Living Shoreline Professionals Advanced Training

August 24 & 31, 2017

Hosted by

Virginia Institute of Marine Science

College of William & Mary

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Center for Coastal Resources Management

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LIVING SHORELINE PROFESSIONALS
ADVANCED TRAINING
AUGUST 2017

Part 1

LIVING SHORELINE TRENDS & CURRENT SCIENTIFIC UNDERSTANDING

Living Shoreline Advocates
in Virginia

State & local agencies with living shoreline advocacy programs & incentives

- Virginia Coastal Zone Management Program VCZM
- Virginia Marine Resources Commission VMRC
- Virginia Shoreline Erosion Advisory Service SEAS
- Virginia Conservation Assistance Program VCAP
- Virginia Department of Environmental Quality DEQ
- Virginia Institute of Marine Science VIMS

- Local Wetlands Boards

Living Shoreline Advocates
in Virginia

Widespread recognition, many fans & supporters advocating for living shorelines in private sector

- Chesapeake Bay Foundation
- Elizabeth River Project
- Friends of the Rappahannock
- James River Association
- Lafayette Wetlands Partnership
- Lynnhaven River Now
- Nature Conservancy
- Virginia Master Gardeners
- Virginia Master Naturalists
- Wetlands Watch
- The Wetlands Project

& others

Living Shoreline Policy & Regulation in Virginia

- General Assembly preferred alternatives for shore stabilization *effective 2011*
- VMRC Group 1 General Permit *effective 2015*
- VMRC Group 2 General Permit *pending*
- Local Wetlands Board policies & expectations
- US Army Corps of Engineers Nationwide Permit 54 *effective 2017*
- Chesapeake Bay TMDL credits for shoreline management practices *in progress*

Living Shoreline Permit Information

- Tidewater Joint Permit Application

- VMRC electronic permit records *searchable database*
- VMRC Group 1 General Permit

- US Army Corps of Engineers Nationwide Permit 54 for Living Shorelines
- US Army Corps of Engineers Regional Permit 19

Code of Virginia Definition *effective 2011*

"Living Shoreline" means

a shoreline management practice that

provides erosion control and water quality benefits;

protects, restores or enhances shoreline habitat;

and

maintains coastal processes through the strategic placement of plants, stone, sand fill, and other structural and organic materials

Living Shoreline Practices
used alone or in combination

Non-Structural

Stormwater management

Riparian buffer management

Bank grading

Sand fill & beach nourishment

Tidal marsh management

Planted tidal marsh

Coir & geotextile products

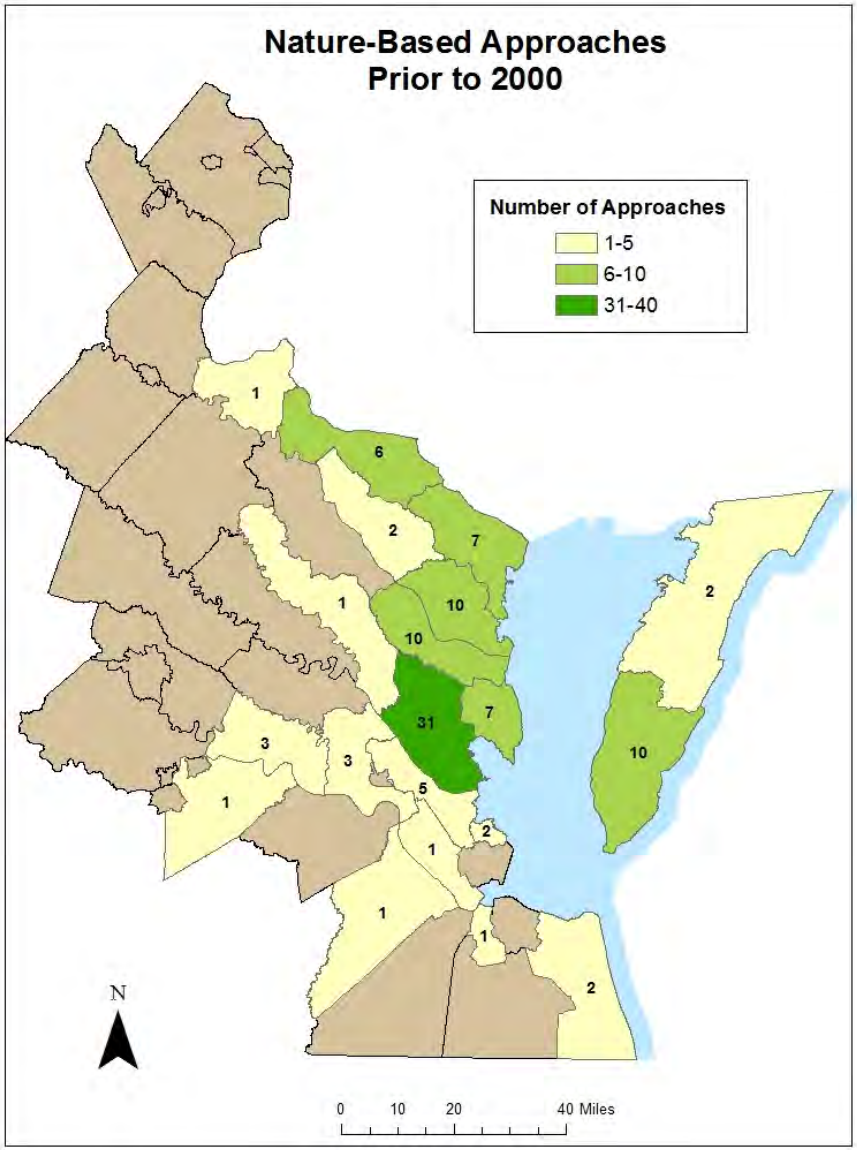
Structural or Hybrid

Stone sills

Offshore breakwaters

Oyster reef sills

Coastal Virginia Nature-Based Projects Prior to 2000

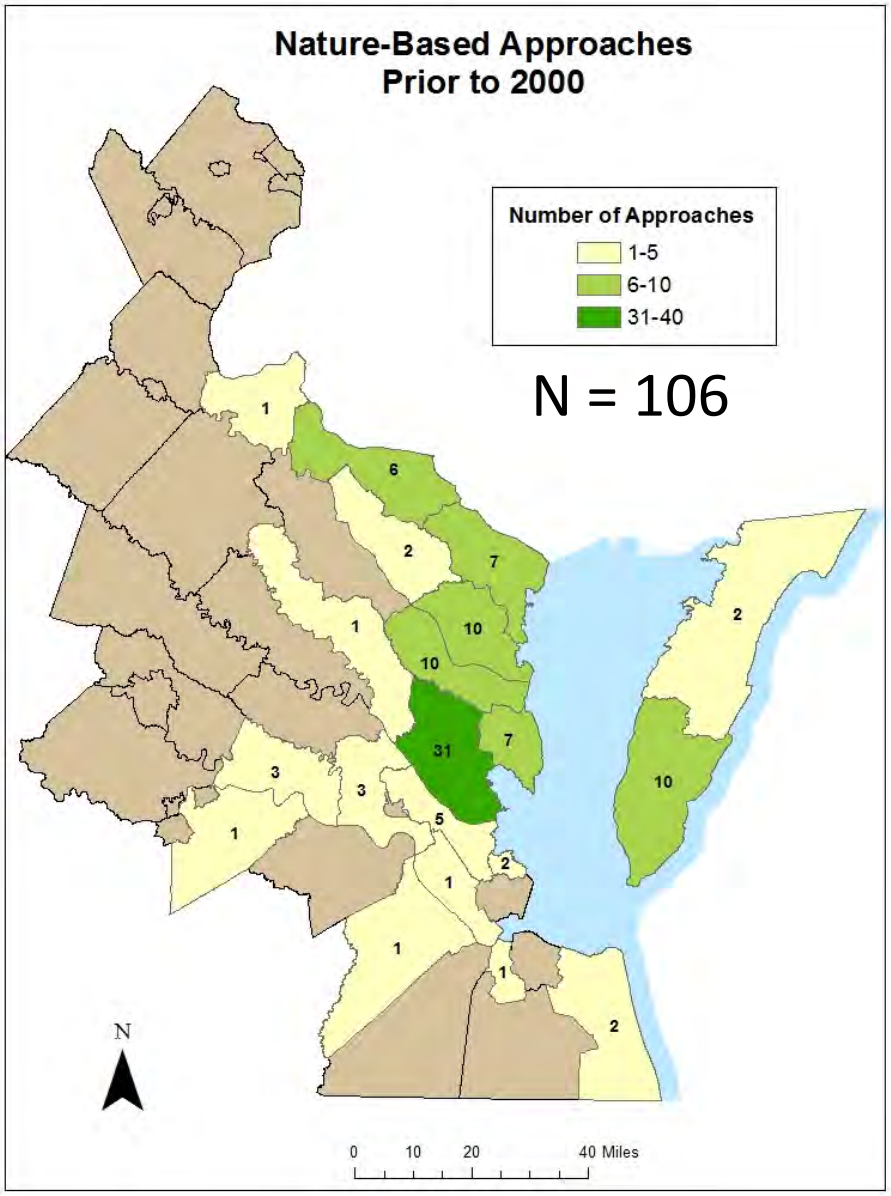


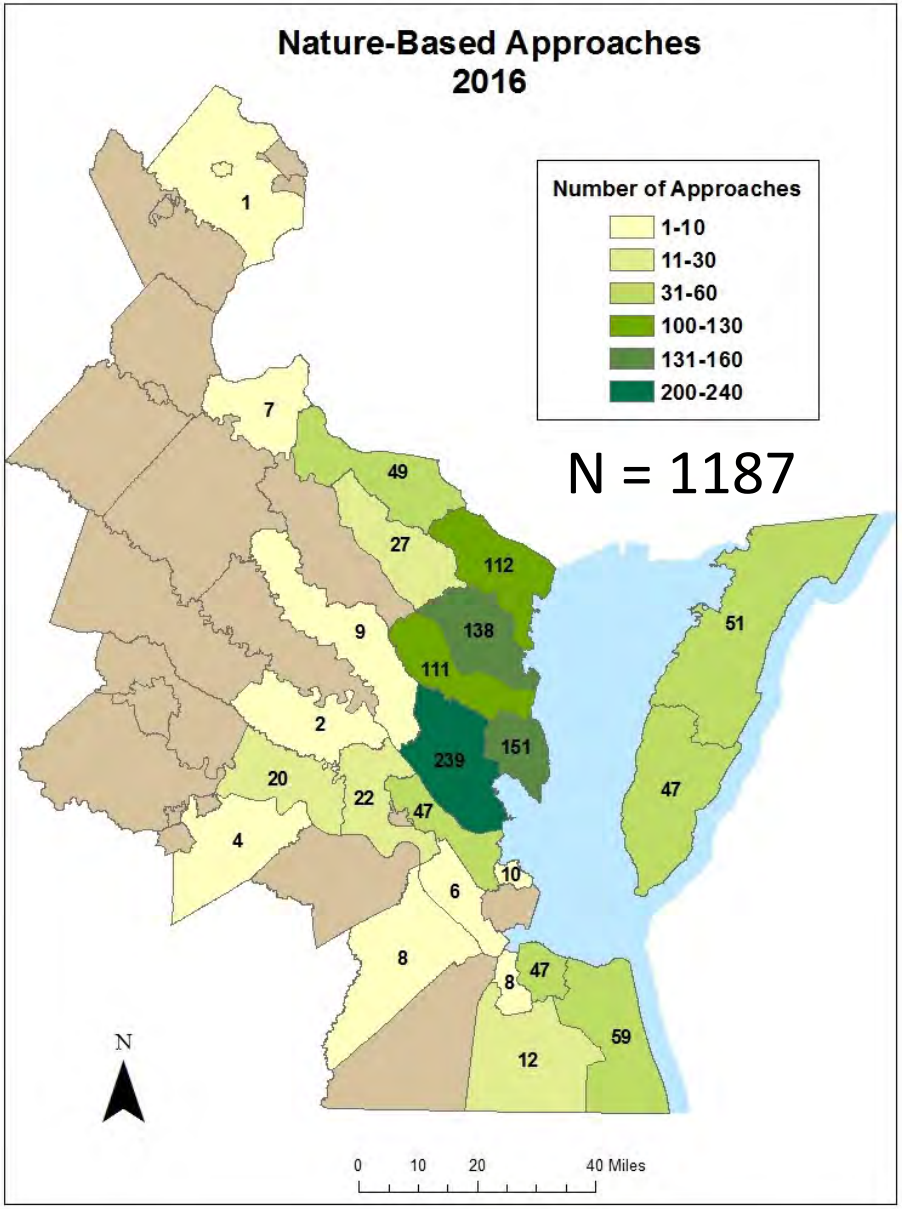
Tidal wetland vegetation only
Tidal wetland vegetation plus structure
Breakwaters with beach nourishment

N = 106

VIMS Marsh Sill constructed 1984

Nature-Based Project Increase

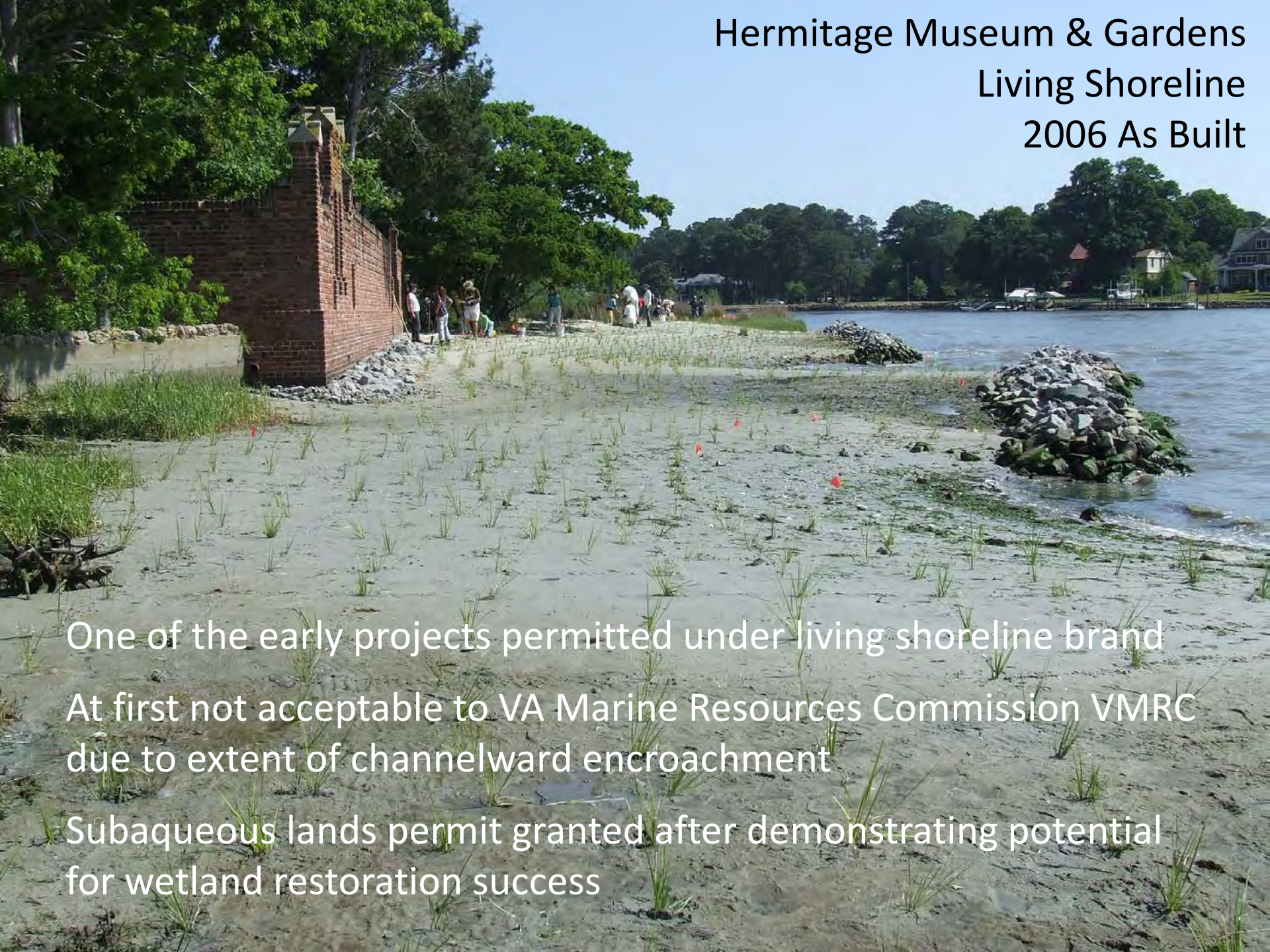




Source: VIMS Center for Coastal Resources Management

Living Shoreline Project Types in Virginia

- Public & private tidal shorelines
- Urban & rural settings
- Very low to high energy settings
- Small & large scale
- Mostly salt water, some freshwater sites
- Grant-funded & privately funded
- Many successes, some less than successful
  - Property owner engagement is key factor



Hermitage Museum & Gardens
Living Shoreline
2006 As Built

One of the early projects permitted under living shoreline brand

At first not acceptable to VA Marine Resources Commission VMRC due to extent of channelward encroachment

Subaqueous lands permit granted after demonstrating potential for wetland restoration success


Hermitage Museum & Gardens
Living Shoreline
+ 8 Yrs
Productive tidal marsh 8 years later

Hermitage Museum & Gardens
Living Shoreline

Part of Lafayette River network of marsh & oyster restoration sites

Measurable co-benefits for shore protection, water quality, habitats


Longwood University's Hull Springs
Living Shoreline 2008 as built
Public demonstration project


Hull Springs Living Shoreline
+3 yrs.


Hull Springs Living Shoreline
+7 yrs.
Marsh ecology develops over time
5-10 years

Urban Landfill Removal for Marsh Creation

Another successful example

Virginia Zoo

Norfolk, VA

2009

2015

Phoebus Waterfront Park

Marsh establishment challenges
Tidal marsh planted twice behind sills

Phoebus Waterfront Park

Phoebus Waterfront Park

Phoebus Waterfront Park

June 2017 - 1 year later marsh still not established

Too much energy?
Sills too low?
Inadequate runoff control?

Stormwater runoff erosion

Not the only project where stormwater runoff interferes with successful establishment

Example of Unexpected Erosion Problems

Narrow fetch – few boat wakes – forested bank - extensive marshes

No serious problem expected from desktop review…..

Site photo revealed surprising erosion

Catastrophic bank failure during Hurricane Matthew 9-inch rain event

Integrating
Stormwater Management + Shoreline Protection

Stormwater runoff contributes
to bank erosion & water quality problems

Runoff can damage
living shoreline projects

NOW RECOMMENDING:
Top-to-bottom site evaluations to account for runoff energy

Living shoreline practices in upland area
to address runoff problems

Notable Coastal Storms

9/1/2003	Tropical Storm Isabel
9/1/2006	Tropical Storm Ernesto
10/1/2006	Nor'easter
11/1/2006	Nor'easter
11/1/2009	NorIda - Veterans Day storm
9/1/2010	Tropical Storm Nicole
8/1/2011	Hurricane Irene
9/1/2011	Tropical Storm Lee
10/1/2012	Super Storm Sandy
3/1/2013	Winter Storm Saturn
6/1/2013	Tropical Storm Andrea
10/1/2013	Winter Storm Atlas
5/1/2015	Tropical Storm Ana
10/1/2015	Not Joaquin
9/2/2016	Hurricane Hermine
10/6/2016	Hurricane Mathew

VIMS Analysis of Notable Storms

http://www.vims.edu/bayinfo/tidewatch/notable_storms/index.php

Storm Performance - Realistic Expectations

Living shorelines are usually submerged during storm events

lmpact on waves is much less when water depth exceeds plant height

Hull Springs living shoreline project during Veterans Day Nor'Easter 2009

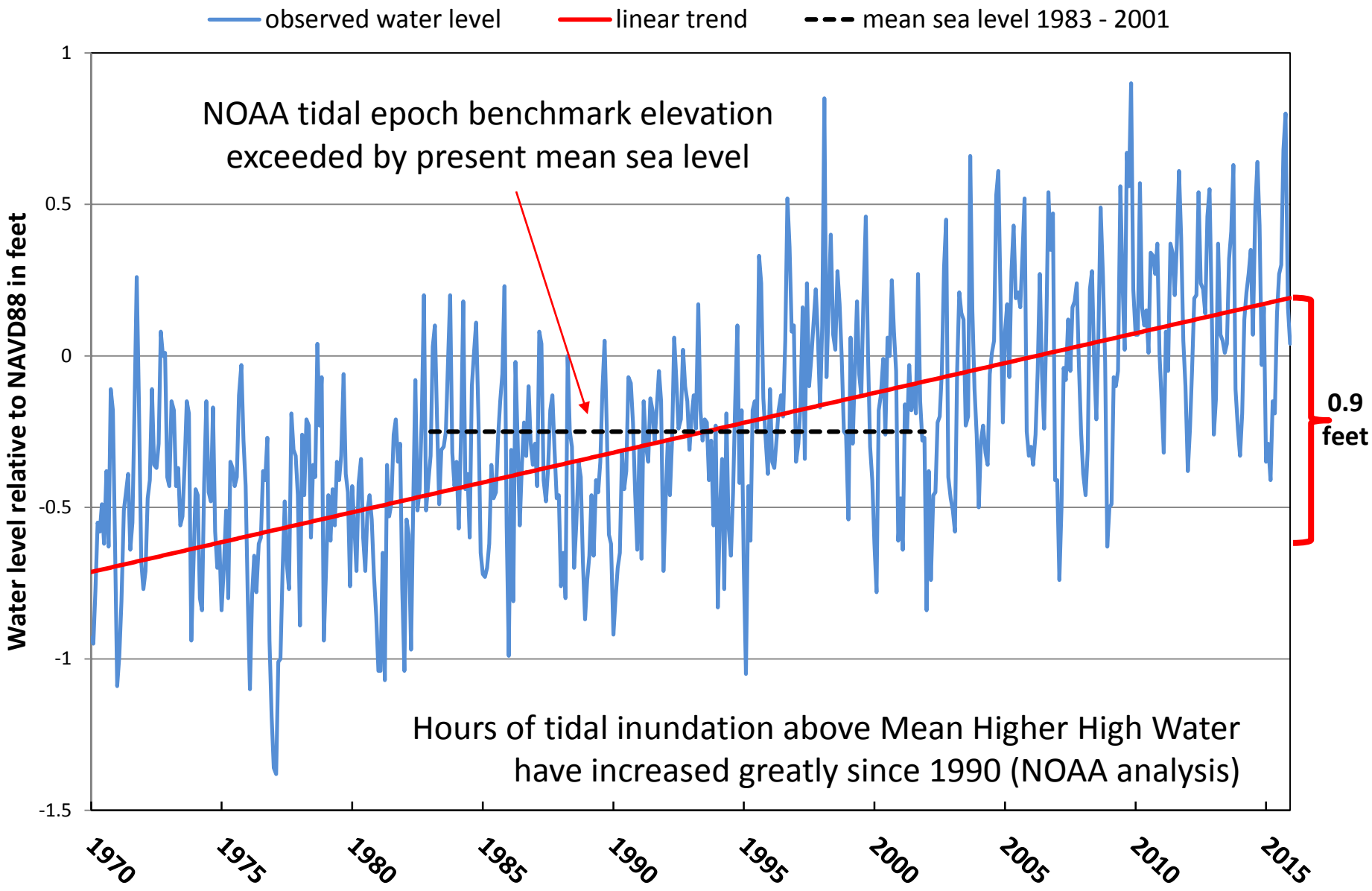
Living Shoreline Resilience

Post-storm recovery has been demonstrated after multiple storm events

Same planted marsh the day after Hurricane Irene 2011

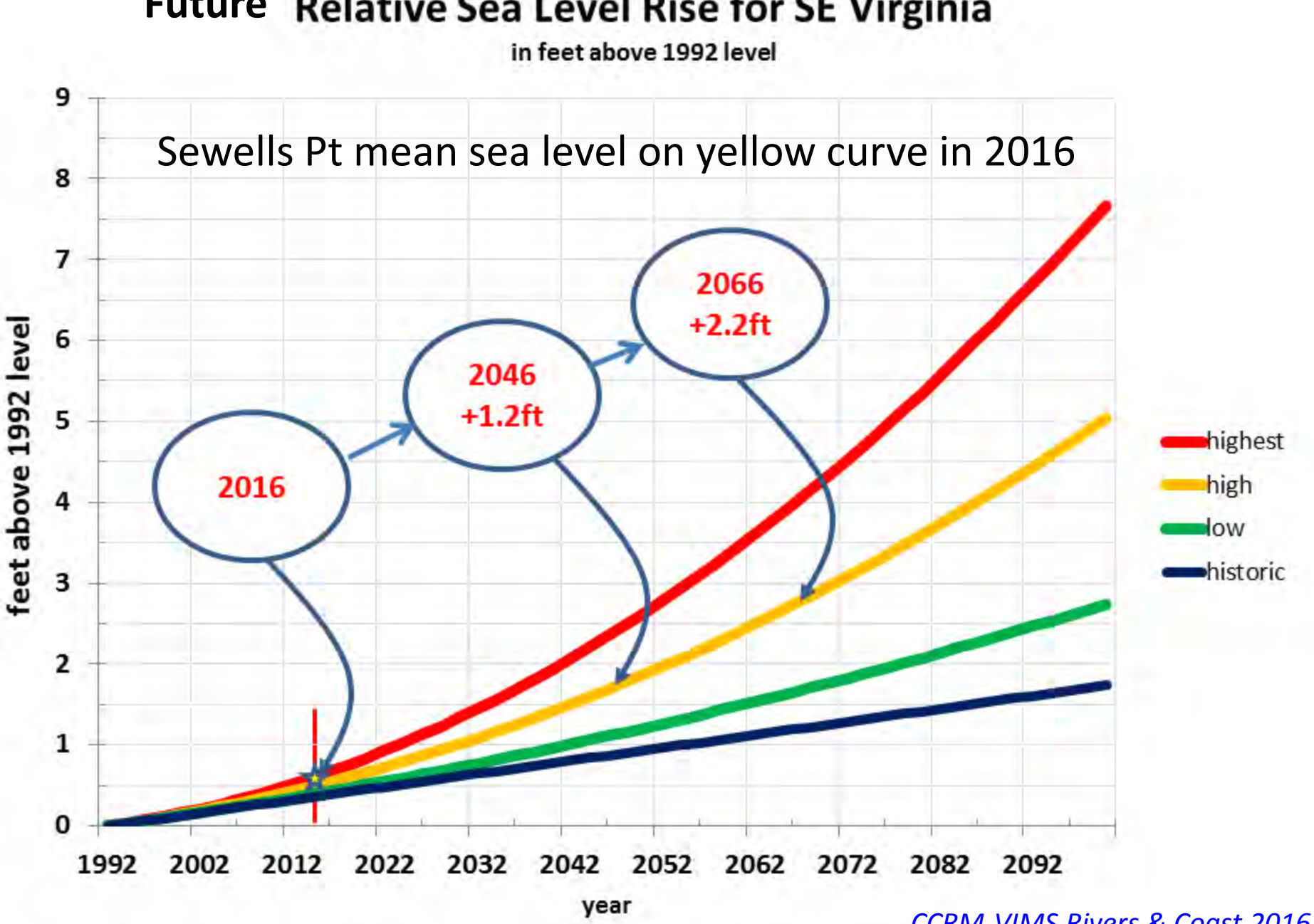
Sea Level Rise Trends

Sewells Point tide gauge water levels 1970 through 2015



CCRM-VIMS Rivers & Coast 2016

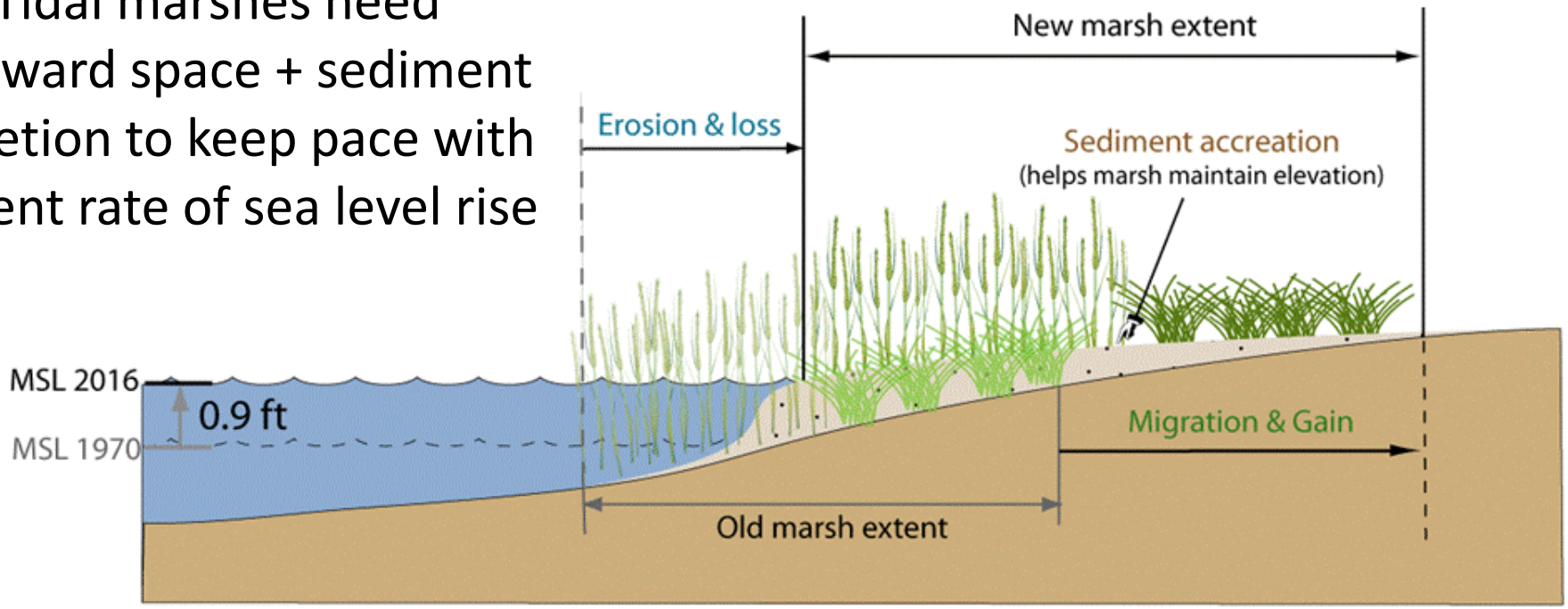
Future Relative Sea Level Rise for SE Virginia



CCRM-VIMS Rivers & Coast 2016

Tidal Marsh Migration

Current Assumption:
Tidal marshes need landward space + sediment accretion to keep pace with current rate of sea level rise



Sediment accretion is controlled by rates of plant production, decomposition, & sediment sources

Migration & Gain of marsh is controlled by elevation, rates of sea-level rise & land use (is the shoreline stabilized?)

Erosion & Loss of marsh is controlled by rates of sea level rise, wave energy, & sediment supply

Sea Level Rise Design Implications for Living Shorelines

- Tidal benchmarks based on last tidal epoch may not be reliable for designs
  - Local tide studies can verify tide range & extreme tides
- Accommodate marsh migration
  - Incorporate adjacent upland inundation areas
- Watch out for marsh sediment supply interruption
  - Sill height & placement
  - Plan for periodic replacement of sand fill

Adapt Virginia

Adaptva.org

New gateway to information & tools
about sea level rise & recurrent flooding adaptations

- Sea level rise viewer
- Virginia flood risk information system
- Geoportal with lots of GIS data
- Legal analyses & reports
- Much more

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VIMS Living Shorelines Research

- Performance assessments
- Geo-spatial GIS research & tools
- Ecology research
  - Comparing living shoreline planted marshes & structures with natural habitats
  - Viability of using Unmanned Aerial Vehicles to improve data collection efficiency & analysis

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Performance Assessment

Duhring et al 2006

While approved as a 'living shoreline' project, this example is not consistent with Code of Virginia definition

- 2006 study led to 2010 Design Guidelines
- No standardized post-regulatory monitoring
- Voluntary monitoring not well documented
- No formal performance assessments have been repeated for the past 10 yrs in VA

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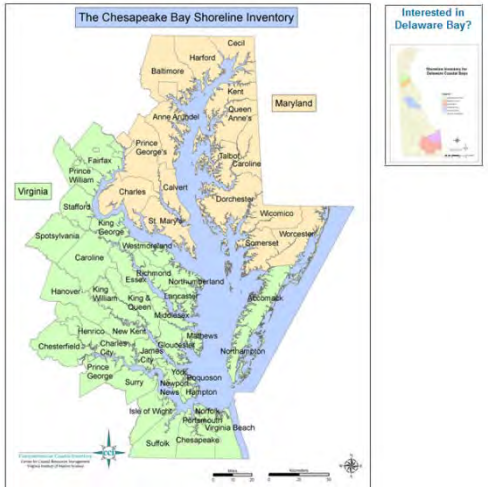
Geo-Spatial Research & Tools

Shoreline Inventories *depict land uses, shoreline conditions & protection structures in Virginia, Maryland, Delaware, & North Carolina*

Tidal Marsh Inventories *depict tidal marsh areas & dominant plant community type*

CCRMPs & Shoreline Management Model *preferred shoreline best management practices based on observed, mapped, & forecasted conditions*

Shoreline Evolution *shoreline changes 1937-2009 plotted & erosion-accretion calculated*



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Living Shoreline Ecology Research

- Comparing living shoreline marsh ecology with natural marshes
  - Young LS marsh plant communities are similar to natural marshes
- Using living shorelines to reduce watershed nutrient pollution
  - LS marshes intercept nitrogen in both surface & ground water
  - TMDL credit protocol in progress

Living Shoreline Ecology Research

- Comparing living shoreline marsh fish assemblage with natural marshes
  - Preliminary findings: Diverse & abundant fish assemblages in LS marshes
  - 3 year study underway

Living Shoreline Ecology Research

- Composition, distribution and dynamics of intertidal biota on coastal defense structures
  - Rock structures support epifauna with landward-seaward differences
  - Market-size oysters present but also mortality
  - Still comparing oyster assemblages on rock structures with natural reefs, effects on shellfish source/sink dynamics
  - Still investigating potential for opportunistic species to spread because non-native rock habitats are spreading throughout the Bay watershed

Living Shoreline Ecology Research

Ribbed mussels & Spartina alterniflora

- Improving ribbed mussel recruitment into living shorelines for stabilization & bio-filtration capacity (nutrients & particulates)
  - Ribbed mussels not as abundant in LS marshes
  - Food supply issue or physical barrier or both? Marsh age?
  - Benthic diatoms (larval food source) need moist, nutrient rich substrate
  - Coarse sand is not suitable, looking to see how organic matter accumulates through time

Living Shoreline Ecology Research

- Community development in oyster shell bags (2 growing seasons)
  - Oyster reef life occurs in shell bags where natural oyster production & recruitment occurs
  - Long-term trajectory of shell bag reefs still under investigation
  - When bags break apart, fate of UV-treated micro-plastics unknown & potentially harmful

Still experimental practice

More research needed to determine if net ecological uplift is achieved

Living Shoreline Ecology Research

- Viability of using high-resolution drone imagery – early results
  - Plant community zones discernible
  - Remote plant ID being tested
  - 3D surface maps for profile surveys & storm damage assessment

Data collection & analysis is more efficient than field surveys with this technology

Requires skilled operator & diligent data management plan

Living Shoreline Project Trends & Current Scientific Thinking

Summary

- 10x more living shoreline projects on the ground since 2000
  - in all types of settings
  - supported by policies – regulatory expectations – advocacy
- Successful design usually but not always achieved
  - With property owner engagement from the beginning
- Stormwater runoff, coastal storms & sea level rise important design considerations
- Effective stabilization, resiliency, nutrient reduction & habitat benefits have been demonstrated by research
- Living shoreline monitoring & research continues to investigate performance to inform policy
  - Should design parameters change for better projects?