National Cooperative Soil Survey Newsletter

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Editor's Note

Issues of this newsletter are available on the World Wide Web (http://soils.usda.gov/). Under Quick Access, click on NCSS, then on Newsletters, and then on the desired issue number.

You are invited to submit stories for this newsletter to Stanley Anderson, National Soil Survey Center, Lincoln, Nebraska. Phone—402-437-5357; FAX—402-437-5336; email—stan.anderson@lin.usda.gov.

Series Extent Mapping Tool

By Craig Ditzler, USDA, NRCS, National Soil Survey Center, Lincoln, Nebraska; Sharon Waltman, USDA, NRCS, National Geospatial Development Center, Morgantown, West Virginia; and Brian Bills, Steven Crawford, and Doug Miller, Penn State Center for Environmental Informatics, University Park, Pennsylvania.

In the "old days," records of the geographic extent of soil series were maintained by the soils staff at each of the four (then existing) National Technical Centers. The staffs recorded the extent by hand-coloring the counties on a region-wide map as the soil was correlated at the completion of individual soil survey projects. The progressively updated hard copy map was stored in a file cabinet along with each version of the Official Series Description (OSD) as it was revised over time. The map was a handy tool for a soil correlator, who could readily see where a given soil series had been correlated and thereby its geographic distribution.

With the introduction of computers into the soil survey program beginning in the late 1980s, we quickly advanced to a much improved system of processing and storing Official Series Descriptions electronically. Soon, the rows upon rows of file cabinets in which the records for more than 20,000 OSDs had been stored were rendered obsolete. The new system greatly improved the efficiency of handling the OSD text file. Today, anyone with computer access can easily search, sort, and view the latest OSD copy at www.soils.usda.gov/technical/classification/osd/.

As beneficial as the new system was, however, it had the unintended consequence of the loss of the very useful series extent maps. The hand-colored maps are now mostly lost to history, and for a few decades our technological advancements did not provide a replacement tool for generating these distribution maps. In the early 1990s, I worked with Sharon Waltman when we were both on the staff at NSSC to develop a simple GIS tool that used the Map Unit Use File (MUUF) and soil survey boundaries to map out the acreage of series across the Nation. This tool used the agency GIS software of that time, Geographic Resource Analysis Support System (GRASS), and UNIX scripting. The tool was popular in the Midwest, but it was difficult to maintain for national usage because the MUUF file and the soil survey areas were in a constant state of flux. In 2001, Sharon Waltman and I had the first of several recurring discussions in which we lamented the loss resulting from this "progress" and considered how we might get back some of the digital mapping function we had in the early 1990s.

In recent years, technological tools, such as hard drives, databases, Internet connection speeds, and GIS software, have improved to the point where we are now able to produce a new and improved version of what we once had. The Series Extent Mapping (SEM) Tool has been developed as a result of a Cooperative Ecological Studies Unit (CESU) partnership with representatives from the National Geospatial Development Center, the National Soil Survey Center, Penn State Center for Environmental Informatics, and West Virginia

University. The SEM Tool is a Web application that provides the user with interactive national maps of the extent of soil series. For example, figure 1 shows the distribution of the Sharon series.

This tool helps scientists, educators, and the public to gain a better understanding of soil series concepts and soil taxonomy in relation to the natural divisions of the Nation's physical land resources. The more than 20,000 interactive maps are developed through a complex interaction of several existing databases. These include the calculation of land area of soil series mapped in detailed soil surveys (more than 33 million polygon geometries in SSURGO), the reported acreage totals for areas with no spatial data available (Soil Data Mart), soil series names from the Soil Classification File (SC File), and the Land Resource Regions and Major Land Resource Areas map of the United States. In addition to the map showing the geographic extent of the soil series, the tool also provides tabular acreage summaries for individual soil series by soil survey area and access to the Official Series Description narrative. The SEM Tool is launched when a user queries the Official Series Descriptions at http://soils.usda.gov/technical/classification/osd/ or in free-standing mode from http://soils.usda.gov/survey/geography/. User-generated color maps and tabular reports can be easily printed. Users are encouraged to contribute comments via the SEM Tool microphone icon.

While the initial version of the SEM Tool has generally been received positively, some constructive criticisms have been expressed. The most notable

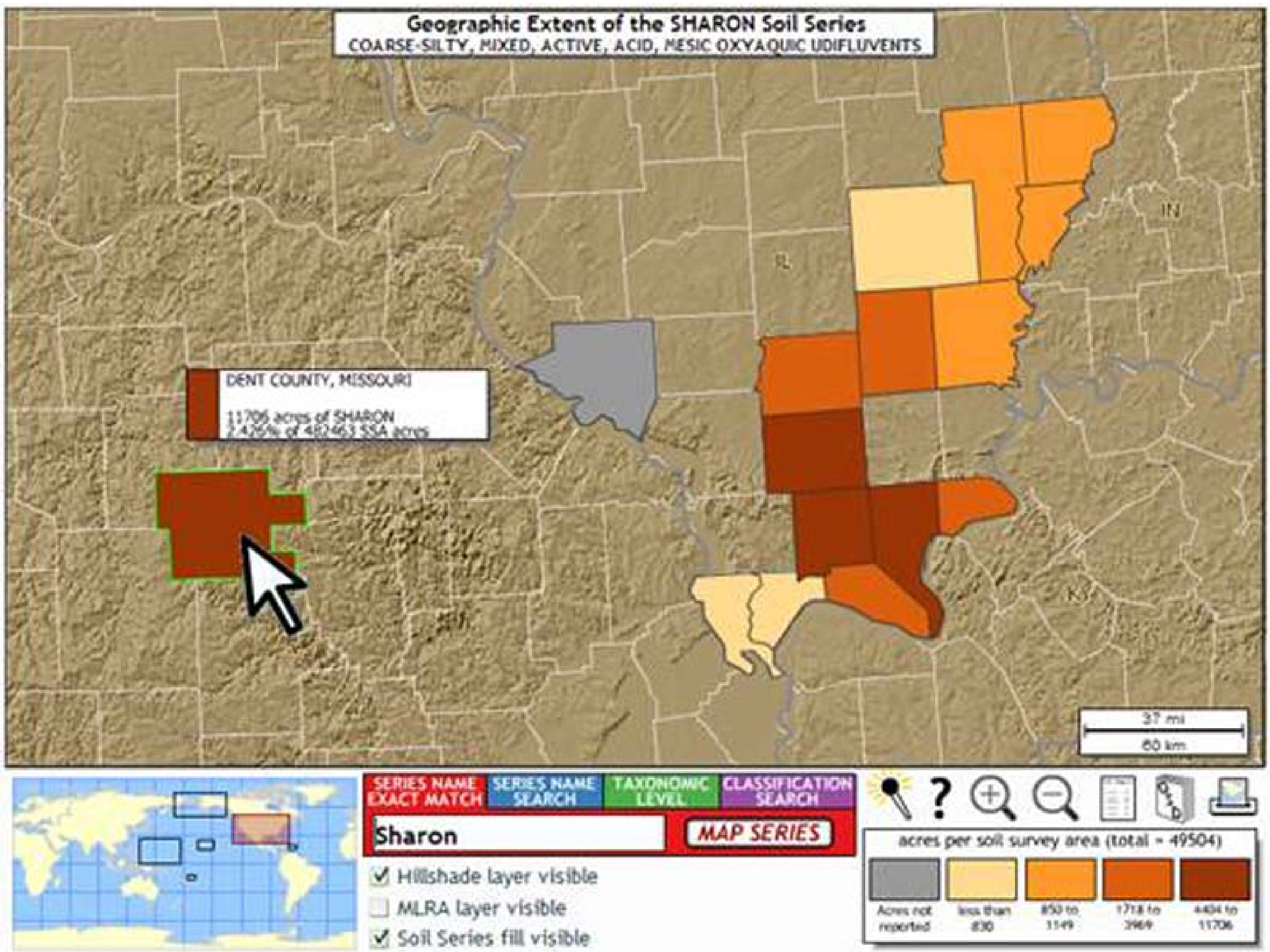


Figure 1.—Extent map for the Sharon series. Note the apparent "outlier" of this series in Dent County, Missouri.

issue probably has been the fact that the tool does not run against real time data. At the time of this writing, the tool shows a “snapshot” of data from February 2006. Thus, it does not reflect correlation changes or the completion of new SSURGO data sets since that time. Our original intention was to refresh the data sets at least twice each year. Technical difficulties with some of our GIS software have kept us from reaching this goal as easily as we hoped. We expect to have a refreshed data set available within the 2007 calendar year. Regular updates will follow. Ultimately, we hope that the system will allow us to refresh the data much more frequently (maybe even nightly). Also, for soil survey operations, we hope to be able to run a SEM tool off local GIS workstations and our live SSURGO/NASIS database to illustrate the extent of series concepts by mapping out individual SSURGO polygons. A number of technical problems have to be solved before we can reach this goal.

Another goal is to be able to generate maps on the basis of various taxonomic levels above the series. A map showing the distribution of a suborder, great group, or some combination of family terms and higher taxa would be a powerful tool for evaluating taxonomic issues. This capability will be available within the 2007 calendar year. A test version of the SEM Tool for developing taxonomic queries is being evaluated. Figure 2 shows the approximate distribution of fragipans in the United States. It is the result of a query for soils with the formative element “Fragi” at the great group level.

We have come a long way since the days of the many file cabinets having hard copy maps and descriptions for all the series in the country. The SEM Tool is a nice example of how we can use technology to help those using soil surveys and those involved in making the surveys to better understand the distribution of soils across our landscapes. ■

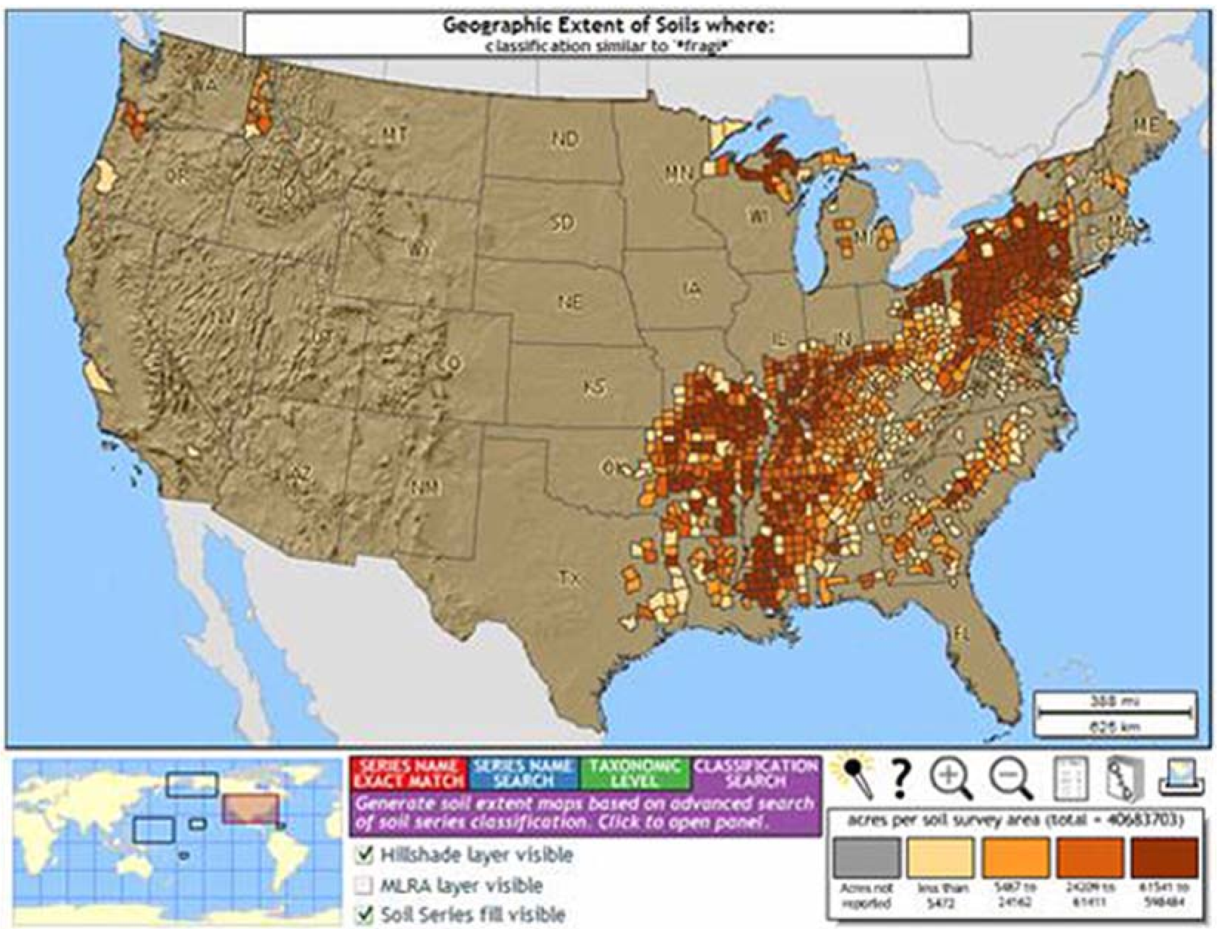


Figure 2. —Approximate distribution of fragipans in the United States.

Park Spotlight—Lassen Volcanic National Park, California

By Susan B. Southard, NRCS-NPS Liaison.

As part of the Department of the Interior's Natural Resource Challenge to inventory all National Park Service (NPS) resources in the Nation, NRCS staff in California has been knee-deep in efforts to map all NPS properties in the State. Presently, there are two parks actively being mapped in California—Lassen Volcanic National Park (LAVO) in the Southern Cascades and Joshua Tree National Park in the Mojave Desert. This newsletter spotlight focuses on the soil survey of Lassen Volcanic National Park, which is now closing its second short field season.

Lassen Volcanic National Park is a 106,000-acre park in northern California. It includes the world's largest plug dome volcano, which rises to 10,457 feet above sea level. Plug dome volcanoes are created by lava that is too viscous to flow away from its source. Adding to the park's complexity is the fact Lassen Peak was glaciated at the same time it was forming. Many park features and adjacent landscapes were deformed during the last 25,000 years as eruptions and dome building occurred under the ice. Lassen Peak started rumbling again in May 1914 and had a climatic lateral eruption on May 22, 1915, with a massive pyroclastic flow that mixed with snowmelt and became a devastating mudflow called a lahar. Before Mount St. Helens, Lassen Peak was the only volcano in the 48 conterminous United States to have erupted in the 20th century.

Andrew Conlin, Lassen Project Leader, explaining landforms and soils to Ed Burton, NRCS California State Conservationist, as Jen Anderson looks on.

LAVO field season starts in June 2007.

The park landscape is dotted by sulphur vents, boiling mud pots, hot springs, fumaroles, landslides, and massive cinder cones that have periodically draped the area with scoria.

Jen Anderson, still smiling while digging in glacial till.

Garrett Liles, graduate student, cleaning out soil for monolith sampling.

Julie Baker, graduate student, and Dr. Randy Southard, clearing out soil in Lassen NP Manzanita campground.

Dean Burkett helps to sample soil in the Painted Dunes area.

Erin Hourihan, plant specialist, helps with sampling.

Left to right, Andrew, Garrett, Jen, Erin, Julie, and Dean in back; Sue in front.

The story of the soils in Lassen Volcanic National Park is being pieced together by a crew led by Andrew Conlin, NRCS Project Leader out of Chico, California. The main field crew has included Jen Anderson, NRCS soil scientist from Chico, and Garrett Liles and Julie Baker, both Ph.D. soils graduate students at the University of California at Davis. Assisting the crew with plant data collecting has been summer hire Erin Hourihan from Reno, Nevada. Susan Southard, NRCS-NPS liaison, has remained as the survey review team leader, and correlation of the soils is being provided by Dean Burkett, NRCS MLRA Project Leader out of Chico. Study of plant relationships is being guided by Kendra Moseley, Ecological Site Description (ESD) coordinator at the California NRCS State Office. Kendra has hired a contract plant specialist, Marchel Munneke, to write the ESDs.

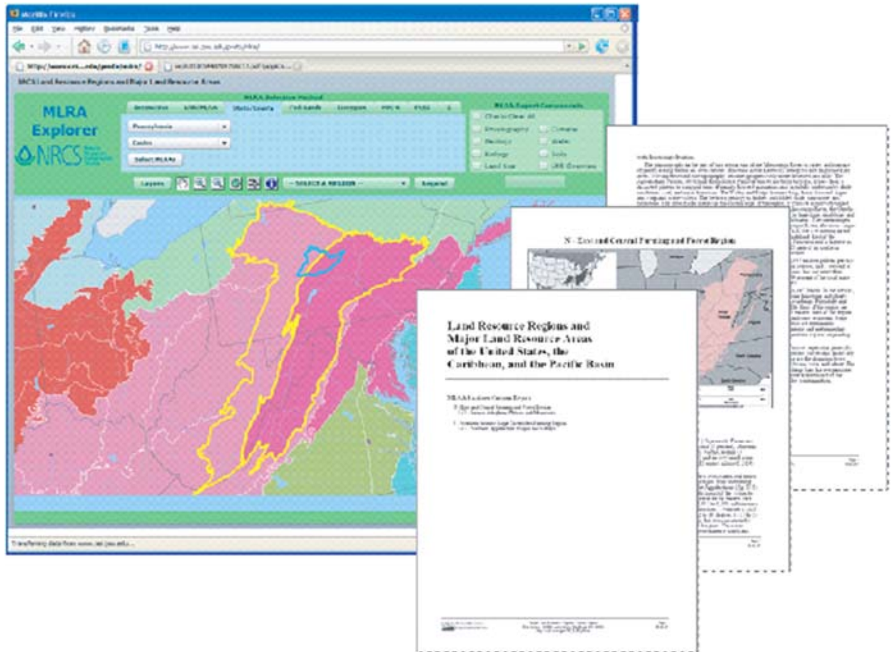
Separating glacial till and outwash from volcanic debris flows and tephra deposits has been the major task for the crew. Dense till and duripans occur throughout the landscape. Most of the soils are very deep. Very few are shallow. Early lab characterization performed on major pedons after the first season has given the crew a good handle on the soil orders in the park. Last month two soil monoliths were sampled from the park in hopes of displaying Lassen's volcanic history and glaciated past in soils.

As anyone who has worked on a national park soil survey knows, access to the parks is limited. There are few roads, and most trails only take the easy route to places you had not planned to sample. With team perserverance and a cooperative staff that includes Louise Johnson, Acting LAVO park superintedent, Pete Biggam, NPS soil inventory program manager, and Dave Smith, NRCS State Soil Scientist, the soil survey crew has had few problems with archaeological clearances, park housing, sampling protocol, and access. Weather has been the most unpredictable factor and is the only factor that has been able to close the survey down.

With park closure now due to snow and ice, the soil survey crew in Lassen Volcanic National Park will refocus their energies on compiling and analyzing their field data into a concise report and Web Soil Survey product for all Americans to enjoy. ■

Major Land Resource Area (MLRA) Explorer

By Brian Bills, Douglas A. Miller, Allen Huber, and James L. Sloan II, Penn State Center for Environmental Informatics; Sharon W. Waltman and Jon Hempel, USDA-NRCS, National Geospatial Development Center; and Karl Hipple and Stanley Anderson, USDA-NRCS, National Soil Survey Center.



What is the MLRA Explorer?

The MLRA Explorer is a World Wide Web application that presents USDA Agriculture Handbook 296, *Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin* (2006), in an online interactive format. Through the use of Adobe Flex and Internet map services technologies, the tool enables users to:

- Search for MLRAs using geographical and textual queries.
- Select which handbook sections to display.
- Print and save a customized subset of the handbook.

What search methods are supported?

- Browse an interactive map and identify a point or area of interest.
- Choose an LRR symbol and name from a list.
- Choose an MLRA symbol and name once an LRR has been chosen.
- Select a state or territory name from a list.
- Select a county name once a state has been chosen.
- Type an 8-digit hydrologic unit code (HUC-8).
- Specify a Public Land Survey System township.
- Choose a federal land managed by USFS, NPS, BLM, or DOD.

How do you use the tool?

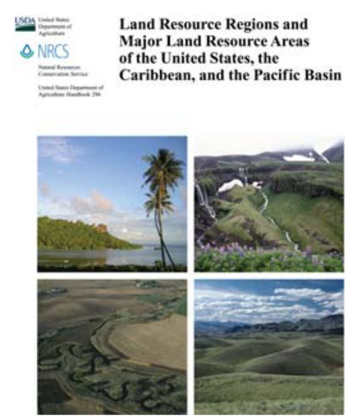
- Visit the MLRA Explorer Web site to browse LRRs and MLRAs in the context of other spatial data or create a selection query.
- Execute a search for MLRAs based on geographical or textual criteria.
- MLRAs matching the criteria will be selected and displayed on the map.
- Select which sections of the handbook to display on the report.
- A customized Adobe PDF document will be prepared to be printed and/or saved.

What are the sources of data?

- To this point the rich narrative content of the handbook has been maintained in desktop publishing formats. In order to enable real-time report creation, we built a simple Access database from the PageMaker documents. This database also will enable more efficient maintenance of the LRR and MLRA information.
- The primary LRR/MLRA data set was provided by the National Geospatial Development Center.
- Ancillary geospatial data sets were provided by the Web Soil Survey team.

How do I access the tool?

- www.cei.psu.edu/mlra ■



Benchmark Soils: Status and Questions

By R. David Hammer, former National Leader, Soil Survey Investigations, National Soil Survey Center; Bob McLeese, State Soil Scientist, Illinois; and Thomas Reinsch, Supervisory Soil Scientist, National Soil Survey Center.

Introduction

The National Cooperative Soil Survey (NCSS) is moving into “the next generation,” which will include map unit verification; quantification of soil variability within map units; investigations into soil-landscape processes important for an increasing variety of land uses; development of a broader suite of user-requested soil interpretations; and integration of new forms of technology into field work, data analyses, and soil landscape modeling. Challenges for soil scientists conducting the next generation of soil survey work will include reduced sizes of field staffs; increasing and different “out-of-field” demands for soil scientists’ time; fewer opportunities for soil scientists to go to the field; the need for more and different soils data than were acquired for classification and mapping; and, for newly employed soil scientists, the challenge of learning about soils in the field without the benefits and rigors of daily field mapping. The major question facing State Soil Scientists and their staffs is, “How will we do it?”

Increased efficiencies, pragmatic long-range planning, and focus upon key, regionally “representative” soil series would seem to be obvious responses. Benchmark soils, in their original context, would seem to be best suited to the development of databases for regional soil needs. Long-range planning will require some retrospective review of what we have and how we got it in order to determine how to supplement existing data so that we get what we need. For example, if one were to consider what we know about the Drummer soil, which is a fine-silty, mixed, superactive, mesic Typic Endoaquoll and an Illinois benchmark soil, several questions probably would arise, including:

- How much of this soil exists?
- Where is this soil?
- How much and what kinds of data do we have for this soil?
- Are the data we have of sufficient quantity and quality for our current needs, and do they represent the natural distribution and current land uses of this soil?
- Can we extrapolate data from Drummer soils to adjacent soils on the landscape or to similar soils in the region?

The objectives of this paper are to review the benchmark soil concept and evaluate the concept in the context of the next generation of soil survey, describe our concept of a “complete,” relevant database for a benchmark soil series, and illustrate the concept with a discussion of Drummer silty clay loam.

The Benchmark Soil Concept

Benchmark soils are defined and justified in the National Soil Survey Handbook (NSSH 360). The most important attributes of a benchmark soil are:

- It is a soil of large aerial extent, generally 100,000 acres in a Land Resource Region (LRR) or 10,000 plus acres in a Major Land Resource Area (MLRA).
- It holds a key position in the soil taxonomic system.
- A large volume of data about this soil is available, or the soil has special significance for important land use(s).

The purpose of the benchmark soil concept is to acquire significant information about a soil of regional importance, so that the information can be extrapolated to related or neighboring soils (NSSH 360). This important concept has increased relevance now, when shrinking budgets and staff sizes are merging with new, more technologically driven and more complex interpretive needs.

In the context of the next generation of soil survey, the most important purpose of the benchmark soil concept would seem to be that it allows MLRA project offices to focus on the most important and extensive soils and land uses. Once baseline data are identified and obtained for these soils, work can logically and systematically be designed to “fill the gaps” and to represent locally important soil-landscape processes.

What Data Currently Exist?

A quick review of the data that represent soils being carried as benchmark soils revealed that fewer than one-half of the listed benchmark soils had data in the NSSC database. Most of the data on file would be considered incomplete for physical and chemical characterization. Collection of data to determine taxonomic criteria for production field mapping often eliminated time-consuming sampling, particularly for bulk density and soil water relationships.

What Data Would Constitute a “Complete” Data Set?

In a general sense, a complete data set would include all of the information necessary to understand how the Drummer soil functions on the landscape with its associated, neighboring soils. This information would include:

- Precise geo-referencing of described and sampled soil profiles.
- Complete, detailed soil profile descriptions that would represent two or more drainage flow-nets across the geographic distribution of the soil.
- Full chemical, mineralogical, and physical characterization of each described horizon in each soil profile, including the following data that currently are not routinely collected for each profile/horizon—

  Bulk densities
  Water infiltration
  Ksat measurements of all horizons that seem to be aquitards (restricting vertical water movement) or aquifers (enhancing vertical and/or lateral waterflow)
  Soil organic carbon
  Total Fe and Mn (in ustic, udic, and aquic soils)
  Total gypsum (in xeric and aridic soils)
  Seasonal monitoring of perched or temporal water tables and correlation of the water table data with morphological and chemical soil attributes, particularly redoximorphic features

The ultimate goal would be to obtain the ability to model recharge, throughflow, and discharge within a representative benchmark soil catena or watershed. One benefit of this approach to completing the database for the Drummer soil is that soil scientists would have to consider and discuss where and why to sample the soil and would have to design field monitoring to test their hypotheses of how water is temporally and spatially distributed on the landscape. As McLeese noted in discussions about this presentation, “This is the fun work of pedology that would allow field crews to be soil scientists again, instead of geographers and cartographers.”

What Did a Preliminary Investigation of the Drummer Soil Reveal?

The Drummer soil is most abundant in Illinois, where it is mapped on about 1.3 million acres. It is mapped into Wisconsin (four survey areas —9,600 acres) and Indiana (seven survey areas —130,000 acres), and an “outcrop” of it occurs in Ohio (one survey area — about 3,500 acres), at some distance from its nearest neighbors in west-central Indiana. Abrupt discontinuities in the distribution occur at county boundaries, at MLRA boundaries, and at the Illinois-Indiana State line (fig. 1).

The obvious questions about the distribution, composition, and processes in the Drummer soil landscape can be systematically addressed without remapping the area. Computer technology can be combined with quality terrain attribute data to model the distribution of Drummer soils. On field trips, soil scientists can verify the occurrence of Drummer and associated soils and sample the soils systematically in order to complete a substantive, representative database. This approach allows soil scientists to strategize, think, apply what they know, and be more efficient and more “selectively thorough” than they could be in a production soil survey mode, where the goal was to map as many acres as possible.

Most of the laboratory data for the Drummer soil are in the University of Illinois database, and most of the few soil profiles in the NSSC database were

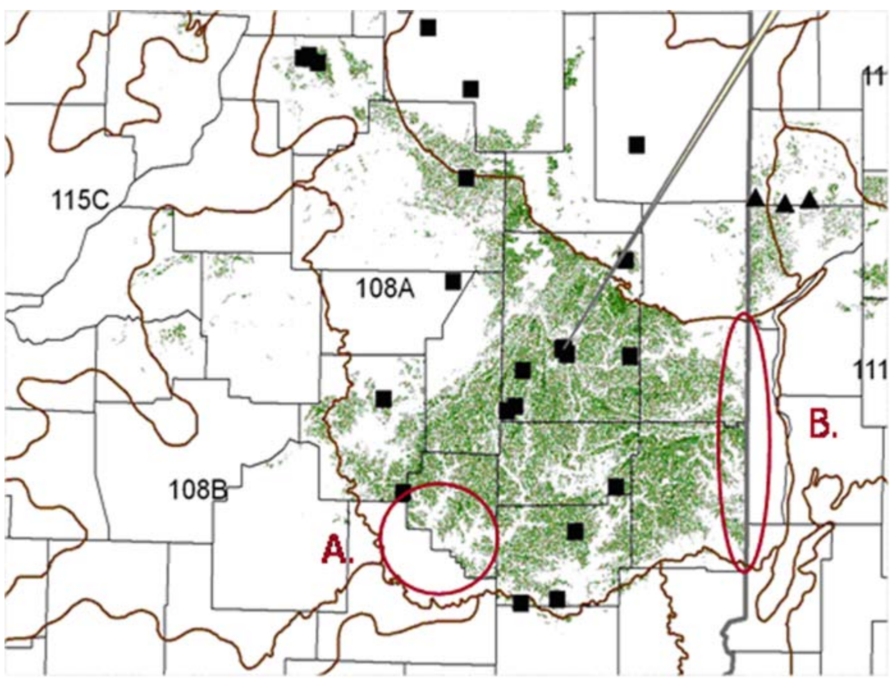


Figure 1.—Distribution of Drummer soils in east-central Illinois. Soil profiles for which data are in the University of Illinois database are indicated by square boxes. Soil profiles with data at the National Soil Survey Center are indicated by black triangles. “A” indicates a soil discontinuity at a county boundary. “B” indicates a soil discontinuity at the Illinois-Indiana State line.

sampled in Indiana. There is no "hillslope catena" set of soil data—all of the sampled soil profiles are unrelated in terms of seasonal distributions of soil water. The northern area of the Drummer distribution (northern Illinois and southeastern Wisconsin) is not represented by data. Measured by the standards described earlier in this paper, the soil profile data are not "complete."

Related Interpretive Work with the Drummer Soil

The Drummer soil is highly productive, and most of it is intensively managed for corn and soybeans. The soil formed in loess underlain by glacial outwash, is in areas of gentle slopes and minimal relief, and naturally is poorly drained. The original concept of the Drummer soil—loess over glacial drift—was narrowed to the present concept. Soils "split" from the Drummer series are El Paso soils (fine-silty, mixed, superactive, mesic Typic Endoaquolls—loess over till) and Milford soils (fine-silty, mixed, superactive, mesic Typic Endoaquolls—loess over lacustrine sediments). Tile drainage has been used for decades to remove water from the Drummer soil so that crops can be planted in the spring, when the soil is naturally wet. Paradoxically, center-pivot irrigation is often required late in the summer to optimize crop yields when evapotranspiration is not matched by precipitation. The Drummer soil is a major contributor of agricultural nitrogen to surface streams because of the tile drainage systems.

The NRCS state staff is working to develop models for controlling N-enriched field water release from the tile system. Discharge gates (riser boards) are being installed on the drainage tiles, and the water table is being lowered more gradually (fig. 2).

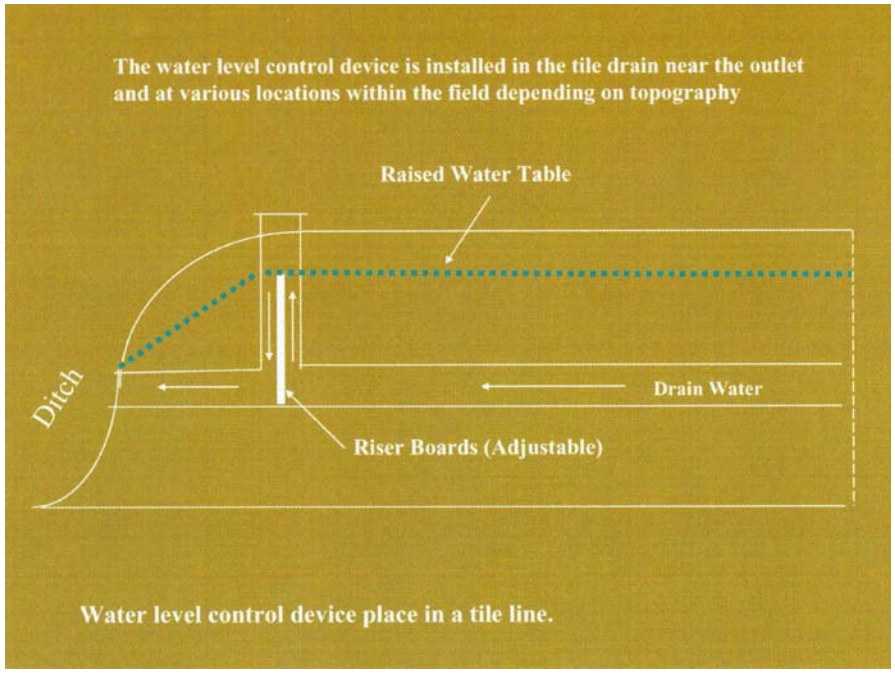


Figure 2.—Example of the installation of an adjustable riser board in a Drummer soil. Riser boards are installed where drainage tile discharge into the drainage ditch network. Illustration courtesy of Don Pitts, Illinois State Water Quality Specialist.

The goal is to keep soil water in contact with plant roots throughout the growing season, rather than releasing all of the water at once. This system provides more water to growing plants and allows more of the dissolved nitrogen to be taken up by field crops.

While this system requires that farmers invest more time in management, the resulting economic and environmental benefits are noteworthy and important. Farmers using the system appreciate the opportunities to discuss the soil-water dynamics with NRCS soil scientists, who, in turn, appreciate the opportunities to be relevant to practicing land users. This is a "win-win" situation for everyone. It places pedologists at the forefront of locally managed land management issues with national and international importance.

The other benefit of this project was that it placed agricultural engineers, hydrologists, and pedologists at a common table to solve a mutual problem. Everyone involved learned and benefited from the experience.

Summary

Evaluation of the data inventory and data needs of benchmark soils, particularly when data applications for land use are considered, is a scientifically sound way to focus dwindling human and economic resources in ways that are relevant and important. Soil scientists and landowners can benefit from the exercise. Also, the exercise greatly enhances the probability that the data for the benchmark soil can have applicability beyond that particular soil series. ■

Task Force Formed To Address Issues of Gypseous Soils

The National Soil Survey Center (NSSC), in response to requests from several Western States, has established a Gypseous Soils Task Force to study several aspects of soils that have a high content of gypsum. The Gypseous Soils Task Force is made up of four workgroups with members and scientists from universities, state offices, field soil survey offices, and the NSSC. The four workgroups are:

1) Laboratory Methods and Analyses
2) Soil Interpretations
3) Soil Geomorphology
4) Morphology and Classification

A field tour was conducted in the spring of 2007 to observe, investigate, and discuss gypseous soils in their natural environment. Since then, the workgroups have been conducting business via teleconferences. Also, workshop was held at the NSSC in August 2007. To date, substantial progress has been made on several items. These items include developing a new soil interpretation for unsurfaced roads, modifying 30 existing soil interpretations to account for soils with a high content of gypsum, identifying a minimum National Soil Information System (NASIS) data set for gypseous soils, addressing other standards and taxonomic issues related to textural modifiers, developing terms used in lieu of texture terms, establishing naming conventions for different forms of gypsum, defining stages of gypsum accumulation, and developing mineralogy classes for gypseous soils. Testing of the modified interpretations will begin in early 2008. The final release is expected to occur in mid to late 2008. ■

Profle of a classic gypseous soil. This soil has more than 40 percent gypsum throughout.

Honeycomb gypsum, a porous cemented layer, appears to exhibit precipitation and dissolution soil-forming processes.