SOIL SURVEY TECHNICAL NOTE

NATIONAL SOIL SURVEY CENTER
Federal Building, Room 152
100 Centennial Mall North
Lincoln, Nebraska 68508-3866

Soil Survey Technical Note 430-SS-12

Coastal and Subaqueous Soil Interpretations

This technical note provides information on subaqueous soil interpretations that are now available on Web Soil Survey and gives a projection of the needs for future work.

Background

The National Cooperative Soil Survey (NCSS) provides detailed information on the properties and qualities of soils throughout the United States in support of land use and management. To meet more varied uses of soils data, the NCSS has been continuously collecting and recording the data needed to create a variety of innovative soil interpretations. When the NCSS started, the focus was on agricultural land and identification of prime and important agricultural areas. Today, the NCSS has shifted its priority to cooperatively investigate, inventory, document, classify, interpret, disseminate, and publish information on all soils, including subaqueous soils (Demas, 1993).

As the needs and interests of soil data users change, so should the interpretations used for informing land use decisions. According to the 2010 census, 39 percent of the U.S. population lives in counties directly on the coast, an area that totals less than 10 percent of the total U.S (NOAA, 2013). Because of these coastal population concentrations, the property of a significant number of people and valuable infrastructure are at risk for damage and inundation due to sea level rise as well as flooding and erosion from coastal storms. Additionally, nearshore areas are increasingly being used for aquaculture, offshore wind power, and recreation. These areas are in and adjacent to eelgrass meadows, salt marshes, and mangrove swamps—some of the most productive ecosystems on earth. They have the potential to sequester atmospheric carbon and buffer the wind and wave energy that erodes shorelines. Detailed maps, data, and interpretations of the coastal and nearshore areas are vital tools for the sustainable development and increased resiliency of these important ecosystems and population centers.

Increasing the scope of soil surveys to include coastal areas can provide valuable information for planning and managing these areas of high development value, high hazard potential, and significant ecological value. In 2016, NRCS State Conservationists of northeastern States signed the Coastal Zone Soil Survey (CZSS) initiative for the Northeast, requesting that the Soil and Plant Science Division focus on coastal zone mapping to provide needed soils data. In response to this request, a national CZSS Focus Team was established to move the CZSS initiative forward and personnel were directed to develop new interpretations for the subaqueous environment.

What is Coastal Zone Soil Survey?

A CZSS is a seamless dataset of soils information that encompasses terrestrial and shallow subaqueous soils to an approximate water depth of 5 meters (15 feet) in areas where submerged aquatic vegetation is either growing or has the potential to grow. Soil surveys include 3D datasets that provide properties of soil and geology from the soil surface to a depth of approximately 2 meters (6 feet) (Stolt et al., 2011).

Several States have conducted CZSS projects in association with local partners, and this soil survey information is now available in Web Soil Survey. Areas where subaqueous soils are mapped include the coastal ponds of Rhode Island; Barnegat Bay, New Jersey; Indian River and Rehoboth Bays, Delaware; Chincoteague Bay, Rhode River, and Sinepuxent Bay, Maryland; selected locations along the Connecticut coast; and South Padre Island and Baffin Bay, Texas.

Interpretations

Soil interpretations are models which synthesize a large amount of technical soils data to produce specific recommendations or ratings. Local, regional, and national soil interpretations are developed by the NCSS and made available through the Web Soil Survey (WSS). Traditional soil interpretations are appropriate for the terrestrial components of coastal zone soil surveys, but due to the unique nature of subaqueous soils, new interpretations have been developed for uses specific to their subaqueous nature.

In October 2017, 11 new soil interpretations were published on Web Soil Survey specifically for subaqueous soils. They are housed in the Soil Data Explorer, under the tab “Suitabilities and Limitations for Use Ratings,” under “Subaqueous Soils.”

Interpretations for subaqueous soils are listed below, and definitions of each follow.

- CMECS Substrate Class
- CMECS Substrate Origin
- CMECS Substrate Subclass
- CMECS Substrate Subclass-Group
- CMECS Substrate Subclass-Group-Subgroup
- Eastern Oyster Habitat Restoration Suitability
- Eelgrass Restoration Suitability
- Land Utilization of Dredged Materials
- Mooring Anchor – Deadweight
- Mooring Anchor – Mushroom
- Northern Quahog (Hard Clam) Habitat Suitability

Coastal and Marine Ecological Classification Standard (CMECS) Interpretations

The terminology standard used by the Federal Geographic Data Committee (FGDC) for classifying substrate in studies on estuarine and marine systems is the Coastal and Marine Ecological Classification Standard (CMECS; US FGDC, 2012). This standard follows the approach of Wentworth (1922) to define sediment particle sizes and that of Folk (1954) to describe mixes. CMECS includes descriptors, such as clay, silt, mud, and sand, that differ from the USDA Textural Classification System used by the NCSS. These interpretations convert USDA textural classes to the CMECS substrate component for description of subaqueous soils. The substrate component describes the composition and size of the estuary bottom and sea bed materials in all CMECS systems.

Eastern Oyster Habitat Restoration Suitability

Oysters (*Crassostrea virginica*) are considered a keystone species in most estuaries along the Atlantic and Gulf coasts. In addition to the production of oysters for harvesting, oyster reefs provide water filtration services, habitat for other aquatic species, nutrient sequestration, and stabilization of adjacent habitats and shorelines. Despite their significance, however, oyster reefs are one of the most threatened marine habitats on earth. In restoration efforts, it is important to identify sites with the highest probability of success. This soil interpretation ranks the suitability of subaqueous soils for oyster restoration based on soil texture, sulfide content, soil pH, and soil salinity.

Eelgrass Restoration Suitability

Eelgrass is a submerged, rooted vascular plant. Eelgrass beds rank among the most productive marine and estuarine plant habitats. They support an abundance of marine life, especially young, commercially valuable fish species. Worldwide eelgrass populations are declining due to disease, disturbance, and degrading water quality. Restoration of eelgrass beds consists of planting eelgrass in areas suitable for growth. This soil interpretation ranks the suitability of subaqueous soils for planting eelgrass beds based on water depth, soil texture, rock fragments, soil organic matter, presence of monosulfides, oxidized pH, and electrical conductivity.

Land Utilization of Dredged Materials

Sulfur is a common element in seawater. In anoxic marine environments, soil can develop accumulations of reduced sulfide. When these soils are exposed to oxygen through dredging or draining, the sulfide can oxidize and produce sulfuric acid. The sulfuric acid drastically lowers the soil pH (to less than 4) and results in the formation of acid sulfate soil. An acid sulfate soil is toxic to the growth of most plants; can corrode concrete, iron, and steel foundations and piping; creates runoff water that contains sufficient amounts of sulfuric acid and aluminum, which cause fish disease and mortality; and mobilizes heavy metals within it. This soil interpretation rates subaqueous soils, based on oxidized pH, for their potential to become acid sulfate soils if removed from an anoxic environment through dredging or drainage.

Mooring Anchor - Deadweight and Mushroom
The best type of permanent mooring or anchor for holding boats in place is dependent on the soil type. Mushroom anchors are more suitable for areas with highly fluid soil surfaces, while deadweight moorings work better in soils with sandy or gravelly surfaces. These soil interpretations rate the suitability of subaqueous soils for deadweight and mushroom anchors based on the manner of failure or *n* value (fluidity).

Northern Quahog (Hard Clam) Habitat Suitability
The northern quahog or hard clam (*Mercenaria mercenaria*) is a clam species found in intertidal and subtidal areas from Nova Scotia to Florida. It has high economic, ecological, and cultural value. Identifying habitat that is suitable for restoration or preservation is important in maintaining and increasing hard clam populations. This soil interpretation rates the suitability of subaqueous soils for hard clam habitat potential based on soil texture, sulfide content, soil salinity, water depth, and soil pH.

Needed Subaqueous Soil Interpretations

The soil interpretations listed below have been requested through the NCSS and are not yet developed.

Requested interpretation	Purpose of interpretation
Soil potential for coastal acidification	Identify areas at higher risk for coastal acidification. Acidification affects shellfish recruitment and growth.
Blue carbon assessment	Report carbon stocks in soils. Coastal and subaqueous soils have been identified as important carbon sinks.
Ground-water discharge - freshwater inputs	Identify soils where ground water discharges into estuaries and bays.
Living shorelines	Identify soil suitability for living shoreline development.
Scallop restoration	Identify soil suitability for scallop restoration.
Clam stocking	Identify soil suitability for clam stocking.
Diamondback terrapin nesting areas	Identify coastal soils that are suitable for diamondback terrapin nesting and so preserve habitat for this endangered/threatened species.
Thin layer deposition on tidal marshes	Report stability of marsh soils and suitability of soil material for marsh restoration projects involving thin layer deposition.
Heavy metal deposition	Identify soils that are likely to have heightened levels of heavy metals.
Storm surge inundation	Identify soils that would be inundated by storm surge.
Salinization risk/recovery	Identify soils where productivity would be compromised if they were inundated with salt water from storm surge or tidal flooding.
Salt effects	Identify risk of damage to range, pasture, crops, and other plants due to salt-water inundation for various periods of time.
Coastal and shoreline erosion	Identify risk of erosion and scouring of soils from storm surge or tidal flooding.
Chemical/oil leaching potential	Identify soils at risk for chemical or oil contamination if subjected to coastal flooding.
Chemical/oil remediation	Identify soil suitability for various types of remediation cleanup.
Mosquito habitat	Identify soils where mosquitos breed. Increased populations of mosquitos can lead to higher rates of disease transmission.
Soil-borne pathogen	Identify soils that pose a health threat by harboring soil-borne respiratory pathogens.
Water quality	Identify soil types that are indicative of degraded water quality.
Reef balls	Identify soil suitability for reef ball placement.
Dock development	Identify soil suitability for dock development.
Lobster habitat	Identify soil suitability for lobster habitat.
Critical habitats for migrating birds	Identify soils that host critical habitats for migrating birds.
Critical habitats for wading shore birds	Identify soils that host critical habitats for wading shore birds.

Fish nurseries and spawning areas	Identify soils suitable for specific fish nurseries or spawning areas.
Dredging island creation	Identify soil suitability for island creation.
Beach/dune nourishment	Identify soil suitability for beach and/or dune nourishment.
Horseshoe crabs	Identify soil suitability for horseshoe crab habitat.
Invasive species	Identify soil limitations and suitabilities for controlling specific invasive plants.
Energy placement (offshore winds)	Identify soil limitations for sites for energy sources using offshore winds.

Contact

The contact for this technical note is the National Leader for Technical Soil Services and World Soil Resources, Soil and Plant Sciences Division, Washington DC.

Literature Cited

Demas, G.P. 1993. Submerged soils: A new frontier in soil survey. Soil Survey Horizons 34(2):39-60.

Folk, R.L. 1954. The distinction between grain size and mineral composition in sedimentary-rock nomenclature. Journal of Geology 62:344-359.

National Oceanic and Atmospheric Administration (NOAA). 2013. National Coastal Population Report: Population Trends from 1970 to 2020. https://aamboceanservice.blob.core.windows.net/oceanservice-prod/facts/coastal-population-report.pdf

Stolt, M., M. Bradley, J. Turenne, M. Payne, E. Scherer, G. Cicchetti, E. Chumchenia, M. Guarinello, J. King, J. Boothroyd, B. Oakley, C. Thornber, and P. August. 2011. Mapping shallow coastal ecosystems: A case study of a Rhode Island lagoon. Journal of Coastal Research 27(6A):1–15.

U.S. Federal Geographic Data Committee (US FGDC). 2012. Coastal and Marine Ecological Classification Standard. FGDC-STD-18-2012.

Wentworth, C.K. 1922. A scale of grade and class terms for clastic sediments. Journal of Geology 30:377–392.