USDA
United States Department of Agriculture

Cooperative Soil Science

2017 Highlights

Wisconsin
Natural
Resources
Conservation
Service

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

Follow us on twitter.
www.twitter.com/NRCS_WI

Sign up for GovDelivery emails.
https://public.govdelivery.com/accounts/USDANRCS/subscriber/new

Find us on flickr.
www.flickr.com/photos/nrcs_wi

Find us on YouTube.
www.youtube.com/user/TheUSDANRCS

Contents

Preface

Helping People Understand Soils

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 soil 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 collaborate on future projects. The need to collaborate is driven by changes in science, technology, fiscal conditions and professional culture. The Cooperative Soils 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.

Soils play a key role to 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 been housed under an umbrella to include soil formation; physical, chemical, biological, and fertility properties of soils and their 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 soil survey activities. Data science, geospatial analytics and new delivery tools will be the key to a successful soil science future.

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 national NCSS 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 will strive to address state, national and global needs of new customers. As needs change, new data methods and what we collect will change. What we collected and knew 30 or 100 years ago is different than what we know and collect 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, or any other science as it continually evolves. Data is continually being improved, enhanced and maintained.

Disclaimer

Soil surveys seldom contain detailed, site-specific information and are not designed for use as primary regulatory tools in site-specific permitting decisions. They are useful for broad regulatory planning and application. Official soil survey information is public information and may be interpreted by organizations, agencies, units of government, or others based on their own needs; however, users are responsible for the appropriate application of soil survey information. NRCS will not accept reassignment of authority for decisions made by other federal, state, or local regulatory bodies. NRCS will not make changes to official Web Soil survey (WSS) information or of any supplemental soil mapping for purposes related solely to state or local regulatory programs.

Soil Science Division Update

National Cooperative Soil Science and Soil Science Division Strategic Plans

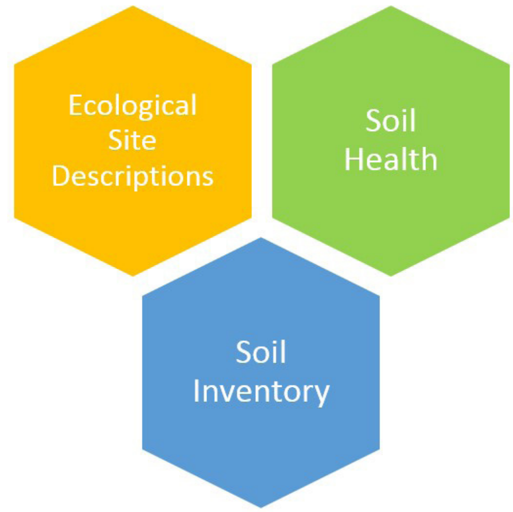
The National Cooperative Soil Survey (NCSS) is a nationwide partnership of Federal, regional, State, and local agencies and private entities and institutions. This partnership works to cooperatively investigate, inventory, document, classify, interpret, disseminate, and publish information about soils. NCSS is in the process of developing a national strategic plan for the first time. NCSS realizes a strategic plan is only as good as the process and team members who develop it and it will constantly evolve as technologies and information develop and change. NCSS will develop the plan to be flexible and accomplish the key vision and mission of the soil survey.

- Vision—Develop, establish and promote a society that values soil as an ecological resource.
- Mission—Provide knowledge to partners, Universities, Web Soil Survey users, and general public about soils and ecosystems for resource management.

Goals

1. Communicate the importance of soils to society.
2. Increase the knowledge base for soils and ecosystems.
3. Strengthen and expand collaboration between partners.
4. Ensure a critical mass of well-qualified scientists and technical specialists to support NCSS.

The NCSS overall vision is externally focused, teaching and informing all audiecnes what it is that NCSS does. Promoting an overall vision that soils are valuable and are an ecological resource. Goals include developing a committee to work towards the simplistic vision and mission statements. NCSS scientists and technical specialists strive to wake up every day and provide knowledge about soils and ecosystems for resource management. NCSS will strive to meet goals by communicating the importance of soils to society, increase overall knowledge-base for soils and ecosystems, strengthen and expand collaboration, and ensure critical mass of well qualified scientists and experts.



Soils2026: A 10 Year Strategic Plan for the Soil Science Division

- Vision— A society that values soil as essential to life.
- Mission—Provide scientifically-based soil and ecosystem information to manage natural resources.

We will strive to follow this vision and mission over the next ten years and beyond these. A focus on inventory statements within the Cooperative Soil Sience will be critical. An empasis on completing thorough ecological site descriptions and working more in the soil health arena will also be a future focus. A key focus on soil inventory will remain at the base of what we do. Soil2026 is not only about surveying; it is about integrating many aspects of soils into our future work accomplishments over the next decade and beyond.

Demand and user volume for technical soils information is growing. We look at the agricultural community as a critical user base but also recognizes many other user groups who utilize soils information. Needs are constantly changing nationally. It is critial that the NCSS and SSD continue to work together by sharing resources and information. This will enhance our ability to provide our present clients the ability to plan, manage and model our resources on national and global scales. We must also strive to address needs of new customers as well.

Why Soils2026?

Demand has grown.

- Water quality and quantity
- Urban agriculture
- Wetlands
- Climate change
- Watershed planning

Needs have changed.

- Field to county, to national in scope
- New customers
- Enhanced data
- Updates

An Iterative Approach

- Combine traditional field work with advanced technologies to increase our understanding of soil-landform-plant community relationships.
- Develop national field weeks to address critical or emerging issues

We will work to understand and educate users on how soils fit into the bigger picture. This element will be critical in developing educational tools to present at workshops for Soils2026.

- Embrace a culture of continuous investigation and improvement.
- Increase knowledge of soil science.
- Increase use of technology and analytics.
- Increase flexibility for a variety of customer and resource needs.

We will address these issues as a national team and focus on these areas to embrace the culture of continuous investigation and ongoing work and research. We will work to continually update what is known and increase knowledge using recent technologies, resulting in an increase of flexibility for the customers. We will work to keep current customers and promote outreach to new customers with products that are new, ever-evolving and vibrant.

Expectations

- Flexible and adaptable to changing needs
- Internal and external
- Authoritative information products
- All products national in extent (no gaps)
- Both properties and classes

We will work to meet expectations and maintain flexibility. We realize the importance of growing and evolving to continue to be the sole authoritative product. When someone needs soils information, they think our products and resources; a tool that's national in scope and has no gaps. We recognize this does not require everything to be mapped and produced exactly the same; but the national team needs to work to have no gaps, including having properties, as well as classes.

- Knowledge vs information
- Using maps vs making maps
- Services vs products
- Relational vs singularity
- Continuous vs completed
- Projects vs acres

Team expectations are to have increased knowldege, not just information. Team members should strive to take information and share and teach to expand knowledge. Not only making maps, but sharing, educating, and using maps to teach customers how to use those maps effectively and efficiently in more areas. We will strive to provide services, not just products to customers. Team members will strive to develop customer relationships and educate users to understand how peices fit together, while tying soil type to ecological system, to the soil health, and to management in more effective ways.

Continuous mapping and updates are key. Team members will work to continually update and improve mapping tools, technologies, and resources provided to customers.

Embrace a Culture of Continuous Investigation and Improvement

"... I cannot conceive of the time when knowledge of soils will be complete. Our expectation is that our successors will build on what has been done, as we are building on the work of our predecessors." - R.S. Smith, Director of the Illinois Soil Survey, 1928.

"... if this is to be a permanent nation we must save this most indispensable of all our God-given assets-the soil, from which comes our food and raiment. If we fail in this, remember that much sooner than we have expected this will be a nation of subsoil farmers." - H.H. Bennett 1933.

That's what we're doing. We want to continually move forward. We are encouraged to remember and be inspired by H.H. Bennetts and R.S. Smith's words.

Section References

Lindbo, Dave [NRCS NSSC]. (2016, December 9). National Soil Science Regional Conference Soil Science Division Update [Dave Lindbo Presentation]. Retrieved from https://www.youtube.com/watch?v=TFQT3O-ac--U&list=FL7nX_6WqcoTVHiPixjxYnSA&index=2.

Lindbo, Dave. (2016). Soil Science Division Update [Full presentation]. Retrieved from http://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1272810&ext=pdf.

Revisiting the Soil Landscape with Digital Soil Mapping & Disaggregation in MLRA Field Projects

Section by Joe Brennan

In 2017, the Soil Data Join Recorrelation (SDJR) Initiative will draw to a close. SDJR has institutionalized the MLRA approach to soil survey, emphasizing the inventory and assessment, with the added benefit of improved consistency of soil attributes. The Soil Science Division is now well positioned to commence MLRA field projects (addressing concerns from the inventory and assessment). These projects will be augmented by new technologies to reapply the soil-landscape paradigm in pursuit of seamless products of continued relevance to an evolving user base. Digital soil mapping (DSM) facilitates extrapolation of field-based investigations to the greater landscape, often at more detailed scales than traditional soil maps. With decades of research in DSM, paired with improved geographic data, there is great potential for more detailed, consistent, and efficient investigations.

In the soil survey (SSURGO), scale-dependent delineations of soil bodies are grouped into map units emphasizing suitability and limitation for use and management. Map unit design captures some of the known spatial variability. However, minor variations in methods of capturing this variability can result in some of the greatest inconsistencies in SSURGO. Spatial disaggregation divides soil map units or geomorphic areas into facets related to hillslope position or soil classification, effectively bypassing scale dependent considerations of SSURGO. Disaggregated soil data has potential to provide more quantitative and targeted updates to SSURGO, with the added benefit of potential secondary raster-based products providing refinement of what is known of soil variability at higher resolution.

Case Study

MLRA 55A: Barnes series—Investigation of Souris Lobe, Soil-Water Monitoring, and Map Unit Recorrelation (North Central North Dakota).

In 2016, a MLRA field project was initiated to investigate soil development, parent material chemistry as well as inconsistencies and concerns related to soil development and saturation on a benchmark soil series and associated soils across a glacial advance in northern North Dakota. Updated data population will be framed by field documentation, calibrated with available laboratory data, and will be continuously evaluated based on monitoring (soil moisture). Field documentation was stratified by geographic area and summarized by hillslope position. Resulting documentation related to diagnostic soil features, soil classification (series) and hillslope position were modeled into a continuous raster (grid) using terrain covariates from LIDAR across the project extent. A combination of DSM techniques including knowledge-based, regression and tree-based models were employed to arrive at results.

Resulting raster-based predictions were utilized to improve the existing soil survey by confirming component composition at the map unit level, assessing variability in map units at the polygon level and targeting areas where refinement to SSURGO polygons were necessary to best capture the updated MLRA map unit design in a seamless and consistent manner. A planned accuracy assessment will validate the taxonomic correlations in the raster and the precision of modeled soil properties to confirm viability of a disaggregated raster for secondary product development.

Section References

Thompson, J.A., Prescott, T., Moore, A.C., Bell, J., Kautz, D.R., Hempel, J.W.,Waltman, S.W., Perry, C.H., 2010. Regional approach to soil property mapping using legacy data and spatial disaggregation techniques. 19th World Congress of Soil Science, Brisbane, Queensland.

Hudson, B.D., 1992. The soil survey as a paradigm-based science. Soil Sci. Soc. Am. J. 56: 836–841.

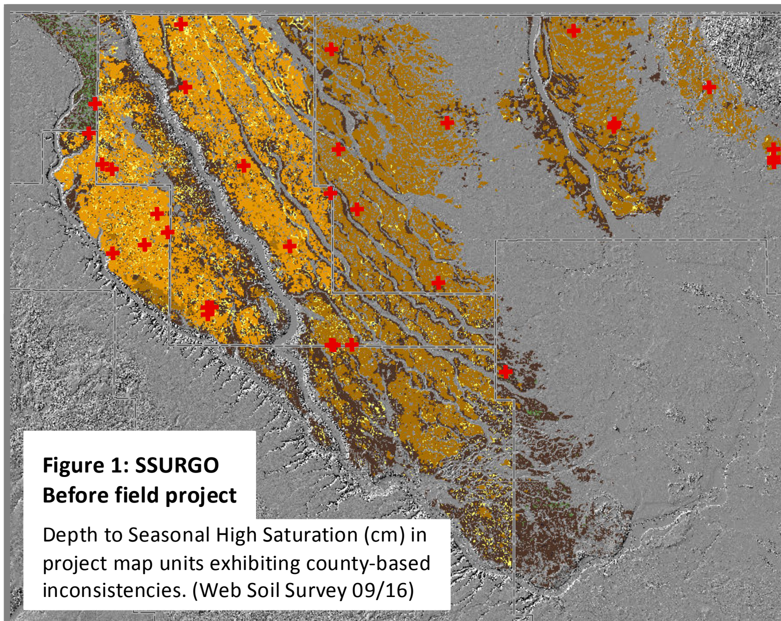


Figure 1: SSURGO Before field project

Depth to Seasonal High Saturation (cm) in project map units exhibiting county-based inconsistencies. (Web Soil Survey 09/16)

Figure 2: Initial hillslope summary

Observed depth to redox concentrations and depletions across field sites summarized by hill-slope position (L. Duey 3/16)

	SU	SH	UBS	MBS	LBS	FS
MEAN	75.9	74.7	64.5	60.7	58.9	42.4
STD	22.1	23.9	14.2	14.0	18.5	6.9
MIN	25.4	45.7	38.1	22.9	30.5	30.5
MAX	127.0	101.6	81.3	91.4	86.4	50.8
MED	71.1	76.2	69.9	61.0	59.7	43.2
CONF	6.4	17.8	8.1	5.6	9.7	5.3
KURT	0.8	(4.8)	(0.8)	4.1	(3.0)	5.6
SKEW	1.5	(0.3)	(2.3)	(1.0)	0.3	(2.5)
VAR	191.8	226.8	79.2	77.2	134.9	18.0
n =	48	7	12	24	14	6

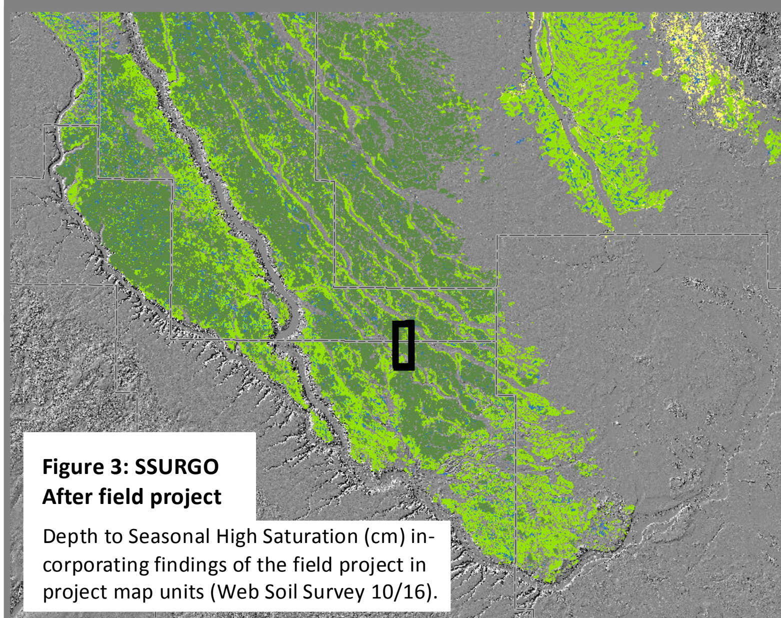


Figure 3: SSURGO After field project

Depth to Seasonal High Saturation (cm) in-corporating findings of the field project in project map units (Web Soil Survey 10/16).

Soil Saturation - Seasonal High Water Table

Average depth (cm)

- 0 - 24
- 25 - 49
- 50 - 64
- 65 - 69
- 70 - 84
- 85 - 99
- 100 - 114
- 115 - 200

Field Sites

County Boundary

Detailed Extent

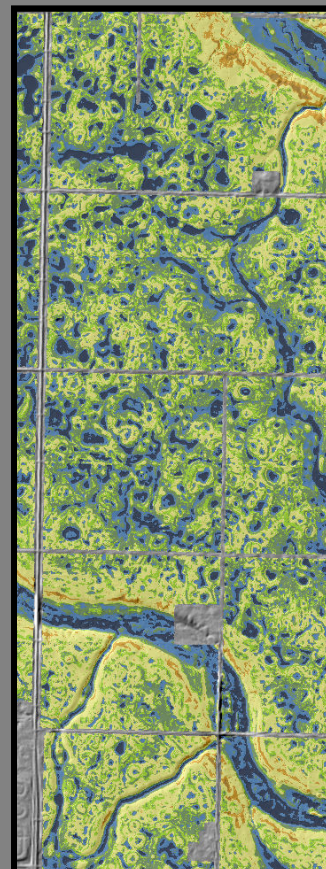
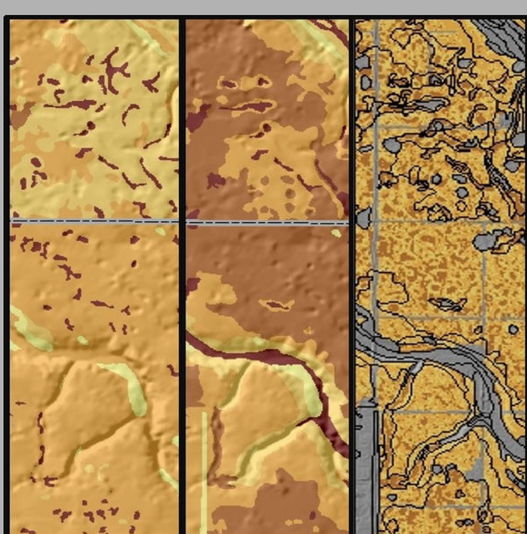


Figure 4: Modeled soil saturation

A contiuous raster of soil satur-ation used to update SSURGO (Figure 3). Raster model com-bined terrain covariates from LIDAR and morphological proxies. (Figure 2)



Soil Organic Carbon

Upper meter (kg/m2)

- 10 or less
- 10.1 - 15
- 15.1 - 20
- 20.1 - 25
- over 25

Figure 5: Update Progression - Detailed Area

Left -- Original SSURGO product exhibiting subset-based inconsistencies and data voids.
Middle -- SSURGO following inventory and assess-ment (SDJR) with consistent and fully populated map units of estimated component composition.
Right -- Disaggregated soil components displayed across a suite of soil map units, with resulting soil delineations from the MLRA field project.

Future of Soil Science: The Role of Soils and Soil Survey

Section by E.C. Brevik, S.J. Indorante, D.E. Beaudette, and R.W. Arnold

Abstract

Human population, resource consumption, and waste generation have increased rapidly throughout the Anthropocene. Feeding this growing population, supplying needed resources, and dealing with waste products require expanding our knowledge of and sustainable use of soil resources. At the same time, anthropogenic activity has created major changes in ecosystems, including the soil system. These changes may alter the functions of soils that mankind depends on to sustain both life and modern standards of living. To ensure productivity, conservation, and general respect of soils, humans need to overcome the stigma of “dirt” or “filth” often associated with soil and instead treat soil as a vital natural resource. Doing so will require expanded use of modern technologies/advances including proximal and remote sensing, geographic information systems, and spatial statistics. However, it is equally important to recognize that the models and predictions generated by these new techniques are limited by the quality and quantity of field-based observations. Therefore, more traditional field investigations, including soil landform studies, continue to be important to soil science heading into the future.

Introduction

Studies indicate that during the Anthropocene, humanity has experienced exponential growth of consumption, gene- ration of waste, and population. The human economy depends on the planet’s natural capital that provides all ecological services and natural resources, and since about 1980, human demands have exceeded the capacity of the earth to sustain such use.

Cultural attitudes determine the role of soils in the world as our fragmented global community struggles to resolve the global issues of food security, environmental protection, and overall sustainability. A variety of world views influence the search for a sustainable, socially acceptable balance among soil functions that provide for viable economic growth and development, safe healthy environments, and intergenerational equity.

Linking entire social systems in a web of production, distribution, and consumption, agriculture often foreshadows the degree of economic well-being. Because agriculture operates simultaneously in the realms of ecology and economics, each of which marks time by different clocks, decisions affecting food security and environmental protection have become increasingly complex and variable over time and space.

The Pedosphere

Soils are a critical interface between society and natural resources. Thus, the basic principles of the organization and functioning of the earth’s soil cover, the pedosphere, can provide a scientific basis for addressing global environmental, social, economic, agronomic, and human health issues throughout the 21st Century.

Natural soils result from the interaction of processes taking place over time on the earth’s surface. Most involve gases and liquids that transform the solid phase of the surficial materials into features recognized as soils. These processes are influenced by soil-forming factors—namely climate, biota, topography, parent material, and time—leading to great heterogeneity in the world’s soil cover. Geomorphic processes that alter the landscape by erosion, transport, and deposition of rocks and sediments and the interaction of biological systems with soils are all subject to major modifications associated with global and regional climate changes. The result is an intricate patchwork of soils, ranging in size from a few square meters to thousands of square kilometers.

For millennia, naturally evolving soils were dominant in the world, and determining the properties and distributions of major kinds of soils and their local geographic associates enabled societies to effectively tap these resources to satisfy their needs. Soils provided habitats for plants, animals, and microorganisms. Soils possessed the capacity for fertility and potential productivity because of water, physical sup- port, and biological interactions that provided nutrients.

Mapping the pedosphere and deciphering the sequence of events and processes causing such complexity have revealed a multidimensional hierarchy that is meaningful for assessing many kinds of soils and predicting soil-related behavior.

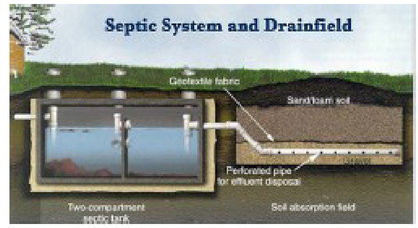
Altered Ecosystems

For more than a century, scientific studies of soils as natural independent entities on the earth’s surface have contributed to a better understanding of the interconnectivity of the earth’s systems. As societies introduced more and more invasive procedures, they drastically altered ecosystem processes and biogeochemical cycles. Although some eco-systems have been enhanced, more have been degraded and are being used unsustainably.

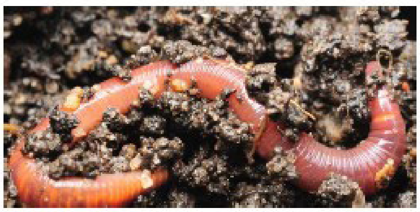
Soil Functions

Biomass Transformation

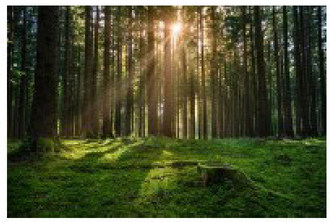
Filter and Buffer



Habitat



Usable Materials



Foundation of Our Cultures

It has become relevant to monitor, predict, and mediate the behavior and responses of both natural and artificial (anthropogenic) soil environments and landscapes. It is believed that many changes being made in ecosystems are increasing the likelihood of detrimental, nonlinear changes.

With increases in the size of the human population and its increasing rate of consumption, the available natural resources are stressed, some beyond their limits of resilience. One estimate is that human resource use in 2000 was about 20% above the global carrying capacity. When soils are so stressed, they are unable to return to their former productive states without massive external inputs. Thus, sustainable reconciliation of societal desires and natural resource capabilities is commonly jeopardized.

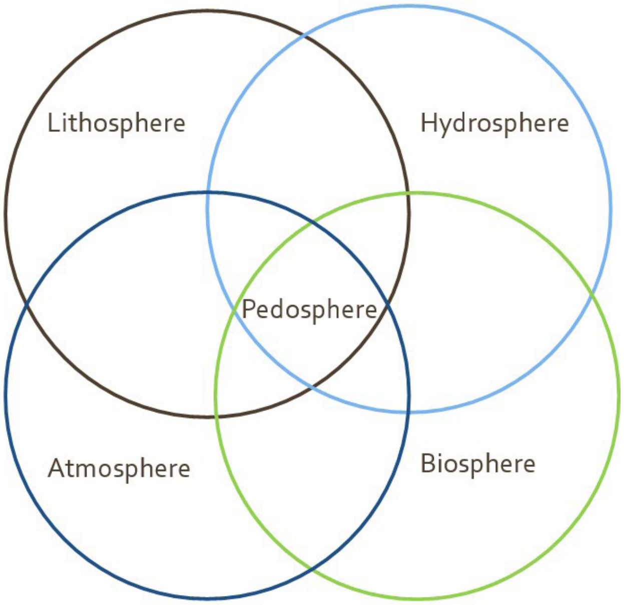
Soils are primarily used by most people for the production of food, feed, fuel, and fiber. The capacity to store and release water and the ability to renew, store, and release plant nutrients have dominated agronomic and forestry research and practical experimentation for many years, going back as far as the 16th Century. Biomass transformations are highly dependent on the microbiological populations that inhabit soils and facilitate the formation and use of beneficial compounds.

The pedosphere is a sensitive geomembrane which mediates the transfer of air, water, and energy into, out of, and among the biosphere, atmosphere, hydrosphere, and lithosphere (see figure above). Temperatures are moderated with depth, and water and associated compounds are filtered, retained, stored, and transferred in ways that contribute to clean, healthy environments.

Soils are the habitat for millions of organisms, ranging from cellular bacteria to burrowing animals. Communities of microorganisms decompose organic materials, facilitate the release of mineral elements, and produce the chemical and biological compounds essential for life on earth.

Many soils are directly used as raw materials for constructing dams and foundations; others are source materials for landscaping industrial and urban sites; and some are ingredients for bricks, aluminum, ceramic products, and medications. Most transportation networks and urban communities rest on soils. In addition, soils are excavated to create disposal sites for society's numerous wastes. Soils that are disturbed or removed from their natural environments are commonly called "dirt." As such, displaced soil materials are generally considered a nuisance in our daily activities and need to be washed out, removed, and personal contact with them minimized. Historically, stigma was often attached to those associated with the "filth and dirt" of using and managing soils.

In the stories of most indigenous cultures, the earth is sanctified and revered as a vital element of nature, thereby reinforcing humankind's link with it. This sacredness remains in the use of soils as cemeteries and as places where the spirits of ancestors reside. Archeological investigations often involve deciphering the memories of times and events recorded in soil properties.



The pedosphere results from the interaction throughout space and time of the atmosphere, biosphere, and hydrosphere with the lithosphere. Once developed, the pedosphere plays a significant role in supporting and maintaining life on the planet.

Continuing Needs

It is obvious that soils continue to be used to maintain and improve productivity for food, feed, fuel, and fiber for a long time because the supply of elements and minerals necessary for life is derived, directly or indirectly, from soils. Healthy ecosystems and environments depend on soil-hosted microorganisms that facilitate filtering and purifying. There is much to be learned about how soils behave in maintaining healthy anthropogenic landscapes. Unprecedented demands to safely handle wastes and provide major increases in food and feed are enormous challenges.

Perhaps less appreciated is the need of the human psyche for renewal through contact with nature. It appears that psychological well-being is, in part, related to our communion with the beauty, tranquility, and mysterious forces of nature.

Although we are connected to the land and soils in ways that most of us do not readily comprehend, we do recognize the sense of belonging and the feeling of renewal associated with our contacts with the natural world. Is it a "dust thou art, and to dust thou shall return" syndrome in which our life cycle is subsumed in other natural life cycles? Whatever the explanation, the human-to-nature relationship is important, and soil is vital to our survival and growth.

Changing Demographics

It is estimated that during the 21st century, more people will be living in cities than currently live on earth. As cities evolve into megacities through the use of adjacent lands, the unique culture of urban dwellers, including their estrangement from rural landscapes and ecosystems, also develops.

Ecological functions of soils are common in extensive rural areas of the earth, where the productive capacity of soils is easily recognized. In urban landscapes, which are very different in appearance, structure, and composition, the role of soils is commonly not observed, or even imagined, except in parks and residential lawns and gardens. Sewers and trash trucks remove numerous waste products, smoke stacks and vehicles exude particulates into the atmosphere, and streams and rivers wash away other debris. In rural landscapes, many of these functions are provided by the pedosphere—the covering of soils that seems to be ubiquitous and so common that it is taken for granted. How much relatively undisturbed land would be required to provide the energy and products consumed in an urban environment, and to adequately handle its wastes? Such a measure could be thought of as a city's environmental footprint. We do not measure and monitor the enormous fluxes that occur in urban environments, yet they are becoming major stressors on our global habitat.

Influencing the Role

Is there a possibility of simply stretching ecological theory to encompass urban ecosystems? It can be argued that our understanding of dynamics and processes of populations and soils can be extended to homeowners' associations and pavement. If people act as other organisms do, guided by individual self-interest, there is no basis for a moral or aesthetic call to environmental stewardship. Is there, perhaps, a spiritual or moral dimension that defies explanations offered by evolution or natural selection? The challenge of understanding urban ecosystems requires specialists from many different disciplines but it also requires that at least some individuals think in interdisciplinary and transdisciplinary ways—a task that may be difficult to accomplish. The single most important force of landscape change in urban areas is land conversion driven by institutional decisions, population growth, and economic forces. A city's footprint, which indicates the dependence of an urban ecosystem on other ecosystems, may be tens or hundreds of times larger than the city itself. Soil ecosystems are being altered, and even created, to meet the expectations of urban communities. Consequently, the kinds and patterns of adjacent soil landscapes are important to the monitoring and assessment of environmental health and sustainability.

The Future

There are many challenges that need to utilize soil knowledge if they are to be adequately addressed. A global consensus must develop that will clearly define a mini-

Soil Attribute	Constraint
Resilience	Recovery from disturbance
Productivity	Capability for plant growth
Responsiveness	Capacity for external enhancement
Sustainability	Dynamic equilibrium of interactions
Resistance	Stability to maintain current condition
Flexibility	Multiplicity of uses related to properties
Pedoclimate	Location and extent of suitable climate
Residence time	Capacity to store and release compounds
Geography	Availability due to location or intricacy of pattern

mum set of common norms and international standards for sustainable uses of various kinds of soils. Knowledge about the limitations of specific kinds of soils for particular uses is essential for informed decisions and agricultural policies (see table above). For every conceivable use of soil, there is a hypothetical ideal soil with the right set of properties and supporting processes to achieve a satisfactory level of success. Comparing local soils with a specified "ideal" soil can lead to recommended measures that minimize limitations and contribute toward attaining the expected behavior of such an ideal soil. When local economics of managing individual soils are considered, it is possible to develop rankings of suitability and economic feasibility. Since the 1980s, the amount of field work done in soil science has significantly declined due to shifts in priorities leading to cuts in funding and diminished field training at Colleges and universities.

New techniques utilizing proximal and remotely sensed information gathered with geographic positioning system technologies and analyzed in geographic information systems, often incorporating geostatistical models, have grown in popularity. This popularity is due in part to the high data density that proximal and remote sensing can provide and quantitative models linking these measurements to specific soil properties. The popularity is also partly because proximal and remote sensing techniques are less expensive than traditional field work. Providing soil information that can address the challenges of the future will require the high data density that proximal and remote sensing can provide evaluated with geostatistical and other advanced mathematical techniques. However, it is very important that field work continues to be supported as well. The models and predictions generated from proximal and remote sensing techniques are limited by the quality and quantity of field-based observations and measurements of soil and landscape parameters. Therefore, more traditional field investigations, including soil landform studies, need to be supported so that information modeled from proximal and remotely sensed data can be verified as being meaningful or improved when field checks show the model to be flawed. The soil scientist of the future will need to be able to combine competence in the field with competence in quantitative methods.

Conclusions

Humanity surpassed the earth's capacity to support our ever increasing demands on natural resources several decades ago. There is great disparity among nations in their ecological footprints, thus the challenges of implementing practices to attain sustainability are many. Supplying quantitative soils information at scales suitable to address needs is a challenge facing the soil science community. Soils are vital to supplying food, feed, fiber, and fuel to support the development of future generations; consequently, improved understanding of the functions and limitations of local soils is relevant to helping meet the desires for resources and the handling of wastes in a sustainable global habitat for all humanity.

Reference

Indorante, S.J., R.L. McLeese, R.D. Hammer, B.W. Thompson, and D.L. Alexander. 1996. Positioning soil survey for the 21st century. Journal of Soil and Water Conservation 51(1):21-28.

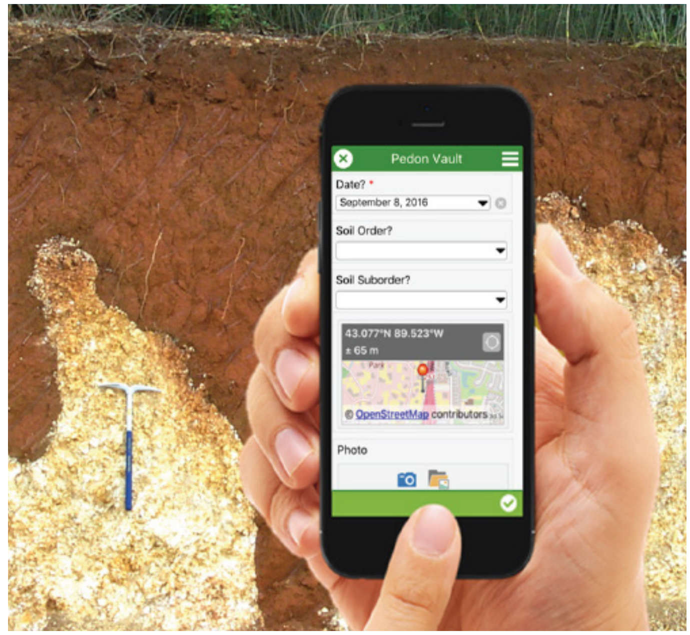
The New NRCS "Pedon Vault" App: Soil Profiles at Your Fingertips

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 Wisconsin State Soil 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



Screen view of the new Pedon Vault app.

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.

The NRCS Web Soil Survey: Uses and Limitations in Wisconsin

Soil is a living and life-giving natural resource farmers depend on daily. The National Cooperative Soil Survey Program (NCSSP) is essential in understanding soil types on your farm to help in conservation planning for the future. The NCSSP is an endeavor of the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), 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. Read the full Soil Survey Uses and Limitations Report.

The first soil map of Wisconsin was published in 1882. Much of the early survey work was done by the Wisconsin Geologic and Natural History Survey, the University of Wisconsin (UW) Soils Department, and the U.S. Bureau of Soils. Federal soil survey work in Wisconsin began in 1899, and thereafter, the soil survey became a cooperative effort between the Federal Government and state agencies. In 1933, the U.S. Department of Interior created the Soil Erosion Service to address national soil erosion problems. In 1935, the Soil Erosion Service was transferred to the USDA and is now, today, the NRCS. During the 1960s through the 1990s, soil survey work in Wisconsin moved around the state on a county-by-county basis as cost-sharing became available. In 2000, the state of Wisconsin weighed in to support soil surveys. The Wisconsin Department of Administration signed an agreement with NRCS to complete the initial soil survey of the state. In 2006, Wisconsin became the 10th state to have science-based soil survey information for the entire state on the Official Web Soil Survey (WSS).

WSS can be used for farm, local, and wider area conservation planning. It allows customers to prepare reports for their particular area of interest, save a digital copy, and/or print a copy. WSS is the sole source for official soil survey data. Every year on October 1, refreshed soil survey data from ongoing work and research is released to the public. Users can subscribe to receive notifications when soils data is refreshed. Older soil surveys are now being updated to modern standards for mapping and soil science as more detailed soil maps and data are developed using the latest GIS technologies. A starter how to guide for WSS is available for the public.

Soil survey information is important for planning specific land uses and practices needed to obtain positive results on your farm. For example, a soil survey can indicate the limitations and potentials of the soil for development of recreational areas. A landscape architect can use a soil survey when designing for a specific area. A contractor can use the survey in planning, grading, and implementing an erosion control project during construction. A horticulturist can use it in selecting suitable vegetation. WSS provides the basic information needed to make decisions about land management, including those operations that must be combined for satisfactory soil performance. Soil surveys are also helpful for locating possible sources of sand, gravel, or topsoil.

Soil survey data seldom contain detailed, site-specific information. WSS is not intended for use as a primary regulatory tool in site-specific permitting decisions and cannot replace site-specific details, which require onsite investigation. It is, however, useful for broad regulatory planning and application. Understanding the capability and limitations of the different types of soil data is essential for making the best conservation planning decisions.

In addition to updating the inventory of the soils, the NRCS Wisconsin Soils Program also provides training and support for the interpretation and use of soil survey information. Any use of soils data to make predictions falls under the broad category that soil scientists call soil interpretations. Outside organizations, agencies, and partners use soils data for interpretations and/or decision support systems. For example, a number of soil interpretations related to soil fertilizer recommendations and environmental risk are used for nutrient management planning in Wisconsin. These interpretations are incorporated in the UW's popular SnapPlus soil nutrient application planning software. Please note, partners must update their soils data in their interpretations on an annual basis when NRCS updates official soils information, otherwise, there will be differences between their soils data and the official WSS. Soil interpretations are also used in assessing farmland for taxation and equalization, in appraising land for loans, and in guiding land buyers. NRCS maintains a set of interpretations in the

WSS. These include calculated values, such as Soil Loss Tolerance (T) and soil Erodibility (K factor). Simplified infographics are available on the NRCS Wisconsin Soils Homepage explaining technical soil services NRCS provides, T and K factor, and more. NRCS interpretations also include various ratings of suitability and limitation for land uses. Read the full Soil Survey Uses and Limitations Report.

1. What is the Soil Survey Program?

The National Cooperative Soil Survey Program is an endeavor of the 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.

2. The History of Soil Survey in Wisconsin

The first soil map of Wisconsin was published in 1882. Much of the early survey work was done by the Wisconsin Geologic and Natural History Survey, the University of Wisconsin Soils Department, and the U.S. Bureau of Soils. The Federal soil survey work in Wisconsin began in 1899, and thereafter the soil survey became a cooperative effort between the Federal government and State agencies. The National Cooperative Soil Survey Initiative for the U.S. was launched in 1899 under the leadership of the U.S. Department of Agriculture (USDA), Division of Agricultural Soils, which became the USDA Bureau of Soils in 1901.

Soil survey work in Wisconsin began in earnest during the early 1900s, shortly after the inception of the National Cooperative Soil Survey. One of the earliest published soil surveys in Wisconsin was the Soil Survey of Racine County, Wisconsin. Field mapping for this survey was completed during the summer of 1906. The soil survey report, including the soil map, was published in 1907.

In 1933, the U.S. Department of Interior created the Soil Erosion Service to address the severe national soil erosion problems. Hugh Hammond Bennett was the Chief of the service. In 1935, the Soil Erosion Service was transferred to the U.S. Department of Agriculture and became the Soil Conservation Service (SCS). In 1995, the Soil Conservation Service became the Natural Resources Conservation Service (NRCS).

During the 1960s, 1970s, and 1980s, soil survey work in Wisconsin leapfrogged around the State on a county-by-county basis as cost-sharing monies became available from counties and other sources. In 2000, the State of Wisconsin weighed in to support soil surveys in

Albin Martinson and Donald Owens using a truck mounted hydroloc probe.

Wisconsin. The Wisconsin Department of Administration signed an agreement with NRCS to complete the initial soil survey of the State. NRCS used the influx of funds from the State to hire more staff. The additional staff accelerated progress, and the last of the field mapping was completed in the fall of 2005. A "Last Acre Ceremony" was held October 7, 2005, at the Lac Courte Oreilles Conference Center in Hayward. On May 16, 2006, Wisconsin became the 10th State to have soil survey information for the entire State on the Web Soil Survey.

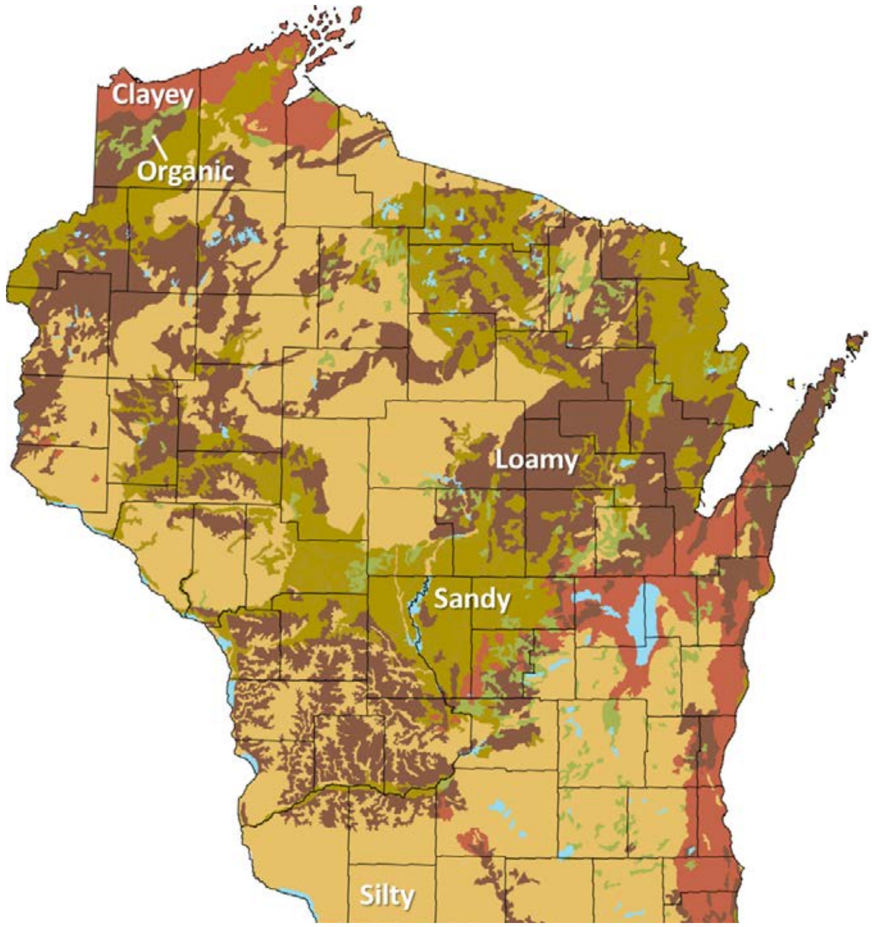
3. Ongoing Soil Survey Mapping

The completion of initial field mapping in 2005 marked the end of two eras for the NRCS Soil Survey Program (pretaxonomy and "modern mapping" post 1965) in Wisconsin and the start of another. The central focus of the program in Wisconsin shifted to updating and applying existing soil surveys. The older soil surveys are now being brought up to modern standards for mapping and soil science as more detailed soil maps and data are being developed using the latest GIS technologies. The surveys for Dunn, La Crosse, Pepin, Pierce, and Richland Counties have already been updated. Initials surveys were done on a county-by county basis. Survey updates are being done by physiographic region.

The physiographic regions are known as Major Land Resource Areas (MLRAs). In addition to updating the inventory of the soils, NRCS also provides training and support for the interpretation and use of soil survey information.

Soil Survey Annual Data Refresh

NRCS in Wisconsin works with Regional Soils Offices and traditional partners to prioritize ongoing soil science priorities. Every year on September 30th, the new soil



survey information from ongoing work is released to the public.

4. Official Soil Survey Data

Official soil survey information is in the public domain and is available on the Web Soil Survey (http://websoilsurvey.sc.egov.usda.gov/). The Web Soil Survey is the sole source for official soil survey data. When data is updated on the Web Soil Survey, the older data is no longer considered official.

Example:

The soils data files for RUSLE2 (R2) are currently generated by the State Agronomist from official soils data. Because of soils data being refreshed once a year, there may be minor differences between the soils data in R2 and the soils data in the WSS until the State Agronomist updates the R2 soils information.

Other soils data:

Outside groups are free to use whatever soils data they want to use for models or decision support systems like SnapPlus. If they chose to not update their soils information on an annual basis when NRCS updates our official soils information, there will, inevitably, be differences between their soils data and the official soils data and these will increase over time.

5. Uses of the Soil Survey

Soil survey information can be used to predict or estimate the potentials and limitations of soils for many specific uses. A soil survey includes an important part of the information that is used to make workable plans for land management. The information must be interpreted to be useable by professional planners and others.

Predictions based on soil surveys serve as a basis for judgment about land use and management for areas ranging from small tracts to regions of several million acres. These predictions, however, must be evaluated along with economic, social, and environmental considerations before they can be used to make valid recommendations for land use and management.

Examples

Soil survey information is important for planning the specific land uses and practices needed to obtain specific results. For example, a soil survey can indicate the limitations and potentials of the soil for development of recreational areas. A landscape architect can use a soil survey when designing for the area. A contractor can use the survey in planning, grading, and implementing an erosion control program during construction. A horticulturist can use it in selecting suitable vegetation.

Soil surveys provide the basic information needed to make decisions about land management, including those operations that must be combined for satisfactory soil performance. For example, soil survey information is useful in planning, designing, and implementing an irrigation system for a farm. A knowledge of the characteristics of the soil helps in determining the run length, water application rate, soil amendment needs, leaching requirements, general drainage requirements, and field practices needed to maintain optimal soil conditions for plant growth.

Soil surveys are also helpful for locating possible sources of sand, gravel, or topsoil.

Technology Transfer

Soil surveys are an important component of technology transfer. They are needed to move knowledge from agricultural research fields and plots to other areas. Soil surveys allow us to identify areas that have soils that are similar to those in the research fields. Knowledge about the use and management of soils is spread by applying experience from studied areas to areas that have similar soils and related conditions.

The relationships between soils and deficiencies of phosphorus, potassium, nitrogen, magnesium, and sulfur are widely known. In recent years, important relationships have been worked out between many soils and their deficiencies of trace elements, such as copper, boron, manganese, molybdenum, iron, cobalt, chromium, selenium, and zinc. Relationships between soils and some toxic chemical elements have also been established. By no means have all of the important soils been characterized, especially for the trace elements. More research is needed.

Land Valuations

Soil is one of many attributes that contribute to land value. The relative importance of soil varies widely among land uses. The soil is a major factor in areas used for farming, ranching, and forestry. In these areas, the soil's capacity to produce and its requirements for production are critical elements of land value. Soil interpretations are used in assessing farmland for taxation and equalization, in appraising land for loans, and in guiding land buyers.

The soil is one of several elements in the appraisal of land value within a specific local, economic, and institutional environment. Many of the other elements that determine value of real estate change with time. The soil types recorded in an official soil survey, however, remain valid over time and can be easily reinterpreted as economic or institutional conditions change.

6. Limitations of the Soil Survey

Soil survey data seldom contain detailed, site-specific information. They are not intended for use as primary regulatory tools in site-specific permitting decisions. They are, however, useful for broad regulatory planning and application.

Soil survey information cannot replace site-specific details, which require onsite investigation. It is a valuable tool where acquiring onsite data is not feasible or is cost prohibitive. It is most useful as a tool for planning onsite investigation. Understanding the capability and limitations of the different types of soil data is essential for making the best conservation-planning decisions.

Soil Interpretations

Any use of soils data to make predictions falls under the broad category that soil scientists call "soil interpretations." NRCS maintains a set of interpretations in the Web Soil Survey. These include calculated values, such as K and T, and features, such as Hydrologic Soil Groups and Unified Soil Classification. The interpretations also include various ratings of suitability and limitation for land uses.

Official soils data may be interpreted by organizations, agencies, units of government, or others based on their own needs; however, users are responsible for this use. NRCS does not accept reassignment of authority for decisions made by other Federal, State, or local regulatory bodies. NRCS will not make changes to Official Soil Survey Information, or provide supplemental soil mapping, for purposes related solely to State or local regulatory programs. Official Soil Survey Information is science based. NRCS should be consulted regarding the potentials and consequences of soil interpretations beyond those in the Web Soil Survey.

NRCS understands that other entities will develop soil interpretations without technical assistance from NRCS. It is important, however, to reiterate that NRCS does not accept responsibility for soil interpretations other than those delivered by the Web Soil Survey. Collaboration with NRCS on soil interpretations is critical to the successful use of soils data.

7. Tool for Planning

Soil survey data is an invaluable tool for comparing soil properties over broad areas. It can dramatically facilitate planning and preparation for onsite investigation. Soil maps can effectively communicate the nature of soil differences across an area. In the context of general land-use planning, soil survey data provides an irreplaceable tool for basic and objective-based resource planning. In the context of land-use planning for areas smaller than 4 or 5 acres, on-site investigation is clearly required. At the intensity of a single auger boring or a half-acre lot, caution must be raised on the use of the published information. On-site data is required when the focus is on a specific parcel of land.

Soil Survey Mapping Scales and Minimum Delineation Size

Map scale	Inches per mile	Minimum size delineation (acres)
1:10,000	6.3	1
1:12,000	5.3	1.4
1:24,000	2.64	5.7
1:250,000	0.25	623
1:30,000,000	0.0021	9,000,000

Soil surveys are conducted at various scales. The "minimum size delineation" is the smallest area that will be separated on a soil map at the indicated scale.

Soil Survey Database and Wisconsin Data Facts

Field	Count	Note
Legend Map Unit	8,383	The number of map units linked to soil survey areas and related to spatial data polygons by the database element "lmapunitiid," a.k.a. "mukey."
Map Unit	6,427	The number of map units identified by the database element "muiid."
Major Component	5,921	The number of soils listed as major components. Typically, a major component is greater than 10% of a map unit. The total number of components in the State is 11,839.
Minor Components	5,918	The number of soils listed as minor components. Typically, a minor component is less than 10% of a map unit.
NRCS Soil Interpretations	122	The number of soil interpretations available on Web Soil Survey for the State. Soil interpretations are models that use specific soil properties or qualities that directly influence a specified use or management of the soil. Examples of soil interpretations include texture, K-factor, T-factor, suitability for septic tank adsorption fields, AASHTO classification, Unified classification, and hydrologic soil group (HSG).
Properties	600	Properties are attributes of soils or sites that are (or can be) directly measured. Examples are sand, silt, clay, and Calcium Carbonate. The count of 600 is an estimate of the number of properties measured for map unit components, horizons, sites, pedons, ecological sites, and lab data.
NASIS Columns	3,914	Total number of data columns.
NASIS Tables	785	Total number of data tables.
Soil Survey Area	69	Total number of soil survey areas.
Spatial Soil Map Unit Polygons	1,496,783	Total number of spatial polygons represented.

NRCS develops and maintains soils information in the National Soil Information System (NASIS). This table refers to elements in NASIS for Wisconsin.

NRCS Technical Soil Services

Submitted by Michael Robotham Ph.D., National Leader – 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.
- A State Soil Scientist is assigned to every State.
- Some States also have an Assistant State Soil Scientist.
- Contact a resource soil scientist.
- They are located in national, regional, area, and field offices.
- Approximately 75 resource soil scientists provide full-time TSS support.
- Contact a Soil Science Division staff soil scientist.
- They are located in 12 regional offices and 124 soil survey offices nationwide.
- Approximately 350 soil scientists spend an average of 15% of their time providing TSS.

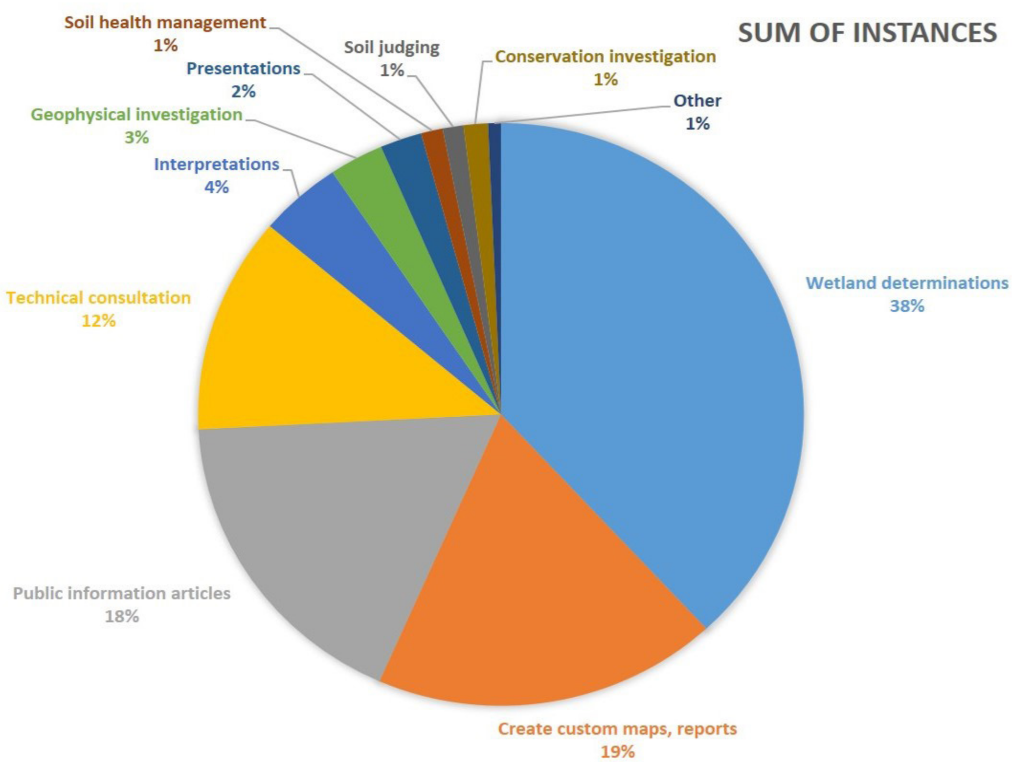
Wisconsin Technical Soil Service Priorities (Top 5)

1. Provide Soil Information to internal/external customers (need to develop measurements)
2. Site-Specific Soils Investigations (need common request protocol from NRCS-Wisconsin)
3. Site-Specific Soils Investigations for Waste Storage Facility (need defined task and request protocol from NRCS-Wisconsin)
4. Ecological Sites – Data collection and analysis; review descriptions
5. Soil Training Course for Field Offices and Partners

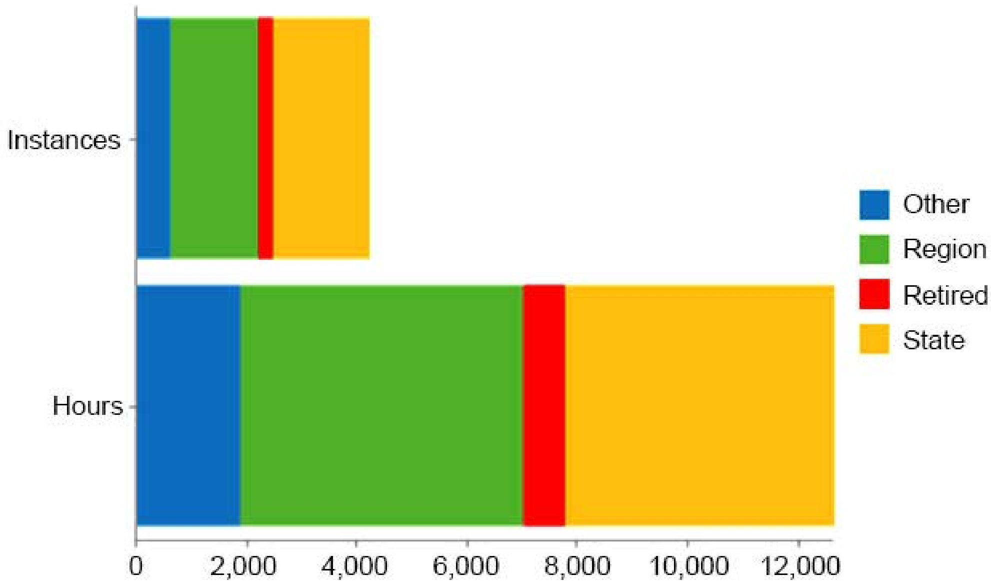
Types of Technical Soil Assistance
Area wide knowledge of Soils to assist in Easement sites
Assistance on resolving wetland issues relating to Department of Natural Resources permits for crossings and streambank
Data collection and analyses
Determining Lateral Effects for Wetlands for Engineering
Developing 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

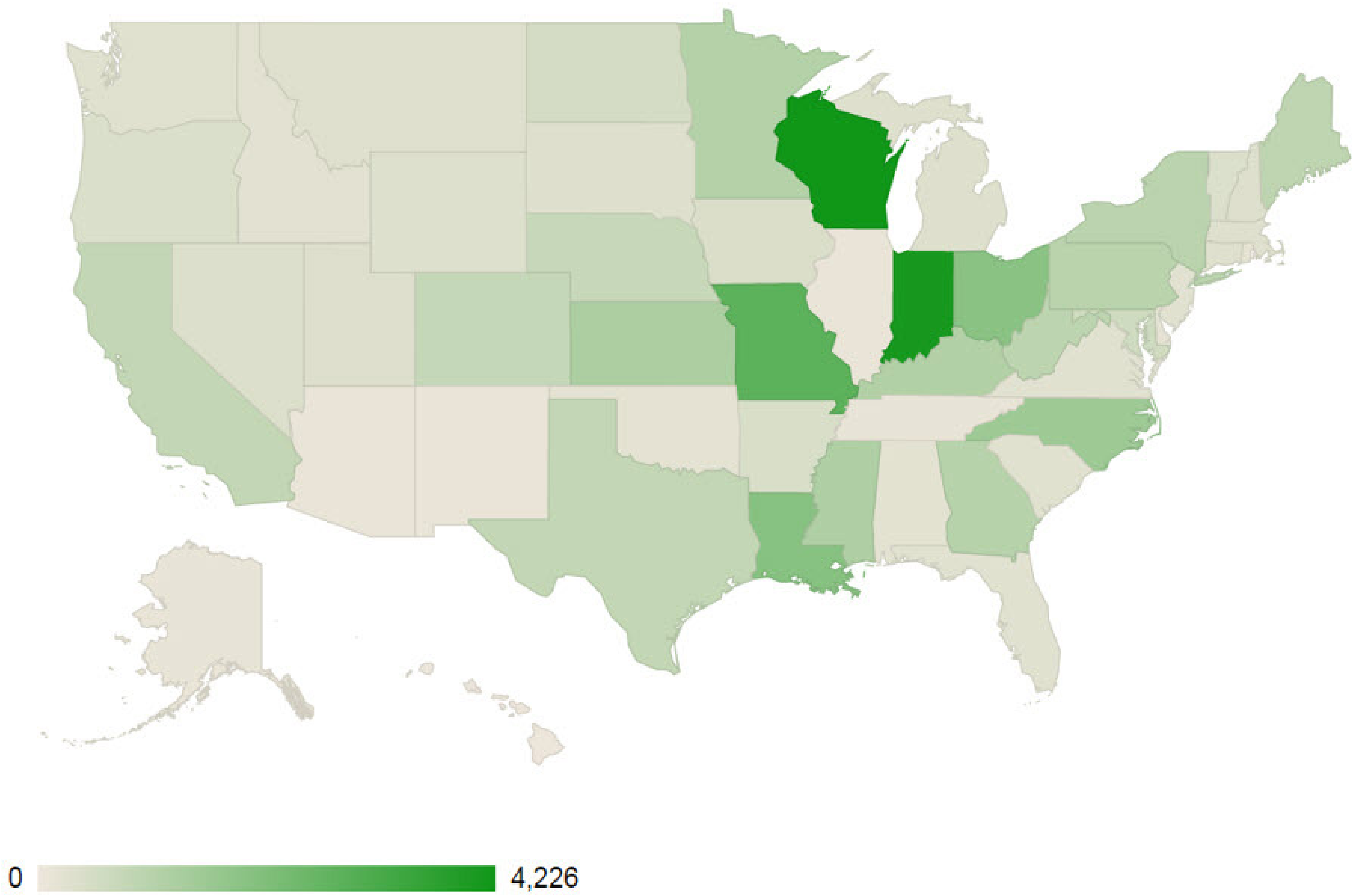
Sum of Instances



Note in Wisconsin, there is a large difference in national dominance of wetland workload, particularly for the Resource Soil Scientist position.



- A total of 4,226 instances of TSS activity were reported in FY 2016
- A total of about 12,646 staff hours of TSS activity were reported in FY 2016



Wisconsin is ranked first in the nation with hours and instances.

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).

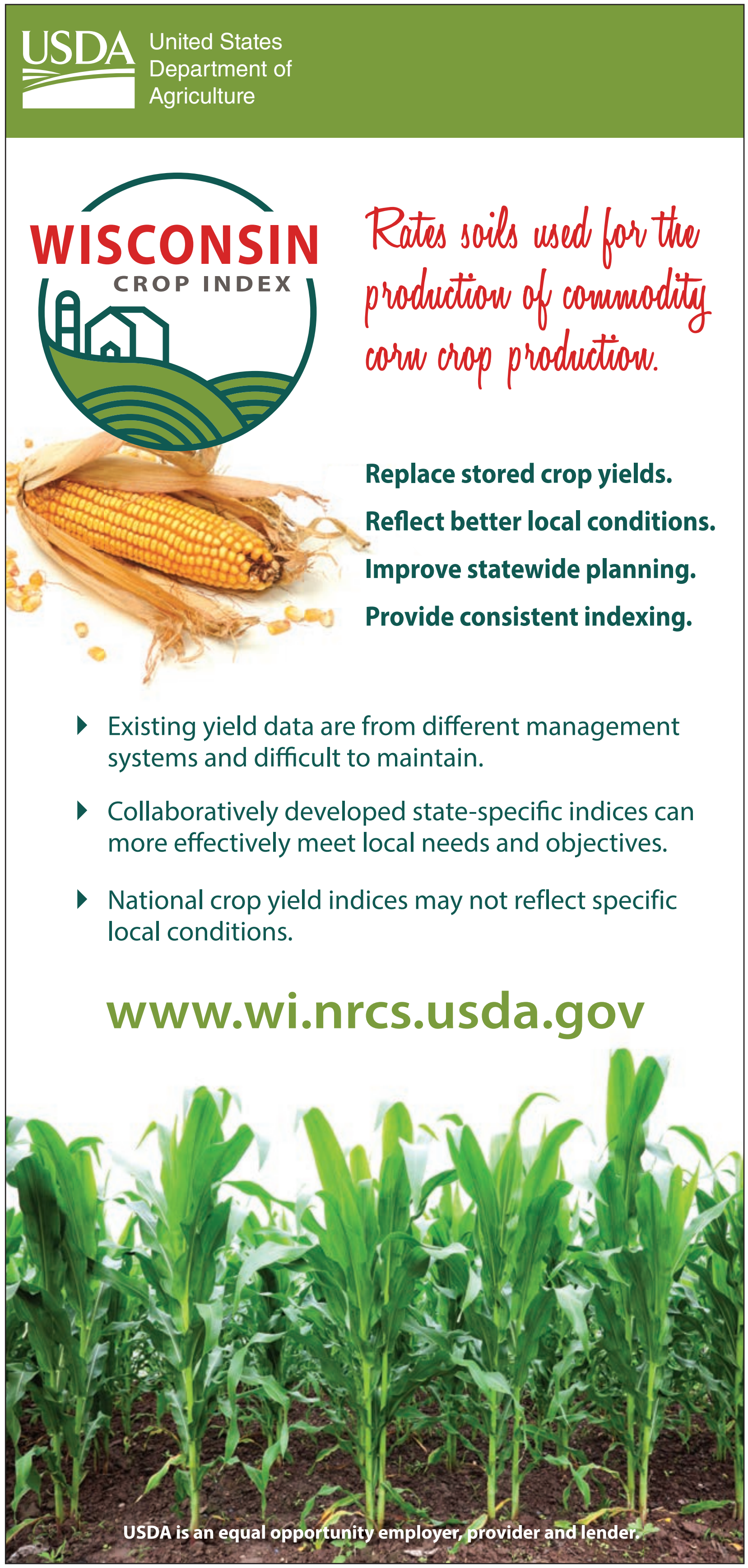
Wisconsin's New Commodity Crop Productivity Index for Corn

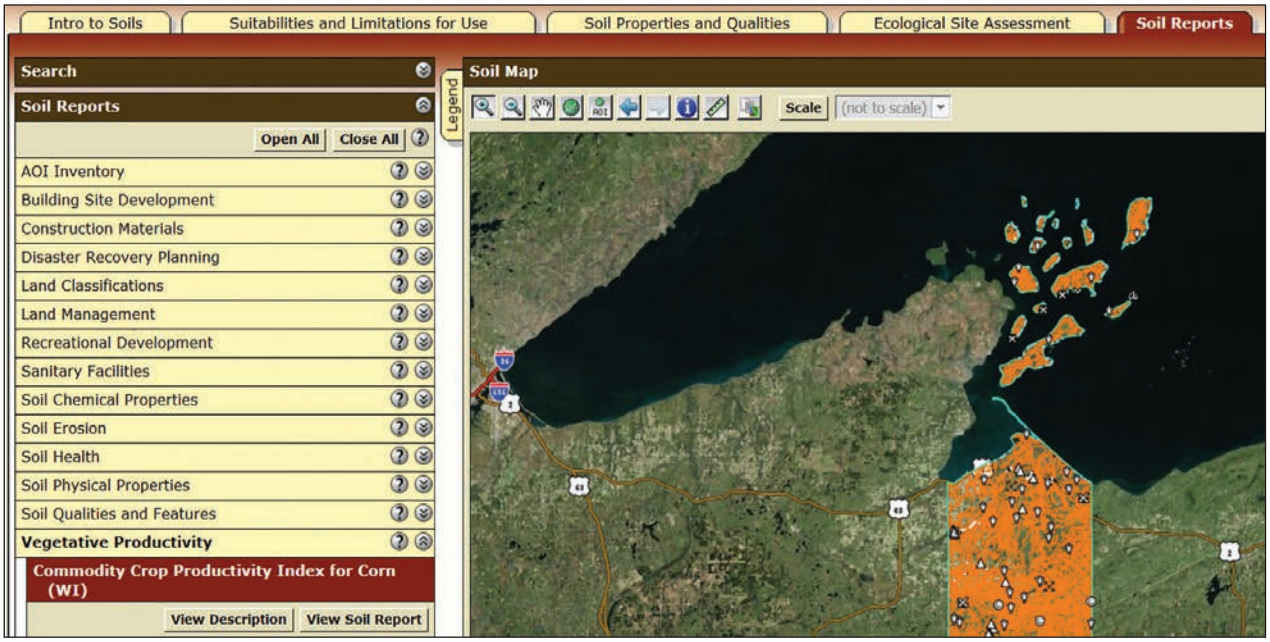
The U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) has added a new web interpretation for Wisconsin to the National Web Soil Survey (WSS). The Wisconsin Commodity Crop Productivity Index (WCCPI) for Corn Interpretation provides soil survey users with an inherent soil property based ranking of Wisconsin soils and map units for common crop productivity. It replaces stored crop yields, produces a consistent statewide crop production index, better reflects local conditions, and improves statewide planning. Productivity indices have the advantage of being less vulnerable to changes in technology than expressions of productivity based on yield.

The interpretation is shown in WSS as a report and thematic map. The report and thematic map are found in two locations within the WSS. The thematic map is located under the “Stabilities and Limitations for Use” tab, then under the “Vegetative Productivity” folder. The report is located under the “Soils Reports” tab, then under the “Vegetative Productivity” folder.

NRCS partnered with many Universities, Extensions, Resource Soil Scientists, NRCS State Soil Scientists, Soil Science Regions, and the National Soil Survey Center to complete this project. Read the new, detailed soil interpretation report here or view the condensed poster here.

Soil survey data currently available via the WSS, include only crop yield estimates from original soil surveys indicating the performance of different areas of soils for certain crops. Many of these crop yield estimates are very outdated, inconsistent, and highly subjective to variable management inputs. Using the new interpretive index gives farmers, landowners, partners, and other WSS users the capacity to relate directly to the ability of





An app screenshot of the location to find reports in the national Web Soil Survey.

soils, landscapes, and climates to foster crop productivity. Fluctuations in productivity caused by good or bad management and year-to-year variations in weather are not addressed. Productivity indices have the advantage of being less vulnerable to changes in technology than expressions of productivity based on yield.

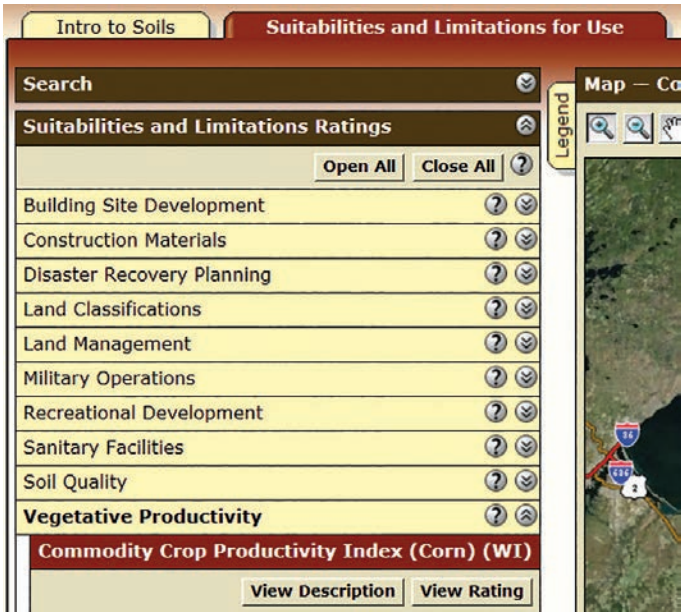
A mechanism that determines soil productivity in Wisconsin consistently across political boundaries, over time, is needed for many uses. Crop varieties, management scenarios, and yields vary by location, over time, reflecting choices made by farmers. These factors partially mask inherent soil quality. Except for extreme circumstances, inherent soil quality or inherent soil productivity varies little by location, over time for a specific soil (map unit component) identified by NRCS soil surveys.

Depths for data entry for many of these properties are based on typical rooting depths for corn. For example, over 90% of corn roots are found in the upper meter of the soil. Over the growing season, about 70% of water used by corn will come from the first 60 cm of soil. Extraction is most rapid in the zone of greatest root concentration and where the most favorable conditions of aeration, biological activity, and nutrient availability occur. Therefore, properties are weighted heavily for conditions found in the upper meter of the soil.

Properties also quantify the capability of the soil, climate, and landscape to supply water for crop growth. Soil moisture availability is determined by the interaction of four factors (1) amount of moisture present in the soil, (2) characteristics of the soil profile, (3) moisture capacity of the crop, and (4) demand for water by the atmosphere. The WCCPI uses the properties of slope gradient; depth to a water table during the growing season; and the occurrence, timing, and duration of ponding and flooding during part of the growing season in calculating crop productivity index.

Climate conditions in June, July, and August are good indicators of a soil's productivity for corn and soybeans. Rainfall and temperature during this time frame greatly affect crop productivity. The impact of rainfall for a given area is decreased because of the effects of temperature, day length and latitude, and crop use. For example, consider two soils, both receiving the same amount of rainfall. One soil is hot, thermic, while the other is cool, mesic. A larger amount of rainfall on the cooler site is more readily available for crop growth due to lower evapotranspiration rate, and so the cool, mesic site receives a higher water balance value. The ratings are both verbal and numerical. Rating class terms indicate the estimated productivity which is determined by all of the soil, site, and climatic features that affect crop productivity.

Individuals interested in knowing when surveys in a particular state are updated should visit the WSS and click on the "Download Soils Data" tab, then choose the State they are interested in. WSS will display a list of all soil survey areas. Individuals interested in soil related issues may subscribe to topics of interest using a free



An app screenshot of the location to find thematic maps in the national Web Soil Survey.

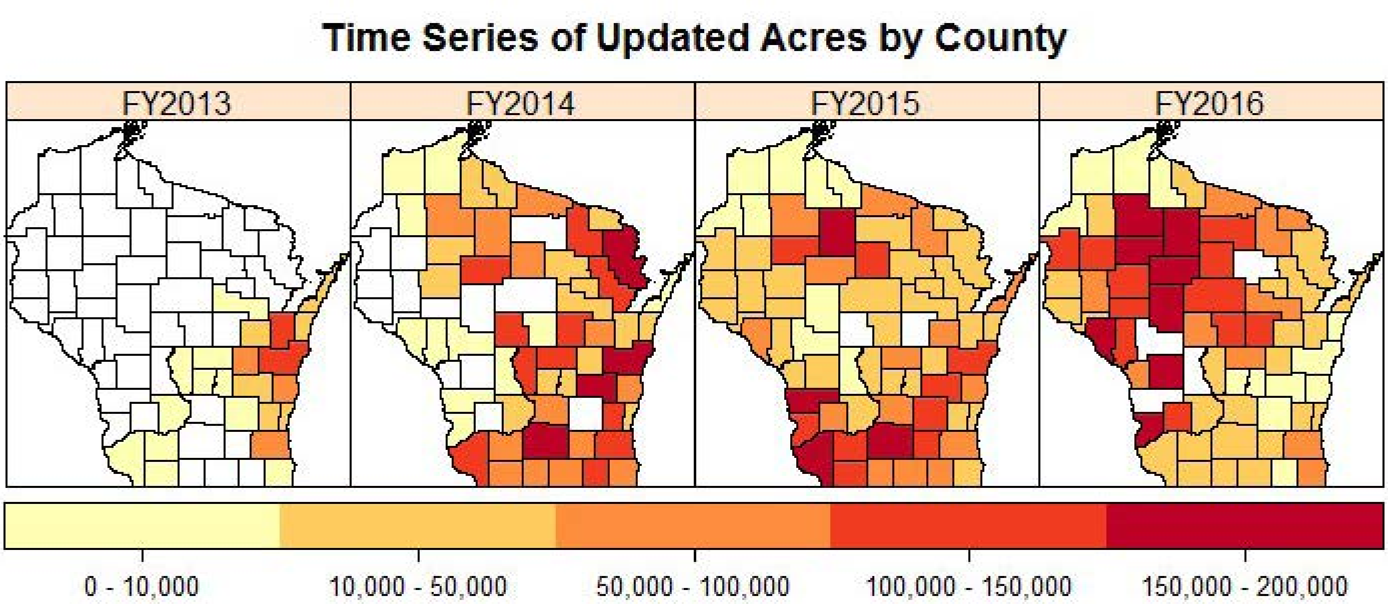
subscription service through GovDelivery. Individuals can e-mail inquiries to soilshotline@lin.usda.gov for assistance with GovDelivery and WSS.

Customers may click on the "Contact Us" link in WSS to receive assistance though the Soils Hotline, a State Soil Scientist, or a local NRCS Service Center. Questions about soil data in a specific state should be directed to the State Soil Scientist. Contact information for all State Soil Scientists is available. For more information on the Web Soil Survey, see our recent report Soil Survey: Uses & Limitations or visit the Wisconsin NRCS Soils Webpage.

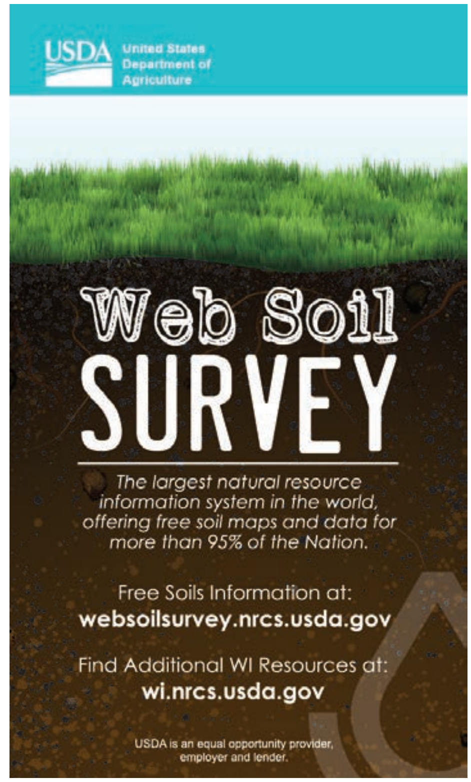
Soil Updates

Submitted by Stephen Roecker

Fiscal Year	Top 5 Soil Series Updated
2013	Kewaunee, Manawa, Hochheim, Poygan, Chaseburg
2014	Lupton, Plainfield, Newglarus, Withee, Loyal
2015	Magnor, Dorerton, Houghton, Newglarus, Palsgrove
2016	Seaton, Freeon, Rosholt, Pence, Padus



Official Web Soil Survey Available: Soil Science Annual Data Refreshes in October



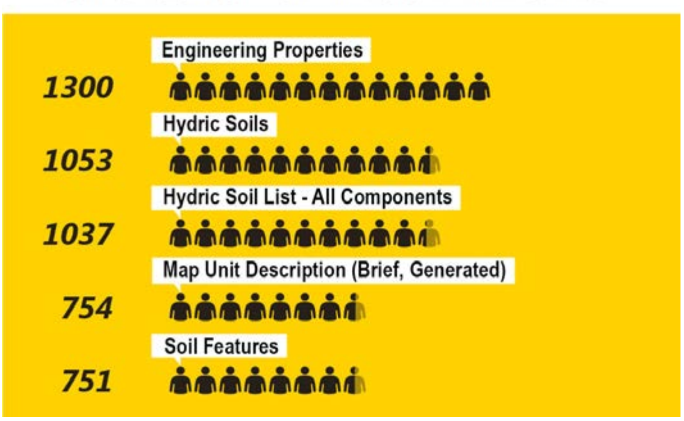
The National Cooperative Soil Survey Program is an endeavor of the United States Department of Agriculture Natural Resources Conservation Service (NRCS) and other federal agencies; state and local governments; and other cooperators. It provides a systematic study of the soils in a given area, including 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.

The entire national official soils data will be refreshed in October during each calendar year to ensure updated official data is available to all farmers, landowners, and partners. Refreshed soil survey information published to the Official Web Soil Survey (WSS) will include the 2012–2016 Soil Data Join and Recorrelation (SDJR) national initiative, charged by congress to inventory the soils of the U.S., interpret the soils for various uses, publish info to the public, and maintain inventory to meet user needs, will be completed in October. The SDJR national initiative has fully populated components for almost 700 million acres. Almost 2,900 of the 3,300 soil survey areas have been touched during SDJR. Interpretation criteria will be updated for many national interpretations.

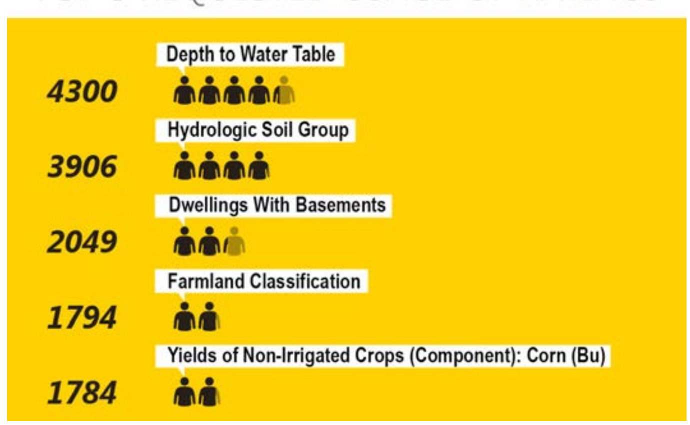
Individuals interested in knowing when surveys in a particular state are updated should visit the WSS and click on the "Download Soils Data" tab, then choose the State they are interested in. WSS will display a list of all soil survey areas. Individuals interested in soil related issues may subscribe to topics of interest using a free subscription service through GovDelivery. Individuals can e-mail inquiries to soilshotline@lin.usda.gov for assistance with GovDelivery and WSS.

Customers may click on the "Contact Us" link in WSS to receive assistance though the Soils Hotline, a State Soil Scientist, or a local NRCS Service Center. Questions about soil data in a specific state should be directed to the State Soil Scientist. Contact information for all State Soil Scientists is available. For more information on the Web Soil Survey, see our recent report Soil Survey: Uses & Limitations or visit the Wisconsin NRCS Soils Webpage.

TOP 5 USAGE OF WI SOIL REPORTS



TOP 5 REQUESTED USAGE OF RATINGS



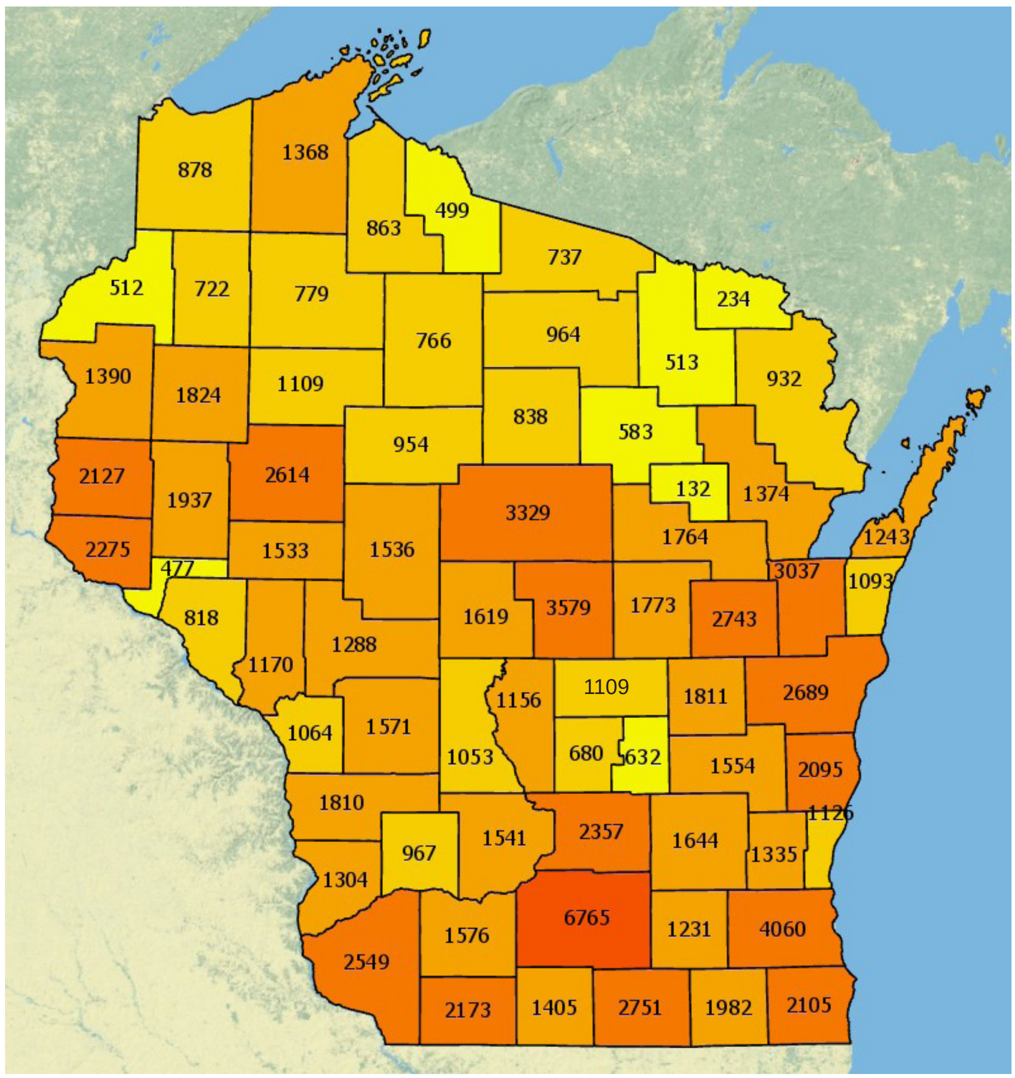
Web Soil Survey: Wisconsin AOI Created by Soil Survey Area

Welcome to the FY17 SDM Refresh

By Paul Finnell

Web Soil Survey began its humble beginning as a 'soft release' in August 2005 in a cooperative effort hosting the software and data on the ESRI web farm. In January 2006, it was moved from ESRI web farm to the NRCS web farm. From that early beginning, the following was a 'green sheet' estimate of potential usage: 'Web Soil Survey was released in August 2005 providing easy user access to soil survey maps and tables for about 3/4 of the country and is currently receiving about 1,500 visits per day. At this rate the number of visitors in the first year will exceed the number of soil survey copies printed in the last 8 years and the number of first year unique visitors will exceed the number soil survey copies printed in the last 6 years. Additional functionality and information will be added to Web Soil Survey over the next year, reducing the number of hard copies that will need to be printed and decreasing the time it takes to make the information available to the public. (Estimating a total of 3300 survey hardcopy publications, multiplied by the approximately 1000 copies produced per survey is about 3.3 million total books since 1957).'

The growth has far exceeded those early expectations. After ten years, WSS has become the number 1 USDA web portal providing soils information to an international community. The above paragraph was updated to read: 'In 2015, the Web Soil Survey website logged over 2.9 million user visits (a 7.15 percent increase over 2014) and averaged over 242,000 visitors per month. Over 524,000 customized soil reports for individual small portions of the country were developed through Web Soil Survey in 2015 (a 4 percent increase from 2014). At the end of 2015, the total number of visits to the Website since its initial release in 2005 topped 18 million. Working in conjunction with Microsoft Bing, the revised application now displays soil map unit delineations overlain on Microsoft Bing imagery. Users can view summaries of soil types for any geographic location where NRCS soil data exists. Detailed information on the named soils is now seamlessly linked and formatted within the application.'



The most requested counties for WSS information in Wisconsin. The results were limited to 100k requests. (10/1/2015-9/30/2016)

There has been a substantial increase in the number of horizons and components in the last few years. A few statistics:

FY17

3,270 Legends
306,558 Map units
1,043,057 Components
3,173,354 Horizons

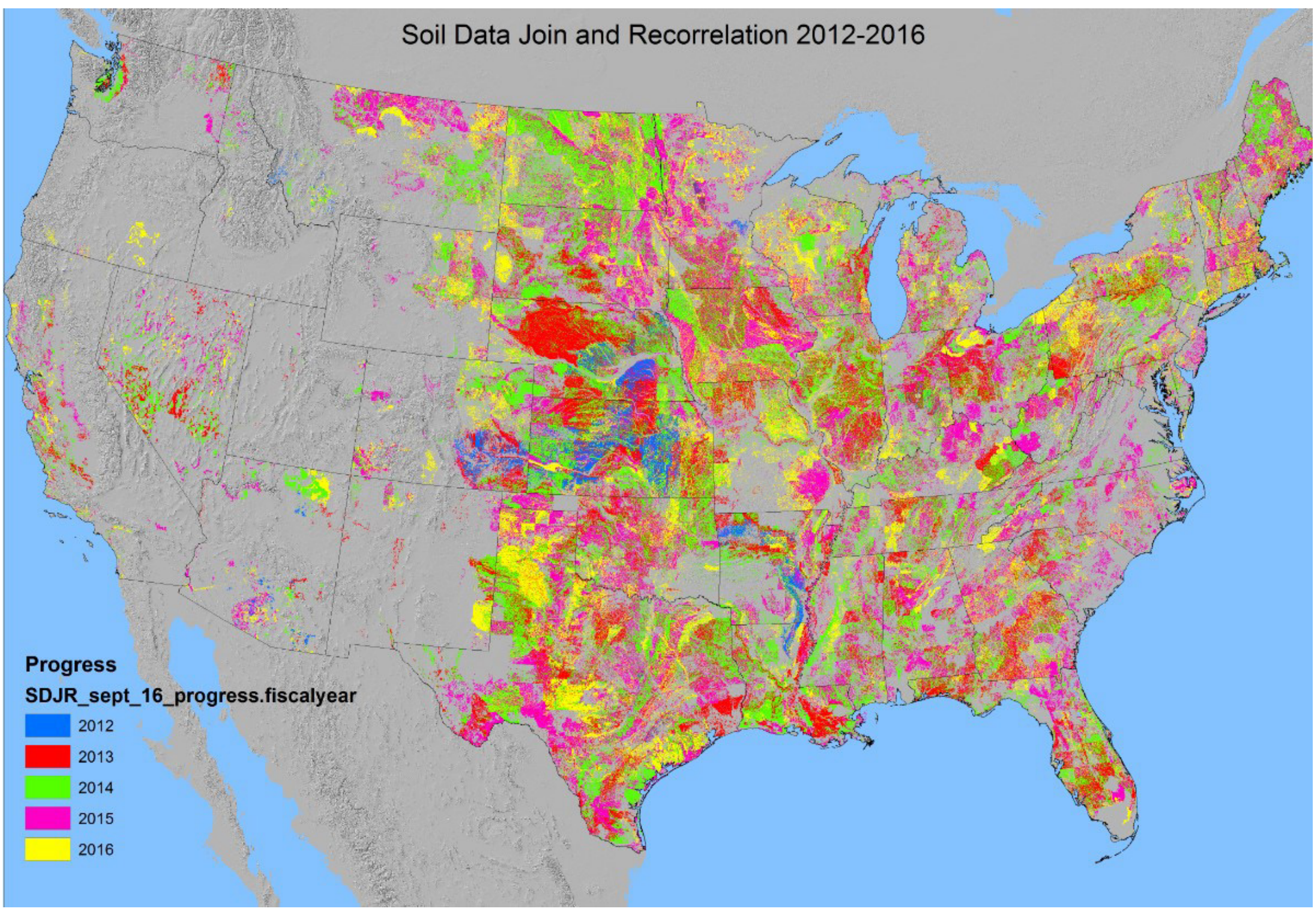
FY16 Refresh

3,263 Legends records
305,165 Map units' records
1,022,195 Components records
3,043,776 Horizons records

FY15 Refresh

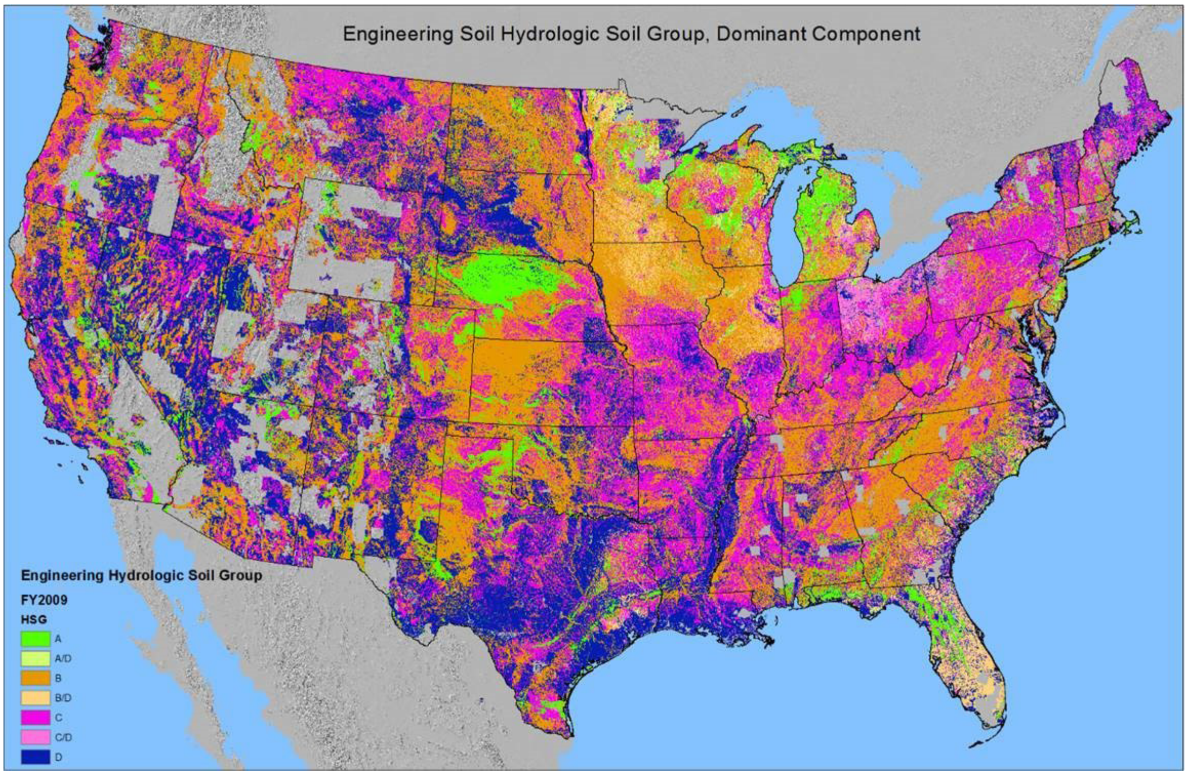
303,815 Map unit records
966,616 Component records
2,829,698 Horizon records

The last five years have been spent on the specific SDJR initiative focused on evaluating map units within the MLRA, harmonize and update the information to today's standards, and identify the future workload. Of the 313,000 total map units, over 65,000 map units were reviewed and condensed to almost 15,000 map units with over 650,000,000 acres having been reviewed. That is a significant accomplishment. The SDJR 2012-2016 initiative may be complete, but there is still work on the remaining 1.6 Billion acres to complete the initial mapping and continue the evaluation. Initial mapping is a priority and well understood on the processes to complete. However, the update of the existing mapping has been a challenge on prioritizing time and resources. The SDJR initiative was created to evaluate the initial mapping to identify future workload and the specific work needed to improve the soil survey inventory. Post SDJR projects are to be designed to clearly identify what work is necessary (on the map unit or landform) and the specific locations to collect that needed information.

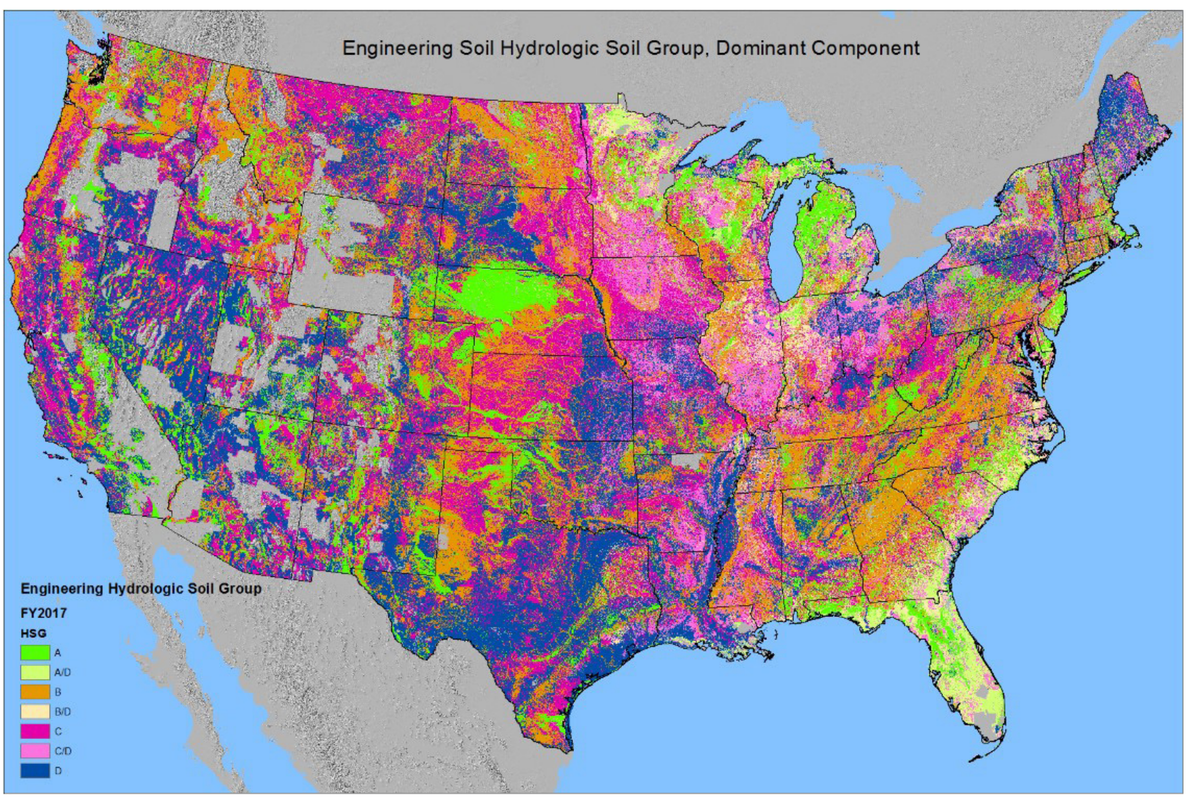


The 5 year SDJR initiative, 2012-2016, has made significant positive changes in the data

FY2009



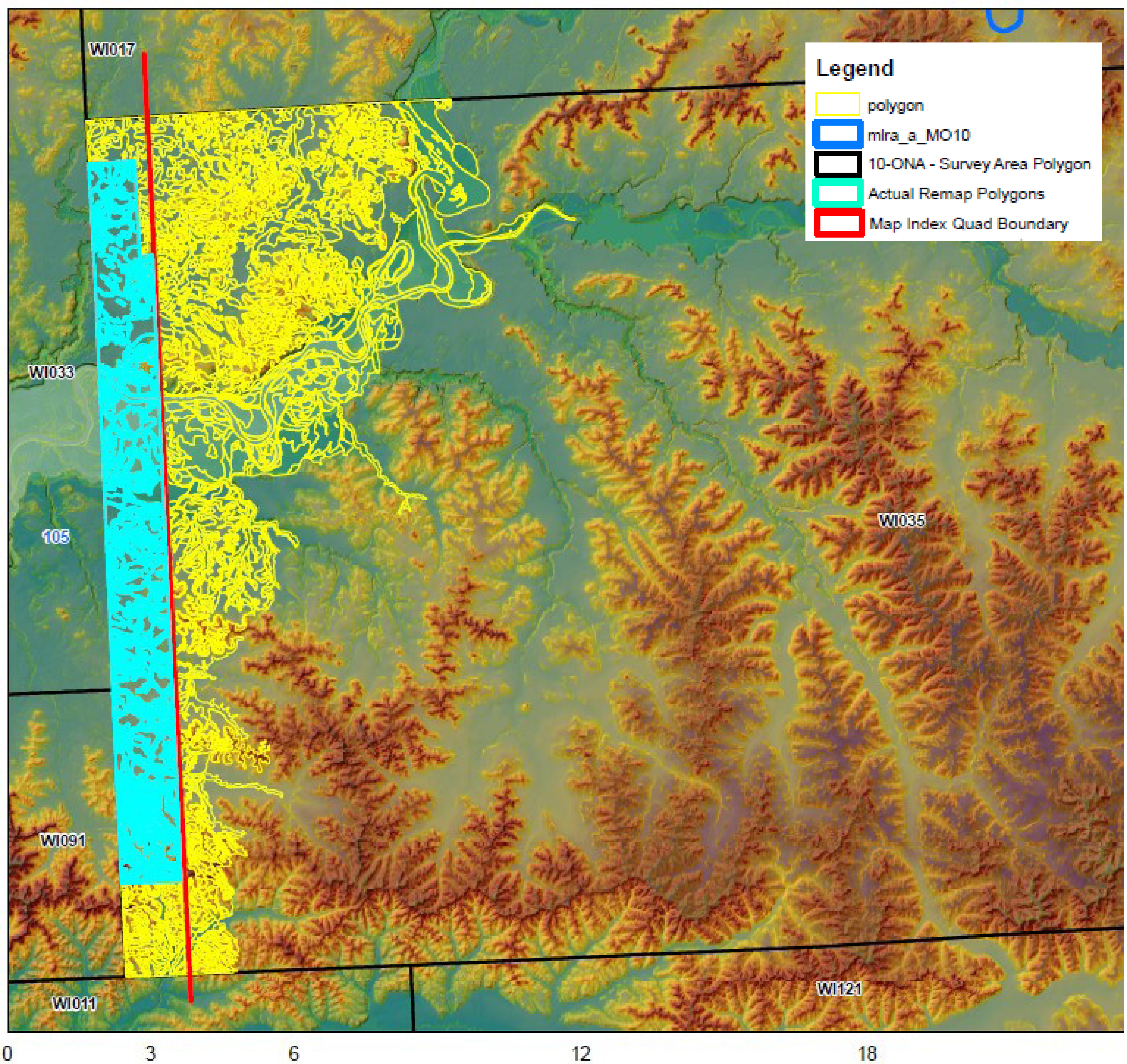
FY2017



MLRA 105 Project: FY16 Digital Incorporation of Remap Overlay

Submitted by Mike England, Soil Scientist, Onalaska, WI

In the mid 1990's to early 2000's, remapping efforts took place on a county basis for select soil survey areas in Wisconsin. Soil Survey Areas (SSAs) are mainly based as a county subset in Wisconsin with a few exceptions throughout the state. These field map updates to SSAs were incorporated into previously existing counties because of interpretation issues and insufficient data from previous initial soil mapping. Most of these initial mapping efforts were done in the early 1960's to the mid 1970's. Landform based mapping was not accurately applied to these soil survey areas and certain counties were selected as worst offenders to re-delineate their SSA. Remaping updates were completed for three Wisconsin Counties include Pepin, Pierce, and Dunn. Note, some field mapping data extending into adjacent Wisconsin counties was not submitted as official data



upon completion of the approved remapping areas because of time, money and technology.
During these remapping efforts, soil scientists in charge of mapping areas were asked to continue mapping to the quadrangle designated line, as compared to the county line of surrounding areas. Since these three counties were already adjacent to each other, this made the progress for the first county a little slower, but increased the efficiency for the surrounding areas. Since these efforts were not accepted as part of the modern standard of updating, maintaining and enhancing the data, there were areas into adjacent counties that did not have the update. These updated overlay areas extended their landscape based mapping convention beyond the political boundaries to document the difference in change. This was a starting point to prioritize additional updates to adjacent SSAs in Buffalo and Eau Claire Counties. This field mapping information was displayed on 11×11 in. aerial photography sheets made of clear plastic Mylar and used for adjacent SSAs counties to update a consistent model (perfect join) between SSAs in Buffalo and Eau Claire Counties.

In 2012, during initial updating of Buffalo County, newly digitized line work was incorporated into the northern boundary of the county adjacent to the remap counties. Subsequently, Eau Claire County will receive the same update to its western edge extending to the east stopping on similar physiographic boundaries the remapping model described. This project will incorporate new revised line work from field mapping sheets occurring from adjacent SSAs west of Eau Claire County (WI035). During remapping events in the early 1990s to early 2000s, Pepin (WI091), Pierce (WI093), and Dunn (WI033) were remapped to update spatial delineations, modern map unit concepts and conventions on a landscape basis.

Processes involved for incorporating these revised lines included scanning, digitizing, and merging with remap delineations along with initial soil survey spatial layer of WI035, editing the polygons to the adjacent SSA in order to follow a MLRA concept model. This will result in a consistent MLRA model for the remapped area that extends to a physiographic landscape break. No new data emerged; everything used already existed from Soil Data Join Recorrelation (SDJR) data and previous consolidation data projects. This will allow a perfect join between spatial and tabular data for the catena of map units in the adjacent Soil Survey Areas on a landscape extent. There is also an update to a central concept to the miscellaneous area map units throughout the SSA to minimize official data and to meet current standards. This project encompassed approximately 130 DMUs/MUs for this area and minimized the needed efforts of correlations in Eau Claire County.

Juneau Wisconsin Soil Survey Office

In 2016 and 2017, as a result of future project identification, MLRA 95 crew is implementing soil sampling, soil moisture and temperature studies throughout the MLRA.

MLRA 95 has many soil series mapped over time with dual drainage classes. The NASIS database allows users to populate water table by map unit component by month. In order to correctly sort out dual drainage class issues, clear up inconsistently populated databases, and populate component water table by month, an ongoing water table study is needed. This study was started in late 2014 with the installation of 6 piezometer wells in the St. Charles component. It will progress across many components in question and eventually complete with a much broader database reflecting upon groundwater table observations.

MLRA 95 is bisected by the Mesic Frigid Temperature Regime Boundary. This boundary represents a large break distinction within soil taxonomy and is based largely on important temperature thresholds for native vegetation and cropping systems. We are quantifying this boundary by placement of soil temperature loggers throughout this boundary zone.

Soil sampling will be a part of Soil Survey in MLRA 95 for years to come. Refining concepts and replacing database values with actual measured values will result in a much more complete portrayal of soil series concepts and a large step in supplying accurate interpretations in MLRA 95.











Soils on the Farm

In fall of 2016, NRCS Juneau Soil Science Staff provided an opportunity for private consultants and farmers to learn about "Soils on the Farm." This allowed stakeholders to see soil profiles, learn about soil sampling and understand soil survey usage and limitations. Stake holders also learned about soil property differences between outside groups using soils data and interpretations, scale or mapping. Soil survey data seldom contains site-specific information and is not intended as a primary regulatory tool in site specific permitting decisions. They are however, useful for broad regulatory planning. Special thanks to Steve Hoffman for organizing the event and Soaring Eagle Dairy for hosting it.

Soil survey crews described and collected samples from a Kewaunee pit. The soil profile did not match the Kewaunee series as it was an inclusion. The soil profile was described with silty clay loams at its densest part. Soil clods were collected to determine bulk density. This soil profile looked less dense than others in the Kewaunee area. However, there was still very little root penetration into the heavy argillic layers, except along the cracks and soil ped faces. Scope and scale were also discussed along with intended use of soil survey products. Differences were discussed concerning soil properties, i.e. bulk density, and soil interpretations, i.e. permeability. The attendees appreciated the opportunity to learn more about densic soil layers and rooting depth.

Chris Miller, MLRA Soil Survey Leader, discussing map unit design with private consultants and landowners.

Private consultants, farmers and landowner looking at a Kewaunee like soil profile while Chris Miller discusses how outside user groups developing their own soil interpretations and how they use the data which they need to own up to it and does reflect NRCS data.

Wisconsin and Region 10 – NEON Project: UNDERC, Steigerwaldt, and Treehaven

Submitted by Ryan Bevernitz, Soil Scientist, Rhinelander, WI

The 10-RHI MLRA Soil Survey Office was tasked with sampling three NEON sites within their area of responsibility. This project was completed with the help from multiple MLRA offices, Soil Survey Region 10 staff, USFS, NRCS field office staff, and a retired NRCS Soil Scientist/ESD Specialist.

As the remaining patches of snow reluctantly melted in the last week of April, sampling at the University of Notre Dame Environmental Research Center (UNDE) began. This site was located within the Upper Peninsula of Michigan within MLRA 93B: Superior Stony and Rocky Loamy Plains and Hills, Eastern Part. This property is used primarily for environmental research and education for graduate, and undergraduate students. The sampling crew for this site consisted of soil scientists from the 10-RHI, 10- ONA, 10-DUL, and R-10 offices.

Nine distributed and four tower plots were selected from the 34 potential plots that would best characterize the variability of soils across the UNDERC site, as well as provide useful data for future MLRA update projects. This site was located within the Winegar Moraines which are characterized by disintegration moraines with ice block depressions forming lakes and bogs. Soils sampled and described ranged from coarse-loamy tills with fragic properties, to loamy mantled outwash, with interspersed Histosols in the form of Euic swamps, and Dysic peat bogs. When the sampling was complete, NEON staff invited the crew to visit the tower and explain the instrumentation and research goals of the project.

Sampling at the Steigerwaldt Land Services (STEI) NEON site was completed the second week of September. This was a unique situation where the distributed plots were located within the Chequamegon-Nicolet National Forest in Eastern Price County, WI approximately 30 miles northwest of the Tower site located in Lincoln County, WI. This cooperative effort consisted of staff from the 10-RHI, 10-ONA, 10-DUL, 10-FER, and Region 10 offices as well as a Soil

UNDERC NEON sampling crew at the tower. Back row, left to right: Larissa Hindman, Scott Eversoll, Mike Rokus, Pete Weikle, Roger Risley. Front row, left to right: Michael England, Ryan Bevernitz, Jo Parsley, Myles Elsen.

Conservation Technician from the Rhinelander NRCS Field Office and a USFS Soil Scientist.

The two selected tower sites were located on low-relief ground moraines with soils formed in sandy loam till with a perched water table. The landscape at the 12 distributed plots were characterized by water worked drumlins and ground moraines with soils formed in coarse-loamy, or loamy-skeletal till with local loess influence. Upland soils at this site had over thickened A-horizons and lacked the typical thin organic surface formed from leaf litter. This is a common condition in loamier soils that have been infested with earthworms. Other sites sampled consisted of loamy-mantled outwash on the footslopes and flats, closed depressions forming acidic bogs, and poorly drained mineral drainageways.

The final site, Treehaven (TREE), was completed the third week of October. Treehaven is located in Lincoln County, WI and is owned and operated by the University of Wisconsin – Stevens Point. This facility is dedicated to provide natural resources education, research, and recreation. The sampling crew for this site consisted of Soil Scientists from the 10-RHI, 10-ONA, 10-DUL, R-10 offices, as well as Soil Conservationists from the Rhinelander and Merrill NRCS Field Offices, a Soil Conservation Technician from the Rhinelander Field Office, and a retired NRCS Soil Scientist/ESD Specialist.

Eleven plots were selected for sampling at this site, all within MLRA 94D: Northern Highland Sandy Drift. These plots were “easy digging’ with soils formed in dominantly sandy and gravelly outwash with several sites having loamy sand or sandy loam till substratums. Also

Profile of the Schweitzer soil; Coarse-loamy, mixed, superactive, frigid Alfic Fragiorthods, formed in modified loamy eolian deposits over gravelly sandy loam till.

described and sampled were two Histosols

with one being a Dysic, frigid, Typic Haplosaprist in a black spruce and tamarack swamp, and the other being a Loamy, mixed, frigid Terric Haplosaprist in a alder drainageway.

Overall these three NEON sites provided useful documentation and data for the 10-RHI MLRA office as well as provided hands on experience in local soils for the NRCS Field Office staff. The greatest benefit of this project was that it allowed face to face discussion of soils and projects with the regional office and between MLRA staff with adjacent survey areas.

Close up of vesicular pores in a 2E/Bx horizon.

Steigerwaldt NEON Sampling Crew: Left to right: Mike Rokus, Jo Parsley, Michael England, Ryan Bevernitz, Scott Eversoll, Tom Melnarik, Mark Farina, Andrea Williams, Larissa Hindman (Not pictured: Michael Whited and Betsy Schug).

Treehaven NEON Crew: Left to Right: Roger Risley, Mike Rokus, Pete Weikle, Ryan Bevernitz, Michael England (Not pictured: Mark Krupinski, Tom Melnarik, Beth Stanley, and Celie Borndal).

Waverly, Iowa – Soil Survey Office Outfits a Soil and Ecological Data Trailer

Submitted by Ryan Dermody, MLRA Soil Survey Leader, Waverly, IA

After 4 years of planning and gathering equipment, the Waverly Soil Survey Office put the finishing touches on their Soil and Ecological Data Trailer, (SEDT or acronym of your choice, we will take suggestions). The idea for this trailer was shamelessly stolen from Soil Survey Region 5.

The addition of this trailer satisfies the following needs:

- Storage and transport of 10 Amoozemeters
- Water storage for Ksat and infiltration measurement
- Place to process and transport dynamic soil property samples
- Storage of equipment, freeing up laboratory space
- Potential to expand water and or soil core storage under shelving
- Storage of ecological equipment
- Processing of ecological samples

To save money the trailers interior was designed and built by the Waverly soils staff. Cost for the trailer was $4,000, with an additional $1,000 for the storage containers, paint, and shelving.

With this trailer, the Waverly soil staff will be able to collect more soil and ecological data, in a shorter amount of time.

We would like to thank the past and current leadership of Region 11, for approving our many equipment requests over the past 4 years. We would also like to thank the staff of region 5 for letting us steal your idea for this trailer.

If anyone wants more information on this trailer or for larger images you can reach Ryan at: Ryan Dermody, Soil Scientist, Waverly Soil Survey Office, 1510 3rd St. SW, Waverly, Iowa 50677, Phone: 319-352-4038 ext 327.

On-Farm Soil Health Study

In fiscal year 2017, the Iowa State University's Agronomy Department and the Waverly NRCS Soil Survey Office are investigating the effects of topography and land-use management on soil health indicators. Our goal is to optimize soil health assessment and understand the relationship between soil health indicators and crop production. This includes determination of the optimum number and location of soil samples needed to properly measure each soil health indicator across a field. To do this, we are looking for at least two farm fields with good management records, where we can compare existing differences in management practices (e.g., cover crops vs. no cover crops, conventional vs. non-conventional tillage, etc.). Farmers will receive a detailed (~50 sq. ft) soil health assessment for each field sampled.

MLRA 104: Aquolls, Aquents, Intermittent Water, Wetlands Recorrelation Project

The Aquolls, Aquents, Intermittent water, and wetland map units in MLRA 104-108C are found in 59 map units, 2792 polygons, and cover 66,580 ac. They are not mapped consistently by landform or to the series level. These map units do not have enough data to determine ESD groupings, or have hydric soil properties populated. These soils are mapped in river valleys too upland depressions. The Waverly SSO staff will separate the polygons by landform position using GIS data in the office, then transect the polygons by landform to determine soil series and map units composition. This project was requested by NRCS area and field staff (wetland specialist, Ecologist) to aid in hydric soil determination and Ecological site development.

Pursuing a Strong Education at UW-Stevens Point

Submitted by UW-Stevens Point

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.

Choose a Specialization

As a Soil and Waste Resources student, you will choose from major options in:

- soil science, http://www.uwsp.edu/cnr/Pages/major.aspx?name=Soil%20Science, trains you to be a soil scientist, soil conservationist or agronomist through a strong science-based curriculum. A soil science minor is also available;
- soil and land management, http://www.uwsp.edu/cnr/Pages/major.aspx?name=Soil%20and%20Land%20Management, provides you with skills in the techniques of tillage, nutrient management, water management and sustainable crop production while minimizing erosion and maintaining water quality; and
- waste management, http://www.uwsp.edu/cnr/Pages/major.aspx?name=Waste%20Management, 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.

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.

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.

Soils Education and Research Activities Available at UW-Platteville

Submitted by UW-Platteville

Education

The Soil and Crop Science, Environmental Horticulture, and Reclamation, Environment, and Conservation (REC) programs are currently in the process of conducting a major curriculum revision, which would combine these three programs into one major, with multiple submajors. The combined programs would improve efficiency in program delivery and enable additional submajor specializations and new courses. Potential submajor programs include Agronomy, Environmental Horticulture, Land Reclamation, Restoration Ecology, Professional Soil Science, and Plant Breeding and Genetics.

Research

Dr. Chris Baxter is concluding sponsored research investigating the effects of conventional and biological fertilizers on established alfalfa. Part of this work includes investigating changes in soil respiration and soil carbon under various fertilizer treatments. Dr. Baxter is also conducting preliminary work on soils affected by historic lead and zinc mining in Southwest Wisconsin. Current work has focused greenhouse and field plot studies of soils exhibiting zinc phytotoxicity. Various treatments, including phosphate, liming materials, and biological amendments are being investigated. Additional work is being proposed that will focus on field characterization of soils and vegetation in areas known to have been impacted by historic mining activities. Two undergraduate students were hired to assist with these projects.

Extra-Curricular Activities

The UW-Platteville Collegiate Soils Team recently competed in the regional competition hosted by Northern Illinois University in Dekalb, IL. The team placed second and qualified for the national contest in spring 2017 which is also being hosted by Northern Illinois University. The team also plans to attend the National Association of College Teachers in Agriculture (NACTA) competition, hosted by Kansas State University in Spring 2017. The soils team also has an exciting opportunity to attending the Australia-New Zealand Soil Science Society conference and associated soil judging competitions which is being held in Queenstown, New Zealand Dec. 12-16. The team plans to attend the conference and participate in the contest, which will use the New Zealand Soil Classification system. Following the contest and conference, the team will tour sites throughout New Zealand to learn more about the geomorphology, cultural history, and how the country is balancing competing land uses from its major industries which include agriculture, forestry, mining, and tourism.

Soils Science at UW-River Falls

Submitted by UW-River Falls

Our Program

At UW-River Falls, we offer a degree in Crop and Soil Science with options/tracks in Crop Science, Soil Science, and Sustainable Agriculture. We currently have approximately 75 undergraduate students in the major with 15-20 students in the Soil Science option. 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. This course has been revamped and is taught at the freshman level to introduce students to soil science early in their academic career and encourage them to take further soils coursework.

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 & 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 10-15 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 8-14 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 use of green seeker technology in soil nutrient management, soil quality pre and post frac sand mining, carbon dynamics and losses since European settlement, and conservation initiatives coupled with renewable energy projects.

Soil Science Activities at UW-Whitewater

Submitted by Peter Jacobs

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 this course students complete a field project where they apply GPS and GIS skills from other classes to soil science to analyze the spatial variation of soil organic carbon (SOC) in the 40 acre woodlot in our campus nature preserve. Random points assigned by the GIS are navigated to by GPS, where the students collect site information, A horizon characteristics, and a sample for SOC and pH measurement in the lab. The data are entered into an attribute table that is used to produce maps and scatterplots that are the basis of their report on controls of SOC storage in the landscape.

A small subset of students who complete the soil science course can choose to participate in the soils team that travels to the Regional Collegiate Soils Competition each fall. 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. UW-Whitewater will be hosting the Regional Soils Competition in October 2017, bringing schools from the region to the carbonate-rich glacial sediments of southeast Wisconsin.

Research projects in soil science at UW-Whitewater primarily focus on soil geomorphology and loess in Wisconsin. On-going projects include: (1) Loess cover on the southern Green Bay Lobe, including the origin and source of the loess; (2) weathering characteristics of a loess-paleosol sequence in the Driftless Area; (3) controls on SOC storage in uncultivated forest topsoils; and (4) Differences in A horizon clay mineralogy of native prairie and adjacent ag fields.

The Green Bay Lobe loess study is largely wrapped up and published (see references below), but I continue to build a geochemistry dataset from the samples in an effort to traces the landscape that supplied much of the dust. The loess mantles glacial sediments on topographically high landscapes east of the outcrop of the Prairie du Chien dolostone (i.e., Oneota escarpment). The smectitic clay mineralogy of the loess matches the loess of the Upper Mississippi Valley, which was transported to the southeast across the sand plains of central Wisconsin. The next step is to build a geochemistry database with trace elements and rare earth elements to attempt to correlate with geologic units to the west that may have been the ultimate source of the dust. To complete this project will require acquiring samples or comparably-prepared data from areas west of the Mississippi River.

The longest known loess-paleosol sequence in the Upper Mississippi Valley is located in the Kickapoo Valley near Oil City, in southern Monroe County. The site is located on an interfluve nestled below the uplands but well above the river floodplain and contains eight lithologic units with 5 buried soils, all with normal remanent magnetism (i.e., <790 ka). The units are a mix of colluvium and loess, with loess dominating the upper part of the sequence. Previous work I did for my Master's thesis characterized the stratigraphy, pedology, micromorphology, and clay mineralogy of the section (Jacobs and Knox, 1994). In addition to good facilities for x-ray diffraction work, UW-Whitewater recently acquired a portable x-ray fluorescence (pXRF) device and I am using both tools to investigate weathering of the 8-63 µm silt fraction using x-ray diffraction (XRD) and elemental geochemistry by portable x-ray fluorescence (pXRF). The preliminary results were presented at the LoessFest2016 conference in Eau Claire in September. With the help of an undergraduate research student, we are finishing up duplicate (XRD) and triplicate (pXRF) analyses of the samples to finish drawing our conclusions. So far, the geochemistry supports original interpretations that the paleosols show interglacial-scale mineral weathering, with the paleosol beneath the Sangamon Soil showing the greatest weathering.

The project investigating the controls on SOC storage in uncultivated forest topsoils is a slowly-progressing project that I have worked on as sampling opportunities arise. I collect bulk density samples and am looking at correlations between SOC content and basic soil characteristics (particle size fractions, pH, clay mineralogy, base cations, and depth to free carbonates when I can determine that). From about 30 samples analyzed, the strongest predictors are pH and Ca content, which point to Ca bridging to stabilize humus compounds. Interestingly, of the particle size fractions, silt is a predictor while clay content shows no correlation with SOC.

A final, and very slow-moving, project is looking at differences in the clay mineralogy of A horizons in well drained native prairie versus adjacent ag fields. I only have a few samples collected so far and have barely analyzed the differences, but want to list the project in the event any of the collaborators reading this volume know of any potential study sites. Please feel free to contact me if you know of any sites where I could gain access to sample. The sample volume needed is small and can be done with an Oakfield probe.

References (feel free to contact UW-Whitewater for copies of these or other papers)

Jacobs, P.M., Mason, J.A., and Hanson, P.R. 2012. Loess Mantle Spatial Variability and Soil Horizonation, Southern Wisconsin, USA. Quaternary International 265: 43-53.

Jacobs, P.M., Mason, J.A., and Hanson, P.R. 2011. Mississippi Valley regional source of loess on the southern Green Bay Lobe land surface, Wisconsin. Quaternary Research 75: 574-583.

Jacobs, P.M. and Knox, J.C. 1994. Provenance and pedology of a long-term Pleistocene depositional sequence in Wisconsin's Driftless Area. Catena 22: 49-68.

New Web Soil Survey Feature Reports for Wisconsin

Water Feature (WI) Report

"Water Features" is located in Web Soil Survey and then under the Soil Data Explorer tab, Soils Reports sub-tab, and then the Water Features folder. This new report gives estimates of various soil water features. Estimates are used in land use planning involving engineering, wetland considerations or conservation planning. The new column, "water features" kind, was added to help users to determine if water table is saturated throughout or sitting on top of a restrictive root limiting pan. The report also aggregates similar months together making it simplistic and easy to read.

Hydric Rating by Map Unit (WI) Report

"Hydric Rating" is in Web Soil Survey under the “Soil Data Explorer” tab and “Soils Reports” sub-tab and in the “Land Classification” folder. This new report gives the hydric soil category rating, indicating the components of map units that meet the criteria for hydric soils. Estimates are used in land use planning involving engineering, wetland considerations, and conservation planning.

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.

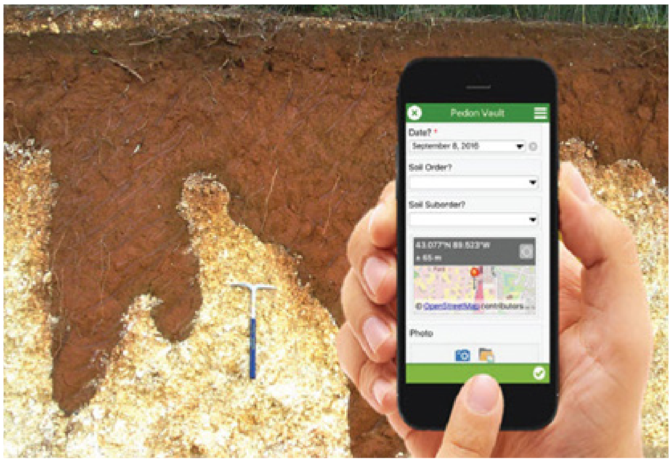
Soil Data Access

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.

Cooperative Soil Science Tool Continued

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

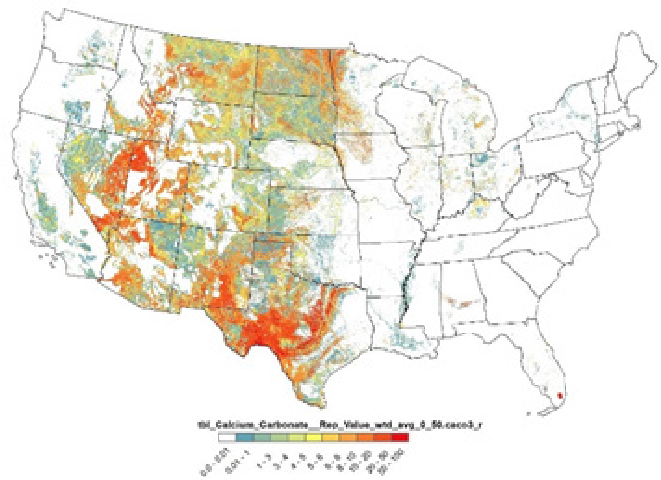


Scientists, educators, farmers, anyone interested in soils, have you ever tried to learn about your local land by looking at a cross section of your soil, known as a soil profile, only to realize the sample doesn’t have the layered exposure you were looking for?

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!

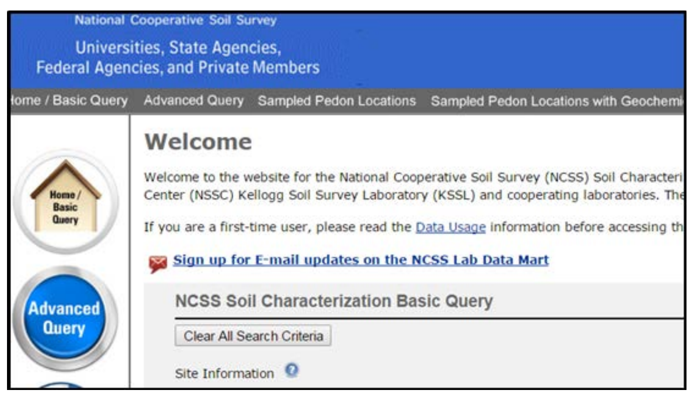
http://www.nrcs.usda.gov/wps/portal/nrcs/main/wi/soils/



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@nc.usda.gov or Jason Nemecek at jason.nemecek@wi.usda.gov.

Soil Lab Data: Lab Data Mart

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



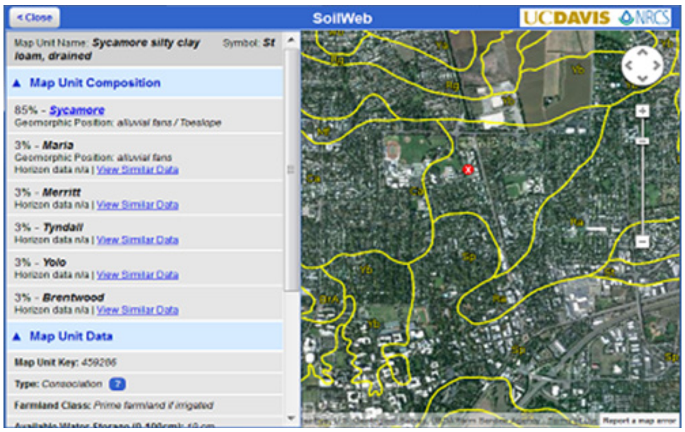
The National Cooperative Soil Survey (NCSS) Soil Characterization Database. This application allows you to generate, print, and download reports containing soil characterization data from the National Soil Survey Center (NSSC) Kellogg Soil Survey Laboratory (KSSL) and cooperating laboratories. The data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

Cooperative Soil Science Tool Continued

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:

SoilWeb

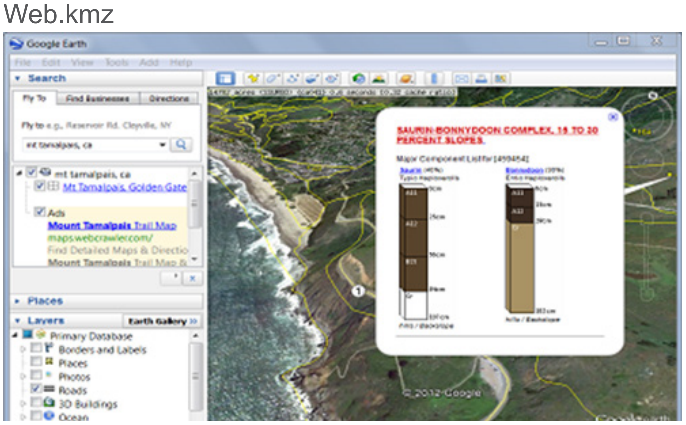
https://casoilresource.lawr.ucdavis.edu/gmap/



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 Earth

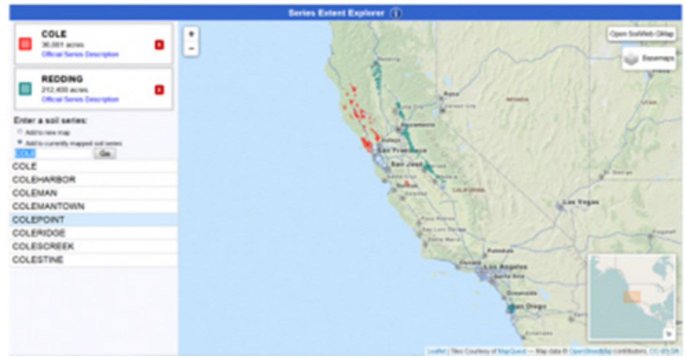
http://casoilresource.lawr.ucdavis.edu/soil_web/kml/SoilWeb.kmz



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/

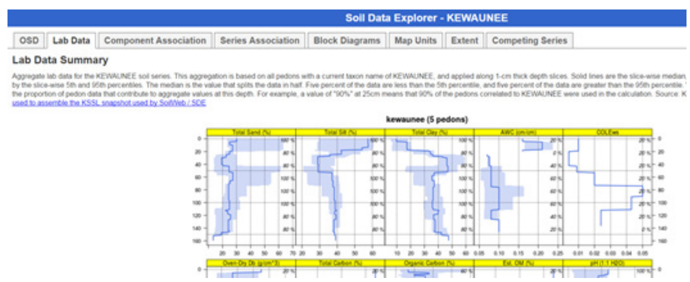


SEE allows users to explore the spatial extent of soil types nationwide.

SDE: Soil Series Data Explorer (SDE)

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

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

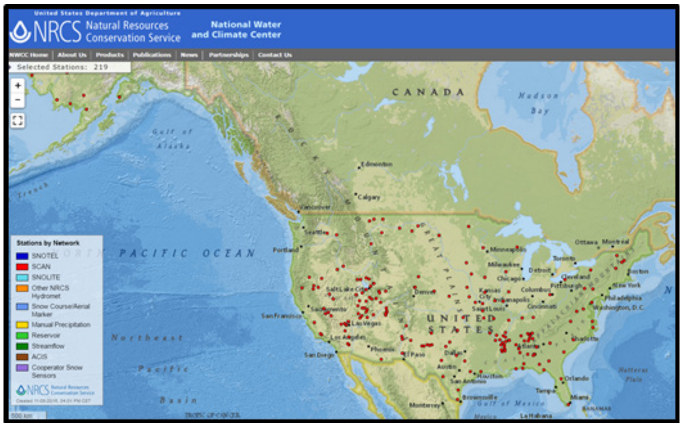


This website is accessible via SEE (see above), or can be used by appending a soil series name to the end of the URL. SDE integrates KSSL, SSURGO, block diagrams, OSD, and SC databases.

Cooperative Soil Science Tool Continued

SCAN/ SNOTEL

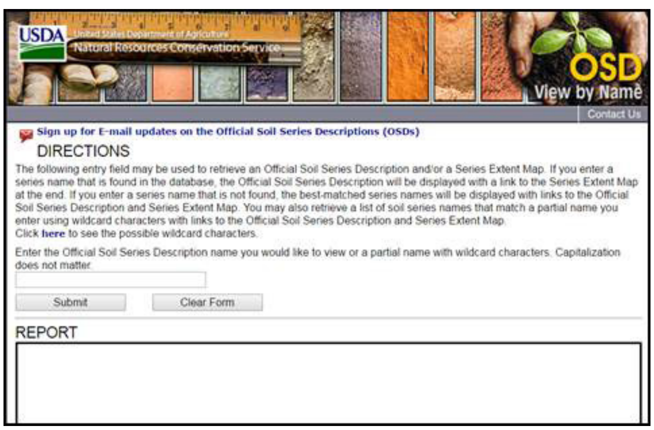
http://www.wcc.nrcs.usda.gov/scan/
http://www.wcc.nrcs.usda.gov/snow/



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.

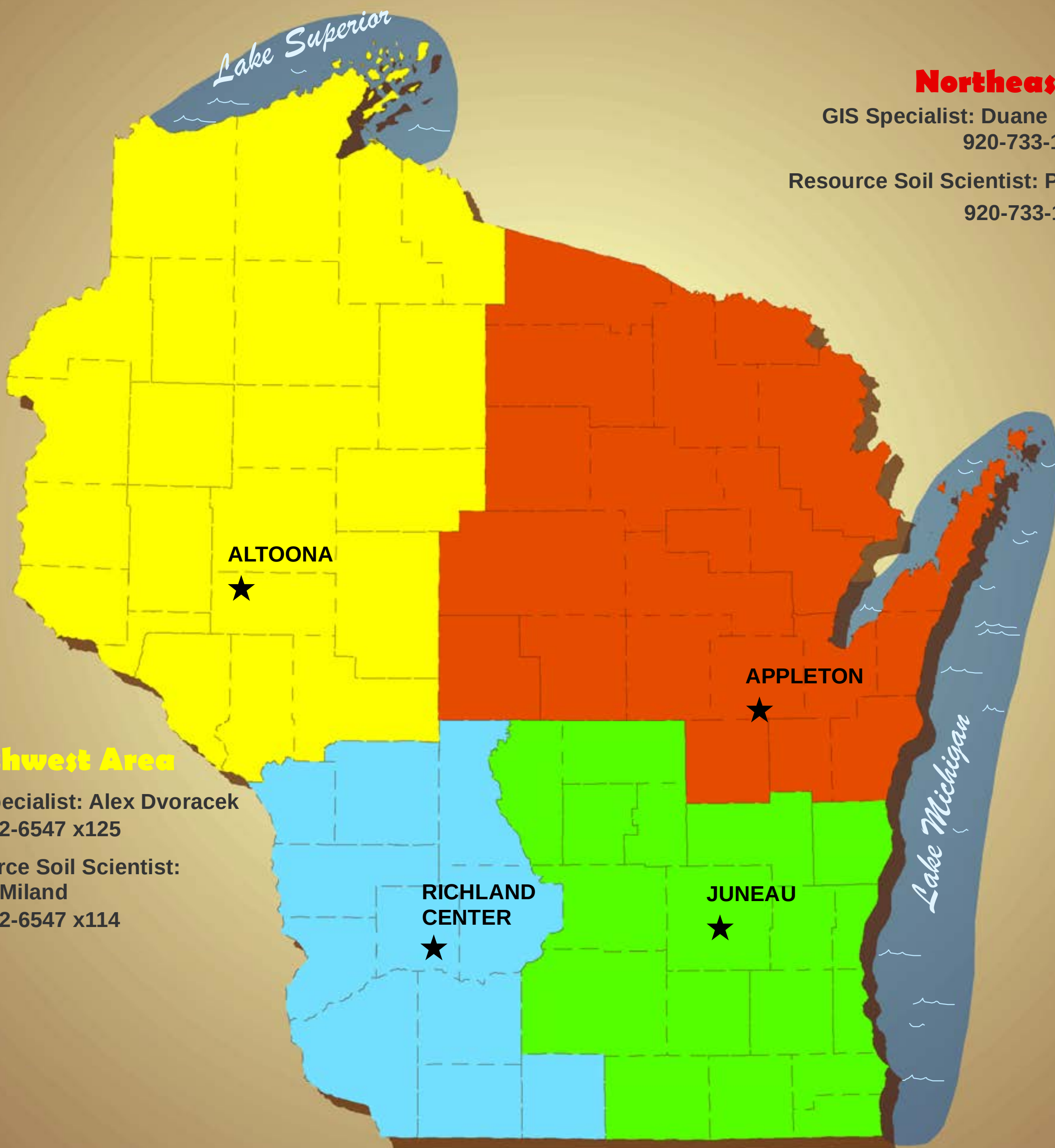
WISCONSIN

Area Specialists

Northeast Area

GIS Specialist: Duane DeVerney
920-733-1575 x124

Resource Soil Scientist: Phil Meyer
920-733-1575 x118



Northwest Area

GIS Specialist: Alex Dvoracek
715-832-6547 x125

Resource Soil Scientist:
Tim Miland
715-832-6547 x114

Southwest Area

GIS Specialist: Craig Surman
608-647-8874 x131

Resource Soil Scientist:Jeff Deniger
608-647-8874 x116

Southeast Area

GIS Specialist: Vacant

Resource Soil Scientist:Jeremy Ziegler
920-386-9999 x122


WISCONSIN
Soil Science Offices
Lake Superior
Rhinelander Major Land Resource Area
Duluth Major Land Resource Area
RHINELANDER
Waverly Major Land Resource Area
ONALASKA
JUNEAU
Lake Michigan
Onalaska Major Land Resource Area
Aurora Major Land Resource Area
Juneau Major Land Resource Area

USDA is an equal opportunity
provider, employer, and lender.

Wisconsin Soils Program • January 2017