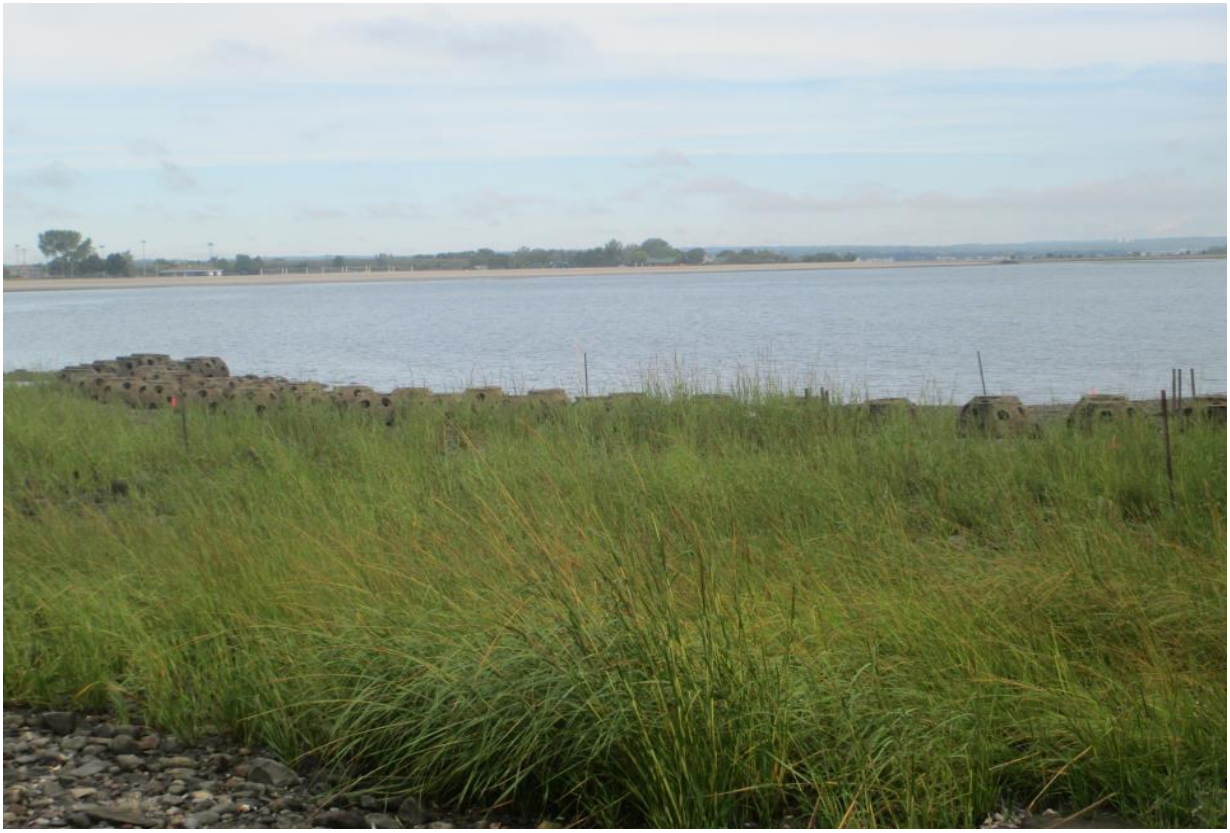
Sacred Heart UNIVERSITY

DEPARTMENT OF BIOLOGY

The Stratford Point Living Shoreline



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In June 2016, the Connecticut Institute for Resilience and Climate Adaptation (CIRCA) awarded Sacred Heart University (SHU) matching funds to expand an existing "living shoreline" at Stratford Point, Fairfield County, Connecticut. The purpose of this final report is to provide the following information (pursuant to section 6 of the subaward agreement):

- Overview of the project along with its objectives and methods
- Effectiveness as a living shoreline strategy and expected outcomes
- Explanation of how the project advanced CIRCA's mission and grant priority areas
- Elements that are transferable to other coastal communities
- Final project schedule
- Maps and photos of the completed project

Project Background

In May 2014, SHU constructed a living shoreline pilot project in the intertidal zone adjacent to the Housatonic River Estuary at Stratford Point (Photographs 1 and 2). The pilot project, which includes an artificial reef (constructed of precast concrete "reef balls") and a smooth cordgrass (*Spartina alterniflora*) marsh was constructed as a "proof-of-concept" to demonstrate the potential for living shorelines to decrease erosion of intertidal sediments and restore wildlife habitat. Subsequent monitoring demonstrated that the pilot project was successfully achieving both objectives (Photographs 3 through 6). Monitoring results also suggested that expansion of the project would further protect and enhance coastal habitats at the site and provide additional understanding regarding the potential effectiveness of living shorelines as a means to increase the resilience of Connecticut coastal communities. Funds were awarded by the U.S, Army Corps of Engineers ($250,000) and the National Fish and Wildlife Foundation ($114,000) to support the expansion; CIRCA provided $91,000 in match funds ($62,500 and 28,500, respectively). CIRCA match funds were used to purchase precast concrete "reef balls" to construct the artificial reef portion of the living shoreline.

Project Effectiveness

The artificial reef was designed to dissipate wave energy and associated scour, and disrupt long-shore sediment transport. Alteration of these processes was intended to result in a quiescent environment, which would minimize erosion of intertidal sediments and promote sediment accretion. This would allow for reestablishment of the intertidal marsh that was historically present at Stratford Point.

The reef was successfully constructed at the site in November 2016 (Photographs 7 through 10). Construction generally followed the proposed design, though some modifications were made in the field to account for unanticipated conditions, primarily rocky outcroppings and boulders that precluded placement of the reef balls in some proposed locations (Figure 1).

Over the first five months post-construction, the artificial reef is functioning as designed. Visual observations suggest that wave energy has been substantially reduced and that fine grained sediment is being deposited in the project area (Photographs 11 and 12). A robust annual monitoring plan is being implemented and will continue as the next several phases of the project are installed. These include planting native low and high marsh communities and restoring the existing, though substantially impacted, coastal dune to create a cohesive living shoreline.

Benefits to the CIRCA Mission

Controlling erosion of intertidal sediments in nearshore coastal and estuarine environments is a critical management issue. Historically, efforts to control erosion have focused on the use of hardened structures such as seawalls, bulkheads, revetments, jetties, groins, and/or breakwaters to dampen or reflect wave energy. However, these structures may fail catastrophically, require regular maintenance, and often increase erosion at adjacent properties. Living shorelines, which incorporate minimal structural elements with native vegetation, are an alternative to the conventional stabilization paradigm. Living shorelines provide erosion control benefits by protecting, restoring, and/or enhancing natural coastal functions and processes. They are also resilient to changing coastal conditions and provide valuable ecosystem services, such as improved water quality and habitat complexity. However, living shorelines are a relatively new concept in Connecticut and there is limited guidance on their design and implementation for erosion control purposes. As a result, conventional methods of erosion control are often preferred.

Living shorelines can take many different forms and may include the following conceptual elements:

- Intertidal marsh plantings
- Coir log protection
- Marsh sill
- Offshore breakwaters
- Artificial reefs

Construction materials include:

- Native vegetation
- Shell cultch
- Stone
- Pre-cast concrete structures (e.g., reef balls, oyster castles, etc.)

The artificial reef at Stratford Point provides an example of a successfully constructed living shoreline technique that Connecticut coastal communities can refer to as an alternative to the conventional stabilization paradigm. It also provided a test case and paved the way for future living shoreline projects that must go through the regulatory review / permitting process. In doing so, it further advanced the following CIRCA priority missions:

- Undertake or oversee pilot projects designed to improve resilience and sustainability of the natural and built environment along Connecticut's coast and inland waterways.
- Develop and deploy natural science, engineering, legal, financial, and policy best practices for climate resilience.
- Foster resilient actions and sustainable communities – particularly along the Connecticut coastline and inland waterways – that can adapt to the impacts and hazards of climate change.

Transferable Elements

Addressing uncertainties in living shoreline project design and documenting observed benefits will hopefully support increased implementation of living shorelines for erosion control across the Connecticut coastline, thereby allowing communities to better prepare for, and adapt to, changing coastal conditions (i.e., climate-induced sea level rise). To facilitate the transfer of knowledge, information regarding the design, permitting, and performance of the expanded living shoreline is already being shared at regional and national conferences, with local communities, and on the SHU Living Shorelines: Restoring Habitat Structure and Function website (www.sacredheart.edu/livingshorelines). Undergraduate and graduate students are also using the expanded project as a living classroom and outdoor laboratory to pursue ambitious projects to further advance the science and understanding of living shoreline design.

Final Project Schedule

The artificial reef is one element of the final living shoreline design for Stratford Point. Other elements, funded by the U.S. Army Corps of Engineers and the National Fish and Wildlife Foundation, consist of the following:

- 3.0 acres of low marsh, consisting of smooth cordgrass
- 1.5 acres of high marsh, consisting of saltmeadow cordgrass (*Spartina patens*)
- 1.5 acres of coastal dune habitat, achieved by amending existing soils, and planting beachgrass (*Ammophila breviligulata*) and switchgrass (*Panicum virgatum*)

The following schedule is anticipated to complete this work:

Anticipated Final Project Schedule

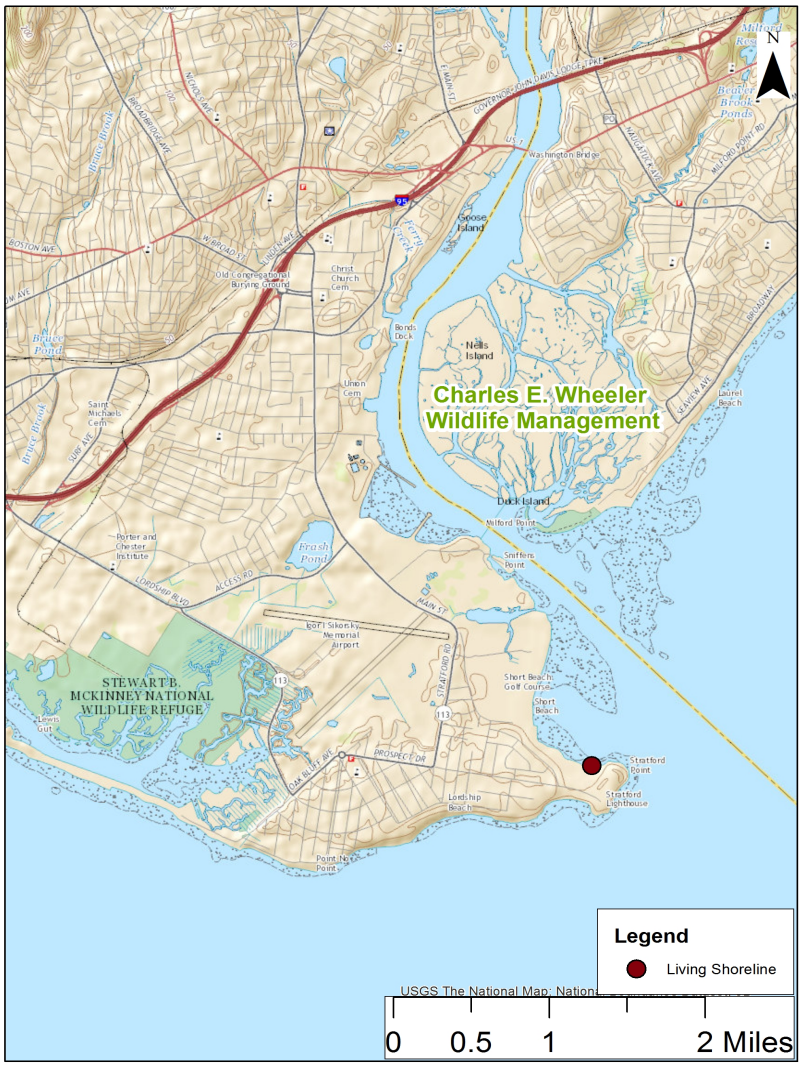
Living Shoreline Element	Anticipated Schedule

Artificial reef construction	Completed!
Low marsh planting	Spring 2017
High marsh planting	Spring 2018
Coastal dune restoration	Spring 2018

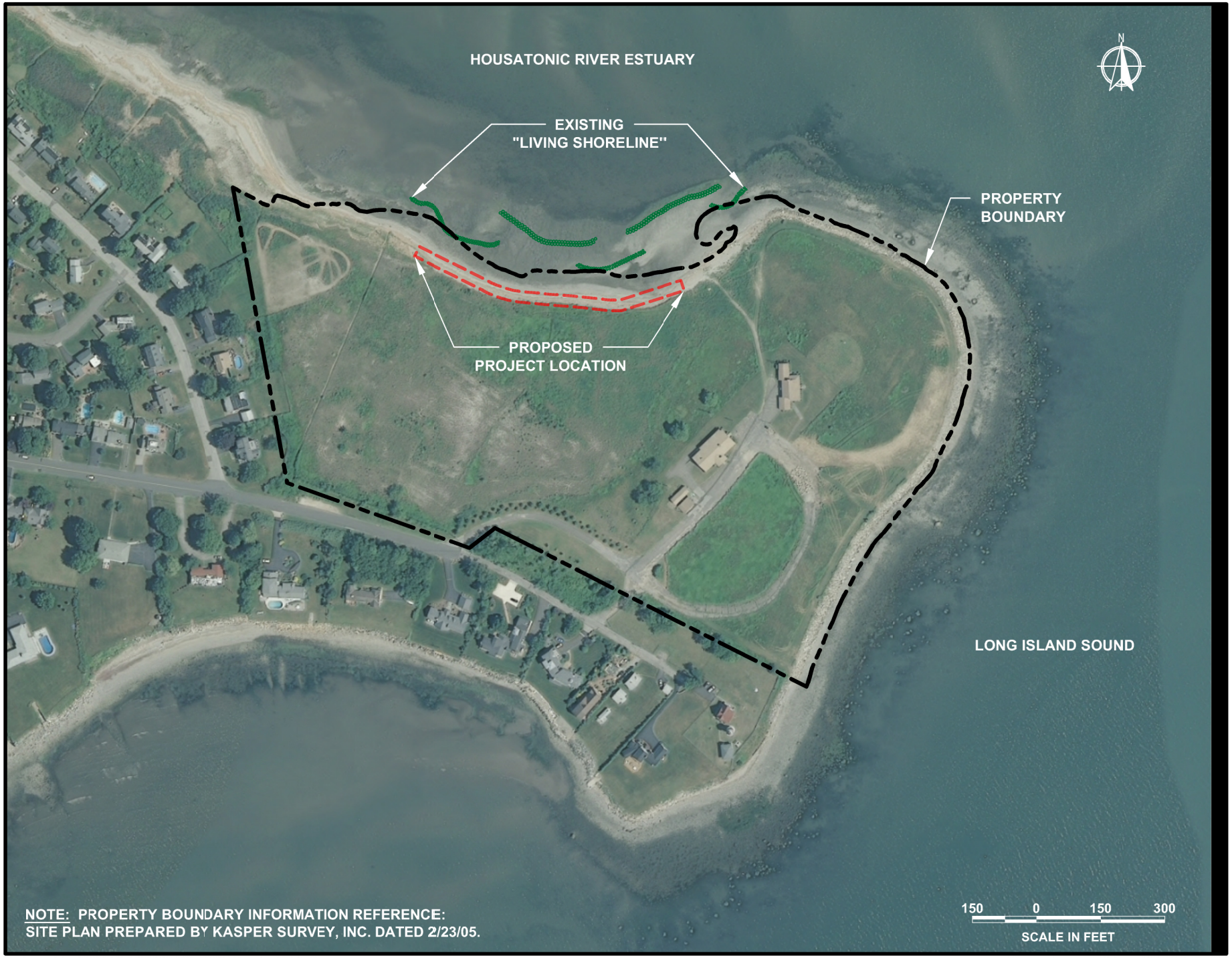
Upon completion, the project will provide critical ecosystem services that have been degraded or lost at the site, and throughout the region, including:

- Improved water quality via nutrient uptake and retention.
- Atmospheric carbon storage.
- Decreased erosion and restoration of natural sediment transport dynamics.
- Enhanced ecosystem resilience to severe storms and sea level rise, both of which may be attributable to climate change.
- Abiotic and biotic habitat for federally- and state-listed fish and wildlife species, as well other as species of regional conservation concern.
- Connectivity between the upland and aquatic habitats at the site.
- Critical connectivity between two subunits of the Stewart B. McKinney National Wildlife Refuge and several other natural areas in the region.

The project will also provide additional understanding regarding the potential effectiveness of ecosystem restoration as a means to improve the resilience of coastal communities, and will serve as a demonstration for how to adapt to changing coastal conditions.



Site location in Stratford, CT.



AECOM

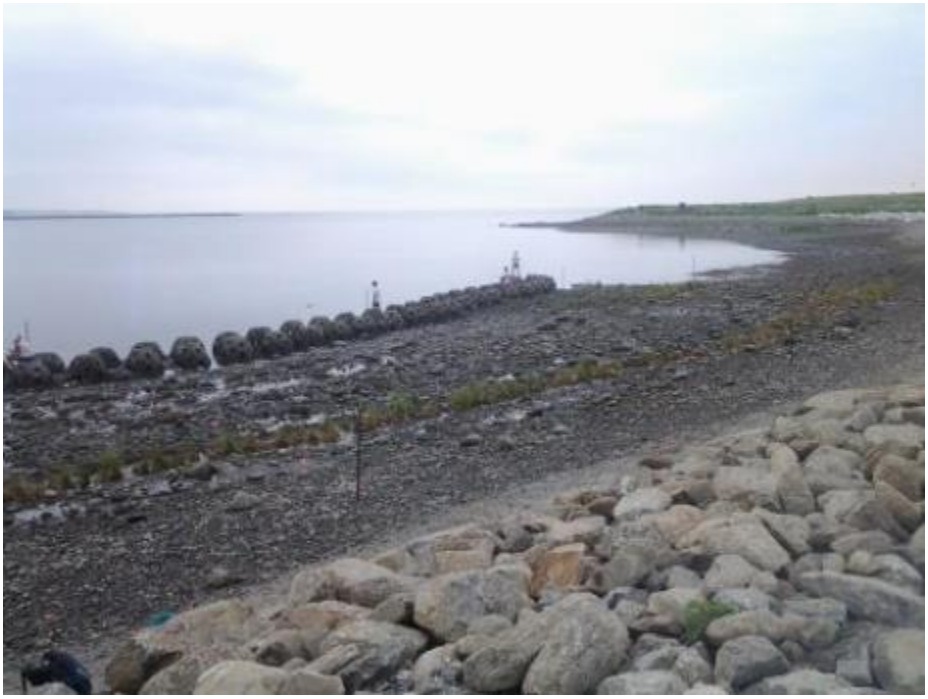
Figure 3

PROJECT LOCATION MAP

COASTAL DUNE RESTORATION
LONG ISLAND SOUND COMMUNITIES
STRATFORD, CONNECTICUT
Project No.: 60481699 Date: 2017-02-20

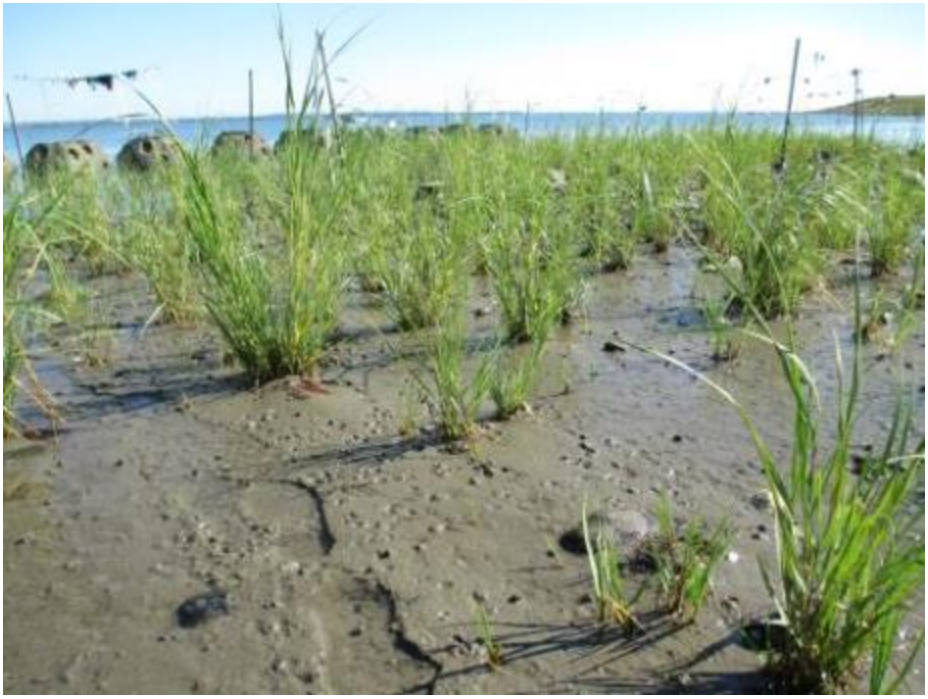
Last saved by: JASON.JERRYTONE(2017-02-20) Last Plotted: 2017-02-20 Project Management Initials: Designer: JRJ Checked:CH Approved: CH ANSI A 8.5" x 11"
Filename: S:\PROJECTS\PRIVATE-SECTOR\DUPONT\DUP_LORDSHIP_PROJECTS\LIVING SHORELINE PILOT PROJECT\DESIGN SUPPORT\DUNE REHABILITATION\PROJECT LOCATION MAP.DWG

Photograph 1



The living shoreline pilot project consisted of an artificial reef and intertidal marsh. This photograph was taken approximately three months after construction in July 2014. Note the gravel / cobble substrate.

Photograph 2



This photograph was taken approximately one and half years after construction in September 2015. The gravel / cobble substrate that was present prior to, and immediately following, construction has been covered / buried with fine-grained sediment. Over the three year monitoring period, up to 60 cm of sediment has been deposited in the project area. Intertidal marsh vegetation has become established and is beginning to thrive.

Photograph 3

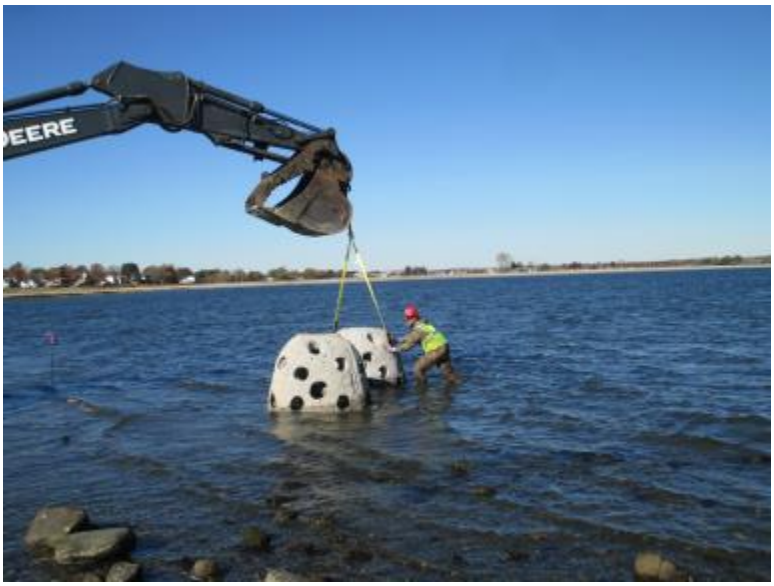
This photograph was taken in November 2013, prior to construction of the living shoreline pilot project. Note the lack of abiotic biotic structural habitat.

Photograph 4

Photograph taken in July 2014, approximately three months post construction.

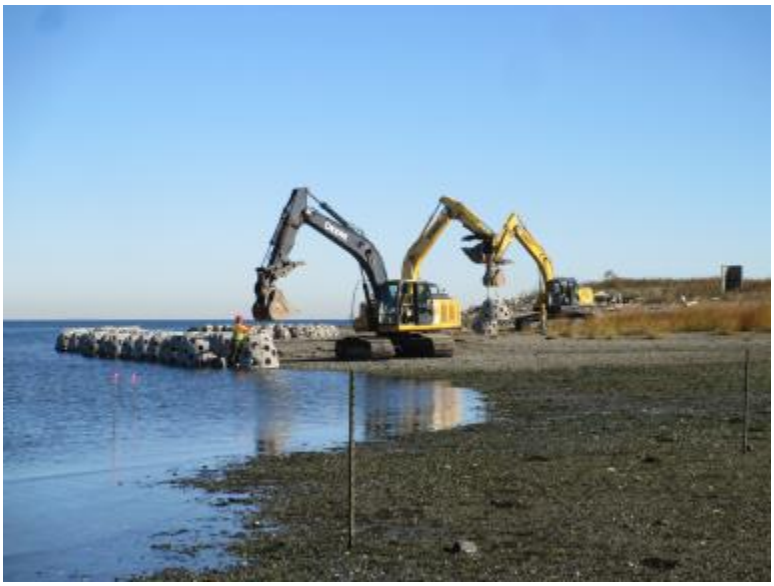
Photograph 5

Photograph 7



The first phase of the project consisted of expanding the artificial reef included in the pilot project. The reef was again construc precast concrete reef balls, which CIRCA match funds were used to purchase.

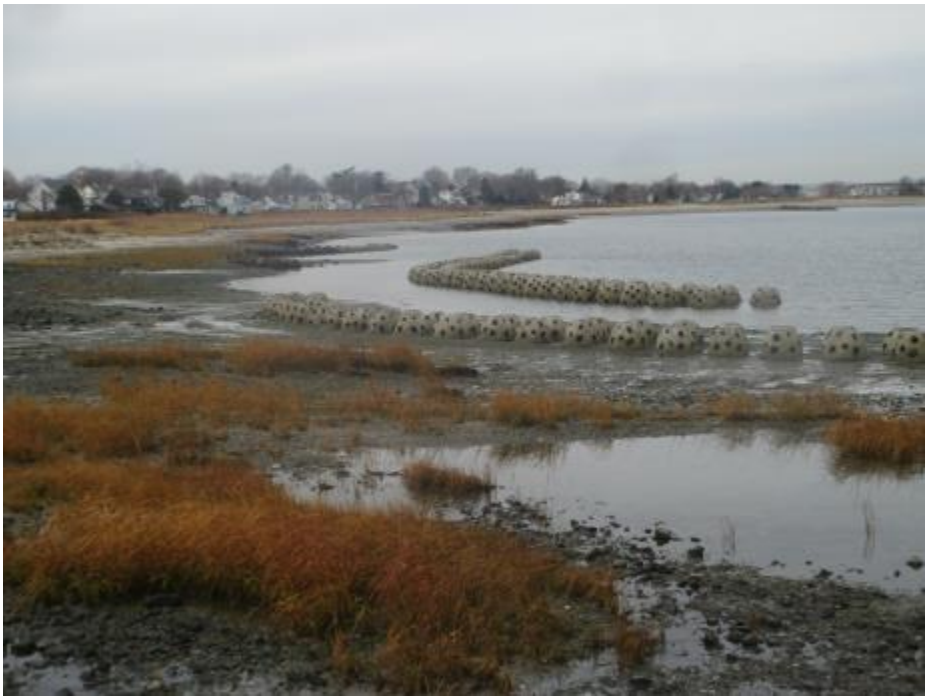
Photograph 8



The artificial reef was constructed in five days between November 14 and 18, 2016. Construction occurred during low tide to minimize disturbance.

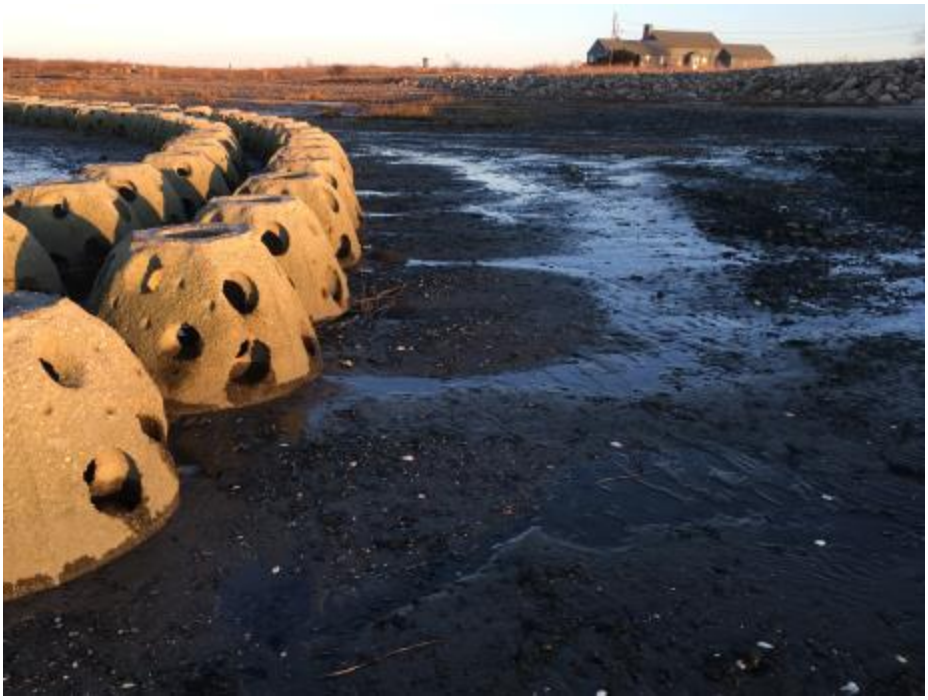
Photograph 9

Photograph 11



This photograph was taken in December 2016. Visual observations suggest that wave energy in the intertidal zone has been substantially reduced, which will allow for reestablishment of the intertidal marsh that was historically present at the site.

Photograph 12



This photograph was taken in January 2017. The artificial reef is functioning as designed; fine grained sediment is being deposited across the project area, which is necessary for the establishment of marsh vegetation. As the next phase of the project, marsh vegetation will be planted in spring 2017.