GREEN SHORELINE PROJECTS ON LONG ISLAND

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Presented To: Sea Grant New York

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GEI Consultants

Geotechnical, Water Resources,
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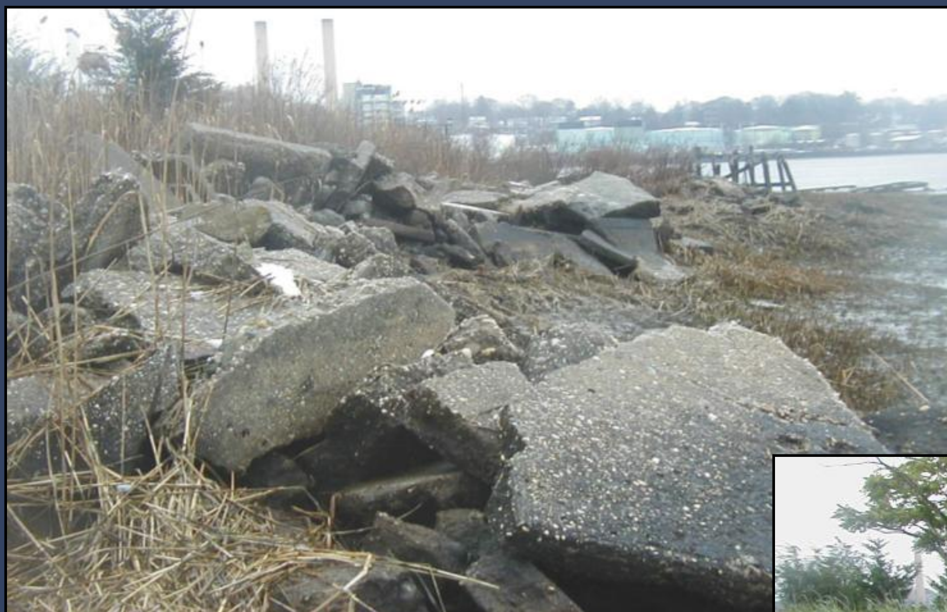
WHAT IS A LIVING SHORELINE?

"A shoreline management practice that provides erosion control benefits; protects, restores or enhances natural shoreline habitat; and maintains coastal processes through the strategic placement of plants, stone, sand fill, and other structural organic materials (e.g., biologs, oyster reefs, etc.)."

- *NOAA Shoreline Glossary*

“PROTECTS, RESTORES & ENHANCES 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

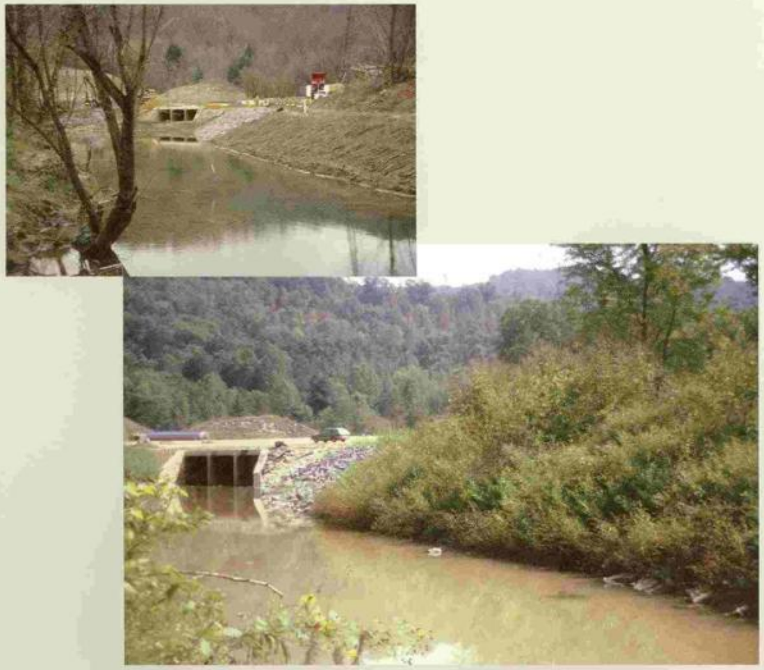
HOW? … ONE OF MANY HANDY REFERENCES

United States Department of Agriculture

Natural Resources Conservation Service

Engineering Field Handbook

Chapter 16 Streambank and Shoreline Protection



Preface

Chapter 16, Streambank and Shoreline Protection, is one of 18 chapters of the U.S. Department of Agriculture, Natural Resources Conservation Service, Engineering Field Handbook, previously referred to as the Engineering Field Manual. Other chapters that are pertinent to, and should be referenced in use with, Chapter 16 are:

Chapter 1:	Engineering Surveys
Chapter 2:	Estimating Runoff
Chapter 3:	Hydraulics
Chapter 4:	Elementary Soils Engineering
Chapter 5:	Preparation of Engineering Plans
Chapter 6:	Structures
Chapter 7:	Grassed Waterways and Outlets
Chapter 8:	Terraces
Chapter 9:	Diversions
Chapter 10:	Gully Treatment
Chapter 11:	Ponds and Reservoirs
Chapter 12:	Springs and Wells
Chapter 13:	Wetland Restoration, Enhancement, or Creation
Chapter 14:	Drainage
Chapter 15:	Irrigation
Chapter 17:	Construction and Construction Materials
Chapter 18:	Soil Bioengineering for Upland Slope Protection and Erosion Reduction

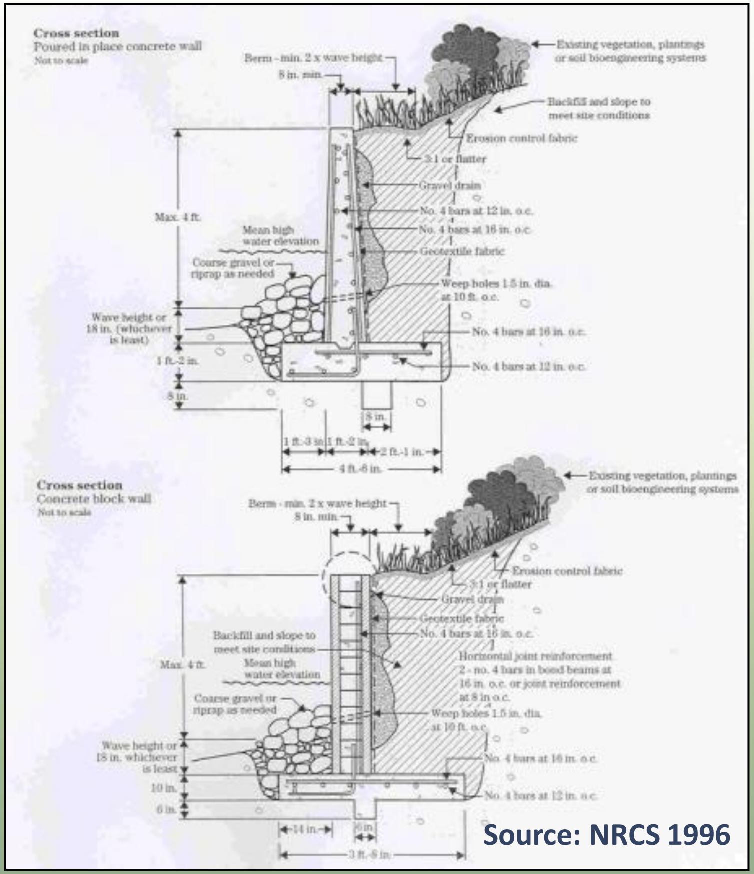
This is the second edition of chapter 16. Some techniques presented in this text are rapidly evolving and improving; therefore, additions to and modifications of chapter 16 will be made as necessary.

WHY? … CONSIDER COST BENEFITS:

Treatment	Relative Complexity	Relative Cost
Conventional vegetation	Simple to Moderate	Low
Live Stake	Simple	Low
Joint Planting	Simple	Low
Live Fascines	Moderate	Moderate
Brushmattress	Moderate to complex	Moderate
Live Cribwall	Complex	High
Branchpacking	Moderate to complex	Moderate
Conventional bank armoring	Moderate to complex	Moderate to High

Table based on “Streambank Erosion Protection Treatment Relative Costs and Complexity” (Fischenich and Allen 1999)

CONVENTIONAL SHORELINE STABILIZATION TECHNIQUES

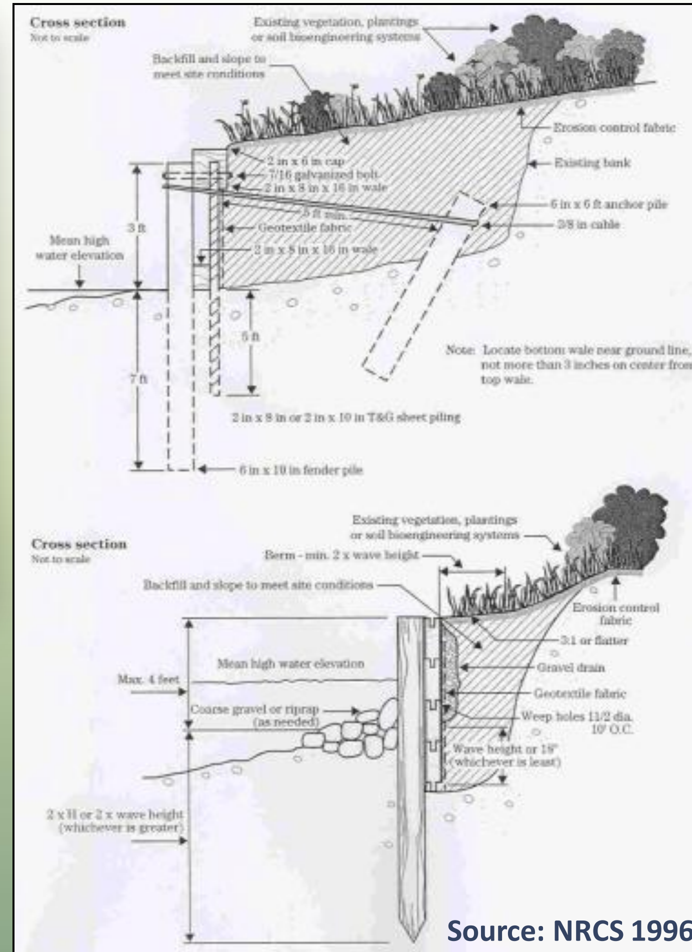


Source: NRCS 1996

Concrete Bulkheads

CONVENTIONAL SHORELINE STABILIZATION TECHNIQUES

Timber or Sheet Pile Bulkheads

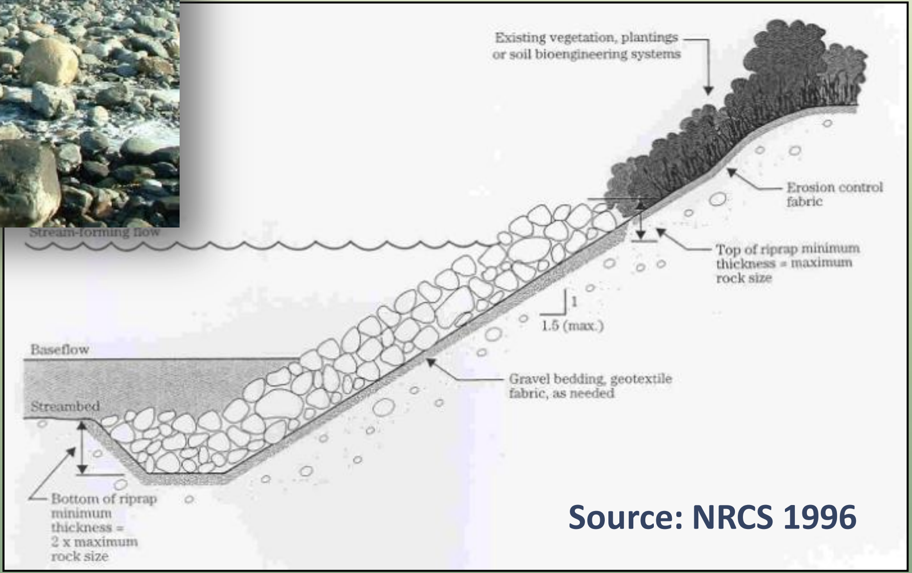


Source: NRCS 1996

CONVENTIONAL SHORELINE STABILIZATION TECHNIQUES

Rock Gabions

Stone Riprap Revetment



Source: NRCS 1996

BIO ENGINEERING FOR SHORELINE STABILIZATION

Key Design Considerations for Treatment Selection:

1. Soil & Salinity

2. Slope

3. Climate

4. Use Intensity

5. Level of Exposure

6. Typical and Anticipated Flow of Water

Treatment Selection Process

Vegetative Treatment Potential for Eroding Tidal Shorelines

DIRECTIONS FOR USE

1. Evaluate each of the first four shoreline variables and match the site characteristics of the variable to the appropriate descriptive category.
2. Place the Vegetative Treatment Potential (VTP) assigned for each of the four variables in the right hand column.
3. Obtain the Cumulative Vegetative Treatment Potential for variables 1, 2, 3 & 4 by adding the VTP for each.
4. If it is 23 or more, the potential for the site to be stabilized with vegetative is very good and the rest of the table need not be used. If it is below 23, go to step 5.
5. Determine the VTP for shoreline variable 5 through 9 and obtain the cumulative VTP for variables 1-9.
6. Compare the cumulative VTP score with the Vegetative Treatment Potential Scale at the bottom of this page.

SHORELINE VARIABLES	DIRECTION FOR USE The Vegetative Treatment Potential (VTP) is located in bold type.					VTP
1. Fetch: Average distance in miles of open water measured perpendicular to the shore and 45 degrees either side of perpendicular to shore.	Less than 0.5 miles **8**	0.5 thru 1.4 miles **7**	1.5 thru 3.4 miles **4**	3.5 thru 4.9 miles **2**	over 5 miles[1] **0**	
2. General shape of shoreline for distance of 200 yards on each side of planting site.	Coves **8**	Irregular shoreline **3**		Headland or straight shoreline **0**		
3. Shoreline orientation: General geographic direction the shoreline faces.	Any less than 1/2 mile fetch **5**	West to North **3**	South to West **2**	South to East **1**	North to East **0**	
4. Boat traffic: Proximity of site to recreational & commercial boat traffic.	None **5**	1-10 per week within 1/2 mi. of shore. **3**	More than 10 per week within 1/2 mi. of shore. **2**	1-10 per week within 100 yds. of shore. **1**	More than 10 per week within 100 yds. of shore. **0**	

Cumulative Vegetative Treatment Potential for Vari...

If this score is 23 or above, the potential for the site is very good and the rest of the table need not b...

5. Width of beach above mean high tide in feet	Greater than 10 ft. **3**	10 ft. thru 7 ft. **2**	6 ft. thru. 3 ft. **1**
6. Potential width[2] of Planting area in feet	More than 20 ft. **3**	20 ft. thru 15 ft. **2**	14 ft. thru 10 ft. **1**
7. On shore gradient slope from MLW to toe of bank.	below 8% **6**	8% thru 14% **3**	15% thru 20% **1**
8. Beach Vegetation	Vegetation below toe of slope **3**		No vegetation b... **0**
9. Depth of sand[3] at mean high tide in inches.	more than 10 in. **3**	10 in. thru 3 in. **2**	less than 3 in. **0**

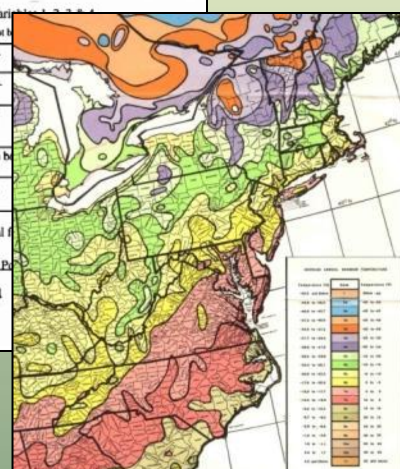
Cumulative Vegetative Treatment Potential f...

1. Do not plant.
2. If tidal fluctuation is 2.5 feet or less, measure from MLW to toe of bank. If tidal fluctuation is over 2.5 feet, measure from MW to toe of bank.
3. Refers to depth of sand deposited by littoral drift over the substrata.

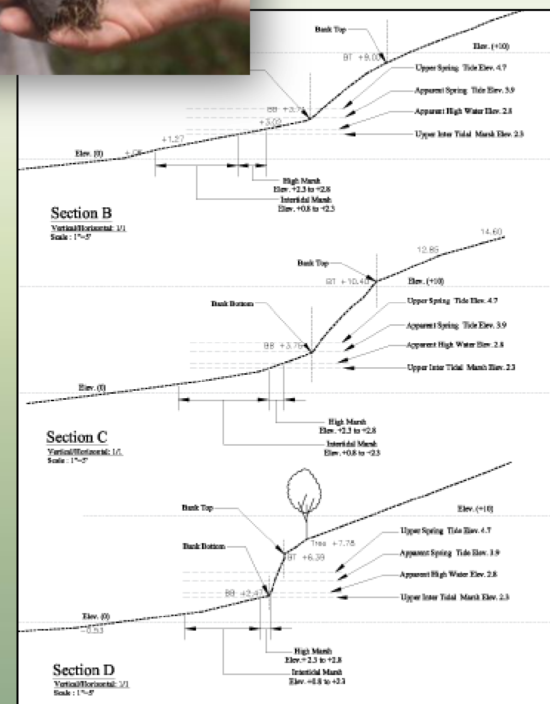
Vegetative Treatment P... If the VTP is, Between	And
40	33
32	24
23	16

Vegetative Treatment Potential Rating Sheet

Soil Analysis



Climatic Regions



Slope & Wave Analysis

What works…what doesn't?

~

Vegetative Treatment Potential Rating Sheet

TABLE I VEGETATIVE TREATMENT POTENTIAL FOR ERODING TITLE SHORELINES IN THE MID-ATLANTIC STATES

DIRECTION FOR USE

1. Evaluate each of the first four shoreline variables and match the site characteristics of the variable to the appropriate descriptive category.
2. Place the Vegetative Treatment Potential (VTP) assigned for each of the four variables in the right hand column.
3. Obtain the Cumulative Vegetative Treatment Potential for variables 1, 2, 3 & 4 by adding the VTP for each.
4. If it is 23 or more, the potential for the site to be stabilized with vegetation is very good and the rest of the table need not be used. If it is below 23, go to step 5.
5. Determine the VTP for shoreline variables 5 through 9 and obtain the cumulative VTP for variables 1-9.
6. Compare the cumulative VTP score with the Vegetative Treatment Potential Scale at the bottom of this page.

SHORELINE VARIABLES	DIRECTION FOR USE The Vegetative Treatment Potential (VTP) Is Located in Upper Left Hand of Each Category Box					VTP
1. Fetch: Average distance in miles of open water measured perpendicular to the shore and 45° either side of perpendicular to shore.	8 Less than 0.5 miles	7 0.5 thru 1.4 miles	4 1.5 thru 3.4 miles	2 3.5 thru 4.9 miles	0 over 5 miles see footnote 1/	
2. General shape of shore line for distance of 200 yards on each side of planting site.	8 Coves	3 Irregular shoreline	0 Headland or straight shoreline			
3. Shoreline orientation: General geographic direction the shoreline faces.	5 Any orientation less than one-half mile fetch	3 West to North	2 South to West	1 South to East	0 North to East	
4. Boat traffic: Proximity of site to recreational & commercial boat traffic	5 None	3 1-10 per week within 1/2 mi. of shore	2 More than 10 per week within 1/2 mi. of shore	1 1-10 per week within 100 yds. of shore	0 More than 10 per week within 100 yds. of shore	

Cumulative Vegetative Treatment Potential for Variables 1, 2, 3 & 4 ______

If this score is 23 or above, the potential for the site is very good and the rest of the table need not be used. If it is below 23, go to step 5 below.

					VTP
5. Width of Beach Above Mean High Tide in Feet	3 Greater than 10'	2 10' thru 7'	1 6' thru 3'	0 Less than 3'	
6. Potential width of 2/ Planting Area in Feet	3 More than 20'	2 20' thru 15'	1 14' thru 10'	Less than 10' Do Not Plant	
7. On Shore Gradient: % slope from MLW to toe of bank	6 Below 8%	3 8 thru 14%	1 15 thru 20%	0 over 20%	
8. Beach Vegetation	3 Vegetation below toe of slope	0 No vegetation below toe of slope			
9. Depth of sand at 3/ Mean High Tide in inches	3 More than 10"	2 10" thru 3"	0 Less than 3"		

Cumulative Vegetative Treatment Potential for Variables 1-9 ______

1/ Do not plant or see page 9 and figure 9 for possible exception.

2/ If tidal fluctuation is 2.5 feet or less, measure from MLW to toe of bank. If tidal fluctuation is over 2.5 feet, measure from MW to toe of bank. See page 7 for more information.

3/ Refers to depth of sand deposited by littoral drift over the substrata.

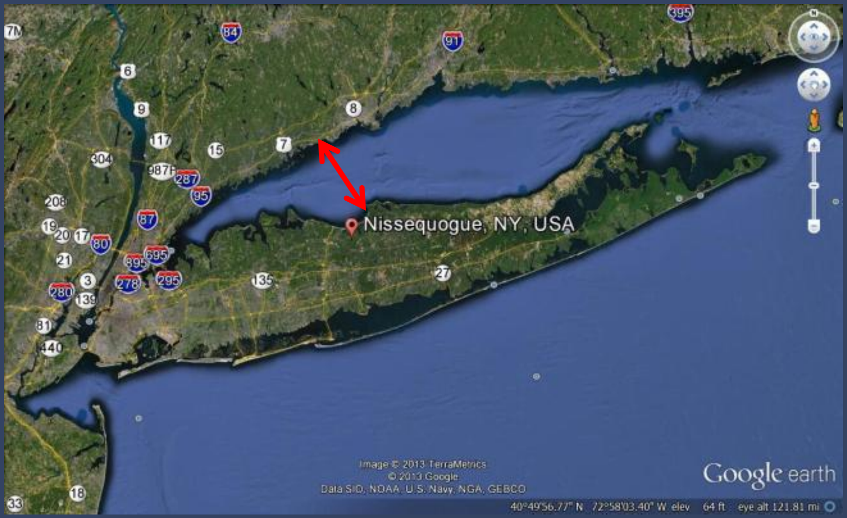
VEGETATIVE TREATMENT POTENTIAL SCALE

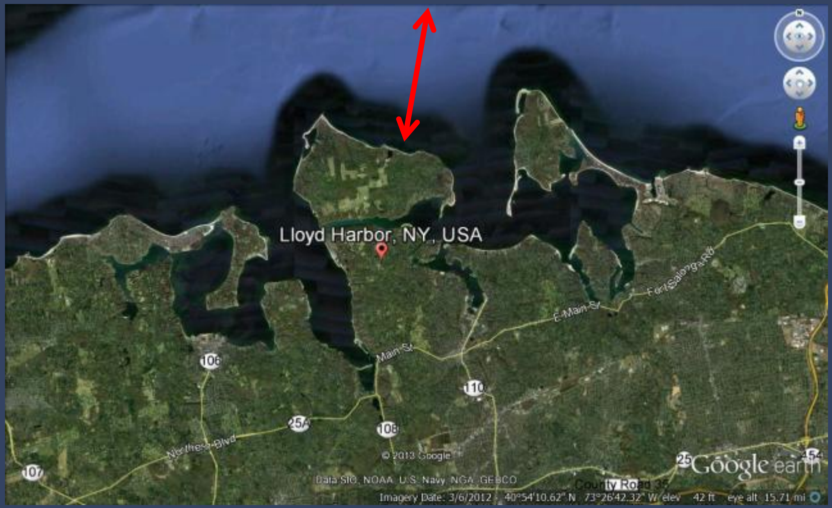
If the VIP is: Between	And	Potential of Site to be Stabilized with Vegetation
40	33	Good
32	24	Fair
23	16	Poor
below 16		Do Not Plant

4 Guiding Principals

- Consider the Length of Open Water or Fetch
- Control Drainage
- Determine the Natural Angle of Repose
- Protect the Base of the Slope or Toe

#1 - Consider Length of Fetch





When vegetation alone just won't do…

#2 – Control Drainage

Both Overland Flow…

…and Subsurface Seeps

#3 –Natural Angle of Repose

Defined as the maximum slope at which loose solid material will remain in place <u>without</u> sliding and the slope remains stable…

…and the critical slope where <u>vegetation used alone</u> will provide long-term stabilization.

Modifying that angle <u>will require</u> some form of structural support.

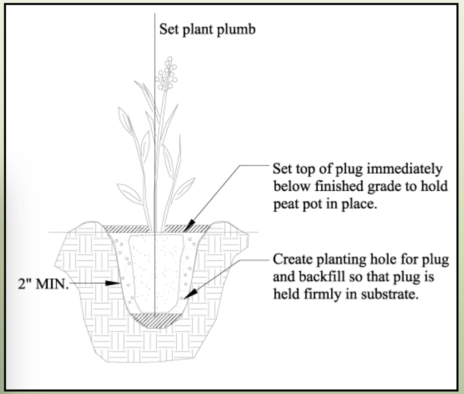
#4 – Toe Protection is Critical

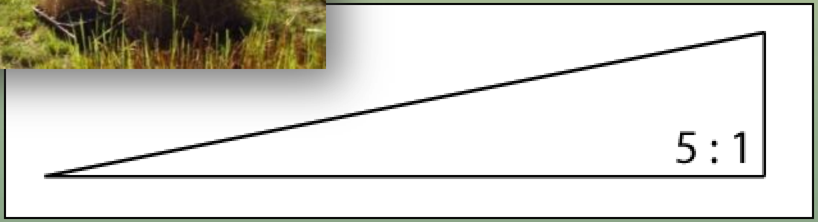
Choice of Treatment

1. **Plants as Primary Support**
   (5:1 and flat)
2. **Plants with Erosion Control**
   (5:1 to 3:1)
3. **Plants as Structural Support**
   (3:1 to 2:1)
4. **Plants with Additional Structural Support**
   (2:1 and steeper)

Plants as Primary Support

- 5:1 (horizontal: vertical) or flat ground
- Not seeded
- Low energy environment
- No concentrated surface flows (sheet flow only)





Planting Plugs

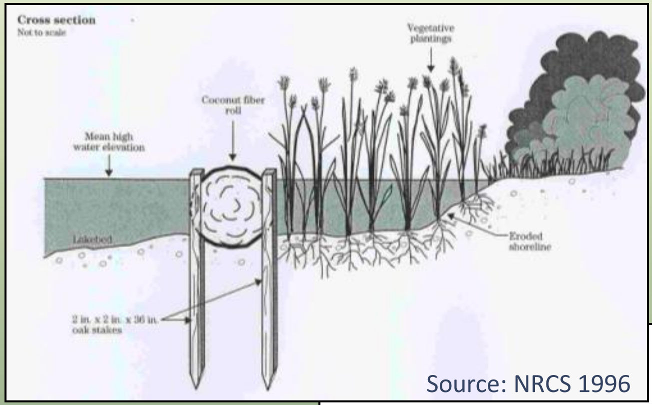
2 Years Later…

Plants With Erosion Control

- 5:1 to 3:1 (horizontal: vertical)
- Seeded
- Low energy environment
- Sheet flow only

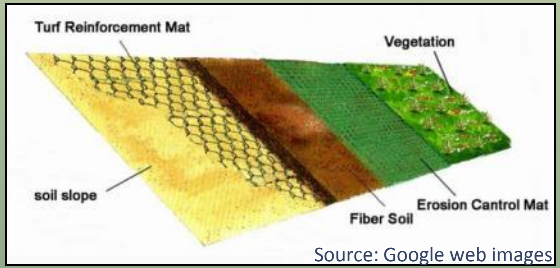
Erosion Control Blankets & Mats

Coir Pallets



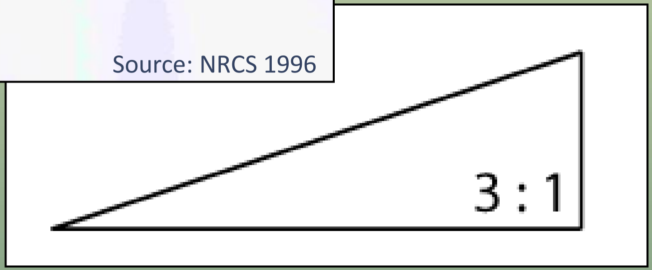
Source: NRCS 1996

Coir Logs



Source: Google web images

Hydro Mulching

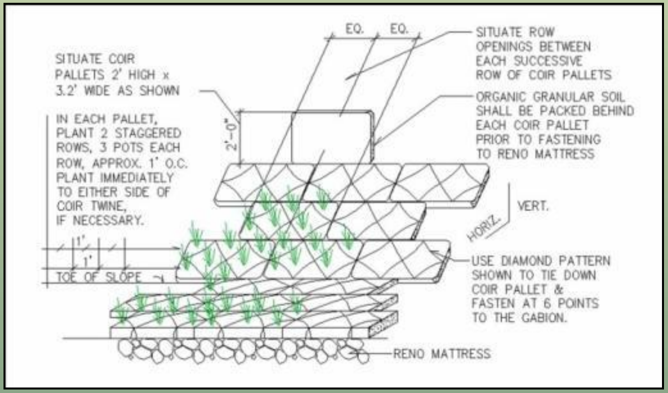


Erosion Control Mats

- Jute Netting
- Prefabricated Blankets
- Turf Reinforcement Mats (TRM)
- Biodegradable Vs. Permanent

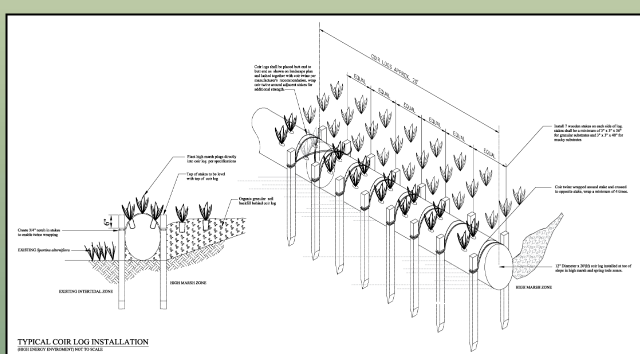
Coir Pallets

Steep Sided Channel & Fresh to Saline Conditions



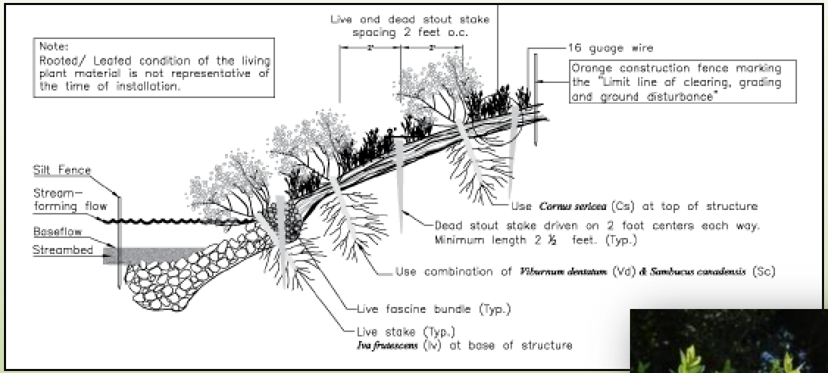
Coir Logs

Tidal and Streambank Application for Toe Protection and Benched Plantings



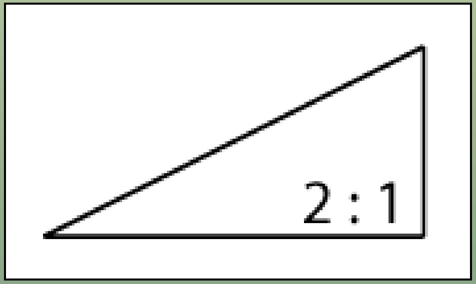
Plants as Structural Support

- 3:1 to 2:1 horizontal/ vertical
- Low to moderate energy environment
- Seeding may be included

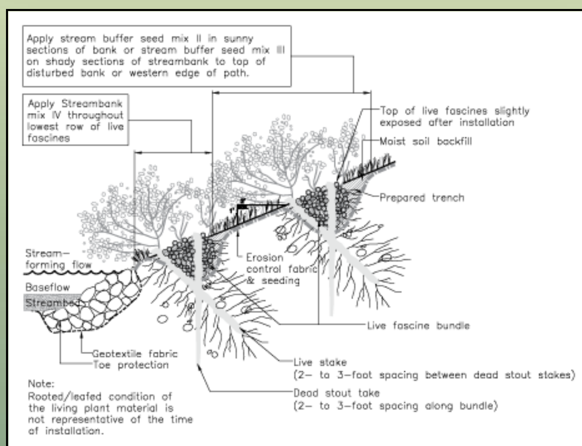


Brushmattress Installation

Live Stakes



Live Stakes & Fascines



Brushmattress

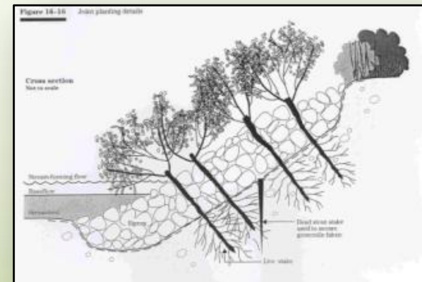
- Live Stakes
- Dead Stakes
- Fascine Bundles
- Galvanized Wire Webbing
- Seeds

Plants With Additional Structural Support

Live Crib Walls

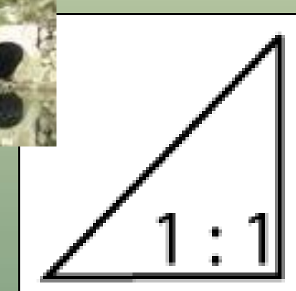
- 2:1 < Approaching Natural Angle of Repose
- Low to Moderate Energy Environments

(On steeper slopes & high energy environments structural stabilization MUST predominate)



Vegetated Rip Rap

Source:
Terra Erosion Control Ltd.

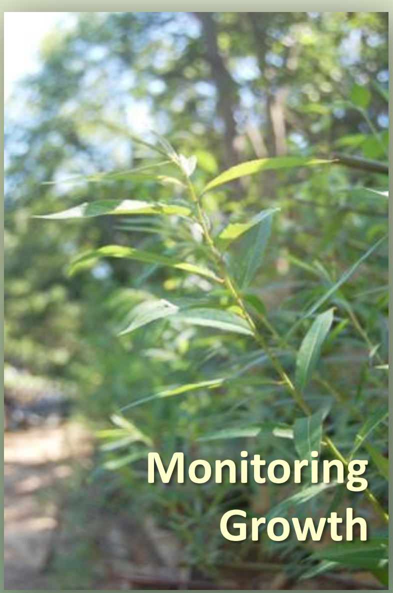


Live Crib Wall

Installation of Structure

Live Crib Wall

Post Construction



QUALITY CONTROL & QUALITY ASSURANCE

Build Into Contract:

- Professional Design Team
- Construction Observation
- Long Term Monitoring

Design Phase:

- Consider Long Term Performance Standards (85%-90% - If You Can't Meet It – Don't Propose It…)

Remember:

- Post Construction Monitoring Spans 2 to 5 Years (1 Year Guarantees May Not Be Adequate)

Case Study 1: Northern Captree Island

- Coir Logs
- Jute Netting
- Live Stakes
- Plug Plantings
- Seeding

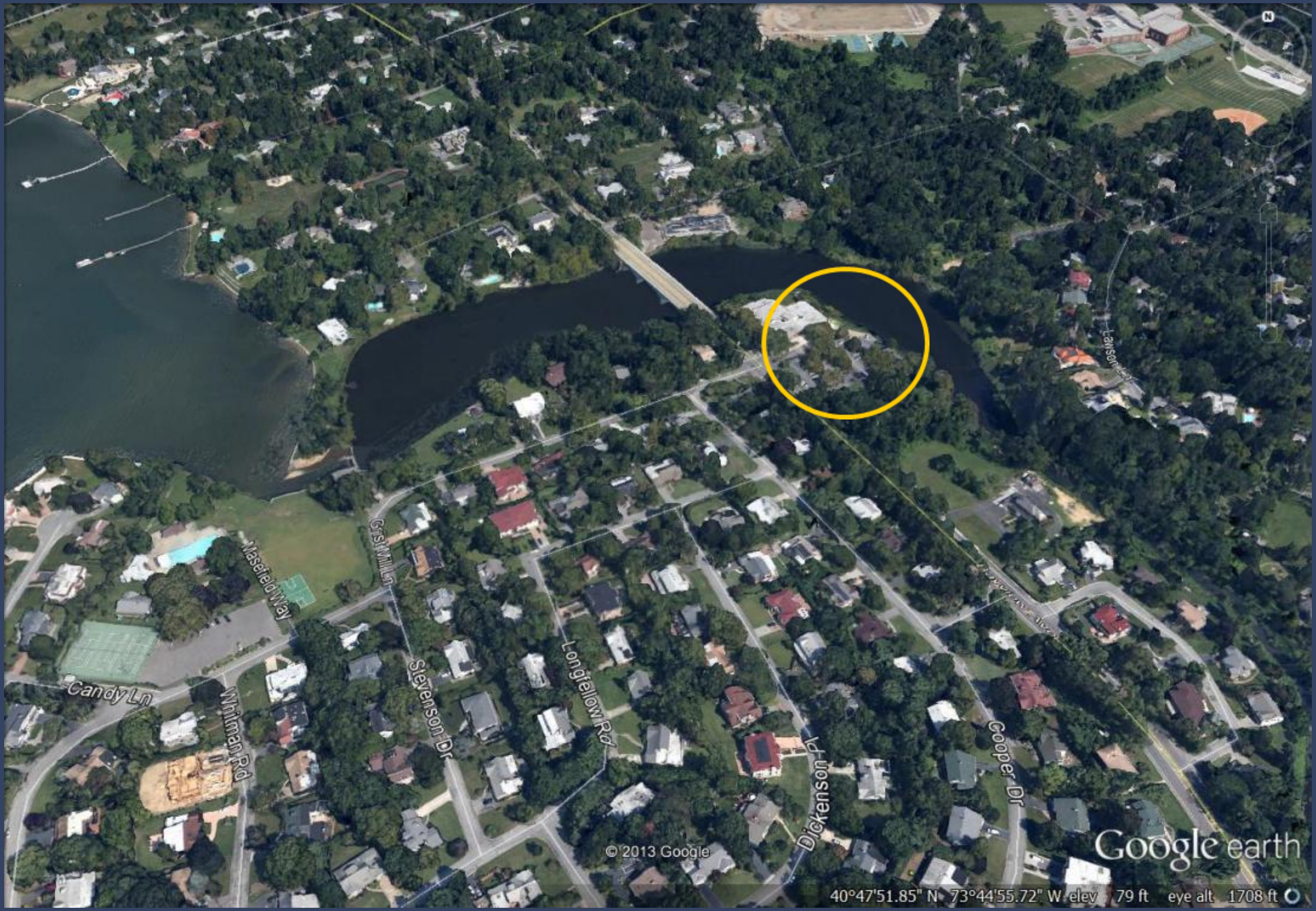
Early Vegetative Success

Post SANDY & Winter Storms

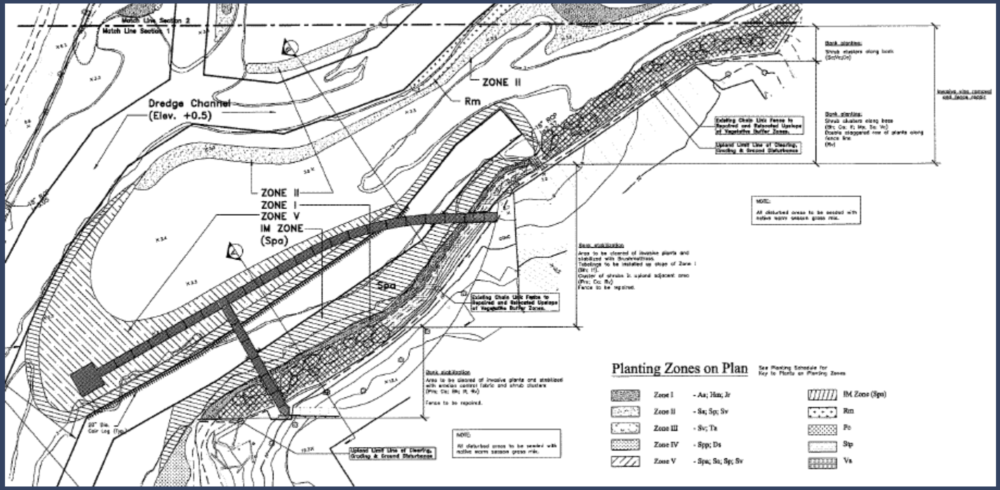
NEW SOLUTION?

Potential Composite Treatment With Toe & Slope Reinforcement

Case Study 2: Shoreline Stabilization
Udall's Mill Cove, Great Neck, NY



- Live Stakes
- Fascines
- Brushmattress



CONCLUSION

1. Key Design Considerations
2. 4 Guiding Principals
3. Approach Site Feasibility Analysis from Less to More
4. Integrate Plant Materials as Structural Elements & Permanent Cover
5. Monitoring is Essential to Success

…ANY QUESTIONS?

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Living Shorelines offer Sustainable Solutions, have Built-in Flexibility for Permanence and Support Biodiversity