Guiding Principles for Currently Defended Shorelines

Guiding Principles for All Currently Defended Shorelines

- **Reduce adverse impacts of shoreline hardening**
- **Remove severely degraded or derelict structures**
- **Replace failing structures according to surrounding ecosystem conditions**
- **Improve performance of poorly designed or installed structures**
- **Simplify shorelines with multiple structures to enhance ecosystem services**

Guiding Principles for Existing Bulkheads

- Remove and replace with gradual slopes and vegetation buffers in low energy settings
- Remove and replace with marsh sills and vegetation buffers in low/moderate energy settings
- Remove and replace with offshore breakwaters & sand beaches OR stone revetments in high energy settings
- Not appropriate on high-energy shorelines
- Most appropriate where navigation is restricted or where deep water is present for navigation purposes

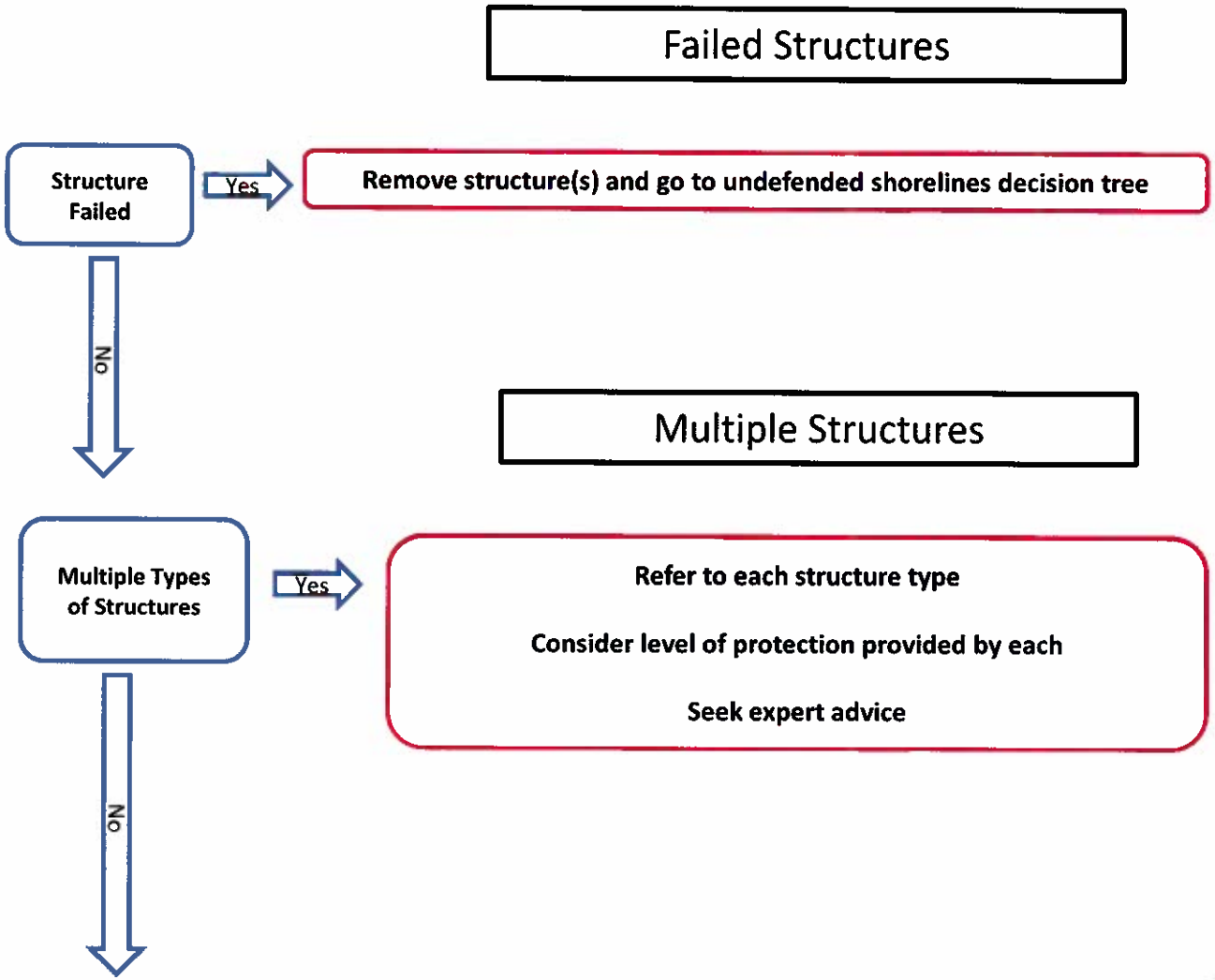
Guiding Principles for Existing Revetments

- Remove and replace with gradual slopes and vegetation buffers in low energy settings
- Remove and replace with marsh sills in low/moderate energy settings
- Remove and replace with offshore breakwaters in high energy settings with wide beaches
- Where these preferred approaches are not possible, maintain revetments with a minimized footprint according to design standards for shoreline setting

Guiding Principles for Existing Groins

- Maintain groin fields with historic wide sand beaches
- Remove and replace with another defense everywhere else
- Remove groins with revetment or bulkhead also present but no beach present
- Remove groins used solely for creating recreational beaches

Currently Defended Shorelines Decision Tree



Failed Structures

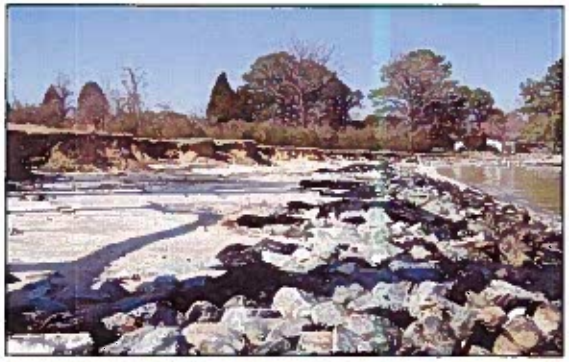
"**Failed**" structures have missing, broken or collapsed parts.
They are essentially ineffective and no longer serve their original purpose.

Failed Bulkheads

missing sheeting, damaged tieback systems, complete loss of backfill material, erosion and tidal inundation are now occurring behind the entire structure.

Failed Revetments

material scattered beyond original footprint, major erosion still occurring, no longer provide wave attenuation



Failed Groins

with separated sections and missing parts, highly permeable, cannot trap sand anymore, not connected to upland

Serviceable Structures

"**Serviceable**" structures are in relatively good condition or can easily be repaired. This condition includes a proper design for the location based on commonly accepted design standards.

Serviceable Bulkheads

retaining upland bank soil with no apparent structural problems; no erosion above, along toe (at shoreline level), or at the ends of bulkhead. Typically constructed with timber or vinyl sheeting with galvanized hardware.

Timber

Vinyl

Serviceable Revetments

properly sloped with spaces between stones to allow for wave energy dissipation; buried toe (excavated trench) and filter cloth under the stone to distribute weight evenly.

Serviceable Groins

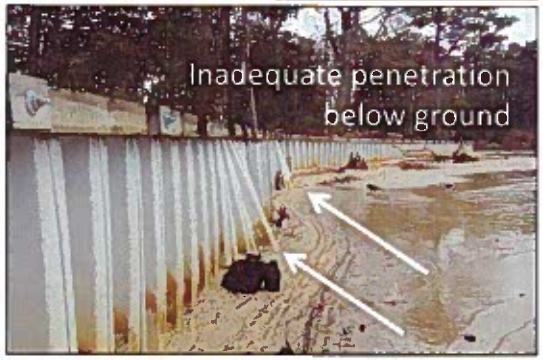
timber or stone intact along entire length; landward ends tie into upland; partial or complete burial under sand indicates they are effective

Failing or Flanked Structures

"**Failing**" structures have some evidence of deterioration or material degradation.
"**Flanked**" structures have erosion above or behind the structure due to material failure or erosion at the ends.

Failing or Flanked Bulkheads

loss of backfill (sinkholes) along top of bulkhead; bowed or leaning sections; rotting timber and/or pilings; missing sheetpiles; erosion is visible behind, above or around end(s) of bulkhead

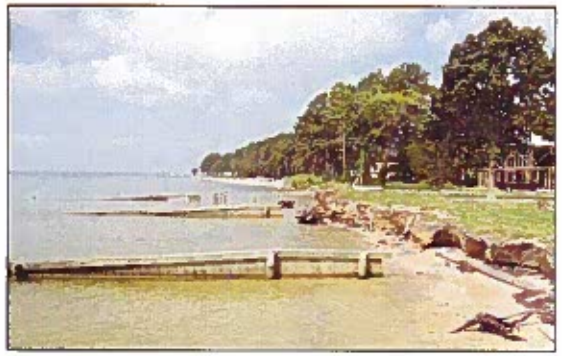


Failing or Flanked Revetments

slope is flattened, stone is scattered either at toe or above structure, stone is collapsing onto shoreline; erosion is visible behind, above or around end(s) of structure

Failing or Flanked Groins

rotting timber or pilings, loss of beach sand (sinkholes) next to groin; bank erosion landward from groins



VIMS – CCRM Coastal Management Decision Tools

Currently Defended Shorelines - Definitions

Defense Types	
Bulkhead	A vertical structure that acts as a retaining wall usually constructed parallel to a shoreline.
Revetment	A sloped structure constructed with large, heavy stone or other material (riprap) placed against the upland bank for erosion protection. The size of a revetment should be dictated by the wave height expected to strike the shoreline.
Bulkhead toe revetment	A sloped stone structure placed on the channelward side of a bulkhead.
Miscellaneous debris	Concrete rubble, old bricks, or demolition debris used as substitute for quarry stone in revetment structures.
Groins	Structures placed perpendicular to the shoreline to capture material moving in the littoral zone and to accumulate sand along the shoreline. The sandy beach provides the desired erosion protection.
Groin Field	A series of several groins built parallel to each other along a beach shoreline.
Marsh sill	A low revetment placed offshore from an existing marsh, or in conjunction with placement of sand to expand an existing marsh or create a marsh where it does not occur naturally.
Offshore breakwater(s)	Series of large rock structures placed offshore to maintain a beach; where no beach or only a narrow beach exists, beach nourishment should be included.
Unconventional defense structures	Unique materials not commonly used or without established performance record, including but not limited to pre-cast concrete, well-casing groins, gabion baskets filled with stone, reef balls, oyster castles, "Sea-Bees", dry-stacked block walls, other engineered walls.
Multiple Structures	More than one type of structure present at same location, e.g. revetment or bulkhead and groins, revetment and offshore breakwater.
Integrated vegetation buffers	Create or enhance wetland and riparian buffer vegetation along gradient from mid-tide landward to upland area; allow native vegetation to grow without frequent mowing or add new wetland and riparian buffer vegetation, e.g. trees, shrubs, deep-rooted grasses, perennials, and ground covers. May require bank grading. Replace waterfront lawn with ornamental grasses, native shrubs and small trees.
Defense Structure Condition	
Structural Integrity	The physical condition of a defense structure.
Serviceable / No erosion	Structure is undamaged and easy to repair; no erosion above, along toe or at ends of structure; of sound structural integrity.
Failing	Structure is losing integrity; structure shows signs of normal wear and tear. Bulkheads: leaning, biodegradation, rotting timber, heavy cover of fouling organisms (barnacles, oysters or algae); loss of backfill (sinkholes) along top of bulkhead, missing sheet piles. Revetments: slope is flat, stones are scattered above or channelward from original footprint, filter cloth is exposed.
Flanked	Erosion is visible behind, above or around end(s) of structure.
Failed	Structure is ineffective and no longer serves original purpose; structure has missing, broken or collapsed parts; also Dilapidated, Derelict

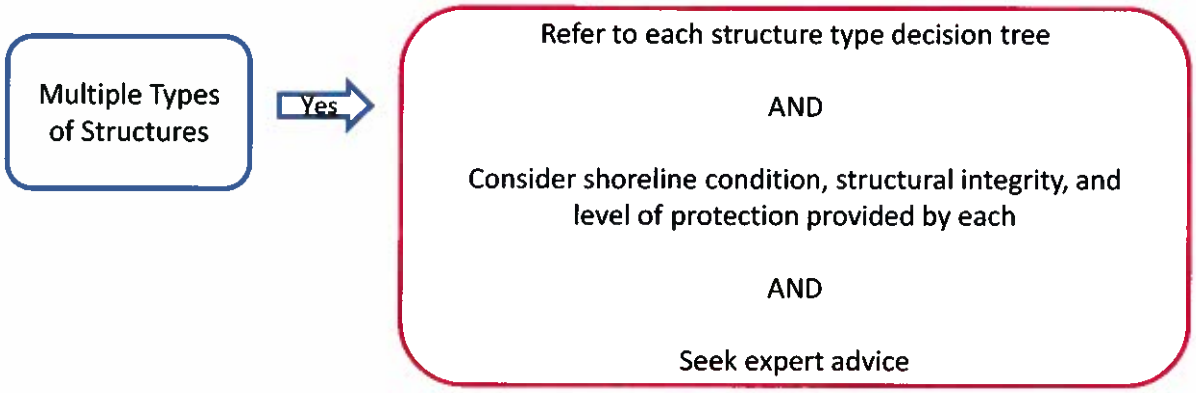
VIMS – CCRM Coastal Management Decision Tools

Currently Defended Shorelines - Definitions

Shoreline Conditions	
Energy/Risk Level	Combination of expected wave energy and threat to property, human health and safety; includes erosion risk and proximity of primary and accessory structures **Low** –narrow fetch generally less than 0.5 mile, upper reaches of tidal creeks, tidal coves, limited navigation by motorized boats, no primary or secondary improvements in close proximity to shoreline, and/or minor erosion. **Moderate** – fetch generally between ½-2 miles, some motorized boat traffic and boat wakes, primary or secondary improvements near shoreline, and/or active erosion. **High** – fetch generally greater than 2 miles, major tributaries, open bays, Bayfront, numerous motorized boats and boat wakes that strike shore, and/or primary or secondary improvements in very close proximity to shoreline, and/or significant storm erosion.
Beach present	Shoreline type dominated by loose, unconsolidated sand. **Wide beach** - generally includes area above Mean High Water elevation and higher than regular tidal action.
Beach potential	Shallow nearshore water depth and gradual intertidal slope is present where a created beach could be placed for sand buffer and offshore breakwaters.
Shoreline length	Length of shoreline currently defended or potentially defended, may include single or multiple parcels along reach with similar shoreline conditions.
Nearshore water depth	The vertical distance between the water surface and the submerged bottom usually referenced in feet below the mean low water elevation (e.g. – 2 ft MLW). **Shallow** - at 30 ft. channelward from MLW, water depth is $\leq$ 3 ft. **Deep** - at 30 ft. channelward from MLW, water depth is > 3 ft.
Navigation condition	Waterway depth and width allowances, presence or absence of motorized boats, natural or dredged channel. **Navigation limited** refers to restricted channels, canals, boat basins, and/or mooring areas that limit ability to put a defense structure further channelward.
Other Actions & Terms	
Inspect and maintain	Periodically check condition and repair existing structure in current footprint.
Modify upland land use	Reduce risk by changing location or elevation of upland structures and improvements, e.g. house moving, house raising, driveway relocation, hook up to public sewer; may include variance requests for setbacks, other zoning restrictions.
Grade bank	Reduce the steepness of a slope to allow for wave run-up and to improve vegetation growing conditions; ability to grade may be limited by upland structures or dense vegetation providing desirable ecosystem services.
Beach nourishment	Placement of good quality sand along a beach shoreline to increase the beach width and raise the elevation of the nearshore area.
Landward	Location toward upland.
Channelward	Location toward water.

VIMS-CCRM Decision Tree For Currently Defended Shorelines

Multiple Structures



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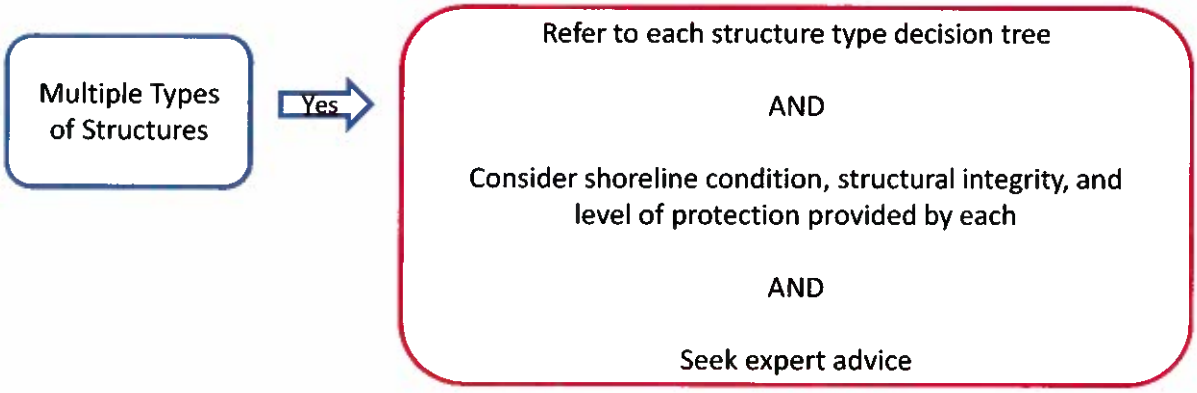

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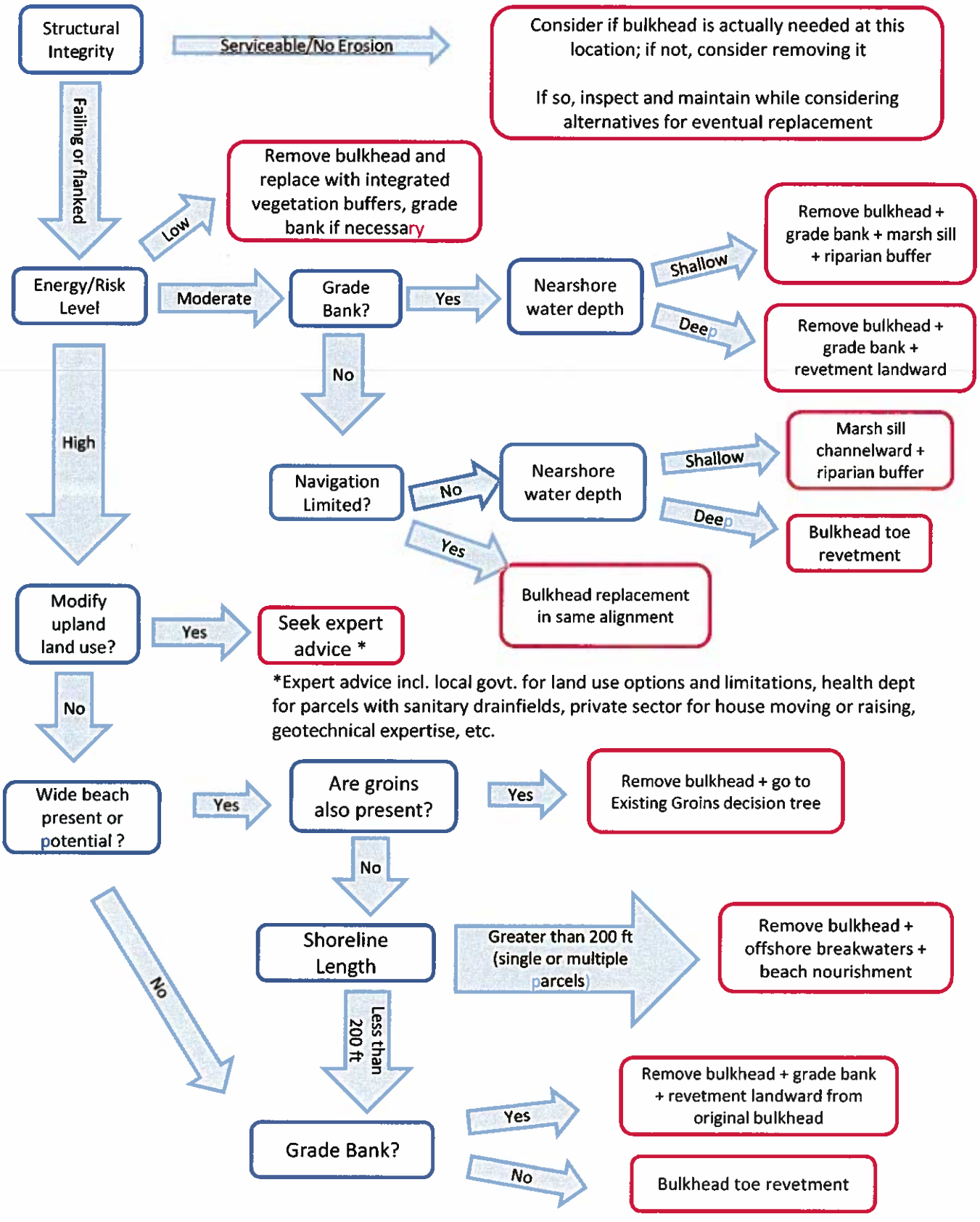
Existing Bulkheads



*Expert advice incl. local govt. for land use options and limitations, health dept for parcels with sanitary drainfields, private sector for house moving or raising, geotechnical expertise, etc.

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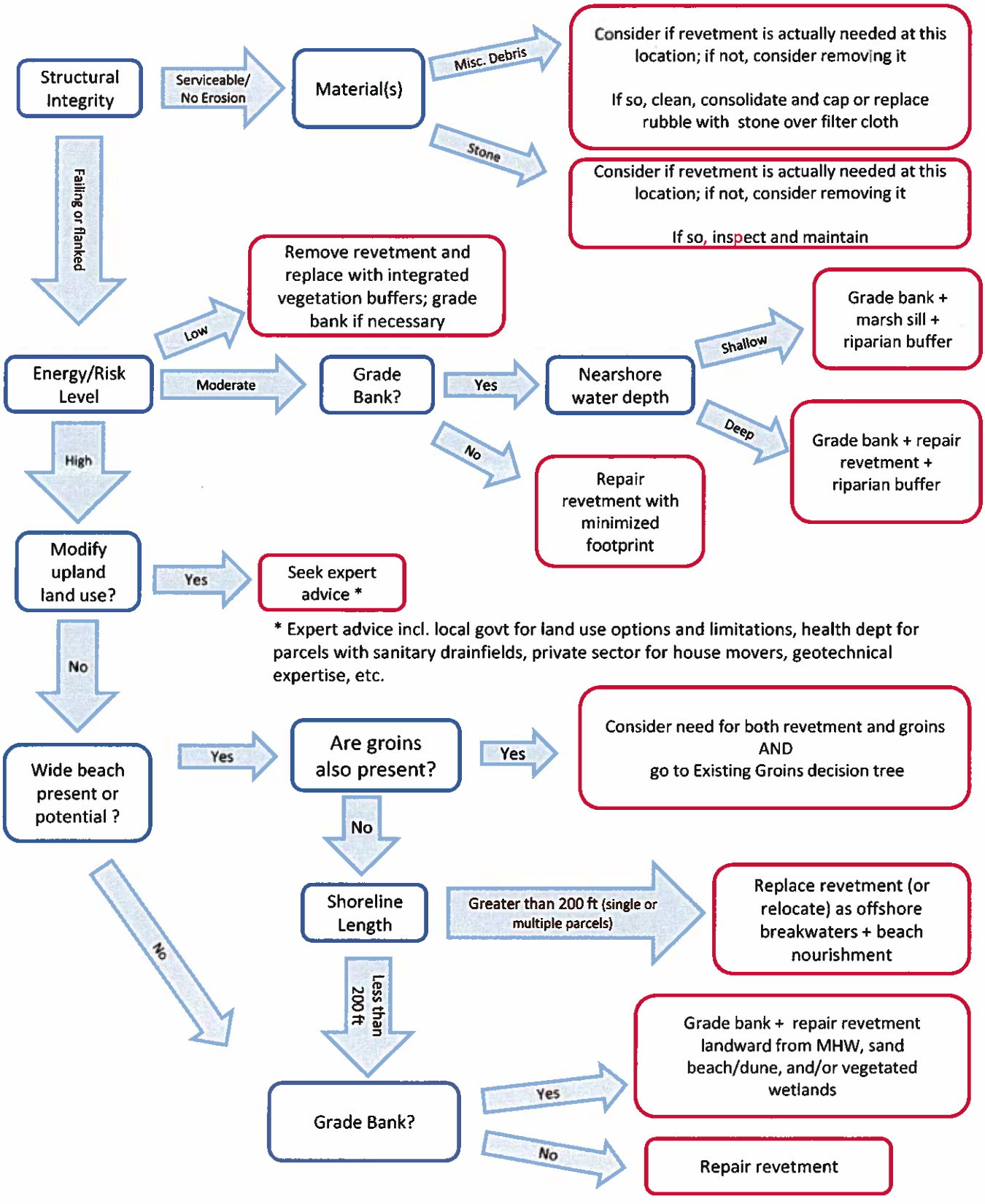
Existing Revetments



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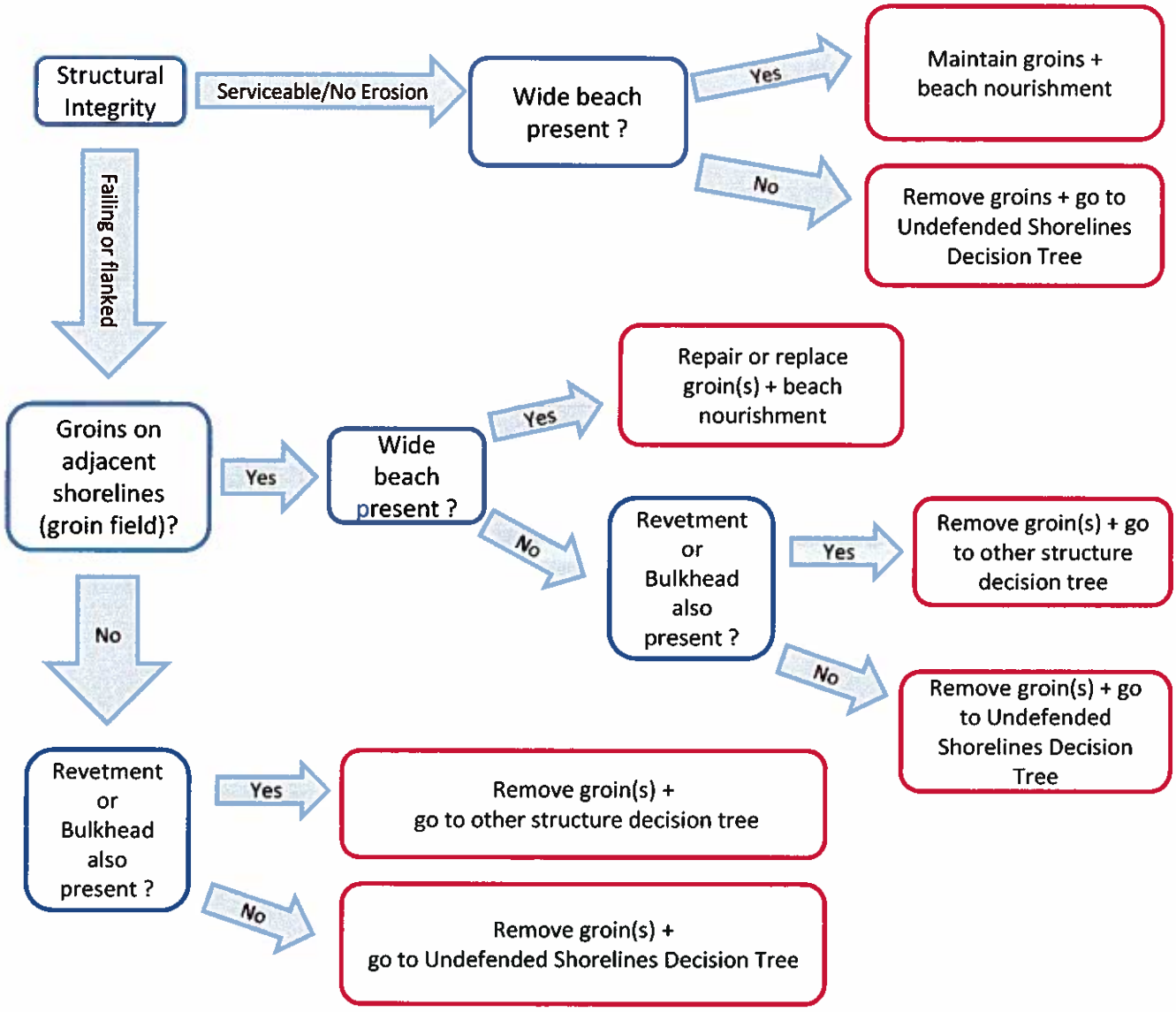
Existing Groins



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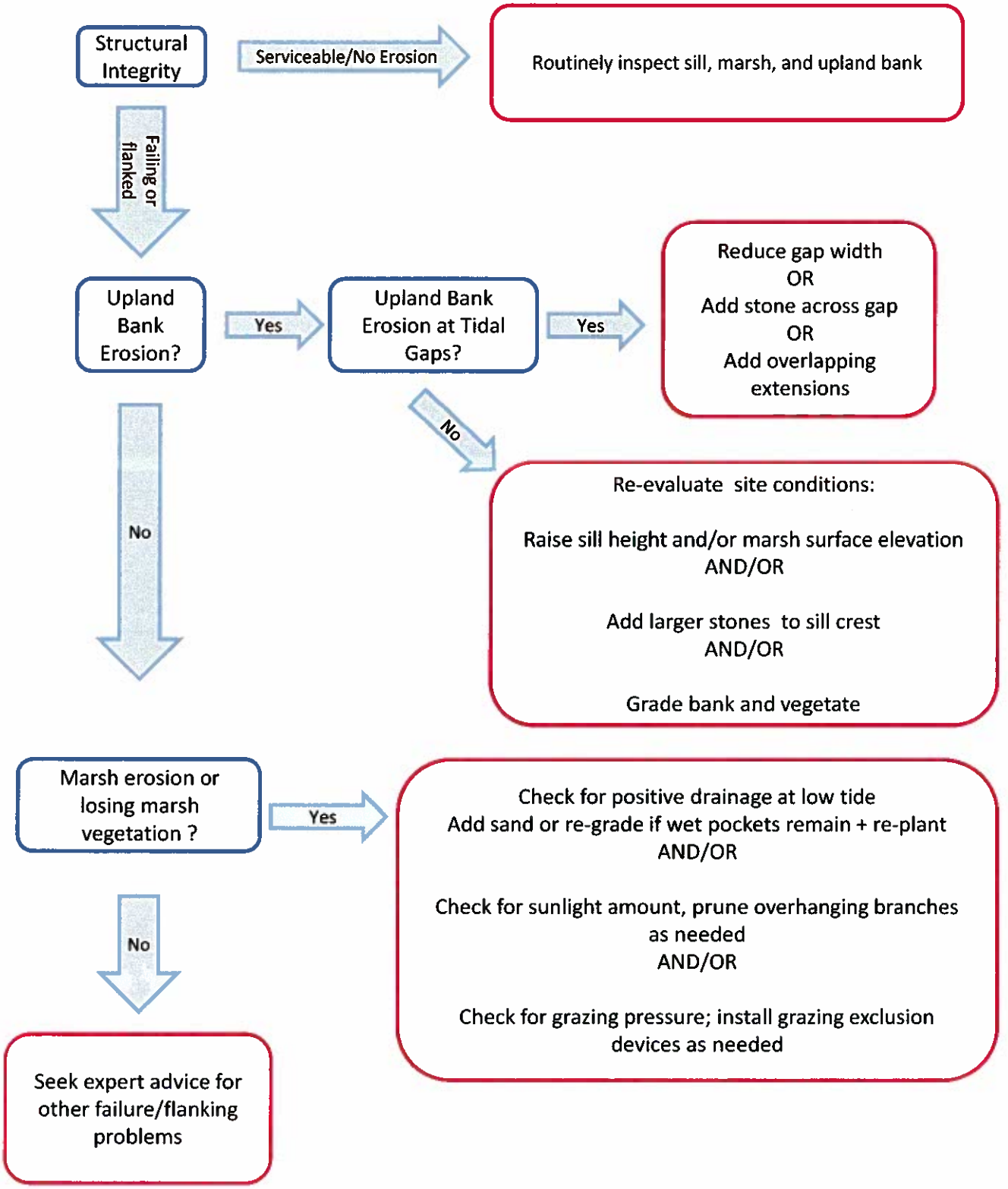
Existing Marsh Sill



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Existing Offshore Breakwaters