New Horizons

A tour of engineering applications of the NRCS SSURGO Soils Data

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Introduction/Background

Ian Sleeper
- GIS Analyst at Terracon
- Past experience at NHDOT Bureau of Planning and Community Assistance (GIS Department)
- B.S. Civil Engineering, University of New Hampshire 2015

Terracon
- Based in Olathe, KS
- Over 3500 employees in over 130 offices nationwide
- Geotechnical, Environmental, Facilities, and Construction Materials and Testing Services
- Ranked 32nd in ENR 2016 Top 500 Design Firms in USA
- GIS Department based in Portsmouth, NH
  - Full-time GIS staff: four
What is SSURGO?

- SSURGO: Soil Survey Geographic databases
- Collected by National Cooperative Soil Survey (local soil scientists) over the past century
- Administered by US Dept. of Agriculture (USDA) Natural Resource Conservation Service (NRCS)
- Collected at scales between 1:12,000 and 1:63,360 – nominally 1:24,000
- Intended for natural resource planning and management
- Spatial data (map units) and related attributes (tabular)
SSURGO Structure

- Map Units (mapped at 1:24,000 scale by NRCS)

- Components (horizontal elements, smaller than map units, that compose map units (as a percentage). Not mapped)

- Horizons (vertical strata of dominant components. Only reported for dominant components, reported with depths to top and bottom of layer)

MUAGGATT: Map Unit Aggregate Attributes

Component Horizon: Many horizon level attributes

Component Interpretations: Interpretations of common soil uses by NRCS

…Other component tables

…Other horizon tables
Map Units

- Approximate mapped boundaries of each soil unit
  - Based on interpolation from test pit data and other factors (topography, aerial photography, etc)
  - Composed of various component soil groups; map units are map-able soil extents with reasonably consistent characteristics
Map Units

- Map unit attributes are almost entirely aggregated or inherited from components and horizons

- Several aggregation methods:
  - Dominant Component (predominance)
  - Weighted average
  - Minimum/Maximum
Components

- Delineated as a percentage of the total map unit
- More detailed attributes than map units
- Horizontal geometry of components undefined within map units
- SSURGO defines “Major” and “Minor” components of a given map unit
  - No “hard-and-fast” rules for major and minor delineation:
    - Map unit with 75% A and 25% B, A is major; unit with 25% A, 25% B, 35% C, and 15% D: A, B, and C could all be major
Horizons

- Horizontal layers of soil (measured vertically with depth)
- Cataloged for major components
- Top and bottom depths of each horizon given, thickness sometimes given but often must be calculated
- Most detailed attributes of any SSURGO data item
- Includes some grain-size distribution, k-factor, and other specific soil classification attributes useful for project planning and management
  - Detailed enough for “back-of-the-envelope” engineering, but should not be considered valid for design calculations
How NOT to use the data

- Not detailed, accurate, or complete enough for true engineering design
- Insufficient resolution to compare with single-site exploration (don’t expect a bore log at a given point to exactly match the SSURGO data it intersects)
- Not a replacement for site survey, geotechnical exploration, soil testing (composition, strength properties, drainage, etc).
Interesting (and valid) applications:

- Pre-work planning:
  - Is ground saturated or near saturation?
  - Expected soil consistency (stony, sandy, silty, etc)
  - Depth to water table and to shallow bedrock outcrops

- Preliminary design and costing:
  - Typical strength parameters for foundation type selection
  - Potential design concerns (uplift, swelling soils, inundation, etc)

- Continued…
Interesting (and valid) applications (continued):

- Project hazard analysis and mitigation:
  - Flooding
  - Drainage
  - Shallow Rock
  - Erosion
  - Shallow Water
  - Expansive Soils
  - Frost Potential
  - Corrosivity
  - Ground movement susceptibility
Pre-construction Planning: Shallow Utilities
Bid and Proposal Research: Transportation Corridors
Geohazard Assessment: Underground Mines in a Pipeline Right-of-Way
Preliminary Design and Risk Management: Soil Parent Materials
Depth to (Shallow) Bedrock
Depth to Shallow Water Table
Soil Hydrologic Groups (Unsung Hero)

A. Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist mostly of clay, loam, or silt loam soils that do not have a high rate of water transmission (less than 0.50 in/hr).

B. Group B soils have moderate infiltration rates when thoroughly wetted and consist chiefly of silt loam to sandy clay loam soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.50-3.00 in/hr).

C. Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine textures. These soils have a low rate of water transmission (0.01-0.50 in/hr).

D. Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a clay layer or clay layer at or near the surface, and shallow soils over nearly impermeable material. These soils have a very low rate of water transmission (less than 0.01 in/hr).
Flooding Frequency

The U.S.G.S. Flooding Frequency Classes are:

None: No reasonable possibility of flooding; one chance out of 500 of flooding in any year or less than 1 time in 500 years.

Very rare: Flooding is very unlikely, but is possible under extreme, unusual weather conditions; less than 1 percent chance of flooding in any year or less than 1 time in 100 years but more than 1 time in 500 years.

Rare: Flooding is unlikely but is possible under unusual weather conditions; 1 to 5 percent chance of flooding in any year or nearly 1 to 5 times in 100 years.

Occasional: Flooding is expected infrequently under usual weather conditions; 5 to 10 percent chance of flooding in any year or 5 to 10 times in 100 years.

Frequent: Flooding is likely to occur often under usual weather conditions; more than a 50 percent chance of flooding in any year or 5 to 10 times in 100 years, but less than a 50 percent chance of flooding in all months of any year.

Very frequent: Flooding is likely to occur very often under usual weather conditions; more than a 50 percent chance of flooding in all months of any year.

Water County ACL
Strengths and Weaknesses

**Strengths**
- Coverage
- Detail
- Availability
- Combination with other data

**Weaknesses**
- Not necessarily standardized
- Converting to shapefile can make a “NULL” look like a “0”
- Very complicated
- Somewhat unwieldy
Summary

- Powerful – not just for agriculture!
- Impress your clients, co-workers, and bosses with info that most others haven’t seen
- Complex (and sometimes confusing and misleading), but you get used to it
- In the words of Spiderman’s Uncle Ben: “With great power comes great responsibility…” – sometimes even if you can do something, you probably shouldn’t (or you should at least put a disclaimer on it)
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