be very fine sand 0.05-0.1 mm and < 15% clay 0.0002-0.002 mm) or finer that is also ≤ 10 cm thick, has a weighted average of < 1.2% organic carbon and has a color value or Chroma of ≥ 4 within the upper 7.5 cm of the horizon or has a texture class of loamy fine sand, fine sand, or coarser and either or both a moist color value or Chroma of ≥ 4 within the upper 2.5 cm (Entic). For the Sarona series soil identified at plot UNDE_037 is reflective of an inclusion of a soil component that is not specifically named in the composition of the mapunit but exists nonetheless albeit unquantifiable for the concept of a mapunits composition as well as the proximity of the pre-selected plot location to the soil delineation edge. This plot would be most similar to the same series as plot UNDE_030 (i.e. Karlin). For the Sarona-Taxadjunct soil identified at plot UNDE_043, it is most reflective of the Annalake series soil minor component. One of the primary differences is that Annalake soils would have an argillic (subsurface soil horizon with evidence of significantly higher percentage vs an overlying layer of illuviated 2:1 clays) within 200 cm of the mineral soil surface that also has a base saturation of 35% or more in some part of it (Alfic). The Sarona-Taxadjunct soil in this specific case would have one of the following qualifications within its Spodic diagnostic horizon; a texture class of very fine sand, loamy very fine sand, or finer that is also ≤ 10 cm thick, has a weighted average of < 1.2% organic carbon and has a color value or Chroma of ≥ 4 within the upper 7.5 cm of the horizon or has a texture class of loamy fine sand, fine sand, or coarser and either or both a moist color value or Chroma of ≥ 4 within the upper 2.5 cm (Entic). Additionally, the Annalake soil would show evidence of saturation with water (redoximorphic concentrations of either or both Fe^{+3} and/or Fe^{+2} as well as potentially Fe-Mn oxides) in one or more layer within 100 cm of the mineral soil surface for either or both ≥ 20 consecutive days and/or ≥ 30 cumulative days whereas the Sarona-Taxadjunct would not show active evidence of this prolonged saturation.

One plot (UNDE_012) was identified as Schweitzer series soil, and two plots (UNDE_001, 019) were identified as Schweitzer-Taxadjunct soils. UNDE_012 and UNDE_001 were identified within Karlin-Keweenaw-Sarona, dense substratum, complex, 6 to 25 percent slopes mapunits. Schweitzer series and Schweitzer-Taxadjunct soils were neither a named major component (Karlin, Keweenaw, Sarona) or currently a minor soil component (Belding, Sarwet) included within either of the mapunits compositions. UNDE_019 was identified within a Gogebic silt loam, sandy substratum, 6 to 18 percent slopes, stony mapunit. Schweitzer-Taxadjunct soil was neither a named major component (Gogebic) nor currently a minor soil component (Gay, Tula, Gogebic, Stutts). The identification of Schweitzer series soils and Schweitzer-Taxadjunct soils at these plots would commonly illustrate an unnamed minor component soil. For the Schweitzer series soil identified at plot UNDE_012, it is most reflective of the Sarona series soil minor component. The primary difference is that Schweitzer soils have within 100 cm of the mineral soil surface a fragipan. For the Schweitzer-Taxadjunct soil identified at plot UNDE_001, it is most reflective of the Sarona series soil minor component. In this particular case the taxadjunct to Schweitzer does not have a qualification for a fragipan. This soil does however have fragic properties (a layer that begins within 100 cm of the mineral soil surface and is ≥ 15 cm with ≥ 30% fragic properties or has a layer ≥ 15 cm with ≥ 60% fragic properties). Additionally, Sarona series soils in comparison would have soil properties that qualify it for classification into an Alfic subgroup taxonomically, whereas Schweitzer-Taxadjunct soil would not. In this case, that qualification consists of an argillic subsurface diagnostic soil horizon (significantly higher clay percent) vs an overlying layer of illuviated (clay loss) clay within 200 cm of the mineral soil surface that also has a base saturation of 35% or more in some part of it. The Schweitzer-Taxadjunct soil identified at plot UNDE_019, is reflective of an inclusion of a soil component that is not specifically named in the composition of the mapunit. In this particular case the taxadjunct to Schweitzer does not have a qualification for a fragipan, but does have fragic properties (has a layer that begins within 100 cm of the mineral soil surface and is ≥ 15 cm with ≥ 30% fragic properties or has a layer ≥ 15 cm with ≥ 60% fragic properties).

One plot (UNDE_013) was identified as McMillan series soil. UNDE_013 was identified within the Gogebic, sandy substratum-Pence-Cathro complex, 0 to 18 percent slopes mapunit. McMillan series soil is neither a named major component (Gogebic, Pence, Cathro) or currently a minor soil component (Annalake, Tula) included within the mapunit composition. The identification of McMillan series soils at this plot would commonly illustrate an unnamed minor component soil, and is most reflective of the Pence series soil minor component. One difference being that McMillan has a Mixed mineralogy class within the control section for mineralogy (i.e. no specific mineral that is more significantly dominant than any other). Conversely, Pence series soil has an Isotic mineralogy class within the control section for mineralogy (i.e. > ½ of the mineral control section must have no free carbonates, a NaF pH of ≥ 8.4, and a ratio of clay to 1500 kPa water of ≥ 0.6). Another difference between McMillan and Pence series soils is that McMillan soils qualify for a Lamellic taxonomic subgroup and Pence soils do not. In the case of the McMillan soils it has at least two or more Lamella (illuvial horizons < 7.5 cm thick that contain accumulations of oriented silicate clay either on or bridging sand and silt grains and has more silicate clay content than the overlying eluvial horizon) within 200 cm of the mineral soil surface that are both below the Spodic diagnostic horizon, but not below the Argillic diagnostic horizon (subsurface soil horizon with evidence of significantly higher percentage vs an overlying layer of illuviated 2:1 clays).

One plot (UNDE_006) was identified as Newot series soil. UNDE_006 was identified within a Karlin-Keweenaw-Sarona, dense substratum, complex, 25 to 50 percent slopes mapunit. Newot series soil is neither a named major component (Karlin, Keweenaw, Sarona) or currently a minor soil component (Sarwet, Belding) included within the mapunit composition. The identification of Newot series soils at this plot would commonly illustrate an unnamed minor component soil. This soil is most reflective of the Sarona series soil major component. Taxonomic classification for the Newot and Sarona series soils is identical. The primary difference being that the Sarona series typically has a thin surface horizon made of organic soil material, while Newot does not and exhibits mineral soil material to the surface.

One plot (UNDE_044) was identified as Worcester-Taxadjunct soil. UNDE_044 was identified within a Gogebic, sandy substratum-Pence-Cathro complex, 0 to 18 percent slopes mapunit. Worcester-Taxadjunct soil is neither a named major component (Gogebic, Pence, Cathro) or currently a minor soil component (Tula, Annalake) included within the mapunit composition. The identification of Worcester-Taxadjunct soil at this plot would commonly illustrate an unnamed minor component soil. The Worcester-Taxadjunct soil identified at plot UNDE_044 is reflective of an inclusion of a soil component that is not specifically named in the composition of the mapunit. As a Taxadjunct, this soil differs from that of the Worcester series soil in this particular case. The Worcester series qualifies in the Argic Endoaquod taxonomic subgroup (i.e. has within 200 cm of the mineral soil surface an argillic diagnostic horizon; subsurface soil horizon with evidence of significantly higher percentage vs an overlying layer of illuviated 2:1 clays) and the Worcester-Taxadjunct soil has such qualification in this case.