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Thin-layer Sediment Addition of Dredge Material for Enhancing Marsh Resilience

Virginia Institute of Marine Science

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Prepared by the
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Background

Coastal marshes are simultaneously among the most economically important and most vulnerable ecosystems in the Commonwealth of Virginia. There are approximately 200,000 acres of marshland in tidewater Virginia (CCRM, 2002) that protect coastal communities from the impacts of storm surge and form the base of the food chain for economically important commercial and recreational fisheries. Marshes are also well known for their ability to improve water quality by absorbing nutrients and pollutants, and sequester carbon from the atmosphere at rates much higher than those of forests. Together, these ecosystem services are valued at approximately $25,000 per acre per year (Barbier *et al.*, 2011). Twenty-five to fifty percent of the world's coastal wetlands have been lost as a result of direct conversion to agriculture and aquaculture land uses. While direct loss of Virginia marshes to sea-level rise has been limited, there is concern that future rates of sea-level rise will cause significant marsh loss since rates of current sea-level rise in coastal Virginia are roughly double the global average.

Building marsh elevations with sediment delivered from nearby dredging projects is a potentially valuable tool for creating, restoring, and maintaining coastal marshes, and may help slow or reverse losses of wetlands due to coastal development and sea-level rise (Woodhouse *et al.*, 1972). In this process, sediment removed from navigation channels during dredging is transported to a marsh restoration site by pipeline or barge, where it is applied to the surface of the marsh by spraying a slurry of water, sand, and silt in a process known as "thin-layer sediment addition." When done correctly, dredged sediment additions to marshes can be beneficial both as a dredge material disposal site, and as a mechanism for increasing marsh resilience. Prominent examples of wetland restoration sites that have incorporated thin-layer sediment additions from dredge spoil include Gateway National Recreation Area (New York City), San Francisco Bay, and numerous sites along the Mississippi River Delta region of Louisiana (Schrift *et al.* 2008).

Natural salt march on the Eastern Shore of Virginia. Photo credit: Jim Perry, VIMS

Physical and Biological Considerations

Where coastal development limits the ability of marshes to migrate inland to higher elevations, marshes must build vertically to survive sea-level rise (Kirwan and Megonigal, 2013). Natural processes such as deposition of silt during tidal flooding and the accumu-

lation of organic root material in the soil result in gradual increases in marsh elevation through time. These processes typically allow marshes to survive in place under moderate rates of sea-level rise, especially along undammed river estuaries where sediment is readily available. However, excessive flooding can diminish plant growth and cause marshes to convert to open water, particularly in locations where sea-level rise is accompanied by land subsidence, as in the southern Chesapeake Bay region, and in sediment deficient areas, such as the Virginia Eastern Shore that has no major rivers. Since marsh elevation influences both vegetation health and the rate of land building, sediment additions from dredge spoil disposal can be used to restore marshes to suitable elevations.

A primary goal of efforts to restore wetlands using dredge material should be to build the marsh surface to an elevation that allows vigorous growth of desired plant species, so that a re-introduction of natural processes can maintain the marsh in years to come. Sediment additions that are too thin may not sufficiently relieve flooding stress to plants, and result in a marsh that is still incapable of resisting sea-level rise and coastal erosion. In this case, wetland restoration efforts would have to be repeated at additional cost or else no long-term benefits would be received. In contrast, sediment additions that are too thick may build the marsh to an elevation that is too high for vigorous plant growth, and make the marsh vulnerable to invasive species such as *Phragmites australis*. In this case, the use of a limited sediment supply is not maximized, and may even lead to undesired ecological change.

Although site-specific geomorphic and hydrologic conditions determine the optimum thickness for dredged material additions to a marsh, most restoration projects attempt to build marsh elevations to somewhere between mean sea level and mean high tide. Challenges include accounting for consolidation and erosion of newly deposited sediment, and maintaining a hydrologic regime that distributes water and nutrients throughout the marsh to ensure plant health. Some of these challenges are met by installing silt fences to contain sediment erosion, planting marsh seedlings to stabilize new sediment, and excavating new channels within the marsh to ensure proper tidal flooding and drainage.

Economic Considerations

Beneficial use of dredged sediment to restore coastal marshes is rarely the cheapest dredge disposal option. Primary costs include transport of dredged material to the marsh location, removal of contaminants in the sediment, preparation of the site to reduce wave erosion, studies of environmental impacts, and planting marsh vegetation seedlings on the newly deposited sediment. As an example, use of dredged material to restore two acres of Big Egg marsh in New York City cost approximately $500,000 per acre. Nevertheless, costs can be reduced by choosing marsh restoration sites close to dredging locations to minimize transport costs, and by choosing sites in low energy areas with relatively intact vegetation so that only shallow additions are necessary and less effort is needed to minimize losses caused by erosion.

Thin-layer application of dredge material on a salt marsh in the Pamunkey River, Virginia. Photo credit: Carlton Hershner, VIMS.

Policy and Regulation Considerations

A thorough understanding of ownership issues will be critical in the planning and implementation of marsh amendment strategies. Virginia embraces the English concept of common rights, which grants public ownership of both tidal and nontidal subaqueous lands, and are in effect today as Virginia rule of law. §1–200 of the Virginia Code, codified in 1919, reads: *The common law of England, insofar as it is not repugnant to the principles of the Bill of Rights and Constitution of this Commonwealth, shall continue in full force within the same, and be the rule of decision, except as altered by the General Assembly.*

The extent of the common and ownership rights reside in §28.2–1200 and §28.2–1202 of the Virginia Code. These read:

§28.2–1200. Ungranted beds of bays, rivers, creeks and shores of the sea to remain in common.

All the beds of the bays, rivers, creeks and the shores of the sea within the jurisdiction of the Commonwealth, not conveyed by special grant or compact according to law, shall remain the property of the Commonwealth and may be used as a common by all the people of the Commonwealth for the purpose of fishing, fowling, hunting, and taking and catching oysters and other shellfish. No grant shall be issued by the Librarian of Virginia to pass any estate or interest of the Commonwealth in any natural oyster bed, rock, or shoal, whether or not it ebbs bare.

§ 28.2–1202. Rights of owners to extend to mean low-water mark.

A. Subject to the provisions of §28.2–1200, the limits or bounds of the tracts of land lying on the bays, rivers, creeks and shores within the jurisdiction of the Commonwealth, and the rights and privileges of the owners of such lands, shall extend to the mean low-water mark but no farther, except where a creek or river, or some part thereof, is comprised within the limits of a lawful survey.

B. For purposes of this section, "lawful survey" means the boundaries of any land, including submerged lands, held under a special grant or compact as required by §28.2–1200, such boundaries having been determined by generally accepted surveying methods and evidenced by a plat or map thereof recorded in the circuit court clerk's office of the county or city in which the land lies.

It is also significant that, because Virginia recognizes property lines to extend to the mean low water mark, most of Virginia's tidal marshes are privately owned. This results in marine habitats of critical ecological importance requiring regulated use.

The removal and disposal of subaqueous material from publicly owned lands must first undergo a rigorous review of need, potential adverse environmental impacts and/or benefits, and effects to local socio-economic infrastructure such as aquaculture, or other waterway and/or riparian use conflicts. These analyses are undertaken by a cadre of local, state, federal, and (in Virginia) academic entities; each acting under specific legal requirements and constraints.

Any encroachment upon, or alteration to state-owned subaqueous lands requires the issuance of a subaqueous permit from the Virginia Marine Resources Commission (VMRC) under the authority granted in §28.2–1203 of the Virginia Code; a Virginia Water Protection Permit (VWPP) from the Virginia Department of Environmental Quality (DEQ) under the authority granted in §62.1–44.15:20 and 9VAC25–210-220; and a permit from the United States Army Corps of Engineers (USACOE) under the authority granted in §401 and §404 of the federal Clean Water Act. Comments on the potential effects and benefits of the proposed project are routinely requested from the Virginia Institute of Marine Science (VIMS), the Virginia Department of Game and Inland Fisheries, the Virginia Department of Conservation and Recreation, the Virginia Department of Historic Resources, and the Virginia Department of Health. The USACOE receives the comments from the Virginia agencies and VIMS, and also entertains comments from the United States Fish and Wildlife Service and the National Marine Fisheries Service.

The only alternative to this review process for dredging operations is for the maintenance of federal project channels, which are exempt from Virginia requirements. It is noteworthy that only dredging is included in this exemption and not any overboard disposal or placement of material on wetlands or beaches.

The Virginia public interest review process for all environmental permitting is administered through the Administrative Process Act (§2.2–4000).

If dredge spoil is placed upon any publicly owned or regulated marine habitat (i.e. subaqueous lands, tidal

wetlands, or beaches/dunes), then a concurrent review is conducted by these same state and federal agencies under their same authorities. VIMS also conducts a technical review of the proposed project. In the specific case of dredge spoil planned for placement upon tidal wetlands, the Wetlands Act (Virginia Code Chapter 13) authorizes localities to make decisions on wetlands within their jurisdiction if they have opted to adopt the Wetlands Zoning Ordinance (§28.2–1302). Adoption of the ordinance results in the formation of a Wetlands Board, which has decision-making authority for the use of regulated tidal wetlands. The VMRC maintains oversight authority for procedural and environmental issues. There are currently 35 localities that have Wetlands Boards, and 14 others that have either chosen not to adopt the ordinance or have rescinded the ordinance. For these 14 localities the VMRC acts as the Wetlands Board.

Amendments to tidal wetlands are considered a "fill" activity which may alter sediment chemistry, affect plant growth and survival (if the wetland is vegetated), alter and/or cause mortality to benthic infauna (those animals that live within the marsh substrate) and marsh inhabitants that are present at the time of spoil placement, alter substrate characteristics and benthic communities if the dredge material is dissimilar in grain size to the indigenous material, and contribute to sedimentation of the littoral water column. Many potential effects are seasonal in nature, and there are other factors that generally are considered such as proximity to commercial and recreational fishing grounds, productive leased bottom, and other local critical habitats such as submerged aquatic vegetation (SAV).

Historically, Virginia's regulatory and review processes have been comprehensive, thorough, and fair. Should a new issue such as tidal marsh amendments be proposed, it would be subjected to the same environmental principles and regulatory reviews that have accompanied all other projects encroaching upon subaqueous lands and shorelines.

Key references and additional resources

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