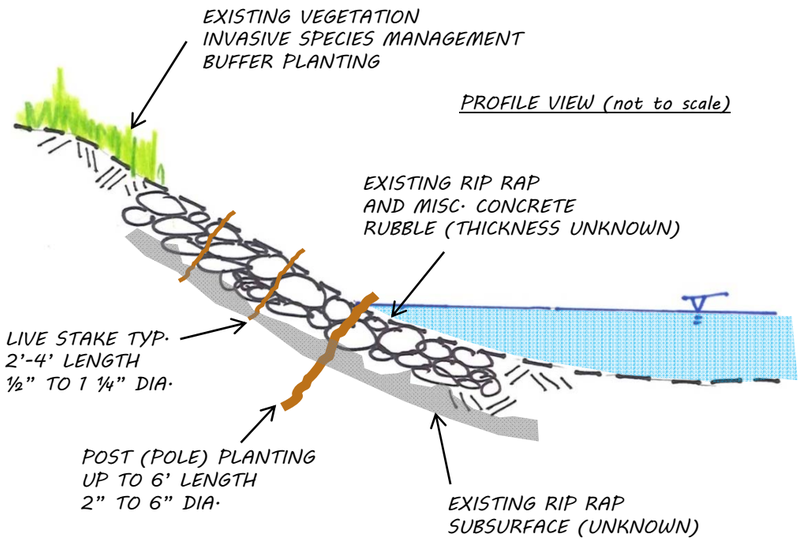
FOCUSED FEASIBILITY STUDY REPORT
FOR
40TH AVENUE PROJECT AREA
IN THE ST. LOUIS RIVER AREA OF CONCERN

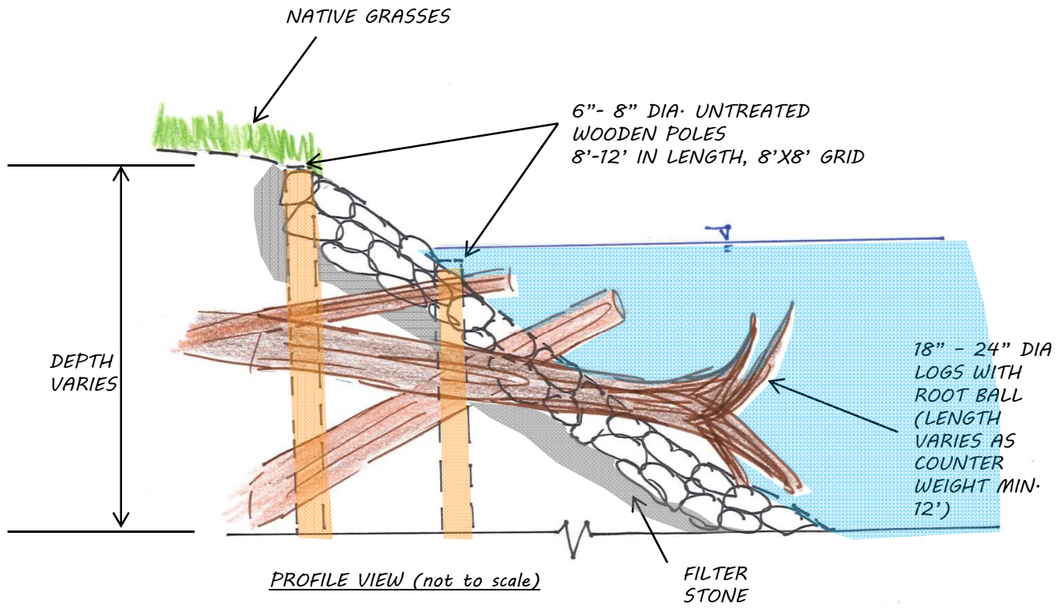
August 28, 2015

APPENDIX M. SHORELINE SOFTENING – AQUATIC HABITAT ENHANCEMENTS

Presented in this Appendix are proposed design elements that were suggested or discussed with members of the Site Team to further enhance the project area. These elements include techniques for naturalizing shorelines and increasing in-water habitat. It is yet to be determined if these additional elements are required to address the needs of the Area of Concern and to meet BUI removal requirements. That said the concepts may be implemented with future projects.

Rip-Rap Shoreline Enhancement





OBJECTIVE

- Provide shoreline stability and naturalized shoreline cover with minimal disturbance

MATERIALS/INSTALLATION

- Rip rap thickness criteria for joint planting
  - live stakes < 18" thick,
  - post (pole) planting 18" – 36" thick,
  - rip rap material > 36" must be reduced/removed
- Live stakes are 2'–4' in length, ½" to 1 ¼" diameter (willow or dogwood sp.)
  - installation is by hand using hydraulic, mechanical or manual methods
- Pole plantings are typically 4' – 6' in length, 2"- 6" diameter
  - mechanical installation is required
- Large woody material includes:
  - logs, 12'- 15' in length, 12"- 24" dia., with or without root balls
  - Untreated wooden poles, 8' -12' length, 6"- 8" diameter

BENEFITS

- Removed rip rap and misc. concrete can be re-used in other proposed features (islands, fish cribs)
- Provides near-shore habitat for fish (all life stages), herpitiles, amphibians and birds
- Low cost

PHOTO - RIP RAP ALONG EAST SIDE OF ERIE PIER

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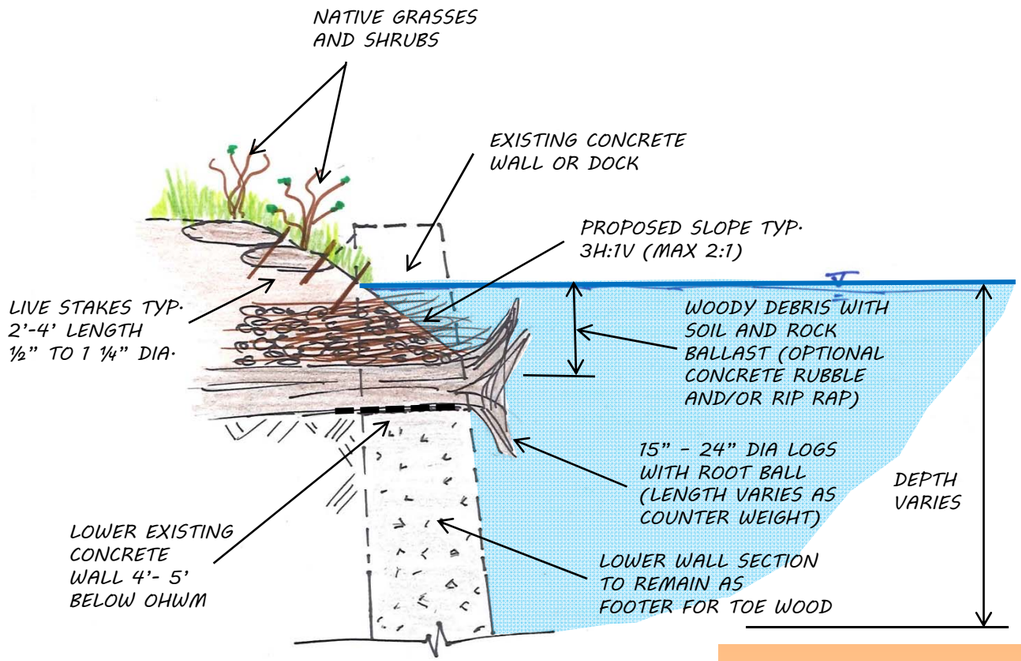
Client/Project

Appendix M - Figure 1
Title

Project No. | Scale

Drawing No. | Sheet | Revision

Concrete / Dock Enhancement



PROFILE VIEW (not to scale)

PHOTO - TOE WOOD W/ TRANSPLANTS

PHOTO - EXISTING CONCRETE DOCK (NEW PAGE)

OBJECTIVE

- Provide shoreline stability and naturalized shoreline cover

MATERIALS/INSTALLATION

- Removal of existing concrete structure to 4' – 5' below OHWM
- Remaining wall provides footing for toe wood
- Toe Wood materials
  - Logs 15'- 20' length, 18" – 24" dia. w/ root ball
  - Woody debris – ½" – 3" limbs, branches and tops (mix of conifer and hardwoods)
  - Ballast rock - reclaimed rip rap and/or concrete rubble from demolition
  - Transplants from adjacent vegetation

BENEFITS

- Lower cost vs. complete wall removal
- Provides near-shore habitat for fish (all life stages), herpitiles, amphibians and birds
- Minimizes disturbance of existing soils
- Construction can be done from shore or water

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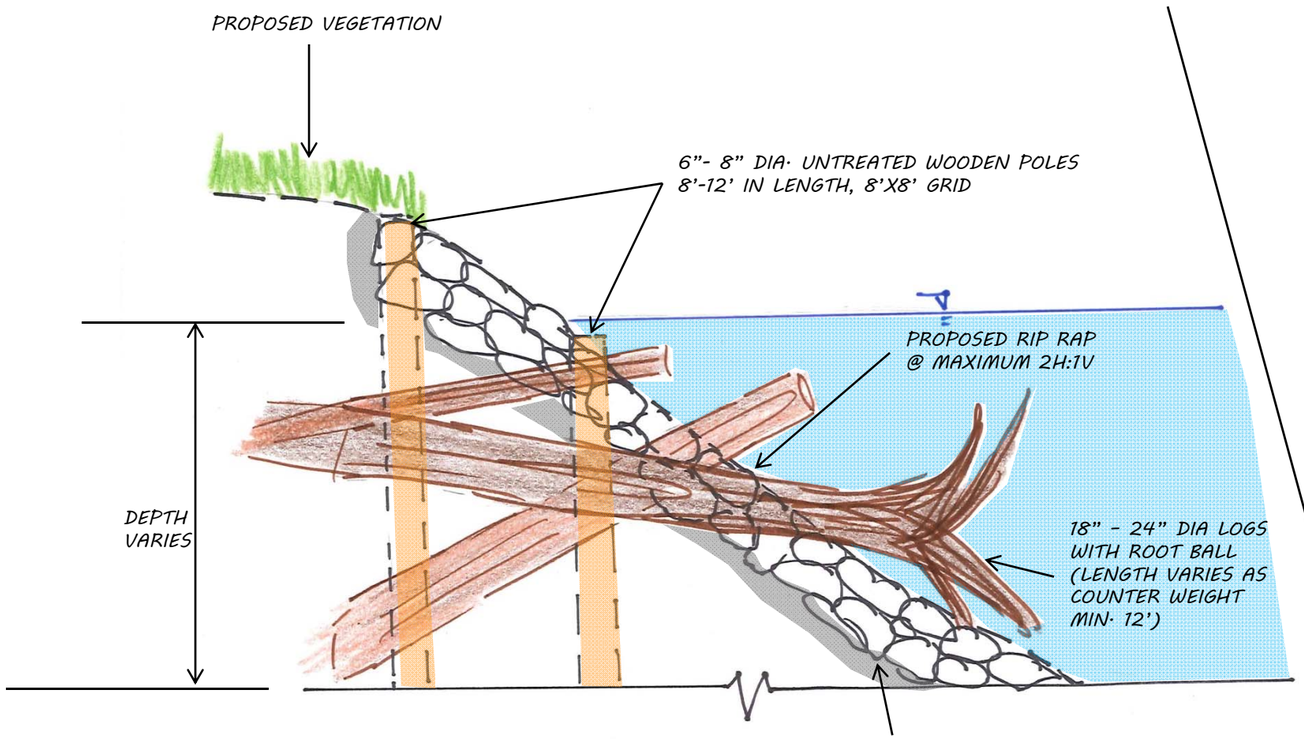
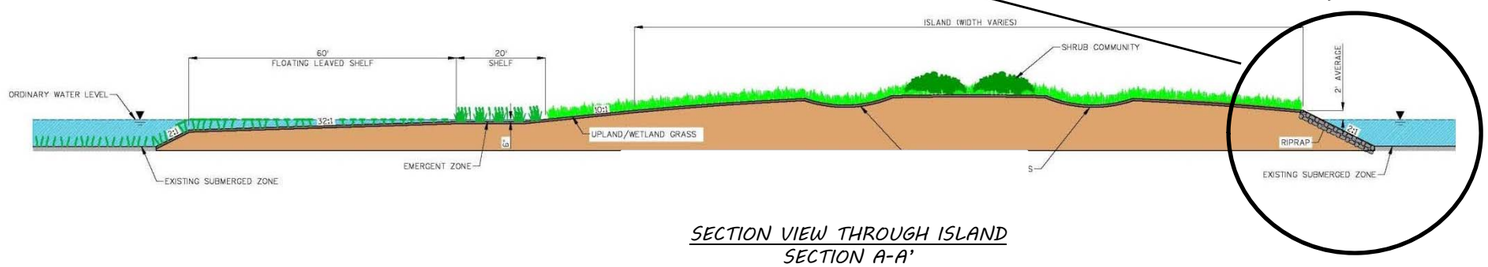
Barrier Island Shoreline Enhancement



PROFILE VIEW (not to scale)



SECTION VIEW THROUGH ISLAND
SECTION A-A'

- Provides immediate shoreline stability and habitat
- Poles and logs provide a framework for the rip rap and fill on large installations
- Woody material includes:
  - logs, 12'- 15' in length, 12"- 24" dia., with or without root balls
  - Untreated wooden poles, 8' -12' length, 6"- 8" diameter
- Wood matrix increases stability of slopes subject to non-fluvial forces including wave action and water height fluctuation
- Woody material can reduce the thickness of rip rap lowering project costs

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Appendix M - Figure 3
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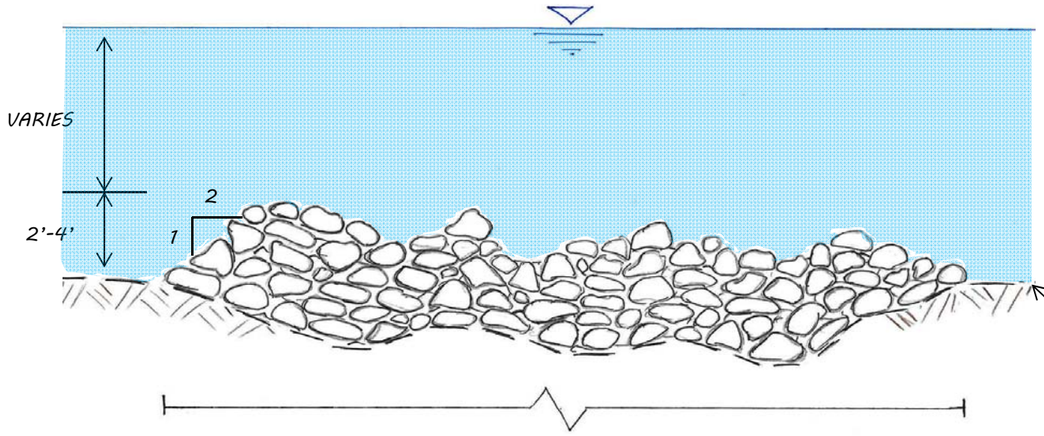
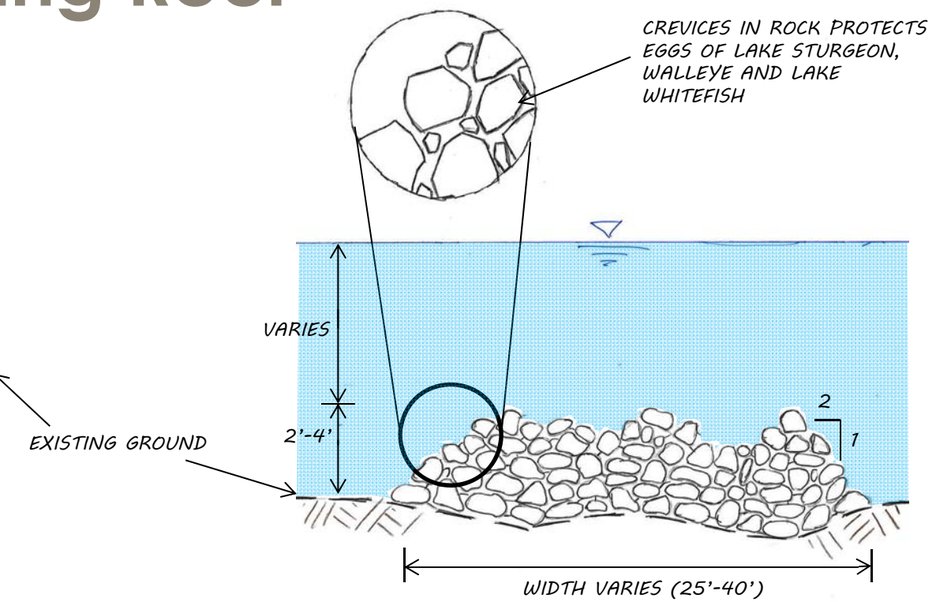
Mid-Lake Feeding and Rearing Reef



PROFILE VIEW (not to scale)



CROSS SECTION (not to scale)

OBJECTIVE

- Provide mid-lake and deep water lake bed habitat

MATERIALS/INSTALLATION

- Structure is comprised of rip rap (angular blast rock)
- Reef material mix:
  - 60% 4"- 8" diameter
  - 30% 8"-14" diameter
  - 10% smaller and/or larger stones
- Rock is applied 2'-4' thick
- Reef width between 25'-40' typically and 100' to 700' long
- Reef can be installed at various depths below OHWM
- Reef constructed from reclaimed on-site rip rap supplemented, if necessary, by off-site material

BENEFITS

- Use of reclaimed materials from site reduces cost
- Increased spawning and feeding habitat for various fish species
- Increased primary and secondary production (algae, phytoplankton, zooplankton and forage fish)

PHOTO - RIP RAP FEEDING AND REARING REEF

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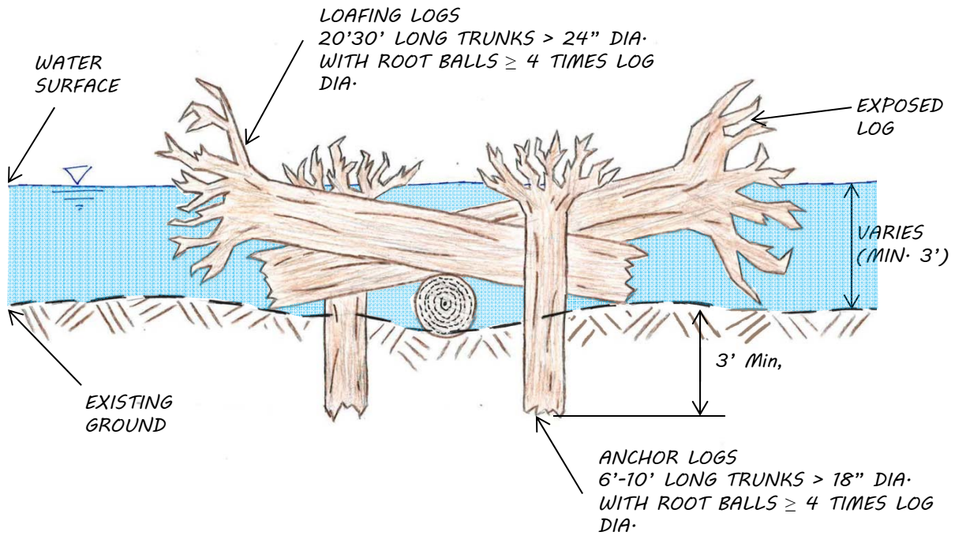
Appendix M - Figure 4

Title

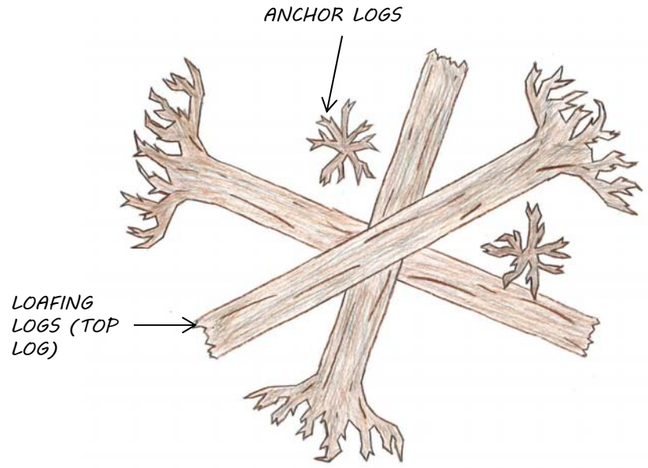
Project No. | Scale

Drawing No. | Sheet | Revision

Cross Log Habitat Structure



PROFILE VIEW (not to scale)



PLAN VIEW (not to scale)

OBJECTIVE

- Provide shallow water and loafing habitat in wetlands and near-shore areas

MATERIALS/INSTALLATION

- Cross logs consist of a minimum of three logs, 24" dia., 20'-30' long, with root balls ≥ 4 times log dia., placed horizontally
- Anchor logs are typically 12"- 18" dia., 6'-10' long, with root ball ≥ 4 times log dia., placed in the gaps of horizontally placed logs, with a minimum of two anchor logs per structure
- Cross log structures are placed in areas protected from wave action
- Structure installed using barge crane or floating excavator

BENEFITS

- Low cost structure
- Provides near-shore and shallow water lake/wetland habitat for fish (all life stages), herpitiles, amphibians and birds
- Provides waterfowl nesting habitat

PHOTO - CROSS LOG STRUCTURE

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Appendix M - Figure 5
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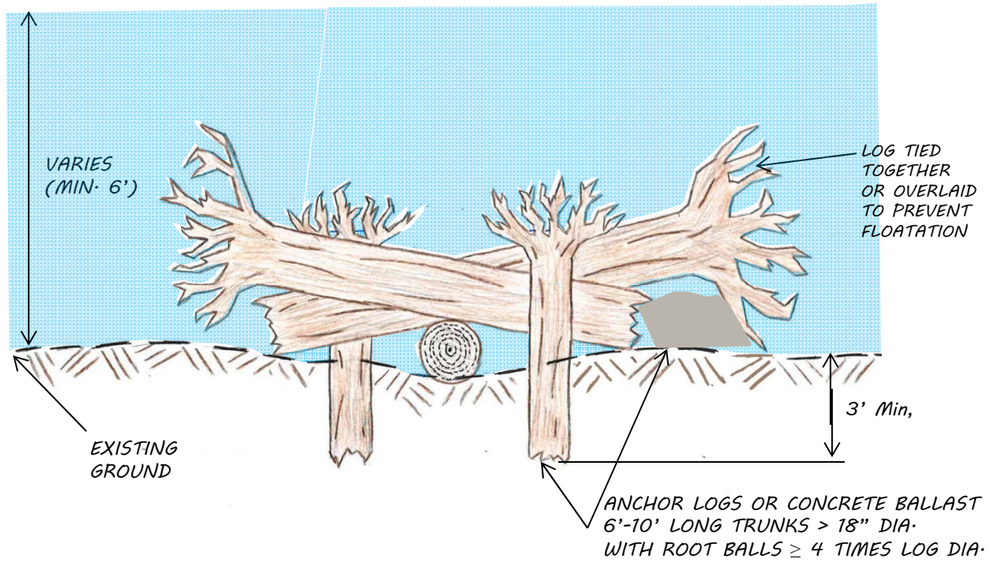
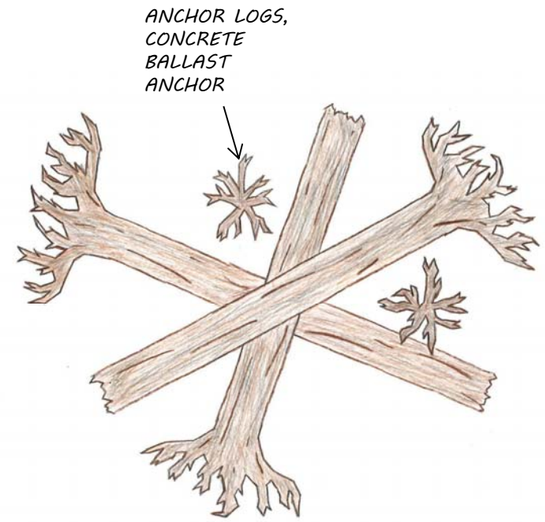
Project No. | Scale

Drawing No. | Sheet | Revision

Deep Water Cross Log Habitat Structure



PROFILE VIEW (not to scale)



PLAN VIEW (not to scale)

OBJECTIVE

- Provide deep water habitat for fish

MATERIALS/INSTALLATION

- Cross logs consist of a minimum of three logs, 24" dia., 20'-30' long, with root balls ≥ 4 times log dia., placed horizontally
- Anchor logs (if used) are typically 12"- 18" dia., 6'-10' long. Concrete ballast are typically 4' – 6' dia. broken concrete or boulders
- Structure is tied together with re-bar or nylon rope to prevent floatation
- Deep water cross log structures are placed in water greater than 6' in depth
- Structure installed using barge crane or floating excavator

BENEFITS

- On-shore construction reduces cost and increases worker safety
- Provides underwater spawning, feeding and resting habitat for fish
- Increase in underwater habitat diversity
- Increase in fish species diversity due to increased available habitat types

PHOTO – CROSS LOG STRUCTURE ASSEMBLED ON LAND PRIOR TO INSTALLATION

PHOTO – CROSS LOG STRUCTURE INSTALLED IN DEEP WATER AREA

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Appendix M - Figure 6

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Project No. | Scale

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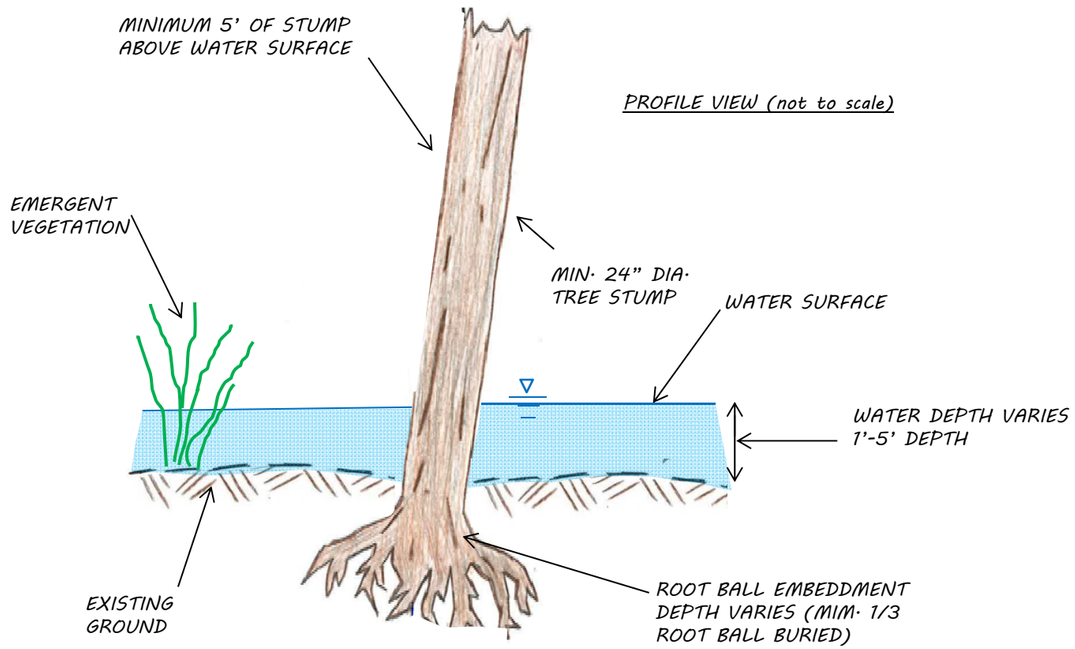
Tree Stump/Woody Snag Habitat Structure



OBJECTIVE

- Provide shallow water and wetland cover, nesting and loafing habitat

MATERIALS/INSTALLATION

- Hardwood tree stump, with a minimum dia. of 24", 10' minimum length, with root balls ≥ 4 times log dia.
- Minimum 1/3 of the root ball installed into substrate (can be completely buried in substrate)
- Structures are placed in shallow areas using barge crane or floating excavator

BENEFITS

- Low cost structure
- Habitat for turtles, fish, amphibians and roosting and hunting perches for raptors
- Waterfowl nesting boxes can be installed on stump

PHOTO - TREE STUMP HABITAT STRUCTURE - OPTIONAL INSTALLATION

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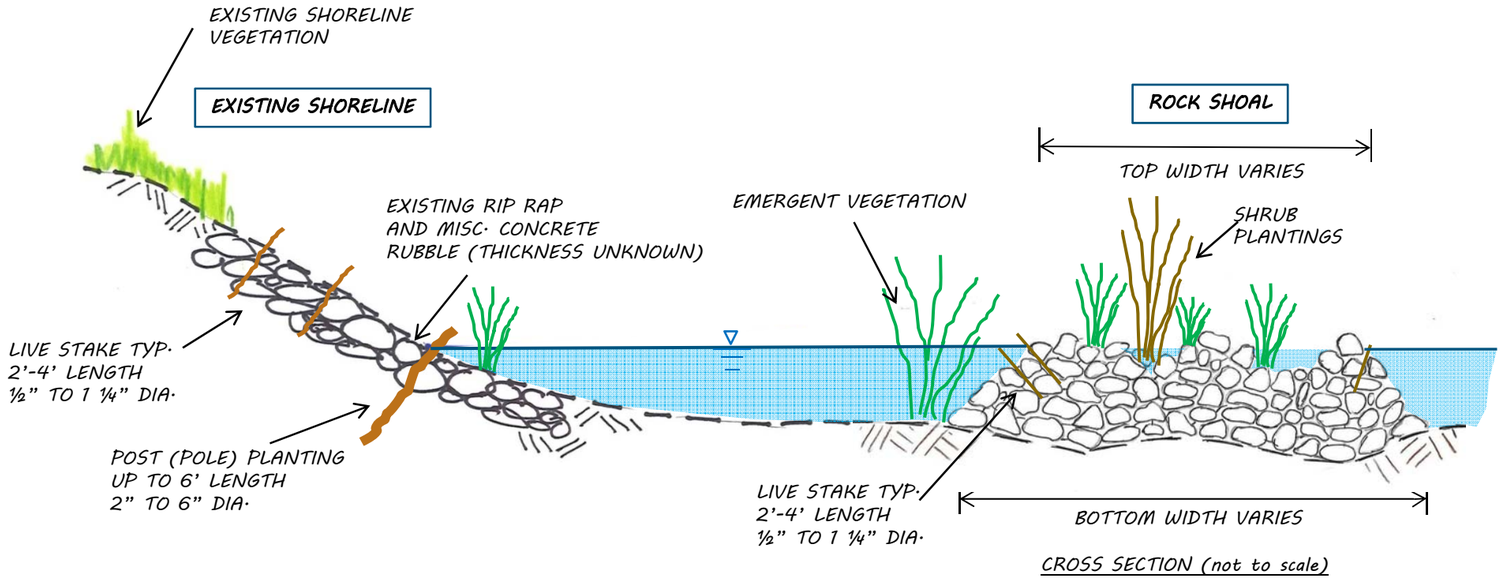
Appendix M - Figure 7
Title

Project No. | Scale

Drawing No. | Sheet | Revision

Near-Shore Rock Shoal



CROSS SECTION (not to scale)

OBJECTIVE

- Provide near-shore shallow water estuary habitat and wave dissipation

MATERIALS/INSTALLATION

- Structure is comprised of rip rap (angular blast rock, variable diameter (4" – 14"))
- Rock is applied 2'-4' thick (dependent on near-shore water depth)
- Top of shoal constructed with areas of protruding rock and planted with emergent herbaceous and shrub vegetation
- Shoal width between 10'-25' and variable lengths and distances from existing shoreline
- Estuary areas can be further enhanced with cross log, stump or other woody habitat
- Reef constructed from reclaimed on-site rip rap

BENEFITS

- Use of reclaimed materials from site reduces cost
- Increased habitat for various fish species, amphibians, herpitiles and shore birds
- Decreased shoreline stress and erosion from wave action

PHOTO - OFF-SHORE ROCK SHOAL

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Appendix M - Figure 8

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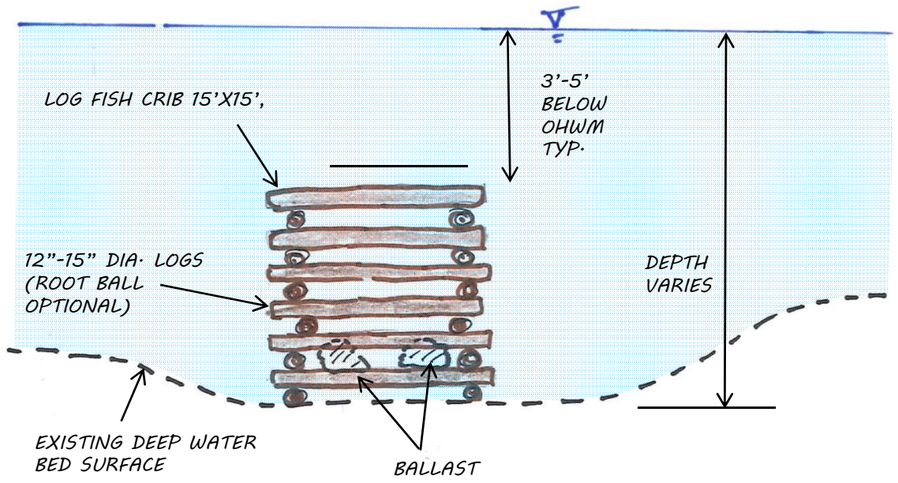
Drawing No. | Sheet | Revision

Fish Crib Habitat Structures



PROFILE VIEW (not to scale)

PHOTO - FISH CRIB UNDER CONSTUCTION

OBJECTIVE

- Provide habitat in deep water areas without fill

MATERIALS/INSTALLATION

- Typical structure dimensions 15' x 15', height 7' – 15'
- Installed to provide 3'-5' (minimum) clearance for small boat navigation
- Crib /Ballast materials :
  - Hardwood logs (cut within 30 days) typically 15' – 18' length, 12" – 15" in diameter
  - Galvanized or stainless steel rods and hardware
  - Reclaimed 3'- 4' diameter boulders, 3' x 1' x 5' concrete dock/wall sections and/or rip rap
- Structure can be installed using barge crane or floating excavator (photo)

BENEFITS

- On-shore construction reduces cost and increases worker safety
- Provides underwater spawning, feeding and resting habitat for fish
- Increase in underwater habitat diversity
- Increase in fish species diversity due to increased available habitat types

PHOTO - INSTALLED FISH CRIB

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Appendix M - Figure 9

Title

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