NRCS Natural Resources Conservation Service

NCSS National Cooperative Soil Survey

Use of Soils Information for Land Management in the United States

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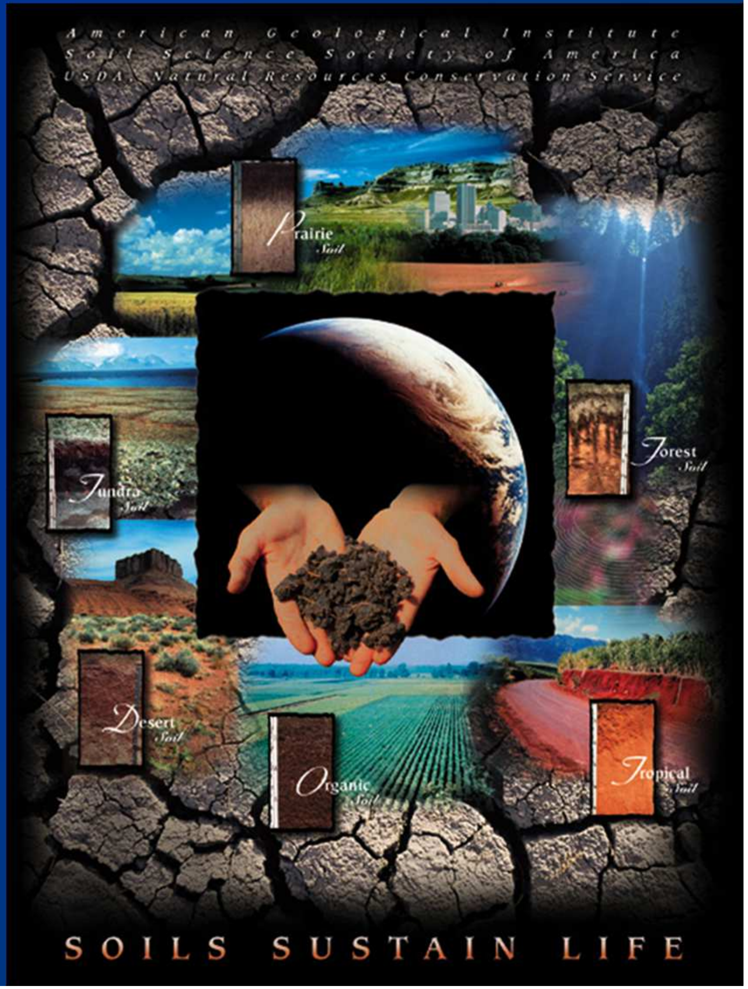
Soil Science Division

USDA-NRCS



Outline of Presentation

- Available soils data in the United States
- Soils information products
- Distribution mechanisms
- Examples of how soils data and information is used for land management
- New Initiatives

"No choice can be made between a utilitarian soil survey and a scientific soil survey. Of course, soil surveys made for predictions about land-use and management, and most of them are, must be practical. But they will not be practical unless they are also scientifically sound"

- Dr. Charles Kellogg

From: The Future of the Soil Survey. An address before the Soil Sci. Soc. Amer., Milwaukee, Wis., Oct., 1949.

Soils Data for the United States available from the National Cooperative Soil Survey (NCSS)

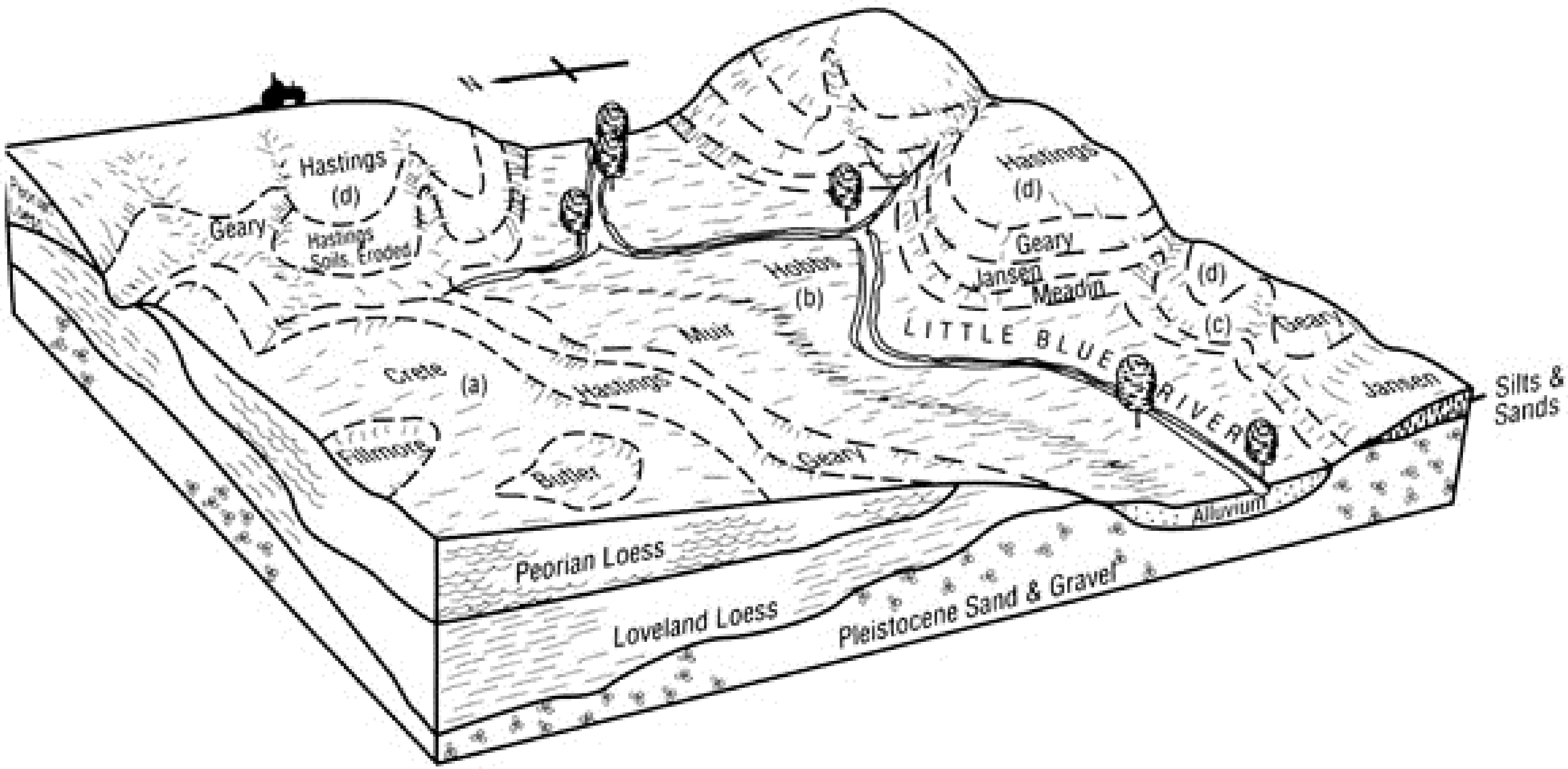
Soil Science Terms

- Soil surveyors delineated **map units** composed of one or more **components** on the landscape
- **Components** are divided and described as **pedons** which are divided in the vertical dimension by **horizons**
- Different types of data are collected and populated at the map unit, component and horizon level.

Definition of terms

- Map unit: a collection of areas defined and named the same in terms of their soil components or miscellaneous areas or both
- Component: a geographically associated group of soils that exist in a characteristic landscape and share a unique set of internal properties (usually synonymous with “soil series”)
- Pedon: A site specific vertical cross-section of soil
- Horizon: A distinct layer of soil, more or less parallel with the soil surface, having similar properties

FIGURE 2-3



Landscapes of Associations of Soil Series (Soil Survey Thayer Co., Nebraska).

Soils data products

- Pedon Characterization Database – KSSL (points)
- Soil Survey Geographic (SSURGO) database (polygons)
  - Recently released in 30m raster format as gSSURGO
- State Soil Geographic (STATSGO2) database (polygons)

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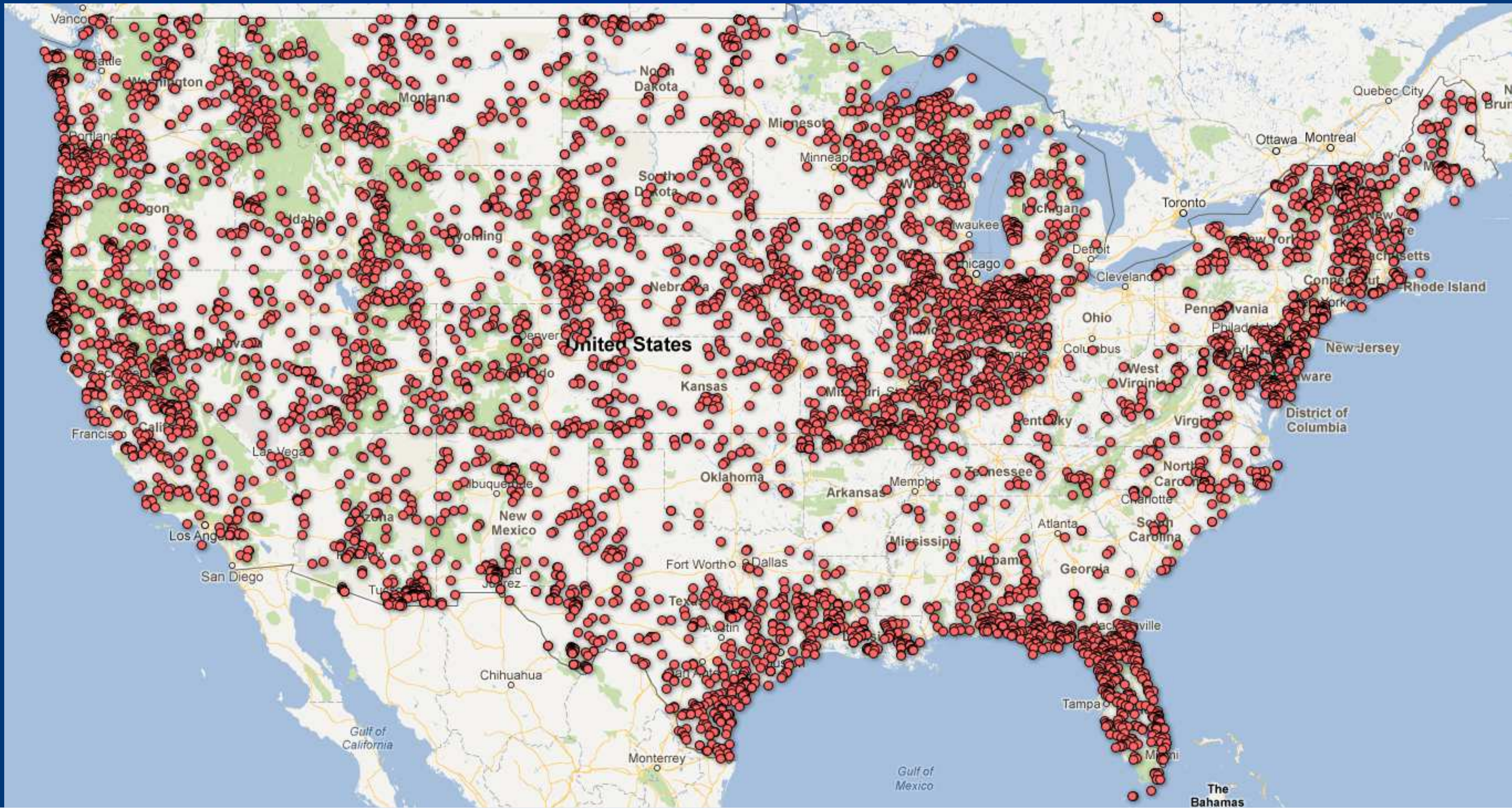
Pedon Characterization Database
(measured point data ~ 50,000 pedons)



Advantages

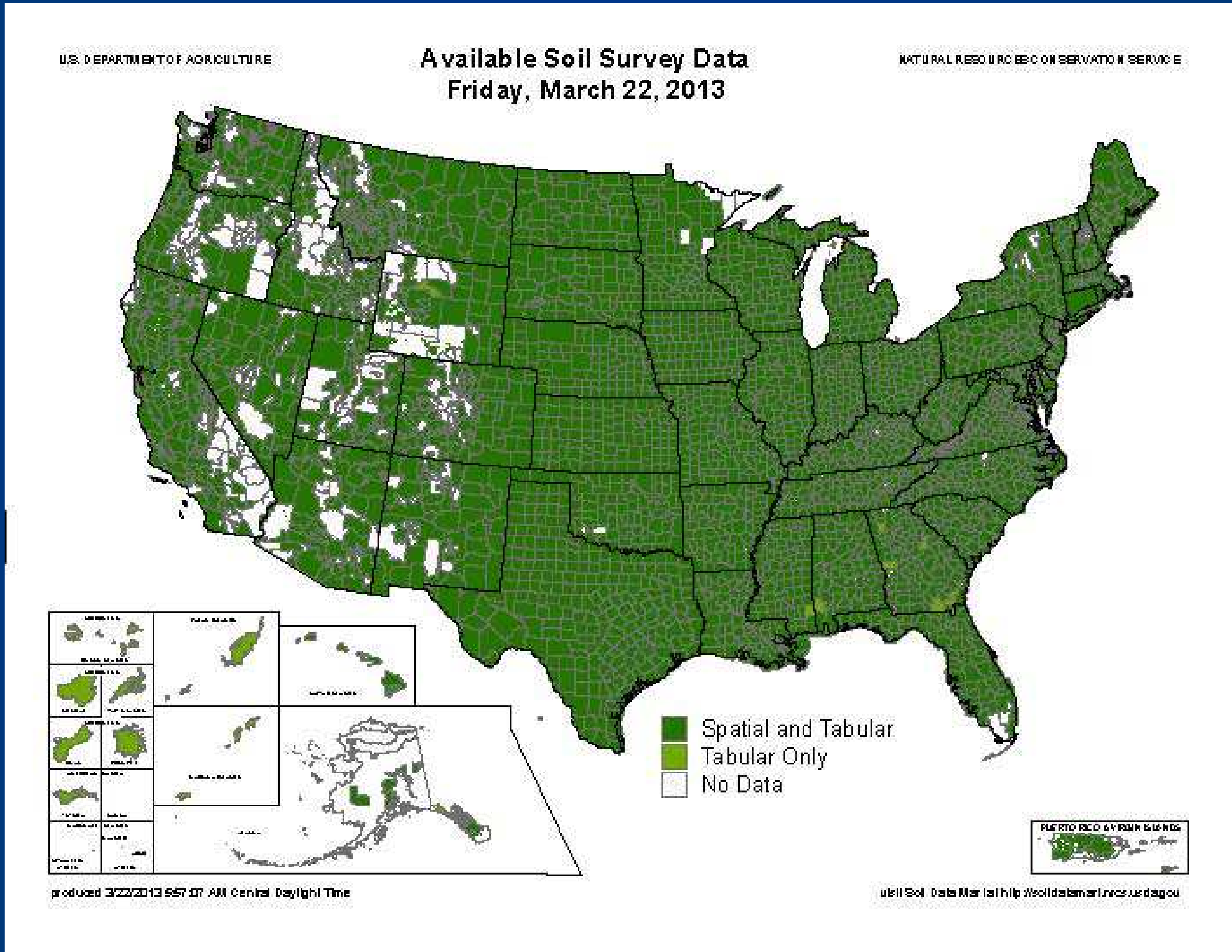
- It is measured data (not estimates)
- It is geo-referenced (vast majority)

Disadvantages

- Sample points largely not systematically distributed
- Points may or may not "match" spatial delineations (components, map units)
- Not all pedons have all characterization data (many collected to answer specific questions)

SSURGO

- Soil Survey Geographic database
  - Originally compiled as ~3,000 independent soil surveys
- Published: Annually (October 1)
- Currency: Oldest data from 1943
  Majority from 1970's and 1980's
- Scale: 1:12,000 to 1:125,000
  1:24,000 most common
- Spatial data: ~36,000,000 polygons
- Tabular data: ~289,000 map units with ~500,000 components


U.S. DEPARTMENT OF AGRICULTURE
Available Soil Survey Data
Friday, March 22, 2013
NATURAL RESOURCES CONSERVATION SERVICE
Spatial and Tabular
Tabular Only
No Data
PUERTO RICO & VIRGIN ISLANDS
produced 3/22/2013 9:57:07 AM Central Daylight Time
Visit Soil Data Mart at http://soildatamart.nrcs.usda.gov

gSSURGO

- **Gridded** Soil Survey Geographic Database
- Identical data to SSURGO
- “Rasterization” of polygon level data
- Each raster cell retains all properties of the reference polygon
- Available in 10m x 10m and 30m x 30m resolution

- Advantages
  - Nearly nationwide coverage (~80%)
    - Virtually all of the major agricultural land
  - Wide range of data and information

- Disadvantages
  - Data are estimates – “representative values”
  - Data is assigned to components and horizons but georeferenced to mapunits

STATSGO2

- State Soil Geographic database
- Published: 2006
- Currency: 1984-1994
- Scale: 1:250,000 (minimum size delineation – 2,500 acres)
- Spatial data: ~78,000 polygons
- Tabular data: ~9,600 map units

Advantages

- Complete coverage for the US (including Alaska, Hawaii and US Territories)
- Contains "common" soils information used in DSS and simulation models
- "Pre-aggregated" to map units at 1:250,000

Disadvantages

- Course scale "simplifies" landscape
- Significantly less data / map unit than SSURGO

Soil Information Products

Calculations and Interpretations

Calculations

- Information products developed by mathematically manipulating soils data (measured or estimated)
- Examples from SSURGO / gSSURGO
  - Available Water Capacity (AWC)
  - Total Organic Carbon

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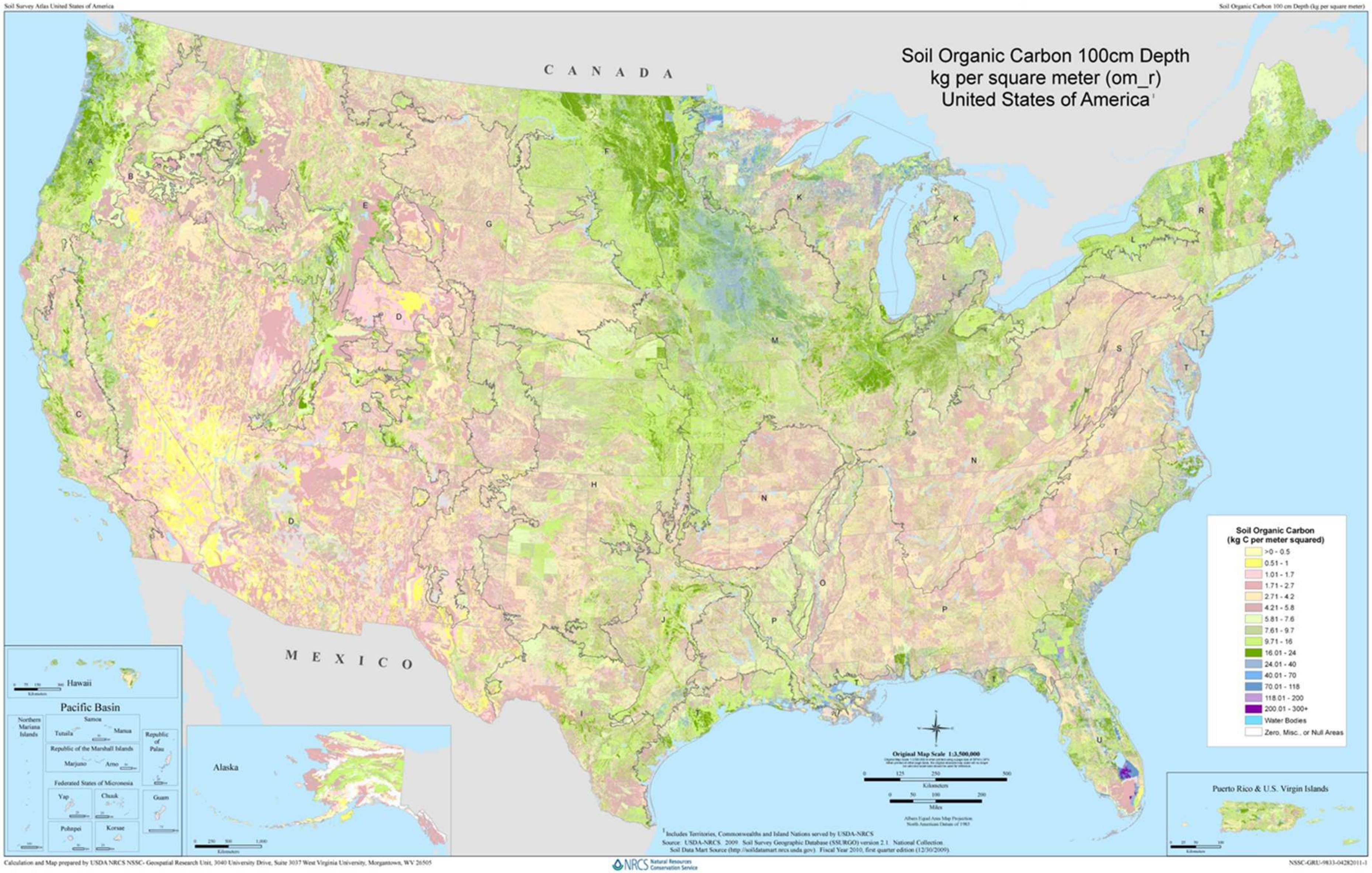
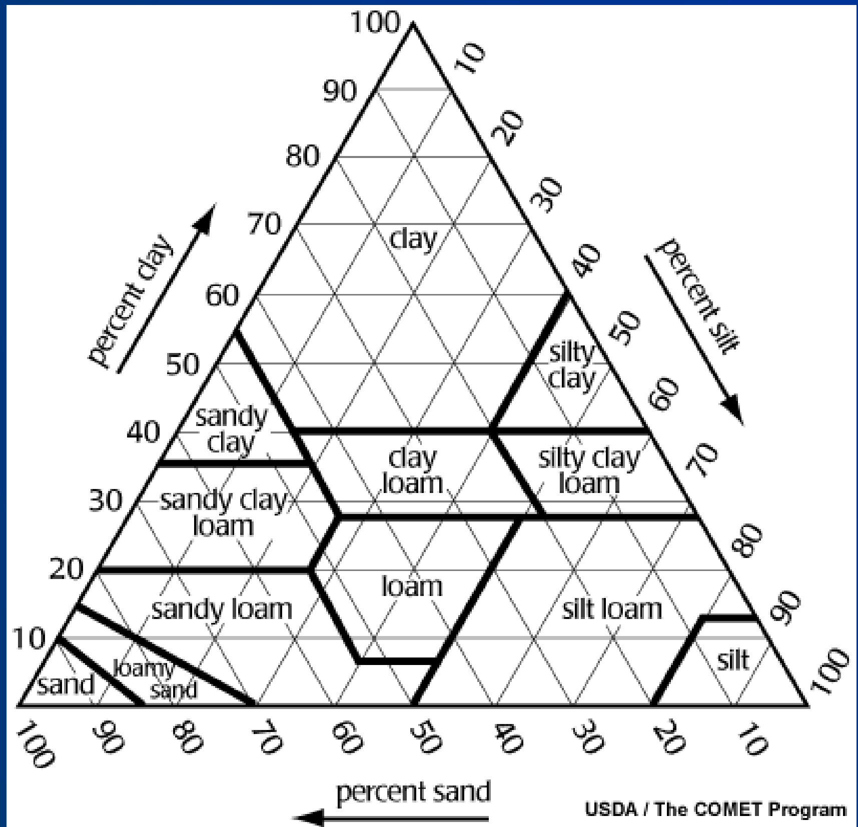


Interpretations

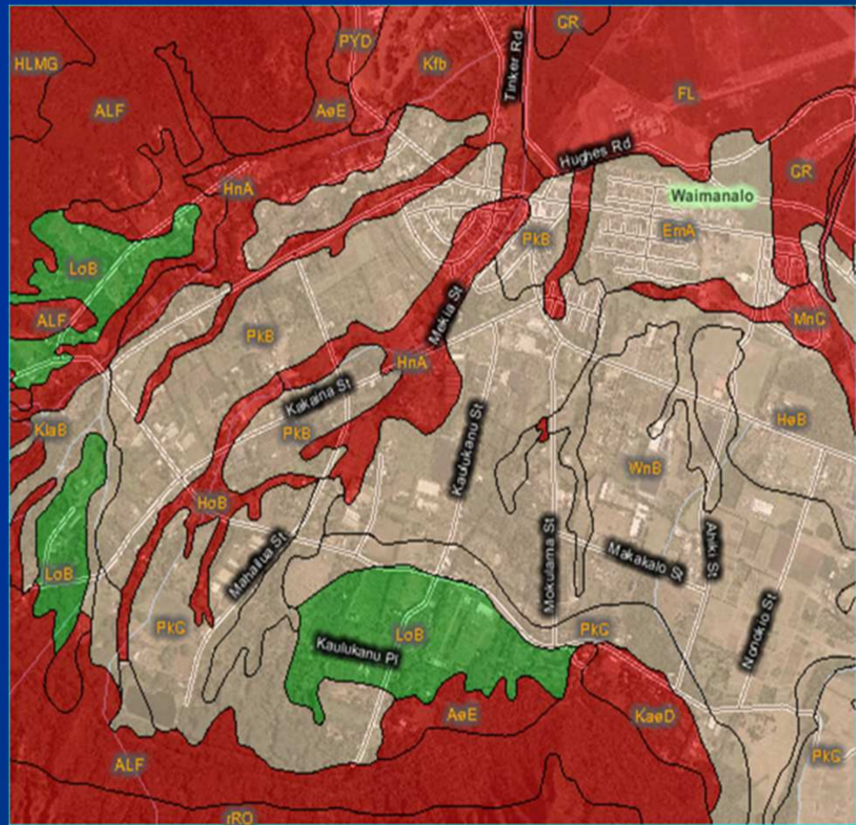
- Information products developed by using sets of rules combine and categorize the impact of soil properties
- Classes – broad categories
- Suitabilities – how “good” is the soil for a given use
- Limitations – what “problems” may limit the proposed use

Classes

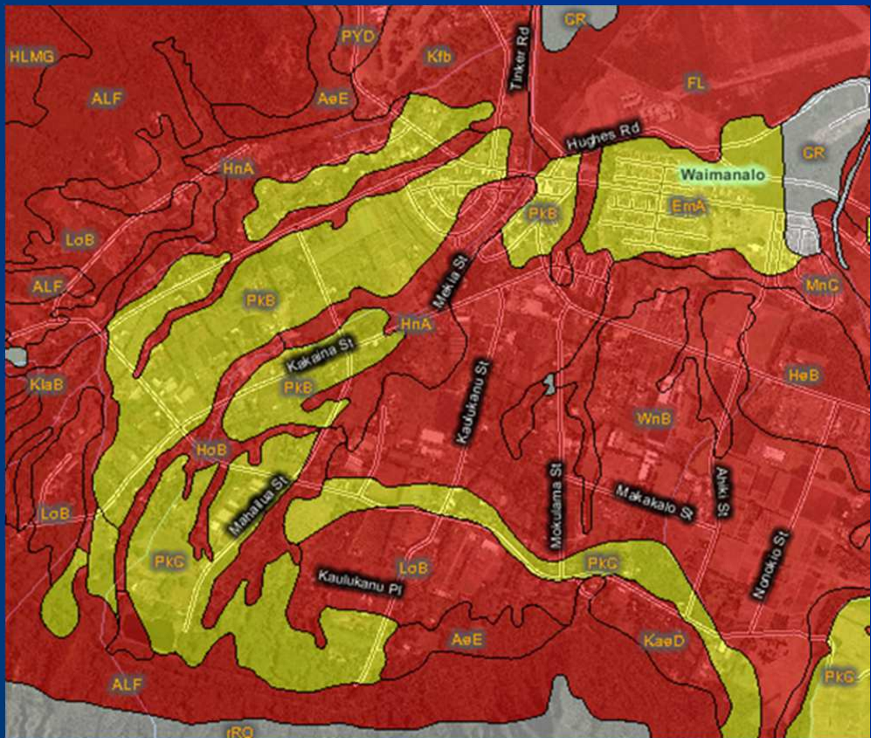
Soil Texture



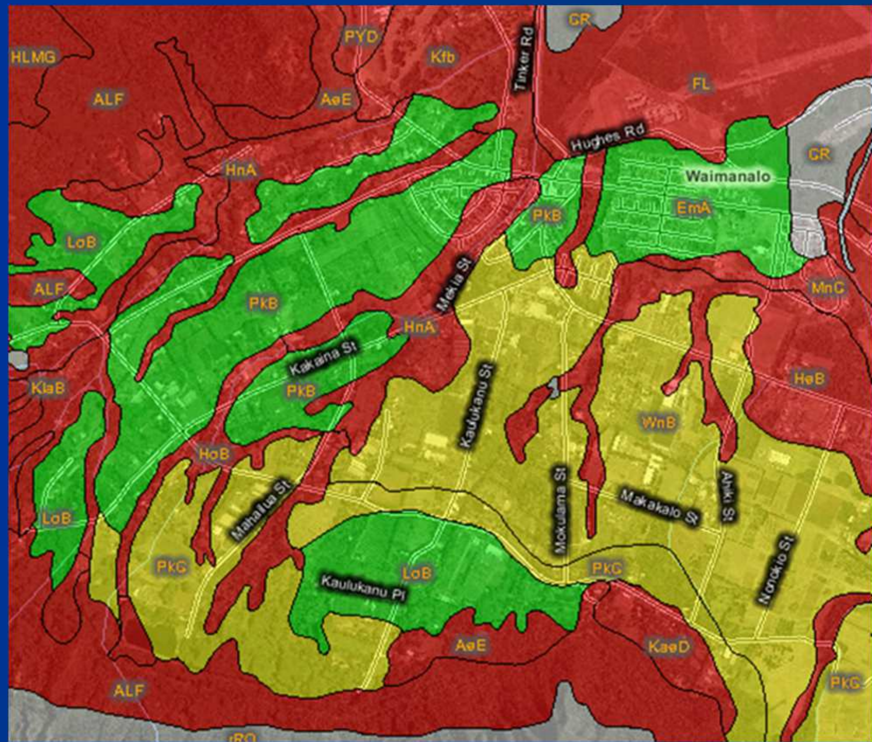
Prime Farmland



Suitability
Source of topsoil



Limitation
Dwellings w/o Basements



Soil Data Resources

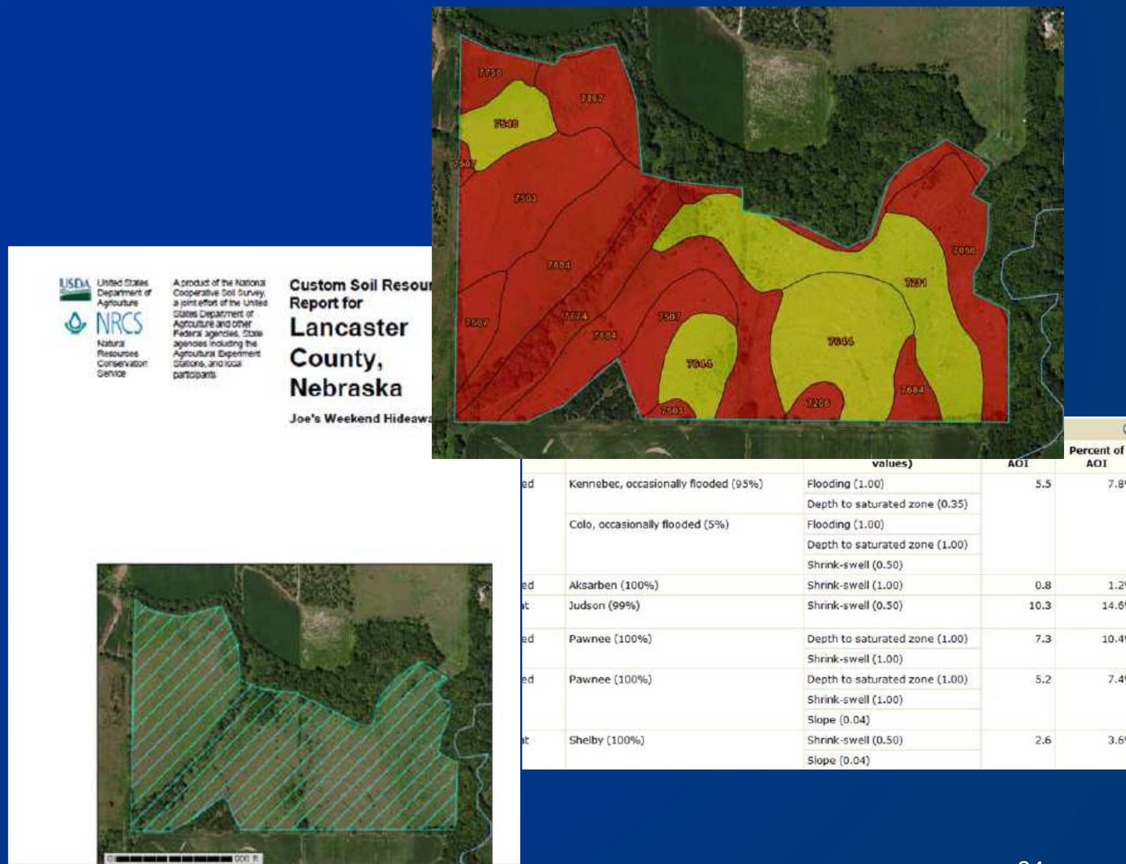
Web and Database Outreach

A Variety of Products for Diverse Public Need

Web Information Delivery

Web Soil Survey

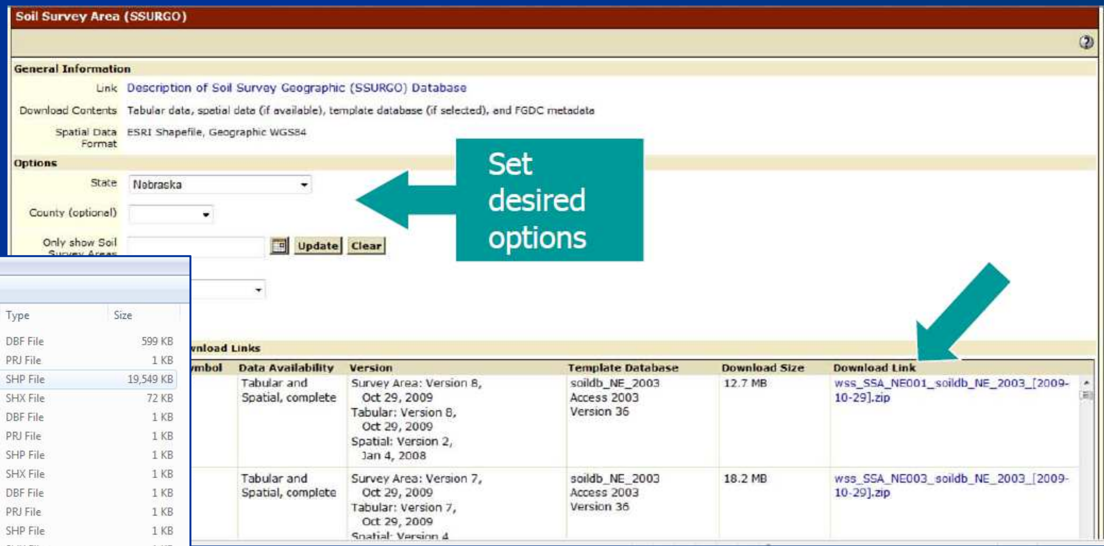
- Most used USDA informational outreach site
- Over 152,000 unique users every month
- Over 493,000 customized soil reports developed every month
- Up to 100,000 acres (40,000 hectares) for a selected Area of Interest
- Tabular reports
- Thematic maps
- Professional customized reports

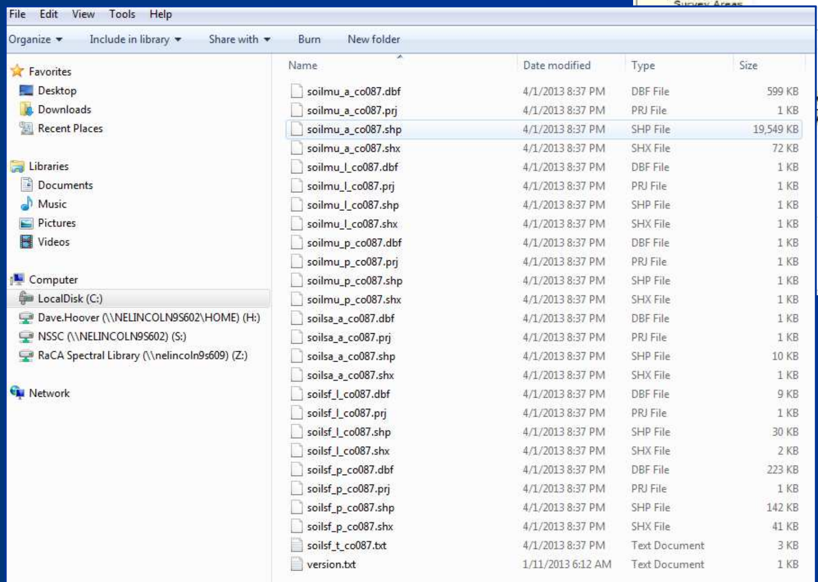


Web Soil Data Download

Web Soil Survey

- Data portal
- Over 3200 soil surveys available
- Update notification processes

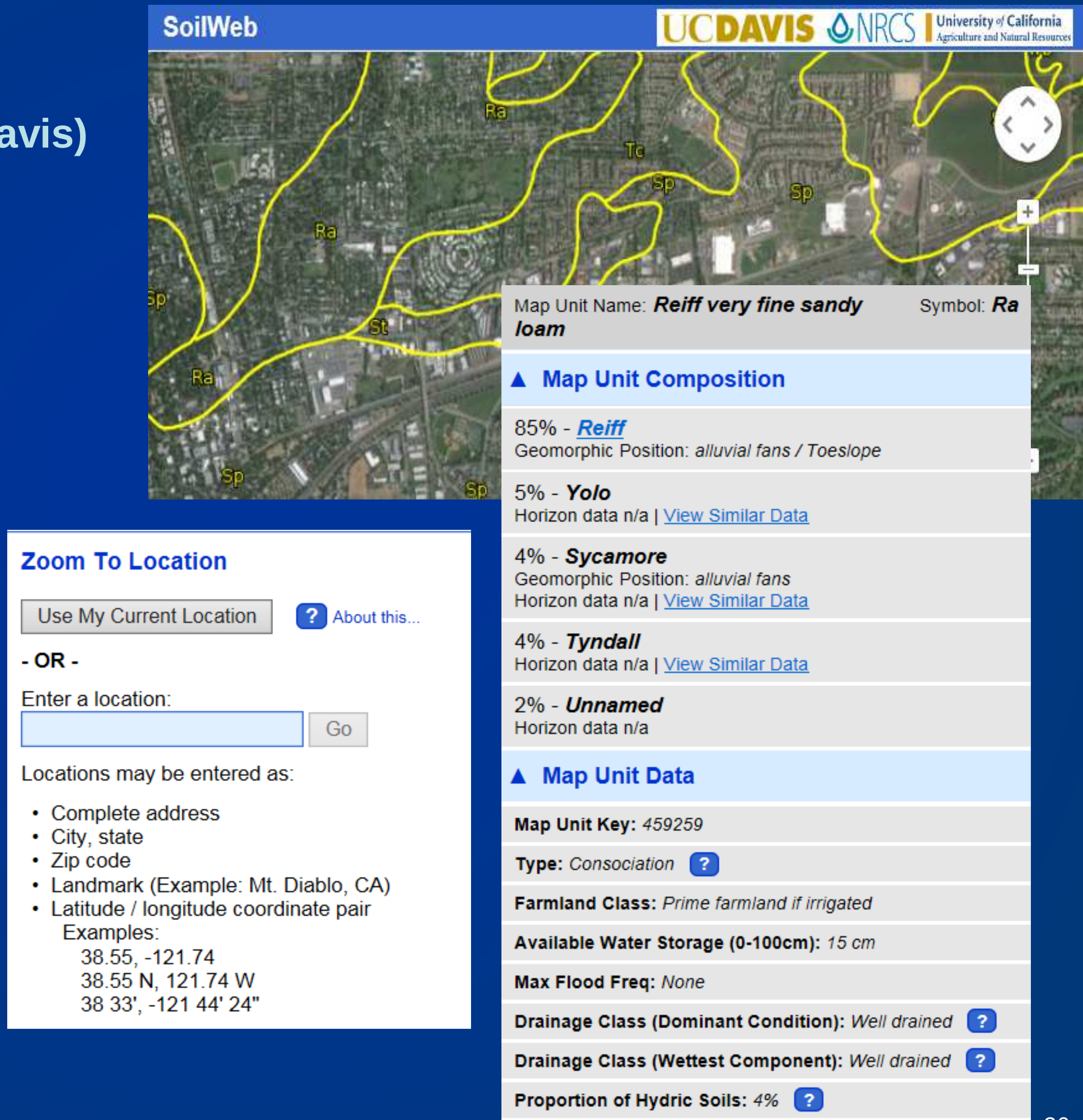




SoilWeb

(cooperative project with UC-Davis)

- Web access based on user defined location, or
- Uses device GPS system for map location
- Utilizes yearly download of authoritative data



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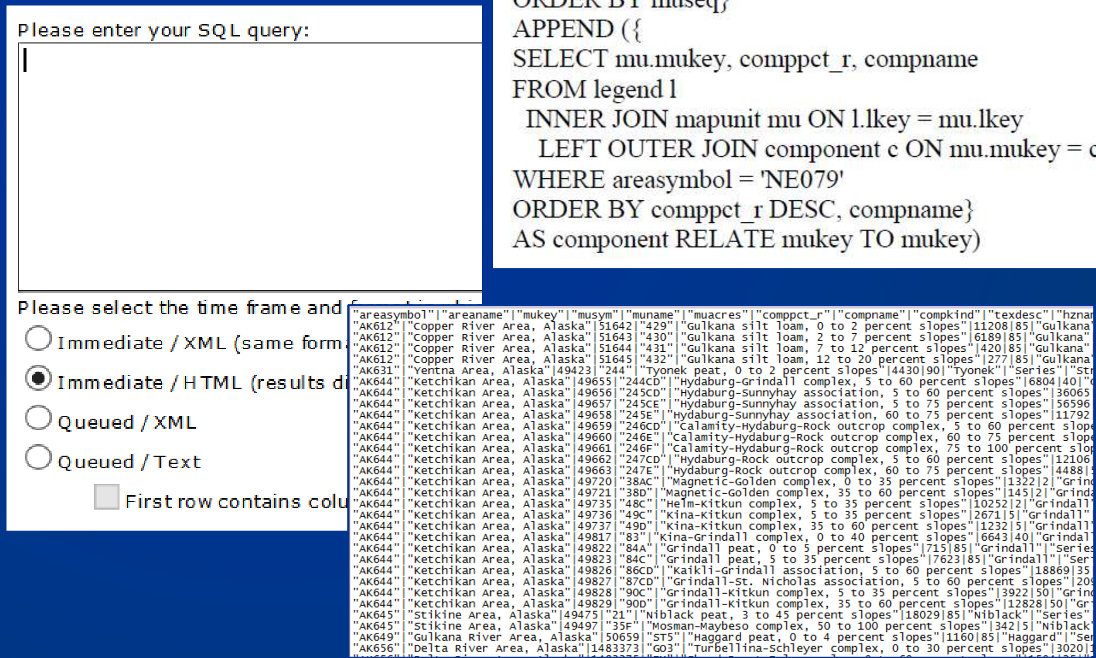
Web Data Services

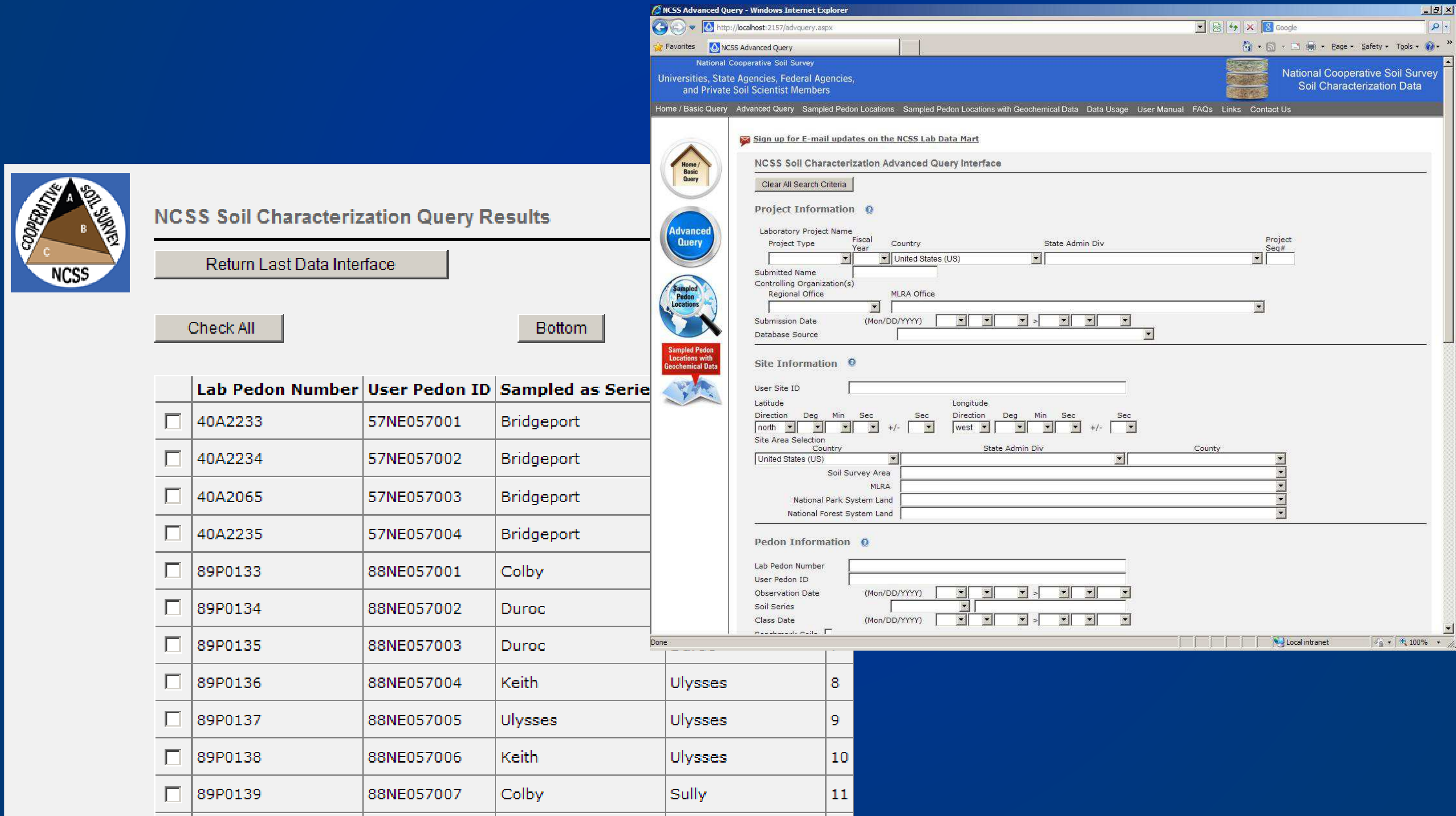
Soil Data Access

- Web Map Services
- Web Feature Services
- Integration with other Web applications
- External access to current authoritative data

```
SHAPE {
SELECT musym, muname, mukey
FROM legend l
  INNER JOIN mapunit mu ON l.lkey = mu.lkey
WHERE areasymbol = 'NE079'
ORDER BY museq}
APPEND ({
SELECT mu.mukey, comppct_r, compname
FROM legend l
  INNER JOIN mapunit mu ON l.lkey = mu.lkey
    LEFT OUTER JOIN component c ON mu.mukey = c.mukey
WHERE areasymbol = 'NE079'
ORDER BY comppct_r DESC, compname}
AS component RELATE mukey TO mukey)
```



National Cooperative Soil Survey Lab Web Data Mart



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National Cooperative Soil Survey Lab Web Data Mart

Soils Analyzed by:
NRCS Kellogg Soil Survey Laboratory &
Cooperating University Laboratories

Site Identifier: S10SP056002
Lab Pedon Number: 12N0035
Sampled As Series Name: Kiko
Correlated Series Name:
Country: Spain
State: Cataluna
County:
MLRA:
Latitude: 41.705
Longitude: -1.7930556

Lab Data Report
Pedon Description Report

Cont. Site ID: S10SP05 **Pedon ID:** S2010SP056002

Slope (%)	Elevation (meters)	Aspect (deg)	MAAT (C)	MSAT (C)	MWAT (C)	MAP (mm)	Frost-Free Days	Drainage Class	Slope Length (meters)	Ups
5.0	320.0							well		

Ap1--0 to 12 centimeters (0.0 to 4.7 inches); silt loam, reddish brown (2.5YR 4/4), moist; moderate fine granular structure; friable; few very fine r percent nonflat 2 to 75-millimeter unspecified fragments; strong effervescence; abrupt smooth boundary. Lab sample # 12N00171

Ap2--12 to 30 centimeters (4.7 to 11.8 inches); loam, reddish brown (2.5YR 4/4), moist; moderate medium subangular blocky structure; firm; few and few coarse roots; few very fine tubular pores; 5 percent nonflat 2 to 75-millimeter unspecified fragments; strong effervescence; clear smooth 12N00172

Bknw1–30 to 51 centimeters (11.8 to 20.1 inches); loam, reddish brown (2.5YR 4/4), moist; moderate fine subangular blocky structure; friable; f roots; few very fine tubular pores; 5 percent carbonate nodules; 10 percent nonflat 2 to 75-millimeter unspecified fragments; violent effervescence sample # 12N00173

Bknw2–51 to 91 centimeters (20.1 to 35.8 inches); silty clay loam, dusky red (10R 3/4), moist; strong medium subangular blocky structure; very firm; few very fine roots; few fine tubular pores; 10 percent carbonate nodules; 15 percent nonflat 2 to 75-millimeter unspecified fragments; strong effervescence; clear smooth boundary. Lab sample # 12N00174

Bt--91 to 129 centimeters (35.8 to 50.8 inches); very gravelly loamy sand, reddish brown (2.5YR 4/4), moist; strong medium subangular blocky structure; firm; few very fine roots; common fine tubular pores; 3 percent carbonate nodules; 5 percent nonflat 2 to 75-millimeter unspecified fragments; strong effervescence; abrupt smooth boundary. Lab sample # 12N00175

2BC--129 to 150 centimeters (50.8 to 59.1 inches);, dusky red (10R 3/4), moist; weak fine subangular blocky structure; friable; few very fine roots; 45 percent nonflat 2 to 75-millimeter unspecified fragments; strong effervescence.

*** Primary Characterization Data ***
(Cataluna, Spain)

Pedon ID: S10SP056002

Sampled as on Sep 08, 2010 : Kiko ; Coarse-silty, mixed, mesic
Revised to :

SSL - Project C2012SP56008 Spain 2012
- Site ID S10SP056002 Lat: 41° 42' 18.00" north Long: 1° 47' 35.00" west NAD83
- Pedon No. 12N0035
- General Methods 1B1A, 2A1, 2B

Layer	Horizon	Orig Hzn	Depth (cm)	Field Label 1	Field Label 2	Fie
12N00171	Ap1	Ap1	0-12	S10SP056002-1		
12N00172	Ap2	Ap2	12-30	S10SP056002-2		
12N00173	Bknw1	Bknw1	30-51	S10SP056002-3		
12N00174	Bknw2	Bknw2	51-91	S10SP056002-4		
12N00175	Bt	Bt	91-129	S10SP056002-5		

Pedon Calculations

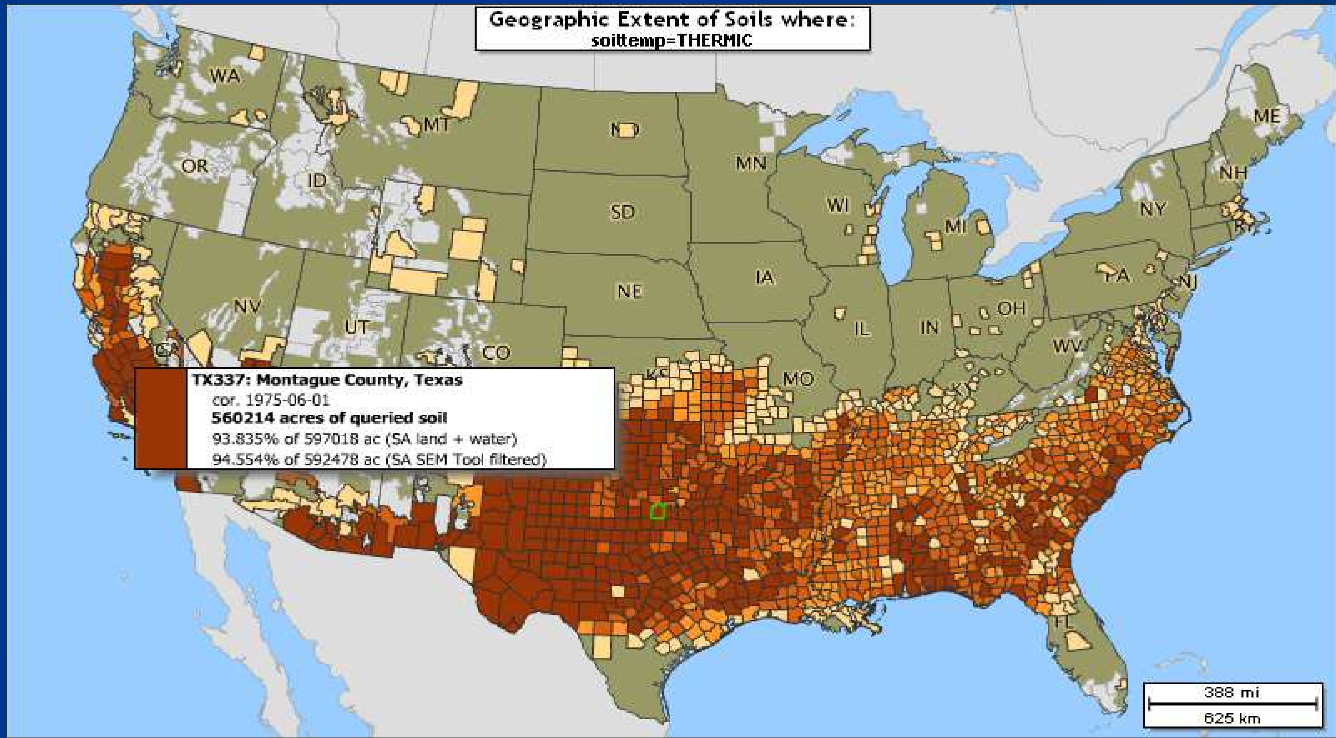
Calculation Name	Result	Units of Measur
LE, Whole Soil, Summed to 1m	1	cm/m

PSDA & Rock Fragments

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-
				(- - - - - Total	- - - - - -)		(- - Clay	- - -)	(- - - - Silt	- - - - -)	(- - - - - - - - -	
				Clay	Silt	Sand	Fine	CO_3	Fine	Coarse	VF	F
				<	.002	.05	<	<	.002	.02	.05	.10
	Depth			.002	-.05	-2	.0002	.002	-.02	-.05	-.10	-.25
Layer	(cm)	Horz	Prep	(- % of <2mm Mineral Soil - - - - - - - - - -								
				3A1a1a				3A1a1a	3A1a1a		3A1a1a	3A1a
12N00171	0-12	Ap1	S	12.5	39.7	47.8		--	20.1	19.6	18.9	17.5
12N00172	12-30	Ap2	S	15.2	41.7	43.1		1.5	21.1	20.6	18.3	12.7
12N00173	30-51	Bknw1	S	17.6	42.2	40.2		2.3	23.9	18.3	17.1	12.7
12N00174	51-91	Bknw2	S	16.1	45.3	38.6		2.3	26.4	18.9	22.2	13.5
12N00175	91-129	Bt	S	16.1	41.0	42.9		2.1	25.5	15.5	20.6	17.0

Series Extent Mapper Web Tool

(cooperative project with Penn State)



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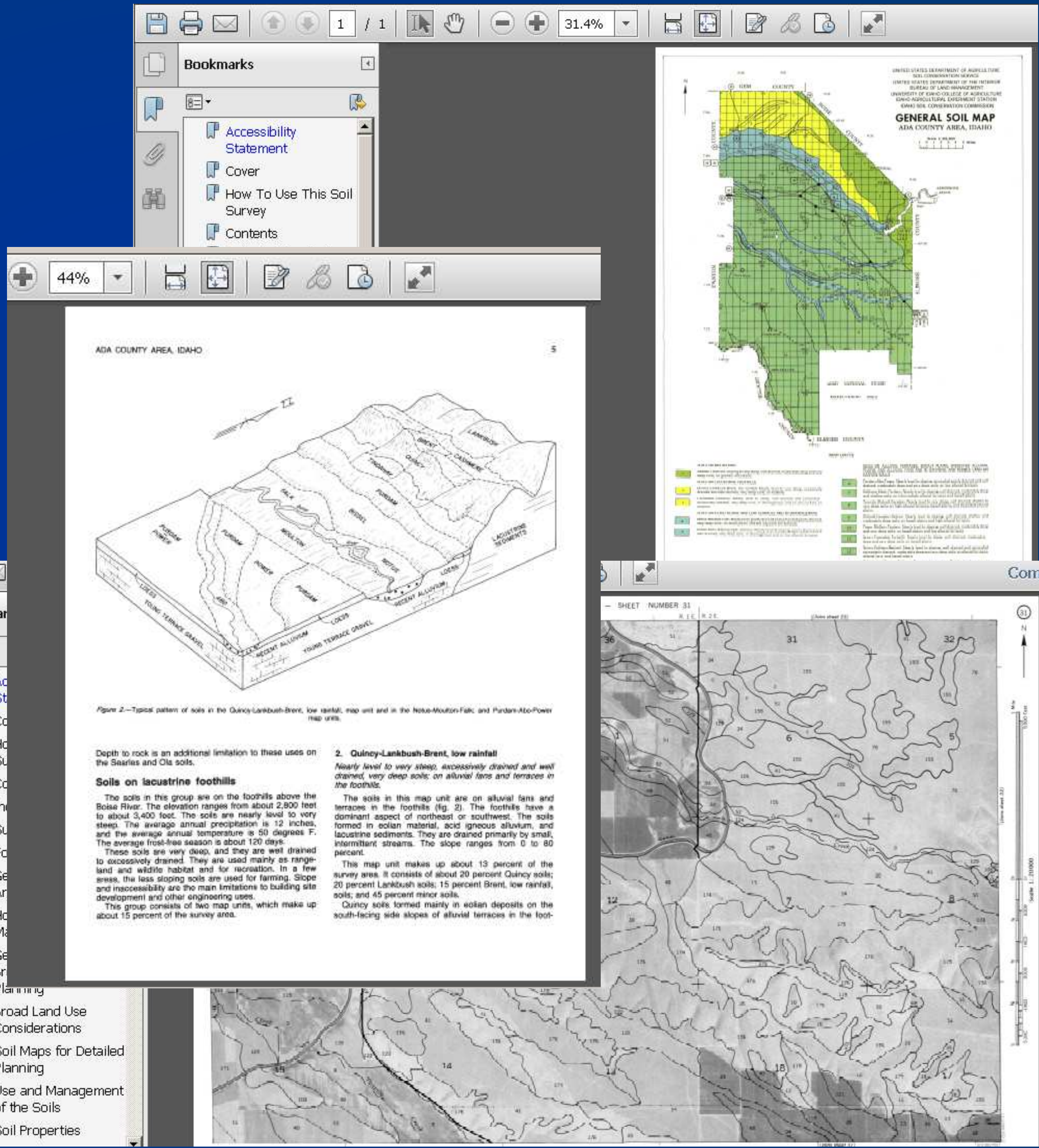
Web Access to Archived Soil Surveys

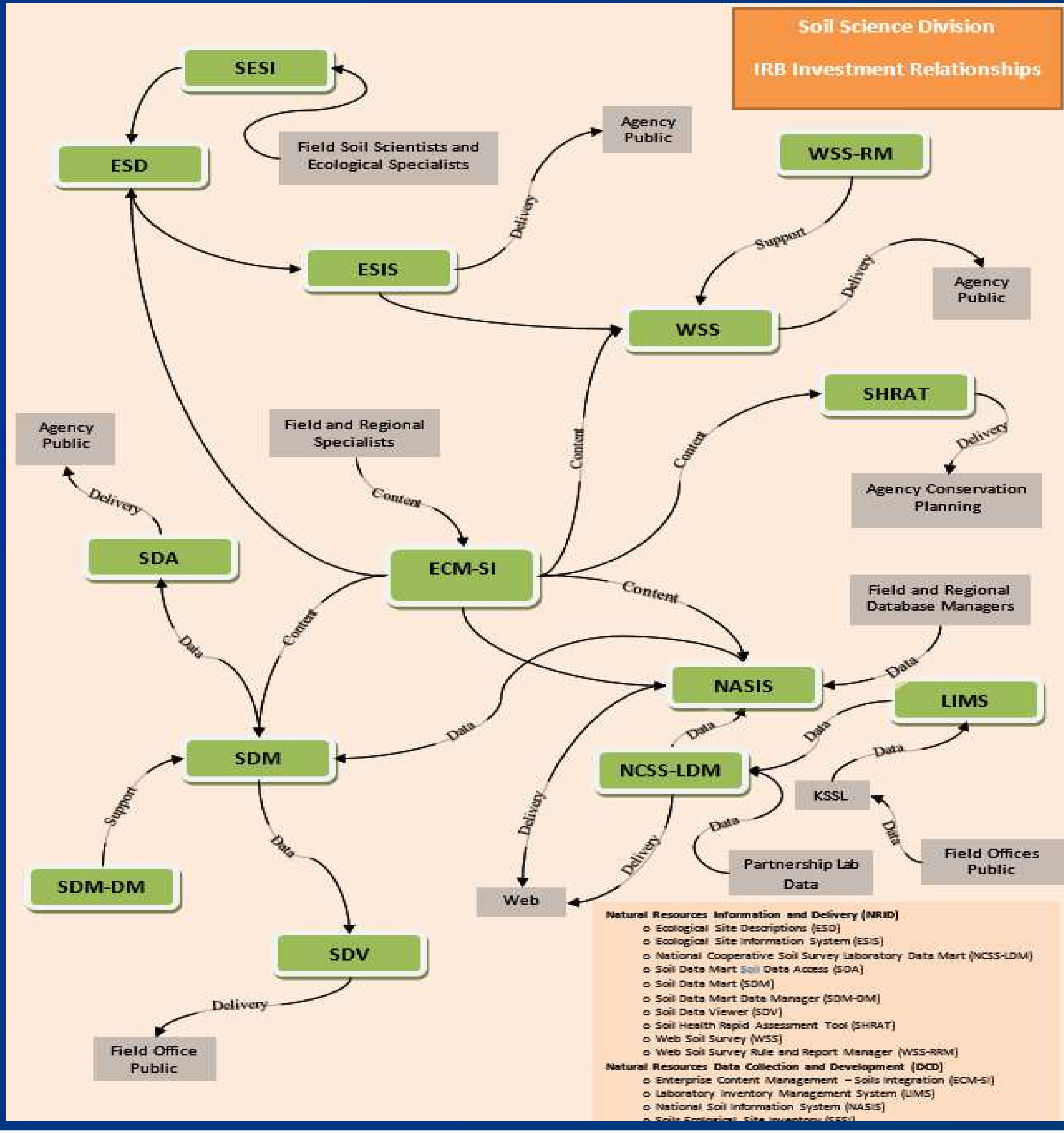
- 4,154 soil surveys digitally archived
- 191,842 total digital manuscripts and maps
- Over 1 million downloads since archiving started

Soil survey name (Follow links for online surveys.)	Date
Ada County	Curren
Ada County Area	1980
Adams-Washington Area, Parts of Adams and Washington Counties	2000
Adams-Washington Area, Parts of Adams and Washington Counties	Curren
Bannock County Area	1987
Bannock County Area, Parts of Bannock and Power Counties	Curren
Bear Lake County Area	2010
Bear Lake County Area	Curren
Bear Lake Valley Area	1926
Benewah County	1930
Benewah County Area	1980
Benewah County Area	Curren
Bingham Area	1973



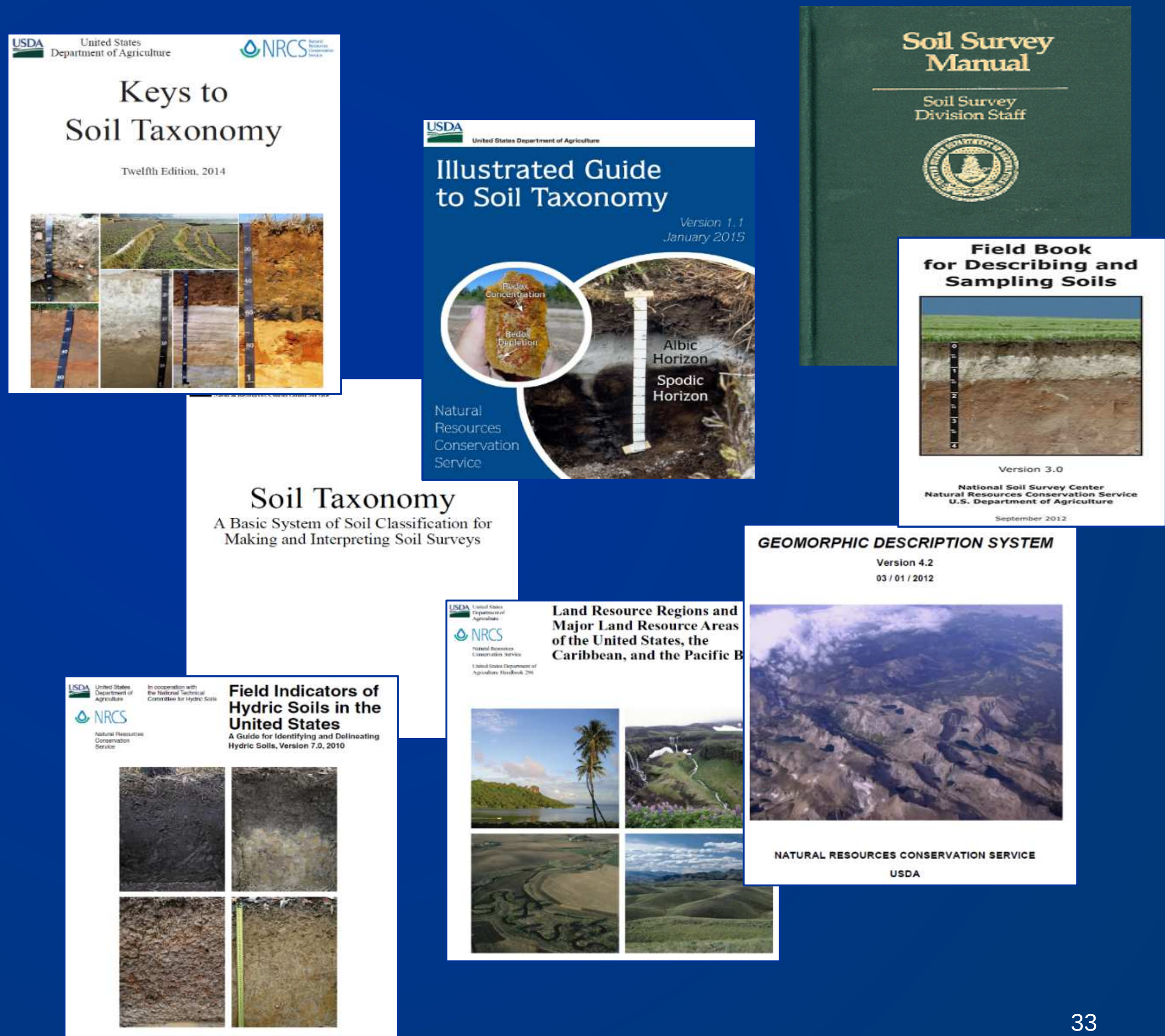
Soil Resource Relations and Dependencies

- Multiple services
- Complex relations and dependencies
- All supported by NRCS
- Relation processes enabled
  - Data Movement
  - Content Transfer
  - Support Services
  - Information Delivery



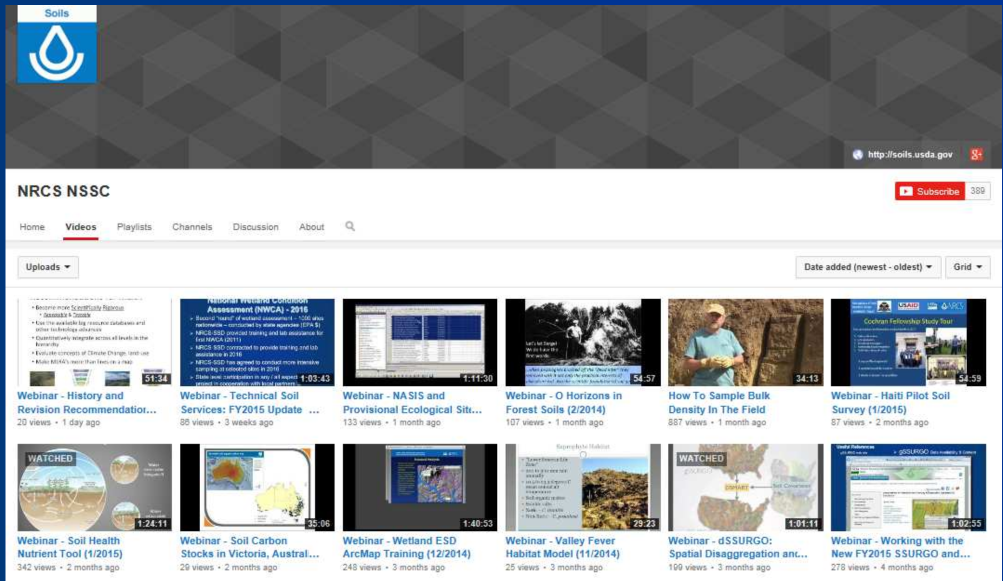
Web Soil Resources

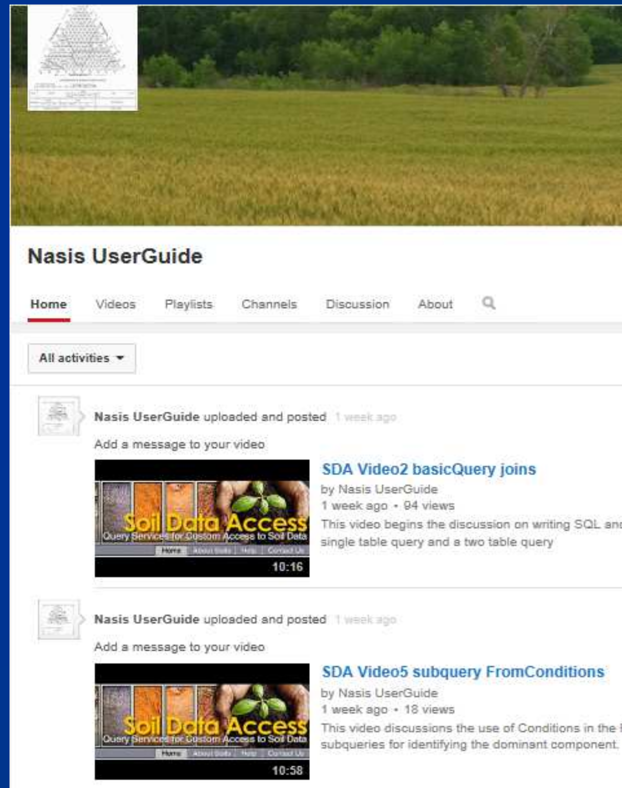
Digital Versions of Technical References



Web Soil Resources

NRCS YouTube Channel





NASIS and Soil Data Access Videos

Web Soil Resources

100 Soil Describing

- 101 How to use the Field Book for Describing and Sampling Soils (PDF; 67 KB)
- 102 How to fill out a 232 soil description form (PDF; 37 KB)
- 103 How to create sketches for a 232 soil description (PDF; 46 KB)
- 104 Understand the differences between soil properties and qualities (PDF; 65 KB)
- 105 How to differentiate and identify soil horizons in the field (PDF; 41 KB)
- 106 Color — How to use the Munsell Soil Color Charts to describe soil colors (PDF; 67 KB)
- 107 Color — How to describe soil matr
- 108 How to describe mottles (PDF; 34
- 109 How to describe redoximorphic fea
- 110 How to describe concentrations (P
- 111 How to describe ped and void surf
- 112 Texture — How to describe sand,
- 113 Texture — How to distinguish sand
- 114 Texture — How to estimate textur
- 115 Texture — How to describe texture
- 116 Fragments — How to describe con
- 117 Fragments — How to describe size
- 118 Fragments — How to describe kind
- 119 How to describe soil structure (PD

On-the-Job Training Modules

OJT for MLRA Soil Survey Offices

OJT module completion checklist for MLRA Soil Surv

SF-182 Instructions for OJT Modules (PDF; 309 KB) –
modules in their learning history in Aglearn. This requires
learning request. These instructions will help facilitate this

000 Map Unit Design and Mapping Soils

- 001 Understand the MLRA concept for doing soil survey
- 002 Understand the relationship of the factors of soil f
- 003 Understand the concepts of landscape models and
- 004 Understand soil variability within the landscape co
- 005 How to differentiate between scales and orders of
- 006 Understand what environmental issues exist in yo emergencies (PDF; 165 KB)
- 007 Understanding the processes of mapping soils (PD
- 008 How to identify native and nonnative plants and re KB)
- 009 How to plan traversing in your soil survey area ba
- 010 How to design a map unit (PDF; 145 KB)
- 011 How to recognize and use components in soil surv
- 012 How to recognize and distinguish map units in soil
- 013 How to name map units (PDF; 130 KB)
- 014 How to establish and track a proposed new map unit (PDF; 73 KB)
- 015 How to use a soils key for your soil survey area (PDF; 225 KB)
- 016 How to develop a soils key for your soil survey area (PDF; 108 KB)
- 017 How to effectively orient yourself on a photographic image while mapping or traveling in the fiel soil survey area (PDF; 34 KB)
- 018 How to use a topographic map in your soil survey area (PDF; 75 KB)

OJT Module Lesson

Title: **107 How to describe soil matrix colors.**

WHAT	WHY, WHEN, WHERE, HOW, SAFETY, QUALITY
Cycle step 1	Trainee should access via the internet and read: • Soil Survey Manual, Chapter 3 section on **Soil Color-Dominant Color**. • *Field Book for Describing and Sampling Soils* section on **Soil Color-Matrix Color**.
Cycle step 2	Do the following:
1. Review definition of dominant (matrix) color.	This was part of the reading assignment in the SSM. Point out that this is determined with broken samples in most situations.
2. Review conditions for measuring color.	This was part of the reading assignment in the SSM and prerequisite modules. Discuss light conditions and moisture content.
3. Use a "broken" sample to demonstrate how to locate hue, value, and chroma on the charts.	Do this in the field. Demonstrate how you "acquire" a broken sample for description.
4. Demonstrate how to add water to reach the appropriate moisture state	SSM reading assignment covers this. Discuss and demonstrate as needed.

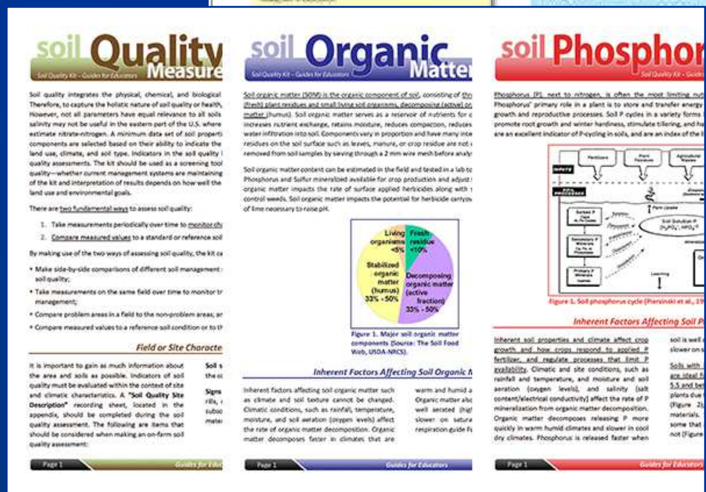
On-the-Job Training Modules

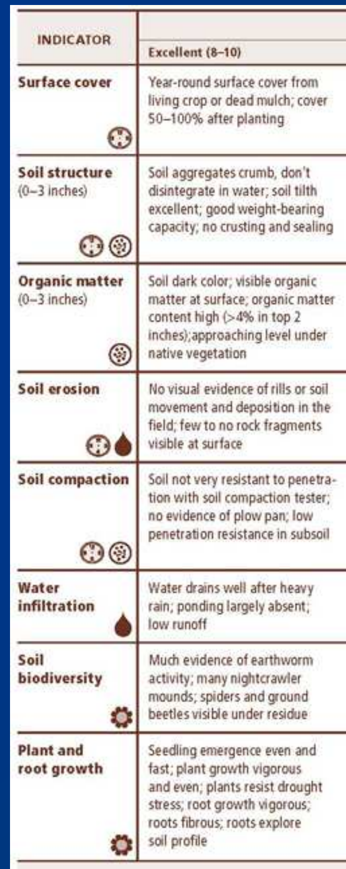
NRCS Natural Resources Conservation Service

NCSS National Cooperative Soil Survey

Web Technical Soil Services

Assistance to Land Owners, Educators and Conservation Planners





INDICATOR	Excellent (8–10)
Surface cover	Year-round surface cover from living crop or dead mulch; cover 50–100% after planting
Soil structure (0–3 inches)	Soil aggregates crumb, don't disintegrate in water; soil tilth excellent; good weight-bearing capacity; no crusting and sealing
Organic matter (0–3 inches)	Soil dark color; visible organic matter at surface; organic matter content high (>4% in top 2 inches);approaching level under native vegetation
Soil erosion	No visual evidence of rills or soil movement and deposition in the field; few to no rock fragments visible at surface
Soil compaction	Soil not very resistant to penetration with soil compaction tester; no evidence of plow pan; low penetration resistance in subsoil
Water infiltration	Water drains well after heavy rain; ponding largely absent; low runoff
Soil biodiversity	Much evidence of earthworm activity; many nightcrawler mounds; spiders and ground beetles visible under residue
Plant and root growth	Seedling emergence even and fast; plant growth vigorous and even; plants resist drought stress; root growth vigorous; roots fibrous; roots explore soil profile

Uses of Soils Information for Land Management

Wide Variety of Customers

Wide Range of Scales

Many Information Needs

Landscape scale

- National, state, watershed (catchment)
- Dominated by class-based information
- Commonly used to inform land use planning and policy
    - Zoning / land use restrictions
    - Taxation / land valuation
    - Rating / ranking / eligibility criteria for government assistance programs

Specific Examples

- Prime Farmland
  - Mapunit level binary information
- Hydric rating
  - Component level binary information
  - Aggregated to 5 classes at mapunit level
- Hydrologic Soil Group
  - Component level, 4-class rating system

Support for modeling

- Watershed and larger landscape scale models are incorporating more detailed soils data and information
  - STASGO2 → SSURGO or gSSURGO
- Often use mix of mapunit, component and horizon-level data
- Expert assistance required to aggregate appropriately

Conservation Effects Assessment Project (CEAP)

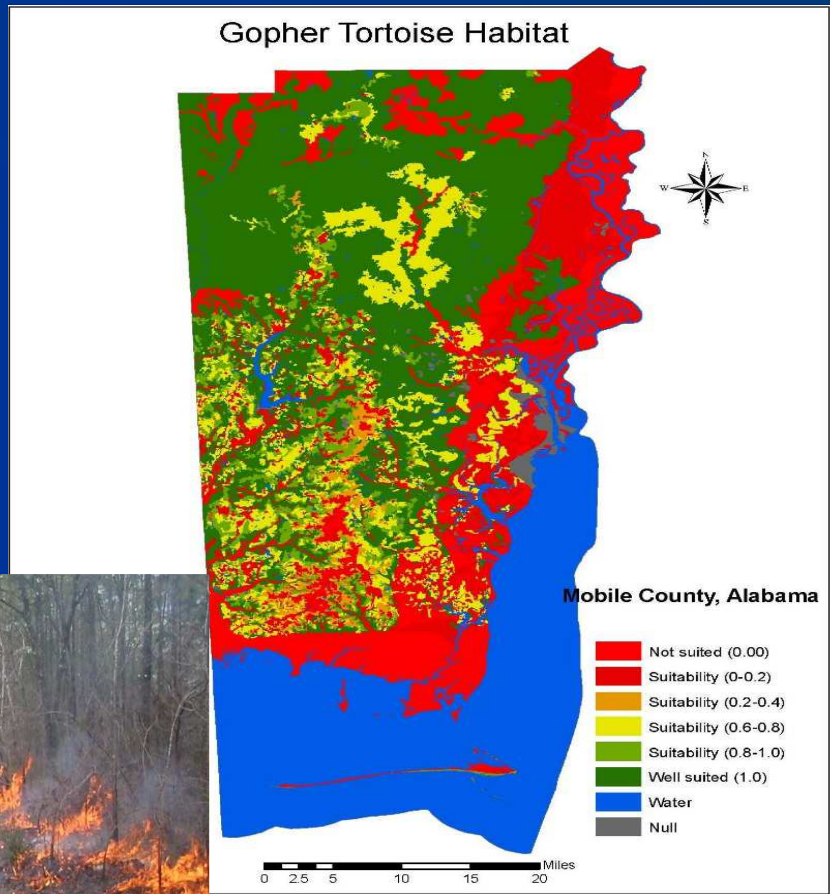
- Major USDA national priority
- Collaborative project between NRCS and the Agricultural Research Service (ARS)
- Detailed studies in ~ 20 specific watersheds (model calibration)
- Extrapolation to larger land use and physiographic regimes nationwide

Example model input variables

- Soil properties (measurable)
  - Organic matter (or carbon) content
  - Depth (to restrictive layer, to water table)
  - Permeability/kSAT
  - Sand/Silt/Clay percentage
- Soil “properties” (derived)
  - Available water capacity
  - Texture
- Interpreted/calculated values
  - Hydrologic soil group
  - USLE k factor

Soils as a Factor in Gopher Tortoise Habitat

- Gopher tortoise burrows provide shelter to many other species
- Suitable soils are sandy and dry
- Savannah vegetation must be maintained



Field and Farm Scale

- Primary scale of NRCS activities
  - NRCS is SSDs primary customer
- Scale most often used by individuals (Web Soil Survey users) for informal assessments
- Scale increasingly used by both private sector and other government agencies

Core NRCS Principles

- Collaborative and voluntary
- Integrated conservation planning process
- Identify and address resource concerns

SWAPAH

- **Soil**
- Water
- Air
- Plants
- Animals
- Humans

Soils Data and Information in Conservation Planning

- Data to support resource assessment models: RUSLE2, WEPS, Win-PST
- Data and information to inform conservation practice selection, location and design
  - Vegetative practices
  - Engineering practices

Other Users of Soils Data for Agricultural Land Management

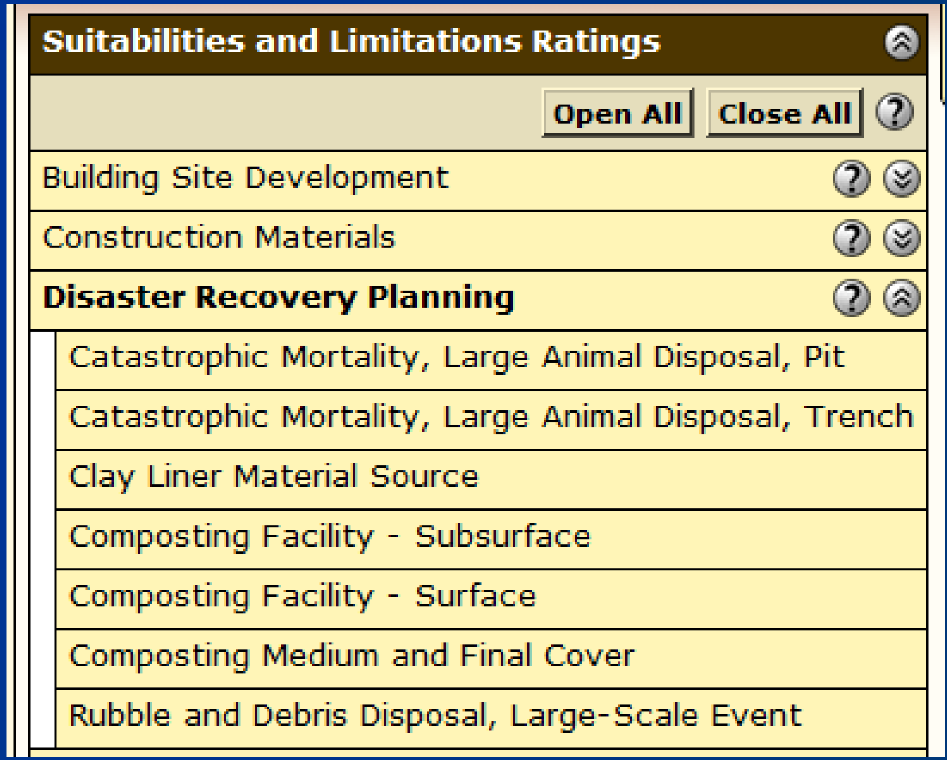
- Agricultural consultants and consulting firms
- Private agribusiness entities
- Other government agencies
  - Risk Management Agency (crop insurance)
  - Farm Services Agency

Other Land Uses

- Increased NRCS interest in and support for management in urban areas – soil information plays a key role
  - Community gardens
  - Other land uses (parks, playgrounds)
- Private sector development professionals
  - Residential, commercial

Disaster Response

- Existing suite of disaster recovery planning interpretations
- Available via WSS or through other web services



Site Specific Management

- Current soils information not directly applicable at the site specific level
- Scientific, technical and practical issues – both historic and contemporary
- Private sector professionals -- Consulting Professional Soil Scientists – fill this role in the US

NRCS-SSD New Initiatives

Collecting new data, creating new information and developing new products for our users

Site Specific Management

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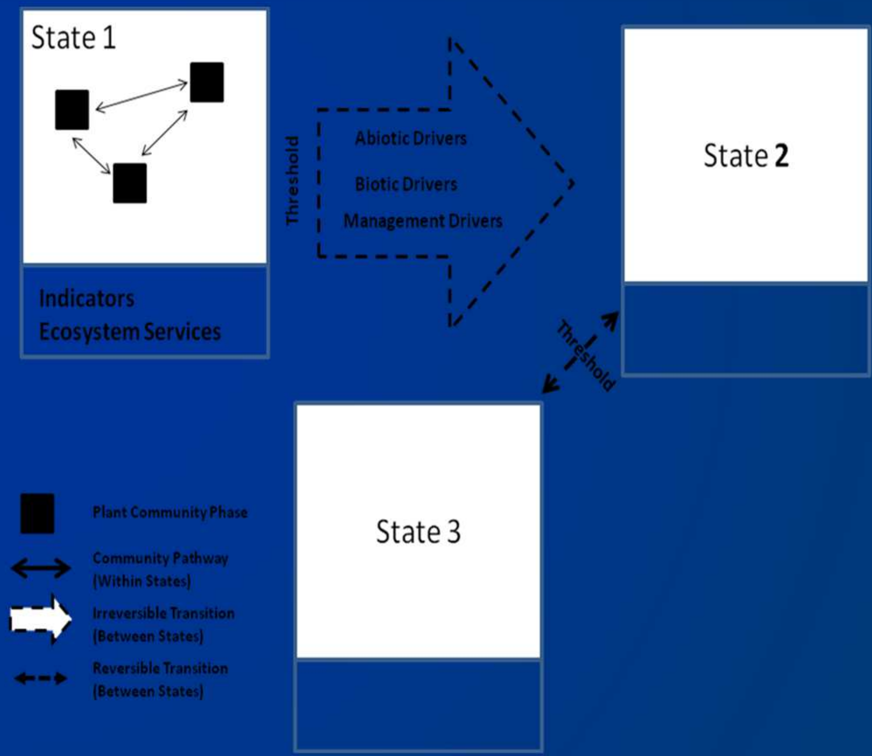
NRCS Natural Resources Conservation Service — NCSS National Cooperative Soil Survey

Ecological Site Descriptions

- Directly referenced to soil components
- Ecological states represent range of possibilities
- Transitions represent ecosystem processes



Climate Change

- Priority USDA and wider US Government initiative
- NRCS and Soil Science Division roles still being discussed and defined
- Key questions:
  - How can existing soils data and information be used to inform activities?
  - Is new data / information needed?

GlobalSoilMap.net

- Collaborative international project to develop global spatial datasets of core soil properties at standard depths
- Attempts to assess uncertainty
- New approach – very different from 'traditional" soil survey
- Additional information available at http://www.globalsoilmap.net

Useful web sites

- Web soil survey: http://websoilsurvey.nrcs.usda.gov/app/
  - Primary gateway to SSURGO data
- Soil characterization database:
  - http://soils.usda.gov/survey/nscd/
  - Pedon data (laboratory analysis)
- Soil Data Access: http://sdmdataaccess.nrcs.usda.gov/
  - Allows SQL-based queries to download soils data
- Geospatial Data Gateway:
  - http://datagateway.nrcs.usda.gov/
  - gSSURGO and much more


Thank You
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