Potential Wetland Soil Landscapes (SSURGO) Data Set

By: John M. Galbraith, Virginia Tech; Sharon Waltman, Steve Campbell, and Robert Dobos; USDA-NRCS, supported by Bill Wilen, DOI-FWS and Jeanne Christie Association of State Wetland Managers, and the Wetland Mapping Consortium (WMC).

Background of the PWSL request: The purpose of this document is to describe simple methods for using the Potential Wetland Soil Landscapes (PWSL) (Soil Survey Geographic Data Base) (SSURGO), SSURGO Metadata and User Guides. The PWSL data set was intended for identifying sites that have a "hydric" soil as dominant or named component but are not mapped as National Wetland Inventory (NWI) wetlands. Areas with dominantly hydric soils but not recognized as wetlands may be because: a) the soil series meets hydric soil criteria 2 but not the hydric definition, b) the area is incorrectly mapped on the NWI maps, c) the area is missing wetland hydrology, d) the area is protected from flooding, or e) the area is not dominated by wetland vegetation. The PWSL data identifies soil landscapes that may be easily, inexpensively, or reliably restored to wetlands or converted to wetlands. The advantage of PWSL is that it is in raster format for spatial analysis and is a seamless set that does not require that users download SSURGO from each soil survey area and then join and register the data before use.

The PWSL data set includes the raster SSURGO spatial layer plus seven associated tables that contain data fields about hydric soils, hydrology, flooding, and ponding. PWSL data can be used for federal, state, and local wetland programs and improved mapping. Areas identified as dominantly hydric but not on NWI may require additional geospatial analysis and field investigation to confirm their potential as wetland landscapes.

Purpose of the maps and data: When wetlands are converted into a non-wetland land use under permit, the permitted person(s) must replace the wetlands or pay into a Wetland Restoration Fund. However, it is currently very difficult for the permitted person(s) to find a suitable site to mitigation the loss of wetland acres and functions because the data do not occur on a single map source. The National Wetlands Inventory (NWI) is a nationwide set of wetland maps but the data do not capture all wetlands and do not identify former wetland landscapes. Normally the "mitigation" sites would be current wetlands that have been converted into a different land use by plowing, logging, or change in dominant vegetation, or former wetlands that have been modified by draining, excavating, filling, or flood protection. The NWI mappers did not identify many wetlands in agriculturally-modified areas but focused on native vegetation and public lands. The areas of interest in this project are those areas where restoration of a current or former wetland to wetland functionality entails a simple plan with a high likelihood of success, and the presence of a dominant or named hydric soil is the single best indicator of a potential wetland landscape. USDA SSURGO hydric soils data is the number one source used to indicate a potential wetland landscape nationwide. For example, farmed wetland pastures need only removal of competitive plants and re-establishment of dominant hydrophytic vegetation to regain wetland status. Filled wetlands may also need expensive removal of fill material along with careful soil and vegetation reclamation.

Customers served/national extent: Users of the data will include state agencies, local government agencies, wetland mappers, private consultants, environmental engineers, private landowners, local municipality planners and developers, and university cooperators.

Negative impacts of no action is taken: If hydric soil data are not available in the PWSL format, it forces users to download SSURGO data by survey area and merge the data. This is problematic because it often results in registration (alignment) errors. The process need not be repeated if USDA-NRCS has already accomplished a seamless data set. The raster format of the seamless SSURGO data produced by Waltman and Bliss and others make the data much more useable with other public domain data sets that come in raster format. The drawback is that raster data sets can be enormous, even if subset by state (think: Texas or Montana). Currently, SSURGO by survey area comes as vector data and must be converted. Many state agency, local government entities and private users do not have the expensive software and hardware needed to use enormous data sets, or those are available only in a state office and not at local offices. Also, the full SSURGO data set of tables is enormous, and many of the data are not used in wetland programs. A smaller subset of spatial data and seven data tables is more manageable using affordable software (such as older versions of (Environmental Systems Research Institute, Redlands, CA) ArcMap® Geographic Information System (GIS) software plus (Microsoft, Inc., Redmond, WA) Access™ or newer versions of ArcMap with the Arc File Geodatabase™ software), and conventional desktop computer hardware.

Services requested of NRCS to meet customer needs: The PWSL data will consist of a 10-m seamless gridded digital map layer of each state in the 48 contiguous United States derived from SSURGO spatial and tabular data sets downloaded from Soil Data Mart (SDM) in January, 2012. SSURGO data (and associated Hydric and Wetland related attributes) is not readily available nationwide as a single shapefile. Also, the SSURGO vector format is not always desirable for merging with other data layers. Sharon Waltman, Norman Bliss (USGS) and others have developed a gridded version of SSURGO spatial data for the entire United States. The intent of USDA-NRCS is to refresh the spatial data every few years. The Wetland Mapping Consortium and other wetland community users would request that USDA-NRCS continue to post these hydric soil data on public domain web sites for free download, and maintain quality control, version release control, metadata, full SSURGO User's Guide, and the official copy of the data.

Partner contribution: A simplified user's guide with applied examples to help average users can be linked to the Wetlands Mapping Consortium Scholar Site hosted at Virginia Tech and the Association of State Wetland Managers (ASWM) Wetland Mapping website, and ideally cross-linked to the USDA-NRCS Soils web site for the full and official data sets. The Wetland Mapping Consortium and ASWM are currently gathering a community of wetland mappers and are holding webinars on federal standards for producing quality, standard wetland map products. Webinars and conference calls can be co-hosted by USDA-NRCS to explain the use of their product.

Discussion of Criteria: The simplest query of raster soil survey data would be to find all contiguous clusters of map unit pixels that have "hydric" dominant or named map unit components but do not intersect with an NWI polygon. Map units with only inclusions of very minor amounts of hydric soil have little chance of being restorable wetland landscapes. The clusters should have some additional data that indicates the site formed under wetland hydrology conditions. National Hydrography Data (NHD) or SSURGO point or line feature to indicate water presence or former presence, or protection from flooding or ponding. Combinations of

layers may identify soils that have hydric soils and hydrology (indicated by drainage class) but have been cleared of hydrophytic vegetation (based on current land use versus climax vegetation type), have shallow fill, are artificially drained or protected from flooding. SSURGO map unit phases such as: *high water table, poorly drained, slightly wet*, and *drained* may be useful. *Depressional* and *salt flats* are map unit components that may help to identify potential wetlands in arid regions.

If a pixel from a SSURGO soil map unit has 50% or more hydric soils, but is not underlying an NWI polygon, it may be a former wetland. This is especially likely if the land use is cropland or pastureland. These areas may have high potential as restorable wetlands. The area is less easily restored if the land use is now urban (assuming an accurate Land Use layer). Comparison of current topography with former topography or an on-site visit is needed. These areas may have moderate potential as restorable wetlands. Other areas would have low potential as restorable wetlands.

Suggested Uses/Justification for the Data Set Creation: Forest and pasture may be former wetlands if ditches or other conveyances are found to intersect hydric soil units with 50% or more hydric soils. The soil data includes tables that give supporting information about why the soil was rated as hydric, the hydroperiod, and soil properties that may indicate what type of wetland may be produced by the restoration. Some map unit names give information such as that can be useful. A map unit with 50% or more hydric soil that has “drained” or “ditched” or “protected” in the map unit name has potential to be easily restored. Ancillary data that also increases likelihood of the soil being a former wetland include hydrology data from NHD (intersection of part of the map units that have 50% or more hydric soil components with NHD marshes, swamps, springs or canal/ditch, connector, underground conduit and perennial stream segments indicate that hydrology may be easily restored). If NHD data is not available, intersection with SSURGO point data that has a marsh, wet spot, ditch, canal, spring, or other such special symbol may be used. The query contains the “mukey” (mapunit key) field, which can be used to join the Microsoft Access™ table or ESRI ArcGIS File Geodatabase™ table to the SSURGO spatial data. The simplest query would be to find all map unit pixels that have 50% or more hydric soil components, are not within an NWI polygon, and may have some NHD or SSURGO feature to indicate water presence or former presence, or protection from flooding or ponding. Combinations of layers may identify soils that have hydric soils and hydrology (indicated by drainage class) but have been cleared of hydrophytic vegetation or have shallow fill or are artificially drained or protected from flooding.

If a pixel from a SSURGO soil map unit has 50% or more hydric soils, but is not underlying an NWI polygon, it may be a former wetland. This is especially likely if the land use is cropland or pastureland. These areas may have high potential as restorable wetlands. The area is less easily restored if the land use is now urban (assuming an accurate Land Use layer). Comparison of current topography with former topography or an on-site visit is needed. These areas may have moderate potential as restorable wetlands. Other areas would have low potential as restorable wetlands.

Forest and pasture may be former wetlands if ditches or other conveyances are found to intersect hydric soil units with 50% or more hydric soils. The soil data includes tables that give supporting information about why the soil was rated as hydric, the hydroperiod, and soil

properties that may indicate what type of wetland may be produced by the restoration. Some map unit names give information such as that can be useful. A map unit with 50% or more hydric soil that has “drained” or “ditched” or “protected” in the map unit name has potential to be easily restored. Ancillary data that also increases likelihood of the soil being a former wetland include hydrology data from NHD (intersection of part of the map units that have 50% or more hydric soil components with NHD marshes, swamps, springs or canal/ditch, connector, underground conduit and perennial stream segments indicate that hydrology may be easily restored). If NHD data is not available, intersection with SSURGO point data that has features that indicate wetness or removal of wetness or flooding protection, such as marsh, wet spot, ditch, canal, spring, etc.

A GIS software program should be used to identify clusters of two or more contiguous pixels (share one or more sides with similar identified pixels) with “hydric” dominant or named soils from the spatial data set. The clusters should not be entirely contained within the boundaries of NWI polygons.

The PWSL data should be provided on a state level (or cluster of small states). PSWL may be aggregated by LRR, MLRA, or watershed boundary. The included SSURGO tables provide a subset of SSURGO attributes needed by planners, developers, conservationists, and managers. A description of the included tables is provided.

Potential Wetland Soil Landscapes (SSURGO) Data Set Description:

An Arc File Geodatabase™ (Environmental Systems Research Institute, Redlands, CA) can be used to open the involved subset of SSURGO tables. Pipe delimited files imported into an Arc File Geodatabase offers a good solution for tables that have greater than 65,000 records (national component and map unit tables). The tabular data may be output for use with a Microsoft (Microsoft, Inc., Redmond, WA) Access™ by users. The subset of the complete SSURGO data table set may be linked to the spatial (area and point) tables in a Geographic Information System.

The following are SSURGO 2.2.5 tables and columns (fields) needed to create the PWSL data set. Linking columns and wetland landscape-related columns are listed in parentheses.

Spatial Table (area) – (mukey)
Spatial Table (point) - Point data that indicates dams, levees, ditches, canals, marsh or swamp, miscellaneous water, perennial water, wet spots, saline spots, closed depression, streams, springs, or flood pool line. Note: These may be found in Feature Description table (areasymbol, featkey, featsym, featname, featdesc), Feature Point table (areasymbol, featkey, featsym) and Feature Line table (areasymbol, featkey, featsym)
Cohydriccriteria table – (cokey, cohydcritkey, hydriccriterion)
Comonth table – (cokey, comonthkey, flodfreqcl, floddurcl, floddurcl, ponddurc, ponddep_r)
Cosoilmoist table – (comonthkey, comonthkey, soimoistdept_r, soimoistdepb_r, soimoiststat)

Component table – (mukey, cokey, majcompflag, compcomppct_r, hydricrating, drainagecl, hydgrp)
Legend table – (areasymbol, lkey)
Mapunit table – (mukey, lkey, musym, muname)

Combinations of data along with SSURGO may be needed to target those areas that warrant a field validation. For example, a high resolution DEM produced from LiDAR may be used with a wetness index to find surface flow accumulation on the landscape. Connectivity to other wetlands is not considered, although the data set may provide some information to be used in connectivity analysis (http://water.epa.gov/lawsregs/lawsguidance/cwa/wetlands/index.cfm; http://www.usace.army.mil/cecw/pages/reg_supp.aspx). Overlaying the gridded SSURGO with the 2006 National Land Cover Data (NLCD2006) impervious surface (urban land) will provide an added benefit for watershed and wetlands managers. Other important data sets include imagery data such as Landsat and NAIP, National Agricultural Statistics Service (NASS) 2010 Cropland Data Layer (CDL), National Hydrography Data set (NHD), TIGER data, Major Land Resource Area (MLRA), Ecoregion, Drainage Districts and HUC Watershed map layers. Additional geospatial data sets can be added in GIS software to produce a myriad of products.

Developed by:
Sharon W. Waltman, USDA-NRCS
Geospatial Research Unit
3040 University Avenue, Suite 3037
Morgantown, WV 26505
Phone: 304-293-9835E-mail: sharon.waltman@wv.usda.gov

Robert Dobos, USDA-NRCS
National Soil Survey Center, MS 36
100 Centennial Mall North, Room 152
Lincoln, NE 68508-3866
Phone: 402-437-4149
402-617-9853 (cell)
E-mail: bob.dobos@lin.usda.gov

The initial Research and Development data will then be made available by USDA-NRCS on national public access download sites. A simple user's guide and case study examples will be posted through the Assoc. of State Wetland Managers until posted on a national public domain server site. Contact:

Jeanne Christie or Sharon Weaver
Association of State Wetland Managers
(207) 892-3399 phone,
(207) 892-3089 fax,
(207) 310-8708 cell
website: http://aswm.org/

blog: http://aswm.org/wordpress/

Example Methodology for Compiling the Geospatial Data Layers (10-m Raster SSURGO data, statewide coverage) for Potential Wetland Soil Landscapes

The following steps are an example methodology to create an Easily Restored Wetlands Geospatial Information System and Database, using the Potential Wetland Soil Landscapes (Easily Restored Wetlands) (SSURGO) Data Set, following the steps and guides provided at: http://soildatamart.nrcs.usda.gov/SSURGOMetadata.aspx.

Step 1) Add the Potential Wetland Soil Landscapes (SSURGO) Data Set for your state or area of interest.

{Insert screen capture/s here}

Step 2) Find all map units or pixels where the dominant soil component is hydric.

{Insert screen capture/s here}

Step 3) Mask out all pixels that do not intersect with an NWI polygons. (call that the "hydric_not_NWI" layer).

{Insert screen capture/s here}

Step 4) Remove all pixels that are single, or only touch other pixels on an edge, leaving clusters of "hydric_not_NWI" pixels.

{Insert screen capture/s here}

Step 5) Identify clusters of "hydric_not_NWI" pixels that are not completely overlapping NLCD 2006 pixels of 23 Developed, Medium Intensity or 24 Developed High Intensity. Exclude those clusters.

{Insert screen capture/s here}

Step 6) Intersect clusters of "hydric_not_NWI_not_developed" pixels with the NLCD 2006 or an improved land cover map to identify the major land cover. Expert knowledge will guide selection of land cover(s) that might cause the hydric soil areas to not be identified on NWI maps because of vegetative manipulation. Call this layer "hydric_not_NWI_bc_vegetation_not_developed".

{Insert screen capture/s here, maybe a table}

Step 7) Use expert knowledge to clusters with evidence that there has been hydrologic modification. For example, intersect the "hydric_not_NWI_not_developed" layer with NHD or SSURGO feature to indicate current water presence (marsh symbol) or former presence (ditches), or protection from flooding or ponding (dams and levees). This might include NHD marshes, swamps, springs or canal/ditch, connector, underground conduit and perennial stream segments. Intersection with SSURGO point data that has a marsh, wet spot, ditch, canal, spring, or other such special symbol may be useful. Also, a map unit that has "drained" or "ditched" or "protected" in the map unit name has potential to be a former wetland. Call this layer "hydric_not_NWI_bc_water_not_developed".

{Insert screen capture/s here}

Step 8) Place a hierarchy (high, moderate or low potential as restorable wetland soil landscapes) on pixel clusters that are most likely to be wetlands or easily restored as wetlands in both the "hydric_not_NWI_bc_vegetation_not_developed" and "hydric_not_NWI_bc_water_not_developed" layers. For example, some areas may be very easily restorable by simply filling ditches, while others may be costly and have low potential for restoration success because of severe previous modification. Each state may choose how to prioritize their layers.

{Insert screen capture/s here, maybe an example hierarchy table}

Step 9) The data may be aggregated or subset by LRR, MLRA, state, county, or watershed boundary. For example, to build the the "NLCD_wetlands_hydric_not_NWI" layer that intersects an NHD "ditch" in Virginia, you would add layer " " in the 'va" folder…..and then ……

{Insert screen capture/s and further steps here }

Contacts:

Bill Wilen Bill_Wilen@fws.gov National Wetlands Inventory

Wetlands Mapping Consortium - Jane Awl jane_awl@earthlink.net, Megan Lang (USFS) megan.lang@gmail.com, or John Galbraith john.galbraith@vt.edu

ASWM (Jeanne Christie or Sharon Weaver) http://aswm.org/wetland-science/wetland-mapping for links to the data and a user's guide (future endeavor).

Potential Wetland Soil Landscapes Simplified User's Guide - John Galbraith john.galbraith@vt.edu

Potential Wetland Soil Landscapes (SSURGO) Data Set - Sharon Waltman Sharon.Waltman@wv.usda.gov

Drainage Districts Maps, Improved land Use Land Cover Data – Anne Neale Neale.Anne@epamail.epa.gov