Chesapeake Channel Sediments Used For Wetland Restoration

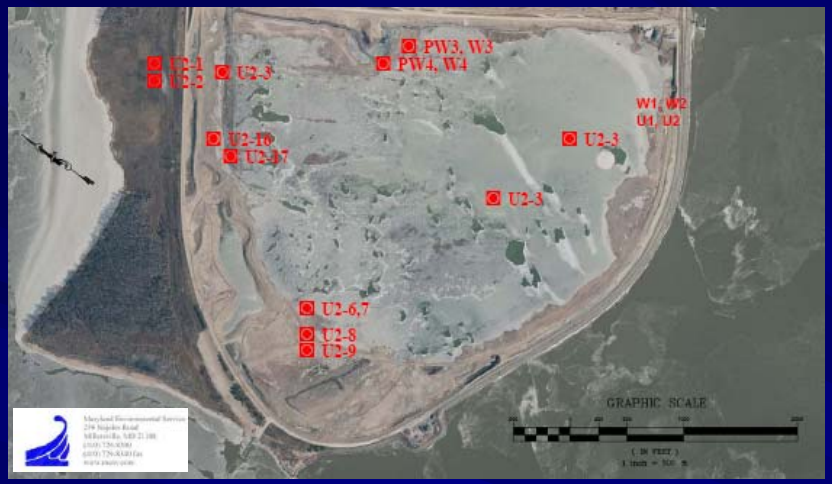
Jeffrey C. Cornwell

UMCES Horn Point Laboratory, P.O. Box 775, Cambridge MD 21613
(410) 221-8445,
cornwell@hpl.umces.edu

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE
HORN POINT LABORATORY

Data Sources

Pond Restoration: Hart-Miller Island



Sediment Chemistry:
Navigation Channels

Wetland Restoration: Poplar Island

Questions

- Where does dredge sediment come from?
- Are these sediments “contaminated”?
- If they’re so useful, why not put them back on farm fields or suburban lawns?
- Is it a good soil for restoring marshes?
- What are the environmental concerns about using dredge sediment for restoring the Chesapeake Marshlands Complex?

Dredge Sediment Comes From…

- The Susquehanna River drainage basin, with some additional inputs from eroding shorelines
- It is mostly recent (<10 years) in origin

Channel Dredging

- Required for maintaining access to Port of Baltimore
- Maintenance dredging averages 3.5 million cubic yards per year
- Any direct disposal of dredged sediment into the Chesapeake Bay is soon ending

Dredge Sediment Used in Restoration Is NOT:

- Dredged from Baltimore Harbor – that sediment never goes further than Hart-Miller Island
- Heavily contaminated with metals and organics – most sediment is recent without a large burden of contaminants
- In its native form, it would be a good upland soil except for pH issues

A Checklist of Chemical Issues:

- Pyrite oxidation-acidification: low pH is found in HMI and Poplar Island “soils”; the main issue is for uplands, not marshes.
- Metal release: with low pH, metal release can be an issue.
- High ammonium concentrations present in dredge sediment are a major challenge
- Could there be phosphorus release?

The pH Issue

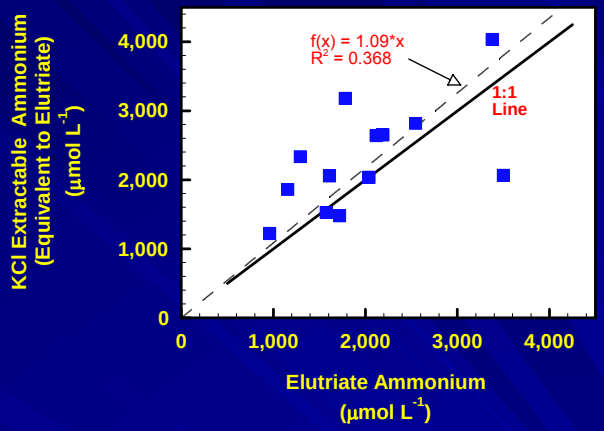
Pyrite forms in marine and estuarine sediments as a consequence of microbial sulfate reduction

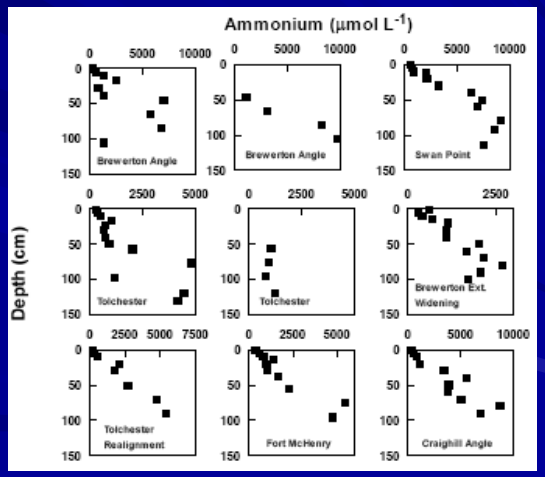
Low pH arises because of pyrite oxidation :

$$4FeS_2 + 15O_2 + 8H_2O \rightarrow 2Fe_2O_3 + 8\,H_2SO_4$$

The Nitrogen Issue

- There are high concentrations of dissolved and adsorbed ammonium in channel sediments
- The total available ammonium is ~ 0.12 lbs of nitrogen per cubic yard
- How sediments are handled makes a difference in how much would be added to restoration sites





Lessons From Poplar Island

- Sediments were characterized by an abundance of available nitrogen (as ammonium) and phosphorus
- Sediment pH was generally acceptable, with most sites having pH's that were amenable to plant success
- The general redox environment was buffered highly by abundant iron oxides; this meant no negative influence of hydrogen sulfide
- Above-ground biomass was very high (up to 3 kg m^2) the first year after establishment
- Fertilization at transplanting does not appear necessary
- Creek dissolved oxygen data did not indicate significant hypoxia
- The overall success of marsh plantings was very high!

How Do We Apply Our Poplar Island Results To Restoration at the Chesapeake Marshlands Complex?

- Similarities: Same dredge material, same goals
- Differences: At the Chesapeake Marshland Complex, we are depositing sediments into a system that is 1) currently critical to wildlife, 2) for the time being has substantial surrounding marsh area, 3) in general has a much softer underlying substrate and 4) surrounding pond waters have a very long water residence time.

Prognosis

- All studies suggest that the general nature of most dredge sediment, combined with abundant nitrogen and phosphorus, make it an ideal soil for marsh restoration
- While it is highly likely that the marsh restoration will succeed, we must be aware of the affects of added nitrogen, phosphorus and sediments on the Marshlands Complex and Fishing Bay, especially during construction
- How sediments are staged may be critical to the question of nitrogen impacts.

Things We Need To Know:

- How much nitrogen will be added to the marshland? What will be its fate?
- Would pond salinity be changed by the addition of brackish water to sediment to form a slurry for pumping?
- Is phosphorus mobile when added to this naturally sulfidic marsh soil?
- Can these restored marshes keep up with sea level rise?

Thinning Marsh along Shorter’s Wharf Road at Blackwater, Oct. 2000

Can declining marshes at Blackwater NWR be enhanced using local dredged materials ?

Thin-layer spraying of dredged materials on marshes has been used in Louisiana for over 20 years.

Marsh at Shorters Wharf one year after “thin-layer application” of sandy materials dredged from Blackwater River bed.

Thanks to:

Maryland Port Administration
Maryland Environmental Service
US Army Corps of Engineers
Mike Owens, J. Court Stevenson,
Lorie Staver, Erica Kiss