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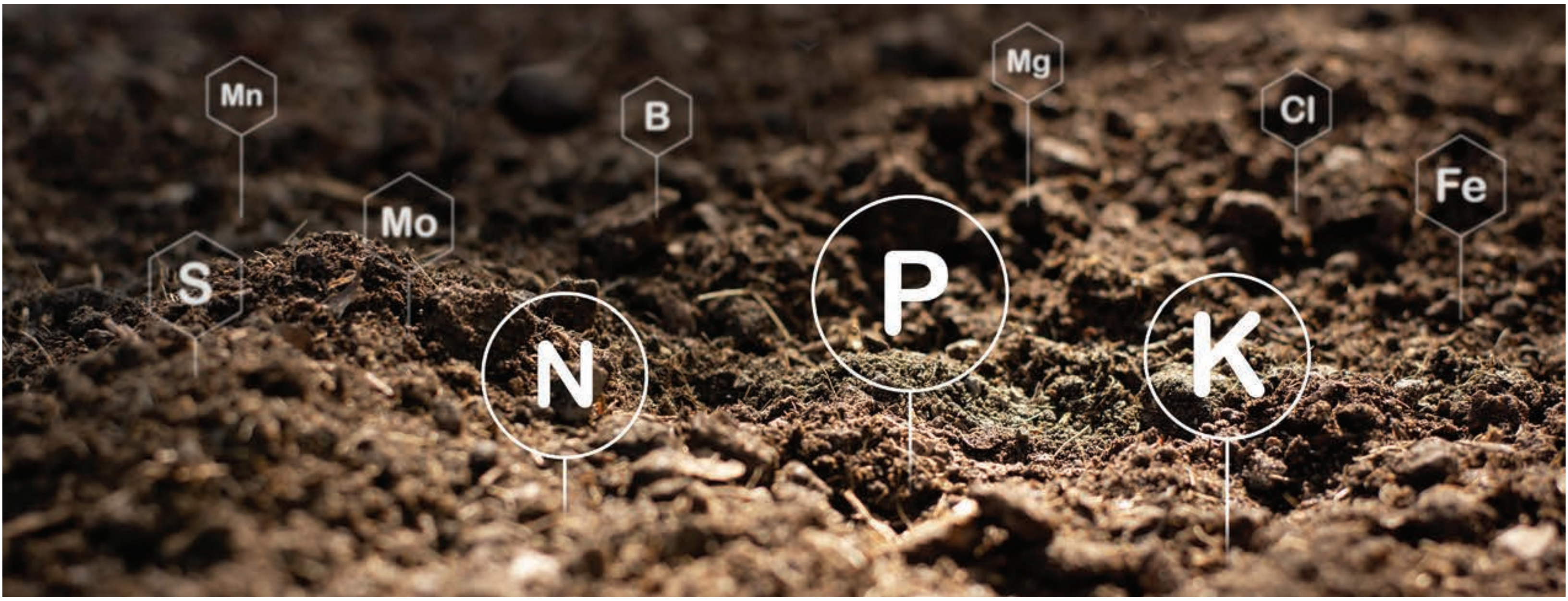
Wisconsin Cooperative Soil Science

2020 Highlights



NCSS National Cooperative Soil Survey

Wisconsin
Natural
Resources
Conservation
Service

www.wi.nrcs.usda.gov/

Helping People Help the Land

USDA Natural Resources Conservation Service
8030 Excelsior Drive, Ste 200
Madison, Wisconsin
53717-2913

(608) 662-4422

www.wi.nrcs.usda.gov

For more information about Wisconsin Cooperative Soils contact the NRCS Wisconsin Soils Program:

Andrew Paolucci, Assistant State Soil Scientist
Andrew.Paolucci@usda.gov or (608) 662-4422

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Preface

Helping People Understand Soils

Soils play a key role in human life by providing most of the world's food. Soils also play a critical role in water quality and support an array of non-food products. There will always be a need for soil scientists to collect and improve data, provide technical soil services and educate landowners and partners on soil practices. Soil scientists must have broad knowledge of many different disciplines, such as ecology, geology, agronomy, forestry, GIS, data science and more. Soil science has traditionally included soil formation; physical, chemical, biological, and fertility properties; and relation to landform and landscapes. As populations increase and climates change, a heavy strain is placed on agriculture. Soils are the backbone of agriculture, and soil quality is critical to our future. Soil quality, soil ecology and the importance of organic matter management are crucial in managing fertility and lessening drought impact. Soil science needs to adapt to the changing times and expand beyond primarily survey activities. Data science, geospatial analytics and new delivery tools will be the key to a successful soil science future.

Wisconsin soils information and technology is a joint effort of the National Cooperative Soil Survey (NCSS) and Wisconsin Cooperative Soil Survey (WCSS). Both initiatives include Federal and State agencies, universities and professional societies to deliver the best, science-based soils information to the public.

This partnership works to cooperatively investigate, inventory, document, classify, interpret, disseminate and publish information about soils. The Cooperative Soil Science program of Wisconsin outlines the strategy for soil science progress in Wisconsin, delivery of data and products and delivery of soils assistance. The purpose of the WCSS is to bring our cooperators and other soil science supporters up to date on soils activities in the state and to collaborate on future projects. The need to collaborate is driven by changes in science, technology, fiscal conditions and professional culture. The Cooperative Soil Science Program acknowledges the importance and challenges of generational staffing turnover, changing societal needs and unique ecological conditions. Team members see this strategy as a pragmatic path towards increasing the sustainability of the WCSS and the science of soils.

Demand and user volume for technical soils information is growing. WCSS looks at the agricultural community as a critical user base but also recognizes many other user groups who utilize soils information. Needs are constantly changing at the local and national scale. It is critical that national NCSS staff and WCSS staff band together and share resources and information to enable our users to have the ability to develop effective models at state, national and global scales. NCSS and WCSS strive to address state, national and global needs of new customers. As needs change, which data we collect and how we collect it will change. The information we collected and knew 30 or 100 years ago is different than what we collect and know today. The world is not flat and data is not static. If we saw a doctor today, we would not request treatment, prescriptions or vaccines from 30 years ago; we would request the most modern treatment from the best science put forward. The same goes with soils information, or any other science as it continually evolves. Data is continually being improved, enhanced and maintained.

2020 Priorities

Soil Science Division

The Soil Science Division (SSD) supports the NRCS mission by delivering vital information and expertise to agency staff, partners, and the public in innovative ways. The division's priorities for 2020 will enable it to continue that service.

Soil and Ecological Site Inventory

Initial Soil Inventory

Accelerate the foundational (initial) soil inventory on all lands, including private, Tribal, and Federal lands

The initial soil inventory is the foundation upon which all subsequent soils products and information are developed, maintained, and interpreted. As of 2017, an initial survey had been completed on more than 80 percent of the United States, including 92 percent of non-Federal lands. Detailed soil survey maps and data are accessible through Web Soil Survey for these areas.

More than 450 million acres of soils have not yet been inventoried. Over 70 percent of this acreage, 330 million acres, is on Federal lands. The remaining 120 million acres include conservation-priority areas, such as Tribal lands in Alaska. The Soil Science Division, in collaboration with National Cooperative Soil Survey (NCSS) partners and State Conservationists, is implementing a plan to accelerate the inventory of the remaining private and Tribal lands. The plan proposes completion of the foundational soil inventory by 2026. Priority will be given to Tribal and private lands on which conservation technical assistance and farm bill program delivery are NRCS priorities.

The initial inventory is the basis for customers to ask questions, request existing data, and seek current soil interpretations. It is also the basis for development of new data and interpretations. It is needed in the development of conservation programs and provides the scientific basis to address soil health issues and other emerging land use concerns.

Ecological Sites

Provide ecological site products to broaden conservation applications and training in collaboration with national, center, and State technical staff and Federal partners

Ecological site inventory, state-and-transition models, and ecological site descriptions are critical for selecting, implementing, and assessing conservation practices; recognizing thresholds of irreversible change in managed ecosystems; and estimating potentials for soil carbon sequestration. The use of ecological site information for conservation planning is an application of existing NRCS guidelines. The first step of this use is selecting the ecological site and ecological state; the next step is defining conservation goals and objectives; the third step is selecting appropriate conservation practices; and the fourth step is monitoring the impact of the practices to adjust future management decisions. Long-range and project plans for soil survey will include protocols for the definition, inventory, and description of ecological sites. Provisional ecological sites are planned to be available for the continental United States by 2020 and for the entire country by 2025.

Dynamic Soil Properties

Accelerate the collection of dynamic soil property (DSP) data

Dynamic soil properties, which are those properties that change with land use and management, enhance soil survey products. Dynamic soil properties are used to frame, measure, and predict the response of soils to disturbances caused by human and nonhuman factors. Dynamic soil properties link soil inventories—as collected by traditional soil survey methods—to advancing areas of soil health, conservation, and management practices. Potential levels of DSPs are determined by inherent soil properties, but a range of actual observed values are possible. The range can depend on land use, land cover, management practices, and individual field conditions. Links can be made between ecological sites, interpretive soil groups (such as forage suitability groups), and DSP values in both absolute and relative terms. There is an increasing demand for dynamic soil property data to inform management activities, to better assess the impact of those activities (ecosystem services), and to provide more detailed and site-specific information for model development and for applications. Collection of DSP data will be integrated into all projects and will become a routine component of soil inventory.

VISION

A society that values soil as essential to life.

MISSION

Provide scientifically based soil and ecosystem information to manage natural resources

Major Land Resource Area Updates

Accelerate field activities of major land resource area (MLRA) updates in order to develop a seamless coverage of soils information across the Nation

Updating soil survey information by MLRA ensures that current, accurate information is available to meet the needs of the majority of users and is delivered in a timely manner. Project plans are coordinated across the existing (i.e., "traditional" or "non-MLRA") soil survey area boundaries and follow natural landforms. The MLRA process facilitates mapping, interpreting, and delivering seamless soils information across broad geographical areas that have common resource values, land uses, and management concerns. The MLRA update process is driven by the outcome of previous and ongoing Soil Data Join Recorrelation (SDJR) activities as well as by collaboration with NCSS partners. NCSS partners will be involved in all aspects of the planning and field work processes through their involvement on technical teams, management teams, and boards of advisors.

Technical Soil Services

Assist States in providing science-based technical soil services to enhance and support soil health activities, conservation planning, and program delivery and to maintain and expand our partnerships with university cooperators and external customers

The Soil Science Division (SSD) is committed to assisting the State Conservationists through State soil scientists. The SSD provides assistance to improve the quality and quantity of technical soil services that support agency priorities. The SSD, the Ecological Sciences Division, and the Soil Health Division will continue to work in partnership with States to provide science-based soil property information and applications. The SSD will continue to collaborate with State soil scientists to promote the application of soils information in resource assessment for conservation planning, onsite investigations to support conservation practice design, assessments of soil health and dynamic soil properties, identification of hydric soils for wetland determinations, and other conservation technical assistance. The SSD is also committed to assisting States as they help customers understand and properly use the soil survey, provide customers with predictions and interpretations about the behavior of soil, and offer help to traditional, nontraditional, and underserved customers through soil workshops, training sessions, and volunteer opportunities. These services will be beneficial for assisting in critical conservation areas and for broadening the conservation partnership.

National Cooperative Soil Survey

Strengthen the National Cooperative Soil Survey (NCSS) through increased transparency and collaboration with internal and external partners

The strength of the NCSS derives from collaboration between NCSS partners—Federal, State, and local government agencies, universities, and the private sector—to achieve common goals in advancing soil science. The Soil Science Division will work through State Conservationists and State soil scientists to strengthen communication lines among NCSS partners. The SSD will promote agency priorities in soil health, conservation initiatives, and conservation planning to landowners. The SSD will encourage NCSS partners to actively participate in regional and national conferences and to serve in subject matter training cadres.

What's Ahead for Soil Survey

Digital Soil Mapping

In the past, soil survey was mapped by vector polygons, but now software technology and new data provide soil scientists the opportunity to map at a greater level of detail. This booklet discusses recent projects and the next generation of potential soil survey products to provide additional information to our users; for example, yield monitor data used in precision agriculture.

These tools allow soil scientists to represent the distribution of soils with greater detail than traditional soil maps. Even with these new products, an onsite investigation will always be needed. However, having a soil map at a greater detail can streamline the conservation planning process. Different soils can be represented individually instead of being packaged together in a map unit. This will make working with the data much easier.

- Digital soil mapping
- Disaggregation "refinement"
- Soil properties in raster form in predefined depths

Digital Soil Mapping: Quantifying the Soil-Landscape Paradigm

By Jay Skovlin, NRCS

Berman Hudson astutely categorized soil survey as a scientific program based on the application of the soil-landscape paradigm (Hudson, 1992). So what is the soil-landscape paradigm and how did Hudson define it?

Hudson's soil-landscape paradigm was his summary of a deterministic approach to mapping soils in which the interaction of soil-forming factors, on a given landscape, results in distinct and repeating "soil-landscape units." Underpinning the soil-landscape paradigm is an equally powerful paradigm, the theory of soil-forming factors, initially conceived by Dokuchaeiv (Glinka, 1927) and Hilgard (Jenny, 1961). The work of Hans Jenny (1941) further articulated and validated the soil-forming factors of climate, living organisms, relief, parent material and time, expressed by the acronym CLORPT, which remains a seminal concept of pedology. Over the last century of soil survey, the soil-landscape paradigm arose as the dominant operative approach validated by decades of repeated observation of soils on the landscape. Hudson's soil-landscape paradigm has since been modified by additional process models and has evolved into the soil-geomorphic approach emphasized today within the Natural Resources Conservation Service (NRCS) and the National Cooperative Soil Survey (NCSS) (Wysocki and Schoeneberger, 2000).

Despite the benefits of operating under such a useful construct as the soil landscape paradigm, we continue to be hampered by its weaknesses. This paradigm is overly dependent on tacit knowledge rather than clearly documented and described evidence and rationale supporting the landscape models learned through experience (Ditzler, 2003). The full knowledge and understanding of the soil scientist who produces the map cannot be easily articulated and commonly cannot be adequately captured in the actual product. Furthermore, the tacit knowledge accumulated in the process of producing a soil survey is difficult to transfer, even among soil scientists. Confounding the difficulty of the transfer of tacit knowledge is the fact that in the past, the documentation collected during the creation of a soil survey was considered less important than the finished product and thus important reference data were often lost or destroyed. As a result, important knowledge of the spatial relationships of the soil landscape that is gained in applying the soil-landscape paradigm is not explicitly distilled and remains embedded in categorical maps which do not convey the complexity of the information in an efficient and transparent manner (Bui, 2004). As noted by Hudson (1992), the cumulative result is that the tacit knowledge gained over time, through decades of soil survey efforts, has not been explained and summarized in language so that the insights from this vast trove of knowledge can be integrated into the soil science literature.

As a field soil scientist, I see digital soil mapping (DSM) playing an important role in the capture and communication of tacit knowledge. Most DSM methods aim to quantify aspects of the soil-landscape paradigm. They can be used to apply the concepts we have developed from our tacit knowledge and help us capture that information in the more specific spatial representation of spatial models and raster maps. Although DSM methods attempt to quantify soil relationships and properties using the often unfamiliar vocabulary of statistics, these methods and models generally reflect a digital version of the thought process that occurs in the mind of any soil scientist engaged in the enterprise of mapping soils. Using multiple input layers derived from digital terrain models, categorical data (such as geologic or vegetation data), remote sensing data and direct observations, the analyst looks for spatial relationships and assesses the strength of relationships between these environmental covariates and the variable of interest. Only in the last several years has the potential in computing power combined with advances in GIS and the availability of geostatistical methods made these more computationally intensive approaches possible (McBratney et al., 2003).

In recent years, the soil survey program has made great strides in converting analog processes of product delivery to digital processes, such as the development of the Soil Data Mart and Web Soil Survey. The release of NASIS 6.0 (Soil Database) and migration to the Microsoft SQL server database platform puts the soil survey program on a solid footing for future advances. In spite of these gains, however, our product development process remains insular and focused on vector mapping products. Digitally produced soil maps appear to have a distinct advantage over traditionally produced soil survey maps with respect to the ability to apply a consistent methodology, assess the level of accuracy, and represent different kinds and amounts of detail (Hempel et al., 2008).

Another important idea comes from Hudson's use of the term "set" (Hanson, 1969), which involves the process of preparing a person to see new phenomena and to see it in a certain way. The idea is that what one can observe and learn depends largely on what one has been prepared to observe and learn. So how can we, as NCSS soil scientists, "set" ourselves to learn more about and be more receptive to applying DSM methods? I would argue that as field soil scientists, trained in seeing the world through the soil-landscape paradigm, we are already primed to understand the appropriate application of DSM methods to soil survey. We as soil scientists need to learn more about DSM methods to ensure that they are prudently applied to the soil landscape. I would challenge each one of us, whatever our experience, to see and understand our work from a new perspective. Many of the changes that have occurred in how we accomplish the work of soil survey in the last 10 years represent a positive shift in thinking and agency culture. NRCS support of such projects as the Global Soil Map Initiative (www.globalsoilmap.net) will drive the broad application of DSM methods and the development of raster products. As products from this and other initiatives become available, the global demand for raster soil survey products will increase (Cook et al., 2008). We should work to understand where we fit within the framework of these efforts and position ourselves to make more direct contributions to it. Ultimately, it will take the ability to collaborate more freely across disciplines, agencies, countries and states and among soil survey offices to form working groups which will focus effort and provide leadership on methods and standards for raster products. Many decisions will need to be made as to how these raster products will be delivered within the context of the existing soil survey products.

Soil scientists are as different in their opinions as the soils they find on the landscape. Attitudes and opinions about DSM methods are wide ranging, but often there is a sense of negativity about modeling and computational approaches. These opinions seem to stem from our extreme reliance on our hard-earned tacit knowledge of local and regional soil landscapes and our reluctance to admit that useful knowledge of soils could be gained by investigating soils any other way. The gestalt shift (transformational shift) in thinking and observation which allows a new soil scientist to dissect the landscape, drape soil-forming factors on it, and "see" the spatial distribution of the resulting soil families is a deeply ingrained rite of passage within our profession. In reality, DSM methods do nothing to undermine or threaten these traditions. In contrast, DSM methods hold great potential as a set of additional tools which can help us further validate our tacit knowledge and capture the results in more spatially explicit products. Now more than ever, the community of NCSS soil scientists needs to take an active role in how DSM methods are applied to our soils data. We know our data and how it was developed—its strengths and limitations. If we continue to sit back, we will find ourselves in the unenviable position of reacting to methods and products that others will develop for us (Arnold and Wilding, 1991).

Options for Communicating Soils Knowledge

By Tom D'avello, David Zimmerman and Susann Kienast-Brown;
and Jim Thompson Ph.D., West Virginia University

Background

During the first 75 to 100 years of the soil survey program, the vector data model was the most practical means of spatial representation. It remained so even after the initial advent of geographic information system (GIS) technologies. The earliest GIS did not support the vector data model. For these early systems, the raster data format was the sole option for representing geographic features. Although some efforts were made to produce soil maps in a raster format, they were only produced as a cartographic exercise. The potential for computer modeling of soil data had yet to be realized, and thus the raster data format did not offer an immediate advantage for use in soil survey.

As GIS software progressed to accommodate vector representation, it was readily adopted to reproduce and develop vector soil maps that previously had been inked on hard-copy media. A humorous quip used to differentiate the two dominant data types was "raster is faster, but vector is corrector." This phrase mainly referred to the fact that the vector data model could more accurately represent specific boundaries but required the increased cost of data input, management and processing time. However, for soil maps intended to convey data that varies continuously across the landscape, the vector data model (i) has inherent cartographic limits, (ii) conveys information in a limited and commonly unrealistic manner and (iii) demands intensive management to maintain topology in a GIS. Given the advances in geospatial technologies and the limitations of the vector data model, recent attention has been devoted to adopting ways of representing our soil knowledge using the raster data model.

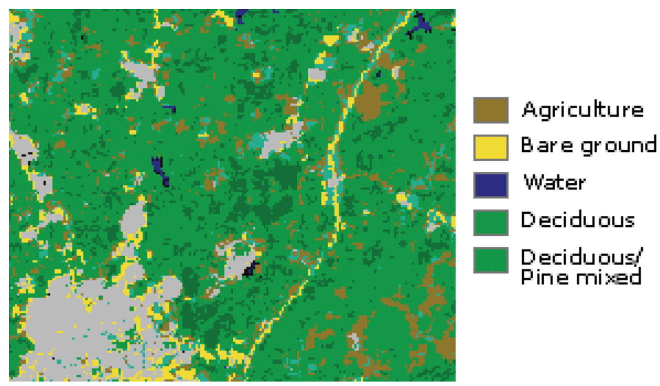
So, what does the raster data format offer us that the vector model lacks?

The Raster Format

A raster is "a spatial data model that defines space as an array of equally sized cells arranged in rows and columns and composed of single or multiple bands. Each cell contains an attribute value with geographic coordinates contained in the ordering of the matrix" (Summer and Wade, 2006).

The size of the cells, known as the spatial resolution, essentially eliminates the cartographic limits of the vector model, i.e., small areas of soils can be represented if desired. Without the constraints of scale-based cartographic limits, many components and small areas of map units that are currently only listed as minor components or inclusions in the database could be identified on the landscape. Showing where these soils occur is a great enhancement to our current model, which just lists or describes where they occur.

One objection to presenting the greater spatial detail is the possibility of misunderstanding the degree of confidence in the detailed representation. All soil map unit delineations, however, are predictions. The small patches that are likely in a raster product are simply predictions that are not cartographically constrained. Raster-driven methods have an important advantage that addresses this issue: the option to calculate uncertainty and provide this information for soil classes or properties.



Graphic example of a raster.

Raster data can be stored and archived with ease. It allows model inputs and outputs to be consistently maintained during model development and accessed after project completion. If data are properly archived, model results can also be traced back to model inputs and parameters. This benefit of the raster data format adds an element of transparency into map building.

Restricting the soil survey product to one data model (vector) limits our ability to fully represent and convey our soil knowledge to users. If multiple product lines and data models are developed and provided, a wider array of users and user needs could be satisfied.

Raster Opportunities

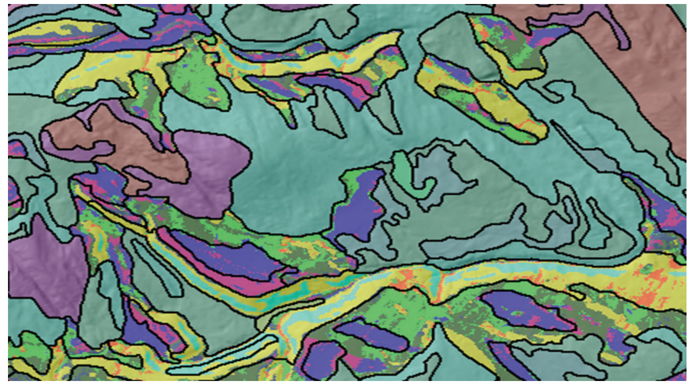
The use of geospatial techniques for mapping soils is broadly covered by the term "digital soil mapping" (DSM) (McBratney et al., 2003). Such use has progressed as soil scientists have adopted the latest tools to assist in the mapping process. The process of making an inference about a landscape segment (e.g., a soil map unit) from a few point-based observations using the operative soil-forming factors is named "modeling." Whether the soil map is produced using nothing but a bucket auger and an aerial photo or using geospatial software, the process is a modeling operation. The use of DSM methods will increase over time and will eventually cease to be considered distinct, novel techniques. A common component of DSM methods are raster data inputs referenced by various algorithms. From raster inputs come raster outputs.

gSSURGO hybrid—One option for producing a raster-based soil survey starts with enhancements to a currently delivered product: gSSURGO, which is a 10-meter resolution raster version of SSURGO. This product is essentially a vector-to-raster format conversion. The footprint of gSSURGO could serve as a template (i.e., snap raster) for raster-based data produced for initial and update soil survey projects. The final products would be directly mosaicked into the gSSURGO dataset. This work flow would require virtually no changes to our current database and delivery systems for gSSURGO. One major change, however, would be the use of the raster output as the final spatial representation rather than as an interim step in the development of a vector product.

An example of a gSSURGO hybrid is the raster survey of Essex County, Vermont, which is available from the Geospatial Data Gateway. The survey is a detailed raster product developed during an initial soil survey using readily available GIS tools. The product is inclusive of one catena formed in a common parent material and was developed using knowledge-based modeling techniques. SSURGO on the following page shows an area of the Essex County raster soil survey mosaicked into gSSURGO. Using contemporary methods, the process of updating by catena or common physiographic region would yield data similar to the Essex County raster. Any soil survey product resulting from an MLRA update or initial soil survey project could be mosaicked into gSSURGO. A "disaggregated spatial representation" may be one way to describe the resulting product for MLRA update projects (Nauman and Thompson, 2014).

A product mosaicked into gSSURGO enables the delivery of a spatially explicit representation and interpretation of individual soil components, something not possible with the vector model. The product accommodates the delivery of legacy survey data. It also allows for rapid updates that might focus on areas of less intense mapping or areas where the needs for use and management changed after initial mapping. The product, which includes data developed at multiple resolutions and from different processes, is akin to the USGS National Elevation Dataset best available data set. It is also akin to some of the national NAIP imagery that has fine resolution in urban and high-use areas and coarser resolution in more remote areas. Educational resources would need to be developed to explain the varying levels of detail and the proper interpretation and use of the data. This option would require very little adjustment to our current system because the database needs are identical and the spatial data manipulations are routine.

Inclusion of non-soil data—Currently, our database contains a multitude of non-soil data, such as climatic, terrain, and land cover variables used to generate interpretations. The

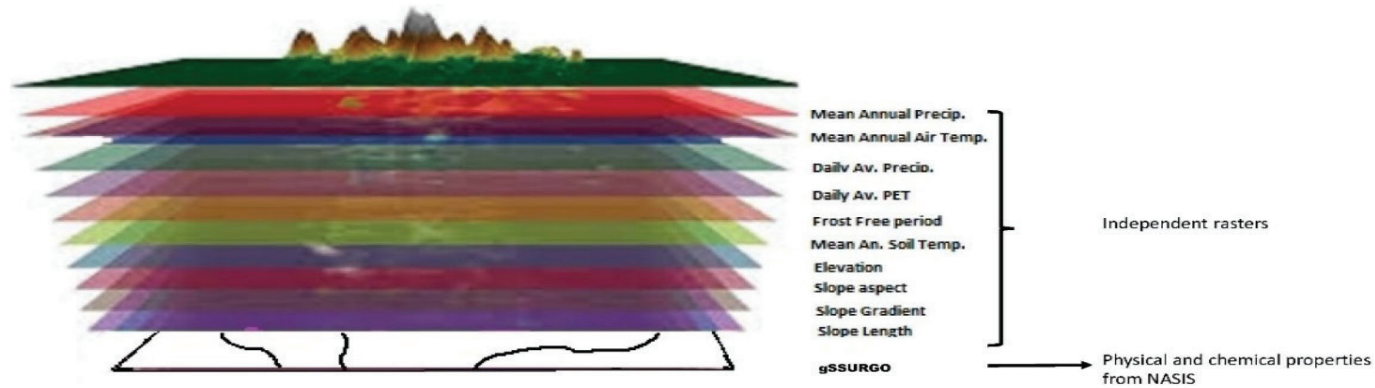


SSURGO vector lines overlaid with gSSURGO. The detailed areas represent the components of the modeled catena of Essex County, Vermont.

inclusion of these variables in a relational database associated with polygonal map units is a relic of the pre-GIS period in which the database originated. Populating this data is time consuming and prone to error. In addition, a database is inadequate for representing geographic phenomenon, such as multi-modal distributions (e.g. slope aspect), or continuous data, such as mean annual precipitation or slope gradient. The capability to utilize separate raster datasets representing pertinent non-soil variables for developing interpretations (below) would improve resulting interpretations and reduce the time and effort required to populate these non-soil data elements. Many of these non-soil environmental layers are produced and maintained by other credible agencies and organizations and could easily be adopted as part of an official raster data set.

Multidimensional soil properties—The most comprehensive option for soils raster data would be the complete raster representation of all properties used for interpretations maintained in a multidimensional dataset (Xu et al., 2016). Multidimensional data is captured at multiple times or depths and typically stored in netCDF, GRIB, or HDF format. Each file contains one or multiple variables, and each variable is a multidimensional array that represents data at a given time or a given vertical dimension. For example, a netCDF file can store temperature, humidity, and wind-speed for every month from 2010 to 2014 and at each elevation of 0, 1, and 10 meters above mean sea level (ESRI, 2017). For soil survey, this format could store soil temperature, soil moisture content, and other dynamic soil properties at multiple soil depths on daily, monthly, and annual steps.

The GlobalSoilMap project (IUSS, 2017; Hartemink et al., 2010) has specifications for a minimal dataset of physical and chemical soil properties at predefined depths. These data could be coupled with the multitude of non-soil environmental variables, including climatic, terrain, land cover, and land use treatments, to support interpretations and simulation modeling. The figure on the following page is an example of how the data might be organized and what this data type would allow. The use of multidimensional data formats would be new to the NCSS, but many organizations have been using multidimensional data in an established,



Non-soil raster layers used in concert with soils data in a raster format for the development of interpretations.

operational manner. Such organizations could serve as excellent examples and references (The HDF Group, 2006-2016).

The raster format greatly expands the capabilities of conveying our knowledge and offers the possibility of providing a relevant, effective, flexible, and interpretable product (Grunwald et al., 2011). By providing raster data as an additional soil information product, we could pursue work in a manner that is more compatible with current earth science data technologies and increase our capacity to develop and deliver significantly updated soils data. These options should be pursued and developed not as replacements to SSURGO, but as additional complementary soil information products that expand our ability to communicate our knowledge of the soil system to a variety of modern soil information users.

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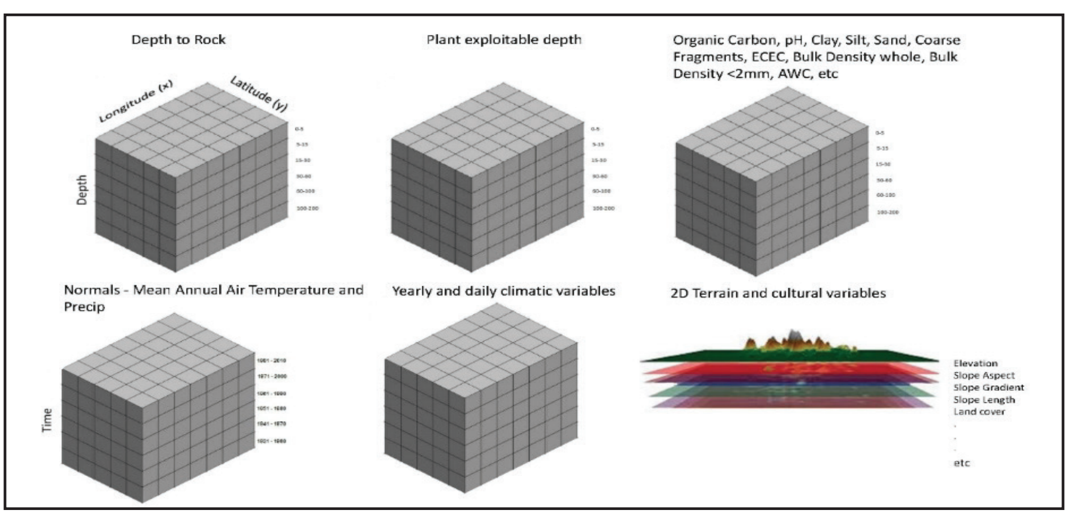


Multidimensional data: Data over an area varying with location, time, and depth.

An Introduction to Soil Survey and MLRA

Growing Education Video Series

Listen to our very own NRCS Major Land Resource Area (MLRA) Soil Science Leader, Chris Miller, discuss soil survey and MLRA covering parts of Wisconsin, Illinois and Michigan. Learn about the history, current projects affecting your area, recent advancements, and more in this video: https://www.youtube.com/watch?v=c1kVMR9Ar6I.

Please subscribe to the NRCS Wisconsin YouTube Channel for more educational videos coming soon.

For more information and local NRCS contacts, visit the NRCS Wisconsin MLRA website: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/wi/soils/surveys/?cid=nrcs142p2_020878.

Cooperative Soil Science Tools

Web Soil Survey

http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

Web Soil Survey (WSS) provides soil data and information produced by the National Cooperative Soil Survey. It is operated by the USDA Natural Resources Conservation Service (NRCS) and provides access to the largest natural resource information system in the world. NRCS has soil maps and data available online for more than 95 percent of the nation's counties and anticipates having 100 percent in the near future. The site is updated and maintained online as the single authoritative source of soil survey information.

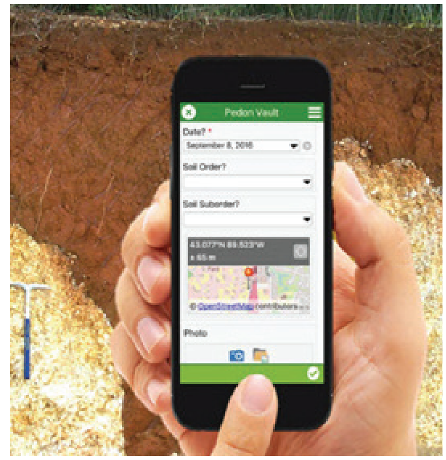
Soil Data Access

http://sdmdataaccess.nrcs.usda.gov/

Soil Data Access is the name of a suite of web services and applications whose purpose is to meet requirements for requesting and delivering soil survey spatial and tabular data that are not being met by the current Web Soil Survey and Geospatial Data Gateway websites.

The New NRCS "Pedon Vault" App: Soil Profiles at Your Fingertips

http://www.nrcs.usda.gov/wps/portal/nrcs/main/wi/soils/

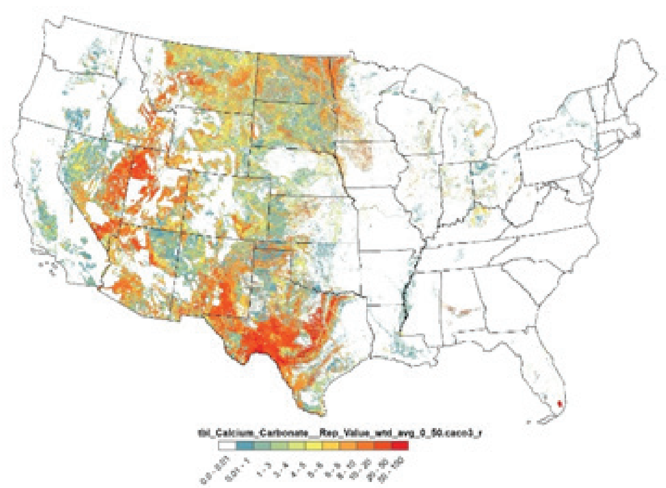


Scientists, educators, farmers and anyone interested in soils, have you ever tried to learn about your local land by looking at a cross section of your soil, known as a soil profile, only to realize the sample doesn't have the layered exposure you were looking for?

The NRCS in Wisconsin and the National Soil Survey Center have made available a new app, Pedon Vault, the first of its kind, to offer a national database of sites to visit in the field offering good exposures of soil profiles and data. Thus, the app name, Pedon Vault, a vault of three-dimensional samples of a soil large enough to show characteristics of all its horizons.

SSURGO OnDemand: NEW Soil Data Viewer Alternative!

http://www.nrcs.usda.gov/wps/portal/nrcs/main/wi/soils/



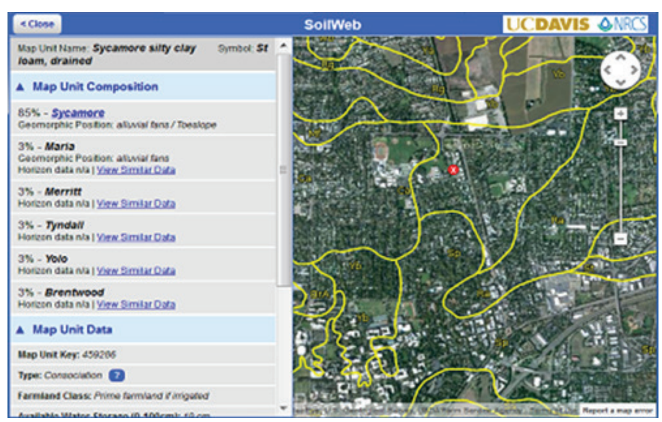
The SSURGO OnDemand Dynamic Spatial Interpretations Tool can process soils data from large geographic areas rapidly and is a one-stop shop for any number of soil survey areas at once for any and all interpretations or properties. It accesses authoritative soils data without the need for downloading external tabular data sets.

Please direct questions and comments to:

Chad Ferguson at charles.ferguson@usda.gov or
Jason Nemecek at jason.nemecek@usda.gov.

SoilWeb

https://casoilresource.lawr.ucdavis.edu/gmap/

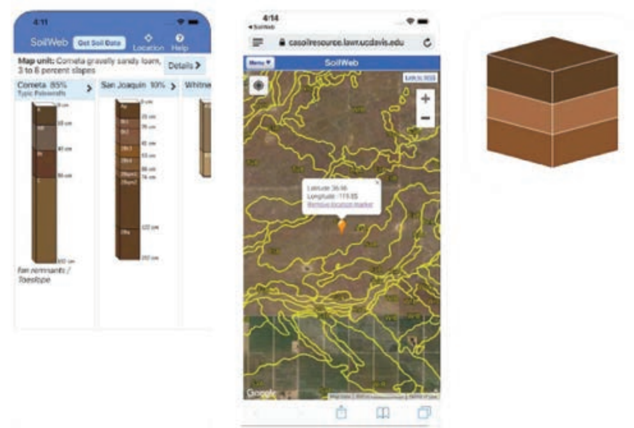


SoilWeb products can be used to access USDA NCSS detailed soil survey data (SSURGO) for most of the United States. Please choose an interface to SoilWeb:

Explore soil survey areas using an interactive Google map. View detailed information about map units and their components. This app runs in your web browser and is compatible with desktop computers, tablets, and smartphones.

SoilWeb iOS and Android Apps

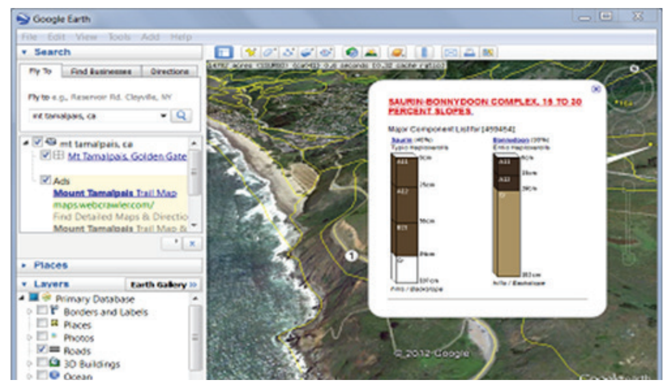
These are native smartphone apps that use your device's GPS to give soil information for your current location. This free app has similar features as the web version of SoilWeb application including details about soil map units, soil profile sketches, and links to related web apps such as the Official Series Descriptions database and Series Extent Explorer.



SoilWeb Earth

http://casoilresource.lawr.ucdavis.edu/soil_web/kml/SoilWeb.kmz

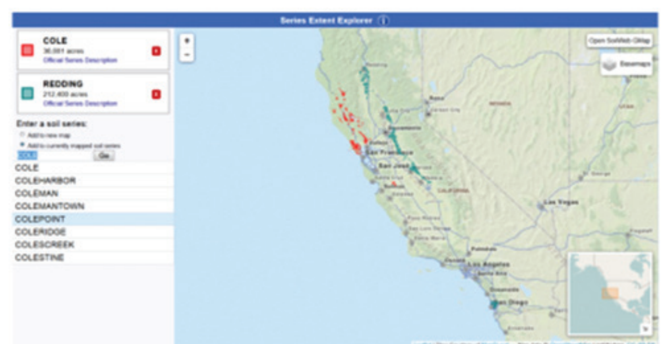
Soil survey data are delivered dynamically in a KML file, allowing you to view mapped areas in a 3-D display. You must have Google Earth or some other means of viewing KML files installed on your desktop computer, tablet, or smartphone.



SEE: Soil Series Extent Explorer

https://casoilresource.lawr.ucdavis.edu/see/

SEE allows users to explore the spatial extent of soil types nationwide.

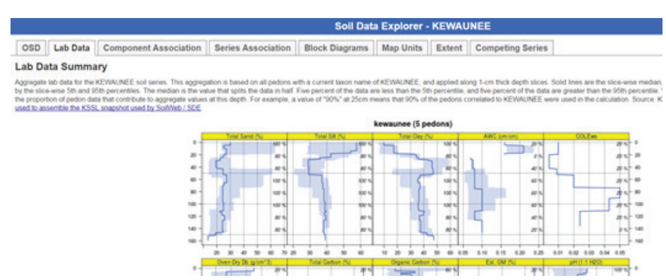


SDE: Soil Series Data Explorer (SDE)

https://casoilresource.lawr.ucdavis.edu/sde/?series=Kewaunee

https://casoilresource.lawr.ucdavis.edu/sde/?series=Manawa

This website is accessible via SEE (see above), or can be used by appending a soil series name to the end of the URL. SDE integrates KSSL, SSURGO, block diagrams, OSD, and SC databases.



SCAN/SNOTEL

http://www.wcc.nrcs.usda.gov/scan/

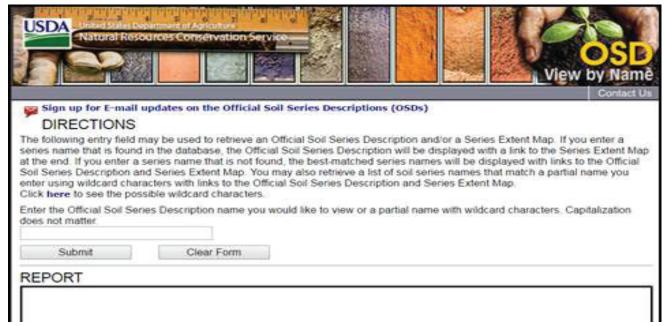
http://www.wcc.nrcs.usda.gov/snow/

Above and below ground sensor data. The interactive map is the simplest way to search for data.

Official Soil Series Descriptions (OSD)

https://soilseries.sc.egov.usda.gov/osdname.aspx

“Official soil series description” is a term applied to the description approved by the NRCS that defines a specific soil series in the U.S. These official soil series descriptions are descriptions of the taxa in the series category of the national system of classification. They mainly serve as specifications for identifying and classifying soils. While doing survey work, field soil scientists should have all the existing official soil series descriptions that are applicable to their soil survey areas. Other official soil series descriptions that include soils in adjacent or similar survey areas are also commonly needed.



Geospatial Data Gateway

https://gdg.sc.egov.usda.gov/

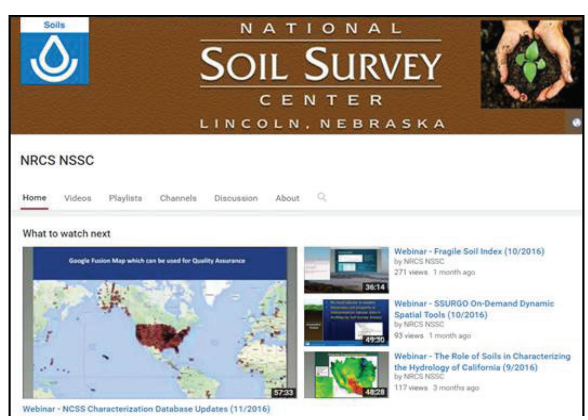
The Geospatial Data Gateway (GDG) provides access to a map library of over 100 high resolution vector and raster layers in the Geospatial Data Warehouse. It is the One Stop Source for environmental and natural resources data, at any time, from anywhere, to anyone. It allows you to choose your area of interest, browse and select data, customize the format, then download or have it shipped on media.

This service is made available through a close partnership between the three Service Center Agencies (SCA); Natural Resources Conservation Service (NRCS), Farm Service Agency (FSA) and Rural Development (RD).

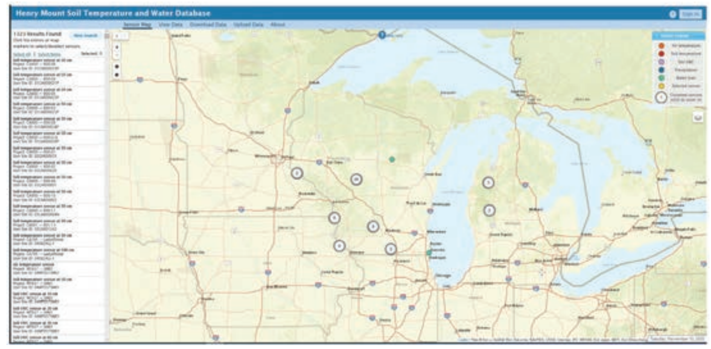
YouTube Channel National Soil Survey Center: NRCS NSSC

https://www.youtube.com/channel/UCqWbDV7-rsBe_dtwm4QqwJA

Videos and webinars for the USDA NRCS National Soil Survey Center which includes the Kellogg Soil Survey Laboratory.



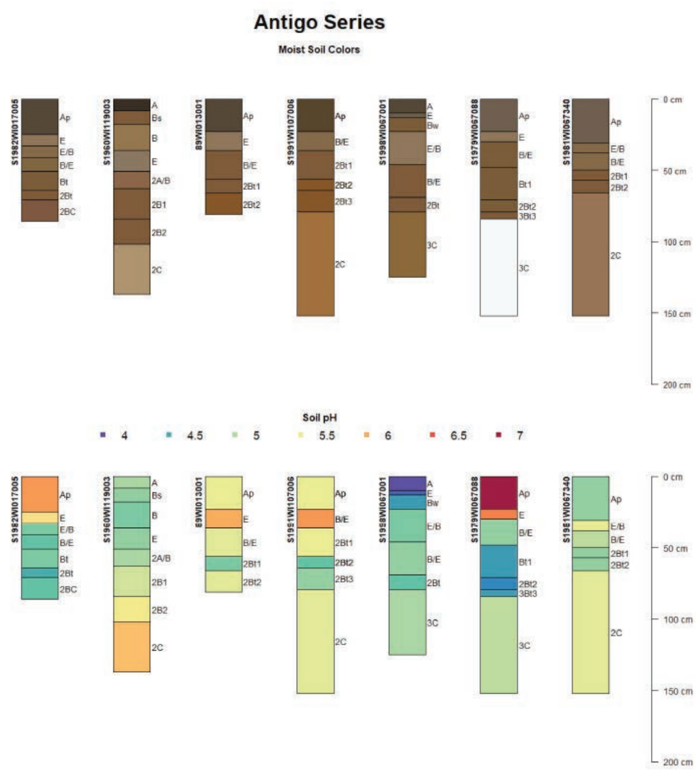
Henry Mount Soil Climate Database



http://soilmap2-1.lawr.ucdavis.edu/henry/

The Henry Mount Soil Temperature and Water database was created to store soil climate data collected by NRCS staff from in-ground sensors (“HOBOs”) and weather stations (Onset Weather Station). The “Henry” database can currently accept soil temperature, soil moisture (volumetric water content), air temperature, and water table depth data. Pending future funding, there are plans to add support for precipitation. This database does not house data collected as part of the SCAN or SNOTEL network of stations.

AQP and soilDB R packages

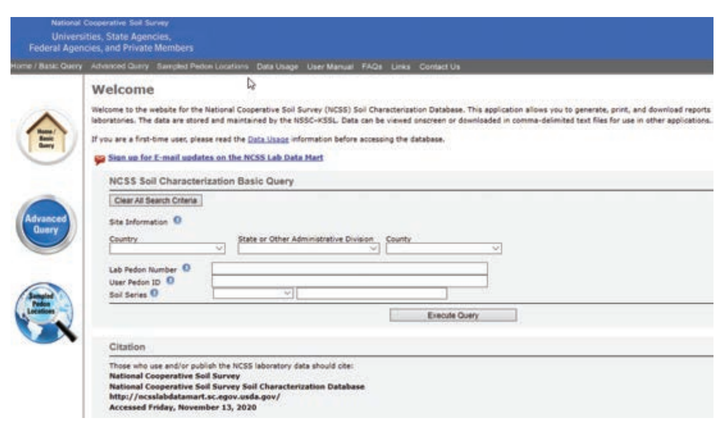


https://rstudio.com/
https://ncss-tech.github.io/AQP/
https://ncss-tech.github.io/soilDB/

R is a programming language and free software environment for statistical computing and graphics supported by the R Foundation for Statistical Computing. R packages are bundles of code and data that can be used in this software for specific statistical analysis or graphing operations.

The Algorithms for Quantitative Pedology (AQP) and Soil Database Interface (soilDB) are packages for R that provide methods and code for extracting soils information from current USDA-NRCS data sources such as SDA, NASIS, OSD, and KSSL databases. The code and data used in these packages can be used to analyze soils information and create plots like the example to the right.

Soil Lab Data: Lab Data Mart



http://ncsslabdatamart.sc.egov.usda.gov/

The National Cooperative Soil Survey (NCSS) Soil Characterization Database. This application allows you to generate, print, and download reports containing soil characterization data from the National Soil Survey Center (NSSC) Kellogg Soil Survey Laboratory (KSSL) and cooperating laboratories. The data are stored and maintained by the NSSC–KSSL. Data can be viewed on-screen or downloaded in comma-delimited text files for use in other applications.

New NRCS Soils Website

The new NRCS Wisconsin Soils Website (visit https://www.nrcs.usda.gov/wps/portal/nrcs/main/wi/soils/) offers tools, information and resources, bringing farmers, cooperators and other soil science supporters up-to-date on soils activities in the State and opportunities to collaborate in the future. The goal of the new site is to provide partners and visitors useful tools and resources 24/7 online, at their fingertips. The new Wisconsin Soils Website simplifies and improves the functionality of navigating and also provides unique, leading edge interactive tools, yet to be used anywhere else in the country. The main homepage features user friendly buttons by topic, to include soil quality, soil surveys, publications & maps, soil judging, technical soil services, tools, news & media, soil data mart, past & present, cooperative program and contact us.

Some highlights of the new website features include the following:

- The Soil Data Mart 2.0 is a real-time data mart of official soils data, providing live, interactive maps, dynamic, up-to-date reports and resources for farmers and partners across Wisconsin. The reports also provide easier and quicker access to soils datasets found on the official Web Soil Survey.
- The Soil Surveys Page houses a tool that provides live official Web Soil Survey as a one-stop shop on the Wisconsin NRCS website. It saves time and steps farmers and partners take inside the tool and provides quicker access to selected areas of interest; i.e., local farm maps.
- The Contact Us Page includes interactive story maps to pinpoint local assistance provided by resource soil scientists by county and area.

Topics to explore on the new NRCS Wisconsin Soils website.

Web Soil Survey Annual Refresh

The National Cooperative Soil Survey Program is an endeavor of the USDA's Natural Resources Conservation Service (NRCS) and other Federal agencies, state and local governments and other cooperators. It provides a systematic study of the soils in a given area, including the classification, mapping, and interpretation of the soils. Soil types are classified from physical properties, drawing heavily on the principles of pedology, geology and geomorphology.

Each year the entire Official Web Soil Survey Database (WSS) is refreshed to ensure that updated official data is available in October of each year for use in implementing national programs affecting landowners and managers. Interpretation criteria will be updated for many national interpretations.

FY2020 Refresh

The last refresh was completed on July 1, 2020. This date reflects a change in the annual soil database refresh cycle from the previous date of October 1st. Going forward, the USDA-NRCS will continue to refresh soils data on July 1 and will no longer use October 1st.

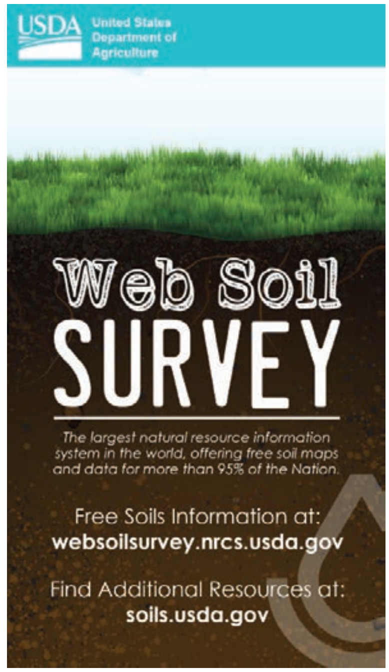
The USDA-NRCS soil survey database contains both tabular data (soil properties and interpretations) and spatial data (soil maps). The tabular data was refreshed for all 3,375 soil survey areas in the United States and Island Territories and the spatial data was refreshed for 327 soil survey areas. One National Interpretation, the National Commodity Crop Productivity Index, was revised and this updated version is now included in the tabular data.

New and/or Revised Interpretations from the October 2019 Refresh

Windthrow Hazard: This interpretation evaluates soil and site characteristics for each soil component to provide a rating which identifies areas where trees may be prone to windthrow. While the characteristics of the trees and silvicultural practices are also factors in windthrow, trees growing where the rooting depth is limited and on exposed positions on the landscape are most at risk.

Mechanical Site Preparation (Surface): This interpretation addresses the difficulty of using surface-altering soil tillage equipment to prepare a site for planting trees or seeding. Criteria such as soil texture, rock fragment content and surface slope are evaluated to determine the degree of limitation for mechanical site preparation. The predictive model was changed to allow better differentiation of the level of limitation for site preparation. Also, the documentation of how the interpretation works was improved.

Mechanical Site Preparation (Deep): This interpretation addresses the difficulty of using deep soil tillage equipment to prepare a site for planting trees or shrubs. Criteria such as soil texture, rock fragment content, restriction depth and surface slope are evaluated to determine the degree of limitation for mechanical site preparation. The predictive model was changed to allow better differentiation of the level of limitation for site preparation. Also, the documentation of how the interpretation works was improved.



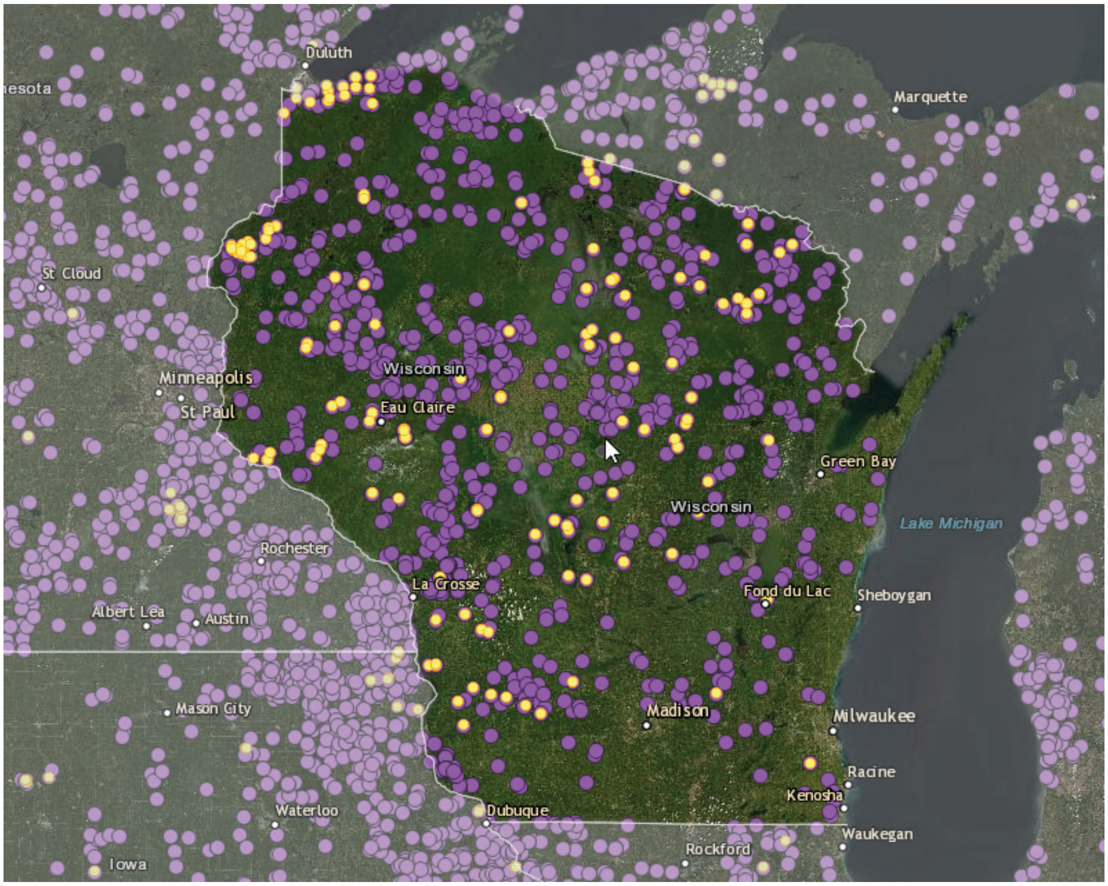
Potential Erosion Hazard (Off-Road/Off-Trail): This interpretation examines the surface erodibility, slope and rainfall erosivity to address the potential for excessive erosion to occur due to relatively small areas of soil disturbance under normal weather conditions. The predictive model was changed to allow better differentiation of the level of potential for erosion. Also, the documentation of how the interpretation works was improved.

Displacement Hazard: This interpretation is designed to predict the hazard of soil displacement from operations of ground-based equipment for forest harvesting and site preparation activities when soils are dry or moist. Displacement is the horizontal movement of soil caused by scraping or machine gouging. Displacement can remove the organic forest litter and upper portions of the mineral surface layer, reducing plant nutrient availability and waterholding capacity.

Puddling Hazard: This interpretation is designed to predict the risk of soil puddling occurring from operation of ground-based equipment for forest harvesting and site preparation activities when soils are moist. Puddling is the loss of soil structure that results from squeezing and churning of soils by tires or tracks of heavy equipment. Soil particles become dispersed in water, and after they have dried and settled, the smaller particles form a crust on the surface.

Mechanical Planting Suitability: This interpretation addresses the difficulty of planting trees or shrubs using a mechanical planter. Criteria such as soil texture, rock fragment content and surface slope are evaluated to determine the degree of limitation for mechanical planting. The predictive model was changed to allow better differentiation of the level of limitation for planting. Also, the documentation of how the interpretation works was improved.

Soil Lab Data Mart Updated



The USDA Natural Resources Conservation Service (NRCS) National Soil Survey Center announces the release of updated geochemical data to an interactive map called National Cooperative Soil Survey (NCSS) Soil Characterization.

The map links to a national database of soil characterization data and allows users to locate pedons that have been analyzed. A pedon is the smallest unit of soil containing all the soil horizons of a particular soil type. Clicking on a pedon location in the map enables users to access lab data about that pedon. The map is also available from the NCSS Soil Characterization Basic Query website by clicking an icon at the bottom left of the page.

"The updated map gives users nationwide a means to view data that can be used by educators, scientists, farmers, landowners, schools, soil judging teams, the general public and more," said Angela Biggs, State Conservationist in Wisconsin.

"The map lets you search for lab data by using filters or by exploring places you care about across the globe," explained Andrew Paolucci, Assistant State Soil Scientist in Wisconsin. Map users can query by location of interest and have soil data available at their fingertips.

The updated tool can assist scientists in developing conservation models for validating outcomes of conservation practices. Users can pinpoint spots using location panels, full screen maps and latitude and longitude. "Our new interactive map provides online access to our rapidly growing collection of lab data," explained Skye Wills, National Leader for Soil Science Research.

Soil scientists, hydrogeologists, municipal water-utility operators and water-quality regulators use soils lab data to understand the subsurface. The data viewer includes over 50,000 individual soil samples from across the world (see map for U.S. sites). Soil sample data can also be viewed in reports. The map offers:

- options for selecting different base maps and adding soil-color maps by depth-slice,
- the ability to search by location or use a current location,
- the ability to search by soil series or geographic location,
- options to download characterization data for a selection of points to be used in other applications,
- two ways to search for lab pedons, filters and the search bar and
- streaming from Soil Data Access web services, where popups for each pedon include several lab reports.

“Pedon Vault” App: Soil Profiles at Your Fingertips

Scientists, educators, farmers, anyone interested in soils, have you ever tried to learn about your local land by looking at a cross section of your soil, known as a soil profile, only to realize the sample doesn’t have the layered exposure you were looking for? Soil profiles with good exposure usually show darker soil near the top of a cross section, and lighter soils below. When exposed, various soil horizons or layers of soil are seen. Each horizon holds physical, chemical, biological, and mineral differences.

The USDA Natural Resources Conservation Service (NRCS) in Wisconsin and the NRCS National Soil Survey Center have made available a new app, Pedon Vault, the first of its kind, to offer a national database of sites to visit in the field offering good exposures of soil profiles and data. Thus, the app name, Pedon Vault, a vault of three-dimensional samples of a soil large enough to show characteristics of all its horizons.

“Pedon Vault give users, nationwide, a means to share data by populating a national database of sites that can be used by educators, scientists, farmers, landowners, schools, soil judging teams, the general public, and many more,” said National Soil Data Applications Scientist, Jason Nemecek. The app records soil exposures across the country and populates a national database. Interested users can then visit sites in the field with good exposures of soil profiles with data available at their fingertips.

“Pedon Vault application offers valuable insight into soil profiles and is a great first step toward citizen science involvement with the national soils program,” said David Hoover, NRCS Director of the National Soil Survey Center. Pedon Vault allows users to download and keep local surveys housed in the app for review and use. Users are able to record, document, and upload photos, share, and update soil profile data around the country. Users can also pinpoint locations using location panels, full screen maps, and latitude and longitude for current locations. Map and text settings are also customizable in the app.

A step-by-step user guide with application screenshots is available on the NRCS Wisconsin Soils Homepage. If you are interested in downloading the application, review specific steps in the user guide. For more information about soil tools available for use and how NRCS can assist you, visit the NRCS National Soils Homepage.

Screen view of the new Pedon Vault app.

NRCS Technical Soil Services

What are technical soil services?

- Technical soil services (TSS) are the professional application of soils information.
- The Technical Soil Services branch of NRCS provides free assistance to partner agencies; public and private, for-profit and non-profit organizations; and the general public.

What does TSS do for NRCS and SWCDs?

- We support conservation planning through compliance determinations and reviews (both HEL and wetlands).
- We support other agency programs and initiatives, including NRI, ecological site development, and soil health investigations.
- We conduct onsite assessments for resource inventories, practice designs, and practice implementation.
- We conduct field and area office quality assurance reviews.
- We maintain official reference documents, such as the relevant sections of the eFOTG.

What else does TSS do?

- We provide general soils-related information in person, on the phone, by social media, and by email.
- We provide soils-related training to partner agencies and organizations.
- We provide support for youth education through soil judging, land judging, conservation awareness contests, and Envirothons.
- We work with you to identify and obtain the soils information you need to address your specific concerns.
- We help you find and use NRCS tools and information resources, such as Web Soil Survey and Soil Data Access.
- We work with you on unique projects that required custom analysis of soil data and information.

How do I get help with TSS?

- Contact your State Soil Scientist or Assistant State Soil Scientist.
- Contact an Area Resource Soil Scientist.
- Contact a Soil and Plant Science Division soil scientist located at one of the MLRA soil survey offices.

Top Wisconsin Technical Soil Services Provided (FY2020)

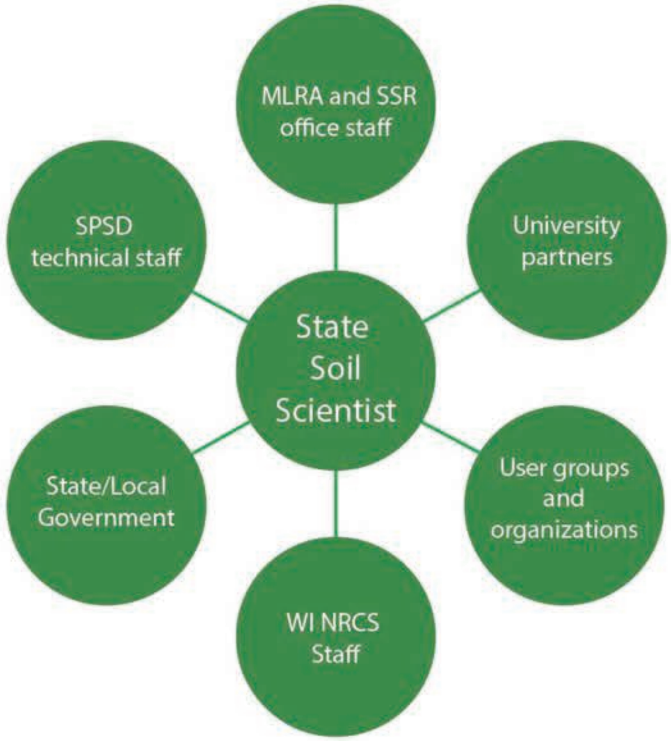
1. Technical consultations where soils Information was provided to internal/external customers.
2. On-site investigations for wetland determination or delineations.
3. Creating custom maps reports, data files, etc.
4. Developing public information articles, pamphlets, booklets, etc.
5. Developing or validating soil survey interpretations.

Other Wisconsin Technical Soil Services Provided (FY2020)

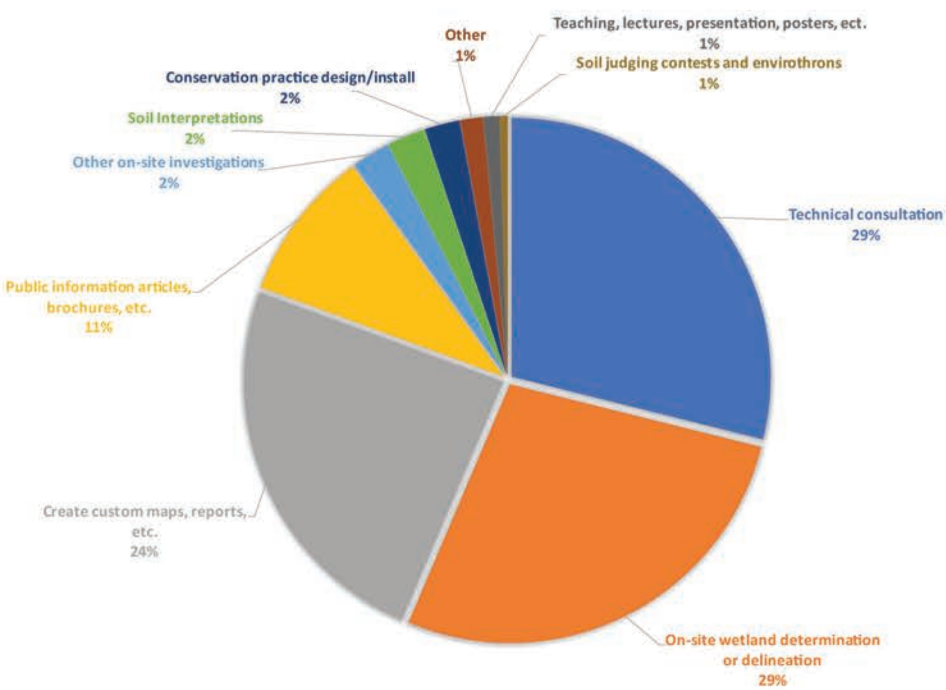
1. Application of ecological site information.
2. Conservation plan resource inventory.
3. On-site investigations for soil health management.
4. Assistance with soil judging contests.
5. Teaching, lectures, presentations, displays, posters, etc.

Types of Technical Soil Assistance
Area wide knowledge of Soils to assist in Easement sites
Assistance on resolving wetland issues relating to Department of Natural Resources permits for crossings and streambank
Data collection and analyses
Determining Lateral Effects for Wetlands for Engineering
Developing Soil Criteria for Conservation Planning (Resource Concern)
Developing soil criteria to use in ranking applications
Developing workload analysis and business plans
Ecological Sites – data collection and analyses; review descriptions
Farmland Policy Protection Act, LESA
GIS (creating maps, performing analyses)
GIS/GPS (creating maps, performing analyses, verifying easement boundaries)
HEL and wetland compliance
HEL/determinations/compliance/appeals
Hydric soils list
Important farmlands identification
Important Farmlands list
Liaison to other Federal, State, Local, or non-governmental agencies
Maintain eFOTG
Maintaining soil databases for Planning and Programs (RUSLE2, initiatives)
Outreach (preparing/presenting informational or technical materials, Envirothon, Land Judging)
Product publications (fact sheets, summary reports)
Program Management and Support
Program Management and Support (organizing annual work planning conference, developing business plan, reviewing/approving MLRA Soil Survey Office projects)
Program Management and Support (preparing reports, drafting bulletins, supervision, performance plans and reviews, recruiting/hiring)
Provide input for ranking
Provide input for restoration planning and design
Provide input for site eligibility
Provide training to field offices on Soil Quality Test kits
Providing soils information to internal and external customers
Quality Assurance Reviews (Area/Field Offices)
Receiving and presenting training
Resource inventories for conservation planning
Review and update soil rental rates
Reviewing conservation practice standards
Site-specific soil investigations
Site-specific soil investigations (Waste Storage Facility-313)
Soil Health Monitoring
Soil Interpretation Training Internal and External
Soil interpretations development
Soil survey – initial (mapping, database, compilation, field reviews)
Soil survey – update and maintenance (transects, database, spatial data edits, reviews)
Soil technology development/maintenance
Soil Training Course for Field Office and Partners
Special studies (carbon, soil quality, other characterization studies)
Wetland delineations/determinations/compliance/appeals
Wetland determinations for all of the above

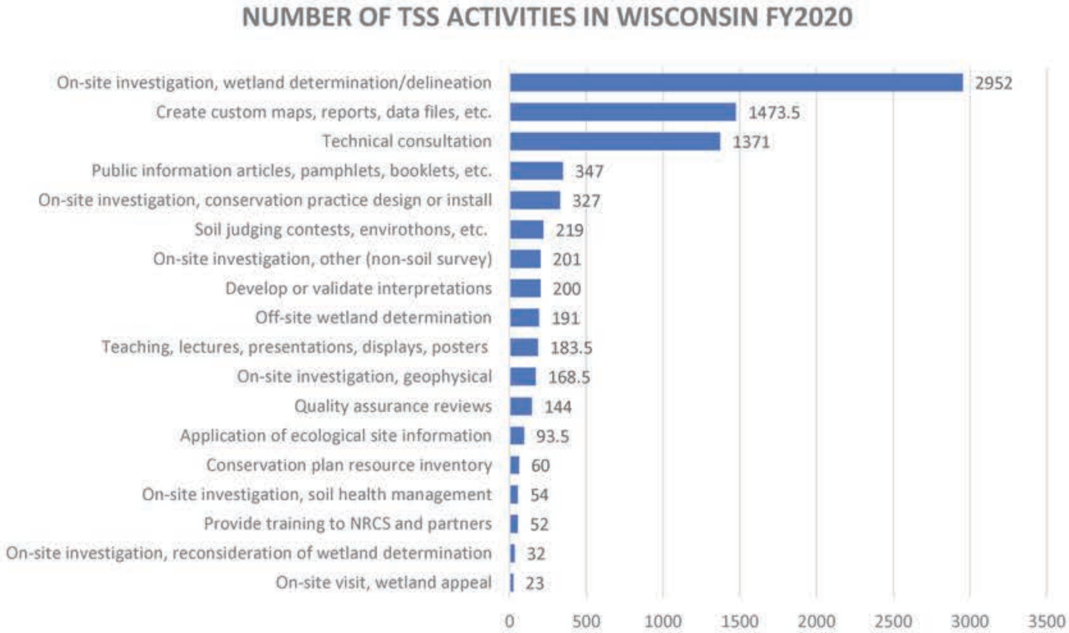
Collaboration is the Key



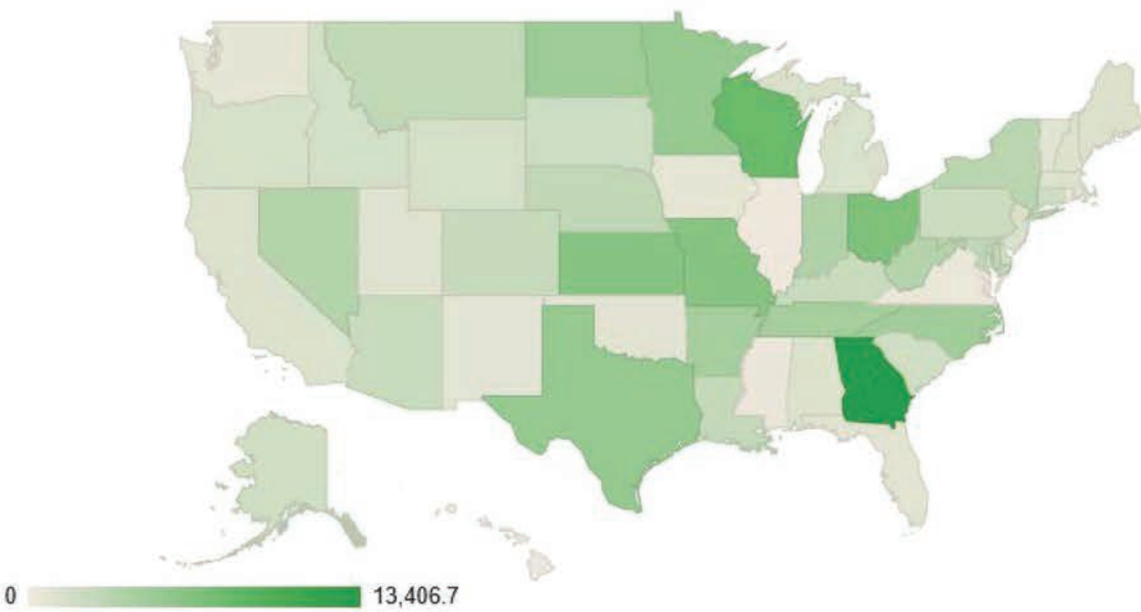
Sum of Instances - FY2020



A summary of TSS Activities in Wisconsin FY2020.



There were over 3,000 Technical Soil Service instances documented in Wisconsin in FY2020. This amounted to over 8,000 hours.



The map above shows the number of TSS hours recorded across the U.S. Wisconsin ranked second in the nation with hours and instances of TSS activities in FY2020.

Soil Interpretations

When a Forester, Conservationist, Biologist or any other soil user goes to the field they are maybe developing an interpretation in their head as it relates to their field. For example, a forester may try to determine how to predict the most optimum location to plant certain species of trees.

Soils are complex and how we use soils data is very important in developing interpretations. This is where a soil scientist can be handy.

How users use the soils data is extremely important

- Depth
- Weighted Average
- Dominate Component
- Dominant Condition
- Minimum
- Maximum
- Thickest Layer
- Average
- Surface Horizon
- Organic Horizons
- Mineral Horizons
- Null
- No Data
- Frequency
- Restrictive Layers
- Component Percent
- Major Components
- Minor Components.
- All Components
- Depth range
- All Horizons

Few people, besides soil scientists, know enough about soils, and about the interactions among the many soil characteristics that define each kind of soil, to do the job by themselves. Few others have interest in all the uses and interpretations. Once a kind of soil is defined and mapped, few besides the soil scientist are concerned with all the interpretations needed, the field and horticultural crops that can be grown; the erosion hazard; the native plants and their ecological successions; how the soil will serve as subgrade for roads or foundations for buildings; and so on. Experience shows that the soil scientist must take leadership in developing the interpretations. This leadership responsibility includes getting the assistance of others, who may develop all or part of certain interpretations. Commonly, the soil scientist prepares a draft for others to react to. Responsibility to see that their work is interpreted for use is inherent in the duties of every soil scientist in the Soil Survey. –Kellogg

The soil scientist must have help and guidance from competent people in the related fields. Agronomists, horticulturists, engineers, foresters, economists, and so on can help them understand what combinations of characteristics and qualities are most important and help him assemble part of the relevant data. To work with them effectively, the soil scientist must learn something of their technical language and points of view. Then after he/she has made their interpretations in draft they can react to them, help him test them in application, and help improve them. –Kellogg

There will always be a need for soil scientists to collect and improve data, provide technical soil services, and educate landowners and partners on soil practices. Soil Science is a broad field mixing ecology; agriculture and economy to include soil formation; physical, chemical, biological, and fertility properties of soils; and these properties in relation to soil land use management. As population increases and climates change, a heavy strain will be placed on agriculture. Soils are the backbone of agriculture and a healthy soil is critical to our future. Soil quality, soil ecology, and the importance of organic matter management are crucial in managing fertility and lessening drought impact.

Understanding the Difference Between Soils Data and an Interpretation

Let's imagine you're setting up a bakery specializing in making cakes. In the figure below, the fresh flour represents official soils data (one important ingredient); the finished cakes represent soil interpretations. If the cake turns out tasting poorly, you wouldn't change the fresh flour, you'd first look at changing the overall recipe instead. The fresh flour is the raw material, or base that holds the cake together; one important ingredient of the recipe. Similarly, current official soils data is the base ingredient to making a good, solid interpretation. If you are an external user developing interpretations, one thing to keep in mind is your model might not turn out as desired the first time. You might need to modify the model several times to get desired results and calibrate it from actual data. The fresh flour (or official soils data) is all-purpose, having many uses for different interpretations and fields. Using fresh flour, or the most updated, official soils data correctly, makes a big difference in the quality of your baking creation or soils interpretation.

A practical example of flour (like official soils data), as an important ingredient to a cake (like interpretations).

An Overview of Hydrologic Soil Groups (HSGs)

A brief overview of the history, criteria and work being done to improve soil survey data related to HSGs.

What are HSGs?

Hydrologic Soil Groups (HSGs) are a fundamental component, that, along with land use, management practices, and hydrologic conditions, determine a soil's associated runoff curve number. Runoff curve numbers are used to estimate direct runoff from rainfall. Soils in each respective HSG have similar runoff potential under similar storm and cover conditions.

History of HSGs

1955—Yearbook of Agriculture introduces four infiltration classes (A, B, C, and D).

1964—Changes to the criteria for the groups included in the National Engineering Handbook.

1989—Soil survey database considered to place soils in HSGs.

1994—National Soil Information System (NASIS) developed. Permeability replaced by saturated hydraulic conductivity.

2004—It was decided that HSGs would be calculated for components in NASIS and Ksat criteria was updated.

Modern Criteria Used to Distinguish HSGs

Depth to water impermeable layer: Depth to any restrictive layer such as bedrock or dense till.

Depth to seasonal high water table: High water table during any month out of the year.

Saturated hydraulic conductivity (Ksat): Quantitative measure of a saturated soil's ability to transmit water when subjected to a hydraulic gradient.

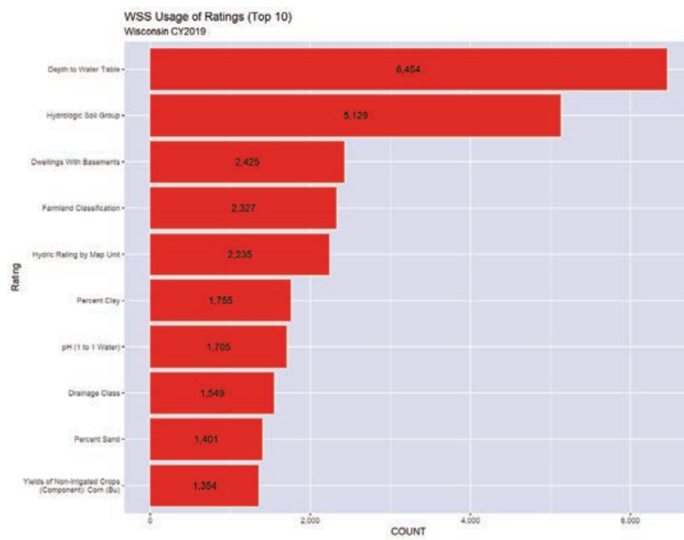
Assumptions

- Soil surface is bare
- Soil is not frozen
- Intake and transmission of water under the conditions of maximum yearly wetness (thoroughly wet)
- Maximum swelling of expansive clays

*The slope of the soil surface is not considered when assigning hydrologic soil groups

Uses

HSGs are specifically designed to generate runoff curve numbers. These curve numbers are used for the design of culverts and grassed waterways. HSGs were not designed to predict deep leaching of soil water. In Wisconsin, hydrologic soil groups are one of the most used interpretations in Web Soil Survey (see graph below).



Top 10 Wisconsin ratings viewed in Web Soil Survey in 2019.

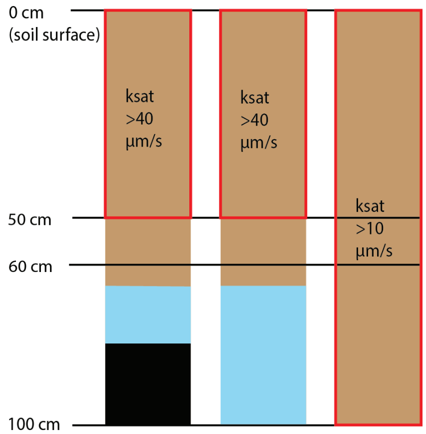
(L to R) Mike Isaacson, Wisconsin NRCS Hydraulics Engineer, conducting an onsite soils investigation to verify mapped HSGs for the design of a grassed waterway. The image on the right shows iron redoximorphic features (red and gray mottles), that are indicative of soil saturation.

Hydrologic Soil Groups A, B, and C

Soils in this group A have low runoff potential and water is transmitted freely through the soil. Group B soils have moderately low runoff potential and water transmission through the soil is unimpeded. Group C soils have moderately high runoff potential and water transmission through the soil is somewhat restricted.

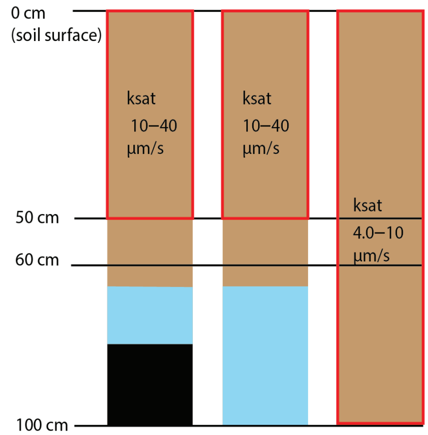
Class A Soils

(Low Runoff Potential)



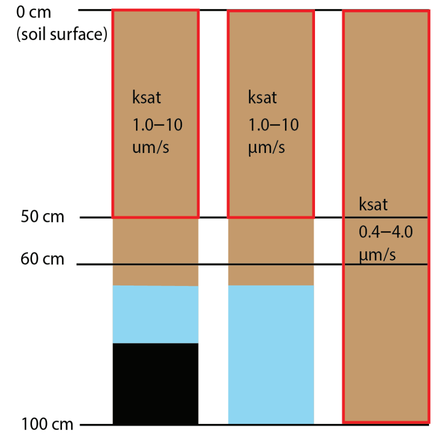
Class B Soils

(Moderately Low Runoff Potential)



Class C Soils

(Moderately High Runoff Potential)

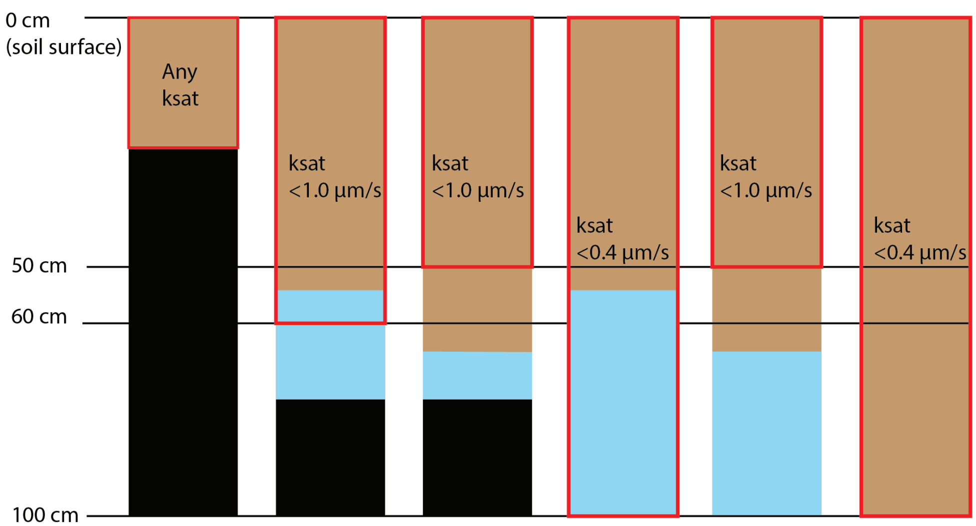


Hydrologic Soil Group D

Soils in hydrologic soil group D have high runoff potential and water movement through the soil is restricted. Soils with drastically different properties can be classify as D. For example a sandy, shallow, excessively drained soil a loamy, very deep, poorly drained soil both would be assigned soil group D.

Class D Soils

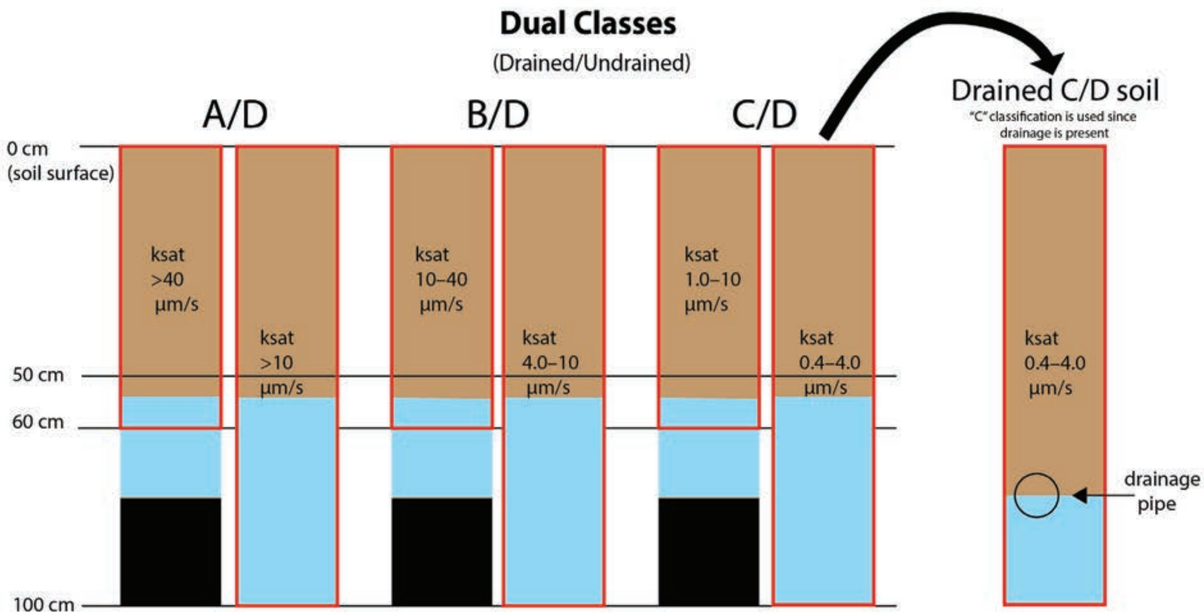
(High Runoff Potential)



Metric to English Conversion	
µm/s	in/hr
0.4	0.057
1	0.142
4	0.567
10	1.417
40	5.668

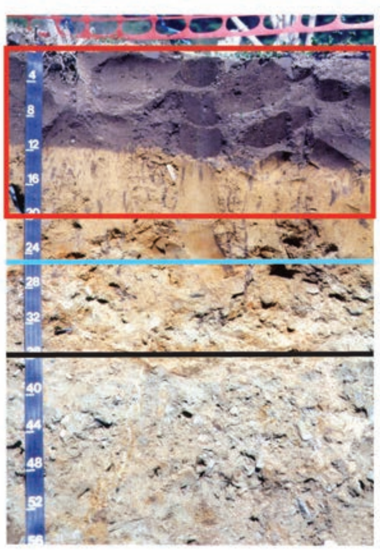
Dual Hydrologic Soil Group Classes

Certain wet soils are placed in group D based solely on the presence of a water table within 60 cm even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, they are assigned to dual hydrologic soil groups (A/D, B/D, C/D). The first letter corresponds to the drained condition which implies the water table is kept below 60 cm. The second layer corresponds to the undrained condition.



An Example

The soil profile on the below has dense till at 36 in. (95 cm) and a seasonal high water table at 25 in (65 cm). Therefore, the saturated hydraulic conductivity (ksat) observable depth range is 0–50 cm. Since this soil has ksat values ranging between 1–10 within these depths it classifies as Group C.



Ksat observable depth range (0–50 cm). This soil has Ksat values ranging from 1–10 um/s within this depth range.

Depth to seasonal high water table (65 cm). The red and gray redoximorphic features suggest this soil is saturated at this depth sometime during the year.

Depth to restrictive layer. This soil has dense till present at this depth (95 cm).

What are Wisconsin Soil Scientists Doing to Improve the Soil Survey Data Related to HSGs?

Soil Scientists in the MLRA soils survey offices around the state are improving soil survey data through update projects and field investigations. Some of these projects, such as the Juneau soil survey office, MLRA 95 Kewaunee loam project, will improve or verify the precision of the physical soil property data used for determining HSGs.

Kewaunee loam is mapped in Waushara, Calumet and Manitowoc Counties, whereas several of the adjacent counties have Kewaunee silt loam mapped in similar landscape positions. In the situations where these map units join at county boundaries, HSGs and other interpretations change across the county line, partly due to the differences in surface texture. These spatial join issues can be problematic for conservationists and engineers who rely on the soil survey data for conservation planning.

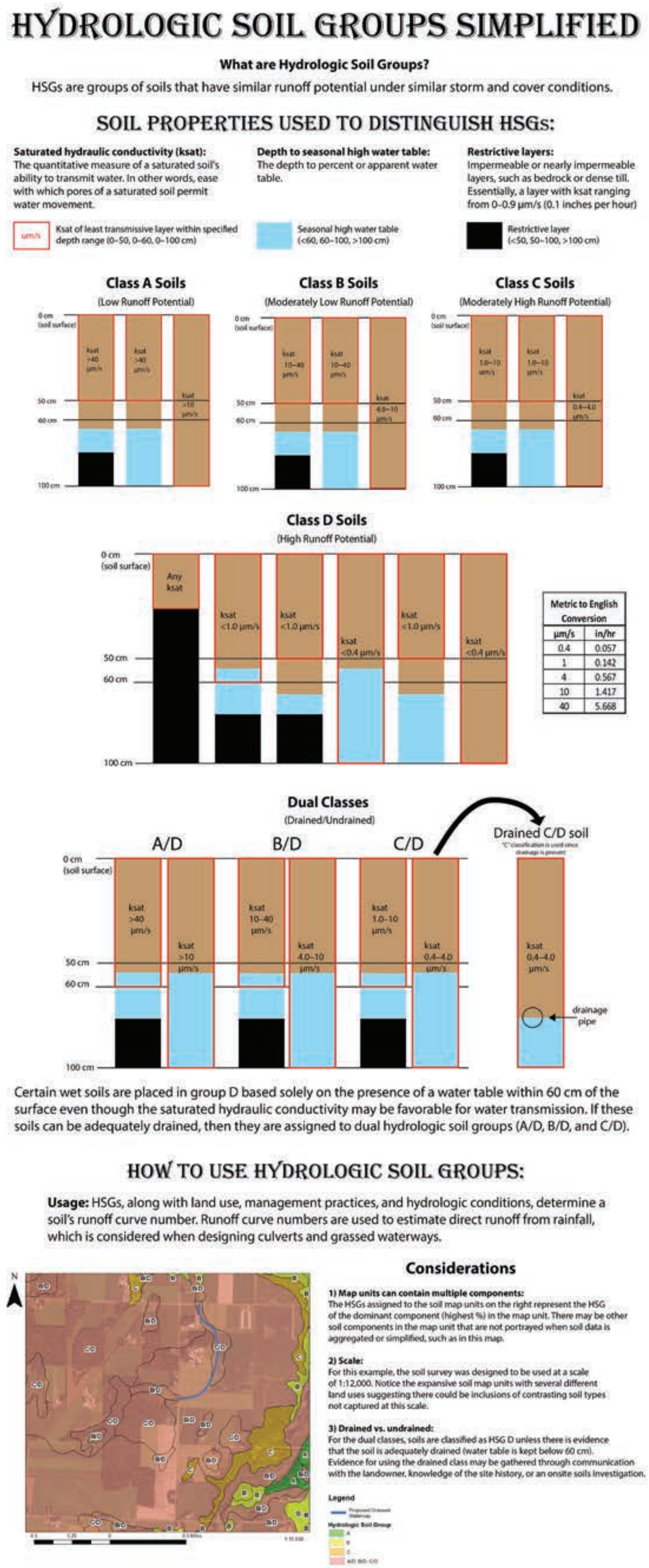
Part of the Kewaunee loam project is to evaluate the physical properties of the surface by describing surface structure and texture, conducting particle size analysis, and using Amoozemeters to verify saturated hydraulic conductivity (ksat) ranges.

(L to R) Three Amoozemeters the Juneau Soil Survey Office is using to measure saturated hydraulic conductivity, one of the properties used to distinguish HSGs. An Amoozemeter, a type of permeameter, is a tool that uses a constant head of water to measure the rate of water movement in a saturated soil. On the right, contact between the device and the soil is shown.

With this project, the Juneau office can either verify the existing data for texture and ksat or update these properties with new data. Either way this project will elevate our knowledge of the Kewaunee soil series and its range in characteristics. The Juneau office Kewaunee project is just one example of the many soil survey projects ongoing throughout the state.

Other references:

The criteria to distinguish HSGs is located in Chapter 7 Part 630 of the USDA-NRCS National Engineering Handbook.



Above was developed to explain some of the criteria behind HSGs and some considerations for using the soil survey HSG data. For a copy of the poster, questions about HSGs or how to access the data from soil survey, contact Andrew Paolucci, Wisconsin Assistant State Soil Scientist at Andrew.paolucci@usda.gov.

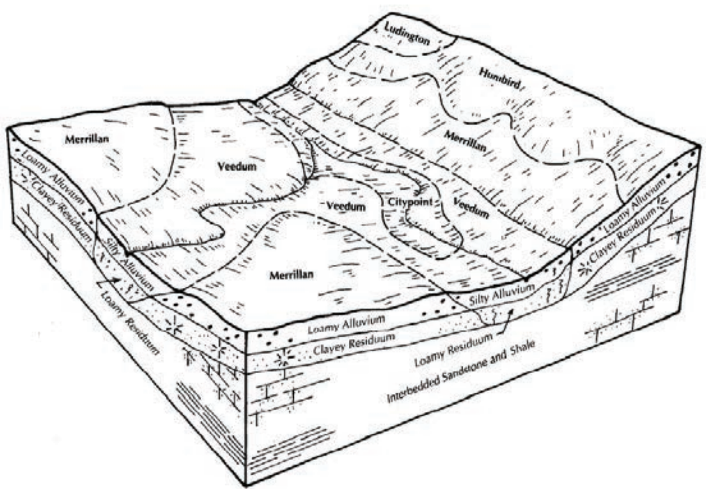
NRCS Onalaska Soil Survey Office

Veedum-Elmlake Water Table Study

The Onalaska MLRA Soil Survey Office is currently in the middle of its first water table study which began in 2018. This water table study focuses on Veedum and Elmlake associated soils in MLRA 89–Wisconsin Central Sands. Staff from the Onalaska MLRA Soil Survey Office coordinated with county foresters in Clark, Jackson and Wood Counties to locate sites on county forest land. The study is expected to continue for a minimum of 5 years or until at least 5 regular years of data can be collected.

The Veedum, Elmlake and associated soils underlain with residuum formed from layered sandstone and shale. This leads to a variable substratum where some areas may be underlain by either sand from a sandstone layer or clay from a shale layer. In areas where the soils are underlain by clay formed from shale, an aquiclude is created. This aquiclude may be present at different depths or absent in other areas. During this study, piezometers were installed above and below the aquiclude layer. By installing piezometers in this manner, soil scientists will be able to determine which way ground water is moving into or through the soil. This means soil scientists can identify the soils better, as either episaturated or endosaturated. Soil scientists will also get better data to model annual groundwater depth trends for these soils. Ponding observations are also being made to better model ponding depths in the soil survey data. This information will support field offices by providing more accurate information when planning in/around wetlands.

Michael England, Onalaska MLRA Soil Scientist, reads data from a water level logger installed in one of the piezometer wells.

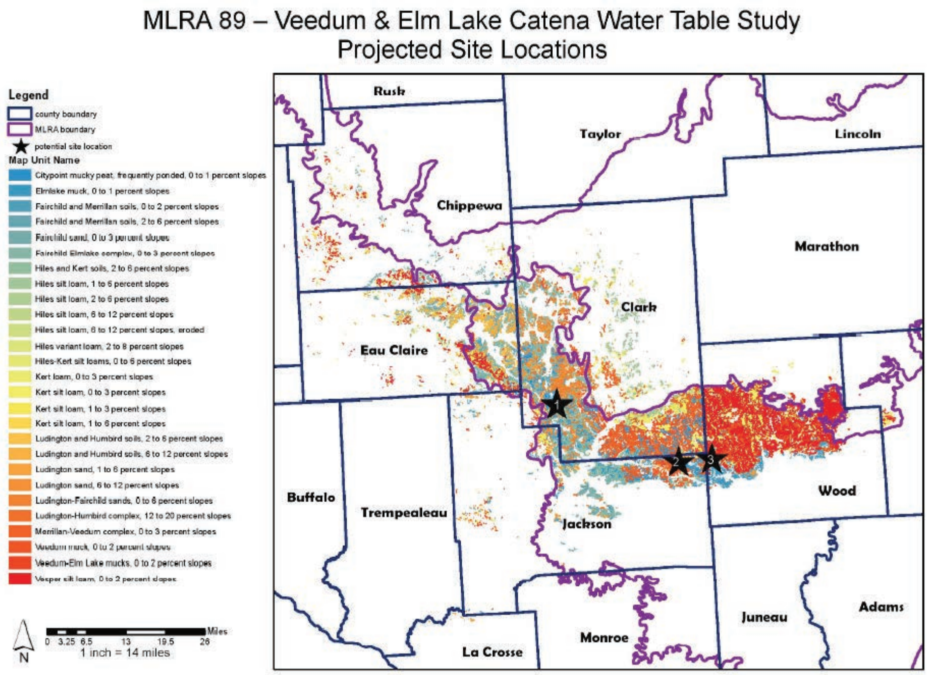


Block diagram showing landscape setting where Veedum soils occur in Jackson County, Wisconsin (Soil Survey of Jackson County, WI; 2001)

A sample of the clay aquiclude layer in a Veedum soil in Wood County. An aquiclude is an impermeable layer that restricts the downward movement of water.

Piezometers in Jackson County, Wisconsin, in an Elm Lake soil in August 2018.Elm Lake soils experience ponding throughout portions of the year.

Piezometers in Wood County, Wisconsin, located in a Veedum soil in January 2019. Veedum soils experience ponding throughout portions of the year.



Distribution of Veedum and Elm Lake soils currently being investigated and the three study site locations.

NRCS Juneau/Aurora Soil Survey Offices

Urban Soil Survey: City of Milwaukee Initial Soil Survey

The City of Milwaukee Initial Soil Survey project is planned for fiscal years 2022–2024. The Aurora, Illinois, and Juneau, Wisconsin, Soil Survey Offices, will be collecting field data and utilizing modern soil survey mapping techniques, such as digital soil mapping, to complete this project.

The City of Milwaukee is primarily in MLRA 110, The Northern Illinois and Indiana Heavy Till Plain. The soils of this area are mainly developed from glacial drift. Till, outwash, lacustrine deposits, loess and organic deposits are common. Fractured dolomite and limestone bedrock of Silurian age lies beneath the glacial drift.

The first soil survey of Milwaukee County was completed in 1918. The 1971 Soil Survey of Milwaukee and Waukesha Counties updated the soil information for much of Milwaukee County. Both the 1918 and 1971 surveys recognized most of the land with the City of Milwaukee as urban land and did not provide the soils information for urban and suburban areas.

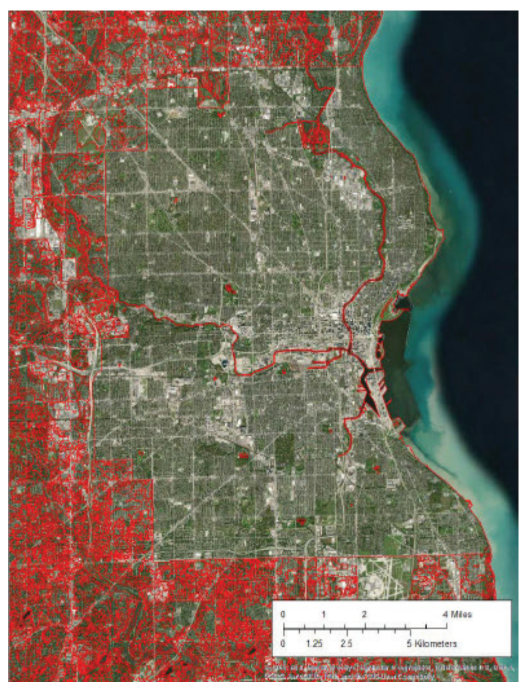
Urban soils are found in watersheds that provide drinking water, food, waste utilization and natural resources to communities. Urban soils are also located within cities in park areas, recreation areas, community gardens, green belts, lawns, septic absorption fields, sediment basins and other uses.

Soils information in urban areas can help city planners, engineers and community groups determine best land uses and management practices. Baseline urban soil survey data can guide the management of the major urban centers and suburban areas where most of us dwell, serving to direct the best use of open space and the optimal delivery of soil ecosystem services.

Recently, a cadre of NRCS soil scientists, the NRCS Urban Soils Focus Team, have started mapping urban soils and providing planning officials with information related to urban soils and their uses. For more information about urban soils or this focus team visit the urban soils webpage:

https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/use/urban/

MLRA 110: The Northern Illinois and Indiana Heavy Till Plain and its extent in relation to Land Resource Region M.



Location of the City of Milwaukee survey area. The area without red soil map unit boundaries is the location where this initial soil survey will be conducted.

NRCS Rhinelander Soil Survey Office

NRCS and USFS Collaborate on Digital Soil Mapping Project

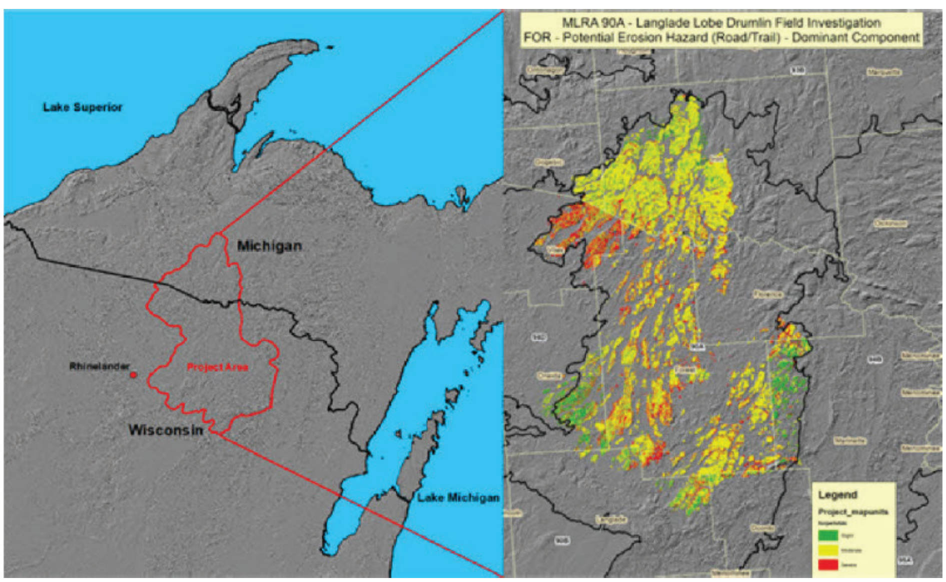
NRCS Soil survey staff from the St. Paul Regional Office and Rhinelander MLRA Soil Survey Office teamed up with employees from the U.S. Forest Service to describe soils and collect KSSL lab samples within the Ottawa and Chequamegon-Nicolet National Forests. This work will provide training points for the MLRA 90A–Langlade Lobe Drumlins Digital Soil Mapping Project.

This project was discussed and given priority during a state workload planning meeting convened by Jason Nemecek, former Wisconsin State Soil Scientist. At this meeting, Forest Service employees, Amy Amman and Mark Farina, discussed the use of SSURGO data in completing National Environmental Protection Act work plans that guide logging operations.

Different soil series mapped across county correlations weren't providing consistent interpretations. The need for a raster soil map, locating soil types more accurately, and delivering better interpretations became apparent. Lab data collected during this joint effort, including bulk density samples, will generate more accurate interpretations.

Ryan Bevernitz and Amy Amman describe and record soil profile.

Betsy Schug and Mark Farina prepare soil clods for bulk density analysis.



Langlade Lobe Drumlins Digital Soil Mapping Project area currently delivers inconsistent data.

Duluth Soil Survey Projects and Future Ideas

The Duluth MLRA Soil Survey Office is primarily focused on completing areas of initial soil survey mapping, but is also working on MLRA update projects and dynamic soil properties studies.

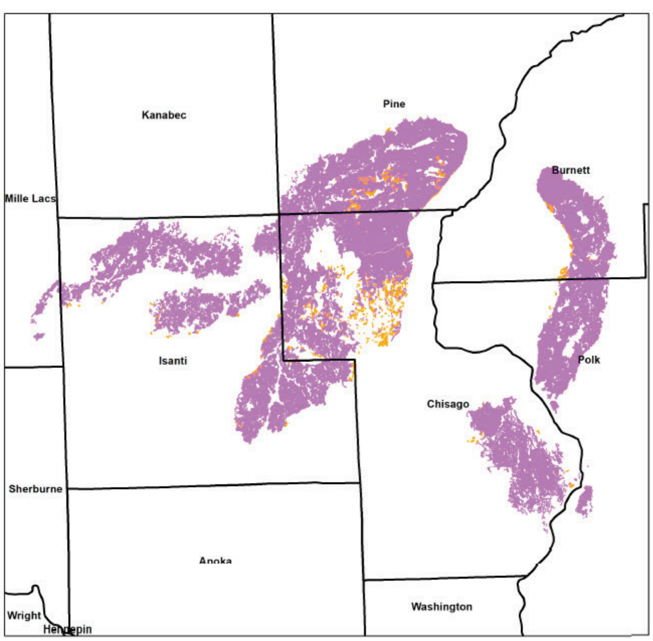
Grantsburg Sub Lobe Till Plain Project

The goal of this 2-year project is to reconcile inconsistencies in soil properties, bring the current soil survey data up to present standards and provide a landscape model with accurate representation of variability across the landscape. This project includes about 30,000 acres of initial soil survey mapping in Minnesota, and 140,000 acres of update mapping throughout several counties in both Minnesota and Wisconsin. The extent of this project spans Pine, Mille Lacs, Isanti and Chisago counties in Minnesota, and Polk and Burnett counties in Wisconsin.

Some of the soil properties or interpretations that are being investigated and updated include the soil series mapped, surface textures, K factor, Crop Productivity Index and Conservation Tree-Shrub Group. The results from this project will include a raster dataset designed for use at a scale of 1:12,000.

The Duluth office is also working on other soil survey update projects and studies that include Ashland, Burnett and Douglas Counties in Wisconsin.

Pagami Creek Fire Area–Dynamic Soil Property Study Discussion between the USFS and NRCS has begun to investigate the effects of wildfire on dynamic soil properties (DSPs).

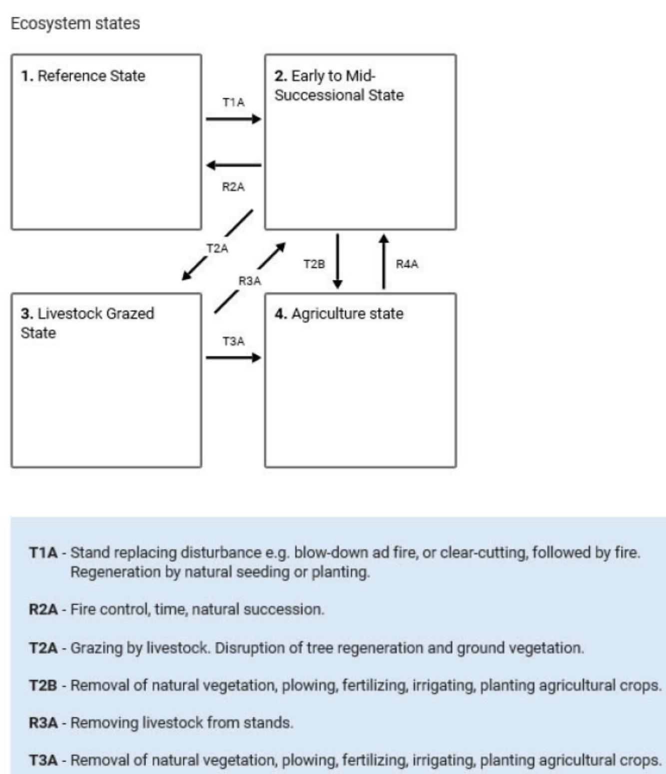


Map showing the extent of the Grantsburg Sub Lobe Till Plain Project which spans the boundary of Minnesota and Wisconsin.

The Pagami Creek Fire started from lightening and burned from late August to early November in Superior National Forest in northern Minnesota. Due to wind and dry conditions, the fire spread from the Boundary Waters Canoe Area Wilderness, threatening homes and infrastructure. The burned area totaled around 90,000 acres.

This fire, and other wildfires like it, provide an opportunity for soil scientists and partners to study the impact of fire on dynamic soil properties and vegetation communities. An interdisciplinary team began to ask questions like: How does wildfire influence soil organic matter? Do different forest communities respond differently to wildfire? (Clear-cut, mature forest, etc.) What other DSPs change due to wildfire? (Example: bulk density).

A future project to answer these questions is currently being discussed. Dynamic soil properties studies, like the project being proposed, provide an opportunity to predict how soils and vegetation respond to fire and provide land managers and conservationists with data to aid in future conservation decisions. The results from this study will likely be incorporated into Ecological Site Description State and Transition Models, like the one below.



R092XY008WI (Sandy Sandstone Uplands) State and Transition Model.

University of Wisconsin–Madison & Extension

By Francisco J Arriaga Ph.D., Assistant Professor and Extension State Specialist

The Dept. of Soil Science at the University of Wisconsin–Madison continues its tradition in providing quality education, research, outreach and extension activities in soil and environmental sciences. Our faculty, staff and students interact with multiple groups around the State, but have a special connection with NRCS.

Outreach/Extension

Often you will find NRCS and Dept. of Soil Science staff working side-by-side during field days and other outreach activities. UW–Extension State Specialist faculty based in the Dept. of Soil Science are members of several NRCS State committees, working together to improve resource conservation and management in Wisconsin. Two notable examples are collaborations in the area of crop nutrient management and soil health. These partnerships are of great benefit to the state.

Research

Research conducted in the Dept. of Soil Science is frequently done in partnership with other departments, institutes and programs within UW–Madison, as well as outside collaborators such as NRCS. Dr. Francisco Arriaga conducts research in the area of soil and water management and conservation. His research efforts in soil health, cover crop impact on soil erosion and nutrient losses, and flue-gas desulfurization gypsum application to agricultural fields has helped document the impact of various practices on soil health, crop productivity and the environment. These findings have helped guide recommendations provided by State and Federal agencies, such as NRCS. For instance, Dr. Arriaga's research team quantified reductions in total runoff volume of 24%, sediment loss of 52%, and total phosphorus loads of 42% when using cereal rye as a cover crop in corn silage production systems. Bioavailable P, which is closely linked to algae blooms in lakes and rivers, was reduced by 34% with the cover crop. Quantifying the impact of specific management practices can help guide programs and economic impacts.

UW Extension
Continuing Education, Outreach & E-Learning

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

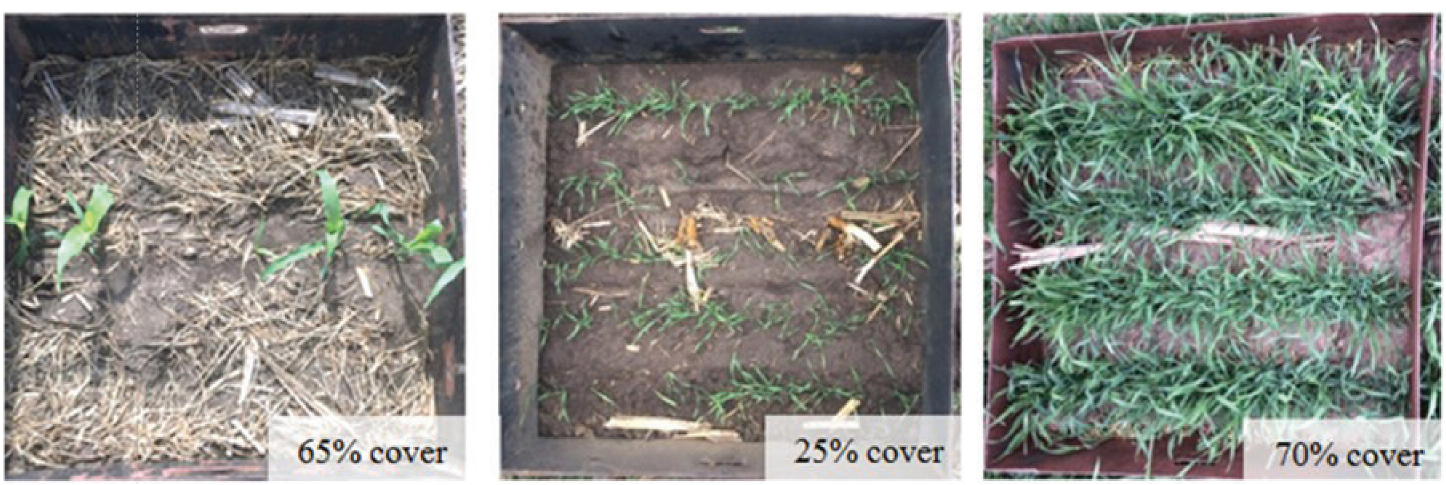


Photo courtesy of Laura Adams.

Soil Science at UW–Stevens Point

By Jacob Prater Ph.D. & Bryant Scharenbroch Ph.D.

Soil and Waste Resources Program

Pursue a strong education, and a bright future with Soil and Waste Resources at UW–Stevens Point. Find ways to improve the crops that feed the world. Develop better land-use plans for rural and urban areas. Enhance forests and inland waters critical to all. Manage our natural and man-made resources with efficiency. If these issues interest you, discover the Soil and Waste Resources discipline at the University of Wisconsin-Stevens Point to start building your career. As a Soil and Waste Resources student, you will choose from major options in:

- SOIL SCIENCE AND LAND MANAGEMENT, trains you to be a soil scientist, soil conservationist, or agronomist. Our program provides you with a strong science-based curriculum and skills in the techniques of tillage, nutrient and water management, and sustainable crop production while minimizing erosion and maintain water quality.
- WASTE MANAGEMENT, prepares you for jobs at landfills, wastewater treatment facilities, recycling and composting centers, and hazardous waste sites.
- A certificate in wetland science through the Society of Wetland Scientists is also available to College of Natural Resources majors who have completed a course of study that concentrates on the identification and management of wetlands.

For more information about the UW–SP Soils and Waste Resources Program visit this webpage: https://www.uwsp.edu/soils/Pages/default.aspx

These majors provide hands-on experiences in laboratory and field courses involving biology, chemistry, math, computers and communication.

Use State-of-the-Art Facilities

Regardless of which major you choose, you will access state-of-the-art laboratories, computers and greenhouses to supplement classroom lectures and discussion. Field trips, internships and a summer field experience provide additional real-world experience. Our faculty have Ph.D.'s in soil science, waste management and engineering, and specialize in solid waste management, soil physics, hazardous waste management, microbiology, soil genesis and morphology, wastewater treatment, nutrient management, and land-use planning.

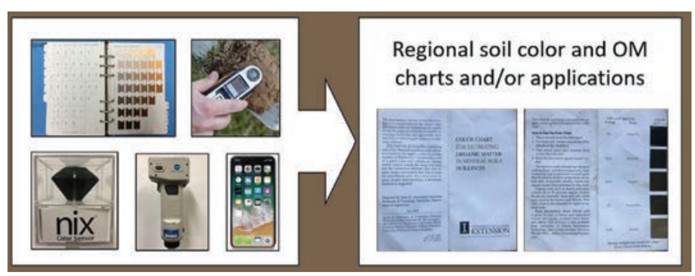
University of Wisconsin Stevens Point

Our graduates enjoy placement rates from 90 percent to 100 percent each year and work at private companies and municipal, county, State and Federal agencies.

Jacob Prater and Bryant Scharenbroch have been working with NRCS and consultants to develop pESDs for the remaining MLRAs in Wisconsin (all but 94D). Working together with the NRCS and a couple of extremely knowledgeable consultants (John Kotar and Dave Hvizdak) the project is going well and is near completion. The approach for pESD development uses the Forest Habitat Types as a site evaluation tool to connect with a soil sort based on abiotic factors to determine pESDs. The team also be refined and developsoil series correlations with Kotar Forest Habitat Types (including the new ones for wetlands!).

For more information about the pESD project see the article this booklet on Ecological Site Descriptions.

The UWSP team also is starting a project studying soil color and its relationship to other soil properties such as soil organic matter and soil organic carbon content.



Above on the left are some of the tools the UWSP team plans to use to measure soil color and investigate organic matter/carbon relationships. One of the deliverables of this project will be an regional OM chart and/or application for conducting in-field soil assessments similar to this color chart used in Illinois.

Soils Education & Research at UW–Platteville

By Christopher Baxter Ph.D., Nutrient Management Specialist, UW–Extension and University of Wisconsin–Platteville

Use of Soil Survey Information in Education

Many courses at UW–Platteville utilize soil survey information. Within the School of Agriculture, these include Crop Science, Soils, Soil Morphology and Classification, Nutrient Management, Introduction to Reclamation, Environment and Conservation, GIS/GPS and Mapping and Wetlands Ecology, Restoration and Management. Additional courses in the geography and civil and environmental engineering programs also regularly use soil survey information.

Soils-Related Research and Outreach

Dr. Chris Baxter is continuing research in collaboration with colleagues at UW–Madison on soils affected by historic lead and zinc mining in Southwest Wisconsin. Current work includes laboratory incubations and greenhouse experiments to determine the effectiveness of various soil amendments at reducing zinc phytotoxicity. A trial will be established in spring 2018 to determine effectiveness of amendments at reducing zinc phytotoxicity under field conditions. Dr. Baxter is also continuing research on nutrient uptake in hops, with the intention of using this information to develop better recommendations for local hop growers, assists with regional and statewide nutrient management training programs, and develops soils-related educational programming for local educational efforts such as the Grant county “Day on the Farm.”

Dr. Yari Johnson guides undergraduate research projects on the creation of a GIS model using soils data to map potential wetland restoration sites and studying the effects of fire and other restoration practices on soil microbial activity and decomposition.

Dr. Muthu Venkateshwaran’s research focus on understanding the molecular mechanisms controlling plants’ associations with symbiotic organisms, such as rhizobia, endo- and ecto-mycorrhizal fungi. His research projects also focus on unraveling plant defense signaling pathways, specifically, investigating the role of volatile organic compounds released by plant growth promoting rhizobacteria (PGPR) as elicitors of plant defense signaling.

In addition the UW–Platteville Pioneer Farm research efforts led by Dr. Dennis Busch continue to investigate the effects of management practices on soil and agricultural runoff quality as part of the USDA ARS Long-Term Agroecosystem Research (LTAR) network.

University of Wisconsin
PLATTEVILLE

Extra-Curricular Activities

The UW–Platteville Collegiate Soils Team placed third among 24 teams that competed in the 2017 National Collegiate Soils Contest (NCSC) hosted by Northern Illinois University. Students Daniel Brumm and Lea Koning placed among the top ten individuals out of the 93 students competing. The team also competed in and placed third among eight teams competing in the National Association of College Teachers in Agriculture (NACTA) soils competition hosted by Kansas State University. In the regional competition hosted by the University of Wisconsin-Whitewater, UW–Platteville placed second and qualified for the 2018 NCSC hosted by the University of Tennessee–Martin. The team also plans to attend the NACTA competition, hosted by Northeastern Community College in Norfolk, Nebraska.

Soil Science at UW–River Falls

Our Program

At UW–River Falls, Crop and Soil Science is one of five majors within the Department of Plant and Earth Science. The Crop and Soil Science majors has three options: Crop Science, Soil Science, and Sustainable Agriculture.

We currently have approximately 65 undergraduate students in the major with around 20 students in the Soil Science option and several students in other majors adding a Soil Science minor to their curriculum. Within the Soils option students can focus their coursework on either agricultural or environmental soil science. Our Introductory Soils course is a foundation course for the College of Agriculture, Food, and Environmental Sciences and teaches approximately 200 students per academic year and is being renovated to be more focused on hands-on activities.

Co-Curricular Activities and Soil Judging

Students have an opportunity to participate in the Crops and Soils Club, which is one of the most active undergraduate student organizations on our campus. The club hosts social and professional activities (speakers, field tours, etc.) and is a member of the national student organization (Students of Agronomy, Soils and Environmental Sciences) affiliated with the Soil Science Society of America. Each year we sponsor 15–20 students to attend the national conference to present research, listen to presentations and participate in tours and other activities.

We have a long tradition on our campus of participation in collegiate national soil judging. The team is coached by Dr. Holly Dolliver and currently trains 10–15 students each year to participate in the North American Colleges and Teachers of Agriculture (NACTA) competition each spring.

Research Activities

The Soil Science faculty are actively involved in research projects in the region. Many of these research activities provide valuable training and career development for undergraduate students. Current research studies include manure management and composting and its effect on soil fertility and soil health (Dr. Natasha Rayne), soil quality, soil health, carbon dynamics in Antarctic soils (Dr. Kelly Wilhelm), and recovery as it relates to short and long-term conservation practices (Dr. Holly Dolliver).

UW–River Falls is one of three campuses that is part of the Wisconsin Dairy Innovation Hub and Soil Science faculty are actively pursuing research opportunities connected to the dairy industry.

University of Wisconsin River Falls

Soil Science Faculty

Dr. Holly Dolliver, Department Chair & Professor
holly.dolliver@uwrf.edu
Courses taught:
SOIL 250: Profile Descriptions
SOIL 380: Soil Judging
GEOL 327: Geomorphology & Glacial Geology

Dr. Natasha Rayne, Assistant Professor
natasha.macnack@uwrf.edu
Courses taught:
SOIL 311: Soil Fertility
SOIL 389: Soil Microbiology
SOIL 489: Urban Soils

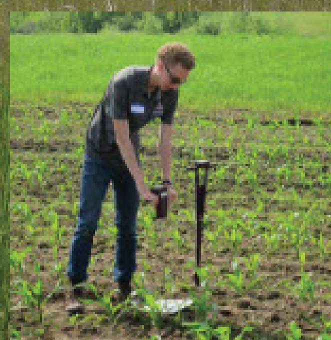
Dr. Kelly Wilhelm, Assistant Professor
Courses taught:
SOIL 325: Hydric Soils and Wetland Environments
SOIL 350: Soil Development and Formation
SOIL 440: Soil and Water Conservation
SOIL 460: Soil Physics

SOIL RECOVERY RESEARCH

Dr. Holly Dolliver, Professor of Soil Science and Geology at University of Wisconsin-River Falls, and her research team are studying the recovery of soil physical, chemical, and biological properties when land is taken out of crop production and enrolled in the USDA Conservation Reserve Program (CRP). Recovery ranged from approximately 30-50 years (aggregate stability, microbial biomass, bulk density and soil respiration) to more than 75-100+ years (infiltration and soil carbon).

Pey, Stella L. and Dolliver, Holly A.S. 2020. Assessing soil resilience across an agricultural land retirement chronosequence. Journal of Soil and Water Conservation 75(2):191-197.

Soil profiles from undisturbed, 30 year, 5 year, and actively cropped lands. White line indicates the extent of the topsoil (A horizon). Soil series across all sites was Koronis (Mollic Hapludalf), a well-drained soil formed in loamy glacial till.



Field equipment and measurements (L: dualhead infiltrometer for measuring infiltration, R: penetrometer).

Soil Science at UW–Whitewater

By Peter Jacobs Ph.D., Department Chair, Professor

Soil science at UW–Whitewater is part of the Geography, Geology, & Environmental Science Department. There is no full curriculum in soil science, but students from across campus are exposed to soil science principles in physical geography, which is taken general education lab science course. As part of the course, students have two labs with a soils focus. Majors and minors have the option of taking a single course titled soil science (Geography 300) that is a mix of basic soil science principles and pedology. In a normal, non-covid 19 year, students in this course complete a field project where they apply GPS and GIS skills from other classes to soil science to either delineate a wetland or analyze the spatial variation of soil organic carbon (SOC) in a natural area. Instead, Web Soil Survey and Soil Explorer were used much more.

UW-Whitewater also hosts a Collegiate Soils Team, but as with all colleges and universities this year, no travel was allowed and the logistics of grouping students into soil pits prevented even training during the fall semester. Normally, students who have completed the soil science course are eligible to participate and travel to the Regional Collegiate Soils Competition. Nearly complete turnover of the team each year means the UW-Whitewater team isn't competitive for a top placing, but the students that participate gain valuable experience in describing soils in a different soil landscape region.

My research activities continue to focus on paleopedology, soil mineralogy, and geochemistry in southern Indiana, where I am a research affiliate at the Indiana Geological and Water Survey (IGWS) in Bloomington. I am working with colleagues on several projects but most notably determining the age of glacial sediments along the southern margin of glaciation in the midcontinent and applying the age information to quantifying rates of weathering and soil development of the Sangamon Geosol (paleosol) in south-central Indiana.

UNIVERSITY OF WISCONSIN WHITEWATER

The age of glacial sediments along the southern margin of glaciation in the North American midcontinent is poorly understood. While largely assumed to be from the Illinois Episode glaciation, the sediments are older than can be determined by the well-established radiocarbon technique (limited to ~60,000 years before present). A newer technique called optical stimulated luminescence (OSL) extends our ability

date suitable sediments back much further, perhaps several hundred-thousand years. My colleagues at the IGWS have established an OSL lab and have had success in applying the technique to dating older glacial outwash (sandy) sediments along the edge of earlier glaciations. Many samples have been processed a analyzed and many of the ages are approximately 140,000 to 130,000 yrs, confirming the Illinois Episode age of the glacial sediments and the duration of Sangamon pedogenesis. Covid protocols including separate vehicles and masks in the southern Indiana heat only allowed limited field work in summer 2020, but we did sample a few more sites and those samples are being analyzed this academic year. Let's all hope for a better 2021.

2020 Joint WI, MN and North Central Soil Region Annual Work Planning Meeting

Treehaven: University of Wisconsin–Stevens Point

The Wisconsin Cooperative Soil Science Program led by Wisconsin NRCS staff and the State of Wisconsin sponsored a three day annual work planning meeting and workshop at the Treehaven Retreat Center in Tomahawk, Wisconsin. The workshop provided participants the opportunity to hear about the changing needs in the state and to discuss how we all can help and work together to bring soils to the forefront to inform and prioritize state needs and provide assistance. The meeting gave participants an opportunity to collaborate face-to-face and bolster the year-round collaboration between the state and regional offices. This is the 5th year of this annual meeting where NRCS and partner organizations are able to plan and prioritize the state's needs for the next year and beyond. In addition to these meetings, Wisconsin also hosts an annual Cooperative Soil Science meeting that is rotated around several universities.

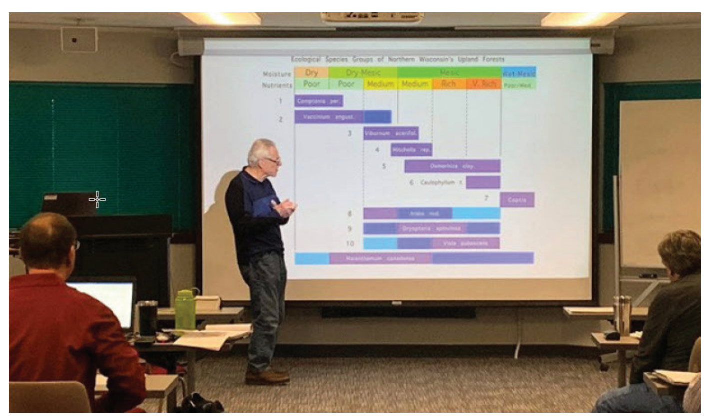
The rotation includes UW–Madison, UW–Stevens Point, UW–Platteville, UW–River Falls, UW–Green Bay and UW–Whitewater. Information and inputs from this work planning meeting will be used by the Wisconsin NRCS soils group at their upcoming annual Cooperative Soil Science meeting to inform review of FY2020 activities and the development of the FY2021 business plan and get at the other issues.

Demand for technical soils information is growing, both in the number of users and the amount of information they require. The Wisconsin Cooperative Soil Science Program looks at the agricultural community as a critical user-base but also recognizes many other user groups who utilize soils information. Needs are constantly changing. As needs change, partners work together to develop new data methods to meet those needs. Soil science has been the basis of the NRCS since it was formed back in 1933. Here in Wisconsin, the Soil Erosion Service, now NRCS, selected Coon Creek as the first watershed in which to demonstrate the values of soil science and conservation. We've made so much progress from that point and are committed to continuing our efforts through the partnership.

Participants at the 2020 meeting identified and discussed state priorities and opportunities for partners to collaborate in meeting statewide soil survey goals. The soil survey program provides soil data and vital information used for a wide variety of purposes affecting millions of Wisconsin residents. These purposes include, but are not limited to, real estate valuation, local property taxation, farm crop productivity, wetland

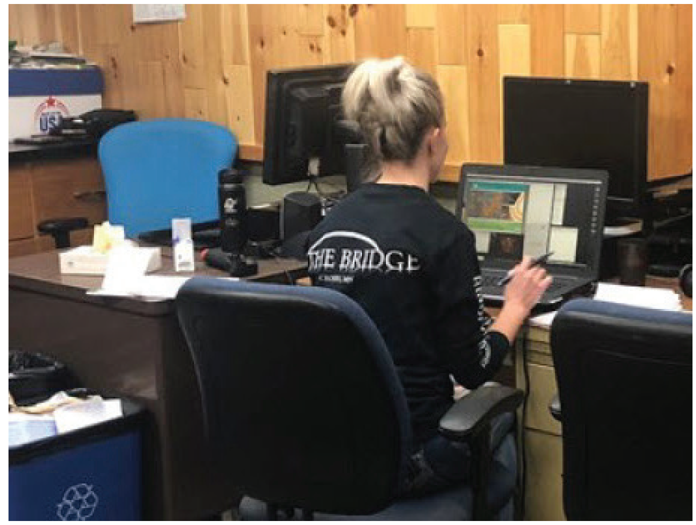
Group photo from the 2020 Annual Work Planning meeting at the Tree- haven compound.

(L-R) Kim Goerg, Kent Peña, Jim Barnes, Ken Lubich and Craig Surman. Kim, Jim and Ken (retired soil scientists) contributed to the meeting. Soil scientists can retire, but their knowledge of soils never does….



John Kotar, Ph. D., presenting habitat types. John is an emeritus professor from the Department of Forest Ecology and Management, UW–Madison. He continues to do research and training with Wisconsin DNR and Wisconsin Stevens Point and the Natural Resources Conservation Service (NRCS) Ecological Site Description agreement.

Karla Petges, Soil Scientist, USDA-NRCS Region 11, Juneau, Wisconsin, moderating the meeting.



Betsy Schug, Soil Scientist, USDA-NRCS Region 10, St. Paul, Minnesota, presenting in the other room while we watched the live Webinar. Mille Lacs, Minnesota Coarse-Loamy Basal Till Investigation: A quantitative and knowledge-based digital mapping approach to reconcile initial and updated soil surveys.

conservation, soil erosion protection, improving water quality and many more uses in Wisconsin. As populations increase, a heavy strain is placed on agriculture. Soils are the backbone of agriculture and soil quality is critical to our future. Soil quality, soil ecology and the importance of organic matter management are crucial in managing fertility and lessening drought impact. Soil science needs to adapt to the changing times and expand beyond primarily survey activities. Data science, geospatial analytics and new delivery tools will be the key to a successful soil science future.

The MLRA Soil Survey offices were represented from Juneau, Onalaska and Rhinelander in Wisconsin, and Duluth, Minnesota, with staff that reported on current soil survey update projects. These efforts include some specific soil map unit updates along with various on-going studies, including water table monitoring, saturated hydraulic conductivity measurements and organic matter analysis. The Soil and Plant Science Division Region 10 and 11 areas are being reorganized so that the state of Wisconsin will be directed as one part of the North Central Region. The Regional Office reported on Digital Soil Mapping efforts, including an in-depth lecture on the techniques and soil sampling needed to model and verify the accuracy on a project. There was a robust round of questions and answers aimed at this new approach to inventorying soil types. The Regional Office also reported on the acquisition and future use of a Mid Infrared Spectrophotometer (MIR) device that has the potential to increase efficiency and improve accuracy of will be more soil property data that is disseminated. The Regional Office also engaged a discussion on future plans to proceed with subaqueous sampling of shallow water bodies, which was of high interest with Aaron Marti, who participated from the Wisconsin DNR. Additionally, soil survey staff reported on adopting a field method for estimating the degree of decomposition in organic material and some proposed updates to Soil Taxonomy regarding the classification of organic soils. Finally, the Regional Office reported on forth-coming updates to the Major Land Resource Area (MLRA) boundaries.

Ecological Site Descriptions (ESDs)

The NRCS in Wisconsin, NRCS Soil and Plant Sciences Division and UW–Stevens Point Team collaborate on provisional ESD development.

What is an Ecological Site?

An ecological site is defined as a distinctive kind of land with specific soil and physical characteristics that differ from other kinds of land in its ability to produce a distinctive kind and amount of vegetation and its ability to respond similarly to management actions and natural disturbances. Ecological sites provide a consistent framework for classifying and describing rangeland and forestland soils and vegetation; thereby delineating land units that share similar capabilities to respond to management activities or disturbance.

How are Ecological Sites differentiated?

Significant differences in the kind, proportion, and production of vegetation and the abiotic factors that determine plant production and composition are used to differentiate ecological sites. Abiotic factors include soil, climate, hydrology, and topography. Ecological dynamics, primarily disturbance regimes such as grazing, fire, drought, management actions and all resulting interactions, are also a primary factor in the development of ecological sites.

Major Land Resource Area 092X
Superior Lake Plain

Accessed: 11/06/2020

Ecological site keys

MLRA 92 Key to Provisional Ecological Sites

I. Unique landforms
- A. Site is a sandy beach ridge along the Lake Superior shore ... R092XY001WI – Sandy Shore Complex

II. Lowlands (floodplains, depressions and flats, and organic soils)
- A. Organic soil and has a Histic epipedon or is a Histosol (≥20 cm of organic soil materials)
  - i. Soil is Muck (mostly decomposed organic material) ... R092XY002WI – Mucky Swamps
  - ii. Surface soil is Peat ... R092XY003WI – Peaty Shore Fens
- B. Mineral soil (Histic epipedon or Histosol absent)
  - i. Site is in a floodplain
    - a). Site is well, mod-well, or somewhat poorly drained ... R092XY004WI – Seasonally Dry Floodplains
    - b). Site is poorly or very poorly drained ... R092XY005WI – Wet Floodplains
  - ii. Site is not in a floodplain and is poorly or very poorly drained
    - a). Soil is sandy textured ... R092XY006WI – Wet Sandy Lowlands
    - b). Soil is loamy or fine textured ... R092XY007WI – Wet Loamy or Clayey Lowlands

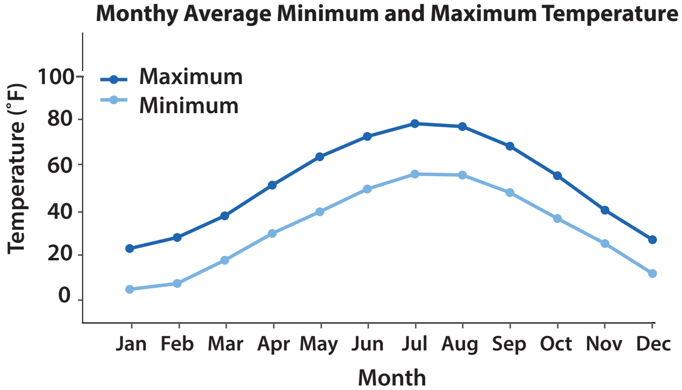
III. Uplands (footslopes, backslopes, shoulders and summits)
- A. Site has a bedrock contact within 200cm
  - i. Soil is dominated by sandy textures ... R092XY008WI – Sandy Sandstone Uplands
  - ii. Soil is dominated by loamy textures ... R092XY009WI – Loamy Sandstone Uplands
- B. Site is somewhat poorly drained (no bedrock contact within 200 cm)
  - i. Soil is sandy textured ... R092XY010WI – Moist Sandy Lowlands
  - ii. Soil is loamy textured ... R092XY011WI – Moist Loamy Lowlands
  - iii. Soil is fine textured ... R092XY012WI – Moist Clayey Lowlands
- C. Site is moderately well, well, somewhat excessively, or excessively drained (no bedrock contact within 200cm)
  - i. Soil is sandy textured ... R092XY013WI – Sandy Uplands
  - ii. Soil is loamy textured ... R092XY014WI – Loamy Uplands
  - iii. Soil is fine textured ... R092XY015WI – Clayey Uplands

The key above is used to distinguish ecological sites within Major Land Resource Area 92, the Superior Lake Plain. The images to the right of the key show an example of a vegetation community and soil profile associated with the Loamy Sandstone Uplands (R092XY-009WI) ecological site.

What are Ecological Site Descriptions?

Ecological Site Descriptions (ESDs) are reports that provide detailed information about a particular kind of land—a distinctive ecological site. These reports provide land managers the information needed for evaluating the land as to suitability for various land-uses, capability to respond to different management activities or disturbance processes, and ability to sustain productivity over the long term. ESDs contain four major sections: site characteristics, plant communities, site interpretations, and supporting information.

Monthy Average Minimum and Maximum Temperature



Representative physiographic features

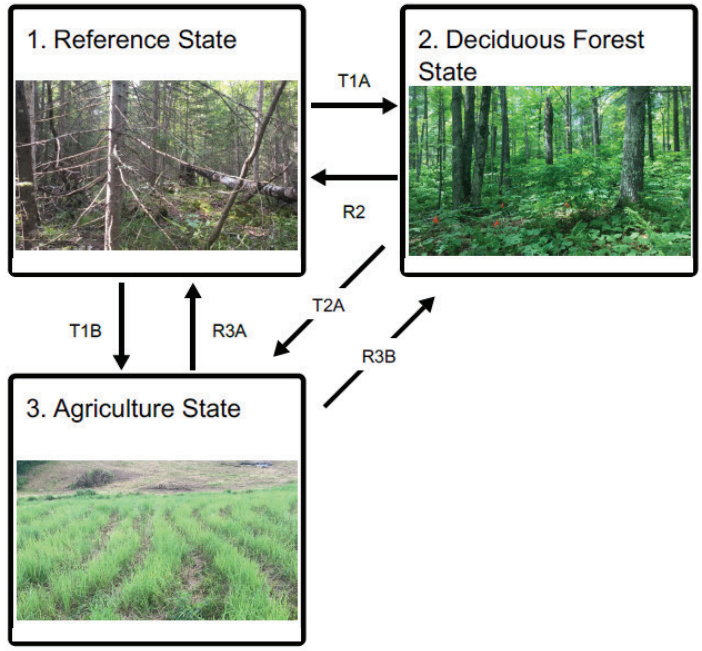
Landforms	(1) Hills > Knoll (2) Till plain > Terrace
Runoff class	Low to very high
Elevation	607–689 ft
Slope	0–15%
Aspect	Aspect is not a significant factor
Water table depth	12–24 in.

The figure and table above are some examples of the content within an Ecological Site Description. The figure shows the minimum and maximum air temperature associated with the Loamy Sandstone Uplands Ecological Site (R092XY009WI). The table to the right shows its representative physiographic features.

State and Transition Models

State and transition models (STMs) are included in each ESD to describe changes in plant communities as well as associated dynamic soil properties and soil health, that can occur on an ecological site through disturbances or management. Below is an example of a STM for the MLRA 92 Sandy Sandstone Uplands ecological site. Within each state there are also phases, or multiple plant communities that exist due to light to moderate disturbance or natural succession.

R092XY009WI State and Transition Model



T1A: Stand replacing disturbance that includes fire.

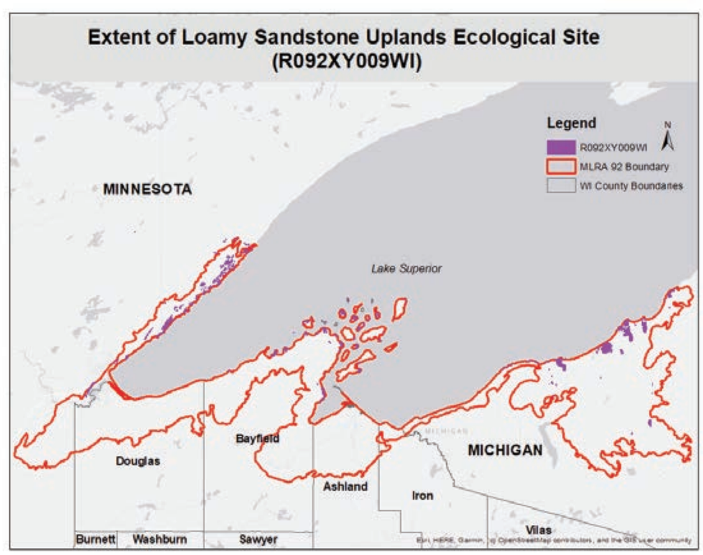
T1B: Removal of forest cover and tilling for agricultural crop production.

R2: Deciduous forest community is slowly invaded by conifers.

T2A: Removal of forest cover and tilling for agricultural crop production.

R3A: Cessation of agricultural practices leads to natural reforestation, or site is replanted.

R3B: Cessation of agricultural practices leads to natural reforestation, or site is replanted.



Ecological Sites and Soil Survey

Ecological sites are linked to one or more soil map unit components. Within an MLRA, soil components are linked to only one ecological site (though differentiation in field data may indicate a need for a project around a particular component).

Access to Ecological Site Descriptions

Ecological Site Descriptions are stored and accessed within an online databased called the Ecosystem Dynamics Interpretative Tool (EDIT). EDIT is a collaborative effort among the USDA Natural Resources Conservation Service, the USDA Agricultural Research Service (ARS) Jornada Experimental Range and New Mexico State University (NMSU). Reports and maps of ecological sites can also be created through Web Soil Survey and many of the external tools used to access soil survey information.

EDIT database URL: https://edit.jornada.nmsu.edu

Status of Ecological Site Development in Wisconsin

The Wisconsin NRCS has partnered with the College of Natural Resources at University of Wisconsin–Stevens Point to develop provisional ecological products for Wisconsin. A provisional ESD briefly identifies the abiotic and biotic characteristics of the ecological site and includes a basic state and transition model. Along with provisional ecological site descriptions, UW–SP is also developing keys to distinguish the site concepts, and a legend that documents every component of every map unit associated with each Major Land Resource Area (MLRA).

Associate Professor Dr. Jacob Prater and Assistant Professor Dr. Bryant Scharenbroch are leading the UW–SP team working alongside NRCS Soil and Plant Sciences Division staff, Wisconsin NRCS, and utilizing other local expert knowledge and data sources such as the Forest Communities and Habitat Types of Northern/Southern Wisconsin developed by John Kotar.

The work began in FY2018 with the completion of a provisional ecological site key and legend for MLRA 90A/B. To date, the field work and provisional products have been completed in MLRAs 89, 90A/B, 91B, 93B and 94D. Field data collection has been completed in MLRAs 105, 110, 94B, and 95A/B and the team is scheduled to have the entire state completed by Fall 2021.

When completed this tool will provide Wisconsin with a unified and seamless tool for conservation planning, wetland compliance, and evaluating the impact of conservation practices or other management activities on soil health.

A screenshot of the EDIT tool available online.

Pictured to the right are the UW–SP field crew: (clockwise) John Kotar (forest ecologist), Dave Hvizdak (soil scientist), Trace Miller (vegetation specialist) and Joel Gebhard (field team leader, soil scientist and vegetation specialist).

Agricultural Conservation Planning Framework

Wisconsin NRCS has been collaborating with various local partners to educate and implement this new tool at the field level.

The Agricultural Conservation Planning Framework (ACPF) supports agricultural watershed management by using high resolution elevation data, SSURGO data and an ArcGIS toolbox to identify site-specific opportunities for installing conservation practices across small watersheds.

This non-prescriptive approach provides a menu of conservation options in the form of output maps to facilitate conservation discussions on farms and in community halls. The framework is used in conjunction with local knowledge of water and soil resource concerns, landscape features, and producer conservation preferences. Together, these provide a better understanding of the options available in developing a watershed conservation plan.

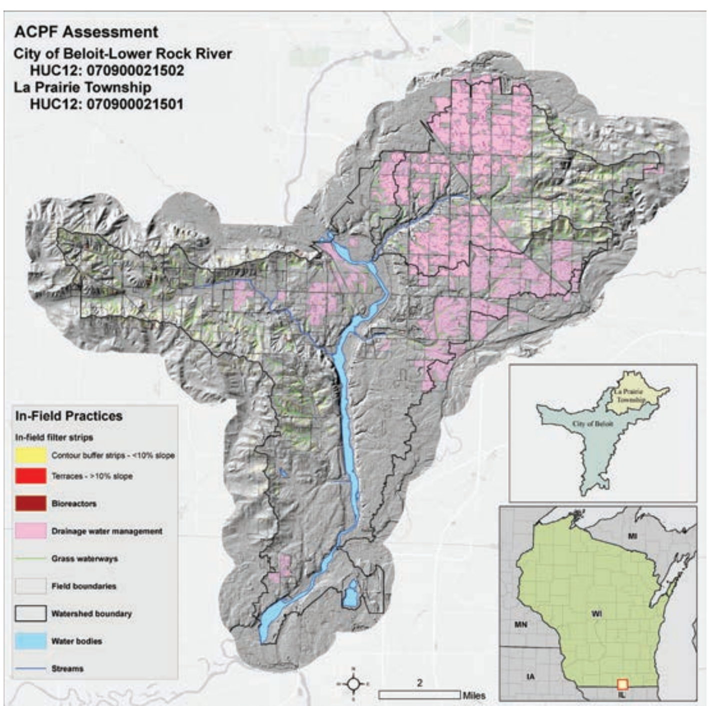
Watershed/Conservation Planners use analyses & outputs to:

• Facilitate targeted conservation

• Make more efficient use of field visits

• Provide scientific validity to conservation plans

Using the ACPF requires two sets of skills:



Precision practices.

• Technical GIS skills to run the ACPF toolset analyses (GIS-based training is available at acpf4watersheds.org).

• Watershed management skills to apply ACPF outputs to planning and implementing conservation practices.

ACPF toolsets produce output maps which can be shared either in group settings to gauge overall interest and involve diverse stakeholders in the planning process or one-on-one to enable a risk-free conversation about landowner options.

The ACPF is:

• Flexible

The ACPF doesn't prescribe what to do, instead allowing landowners and local stakeholders to choose the options that are right for their land, their community, and their watershed.

• User-friendly

The ACPF toolbox semi-automates several GIS processes including hydro-conditioning of elevation data and terrain analysis. This puts the capabilities of powerful hydrologic modeling into the hands of mid-level GIS specialists and local conservationists.

• Widely applicable

The parameters for running the tools can be adjusted to customize results for each watershed's unique landscape.

Requirements:

The ACPF toolbox is run jointly by a GIS technician alongside a field conservationist. The GIS technician needs an advanced version of ArcGIS, and moderate proficiency using ArcGIS. It takes roughly two days to hydro-condition the elevation data, and roughly half a day to run the analyses for one HUC-12 watershed. The field conservationist will help the GIS technician interpret and adjust ACPF results to the local landscape, and apply the output to watershed planning and implementing conservation practices.

For more information visit: https://acpf4watersheds.org/

Agricultural Conservation PLANNING FRAMEWORK

Wisconsin Society of Professional Soil Scientists (WSPSS)

The WSPSS is a statewide non-profit organization of soil scientists involved in the field of classifying and interpreting soils.

Background

WSPSS members include people working in private consulting soil firms, academic institutions, State and Federal agencies, county land use managers, non-profit organizations and land conservation departments. WSPSS members strive to protect the public by making wise land use choices and keep the public, as well as our own members, current in soil education and soil related advancements.

Benefits and Opportunities

Members attend the annual meeting held in the fall each year. The meeting consists of a business session, election of officers, lunch and an informative speaker. An educational meeting in the spring or summer is held each year also. This meeting consists of an informative program on subjects relating to the field of soil classification and interpretation. A field trip is often planned. Members have opportunities to meet and interact with fellow soil scientists on a professional and social basis.

WSPSS Objectives

1. Provide a statewide organization for soil scientists from various specializations.
2. Promote communication among soil scientists.
3. Provide a forum for the continuing education of soil scientists.

Scholarships

The purpose of the WSPSS Scholarship Program is to encourage qualified students to increase their interest in soil science and prepare them for a career in soil science, soil conservation, or a related natural resource field. Two scholarships are given yearly. The John Campbell Family Scholarship and the WSPSS scholarship are awarded to sophomores, juniors, and first or second year senior students in good academic standing enrolled in soil science or a related curriculum at a University of Wisconsin system institution.

Website: www.wspss.wordpress.com

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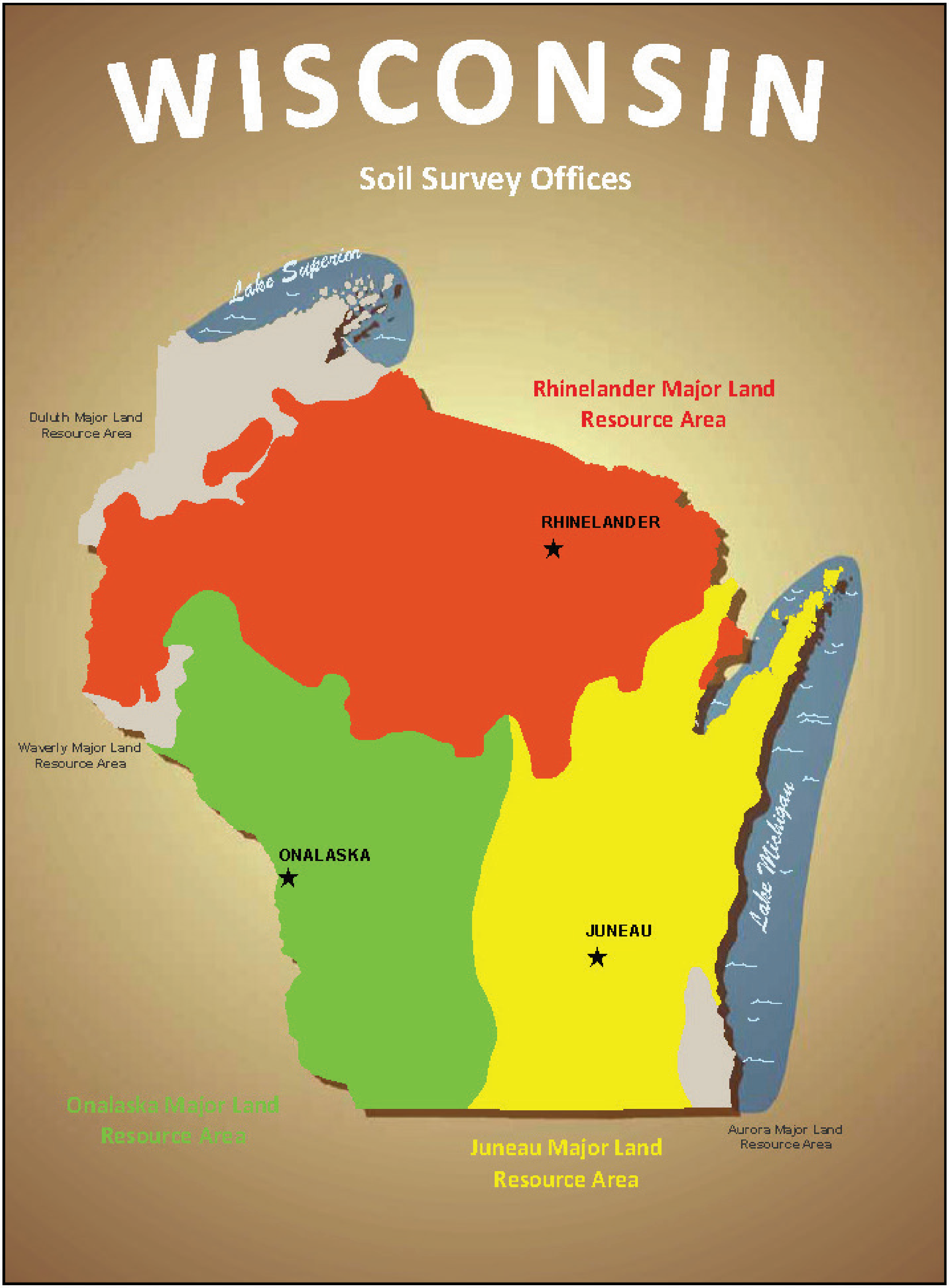
Area Specialists

Northeast Area
GIS Specialist: Duane DeVerney 920-843-6113
Resource Soil Scientist: Kathy Turner 920-733-1575

Northwest Area
GIS Specialist:
Alex Dvoracek 715-461-6031
Resource Soil Scientist:
Tim Miland 715-461-6020

Southwest Area
GIS Specialist: Craig Surman 608-647-8874 x131
Resource Soil Scientist: Jeff Deniger 608-647-8874 x116

Southeast Area
GIS Specialist: Ryan Jacques 920-733-1575 x6098
Resource Soil Scientist:Jeremy Ziegler 920-709-3022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