Southern Regional Soil Survey Conference 2010
Subaqueous Soils Committee Report

Co-chairs: Jerry Daigle and Rex Ellis
Participants: Tom Weber, Dennis Brezina, Susan Casby-Horton, Charles Guillory, Henry Langston, Shawn McVey.

Status of Subaqueous Soils activities in Southern Region coastal states:
Alabama – no activities
Florida – research mapping through the University of Florida
Georgia – no activities
Louisiana – no activities
Mississippi – no report
North Carolina – no activities
South Carolina – no activities (hope to start in two years)
Texas – special soil survey of Lugana Madre adjacent to Padre Island

Subaqueous Soils Rationale:
The study of subaqueous soils is a relatively new field in Pedology or soil science. The concept that sediments in shallow water environments undergo soil forming processes, are capable of supporting rooted plants, and meet the definition of soil according to the criteria defined in Soil Taxonomy has been moving soil scientists into a new frontier of soil survey – mapping subaqueous soils.

Subaqueous and Submerged Soils:
As the name implies, subaqueous and submerged soils are soils that occur under water (both fresh and salt water). The depth range of the water column where these soils may be found is not known, an arbitrary depth of 2.5 meters below the surface has been set for soil survey inventory. The difference between subaqueous and submerged soils is that submerged soils became submerged as a result of rising water tables, flooding events (such as a Beaver Dam), or sea level rise. Submerged soils formed in an upland environment but are now underwater. Subaqueous soils formed under a continuous water column (such as in an estuary), although their sediments may have originated from an upland area such as a dune.

Significance of Subaqueous Soils (by *George Demas, former soil scientist in Rhode Island*)**:**
A major limitation to science-based management of shallow water habitats has been a lack of definitive information on the properties and spatial distribution of subaqueous soils. In part, this lack of information has stemmed from an inadequate paradigm for subaqueous soils, which has not considered them “soils” at all, but rather as “sediments”. During the decade it has been demonstrated that these “sediments” would be better understood as “soils” and that the sedimentary paradigm should give way to a pedological paradigm.

An advantage of using the pedological approach to study shallow water habitat is that soils are studied as a collection of horizons that are linked vertically with depth and horizontally across the subaqueous landscape. These horizons are studied and characterized by examining a combination of properties and characteristics, instead of, say, a single component or parameter. In this manner, subaqueous soil can be characterized as ecological map units and provide a site-based system to identify the geomorphic settings that represent the subaqueous landscape. The following are some advantages of a subaqueous soil approach to shallow water classification:

- Sediment characteristics presented to a greater depth (2 m), rather than a bottom-type classification (such as mud bottom or rocky bottom).
- Provides a comprehensive classification scheme (Soil Taxonomy, Soil Survey Manual) for shallow water sediments.
- Could provide a major or missing data set for submersed aquatic vegetation (SAV) restoration, estuarine protection, planning and management.

Subaqueous Soil Survey:
Several States throughout the U.S. have begun the process of mapping and inventorying subaqueous soils. States with subaqueous soils are responsible for determining the activity in their state related to subaqueous soil mapping.

How are subaqueous soils mapped?
Traditional terrestrial soil mapping is conducted by a field soil scientist trained to understand the interaction of soil forming processes and soil-landscape relations. Mapping soil involves mostly field work with the soil mapper traversing the landscape and digging many holes to observe the soil condition and classify the soil.

Subaqueous soil mapping is performed in much the same way, except the mapper is in water. Instead of topographic maps to provide landscape position, subaqueous soil mapping uses bathymetric maps to identify landscapes and landforms. Shovels are replaced with augers and special tools, such as peat corers and vibracore, to obtain the soil samples.

Uses of Subaqueous Soil Mapping:
A major use of traditional soils surveys is to provide interpretation for various land uses and environmental planning. Interpretations for subaqueous soils are currently being developed for a variety of uses. As more areas are surveyed and more data collected a wide array of soil interpretations are expected. The following is a brief list of some uses of subaqueous soil survey data.

- SAV Restoration
- Crab Habitat
- Clam Stocking
- Management for Sustainable Production Clam, Oyster, and Scallop
- Nutrient Reduction

- Pathogens Pfesteria Cyst Residence Sites
- Benthic Preservation Site Identification
- Wildlife Management
- Wading Shore Birds, Migratory Waterfowl, Nurseries and Spawning Areas
- Habitat Protection for Horseshoe Crab and Diamondback Terrapin
- Effects of Dredging on Benthic Ecology
- Off Site Disposal of Dredge Spoil
- Acid-Sulfate Weathering Hazards
- Dune Maintenance/Replenishment
- Resource inventory
- Baseline conditions
- Dredging considerations
- Resource remediation
- Aquaculture

Charge 1. Contact Jim Turenne in Warwick, RI and document progress from the Subaqueous Soils workshop.

Still on for our 2nd National Workshop on Subaqueous Soils - if you want to announce it at your meeting we really need some non-NRCS folks (university, Feds, etc.)to come. Info and registration is at: http://nesoil.com/sasworkshop.htm

Anyone wishing to give a talk/poster should contact me to get on agenda.

I have a list of the SAS Interps needed and being researched on my SAS page: http://nesoil.com/sas look on the left side above the slide show. I need to update this with current research and needs.

Now that 11th edition has wassents/wassists in it we are moving full steam ahead and will have a SAS survey on the data mart by August.

Jim Turenne, CPSS
Rhode Island State Soil Scientist
USDA-Natural Resources Conservation Service 60 Quaker Lane, Suite 46 Warwick, RI 02886
W: 401-822-8830, Cell 401-255-6206
http://www.ri.nrcs.usda.gov/technical/soils.html
http://nesoil.com
www.mapcoast.org

Charge 2. Review and provide information on progress on methodologies for sample handling protocols and characterization methods for critical data elements.

Questions and problems from the Texas project include:

- n-value determination
- ponded vs flooded
- landform/geomorphic terminology
- parent material terminology (estuarine sediments?)
- unfamiliarity with boating in general
- shallow water
- remoteness/hard to access areas

Specialized equipment needs:

- Sidescan Sonar Image and Geologic Interpretation
- Sediment Sampling Using Vibracore Technology
- Coastal Remote Sensing
- Bathymetry – higher resolution than NOAA
- VNIR
- Soil surface topography – NE employed Garnin Depth Finder linked to GPS to map underwater surface (map X-Y-Z-Time)

Charge 3. Document progress of subaqueous soils research in soil survey and applications to interpretations.

Research:

- revised salinity classes for subaqueous soils
- leaching through dredge spoil
- soft bottom/hard bottom terminology
- n-value for subaqueous environments

Interpretations:

- soft bottom/hard bottom terminology (local interpretation in NE)
- suitability for mooring -dead weight vs mushroom anchor (local interpretation in NE)
- potential for submerged aquatic vegetation (local interpretation in NE)
- sulfidic materials
- oyster bed suitability

The Southern Region endorses the proposals submitted by the Northeast Region:

Proposed Amendment 5:1 Electrical Conductivity

In the Wassents Suborder, Frasiwassents are defined as having an electrical conductivity of <0.2 dS/m in a 5:1 by volume mixture of water and soil. Measuring EC in this manner is the best approach for subaqueous soils as samples containing reduced sulfide must be kept moist to avoid oxidation and production of sulfate salts that can change the electrical conductivity. Soils are diluted 5:1 and directly measured using an electrical conductivity probe (Soil Survey Staff, in review).

Proposed Amendment Satiated Bulk Density

Coastal wetland and subaqueous soils exist in their environment at saturation. Very low bulk density soils in submerged environments often contain a large percentage of water, making them very fluid. These soil qualities are important in subaqueous soil interpretations for shellfish and rooted vegetation habitat as well as construction and dredge operations. It is not possible to collect subaqueous soil samples using the clod method of bulk density, so collecting a known volume at the field moisture state (satiated) is the only option for these soils. A known volume of sample is collected at full saturation using variations on the core method: 3.3 Bulk Density; 3.3.1 Field-State; 3.3.1.4 Soil Cores; After Soil Survey Staff (2004)

Application: Bulk density by the core method offers the opportunity to obtain bulk density information without the expense incurred to obtain water retention. Field-state bulk density by the core method is particularly useful if the soil layers are at or above field capacity and/or the soils have low extensibility (shrink-swell) and do not exhibit desiccation cracks even if below field capacity. This method is not intended for weak or loose soil material. The procedure described herein is after the Soil Survey Staff (2004, method 3B6a).

Summary of Method: A metal cylinder is pressed or driven into the soil. The cylinder is removed, extracting a sample of known volume. The moist sample weight is recorded. The sample is then dried in an oven and weighed. (Soil Survey Staff, 2009)

Proposed Amendment to Texture Modifiers

Purpose: Shell fragments can be recognized in subaqueous or subaerial soils. The presence of shell fragments can have an impact on soil pH or buffering capacity in subaerial soils. Knowledge of subaqueous soil types provides a framework for mapping benthic habitats and managing marine resources. Mollusk growth and distribution are dependent upon soil characteristics; especially surface and near-surface horizons. Thus, certain areas of an estuary or marine system will contain abundant shell fragments. These areas provide important habitat. For example, as generations of oysters settle on top of each other and grow they form reefs that provide structured habitat for many fish species and crabs (NOAA, 2010). Rock fragment classes are to be used in addition to the shell fragment classes where appropriate, similar to the

artifactual classes of anthropogenic soils. Where multiple terms are used, rock fragment classes should be first, followed by the shelly modifier (ie gravelly, shelly silt loam).

Proposed Addition to Horizon Designation Suffix (si)

This symbol indicates the presence of sulfides in mineral or organic horizons. Sulfidic horizons typically have dark colors; values <4, and chromas <2. These horizons typically form in coastal environments that are permanently saturated (tidal marshes or estuarine subaqueous soils) and have a source of sulfur to form sulfides. Such horizons may have a sulfidic odor when first exposed to air. Sulfidic horizons may also be geologic in origin. Examples include coal deposits or coastal plain deposits such as glauconite that have not been oxidized because of thick overburden.

Purpose: Sulfidization is an important soil forming process in estuarine and marine soils where an abundance of sulfur and a lack of oxygen promote the creation of sulfidic materials. The presence of sulfidic materials is a primary characteristic in the classification within Aquents and Wassents suborders. Sulfide content is important in many ecological, use, and management aspects of soils. For example, sulfides precipitate with a number of toxic metals, limiting the bioavailability of these metals (Griffin et al., 1989; Leonard et al., 1996). The sulfide content in subaqueous soils has been shown to have an impact on the suitability of the soil for eelgrass growth (Goodman et al., 1995; Bradley and Stolt, 2006). Sulfide content of soils is also important when considering marine construction and dredging projects. If sulfide bearing subaqueous soils are dredged and placed in a subaerial environment, sulfides will oxidize, creating sulfuric acid, drastically lowering soil pH, and resulting in acid sulfate soils (Fanning and Fanning, 1989). Acid sulfate soils may persist for a number of years and are uninhabitable for plants and animals. If deposited near water, these acid sulfate soils can also create runoff that is toxic to aquatic systems (Demas et al., 2004). The si suffix would be applied to both organic and mineral horizons. The si suffix should be written first if multiple suffix symbols are used. Dark black coloring and sulfide odor are initial indicators of the presence of sulfides in a soil horizon. Green colors may be present in areas with glauconite. The Soil Survey Field and Laboratory Methods Manual (Soil Survey Staff, 2009) outlines field and field laboratory procedures to determine the presence of sulfidic materials in soils.

Proposed Amendment to Natural Drainage Classes

Definition of attribute:

Subaqueous - Free water is at or above the soil surface. The occurrence of internal free water is permanent having a positive water potential at the soil surface for more than 21 hours of each day. Peraquic feature: all soil layers are permanently saturated

Purpose (Why it is necessary, how it is used). In the Keys to Soil Taxonomy 11th Edition, the horizontal boundaries of soil are areas where the soil grades to deep water. These subaqueous soils are classified out at the suborder level as Wassents and Wassists due to a positive water potential at the soil surface for more than 21 hours of each day in all years. The very poorly drained definition does not take into account this frequency and duration of wet periods that classify subaqueous soil. Very poorly drained: Water is removed from the soil so slowly that

free water remains at or very near the ground surface during much of the growing season. The occurrence of internal free water is very shallow and persistent or permanent. Unless the soil is artificially drained, most mesophytic crops cannot be grown. The soils are commonly level or depressed and frequently ponded. If rainfall is high or nearly continuous, slope gradients may be greater (Soil Survey Manual, 1993). For subaqueous soils you will be able to choose a more accurate account of the frequency and duration of wet periods that define the natural drainage classes.