

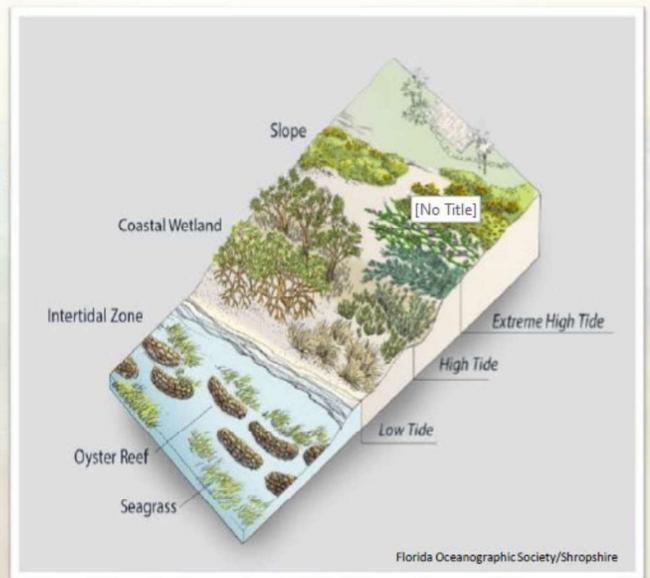
LIVING SHORELINES



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)."

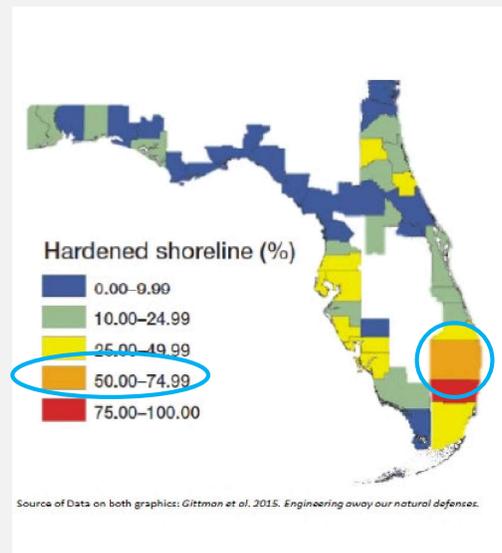
[National Oceanic and Atmospheric Administration](#)



WHAT IS SHORELINE ARMORING

Also known as hard infrastructure: seawalls, bulkheads, retaining walls placed to separate land and water interface for protection against erosion.

Approximately 14% of the US Coastline has been armored, with a much higher rate in Florida and Palm Beach County (50-75%)



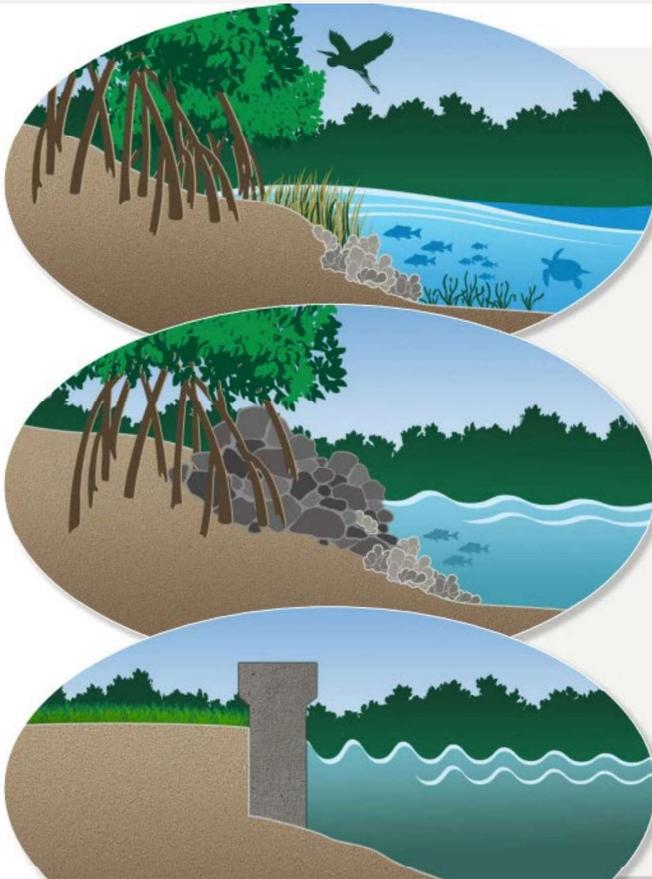
PROBLEMS WITH SHORELINE ARMORING

- **Armoring creates a fixed point in relation to rising sea levels and coastal flooding** The big one is resiliency. As sea levels rise and frequency of coastal flooding increases, the integrity of armored shorelines are increasingly under greater threat.
- **Loss of habitat due to an abrupt transition from shoreline to water** Loss of ecotone when a shoreline is bulkheaded. The intertidal zone is effectively the wall itself, with a much narrower band of habitat formation.
- **Seawalls will eventually fail – high cost to repair or replace** All seawalls will eventually fail, with erosion occurring behind and at the base. Hardened structures may also hasten erosion downdrift from its location, furthering more shoreline armoring.

Living Shorelines...



- Protect shorelines by improving stability and reducing erosion.
- Offer a less expensive, sustainable option to traditional seawalls if they are designed so components establish and thrive.
- Provide essential habitat for fish and other animals which promotes better fishing and ecotourism.
- Improve water clarity while filtering stormwater run off.
- Create feeding areas for wading birds.
- Encourage seagrass growth and reduce sediments in the water.



Shoreline Types

Methods to protect property from erosion have varied costs and benefits. On-site conditions may not always support a simple living shoreline, but all stabilization projects can be designed to maximize their benefit to the shoreline and local ecology.

Natural

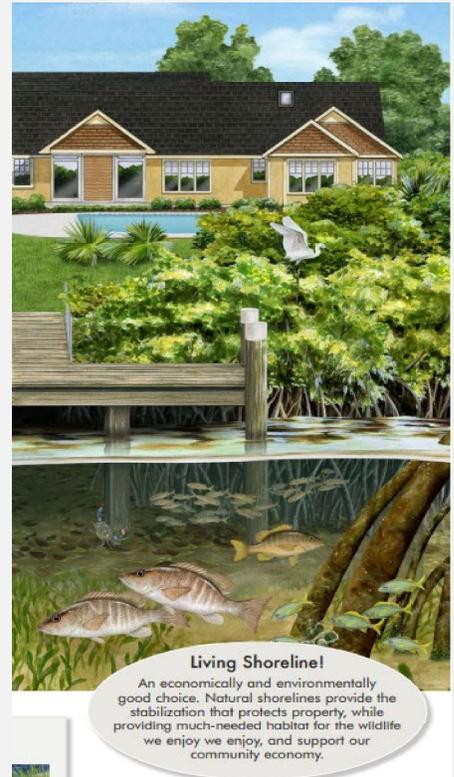
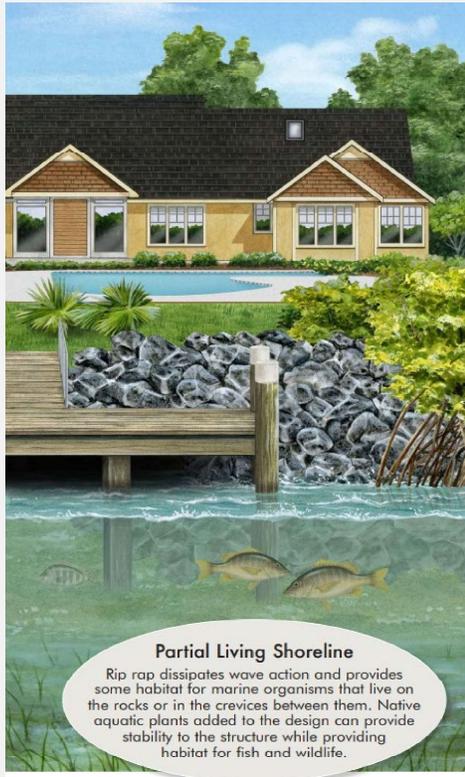
Natural shorelines include seagrasses and oysters that stabilize submerged sediments and reduce wave energy on the shoreline. At the water's edge, smooth cord grass and mangrove trees support a gradual slope. These living shorelines can be a cost-effective alternative to seawalls and rip rap when properly designed and located. Even existing seawalls can have a living shoreline component. Permitting for coastal protection may be easier if the proposed project allows a living shoreline to persist.

Rip Rap

Rip rap is a sloped barrier of rocks that absorbs wave action where moderate/high wave energy causes erosion. Natural limestone (coquina) is generally recommended because it supports native plant and animal species, slowly breaks down into sand/shell, and provides surfaces for oysters to live.

Seawalls

Seawalls are hardened structures of concrete, wood, or vinyl designed to reduce erosion of sediment exposed to moderate/high wave energy. Although upland soil is retained, sediment on the water side of the wall can be lost. These structures are expensive to build and maintain.



LIVING SHORELINES SUPPORT RESILIENT COMMUNITIES

Living shorelines use plants or other natural elements—sometimes in combination with harder shoreline structures—to stabilize estuarine coasts, bays, and tributaries.

- One square mile of salt marsh stores the carbon equivalent of 76,000 gal of gas annually.**
- Marshes trap sediments from tidal waters, allowing them to **grow in elevation** as sea level rises.
- Living shorelines improve **water quality**, provide **fisheries habitat**, increase **biodiversity**, and promote **recreation**.
- Marshes and oyster reefs act as natural **barriers** to waves. **15 ft** of marsh can **absorb 50%** of incoming wave energy.
- Living shorelines are **more resilient** against storms than bulkheads.
- 33%** of shorelines in the U.S. will be **hardened** by **2100**, decreasing fisheries habitat and biodiversity.
- Hard shoreline structures like **bulkheads** prevent natural marsh migration and may create seaward **erosion**.

The National Centers for Coastal Ocean Science | coastalscience.noaa.gov

Some graphics courtesy of the Information and Applications Network, University of Maryland Center for Environmental and Estuarine Science (Chesapeake Biological Laboratory).



Cost Comparison

Design, Permitting & Construction

	LIVING SHORELINE	SEAWALL
Shallow Water/Low Wake	\$85,000	\$130,000
Shallow Water/High Wake	\$105,000	\$155,000
Deep Water/Low Wake	\$155,000	\$165,000
Deep Water/High Wake	\$130,000	\$195,000

Estimates are based on 100 ft shoreline, 2018 costs rounded. Living shoreline costs do not include/require seawall replacement.

Unit Cost

	COST	UNIT
Turbidity Curtain	\$17	Linear Foot
Silt Fence	\$4	Linear Foot
Clearing & Grubbing	\$11,000	Acre
Native Estuarine/Upland Plantings	\$20	Each
Earthen Berm/Embankment Fill	\$36	Cubic Yard
Impervious Liner	\$125	Linear Foot
Geotextile	\$20	Linear Foot
Rip Rap (Rock sill)	\$300	Ton
Oyster Bags	\$3	Each
Seed/Sod	\$9	Square Foot
French Drain	\$160	Linear Foot
8" HDPE Pipe	\$150	Linear Foot
Check Valve	\$500	Each
Living Floating Dock	\$400	Square Foot
Precast Planter	\$5,000	Each
Concrete Seatwall	\$350	Linear Foot
Concrete Stairs	\$3,000	Each
Remove Seawall	\$150	Linear Foot
3 ft Stern Wall	\$350	Linear Foot
Precast Seawall with texture	\$800	Linear Foot
Glass Flood Wall	\$350	Linear Foot
Habitat Panels	\$40	Linear Foot
Annual Maintenance	5%	Lump Sum



- Design and Permitting Costs include survey, geotechnical analysis and biological assessment costs.

- Construction costs are based on RS Means Database and FDOT Index for Broward and Miami-Dade Counties.

- Prices include raising the crest elevation of the shoreline protection option to +5 feet NAVD 88 to account for sea level rise.

- Planting costs will vary depending on type, size and maturity.

- Maintenance of living shoreline and planting elements are lower cost, but more frequent in the first 2 years after installation. Then the maintenance is typical monthly/seasonal landscaping costs, so costs decrease with time.

- Maintenance of concrete structures is typically 3 or more years after installation. Maintenance is more extensive and higher cost to grind & fill cracks and spalled areas with epoxy and paint. Maintenance costs increase with time.



TEQUESTA CODE

- The Village does not currently have **ANY** regulations regarding bulkhead/seawall construction or the placement of fill waterward of property lines.
- It is difficult for the Building Department to regulate construction of bulkheads and seawalls without defined regulations.
- In 2015, the Town of Jupiter adopted new regulations that required some elements of living shorelines to be installed when bulkheads or revetments were replaced. The Jupiter Code **does not require anything to be done to existing** bulkheads, revetments, or natural shorelines. It simply requires mangroves or riprap to be installed during new projects.
- In 2019, the Village of North Palm Beach underwent an extensive re-write of its bulkhead and seawall code, with the assistance of a local Coastal Engineer (Alan Gerwig & Associates).



ISSUE #1: HARDENING SHORELINES

Conservation Element Policy: 2.11.8 Bulkheads and seawalls shall be permitted only to stabilize disturbed shorelines or to replace deteriorated existing bulkheads and seawalls. Riprap shall be placed at the toe of all replaced bulkheads and seawalls.

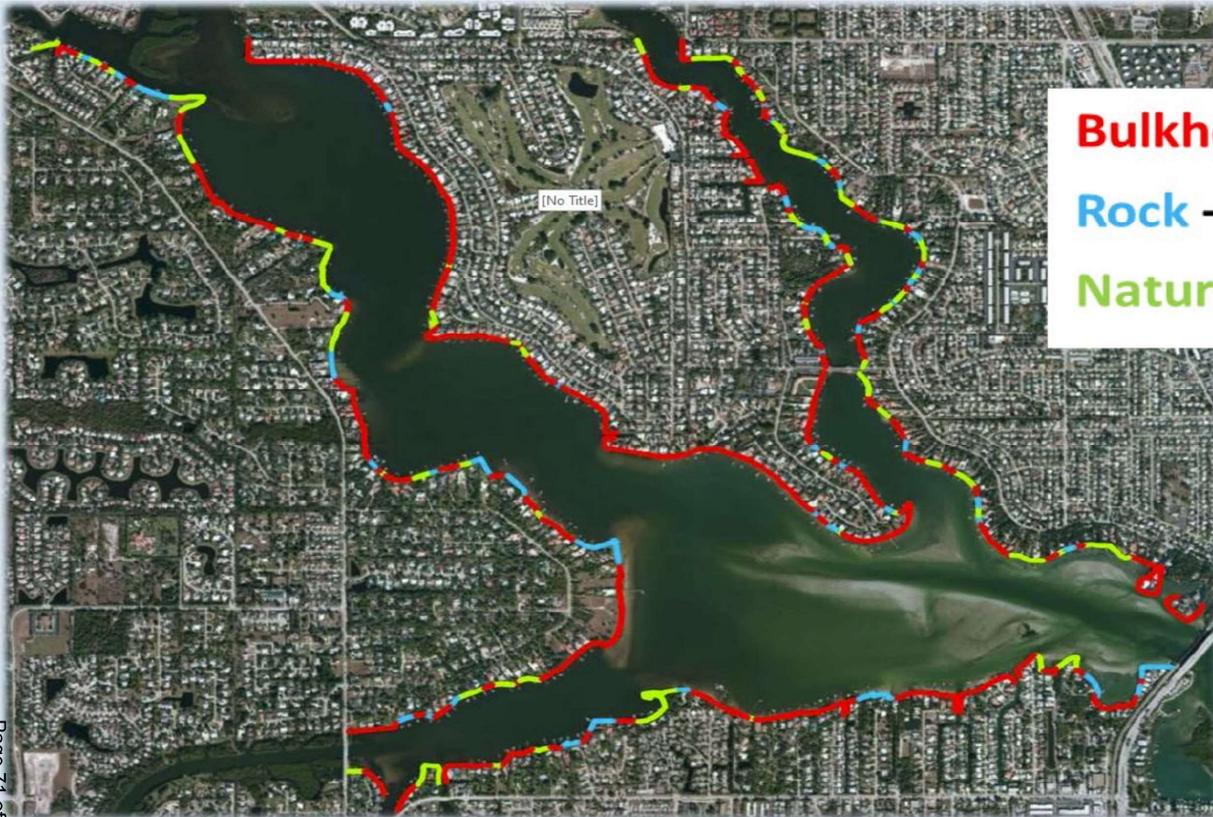
Coastal Management Policy: 6.1.7 The Village shall evaluate opportunities to protect coastal investments and infrastructure, as necessary and feasible, from the impacts of climate change. Specifically, the Village shall maintain shoreline protection and erosion control by:

- c) Considering hard structures, such as seawalls, only when alternative options are unavailable.

Draft Section 76.32 Bulkheads and seawalls shall be permitted only to stabilize disturbed shorelines or to replace deteriorated existing bulkheads and seawalls.

Draft 76.32 (6) In accordance with Comprehensive Plan Policy 2.11.8 of the Conservation Element, the Village encourages existing natural shorelines to remain in their natural state. Properties with natural shorelines shall attempt to utilize living shorelines techniques to stabilize the shoreline in lieu of armoring the shoreline with a bulkhead or seawall. Property owners with natural shorelines or riprap revetments that seek to armor a shoreline with a new bulkhead or seawall **shall apply to the Planning & Zoning Board for a Variance** as outlined in Section 76-7.

Page 0 of 124



Bulkhead – 65%
Rock – 14%
Natural – 21%

JID 2013 Shoreline Assessment

ISSUE #2: ESTABLISHING SEAWALL AND BULKHEAD SETBACKS

- Seawalls and bulkheads that are being repaired where the total cost is more than 50% of the replacement cost shall meet these new standards:
- New seawalls and bulkheads cannot be constructed beyond the rear property line, but an existing seawall may be reconstructed 18 inches waterside of the property line. Jupiter and North Palm Beach both allow replacement 18 inches waterside of the property line.
- Allowing bulkheads to be replaced waterside of the existing bulkhead is necessary because the existing bulkhead must remain during installation of new bulkhead.
- Seawall caps shall extend no further than three feet from the wet face of the bulkhead.

ISSUE #3: ESTABLISHING SEAWALL AND BULKHEAD HEIGHT

Intergovernmental Coordination Objective 1.7.0 Adopt and implement strategies which increase community resiliency and protect property, infrastructure, and cultural and natural resources from the impacts of sea level rise, changes in rainfall patterns, and extreme weather events.

Coastal Management Objective: 6.1.0 The Village shall consider investigating and adopt and implement appropriate and cost-effective strategies which increase community resiliency and protect property, infrastructure, and cultural and natural resources from the impacts of climate change, sea level rise, changes in rainfall patterns, and extreme weather events.

Coastal Management Policy: 6.1.1 The Village shall utilize best practices and initiate mitigation strategies to reduce the risk of flooding in coastal areas that may result from high tide events, storm surge, flash floods, stormwater runoff, and shall consider the related impacts of sea level rise. [Section 163.3178, F.S (Chapter 2015-69, Section 1)]



ISSUE #3: ESTABLISHING SEAWALL AND BULKHEAD HEIGHT

- In 2019, NPB staff and a coastal engineer (Alan Gerwig & Associates) evaluated king tide level data and sea-level rise projections by the South East Florida Climate Change Compact to establish appropriate minimum and maximum seawall heights.
- Properties in the X and X500 Flood Zones can have a minimum seawall cap elevation of 4 feet and a maximum seawall cap elevation of 6 inches above grade or 4.5 feet, whichever is higher.
- Properties in the Special Flood hazard area (AE Zone) can have a minimum seawall cap elevation of 4 feet and a maximum seawall cap elevation of 6 inches above grade or 5 feet, whichever is higher.

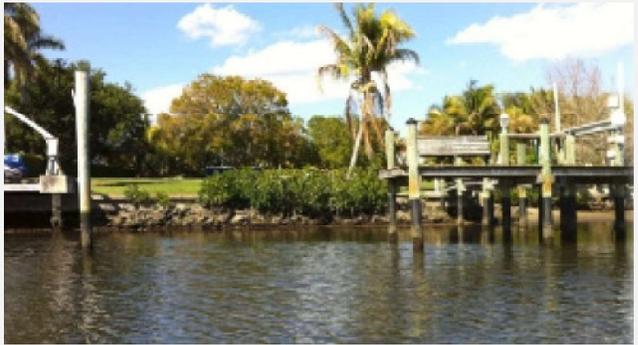


ISSUE #4 COMPATIBILITY BETWEEN PROPERTIES

- Seawall caps at an elevation greater than the adjacent property shall provide a wall return of the same material and type as the seawall cap.
- All areas of the seawall cap or retaining wall that are visible from adjacent property shall have a finished appearance equivalent to or better than painted concrete stucco.
- Seawall caps at a greater elevation of neighboring properties shall also provide a drainage plan that demonstrates there will be no sheet flow of water to the waterway and adjacent properties. The Building Official will review the plan to ensure there is no major erosion or degradation of adjacent property in these instances.



ISSUE #5: CREATING LIVING SHORELINES



ISSUE #5: CREATING LIVING SHORELINES

- Housing Element: Policy: 1.3.2 Continue to institute policies which minimize adverse environmental effects of residential development. Utilize those management practices which will alleviate residential water pollution problems. Special attention should be given to the environmentally sensitive areas abutting the Loxahatchee River, Intracoastal Waterway and the Atlantic Ocean.
- Coastal Management Objective: 1.1.0 Protect and enhance coastal and estuarine environmental quality and other natural resources by maintaining specific ordinances or revising existing code provisions related to water quality, shoreline stabilization, wetland preservation and wildlife and habitat protection.
- Coastal Management Element: Policy 1.1.1 The Village shall cooperate with agencies and municipalities serving to protect the resources of the Loxahatchee River and Indian River Lagoon Aquatic Preserve by actively participating in the development of estuarine policies that are consistent with present management.
- Coastal Management Objective: 1.2.0 The Village shall continue to provide for the protection of estuarine water quality and resources in its Code of Ordinances.



ISSUE #5: CREATING LIVING SHORELINES

- When a new bulkhead is constructed or when an existing one is replaced, 100% of the bulkhead or seawall shall be faced with riprap or mangroves (excluding dock or pier).
- Within 2 years of final inspection of a bulkhead, at least 10% of the shoreline shall be comprised of established mangroves.
- If after 2 years from the final inspection of a bulkhead, less than 10% is comprised of mangroves, then 20% shall be planted with mangroves.
- Properties designated on the shoreline exemption map (canals) are exempt from installing riprap or mangroves.
- Where riprap or mangroves will disturb seagrasses or when another jurisdictional agency (DEP, Army Corps, etc.) denies a permit, riprap or mangroves are not required.

TEQUESTA'S SHORELINE STABILIZATION EXCEPTION MAP DRAFT



ISSUE #6: REVETMENT'S

Existing revetments may be replaced with a new revetment according to the following regulations:

- 100% of the revetment shall be faced with riprap or mangroves when at least 50% of revetment is replaced
- An existing revetment with clean materials may remain and be reinforced with new riprap
- An existing revetment with unclean materials shall be removed prior to replacement.
- Properties on the shoreline exemption map are exempt from riprap or mangroves.
- Properties with existing revetments shall attempt to utilize living shorelines techniques to stabilize the shoreline in lieu of armoring the shoreline with a bulkhead or seawall. Property owners with riprap revetments that seek to armor a shoreline with a new bulkhead or seawall **shall apply to the Planning & Zoning Board for a Variance** as outlined in Section 76-7.



ISSUE #7 FILL PERMIT PROCESS

Conservation Policy: 2.11.9 No dredging or filling shall be permitted within mangrove and wetland areas or on seagrass beds in the Village unless project alternatives that would avoid mangrove, wetland and seagrass impacts are unavailable and sufficient mitigation is provided by the applicant to offset adverse impacts.

Coastal Management Policy 1.3.2 The Village shall preserve and protect existing sea grass areas as a vital food source for manatees and a nursery for estuarine species by prohibiting dredging and filling activities in or near these areas except where expressly provided for in the development of water-dependent land uses or where it is necessary for the general health, safety and welfare of the public.

Coastal Management Objective 4.1.0 Objective: 4.1.0 The Village will continue to prohibit the disturbance of the sensitive sea grass beds and productive mangrove and high marsh areas adjacent and within the Indian River Lagoon Aquatic Preserve, except when necessary for the continued health, safety and welfare of the public.

ISSUE #7 FILL PERMIT PROCESS

- The Village Code **does not** currently have a prohibition on dredging and filling on properties waterward of the property line.
- A Fill Permit process has been created in the draft code. It says:

No fill shall be made, deposited or maintained in the waters of the Loxahatchee River, Indian River Lagoon, canals, or other tidal waters within the corporate limits of the village, waterward or outward from any shoreline, in such a manner so that such fill shall extend beyond any property line.

-There is an exception to allow fill 18 inches waterward of property line, when a bulkhead extends 18 inches waterward, as proposed in the code.

-There is an exception to allow fill that is needed to construct, repair, or maintain living shorelines, mangroves, or riprap revetments that extend waterward of the property line. However, this has to be approved by the building official and community development director.

ISSUE #7 FILL PERMIT PROCESS

- The Village Council has to approve a fill permit.
- Public Notice is required, including letters to any neighbors within 300 feet.

The Village Council shall not grant any fill permit that would violate any statute, zoning law, ordinance or other applicable restriction. In determining whether to grant, grant with conditions or deny any fill permit application, the village council shall consider:

- (1) whether any harmful obstruction to or alteration of the natural flow of the adjacent navigable waters will arise from the proposed construction;
- (2) whether any harmful or increased erosion, shoaling of channels or stagnant areas of water will be created thereby; and
- (3) whether any material injury or monetary damage to adjoining land will accrue from the proposed activities. All fill permits are subject to approval by the trustees of the internal improvement fund of the state and by the U.S. Army Corps of Engineers, as applicable.

SEC. 76-7. - VARIANCES.

(a) Any person desiring a variance from the terms of this chapter shall make application for such variance to the planning and zoning board of the village in accordance with the procedures set forth in this section.

(b) In order to authorize any variance from the terms of this chapter, the planning and zoning board must find with respect to the proposed project as follows:

- (1) The variance being requested meets the definition of the term "variance" as that term is used and understood in [chapter 78](#), zoning.
- (2) No hazardous condition would be created.
- (3) The flow of water would not be impeded or interfered with.
- (4) No obstruction to navigation would occur.
- (5) It would not interfere with traditional public uses of the waterway including, but not limited to, swimming, fishing, or boating.
- (6) It would not create an appreciable obstruction of waterway views or otherwise detract from aesthetic values.
- (7) It would not appreciably disrupt, interfere with, or disturb marine or benthic life.
- (8) It would not contribute to the pollution of the waterway or the degradation of its condition.
- (9) It would not interfere with the lawful rights of riparian owners.
- (10) It would be consistent with any other applicable laws, rules or plans.

