Hybrid Living Shorelines:
A Systematic Approach to Maximized Coastal Resiliency and Ecology

William Young, RLA, PWS - Young Environmental, LLC
Douglas Janiec, Senior Project Scientist, Cardno ENTRIX
Acute Events Remind Us of Our Vulnerability

Can we protect our coasts?

Can we develop resilience?
Living Shorelines: We can build dunes
Post Sandy devastation, crews worked around the clock to restore Ocean Parkway and get two popular beaches opened by Memorial Day, 2013. They succeeded!

(and what Doug Janiec gently reminded me was that dunes are secondary protection.)
And Marshes: Newton Creek NJ
Why Are Islands Sinking? Very Dramatic Losses

- Landfills?
- Impervious surfaces and runoff?
- Wastewater treatment plants?
- CSOs and large volume discharges?
- Sea level rise?
- Pollution?
- JFK International Airport?
- All of the above?
- Some of the above?
Elders Point West

- Elders Point never used to be "east" and "west".
- Urbanization, sea level rise, etc., had reduced the island.
- In 2006, dredged sand was hydraulically placed to restore the island.

**FIGURE 4.3.2** Wetland Loss in Jamaica Bay from 1924 to 1999; Source: NYCDEP
Restoring Island to Historical Dimensions

Sand is slurried/piped over from hopper barges, dredged from Ambrose Channel
Restoring Island to Historical Dimensions

New toe for Elder’s Point restores 34 acres to Jamaica Bay!
Salvaging Existing Hummocks
Jamaica Bay-NY/NJ Harbor Multi-Project Initiative

- Capping NBCDF: 230,000 CY (June 12)
- Black Wall: 150,000 CY, 20 acres (21 Sept 12)
- Rulers Bar: 92,000 CY, 10 acres (3 Oct 12)
- Plumb Beach: 129,188 CY (9 Nov 12)
- Yellow Bar: 375,000 CY, 44 acres (Aug 12)

Ambrose Channel Deepening:
Total 3.6 M CY

Marsh Island Restoration in Jamaica Bay
Beach Replenishment: Very Costly $$ & Not Permanent

SOME PROTECTED, SOME NOT
The status of beach replenishment projects before Hurricane Sandy.

CONSTRUCTED
APPROVED, NOT BUILT
STUDY AREA

Source: Army Corps of Engineers
FRANK CANELA/THE STAR-LEDGER

Cardno
Shaping the Future
We can Build Marshes. We can build dunes
We can replenish Beaches.

But will it last?
Resilient? Beach Nourishment NOT a Permanent Solution
Marshes are not holding up. Chronic scour and erosion

Dr Danielle Kreeger: “We are losing one acre a day in Delaware Bay”

- Rising sea levels
- Excess nutrients and pollutants
- Boat wakes and marine traffic
- Urbanization and increased runoff
- Filling and loss of wetlands
- Storms and high energy stressors
Wave Attenuation Device (WAD)  Attenuate: reduce, especially in thickness, density or force. To reduce in force, value, amount or degree. Reduce or weaken, in strength value or virulence.

Shark Island, New Iberia, LA

Double row configured for maximum energy dissipation
How Long Does A Project Have To Last To Be Resilient?

We need to redefine the project life paradigm.

- Short Project Life Tough on Wildlife & Bill
- Often High & Unfunded O&M Costs
- No Longer Economical

- Acute Toughness/Chronic Endurance
- Multiple Time-Driven Eco-Endpoints
- Low to No O&M Costs
How Do We Achieve Resilient Natural Design?

• First, we identify and go after the causes
  • Wave energy
  • Increased Water Volume
• Second, we deal with major symptoms
  • E.g., Beach erosion
  • E.g., Habitat degradation
• Third, we work with nature
  • Take advantage of the energy, not fight it
  • We provide the framework and let nature do the fine touches

We aren’t making the house furniture – we’re just framing the house out.
Here’s One Technique: **Hybrid Energy Attenuation System** (concept cross section)

- **Step 1** (the wave bunt) Attenuation
- **Step 2** (lower energy) Attenuation
- **Step 3** (severe storm) Attenuation

Created Dune or Other ~ Supratidal Feature

Restored Resilient Island (mixed dune/beach/marsh/flat system)

- **Existing Beach**
- **Passive Accretion and/or Optional Nourishment (may be beach and/or marsh)**
- **Existing Bottom**

- **Red Arrows Represent Wave Energy**
- **MLW**
- **MHW**

**WADs Array (n.t.s.)**

**Example of Spacing (ft)**

00 100 200 300 400 500 600 700 800 900
Hard Armoring Manipulates Energy

- Reflects/Deflects,
- **Diffracts**, and
- Sometimes Concentrates
Newer Technology (e.g., WADs™) Attenuates Energy

Predominantly wave energy attenuation vs. predominantly wave energy refraction

In Other Words:
Directly reducing (deconcentrates) wave energy vs. manipulating (re-directioning) wave energy

Energy attenuation supports sediment management and development of living shorelines
An Example of a Habitat-Based Comparison
Standard Double-Row WAD Array vs Traditional Sill/Breakwater Structure

(Per 500 linear feet)

<table>
<thead>
<tr>
<th>General Description</th>
<th>WAD Array</th>
<th>Sill/Breakwater</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBC - Soft Bottom Coverage (ft²)</td>
<td>Units 10 ft W x 5 ft H, 1.5 ft spacing, 2x row</td>
<td>5 ft H, 5 ft Crest, 2.5:1 slope F, 2:1 slope B</td>
</tr>
<tr>
<td>NHS - New Hard Surface Area (ft²)</td>
<td>2,435</td>
<td>13,750</td>
</tr>
<tr>
<td>SHS Index (SBC/NHS) (lower is better)</td>
<td>49,098</td>
<td>14,850</td>
</tr>
<tr>
<td>DDC - Dimensional Depth &amp; Morphologic Character</td>
<td>5.0</td>
<td>92.6</td>
</tr>
<tr>
<td></td>
<td>5 feet, 3-D</td>
<td>0.75 feet, Planar</td>
</tr>
</tbody>
</table>
Living Shorelines

Build just above MHW.

High marsh: MHW to MHHW. S. patens, Distichlis spicata, Iva frutescens.

Sill or revetment

MLW to MHW. This is intertidal zone, called low marsh. Spartina alterniflora (Smooth cordgrass)

That is a lot of rock to make a bit of Living Shoreline, and you are still causing erosion by diverting energy to neighbor.
Summary of Benefits; WADs make reefs!!
(Living Shorelines Solutions, Inc)

- Supports LS Projects in Moderate to High Energy Systems
- Sediment Conservation
- Cost Saving for Dune and Nourishment Projects
- Infrastructure Projects
- Resilience (50+ years)
- Barrier Reefs
- Oyster Habitat
- Stabilizes Beaches for Horseshoe Crab and Migratory Birds
- Sea grass/SAV Restoration
Figure 2. Aerial view of the study site and locations of the wave measurements.
Waves Dampened

Ping Wang, Ph.D.
Department of Geology
University of South Florida

Submitted to

Loland Broussard
National Resources Conservation Service
646 Cajundome Blvd
Suite 180 Lafayette, LA 70506

water level (m)

sample no.

Offshore
Nearshore
Figure 8. A portion of water level records comparing the offshore condition and condition at site 3, at 16:30.
Vegetation (SAV) and Algae can flourish in calm waters located landward of WAD Arrays, Cape Charles, VA.
Numerous ways to camouflage energy attenuation. One community wanted the WADs to look like the existing nearby stone breakwater. Stones were cemented on top to blend in.

note calm waters
Using *Hybrid Attenuation Approach*, LSs can be placed along almost any coastline.
Passive Accretion and/or Sediment Conservation?

Cape Charles, VA
• WAD Deployment occurred just before SS Sandy hit.
• Year 1 monitoring results.

Above: Note similar tide elevations by the amount the WADs are exposed.

Right/Above: Note the passive accretion in one year.

Thank you LSS, Inc., Dade City, FL & Mid Atlantic Environmental LLC, Virginia Beach, VA for share monitoring photography.
Restoration Sites and Storms No Longer Have an Adverse Relationship.
Sunken Island, Tampa Bay, FL

April 27, 2012 at high tide, 6 months following WAD deployment

Storms bring sand to the site, not take from it.

July 2012 near high tide, shortly after Tropical Storm Debby (65 mph winds & ± 10 inches of rain)
160 WAD units. Precision placed with differential GPS. ~1,700 kg per unit

Est 1,867 metric tons of marine biomass annually after first year!
SECTION SOUTH
A/A
GAIN 10 FEET

21 weeks

SECTION B/B
GAIN 35 FEET

Negril, Jamaica
Beach Profile at
21 week point
post installation
WADs.

POOLBASE

BEACH ACCRETION

Negril, Jamaica
Beach Profile at
21 week point
post installation
WADs.

SECTION B/B
Applicability and Limitations

• Virtually all coastal plain regions, world wide, are in play.

• Coastal beaches, bays, tidal rivers, high energy marshes

• So far, up to 12 feet deep before significant reduction on wave energy attenuation.

• Sized for project, 3 to ~10 feet high.

• Deeper waters for more reef function.

Withstands Cat 4/5 hurricanes. RESILIENCE
Of all the units deployed to date, not one has failed.
Today’s State-of-Science for Coastline Stabilization, Enhancement & Restoration, Allows Us To:

- Reduce, stop, reverse, or better manage coastal erosion and sediment transport
- Preserve critical habitat & species
- Help ensure our future coastal
  - Business
  - Recreation
  - Sports, &
  - Our children’s enjoyment
Lincoln Park, Secaucus, NJ
Carl Alderson, NOAA Marine Center

William E. Young, RLA, PWS
USA Environment, LP
1090 King George Post Rd Suite 708 Edison, NJ 08837
732 267-2876
fax: 732 661-2096
byoung@USAEnviro.com
www.USAEnviro.com

Douglas Janiec, MS
Cardno ENTRIX
10 Corporate Circle Suite 300
New Castle, Delaware 19711
302 395-1919
fax: 302 395-1920
doug.janiec@cardno.com
www.cardnoentrix.com

Thank You!!

Need some WADs here please to protect
Living Shoreline
William E. Young, RLA, PWS
USA Environment, LP
1090 King George Post Rd Suite 708
Edison, NJ 08837
732 267-2876
fax: 732 661-2096
byoung@USAEnviro.com
www.USAEnviro.com

Douglas Janiec, MS
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fax: 302 395-1920
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www.cardnoentrix.com
IF YOU BUILD IT....
Subbing for Doug today, Bill Young, Young Environmental. My involvement started as “the dune guy” for Planting Design for Cove Island Park.

Energy is reflected (to cause erosion elsewhere)
Hard wall degrades from day one
Poor habitat

Need a sill or

Energy is absorbed and dissipated
Living shoreline improves from day one
Great habitat