Let's Get Started...

Varoujan and Laura welcome you...

Who are you?

I'm a Civil Engineer

If olive oil is made from olives, what is baby oil made of? OMG!
Importance of Interdisciplinary Approaches

Case Studies
- Examples of Collaboration
- Lessons Learned
- Simple Rules & Takeaways

Moving Forward: Tools & Strategies for Effective Design & Implementation
CTDEEP Working Definition of Living Shorelines:

“Living shorelines: A shoreline erosion control management practice which also restores, enhances, maintains or creates natural coastal or riparian habitat, functions and processes. Coastal and riparian habitats include but are not limited to intertidal flats, tidal marsh, beach/dune systems, and bluffs. Living shorelines may include structural features that are combined with natural components to attenuate wave energy and currents”. 
“Living Shorelines Protected, Restore & Enhance Natural Habitats & Coastal Processes…”

BEFORE:
Mid 1900’s method of stabilizing shorelines using various forms of construction debris...

AFTER:
Replacing rubble with clean backfill, controlling toe erosion and restoring ecological function & value
Living Shorelines are complex systems. Build them to enhance, protect and increase coastal resiliency...

- An integrated approach is the best possible way to optimize the outcome;
- Engineering, coupled with good science, understanding of coastal ecology and site design through an interdisciplinary approach and regulatory partnership.

Let's review some of the sea level rise effects:

1. Inundation & habitat impacts
2. Erosion
3. Salt Marsh loss and migration
4. Shoreline retreat
5. Upland Flooding
6. Ecological Change
7. Habitat tradeoff evaluation
8. Economic Impact

Source: Environmental Concern
Observed Changes in The Coastal Environment

a. 5,000 Years Ago

b. Today

c. Substantial wetland loss where house is moved or upland is vacant

d. Complete loss of wetlands where bulkhead protects house from rising sea

LEGEND:  
- Sedimentation and Peat Formation
- Marsh
- Fish and Wildlife that Rely on the Marsh
A healthy salt marsh reduces up to 50% of the incoming wave energy within the first 15 to 20 feet of area and up to 95% over 150 to 200 feet.
Benefits:
- Maintains natural shoreline processes and sand migration
- Absorbs moderate storm surge and dynamic energy
- Provides habitat for marine organisms plus an adjacent upland buffer
- Protects shorelines from erosion
- Less costly to build compared to hard structures, sea walls, bulkheads, groins or rock revetments
- Absorbs and traps greenhouse gases
- Enhances the visual appeal of the shoreline
- Minimizes impacts on adjacent properties

Shortfall:
- Not as effective in high energy zones
- Requires annual inspections and periodic maintenance
- Technology and materials are still evolving
- Still many unproven options to consider and/or be wary of
- False sense of security (in moderate to high energy zones)
- The regulatory strategy is still evolving
Low Energy site = Living Shorelines are ideal solution

Less than 2 feet of short waves, low current & low storm surge

Medium Energy site = Consider A Hybrid system, hard sill and plants

Two (2) to 5 foot waves, moderate currents/storm surge

High energy site = Use Hard structures with biogenic design to promote habitat diversity

Higher wave energy (greater than 5 feet), severe exposure, high storm surge, overtopping and erosion
Many Choices for Treatments

Plants as Primary Support (5:1 and flatter)
- Plugged or seeded
- Low energy environment
- No concentrated surface flows
  (sheet flow only)

Plants with Erosion Control (5:1 to 3:1)
- Plugged or seeded
- Low energy environment
- Sheet flow only

Plants as Structural Support (3:1 to 2:1)
- Brushmattress, Fascines, Live stakes, etc.
- Low to moderate energy environment
- Seeding may be included

Additional Structural Support Needed (>2:1 slope)
- Hybrid practices, sills, crib walls, etc.
- Moderate energy environment
Living Shorelines/Hybrid Design must balance the dynamic forces, control erosion and build resilience through restoration, enhancement of natural processes of coastal and riparian habitat, and evaluate tradeoffs.

Design complexities require a variety of expertise:
- Planners
- Engineers
- Landscape Architects
- Coastal Ecologists & Scientists
- Regulatory community
- Public education

Interdisciplinary Coordination is Essential
Some Relevant Project Examples

- Charleston, South Carolina
- Shaffer Paper (Industrial site), South Boston, MA
- Coastal Bank Stabilization, Nantucket, MA
- Clippership Wharf, Boston Harbor, MA
- Aunt Amy’s Creek, Stony Brook Harbor, NY
- Binder Bluff Stabilization, Lloyd Harbor, NY
Salt Marshes are diverse ecosystems that function as spawning beds for a large variety of marine life, and improve water quality through:

- uptake of nutrients, filtration, denitrification and sediment retention; and
- provide habitat enhancement for 80% of breeding bird population.
Converting an existing Broken Granite wall into a Living Shoreline
Dilapidated Timber Bulkhead to be changed to a Living Shoreline
Shaffer Paper, Proposed Living Shoreline Sections
Nantucket MA, Proposed Restoration

Section B

PLANTING:
1. Upper slope to be planted with switchgrass and Atlantic coastal panic 12" O.C.
2. Fiber rolls to be plugged with American beachgrass at 12" O.C.
Alternative Stabilization, Nantucket MA
Alternative Stabilization, Nantucket MA
Clippership Wharf, Boston Harbor, MA
New Development by Lend Lease

Clippership Wharf
Tidal Exposure
April 28, 2015

Low Tide - 1.0
Mid Tide - 6.0
High Tide - 11.0
Mid Tide - 6.0
Low Tide - 1.0
Clippership Wharf, Boston Harbor, MA
Hybrid Living Shoreline
Clippership Wharf, Boston Harbor, MA
Hybrid Living Shoreline
Aunt Amy’s Creek, Stony Brook, NY

Project location
Aunt Amy’s Creek, Stony Brook, NY

2007 - Initial Eroded Condition
Undercut bank varied 2-1/2’ to 4’
Aunt Amy’s Creek, Stony Brook, NY

PLANNING TIMELINE:

- May 2007 – Initial site reconnaissance;
- July 2007 – Site topographic survey;
- November 2007 – Plans completed; USACE, State & local permit applications submitted;
  
  …..16 months later…..
- March 2009 - Permits approved;
  
  …..then…..

Live crib wall

Brushmattress
PLANNING TIMELINE:

- April 2009 – Permit modification (Due to extended agency review period, the undercut banks widened to 4-5 feet requiring additional engineering…)

Aunt Amy’s Creek, Stony Brook, NY
Aunt Amy’s Creek, Stony Brook, NY

CONSTRUCTION PHASE

Site work commenced May 2009
Aunt Amy’s Creek, Stony Brook, NY

CONSTRUCTION PHASE

Crib wall transitioning to brushmattress

Stone base to weep springs & geogrid tie backs
Aunt Amy’s Creek, Stony Brook, NY

CONSTRUCTION PHASE

Live stakes/whips

Live crib wall

Brushmattress
Aunt Amy’s Creek, Stony Brook, NY

AS BUILT LIVE CRIBWALL PLANTING DETAIL
Section View Scale: 1/4” = 1’-0”
MONITORING PHASE - Brushmattress

Aunt Amy’s Creek, Stony Brook, NY

- 1 month
- 1 year
- 3 years
- 5 years
Aunt Amy’s Creek, Stony Brook, NY

MONITORING PHASE – Live Crib Wall

Installed
2009

1 year

3 years

5 years
Binder Bluff, Lloyd Harbor, NY

>5 Mile Fetch &
High Energy Shoreline

Lloyd Harbor, NY, USA
Binder Bluff, Lloyd Harbor, NY

- Bulkhead
- Gabion Toe
- Proposed Stone Revetment With Bioengineered Upper Slope
Binder Bluff, Lloyd Harbor, NY

Initial Pre-Sandy Condition
Binder Bluff, Lloyd Harbor, NY

Note loss of vegetation & 15’- 25’ of bluff face

Post - Sandy Condition
Binder Bluff, Lloyd Harbor, NY

Overtopping & failure of adjacent gabion wall
Key Design Considerations

1. Calculate the length of “Effective Fetch” or open water distance to determine the level of exposure to guide the design;
2. Control overland drainage & hydraulic pressure;
3. Conduct slope stability analysis & sediment gradation test;
4. Protect the base and the toe from undermining;
5. Protect the flanks;
6. Prevent overtopping;
7. Create a diverse habitat;
8. Encourage biogenic processes;
9. Account for sea level rise;
10. 3 Years minimum monitoring & maintenance program
Conclusions / Steps Forward

1. Understanding the Working Definition of Living Shorelines
2. Benefits of Living Shorelines
3. Site Characterization - Low, Medium & High Energy Shorelines
4. Appropriate Treatment Selection
5. Importance of Interdisciplinary Approach
6. Living Shorelines Applications – Case Studies & Lessons Learned
7. Work With Your Regulators
8. Key Design Considerations

QUESTIONS??

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