

North Carolina
Coastal Federation

Working Together for a Healthy Coast

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Living Shorelines Establishing a Hierarchy Approach

Hierarchy of Erosion Control Options



- No Action
- Relocation of Threatened Structures
- Non-Structural Stabilization Measures (Slope Grading, Marsh Creation, Bio- Engineering, beach nourishment)
- Combination Approaches (Sills, Stone containment cells, breakwaters with plantings)
- Hardening Structures (Groins, Revetments, Gabions, Bulkheads)

Cape Lookout Lighthouse



Bank Grading, Riparian Buffer/Marsh Creation/Restoration/Preservation



Harkers Island Marsh Planting



From Dr. Stephen W. Broome, N.C. State University

Biologs

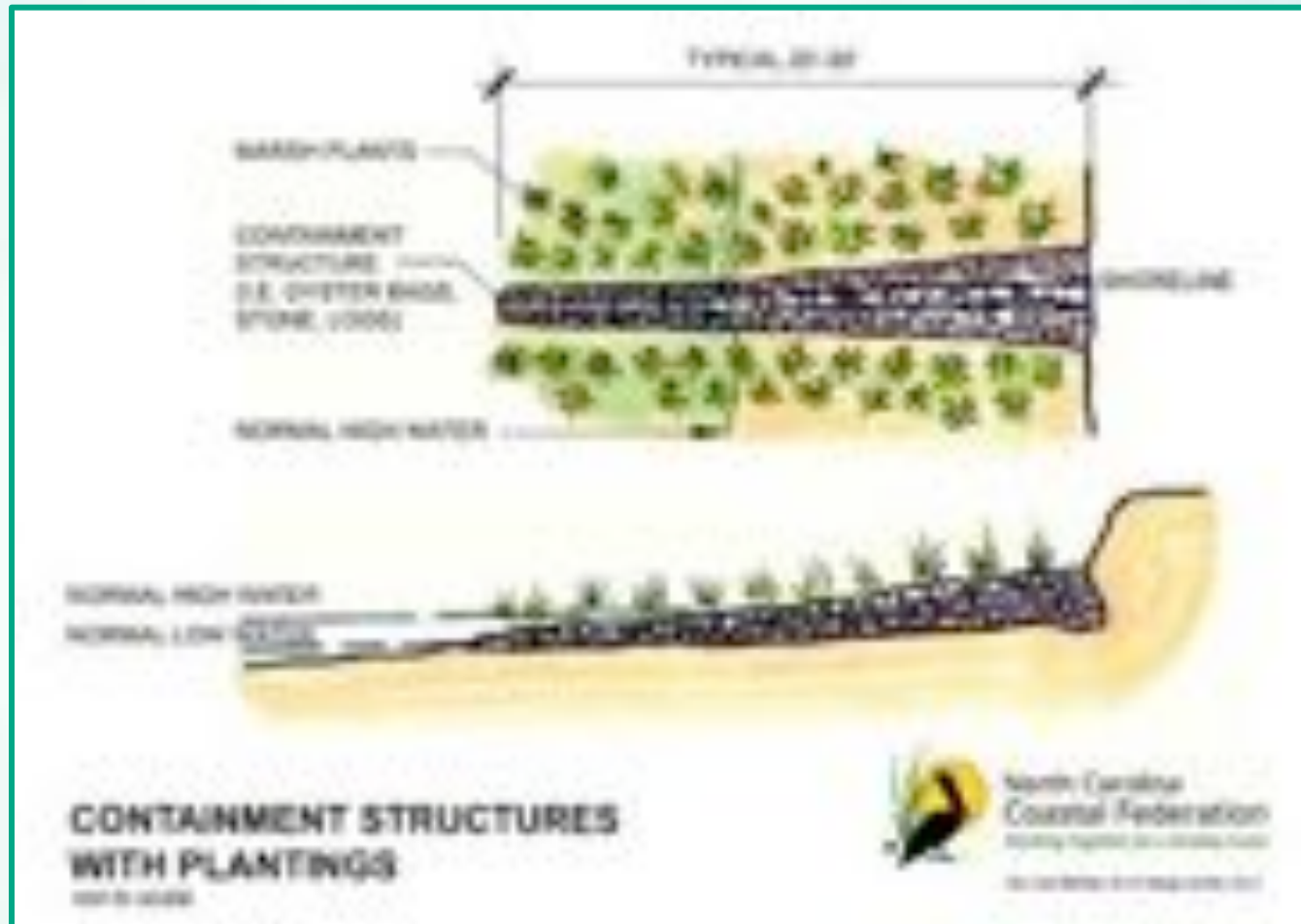




Combination/Hybrid Projects



Containment Structures with Plantings





Vertical Sill with Marsh Plantings



From Spencer M. Rogers, Jr., N.C. Sea Grant

Morris Landing- Stump Sound



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Stone Sill- Albemarle Sound



←Low-profile sill

Riprap revetment →



Pre-project – 2004



August 2005



Construction – July 2004



August 2006



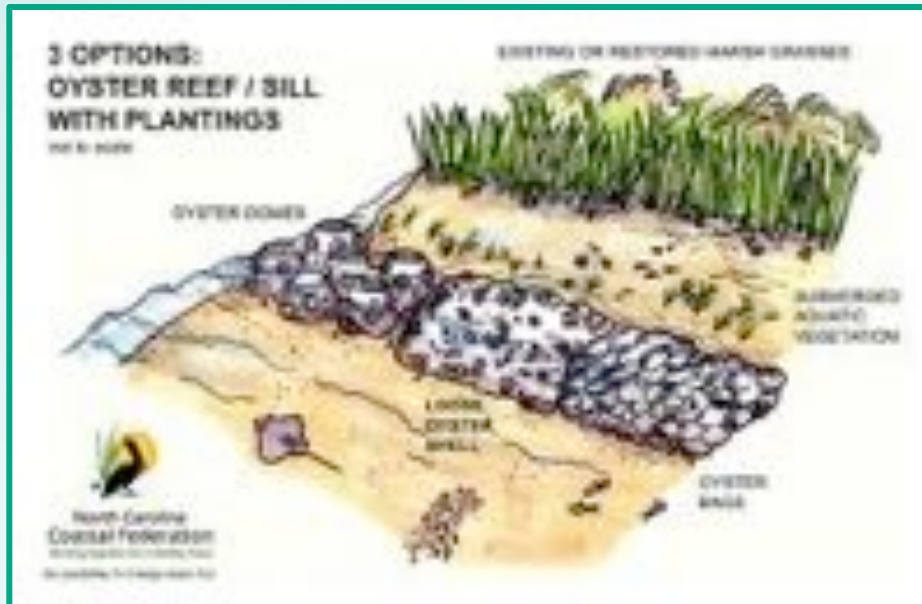
November 2004



July 2007



Oyster Shell Patch Reefs/ Sills



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Marsh Toe Revetments





**Stormwater
Wetland**



**Reef
Balls**

**Oyster
Shell
Bag Sill**

Stone Sill

**Offshore
Breakwaters**

Bogue Sound

Google earth

Carteret Community College





Bogue Sound Revetment During Construction - 5/98



Bogue Sound Revetment 8/98



Bogue Sound Revetment- 7/99

The North Carolina Estuarine Biological and
Physical Processes Work Group's



Recommendations for Appropriate Shoreline
Stabilization Methods for the Different
North Carolina Estuarine Shorelines Types



North Carolina Division of Coastal Management

August 2008



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Functions of Shoreline Types

Table 4-1: Dominant functions of various shoreline types

Shoreline Type	Wave Buffering	Wave Energy Dissipation	Shoreline Stabilization	Shoreline Erosion
Open water	1	1	1	1
Beach	1	1	1	1
Dune	1	1	1	1
Marsh	1	1	1	1
Swamp	1	1	1	1
Bay	1	1	1	1
Canal	1	1	1	1
Drainage ditch	1	1	1	1
Stream	1	1	1	1
River	1	1	1	1
Lake	1	1	1	1
Wetland	1	1	1	1
Forest	1	1	1	1

Table 4-2: Secondary functions of various shoreline types

Shoreline Type	Wave Buffering	Wave Energy Dissipation	Shoreline Stabilization	Shoreline Erosion
Open water	1	1	1	1
Beach	1	1	1	1
Dune	1	1	1	1
Marsh	1	1	1	1
Swamp	1	1	1	1
Bay	1	1	1	1
Canal	1	1	1	1
Drainage ditch	1	1	1	1
Stream	1	1	1	1
River	1	1	1	1
Lake	1	1	1	1
Wetland	1	1	1	1
Forest	1	1	1	1

Table 4-3: Storm and coastal emergency functions of various shoreline types

Shoreline Type	Storm Surge Buffering	Storm Surge Dissipation	Storm Surge Erosion	Storm Surge Flooding	Storm Surge Damage	Storm Surge Erosion	Storm Surge Flooding
Open water	1	1	1	1	1	1	1
Beach	1	1	1	1	1	1	1
Dune	1	1	1	1	1	1	1
Marsh	1	1	1	1	1	1	1
Swamp	1	1	1	1	1	1	1
Bay	1	1	1	1	1	1	1
Canal	1	1	1	1	1	1	1
Drainage ditch	1	1	1	1	1	1	1
Stream	1	1	1	1	1	1	1
River	1	1	1	1	1	1	1
Lake	1	1	1	1	1	1	1
Wetland	1	1	1	1	1	1	1
Forest	1	1	1	1	1	1	1



Table 1-1: Possible habitat changes resulting from specific shoreline stabilization activities

Local Planning	Fragmentation Control	Bankfull	Shoal	Channel	Bankwater's	Shaped Structures	Vertical Structures
Continued erosion with loss of upland	Reduced sediment and nutrient input into channel	Channel bank continues to erode	Reduced sediment and nutrient input into channel	Reduced sediment and nutrient input into channel	Reduced sediment and nutrient input into channel	Reduced sediment and nutrient input into channel	Reduced sediment and nutrient input into channel
	Reduced erosion bankfull	Reduced erosion bankfull	Reduced erosion bankfull	Reduced erosion bankfull	Reduced erosion bankfull	Reduced erosion bankfull	Reduced erosion bankfull
		Channel bank structure for non-natural system (e.g., dune)	Channel bank structure for non-natural system (e.g., dune)	Channel bank structure for non-natural system (e.g., dune)	Channel bank structure for non-natural system (e.g., dune)	Channel bank structure for non-natural system (e.g., dune)	Channel bank structure for non-natural system (e.g., dune)
		Bank bank structure type with soil	Bank bank structure type with soil	Bank bank structure type with soil	Bank bank structure type with soil	Bank bank structure type with soil	Bank bank structure type with soil
			Channel erosion, bank change, non-natural	Channel erosion, bank change, non-natural	Channel erosion, bank change, non-natural	Channel erosion, bank change, non-natural	Channel erosion, bank change, non-natural
			Fragmentation control	Fragmentation control	Fragmentation control	Fragmentation control	Fragmentation control
			Bank bank structure type with soil	Bank bank structure type with soil	Bank bank structure type with soil	Bank bank structure type with soil	Bank bank structure type with soil



4.2. Feeding Areas

Recommendations of Shading Techniques Methods in Harvest Order

1. **Land Flooding** - Land flooding should always be utilized as the first option.
2. **Vegetation Control** - Vegetation control is a management method of reducing the density by creating a wide disturbance buffer. VEC should only be utilized to establish a buffer zone necessary to capture the plume of the phragmites, which will promote to improve the condition of the function of the shoreline zone.
3. **Bank VE** - Bank VE should only be used as the shoreline type if a sandy bank is directly present outward of the marsh bank. Bank VE will decrease the current shoreline type and associated functions and values. Bank VE is used to create a buffer of vegetation or aquatic sandy bank to promote distance from further erosion. The bank buffer acts to decrease wave action buffer. It improves the young forest backbone of the sandy beach through bank VE is a temporary measure to distribute to protect the erosion and sediment to contribute sediment into the system.
4. **Soft, Shaped Vegetation that has protective ability** - Soft and shaped vegetation for natural structure used for marsh bank is not specific and dependent on the soil conditions, and using field projects. Each structure should be evaluated based on the research to will have in the structure the number times of erosion, and the potential structure and impact of each structure. These structures can only be used to be protection on the shoreline structure by use a different field to produce a target shaped structure against. Soft should be considered important of the marsh bank to provide protection against erosion by creating wave breaking zone to reducing the sand and other nearby vegetation. These soft vegetation substituted in comparison with vegetation control that should not only cover the surface of the marsh bank, but also create artificial vegetation. VE should only be used when it will improve condition of the habitat of the shoreline.
5. **Canopy** - Canopy are naturally constructed as wind traps, but can also be designed to decrease wave energy. Canopy cover should be installed off the structure that act equal to a line of sand and bank provide this canopy. VE should use the structure to improve the condition of the function of the shoreline zone.
6. **Breakwaters** - Breakwaters are typically constructed as a sand trap, and they are designed to decrease and slow the incoming wave energy, it create a buffer zone's contribution. Breakwaters also create sedimentation or fill ground behind, resulting in a line of sediment buffer water energy barrier. The breaking water beach will act as a buffer to decrease wave energy but would also be shoreline zone. The breakwater wall is designed to reduce wave action the young wave breaking zone to creating the shoreline. Breakwaters typically have a large diameter, which would catch the soil from the beach.
7. **Vertical Structures** - Vertical structures are not recommended outward of the marsh bank, as a result to decrease risk for the cause contribute the marsh bank. If the vertical structure is constructed with VE, it has a structure will create a movement of the marsh bank, it should be considered a wall.





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