

## **“Ecosystem Tradeoffs Associated with Tidal Marsh Sills”**

Karen Duhring,  
Shoreline Advisory Scientist, Virginia Institute of Marine Science

Ms. Duhring outlined her plans to cover: typical erosion protection strategies in Virginia; what are preferred approaches; marsh sill case studies; and a summary of ecosystem tradeoffs associated with marsh sills.

As background, the Chesapeake Bay system is tidal and its rivers extend quite far west. Typical erosion protection projects include revetments, bulkheads, and bank grading combined with these structures. The area of the Bay is increasing with sea level rise. While tidal range varies, it is moving landward generally. Most of the shorelines in Virginia are under private ownership, and landowners want to protect against erosion. Bulkheads are commonly used, and today’s vinyl materials last longer in the marine environment.

Permit requests to deal with physical changes occurring along tidal shorelines are growing; 200+ sites each year in past 8 years have been visited by Karen alone. The Virginia Institute of Marine Science (VIMS) serves as the advisory agency that reviews permit requests and assesses environmental interests. That information is passed to the state and local permitting agencies, where it is weighed against other interests.

Tidal shorelines include a very wide range of environmental conditions, from high energy to low energy sites, with variable risks. There is growing concern at the state and federal level over the accumulation of hardened shoreline. The cumulative length of new structures permitted from 1993-2006 in Virginia’s portion of the Chesapeake Bay was 255.5 miles, with an average of 18.2 miles permitted each year. Direct loss and isolation of tidal wetlands is one of the results.

How do shoreline projects contribute to this? How can we lessen the overall impact on estuarine resources? There are a number of approaches from most to least preferred:

- No action: leave the shoreline in its natural condition or restore habitats, use vegetation (and reduce further risk through land use changes)
- Non-structural: maximize vegetative cover
- Hybrid approach: use structures to support natural erosion buffers (e.g., tidal marshes, beaches)
- Revetments (sloped) – better for benthic community
- Bulkheads – benthic community becomes less diverse

Preferred approaches that may affect public submerged lands:

- Tidal marsh enhancement or creation
- Beach nourishment in sand-limited system
- Bank grading with cut and fill to create or enhance tidal marsh
- Offshore breakwater systems for high energy beach shorelines

- Tidal marsh sills for low to medium energy shorelines – this is the focus today!
  
- Marsh Sill (with planted marsh)
  - o Low profile revetment, quarry stone, backfilled with sand to create/enhance tidal marsh
  - o Imported sediment from upland source or suitable bank grading material (analyzed first for good sand mix)
  - o Offensive approach – structures built in sand transport region to address impinging waves before they reach upland areas
  
- Typical sill cross-section diagram; no “typical” design exists however
  - o Tidal marsh needs to be very wide to handle the exposure dynamics (average width needed is 20-30 feet)
  - o Can design the sill to go channelward or landward (preferred) by grading bank
  
- Marsh Toe Revetment (natural marsh edge stabilization): low profile revetment placed along the eroding edge of an existing tidal marsh

Ms. Duhring referenced the 2004-05 VIMS Study of 36 marsh structures to see how effective they were. These questions were asked:

- o Constructed as permitted?
- o How persistent were they (TS Isabel)?
- o How did planted vegetation do, or was the natural marsh enhanced?

Case studies were cited:

- The marsh sill at the VIMS boat basin canal, built in 1983: stone sill, saltmarsh cordgrass, salt bushes (from water to upland); very little maintenance ever done and very sustainable!
- Another case study: high, vertical sandy bank, undercutting erosion at bank toe, narrow fringe marsh ~5 ft, tidal creek with regular boat wakes
  - o After 1 year: graded bank now stable, suitable material used for backfill, planted marsh ~25 ft wide, gapped sills
  - o Started with grading, cut and fill; planted tidal marsh; gapped sills for tidal inundation for water to reach salt marsh grasses
- Another case study: sill structure added to remnant marsh, high energy zone; dominated by submerged aquatic vegetation (SAV), desire to protect oak tree from saltwater intrusion
  - o Outcome: perched marsh not accessible to marine organisms
- Tidal openings used: straight, offset gapped, offset end at upland revetment
  - o Important to aquatic animals and vegetation
- Another case study to illustrate ecosystem tradeoffs: sill structure augmented with wide, vegetated inter-tidal area; after 10 years, less open water area, sediment

trapping, nutrient cycling by marsh plants and infaunal community, stable upland bank with dense vegetation

- Habitat comparison: much more diversity results; aerial habitat for spiders, insects, wading birds, waterfowl, mammals; marsh surface and below ground for microbial fungi and bacteria, algae, mesofauna (nematodes, copepods, rotifers, protozoa); foraging invertebrates (polychaetes, gastropod mollusks, fiddler crabs, blue crab, amphipods); filter feeders (ribbed mussel, oyster); aquatic pools and channels for small and juvenile fish, shrimp, blue crab

In general, habitat in riprap reefs is found at lower diversity and abundance than in marshes and oyster reefs. Riprap may support similar or higher nekton abundance than bare sediment.

Potentially negative effects of tidal marsh sills include the covering of shallow water benthic infauna, hydrodynamic changes, construction access/maintenance impacts, altering sediment transport, altering habitat use at marsh edge, and inferred impacts on submerged lands.

Potentially positive effects: wave attenuation; sediment stabilization; vegetation stabilization; tidal marsh creation and restoration; habitat diversity and complexity – for terrestrial, aquatic, and wetland organisms.

Current guidelines for marsh sills: use only if action is required and non-structural methods will not be sufficient; minimize channelward encroachment into subaqueous lands; make porous and as low as possible; minimize/restore construction impacts; periodic maintenance is required.

In conclusion:

Sills are a better choice for low and medium energy shorelines than bulkheads; not as appropriate at high-energy sites; tidal marsh creation/restoration at land/water interface is beneficial for Public Trust resources; more research is needed before and after sill construction. (Referenced the Hull Springs Farm demonstration project underway in Westmoreland County, Virginia.)