Key Interpretation Challenges and Needs Related to Subaqueous Soils: Where Do We Go From Here?

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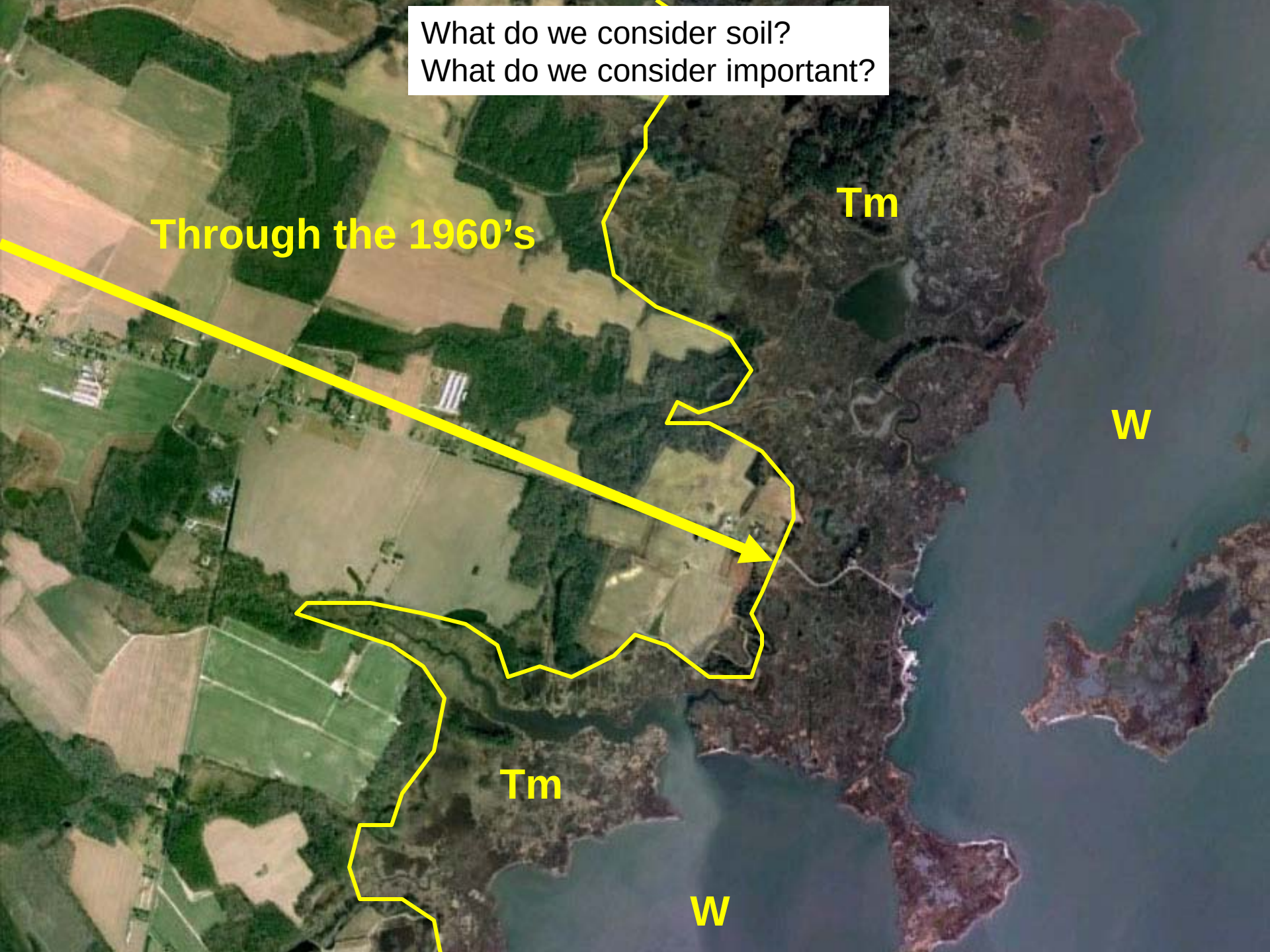
What do we consider soil?
What do we consider important?



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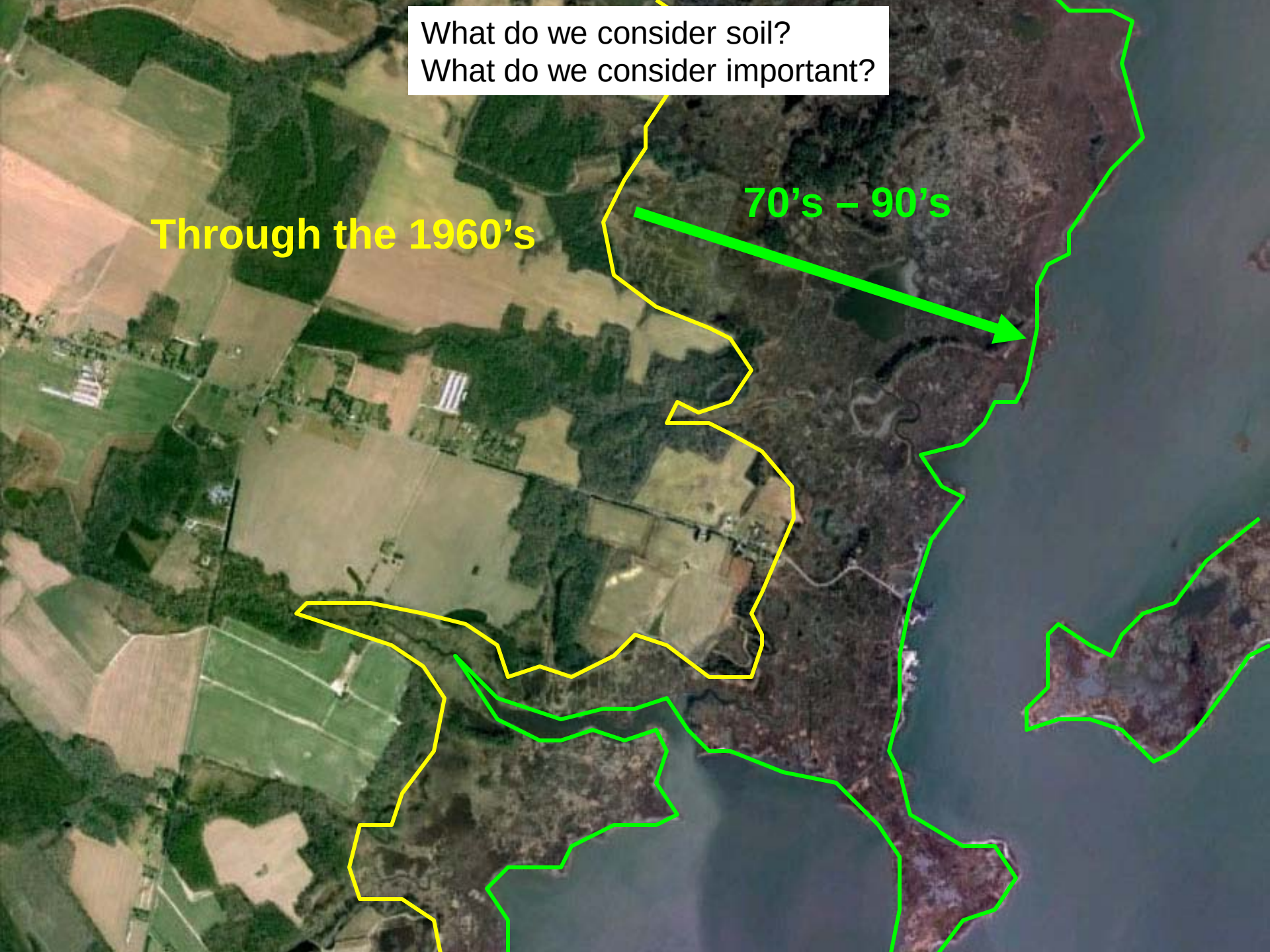

TP – Transquaking and Mispillion Soils
BX – Boxiron and Broadkill Soils

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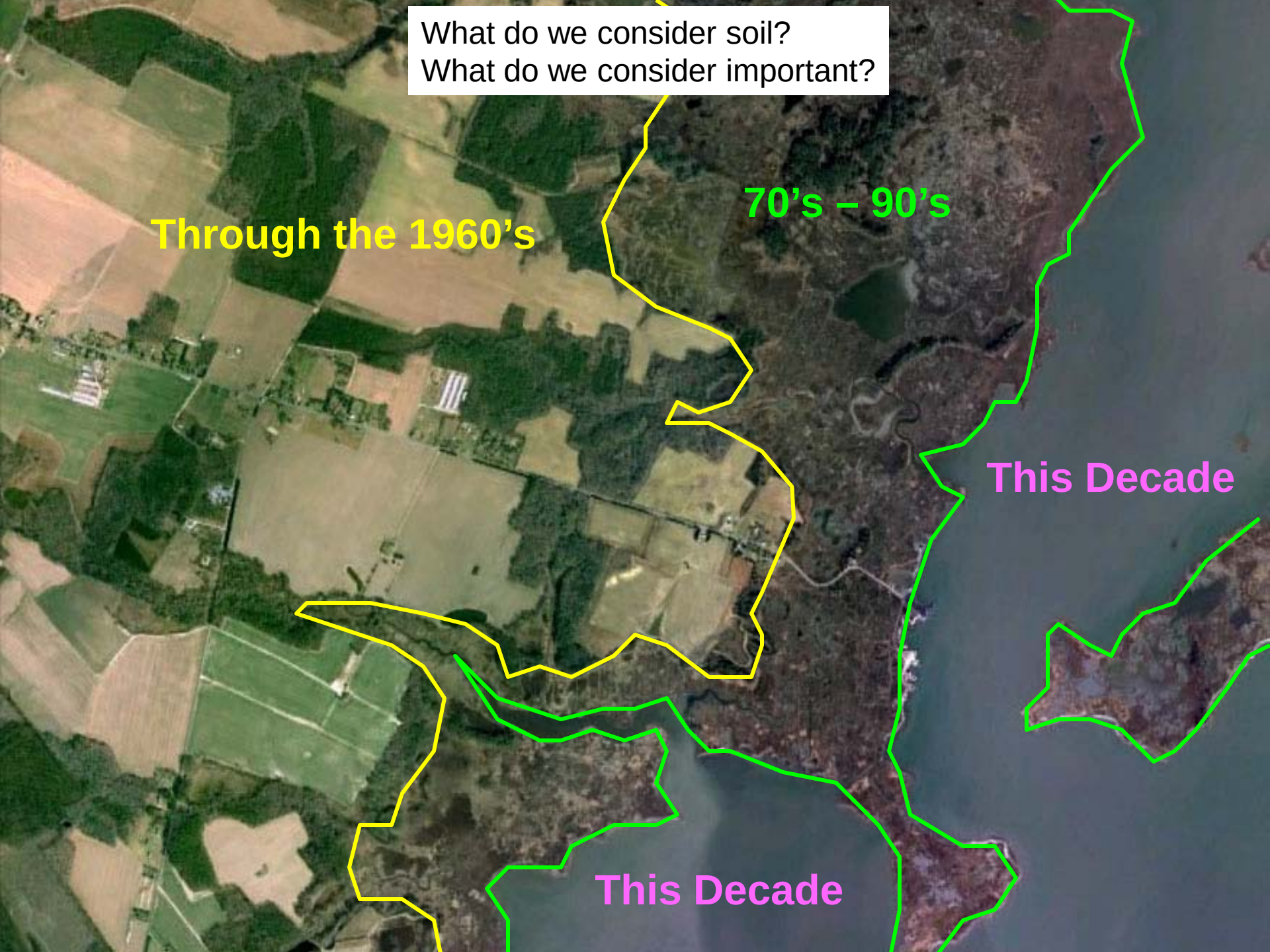
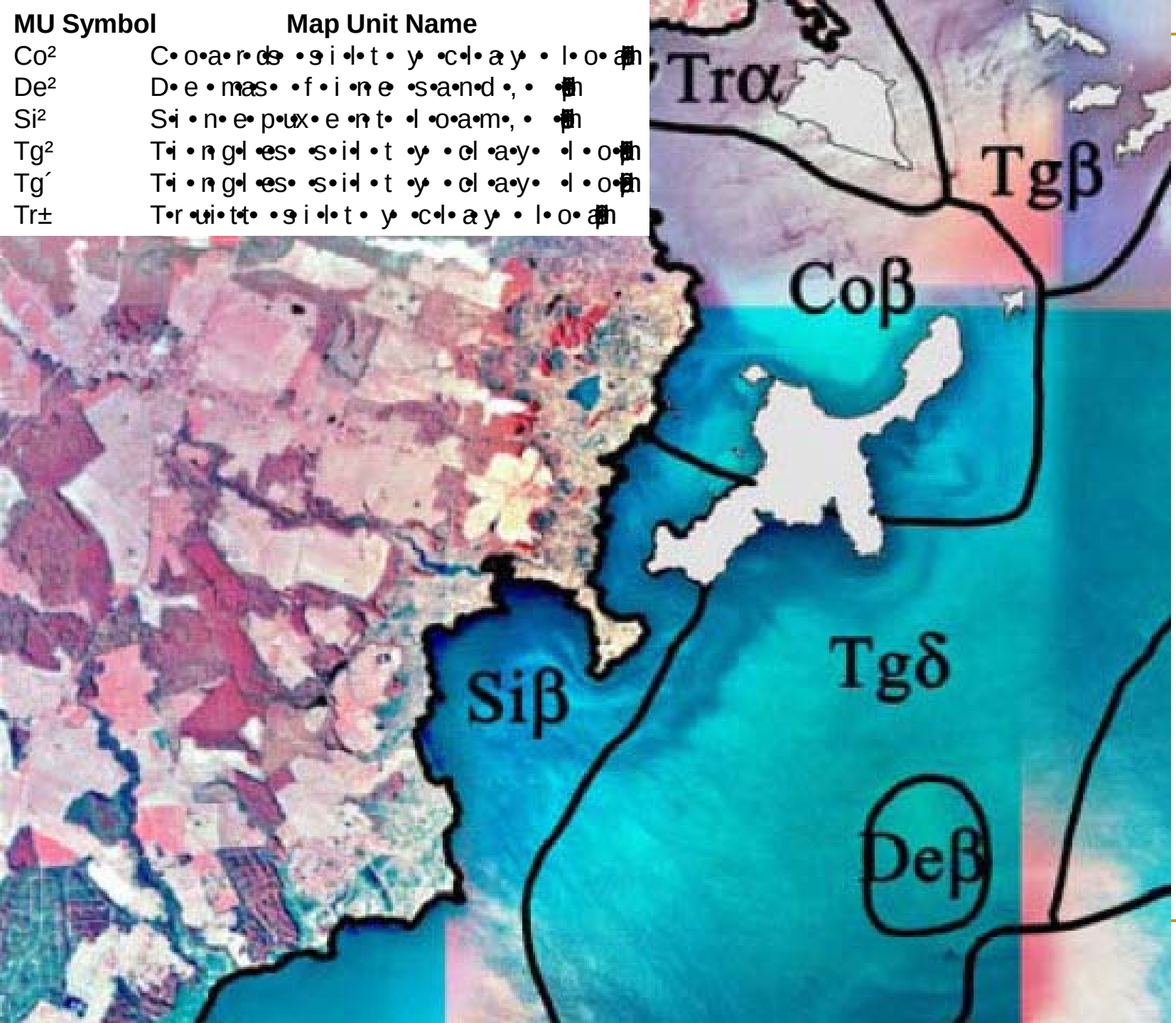
What do we consider important?



MU Symbol	Map Unit Name
Co²	Coards silt y clay loam
De²	Demas fine sand,
Si²	Sinepux ent loam,
Tg²	Tingles silt y clay loam
Tg´	Tingles silt y clay loam
Tr±	Truitt silt y clay loam



1975 Definition of soil…..

- *Soil Taxonomy* (Soil Survey Staff, 1975) stated:
  - *Soil, … is the collection of natural bodies on the earth's surface, in places modified or even made by man of earthy materials, containing living matter and supporting or capable of supporting plants out-of-doors.* ***Its upper limit is air or shallow water. At its margins it grades to deep water*** *or to barren areas of rock or ice.*
- For the most part subaqueous materials were excluded by
  - their permanent saturation beneath “deep” water.
  - the primary requirement that they be able to support rooted plants.

Modification of the definition in 1999….

- *Soil .... is a natural body .... that occurs on the land surface, ... and is characterized by [either]*
  - *1. ..... horizons, or layers, that are distinguishable from the initial material as a result of additions, losses, transfers, and transformations of energy and matter or*
  - *2. the ability to support rooted plants in a natural environment.....*
- *The upper limit of soil is the boundary between soil and air [or] shallow water, ... [not]… too deep (typically more than 2.5 m) for the growth of rooted plants.*

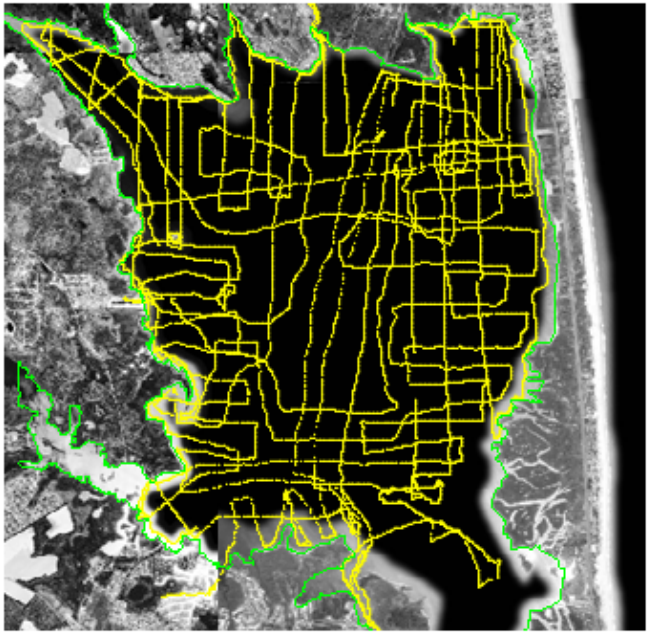
- This opened the doors for recognition of subaqueous soils.

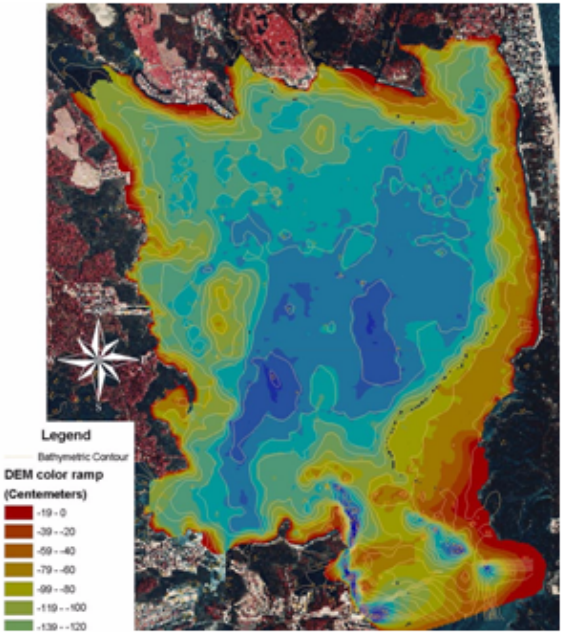
from *Soil Taxonomy 1999*

The Challenge of Subaqueous Soil Investigations

- How does one view or evaluate topography or landscapes here? – the “bathymetry problem”
- How does one observe, describe or sample soils here?

- These were the initial issues that needed resolution

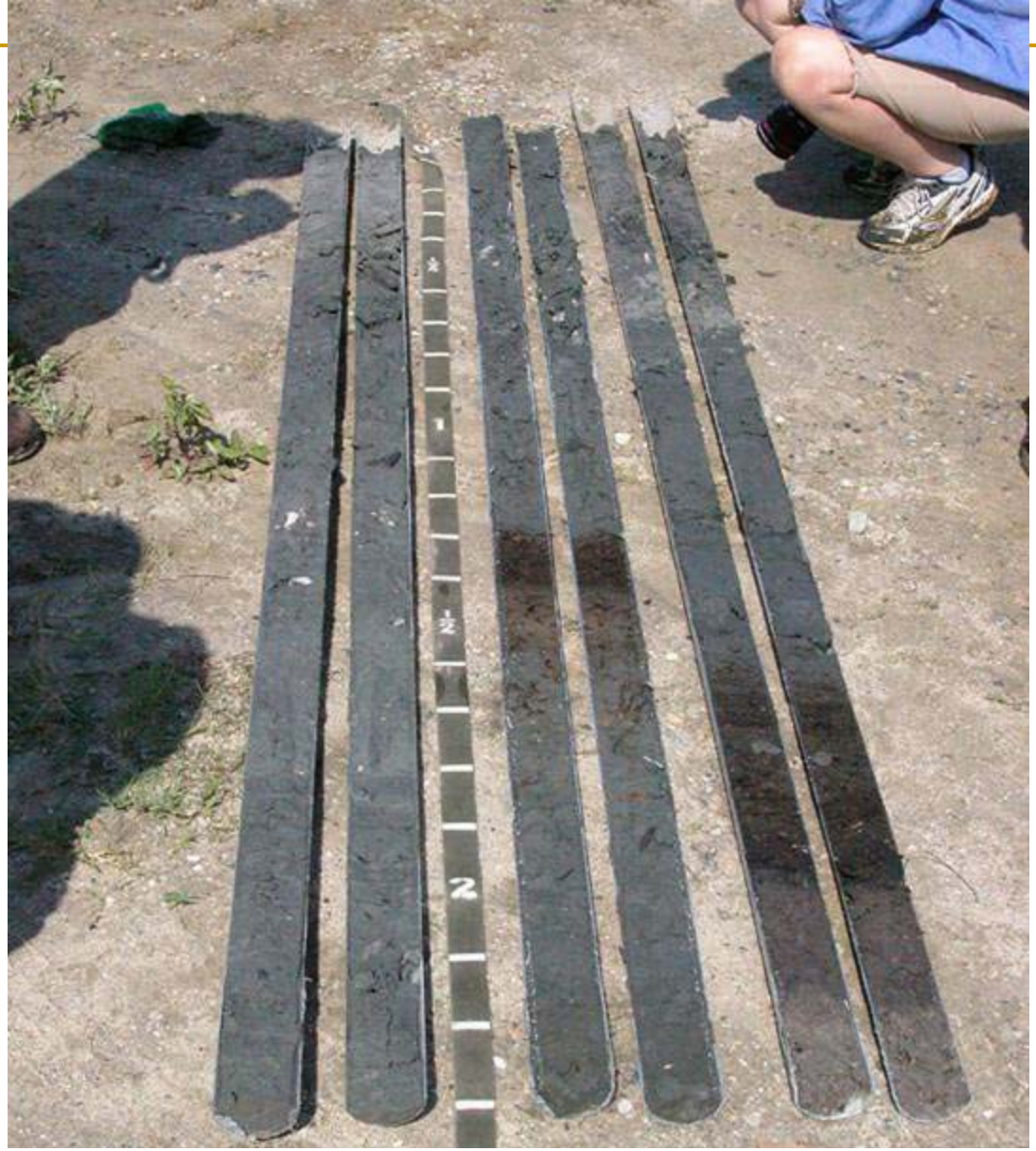




Landform ID based upon:
1) proximity to other landforms
2) shape of a landform
3) water depth
4) slope of subaqueous surface

Recognition and ID of subaqueous landforms permitted translation of the pedological paradigm into the subaqueous environment

Learning to address the sampling issues



Morphology is often akin to that of fluvaquents
Some new features (recent “se” subscript for sulfides)

Application of Soil Taxonomy

- Originally accommodated under Aquic suborders of Entisols
  - Sulfaquents
  - Psammaquents
  - Fluvaquents
- Failed to adequately capture the true degree of “wetness”

Modifications to Soil Taxonomy

2010 – Keys to Soil Taxonomy 11th ed

- Recent approval of Wassi suborders in
  - Entisols (wassents)
  - Histosols (wassists)
- Currently considering possible need in other orders

NATIONAL WORKSHOP ON SUBAQUEOUS SOILS

July 14-18, 2003

Georgetown and Rehoboth Bay, DE

Goals Classroom Topics Field Sessions Registration Info

Weekly Schedule

WORKSHOP LEADERS:

Martin C. Rabenhorst - Professor of Pedology, University of Maryland

Philip King - Soil Scientist, Georgetown, Delaware

Mark Stolt - Associate Professor of Soil Science, University of Rhode Islan

Laurie Osher - Assistant Professor of Soil and Water Quality, University of

Download Brochure (PDF)

Workshop Sponsors

UNIVERSITY OF MARYLAND

University of Rhode Island

2nd National Workshop on Subaqueous Soils

August 8 to 13, 2010

URI Coastal Institute, Narragansett , RI | **View Photos of the Workshop HERE**

Workshop Agenda and Topics – **Click HERE for field schedule matrix** | **Click HERE to Download the Field Booklet.**

Sunday, August 8, 2010

Travel day – folks should check into to lodging Sunday night to get early start Monday morning.

Monday, August 9, 2010

8:00 to 8:30 AM: Registration – Hazard Room, URI (

8:30 to 9:00 AM: Welcome to RI and overview of the

9:00 to 9:45 AM: Introduction to Subaqueous Soils:

9:45 to 10:30: The Coastal Zone Soil Survey of Rhod

10:30 to 10:45 AM: Break

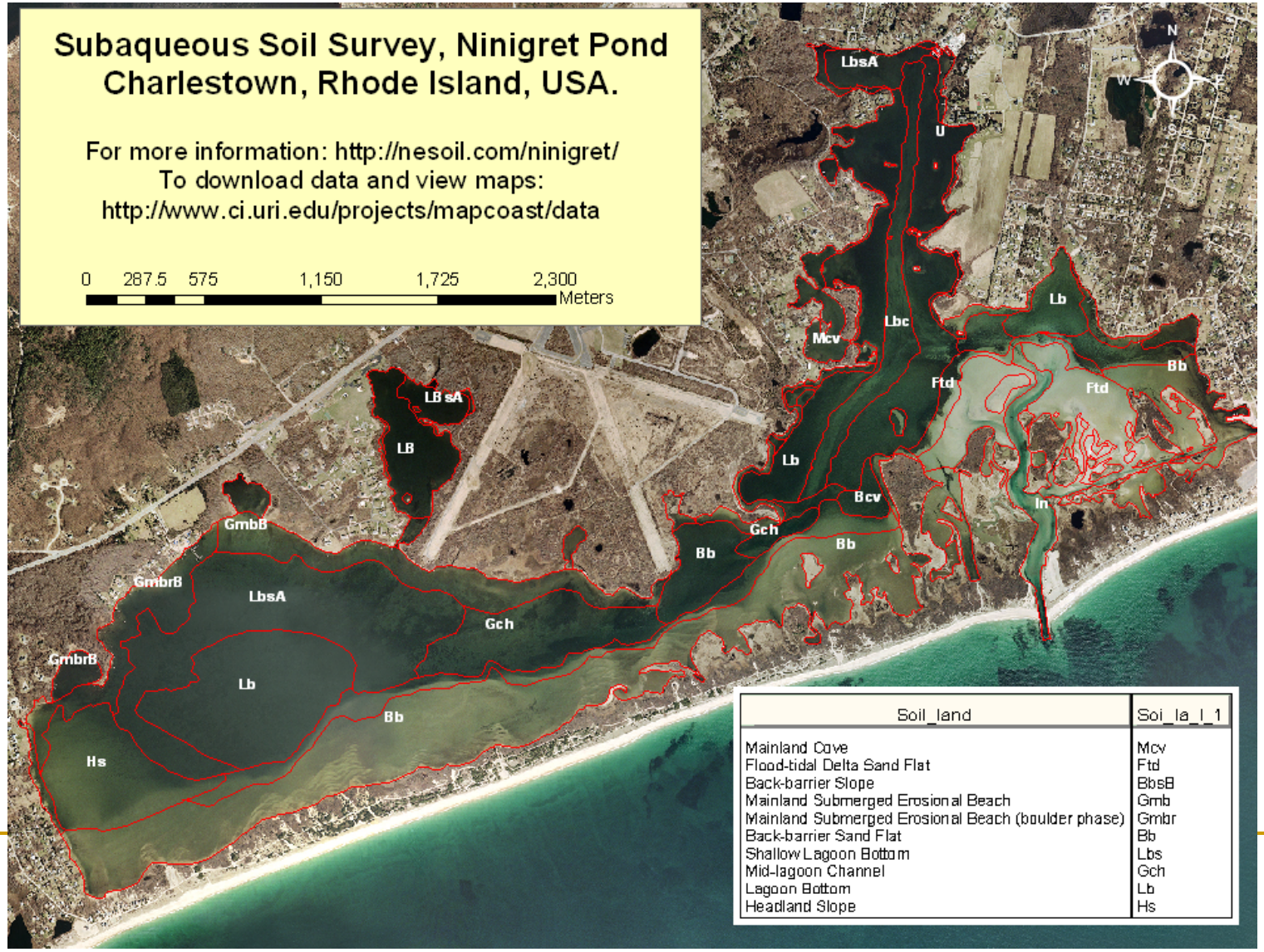
10:45 to 11:30 AM: Overview of the geology of New E

11:30 to 12:00 PM: Boating safety basics – rules of

12:00 to 1:00 PM: Lunch and travel to 1st field sessio

1:00 to 5:00 PM: Field Session 1.

So now that we have subaqueous soil surveys ……..
…… for what will they be used?



Subaqueous Soil Resource Based Interpretations

- Seagrass Restoration
- Crab Habitat
- Clam Stocking
- Sustainable Production Clam, Oyster, and Scallop
- Nutrient Reduction
- Pathogens Pfesteria Cyst Residence Sites
- Benthic Preservation Site Identification
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- Habitat Protection for Horseshoe Crab and Diamondback Terrapin
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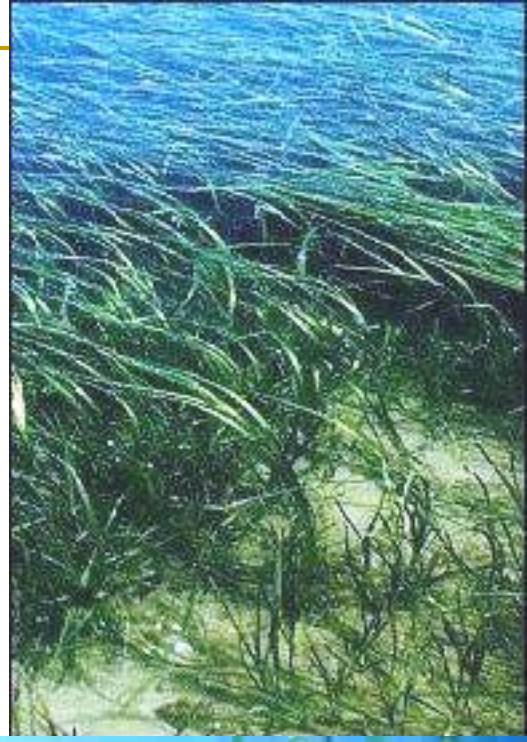
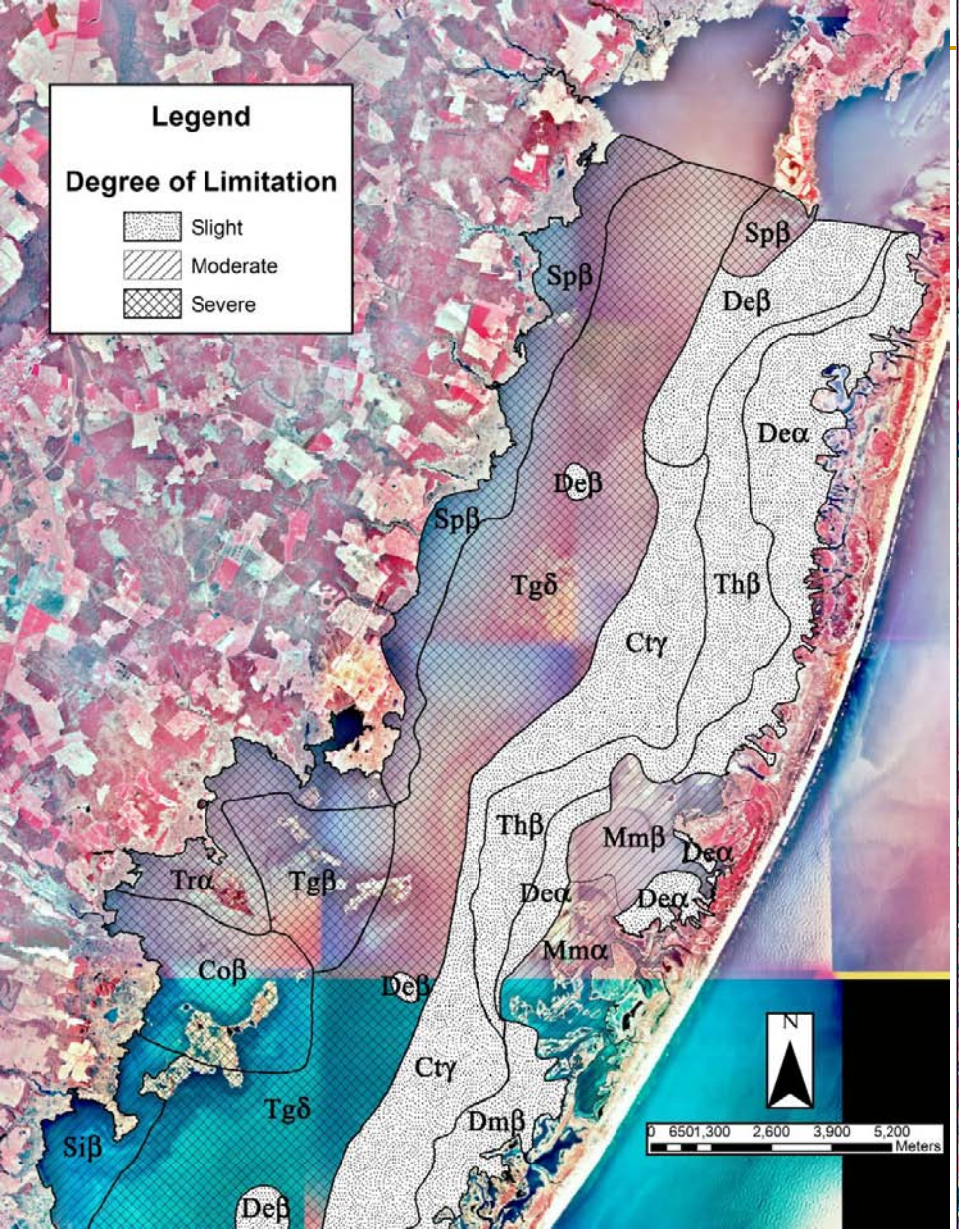
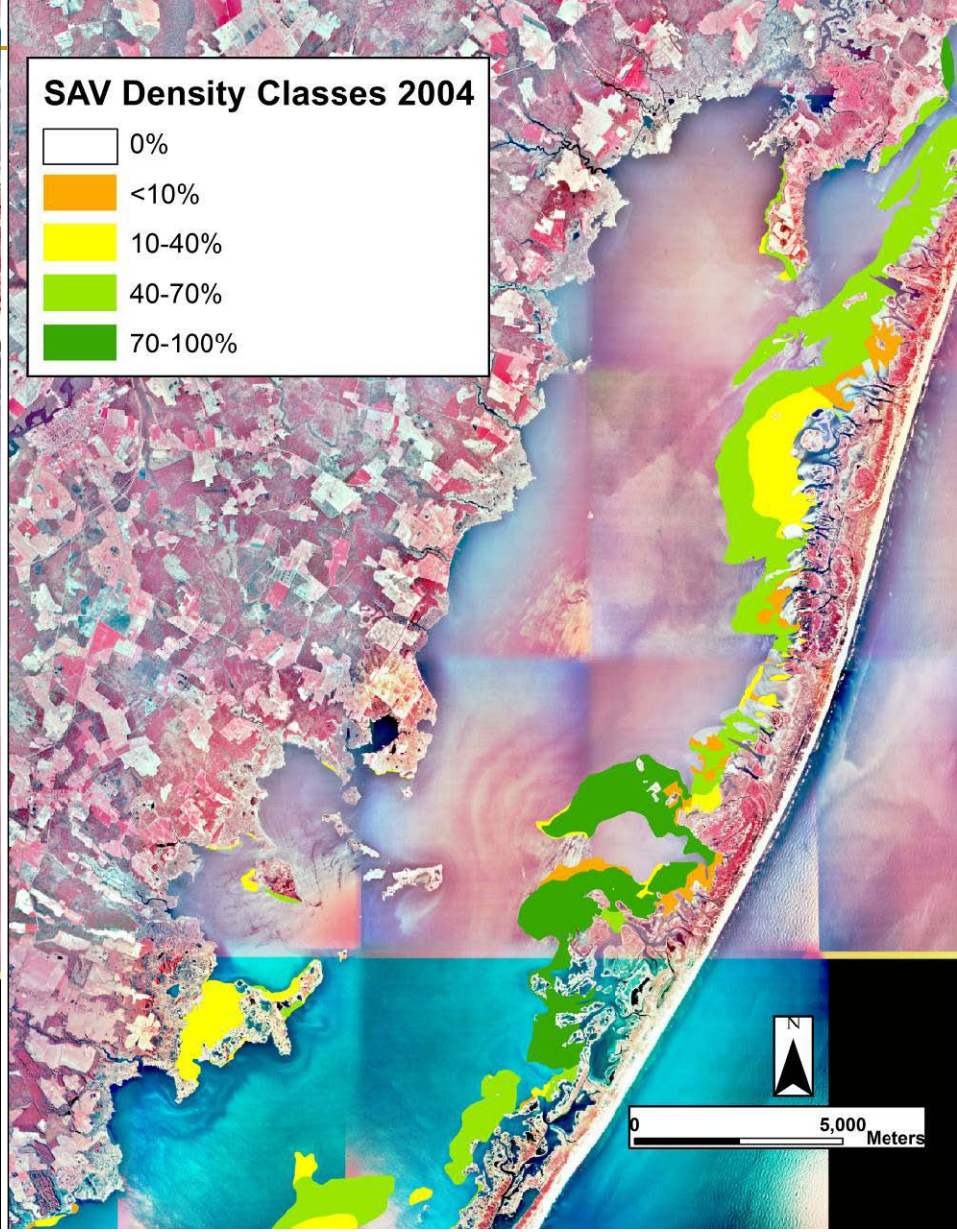
- Off Site Disposal of Dredge Spoil
- Acid-Sulfate Weathering Hazards
- Dune Maintenance and Replenishment
- Carbon Sequestration

Importance of Eelgrass

- **High biological productivity**
  (200 to 600 $gCm^{-2} yr^{-1}$)*Mann, 2000*
- **Habitat for spawning fish, shellfish and benthic infauna**
- **Food source for waterfowl**
- **Trap sediment from water column**
- **Buffer wave activity**







Comparison of Soil properties with Actual SAV distribution in Chincoteague Bay

Summary of Eelgrass Investigations

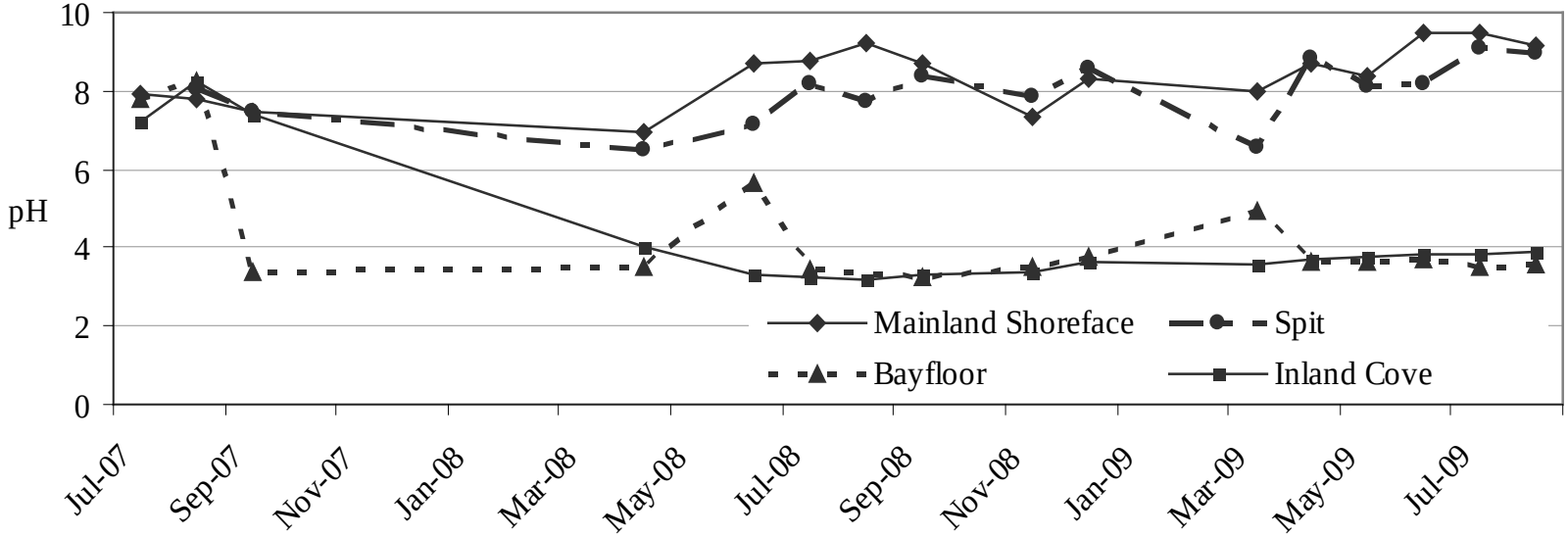
- In Rhode Island
  - Eelgrass cover and growth rates varies by soil-landscape unit
  - Landscape units that supported the most eelgrass and the highest aboveground growth rates had lower success rates for transplantation
- Observations in the Mid-Atlantic (Chincoteague Bay)
  - Also observed that eelgrass cover and growth rates varies by soil-landscape unit
  - However, different conclusions regarding optimum soil units for SAV
- Likely there are region-specific factors
  - Ice scouring

Upland Placement of Estuarine Dredged Material

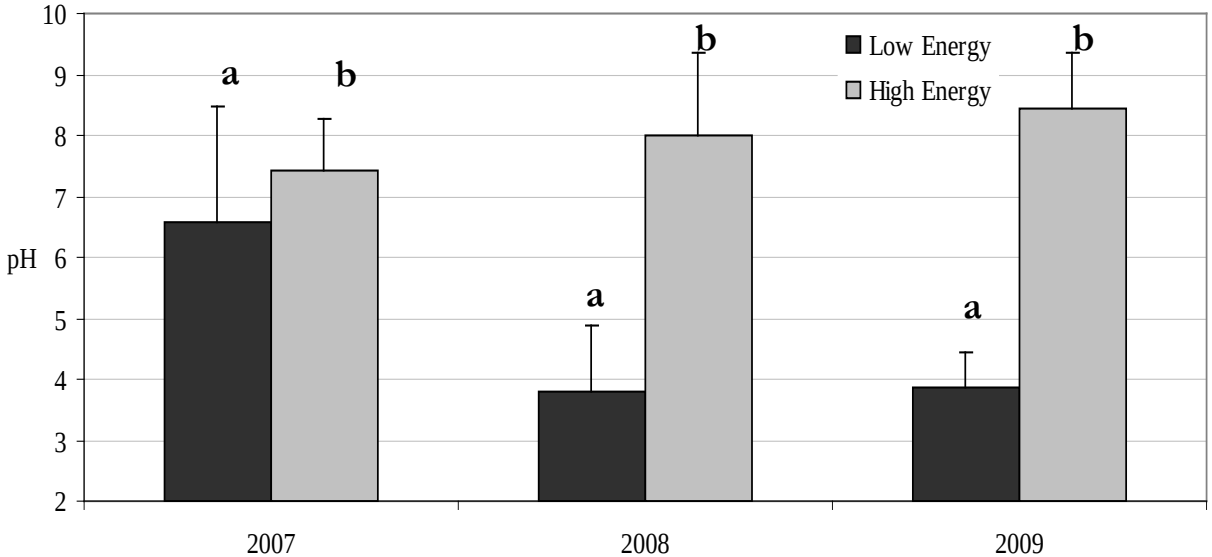
- Benefits and Uses
  - Beach replenishment
  - Eelgrass (SAV) bed restoration
  - Marketable topsoil
  - Island creation

- Hazards
  - **Heavy Metals**
  - Toxins (organic and inorganic)
  - Petroleum products
  - Salts
  - **Formation of acid sulfate conditions**

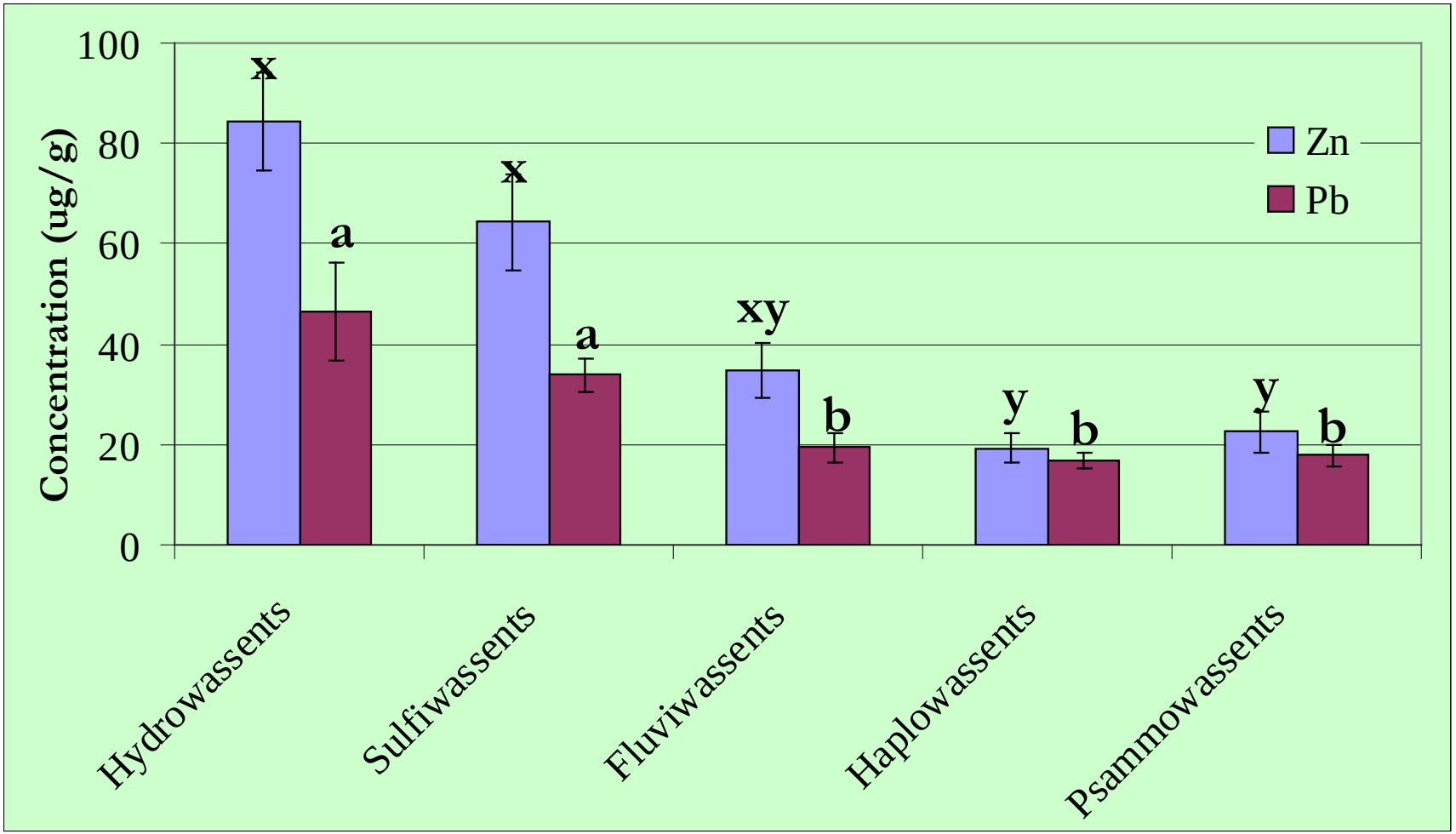
Leachate pH Greenwich Bay



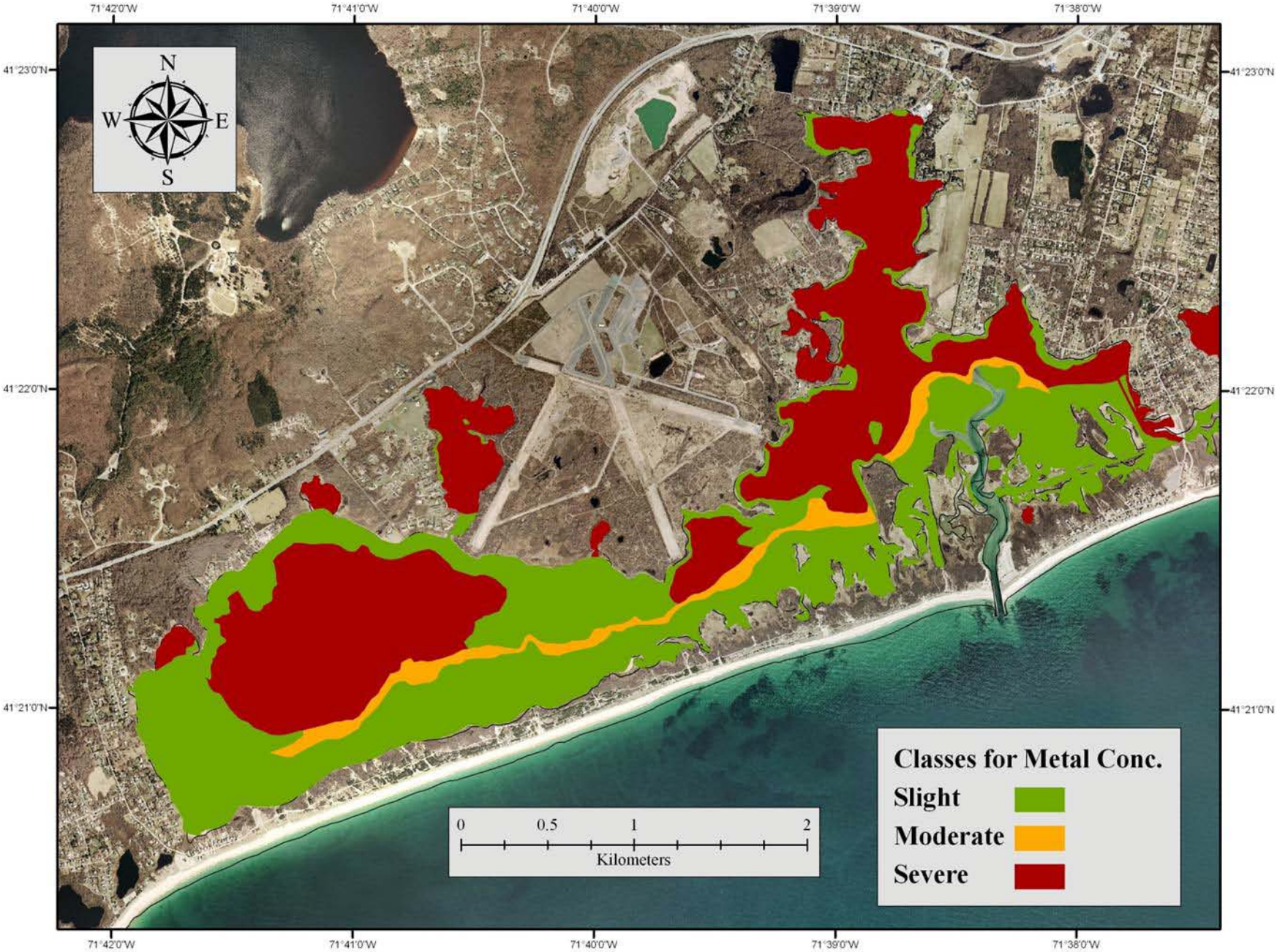
Leachate pH among high and low energy samples by year

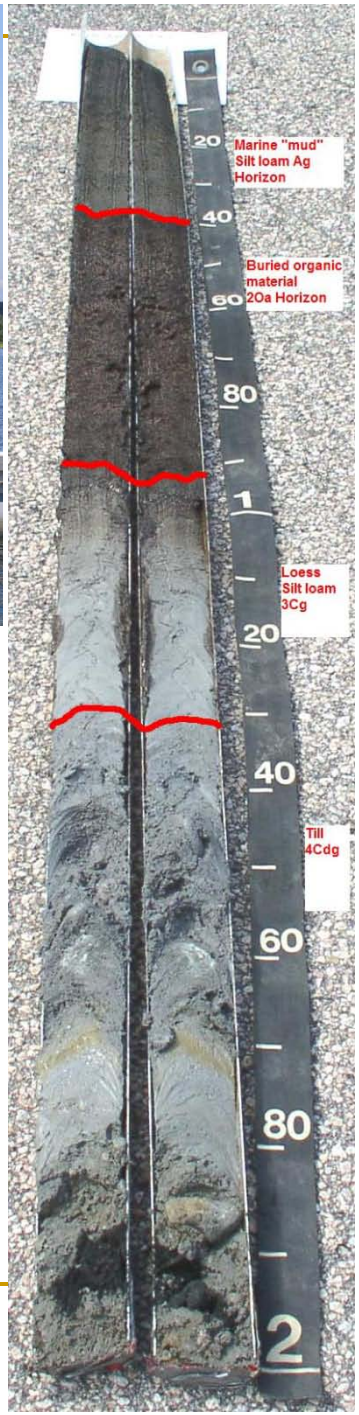


Heavy Metals in Subaqueous Soils (RI)



- Hydro and Sulfiwassents contain greater fine materials, SOC contents, and sulfides which bind metals


71°42'0"W
71°41'0"W
71°40'0"W
71°39'0"W
71°38'0"W
41°23'0"N
41°22'0"N
41°21'0"N
N
W
E
S
0
0.5
1
2
Kilometers
Classes for Metal Conc.
Slight
Moderate
Severe



Soil Organic Carbon in Subaqueous Soils

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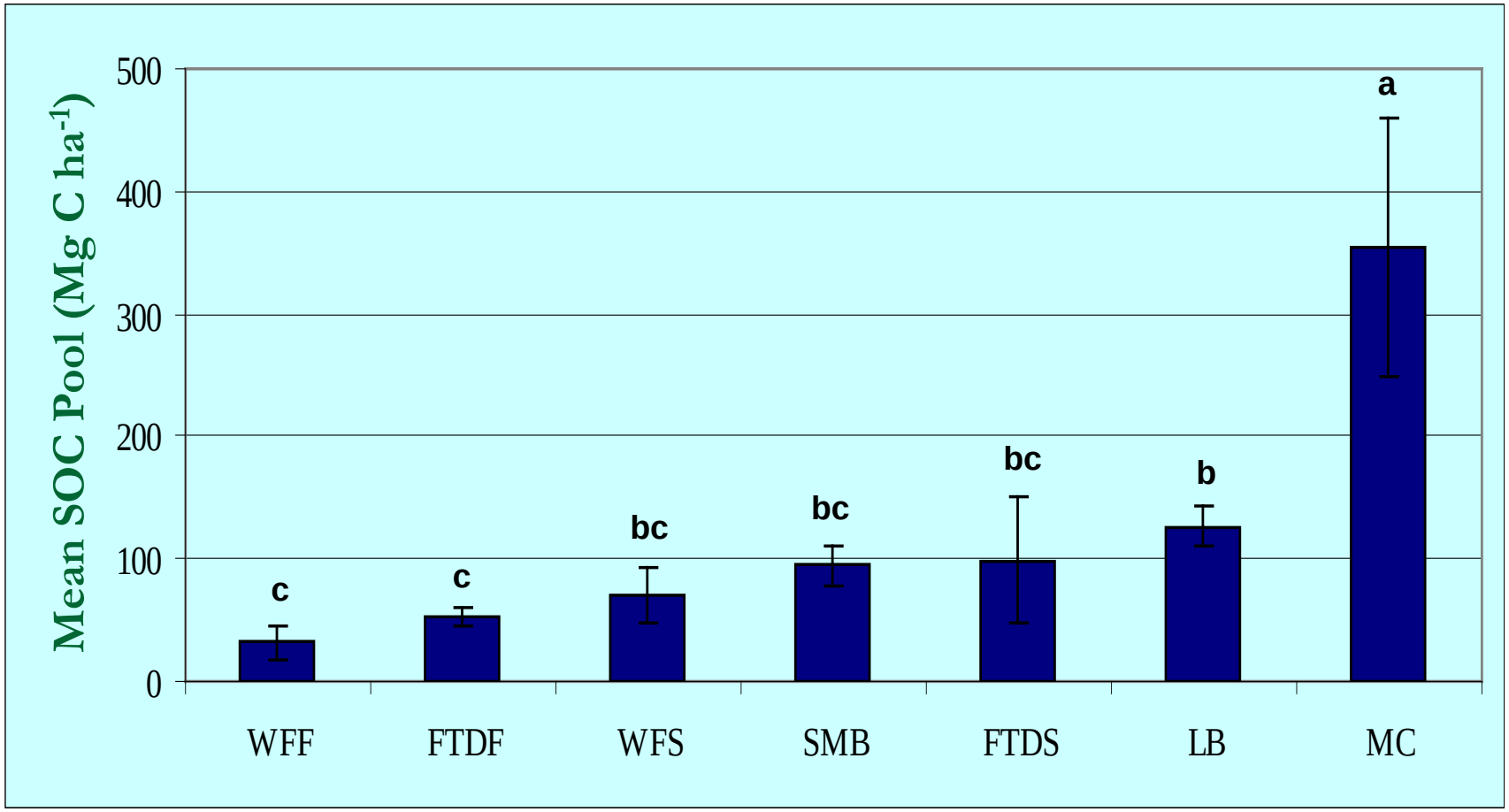

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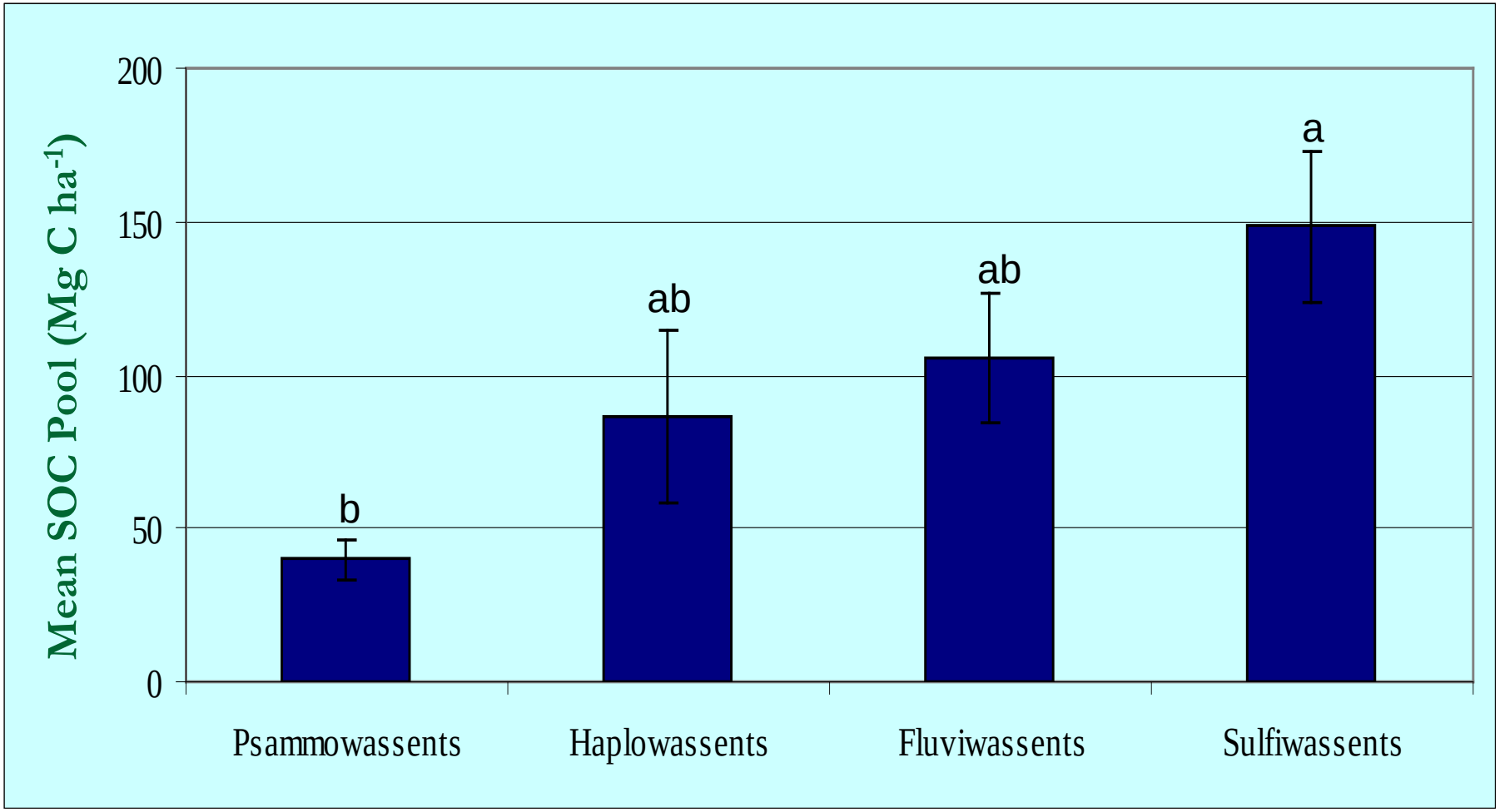
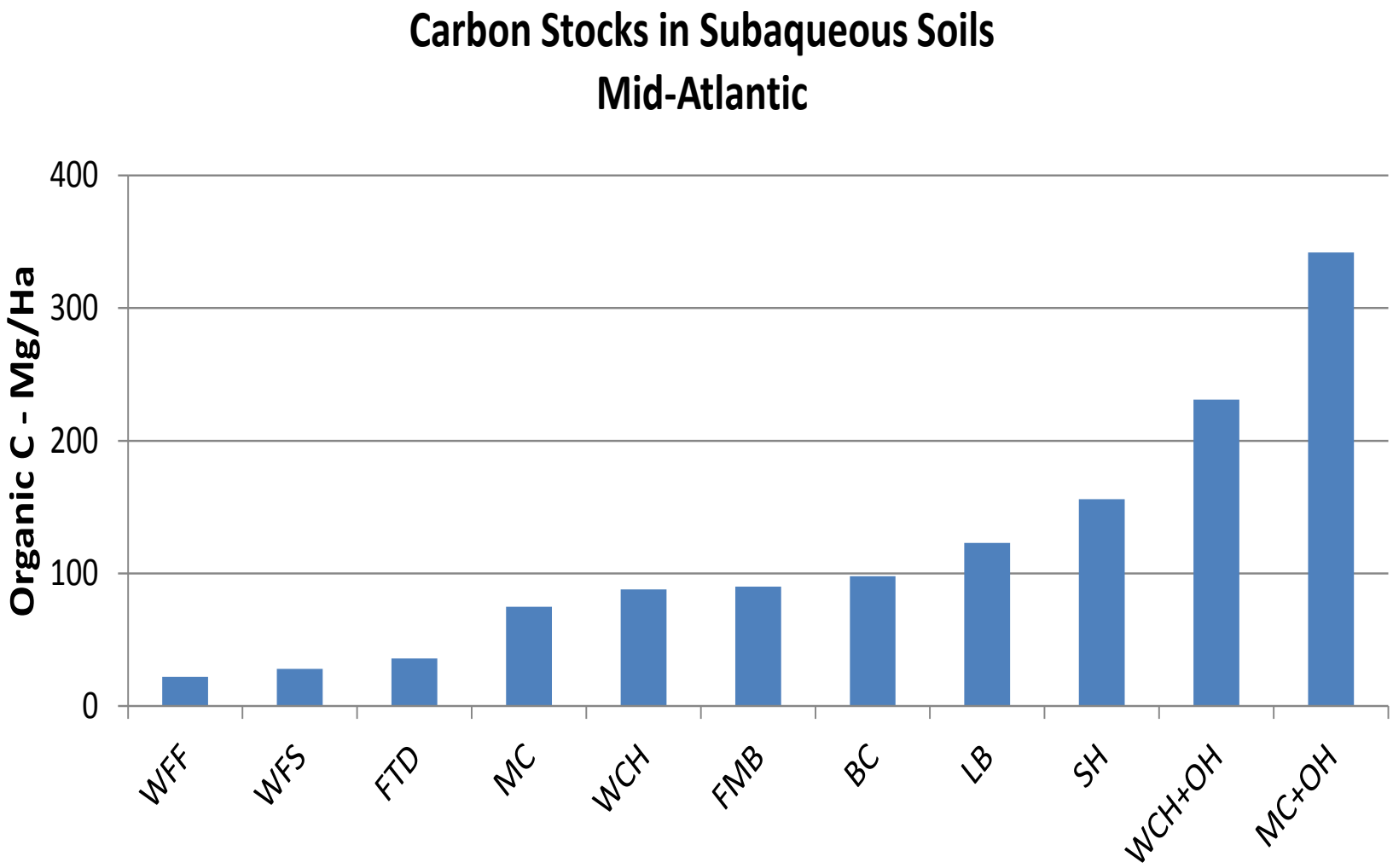
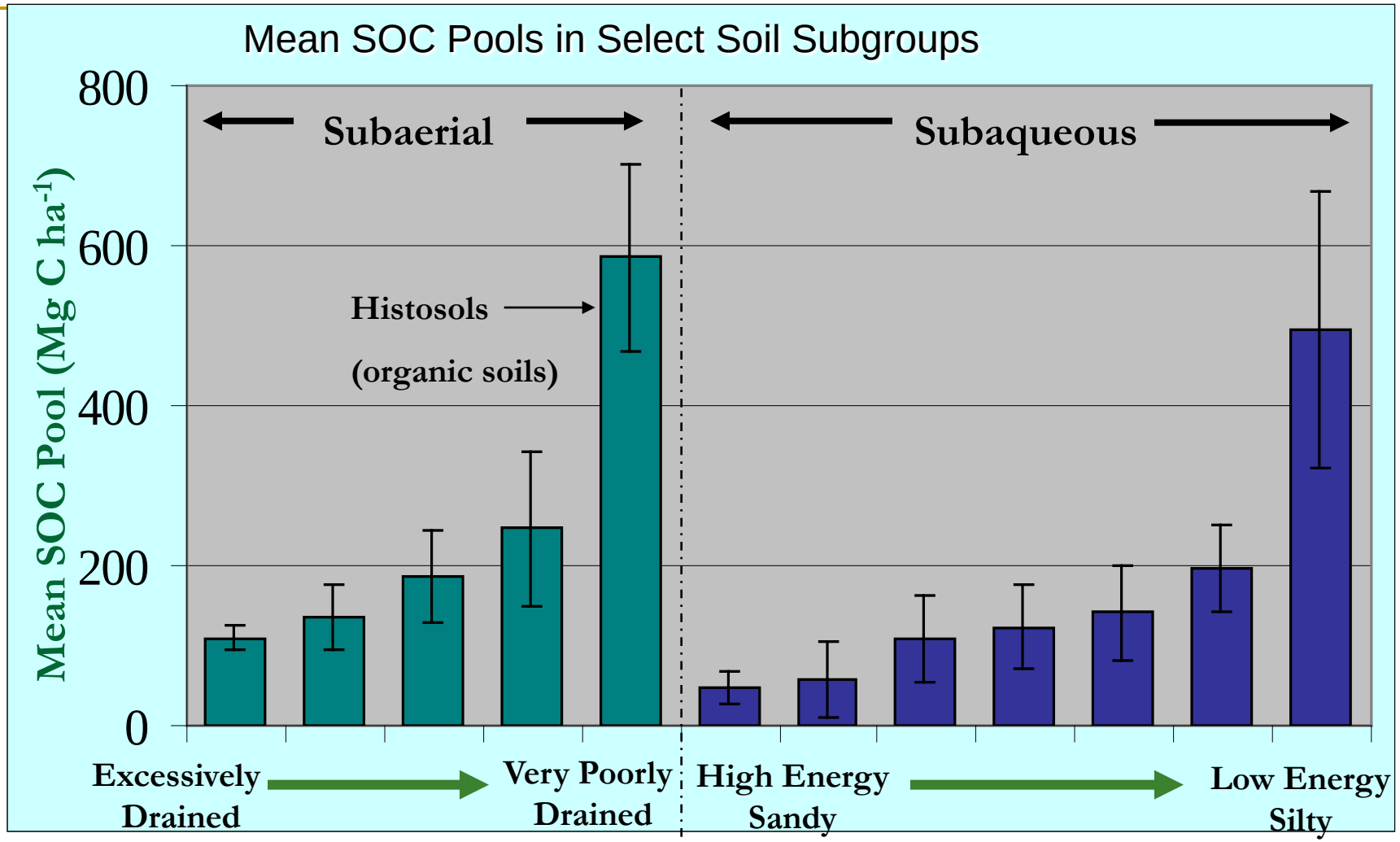



Carbon Stocks in Subaqueous Soils
Mid-Atlantic
Organic C - Mg/Ha
400
300
200
100
0
WFF
WFS
FTD
MC
WCH
FMB
BC
LB
SH
WCH+OH
MC+OH

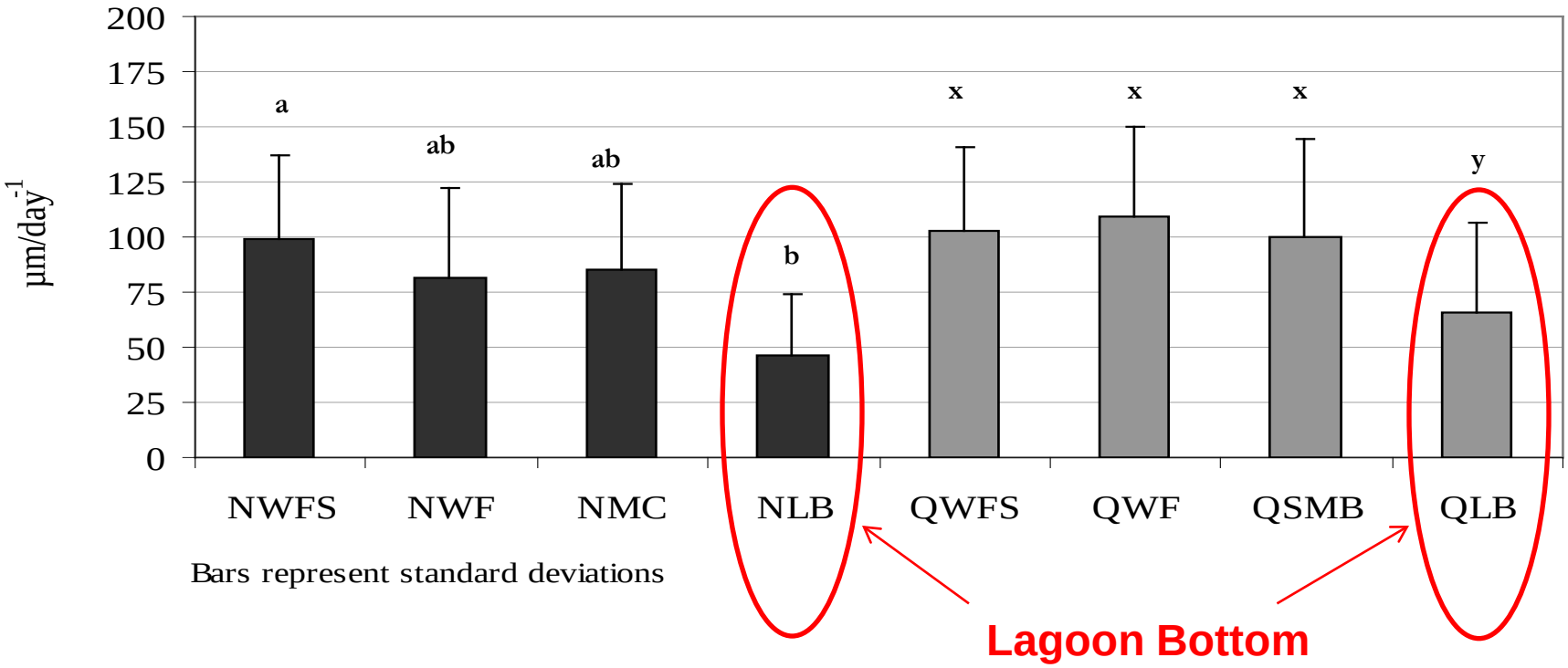


- Subaerial data from forested upland and wetland soils (Ricker, 2010 and Davis, 2004)
- SOC pools in subaqueous subgroups are comparable to forested soils in southern New England

Shellfish Growth Experiment

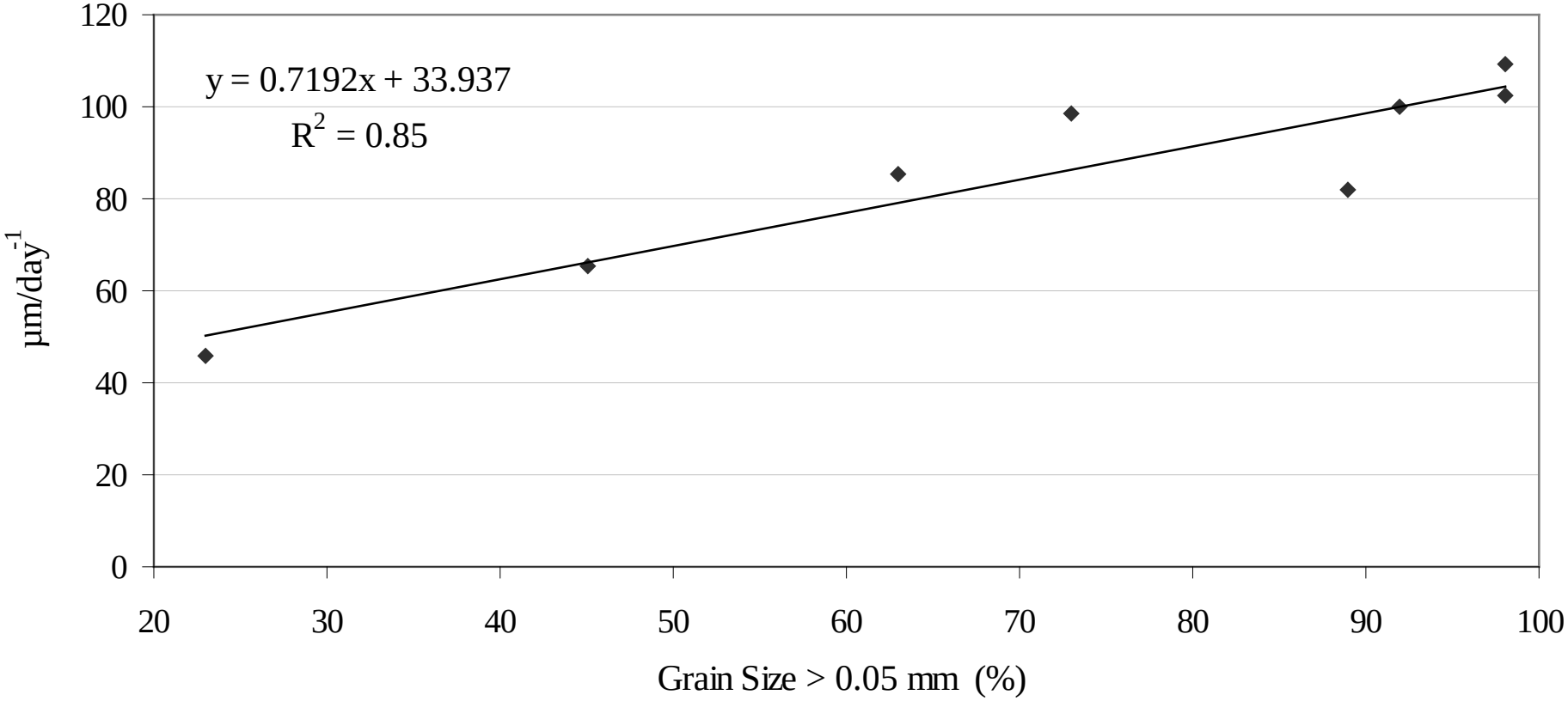
- Conducted in two coastal lagoons in RI
- On several contrasting soil map units

Oyster Growth June 2009 – October 2009



Different letters indicate significant differences. Note slow growth on Lagoon Bottom soils

Grain Size of Surface Horizon Predicting Oyster Growth



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