Living Shoreline - Little St. Simons Island Georgia

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Project 3011

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Introduction

Living shorelines are a method to help stabilize shorelines that are eroding that "utilize a variety of structural and organic materials, such as wetland plants, submerged aquatic vegetation, oyster reefs, coir fiber logs, sand fill, and stone" (NOAA 2014), instead of the traditional sea walls and bulkheads. Traditional methods decrease connectivity between the water way and the upland and Hard structures can increase the rate of coastal erosion, remove the ability of the shoreline to carry out natural processes, and provide little habitat for estuarine species (CCRM 2007). In Georgia, eastern oysters (*Crassostrea virginica* Gmelin, 1791) are found in the intertidal zone, are a keystone species, and their associated reefs are an essential component of the estuaries. Oysters are considered ecosystem engineers (Jones *et al.* 1994; Luckenbach *et al.* 1999; Gutierrez *et al,* 2003, ASMFC 2007), provide essential fish habitat (ASMFC 2007) and reduce phytoplankton and pollutants in the water column through filtration (Nelson *et al.* 2004, Porter *et al.* 2004) and make them an ideal species to utilize in the construction of living shorelines. Studies have found that a hectare of oyster reef through water filtration, habitat, bank stabilization, and harvesting potential can provide up to $100,000 in ecosystem services (Grabowski 2012) and constructed reefs can increase in fish abundance by 38% (Scyphers 2011). Marsh grasses are also an integral component of living shorelines and can reduce nutrient pollution by 90% (Zhang 2011; Bell 1997).

To protect the integrity of coastal marshlands, the State of Georgia passed the Coastal Marshlands Protection Act in 1970 (amended in 1992) that gave the State of Georgia jurisdiction over marshlands, intertidal area, mudflats, tidal water bottoms, and salt marsh area within estuarine areas of the state. Since its passage the State of Georgia applications for permits for shoreline developments and shoreline structures, such as bulkheads, continues to increase as the coastal population continues to grow. In Georgia, the use of living shorelines has been undertaken through cooperation of multiple agencies, The Georgia Department of Natural Resources (GA DNR), The Sapelo Island National Estuarine Reserve (SINERR), The University of Georgia Marine Extension Service (MAREX), The Nature Conservancy (TNC), and the Georgia Department of Natural Resources Coastal Resources Division (GA DNR-CRD) and have formed a living shoreline working group. The working group has recently undertaken developing a Living Shoreline Guidance Document to address the use of living shorelines in Georgia (MacKinnon 2013).

In Georgia, two other living shorelines have been constructed both on Sapelo Island and were constructed on eroding stream banks. The site on Little St. Simons Island will provide a third location to apply living shorelines techniques with the opportunity to remove a failing bulkhead. In coastal Georgia, the use of living shorelines is still in its infancy and understanding how living shoreline effects ecological communities is paramount. Therefore, the objective of this project were to remove the existing bulkhead and replace with living shoreline. The goal of the project is to determine the effect that living shorelines have upon the nektonic community and recruitment and growth of oysters.

Study Site

Little St. Simons Island is a barrier island on the coast of Georgia that accessible only by boat (Figure 1). In the 1920's to 1930's a wooden bulkhead, approximately 370 feet long, was installed on the bank of Mosquito Creek, which is a tidal creek on the west side of the island. The bulkhead is located at the primary entrance to the island and had started to fail. Instead of replacing or repairing the current bulkhead Little St. Simons Island, LLC was interested in the construction of a living shoreline (Figures 2-3).

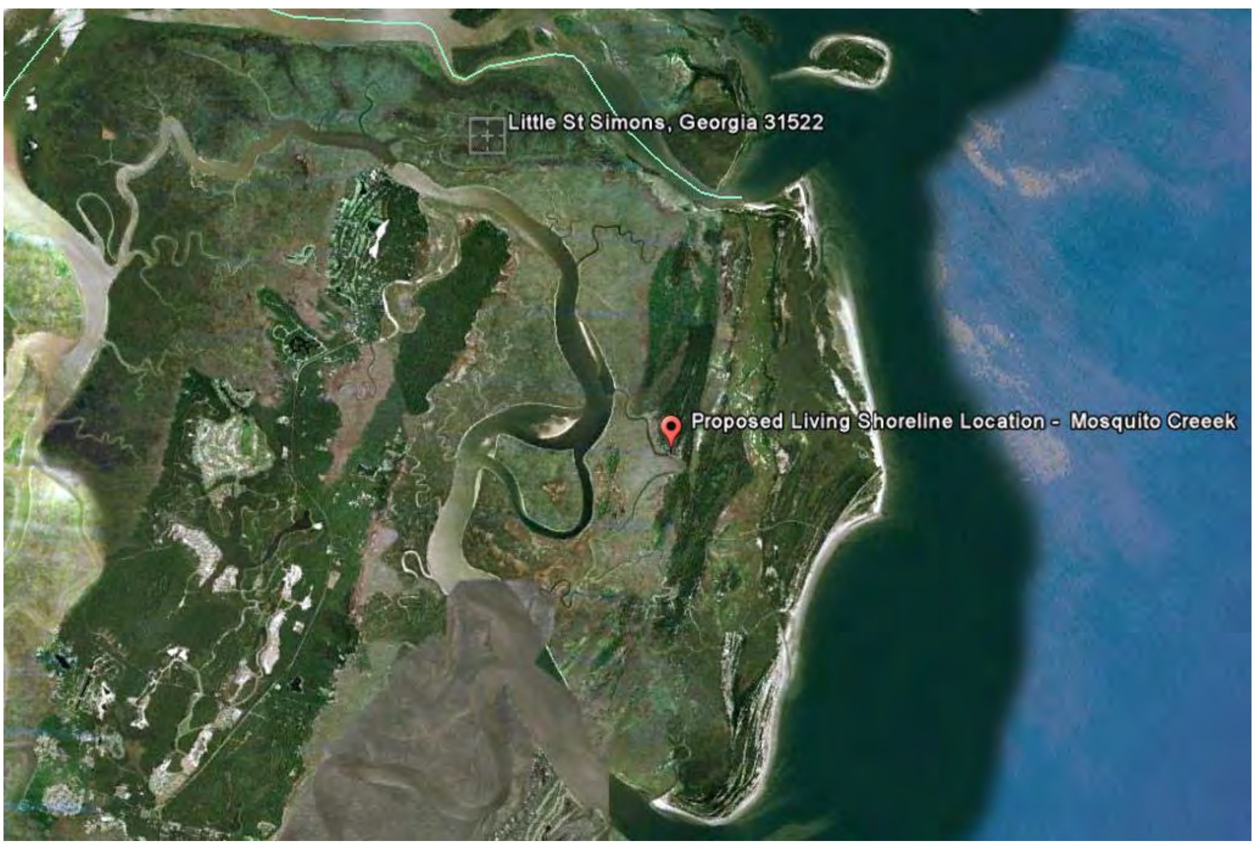

Figure 1. Little St. Simons Island, GA (Google Images) and location of living shoreline site on Mosquito Creek.

Figure 2. Picture of failing bulkhead on Little St. Simons Island.

Figure 3. Picture of water infiltration on land side (right of bulkhead) of bulkhead on Little St. Simons Island.

Design and Permitting

Prior to construction members of the working group and LSSI met with engineers, contractors, and state and federal agencies in charge of permitting to have plans drawn up for the site and to make sure that all necessary permits were obtained. Application for permits was handled by Little St. Simons Island, LLC. The only permit that was necessary was a State of Georgia Revocable License Agreement since a bulkhead was already present at the location and the living shoreline was under 500ft in length. No permits were necessary to obtain from the Army Corps of Engineers or the Georgia Department of Natural Resources Environmental Protection Division.

To engineer the living shoreline we had meetings with engineers from Carter and Sloop and Ed Hoffman on April 17th and June 28th, 2012 respectively, at the site on Mosquito Creek on LSSI. The decision was made to work with Ed Hoffman, who conducted the construction of the living shoreline on Sapleo Island. Drawings for the living shoreline were handled by Tom Havens with Coastal Civil Engineering (Apendix I) and were adapted to allow for established Live Oak (*Quercus virginiana*) trees not to be loss during the construction of the shoreline. To accommodate the Live Oak trees the slope of the shoreline varies from a 1:1 to a 3:1 slope. On the west end the living shoreline ties back into a portion of the bulkhead that was left in place to protect the roots of a large Live Oak. On the east end the living shoreline transitions to established marsh at a small tidal creek. To help determine what plants to use Thomas Angel, a local landscape architect, drew up plans using native plants for the site (Appendix II).

Installation

Construction

Oyster shell and shell bagging supplies were delivered in Fall 2012 and additional shell arrived in Winter 2013. In total 4,875 bushels of oyster shell (11,900 bags) (Figure 4) were used for the shoreline. Six loads of shell were ordered, five from grant funds and one by GA-DNR CRD for a total of 4,500 bushels (11,000 bags), an additional 375 bushels was bagged (900 bags) from oyster shell present on LSSI that had been collected from past oyster roasts. Shell was bagged prior to construction and by AmeriCorps during construction. Shell was delivered to the

Hampton Point Marina and St. Simons Island and was bagged. Bagged shell was then loaded onto a barge owned and operated by LSSI and transported to Little St. Simons Island (Figure 5).

Removal and installation of the living shoreline started in February 2013 and was completed in June 2013. Construction took longer than anticipated due to rainy weather. The bulkhead was removed in sections and then immediately sloped. Once the bank was sloped, a tow of rubble concrete was placed at the base to provide support for the oyster bags. The slope was then covered with a geo-textile grid and the first layer of shell bags laid in place to prevent erosion to the exposed stream bank (Figure 6). Bags were laid to an elevation of 1.3m above the mean high tide line. The layer of the geo-textile grid was then wrapped and brought back over the top of the first layer of oyster bags. The geo-textile was used to tie the first layer of shell bags together. Rebar hooks approximately 4ft long were spaced every three feet up the slope (vertically) and every five feet parallel to the creek (horizontally) to secure the oyster bags to the bank (Figure 7). Once the bulkhead has been removed and the first layer completed, a second layer of bagged oyster shell was laid over top and rebar hooks were pushed flush with upper layer of bags. The first layer of bags was completed in April 2013 and the second layer of bags was completed by the end of August 2013. Placement of bagged shell on the reef was handled by the contractor, instead of volunteers as we had planned, to ensure that bags were placed correctly.

Figure 4. Bagged oyster shell at Hampton Point Marina, St. Simons Island.

Figure 5. Bagged oyster shell being offloaded to living shoreline site, Little St. Simons Island, GA.

Figure 6. Construction of living shoreline in sections, Little St. Simons Island, GA.

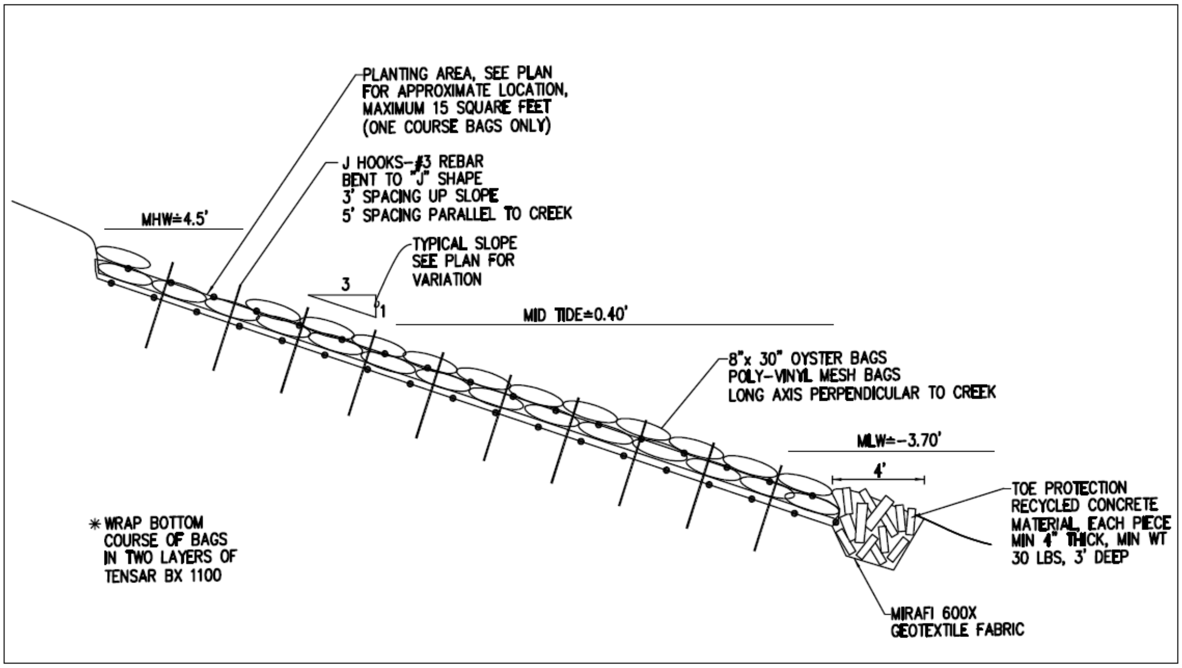

Figure 7. Drawing showing use of concrete rubble toe, oyster bags, geo-textile mesh, and rebar for construction of the living shoreline.

Planting

The upland area adjacent to the bulkhead had been planted with native grasses and plants by LSSI previously and the Muhly grass and sea oxeye daisy present was removed (Figure 8), with the help of volunteers, prior to construction and were held on site at LSSI to be used once the living shoreline was complete. The landscape plans drawn up by Thomas Angel called for marsh plants to be incorporated into the slope (Figure 9-10) of the living shoreline in addition to the adjacent upland (Appendix II). Plants were sourced through a local nursery and plants started to arrive to the site from March 19 - April 2, 2013, and were planted as soon as construction activity allowed. A total of 1,820 plants comprised of 18 species were planted (Table 1). The majority of plants, 1,658, were planted in the spring along with the Muhly grass and Sea oxeye that had been saved. An additional 162 plants were purchased in January 2014 to replace some plants that had died due to environmental factors, over grazing from deer, or to fill in areas (Table 2).

Figure 8. Volunteers digging up plants prior to construction, Little St. Simons Island, GA.

Figure 9. Patch for marsh grasses to be planted into the living shoreline, Little St. Simons Island, GA.

Figure 10. Marsh grasses planted as part of the living shoreline, Little St. Simons Island, GA.

Table 1. Plant names, size of plant, and number of plants planted at the living shoreline in Spring 2013, Little St. Simons Island, GA.

Plant	Size	Number planted
SPARTINA ALTERNIFLORA	Bare root	210
SPARTINA PATENS	1 GAL	335
SEA OXEYE	1 GAL.	244
PALMETTO	15 GAL.	8
MUHLY GRASS	1 GAL.	350
SPARTINI BAKERI	1 GAL	50
DUNE SUNFLOWER	1 GAL.	20
PRICKLY PEAR CATCUS	1 GAL.	6
SEASIDE GOLDENROD	1 GAL.	35
SEA OATS	1 GAL.	30
BEAUTY BERRY	3 GAL	18
LOVE GRASS	1 GAL.	50
PALMETTO	15 GAL.	8
BROOMSEDGE	1 GAL.	75
BUSHY BLUESTEM	1 GAL.	75
YUCCA FILAMENTOSA	3 GAL.	9
RIVER OATS	1 GAL.	75
YAUPON HOLLY	3 GAL.	40
YAUPON HOLLY - FEMALE	7 GAL.	20
Total Plants		**1658**

Table 2. Plant name, size of plant, and number of plants planted at the living shoreline in Winter 2014, Little St. Simons Island, GA

Plant	Size	Number planted
MUHLY GRASS	1 GAL.	115
GRASS, LOVE GRASS 1 GAL. 4.75 142.50		30
HOLLY, YAUPON, SHADOWS FEMALE	7 GAL.	4
SEASIDE GOLDENROD	1 GAL.	11
YUCCA	BARE ROOT	1
1 PALMETTO	15 GAL	1
Total Plants		**162**

Americorps and Volunteers

An application to have an AmeriCorps NCCC team come help with the living shoreline project was submitted in November 2012 (Appendix III). After the initial concept form was submitted we were asked by AmeriCorps NCCC officials to partner with the St. Simons Land Trust who had also submitting a concept form for the same period for work to be completed on St. Simons Island. A joint concept plan was submitted and accepted in November of 2012 and a full proposal was submitted to have a team for nine weeks with five weeks (25 working days) being allotted to the living shoreline project (Appendix IV). The joint application was accepted by AmeriCorps NCCC but due to high number of applications received they scaled back the length of time we had requested from nine weeks to four 1/2 weeks, therefore the time for AmeriCorps was scaled back to 10 working days. The AmeriCorps team Delta 7, comprised of nine members, worked on LSSI from March 12-March 26, 2013 and bagged approximately 6,000 bags of oyster shell, moved the bagged oyster shell to the living shoreline site by boat, and help with starting the planting of plants for the living shoreline (Figure 11). Fifteen volunteer events were held at the at the living shoreline site during 2013 and ranged in size from 1 - 11 volunteers. Volunteers were a tremendous help with preparing the site for plants, planting the plants, and doing garden maintenance (Figure 12). Overall we had 78 volunteers and support from Coastal Wildscapes and TNC's Leaders in Environmental Action for the Future. A total of 1,126 hours work (Table 3) used on the project, and volunteers will continue to help with garden maintenance.

Figure 11. AmeriCorps members working on the living shoreline, Little St. Simons Island, GA.

Figure 12. Volunteers helping plant plants at the living shoreline site, Little St. Simons Island, GA.

Table 3. Number of volunteers, public and AmeriCorps, and hours worked on the living shoreline, Little St. Simons Island, GA.

	Cumulative	Projected:
Volunteer Numbers:	78	20
Total Hours:	1,126	~5,000
-Volunteer Hours:	406	
-Americorps Hours	720	

Monitoring

Mapping and Erosion

The site was mapped before the bulkhead was removed and after the living shoreline was installed with a handheld Archer Field PC unit (Juniper Systems) running ArcPad8.0 (ESRI) to capture the location of oyster shell and *Spartaina* stands. Polygons created were imported into ArcGIS 9.3 (ESRI) to calculate the area of oyster habitat and spartina. The site was re-mapped after the living shoreline was installed to calculate the final area of the living shoreline. To monitor for erosion, 15 marking flags were evenly spaced along the top of the living shoreline and then another flag was set 1m toward to upland. The distance between the set of flags would then be measured to determine if the erosion was occurring. Additionally monthly photo-points were initiated to monitor the reef.

Prior to construction the stream side part of the bulkhead was dominated by mud. Two *Spartina alterniflora* stands covered 53m^2 and one oyster reef 11m^2 were present (Figure 13). After construction the living shoreline measured 92m long and 3-6m wide and shell bags covered an area of 414m^2 and the natural reef found before construction was left intact for a total of 425m^2 of oyster shell. The two spartina stands present before construction were left in place and a four additional plots were incorporated into the slope of living shoreline for a total area 85m^2. Two plots of sea oxeye were added to the shoreline and cover an area of 25m^2. This increased the total area of oyster shell available by 414m^2 and 33m^2 of spartina and 25m^2 of sea oxeye. The extent of live oysters present on the reef covered the lower portion and covered 158m^2 (Figure 14). Monthly photopoints was established to monitor the progress of the living shoreline (Figures 15-28)

Flagging set up at 5m intervals to monitor the top edge of the living shoreline for erosion was not successful (Figure 29). The flags were set up at the end of June when construction was complete, but flagging material did not hold up as anticipated and when we returned to sample flags had been removed or where missing. We did notice two small areas of erosion at the transition from the bagged shell to the upland that coincided with areas where runoff drained from the upland. Additional bags and soil were added to these areas and these areas continue to be monitored. The erosion also occurred early after construction before plants had time to get established. Since the flagging did not work for monitoring erosion, we got in contact with Dr. Jackson at Georgia Southern University who has a 3d ground LiDAR system and he agreed to take images of the living shoreline with his equipment on a bi-annual basis to monitor the site. He was able to visit the site in the fall, but images are not yet available.

Figure 13. Location of *Spartina* and oysters at the site of the living shoreline prior to construction, Little St. Simons Island, GA.

Figure 14. Location of Spartina, sea oxeye, bagged oyster shell, and live oysters at the living shoreline after its construction, Little St. Simons Island, GA.

Figure 15. West side of living shoreline February 2013 Little St. Simons Island, GA

Figure 16. West side of living shorline March 2013, Little St. Simons Island, GA

Figure 17. West side of living shoreline April 2013, Little St. Simons Island, GA.

Figure 18. West side of living shoreline May 2013, Little St. Simons Island, GA.

Figure 19. West side of living shoreline June 2013, Little St. Simons Island, GA.

Figure 20. West side of living shoreline August 2013, Little St. Simons Island, GA.

Figure 21. West side of living shoreline September 2013, Little St. Simons Island, GA.

Figure 22. West side of living shoreline October 2013, Little St. Simons Island, GA.

Figure 23. East side of living shoreline February 2013, Little St. Simons Island, GA

Figure 24. East side of living shoreline March 2013, Little St. Simons Island, GA

Figure 25. East side of living shoreline April 2013, Little St. Simons Island, GA

Figure 26. East side of living shoreline June 2013, Little St. Simons Island, GA

Figure 27. East side of living shoreline August 2013, Little St. Simons Island, GA

Figure 28. East side of living shoreline October 2013, Little St. Simons Island, GA

Figure 29. Flagging (dark green) set out in June 2013 to monitor for erosion, Little St. Simons Island, Ga.

Nekton Sampling

Prior to construction three locations were selected at the base of the bulkhead and were comprised of mud only, after construction three locations along the living shoreline were selected. A bottomless lift net that covered 24 m^2 (8m x 3m) made of 2.4 m tall Delta style netting with 3 mm (1/8 inch) mesh (Nylon Net Company) and a weighted base staked with stakes every half meter was used (Wenner *et al.* 1996; Coen *et al.* 1999). Each site was sampled one day each season (winter, spring, summer, and fall) during daylight hours. After nets were deployed water temperature, dissolved oxygen, pH, and salinity were recorded at the surface and at one meter below the surface using a Qunata (Hach Company). On the following low tide, net edges were checked for specimens as soon as the site was completely exposed (Figures 30-32). Once sampling was complete the nets were removed. Specimens collected were anesthetized in Finquel and placed in 10% seawater buffered formalin to store for identification. Species that could be identified and measured on site were released (Figure 33). Collected specimens were identified in the lab to species or highest classification level if species could not be determined. Fish were identified, enumerated by species, and total length standard length were recorded. Crustaceans were identified, enumerated by species, and measured. Prior to removal of the bulkhead and we collected a total 1,419 specimens and identified 7 species of crustaceans and ten species of fish for all seasons combined (Table 4). Crustaceans were dominated by grass shrimp (*Palamonetes pugio* and *vulgaris*) while fish were dominated by the bay anchovy (*Anchoa mitchilli*). After construction of the living shoreline a total 2,748 specimens comprised of four species of crustaceans and 20 species of fish have been collected in only two sampling periods summer and fall. Crustaceans were dominated by grass shrimp and bay anchovy was the most common fish (Table 5).

Since construction we have observed an increase in the number of species and the number of specimens observed. Therefore we calculated the species richness, species evenness and the Simpson index of diversity for samples caught pre and post construction of the living shoreline for all species combined (Table 6), for fish only (Table 7), and for crustaceans (Table 8). We also noted that species richness increased in the summer and fall after the living shoreline was constructed. The Simpson index ranged from 0.12-0.85 for pre construction and 0.32-0.75 in post construction. The index is quite similar between fall and summer samples pre and post construction, which is not surprising since samples were dominated by grass shrimp and bay anchovies (Table 9). More detail information will be available to examine any changes in the nekton community after a full year of sampling post construction is complete along with two more full years of sampling. at least once a month prior to construction of the living shoreline and after the living shoreline was installed.

Figure 30. Bottomless lift nets set for deployment, at low tide, prior to construction of the living shoreline.

Figure 31. Bottomless lift nets after deployment, at high tide, prior to construction of the living shoreline.

Figure 32. Bottomless lift nets after deployment, at low tide, after construction of the living shoreline.

Figure 33. Sheepshead (*Archosargus probatocephalus*) capture in bottomless lift nets after construction of the living shoreline.

Table 4. Species name, the number of each species, and the total length (TL) and/or carapace width of species captured in bottomless lift nets for all seasons (winter, spring, summer, and fall) combined prior to construction the living shoreline.

Species	Number	Mean TL (mm)	Mean Carapace (mm)
Crustacean			
Alpheus heterochaelis	3	26.00	
Callinectes sapidus	8		42.39
Callinectes similus	2		35.53
Palaemonetes pugio	112	27.71	
Palaemonetes spp.	5		
Palaemonetes vulgaris	71	26.20	
Penaeus setiferus	23	68.83	
Squilla empusa	1	115.00	
Fish			
Anchoa mitchilli	1119	40.57	
Bairdiella chrysoura	8	29.63	
Fundulus heteroclitus	6	63.33	
Gobiosoma bosci	15	40.07	
Leiostomus xanthurus	4	59.75	
Menidia menidia	3	65.33	
Opsanus tau	2	151.50	
Paralichthys lethostigma	19	152.82	
Prionotus carolinus	1	39.00	
Symphurus plagiusa	17	36.59	

Table 5. Species name, the number of each species, and the total length (TL) and/or carapace width of species captured in bottomless lift nets for summer and fall, combined, after construction of the living shoreline.

Species	Number	Mean TL (mm)	Mean Carapace (mm)
Crustaceans			
Callinectes sapidus	1		140.00
Palaemonetes pugio	260	25.79	
Palaemonetes vulgaris	359	24.96	
Penaeus setiferus	318	83.66	
Fish			
Anchoa mitchilli	1714	47.07	
Archosargus probatocephalus	4	238.25	
Bairdiella chrysoura	2	37.50	
Chloroscombrus chrysurus	1	50.00	
Diapterus auratus	2	83.00	
Dorosoma petenense	33	66.20	
Etropus crossotus	3	94.00	
Evorthodus lyricus	9	48.11	
Fundulus confluentus	1	40.00	
Fundulus heteroclitus	8	48.25	
Gobiosoma bosci	1	36.00	
Lagodon rhomboides	1	112.00	
Leiostomus xanthurus	1	130.00	
Lutjanus jocu	2	69.50	
Menidia menidia	8	68.38	
Opsanus tau	8	176.63	
Paralichthys lethostigma	2	110.50	
Prionotus carolinus	1	41.00	
Symphurus plagiusa	8	35.25	
Syngnathus fuscus	1	159.00	

Table 6. Sample, number of species, number of specimens, species richness, species evenness, and Simpson index of diversity for all nekton captured in bottomless lift nets, Little St. Simons Island, GA.

Sample	# of species	# of specimens	Richness (d)	Evenness (J')	Simpson (1-Lambda')
Post-Fall	18	1,115	2.423	0.533	0.754
Post-Summer	17	1,633	2.163	0.275	0.323
Pre-Fall	13	458	1.959	0.424	0.480
Pre-Spring	12	47	2.857	0.846	0.858
Pre-Summer	12	322	1.905	0.395	0.421
Pre-Winter	9	592	1.253	0.157	0.121

Table 7. Sample, number of species, number of specimens, species richness, species evenness, and Simpson index of diversity for fish captured in bottomless lift nets , Little St. Simons Island, GA.

Sample	# of species	# of individuals	Richness (d)	Evenness (J')	Simpson (1-Lambda)
Post-fall	15	417	2.32	0.19	0.18
Post-summer	13	1393	1.66	0.009	0.008
Pre-fall	8	345	1.20	0.17	0.12
Pre-spring	7	18	2.01	0.83	0.78
Pre-summer	6	265	0.90	0.25	0.17
Pre-winter	5	566	0.63	0.007	0.003

Table 8. Sample, number of species, number of specimens, species richness, species evenness, and Simpson index of diversity for crustaceans captured in bottomless lift nets , Little St. Simons Island, GA.

Sample	# of species	# of individuals	Richness (d)	Evenness (J')	Simpson (1-Lambda)
Post-Fall	3	698	0.305	0.995	0.664
Post-Summer	4	240	0.547	0.789	0.655
Pre-Fall	5	113	0.846	0.677	0.621
Pre-Spring	5	29	1.188	0.819	0.702
Pre-Summer	6	57	1.237	0.480	0.396
Pre-Winter	4	26	0.921	0.835	0.652

Table 9. Crustacean and fish species captured in bottomless lift nets pre construction and post construction of the living shoreline during the summer and fall.

	Summer		Fall	
Species	**Pre**	**Post**	**Pre**	**Post**
Alpheus heterochaelis	2			
Callinectes sapidus		1	2	
Callinectes similus	2			
Palaemonetes pugio	44	54	55	206
Palaemonetes spp.	1			
Palaemonetes vulgaris	2	95	41	264
Penaeus setiferus	6	90	14	228
Squilla empusa			1	
Crustacean total	**57**	**240**	**113**	**698**
Anchoa mitchilli	241	1336	323	378
Archosargus probatocephalus		2		2
Bairdiella chrysoura	4	2		
Chloroscombrus chrysurus		1		
Diapterus auratus				2
Dorosoma petenense		33		
Etropus crossotus		2		1
Evorthodus lyricus		1		8
Fundulus confluentus				1
Fundulus heteroclitus		1	5	7
Gobiosoma bosci	3		7	1
Lagodon rhomboides		1		
Leiostomus xanthurus			1	1
Lutjanus jocu		2		
Menidia menidia	2	4		4
Opsanus tau		7	1	1
Paralichthys lethostigma	7	1	4	1
Prionotus carolinus			1	1
Symphurus plagiusa	8		3	8
Syngnathus fuscus				1
Fish total	**265**	**1393**	**345**	**417**

Quadrant and Spat Sampling

Prior to construction the length of the proposed living shoreline was laid out and 10 transects were evenly spaced along the site. Three $0.25m^2$ quadrants were spaced every meter starting at the base of the bulkhead. After construction the same transect locations were used and quadrants were spaced one meter apart starting at the base of the living shoreline to the high tide water line. The numbers of live and dead oysters were counted in each quadrant and the length of up to 30 live oysters, if present, were measured using Venier calipers. Mortality was calculated for each quadrant by taking the number of dead oysters divided by the total number of oysters. The number of *Spartina alterniflora* plants and the length of up to 30 stems were measured. Quadrant sampling occurred in late fall/early winter

The availability of oyster spat was measured prior to installing the living shoreline to determine if oyster spat was available and at what density in Mosquito creek. Three replicate spat sticks were set out monthly from April - November in 2012 to check for availability (Figure 34). After the living shoreline was installed spat on oyster shell was counted to determine if oysters had recruited to the site (Figure 35). Spat monitoring will continue in subsequent years.

Prior to construction no oysters were observed within any of the quads (Table 10). One small reef not located on the transects was present and one 0.25m^2 quadrant was conducted for reference, and had a density of 43 live and 6 dead oysters and the mean length of live oysters was 37.5 mm (n=30). Spartina was found in 3 quads (10%) and had a ranged from 7-20 stems per 0.25m^2 and mean height of 417.9 mm.

After construction of the living shoreline live oysters were found on each transect and that density was greatest on the lower quads (at the base of the reef) with 20.4 oysters per 0.25 m^2 and decreased as you moved toward the upland with 10.7, and 3.2 oysters, respectively. The mean length of oysters was 20.5 mm (N=380) and ranged from 8.6 - 50.0 mm (Table 10). We did have less spartina present with stems only found in 2 quads with stem densities of 1 and 5 (Table 11). The mean height of spartina was 236.0 mm. We did measure spartina in the patches planted on the shell slope and found spartina and found that it had a mean density of 26.1 stems per 0.25m^2 with an mean height of 362.2 mm. No barnacles or mussels were observed in the any of the 0.25m^2 quadrants. The reef will be continued to be monitored for two more years to track oyster recruitment, density, size, and mortality.

Figure 34. Spat collector used monitor oyster spat at living shoreline site prior to construction, Little St. Simons Island, GA.

Figure 35. Oyster spat on bagged oysters used at the living shoreline, Little St. Simons Island, GA

Table 10. Mean oyster density and length of live oysters observed pre construction and post construction of the living shoreline on Little St. Simons Island, GA.

	Live oyster 0.25m2			Mean oyster length		
	L	**M**	**U**	**L**	**M**	**U**
Pre						
1	0.00	0.00	0.00			
2	0.00	0.00	0.00			
3	0.00	0.00	0.00			
4	0.00	0.00	0.00			
5	0.00	0.00	0.00			
6	0.00	0.00	0.00			
7	0.00	0.00	0.00			
8	0.00	0.00	0.00			
9	0.00	0.00	0.00			
10	0.00	0.00	0.00			
Post						
1	91.00	10.00	0.00	23.36	17.89	
2	12.00	35.00	6.00	22.75	18.39	14.07
3	20.00	30.00	3.00	20.46	17.61	21.43
4	7.00	0.00	0.00	19.76		
5	1.00	0.00	0.00	24.40		
6	14.00	0.00	6.00	26.04		17.18
7	95.00	83.00	0.00	18.70	25.12	
8	144.00	12.00	0.00	24.83	21.43	
9	0.00	32.00	21.00		18.32	18.50
10	24.00	11.00	27.00	19.29	18.95	18.85

Table 11. Mean spartina density and length of spartina observed pre construction and post construction of the living shoreline on Little St. Simons Island, GA.

	Mean spartina density			Mean spartina height		
	L	M	U	L	M	U
Pre						
1	0.00	0.00	0.00			
2	0.00	0.00	0.00			
3	0.00	0.00	0.00			
4	0.00	0.00	0.00			
5	0.00	8.00	20.00		203.13	530.95
6	0.00	0.00	7.00			340.57
7	0.00	0.00	0.00			
8	0.00	0.00	0.00			
9	0.00	0.00	0.00			
10	0.00	0.00	0.00			
Post						
1	0.00	0.00	0.00			
2	0.00	0.00	0.00			
3	0.00	0.00	0.00			
4	0.00	1.00	0.00			
5	0.00	0.00	0.00			
6	0.00	0.00	5.00			236.00
7	0.00	0.00	0.00			
8	0.00	0.00	0.00			
9	0.00	0.00	0.00			
10	0.00	0.00	0.00			

Water quality

Water parameters at Mosquito Creek at the surface and 1 meter below the surface from March 2012 - present. Overall the site had a mean salinity of 28.8 ppt, temperature of 21.9°C, DO of 4.6 mg/, and pH of 7.6. Prior to construction March 2012 - January 2013 parameters averaged 31.8 ppt, 23.1°C, 4.2 mg/l, and 7.6 for salinity, temperature, DO, and pH, respectively. Since construction April 2013-present we have observed a mean salinity of 19.7, temperature of 20.6°C, DO of 5.0 mg/l, and pH of 7.6. The lower salinity observed since installation is most likely due to the high amount of rainfall we received from late winter through summer 2013. A complete table of all readings is below (Table 12) and water quality will continue to monitored over the coming years.

Table 12. Water quality data collected at the surface and 1m below the surface at Mosquito creek from March 2012-January 2014, Little St. Simons Island, GA

Date	Depth	pH	Dissolved Oxygen	Temperature (Celcius)	Salinity (ppt)
29-Mar-12	Surface	7.56	4.26	23.07	22.57
	1 Meter	7.57	4.48	23.06	22.64
5-Apr-12	Surface	7.61	3	23.63	30.83
	1 Meter	7.64	3.12	23.65	30.98
12-Apr-12	Surface	7.5	3.78	21.11	29.99
	1 Meter	7.59	3.81	21.13	30.28
20-Apr-12	Surface	7.67	3.36	22.9	32.18
	1 Meter	7.74	3.36	22.9	32.25
26-Apr-12	Surface	7.77	4.37	20.97	30.63
	1 Meter	7.83	4.36	20.93	30.7
8-May-12	Surface	7.31	3.34	26.48	33.24
	1 Meter	7.31	3.19	26.5	33.17
22-May-12	Surface	7.26	3.36	24.26	32.54
	1 Meter	7.3	3.32	24.06	32.61
30-May-12	Surface	7.46	3.97	26.33	31.69
	1 Meter	7.48	3.92	26.2	31.9
5-Jun-12	Surface	7.37	3.21	26.74	33.18
	1 Meter	7.4	3.31	26.74	33.32
14-Jun-12	Surface	7.41	3.87	28.01	31.47
	1 Meter	7.46	3.96	27.94	31.54
20-Jun-12	Surface	7.47	3.71	26.72	31.63
	1 Meter	7.55	3.92	26.7	31.78
28-Jun-12	Surface	7.5	3.81	27.67	29.41
	1 Meter	7.56	3.86	27.04	29.68
5-Jul-12	Surface	7.4	2.63	29.4	28.98
	1 Meter	7.41	2.73	29.4	29.19
9-Jul-12	Surface	7.63	3.9	31.48	31.69
	1 Meter	7.66	4.05	31.11	31.98
21-Jul-12	Surface	7.47	2.89	28.95	31.81
	1 Meter	7.5	2.9	28.96	32.03
24-Jul-12	Surface	7.81	3.58	31.02	33.6
	1 Meter	7.86	3.93	30.56	33.81
31-Jul-12	Surface	7.53	2.66	29.37	33.97
	1 Meter	7.65	2.51	29.36	33.97
1-Aug-12	Surface	7.65	2.82	29.09	34.18
	1 Meter	7.65	2.56	29.08	34.18
12-Aug-12	Surface	7.78	4.41	30.86	33.82
	1 Meter	7.8	4.41	30.47	33.96
16-Aug-12	Surface	7.58	2.59	28.86	32.76
	1 Meter	7.59	2.63	28.9	32.76
24-Aug-12	Surface	7.74	3.25	28.08	32.8
	1 Meter	7.82	3.3	27.66	32.78
29-Aug-12	Surface	7.71	2.86	27.56	30.86
	1 Meter	7.72	2.84	27.55	30.86
4-Sep-12	Surface	7.82	3.24	30.21	32.16
	1 Meter	7.83	3.38	29.89	32.3

Table 12. Continued

Date	Depth	pH	Dissolved Oxygen	Temperature (Celcius)	Salinity (ppt)
14-Sep-12	Surface	7.71	3.19	26.44	28.42
	1 Meter	7.73	3.19	26.35	28.71
19-Sep-12	Surface	7.79	3.69	27.98	30.59
	1 Meter	7.82	3.72	28.02	30.59
27-Sep-12	Surface	7.76	3.03	26.01	31.89
	1 Meter	7.8	2.85	25.99	31.82
1-Oct-12	Surface	8.01	2.87	26.54	32.58
	1 Meter	8.02	2.96	26.51	32.73
9-Oct-12	Surface	7.94	3.61	25.84	30.72
	1 Meter	8	3.68	25.82	30.86
15-Oct-12	Surface	8.16	3.88	24.28	32.39
	1 Meter	8.18	3.9	24.28	32.39
23-Oct-12	Surface	8.17	4.3	23.22	31.9
	1 Meter	8.21	4.32	23.22	32.12
29-Oct-12	Surface	8.18	4.61	20.08	32.98
	1 Meter	8.22	4.58	20.12	33.05
8-Nov-12	Surface	7.31	5.53	16.83	33.73
	1 Meter	7.32	5.5	16.83	33.73
15-Nov-12	Surface	7.31	5.26	16.46	34
	1 Meter	7.32	5.28	16.46	34
20-Nov-12	Surface	7.32	5.95	15.05	33.48
	1 Meter	7.35	5.99	14.97	33.47
1-Dec-12	Surface	7.28	5.86	14.33	34.01
	1 Meter	7.32	5.9	14.31	34.08
7-Dec-12	Surface	7.43	5.77	16.99	33.96
	1 Meter	7.44	5.81	16.95	33.96
20-Dec-13	Surface	7.43	5.81	16.58	32.56
	1 Meter	7.47	5.81	16.52	32.63
14-Dec-13	Surface	7.36	5.53	14.95	33.62
	1 Meter	7.37	5.53	14.95	33.62
27-Dec-13	Surface	7.29	6.01	12.53	32.24
	1 Meter	7.34	6.12	12.54	32.24
3-Jan-13	Surface	7.52	6.42	12.73	33.04
	1 Meter	7.54	6.53	12.71	33.11
10-Jan-13	Surface	7.43	6.13	13.06	31.28
	1 Meter	7.46	6.28	13	31.7
16-Jan-13	Surface	7.45	5.89	18.2	29.13
	1 Meter	7.47	5.91	17.74	29.69
25-Jan-13	Surface	7.51	6.63	13.28	30.09
	1 Meter	7.54	6.63	13.37	30.16
30-Jan-13	Surface	7.4	5.98	15.82	29.73
	1 Meter	7.43	6.03	15.73	30.08
13-Feb-13	Surface	7.21	5.5	16.46	29.91
	1 Meter	7.27	5.49	16.41	30.26
19-Feb-13	Surface	7.24	6.72	14.31	21.25
	1 Meter	7.34	6.67	13.63	24.17

Table 12. Continued

Date	Depth	pH	Dissolved Oxygen	Temperature (Celcius)	Salinity (ppt)
5-Mar-13	Surface	7.21	7.22	12.33	4.61
	1 Meter	7.13	7.15	11.92	6.18
11-Mar-13	Surface	7.16	6.49	14.99	11.77
	1 Meter	7.16	6.49	14.05	16.76
27-Mar-13	Surface	7.1	6.62	13.68	17.81
	1 Meter	7.2	6.64	13.68	17.94
8-Apr-13	Surface	6.87	5.26	18.02	8.96
	1 Meter	6.9	5.22	17.96	9.71
22-Apr-13	Surface	6.75	5.42	18.4	14.29
	1 Meter	6.84	5.43	18.39	14.29
29-Apr-13	Surface	6.92	5.2	23.66	14.58
	1 Meter	7	5.07	23.66	14.71
8-Aug-13	Surface	7.31	3.89	29.35	17.77
	1 Meter	7.49	3.64	29.37	19.14
16-Aug-13	Surface	7.46	3.57	29.58	16.09
	1 Meter	7.49	3.42	29.52	16.42
17-Sep-13	Surface	7.47	2.81	29.22	23.25
	1 Meter	7.72	2.96	29.34	24.17
26-Nov-14	Surface	8.02	5.65	15.66	27.04
	1 Meter	8.1	5.71	15.57	27.52
16-Nov-13	Surface	7.6	5.31	15.41	29.35
	1 Meter	7.9	5.25	15.29	29.42
19-Dec-13	Surface	8.21	6.28	13.5	19.94
	1 Meter	8.27	5.98	13.51	27.28
1-Jan-14	Surface	8.47	6.81	13.31	n/a
	1 Meter	8.53	6.86	13.31	n/a

Outreach

Development of outreach materials was undertaken to provide information on the living shoreline project on Little St. Simons Island and about their use in Georgia. We developed a 2'x3' sign to be installed at the living shoreline site and at the meeting/teaching space on Little St. Simons Island (Appendix V) A rack card was also developed to hand out at public events to inform the public about the living shoreline project on LSSI and about the use living shorelines in Georgia (Appendix VI).

Cost

Little St. Simons Island spent $106,907.88 on the project (Table 13) in addition to the funds supplied by the grant. A cost analysis of living shorelines in Georgia (McKinnon 2013) found that living shorelines are less expensive then bulkheads or revetments. For Little St. Simons Island the living shoreline cost $361/per linear foot for materials and installation and is cheaper than the price for bulkheads which range from $652 - $1022/per linear foot and revetments which ranged from $440 - $469/per linear foot. Below is breakdown of the different structures and their associated cost compiled from McKinnon (2013) (Table 14).

Table 13. Living shoreline expenses that Little St. Simons Island covered.

Item	**Cost**
Engineering plans	$7760.00
Landscape design and grading plan	$9035.50
Construction Contractor	$63,326.19
Native plants:	$3067.04
Barge company	$14,000.00
Labor	$9,719.15
Total spent by LSSI	**$106,907.88**

Table 14Cost comparison of three types of bulkheads, three revetments, and living shoreline for Little St. Simons Island, GA.

Bulkheads:

A bulkhead is any shore-parallel vertical structure or wall designed to prevent erosion of the land.

Vinyl bulkhead *w/toe* protection - Cost per linear foot $283 (materials) $686 (installed).

A vinyl bulkhead is a vertical sea wall constructed of rigid, interlocking vinyl sections. Each section is 18" wide on average, has tongue and groove type edges which lock together with adjacent sections, and is driven into the ground for stability. Additional stability is provided by tie-backs which extend from the exposed face of the wall into the embankment to a fixed anchor. The toe, or the embankment below the bulkhead that is exposed to the water, is protected from currents and waves by large granite rocks called rip-rap.

Wooden bulkhead *w/toe* protection - Cost per linear foot $241 (materials) $652 (installed)

A wooden bulkhead is a vertical sea wall constructed of pressure-treated wood sections. Each section is 12" wide on average, has tongue and groove type edges which fit together with adjacent sections, and is driven into the ground for stability. Additional stability is provided by tie-backs which extend from the exposed face of the wall into the embankment to a fixed anchor. The toe, or the embankment below the bulkhead that is exposed to the water, is protected from currents and waves by large granite rocks called rip-rap.

Concrete bulkhead with toe protection - Cost per linear foot $476 (materials) $1022 (installed)

A concrete bulkhead is a vertical sea wall constructed of concrete sections. Each section is 18"-36" wide on average, has tongue and groove type edges which fit together with adjacent sections, and is driven into the ground for stability. Additional stability is provided by tie-backs which extend from the exposed face of the wall into the embankment to a fixed anchor. The toe, or the embankment below the bulkhead that is exposed to the water, is protected from currents and waves by large granite rocks called rip-rap.

Revetment:
Revetment are sloping structures made of hard materials placed on banks in such a way as to absorb the energy of incoming water. Revetments are usually built to preserve the existing uses of the shoreline, to protect the slope, and as defense against erosion.

Granite Type 1 Rip Rap with Type 1 toe protection - Cost per linear foot $164 (materials) $469 (installed)

Granite Type 1 Rip Rap, also known as "surge stone," is comprised of granite stones, each weighing approximately 125 Ibs on average and measuring 18" to 24" in diameter. It is used in areas where larger stones are needed for stability or to resist the forces of strong currents or wave action. Geotextile, a woven nylon fabric, is placed under the rip rap to further reduce the energy of the water on the soil and further prevent soil loss.

Granite Type 3 with Type 1 toe protection - Cost per linear foot $155 (materials) $443 (installed)

Granite Type 3 Rip Rap is comprised of granite stones, each weighing approximately 15 lbs on average and measuring 6" to 8" in diameter. It is used to reduce the velocity and energy of water currents on the upper portions of the bank. Geotextile, a woven nylon fabric, is placed under the rip rap to further reduce the energy of the water on the soil and further prevent soil loss. Granite Type 1 Rip Rap is used to provide additional stability on the lower portion of the bank.

Granite Type 3 with Type 3 toe protection - Cost per linear foot $152 (materials) $440 (installed)

Granite Type 3 Rip Rap is comprised of granite stones, each weighing approximately 15 lbs on average and measuring 6" to 8" in diameter. It is used to reduce the velocity and energy of water currents on all portions of the bank. Geotextile, a woven nylon fabric, is placed under the rip rap to further reduce the energy of the water on the soil and further prevent soil loss.

Living Shoreline:
A living shoreline is a revetment that mimics natural, native habitat, provides increased opportunities for species diversity and productivity, and can serve to improve water quality and the ecological integrity of the area.
Oyster bags with Recycled Concrete Toe Protection - Cost per linear foot $120 (materials) $361 (installed).

Oyster bags are plastic mesh bags that are filled with loose oyster shells. Each bag is approximately 10 inches in diameter and weighs 10 Ibs on average. Oyster bags are used instead of rip rap to reduce the energy of water currents and also to provide habitat and a growing medium for living oysters. The living oysters in time provide water filtration and natural cementation and structural integrity to the embankment. Native plants are used at the top of the bank to further reduce erosion and provide habitat and water filtration. Granite Type 1 Rip Rap is used on the bottom portion of the bank for additional stability.

Discussion

The use of living shorelines is still in its infancy in Georgia and this project is the third of its type in coastal Georgia. The main focus of this project was to increase our knowledge about living shorelines in coastal Georgia and specifically how nekton community responds to the habitat created by living shorelines. The use of oyster shell has allowed new oysters to settle upon the and has increased the area of live oysters at the site. Intertidal reefs created by oysters classified as essential fish habitat and provide habitat for invertebrates (Wells 1961) and in Georgia, Bahr and Lanier (1981) found that 1m^2 of intertidal oyster reef had 50m^2 of surface area for epifauna to utilize. The added oyster habitat has already had a positive impact upon the fish community at the site. The most abundant fish species remained the bay anchovy (*Anchoa mitchilli*), but we did see their numbers increase and the number species present double from 10 to 20 in the two sampling periods that have occurred after installation of the living shoreline. We also noticed an increase in the number of grass shrimp (*Palaemontes* spp.) present after construction of the living shoreline. Bay Anchovy and grass shrimp are important ecological species since they help form the base of the food webs (Baird & Ulanowicz 1989; Luo & Musick 1991) and are an important component of the diet of many finfish (Williams 1984; Collette & Klein-MacPhee 2002). We also observed an increase in the number commercially and recreationally important species such as white shrimp (*Penaeus setiferus*) and sheepshead (*Archosargus probatocephalus*). This support finding by Dame *et al.* (2002) that found that the biomass of nekton was higher in creeks where oysters where present when compared to creeks with oysters. Subsequent sampling will allow for us to understand the full impact that the living shoreline will have upon nektonic species. Oyster recruitment to the living shoreline is similar to what has been observed at Ahshantily and other artificial reefs that have been established in Georgia. The site at

The cost of living shoreline was less expensive than the estimated cost of bulkhead or revetment at the site. Long term monitoring is needed to know the lifespan of living shorelines, but it does seem that maintenance and repairs will be less since the use of heavy machinery will not be necessary. The site at Little St. Simons Island had sandier soils that are less compact than soils observed at the sites on Sapelo Island. Although, the construction of the living shoreline did differ from the construction used on Sapleo Island, at the Ashantilly site, to address the slumping that was observed, we still feel that comparison of the two sites will allow for insight on how living shorelines will behave on different sediments

The continued monitoring at the site and comparison to other living shoreline sites will increase our understanding of the use of living shorelines in coastal Georgia and help in the development and refinement of guidelines for the use of living shorelines.

Acknowledgement

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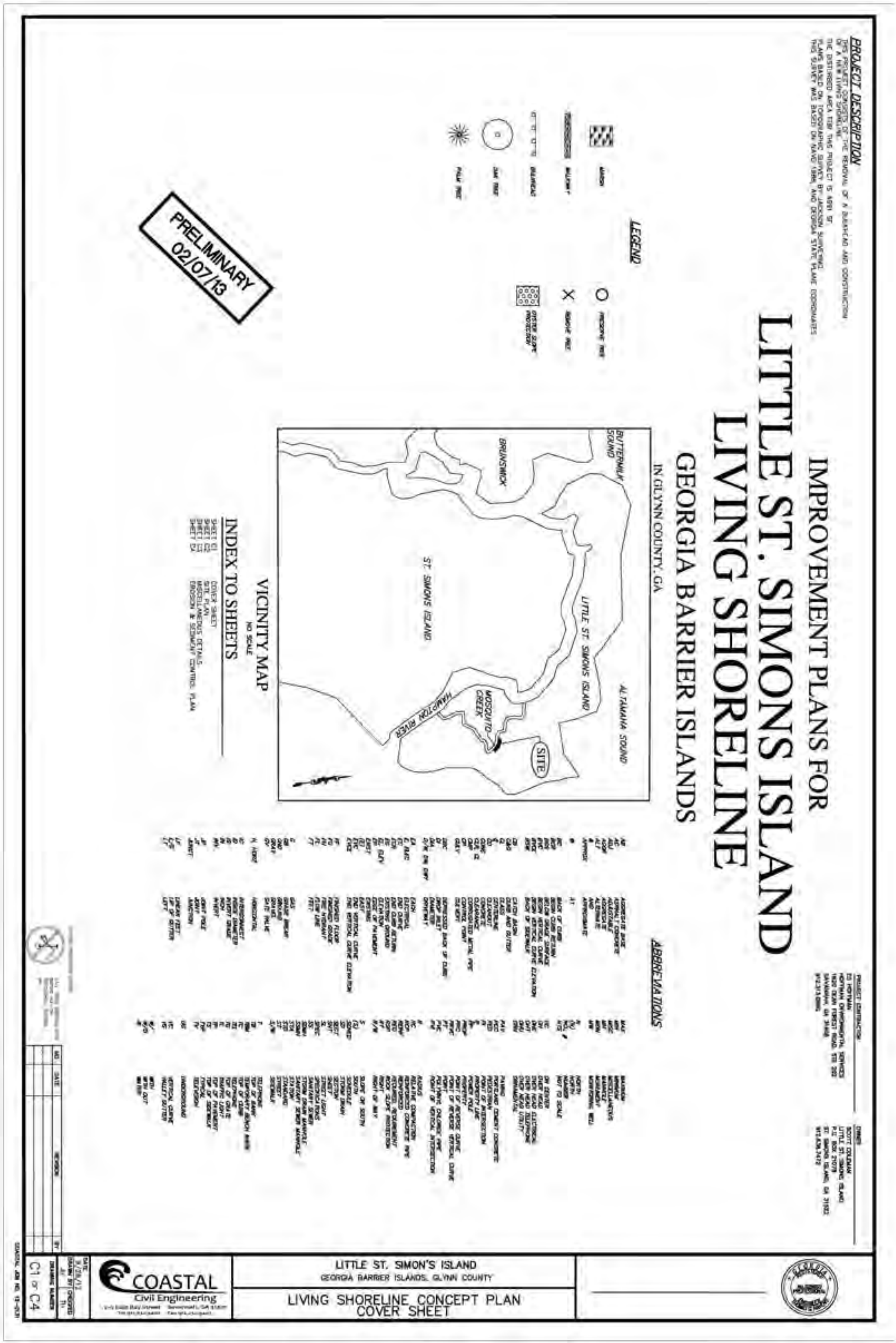
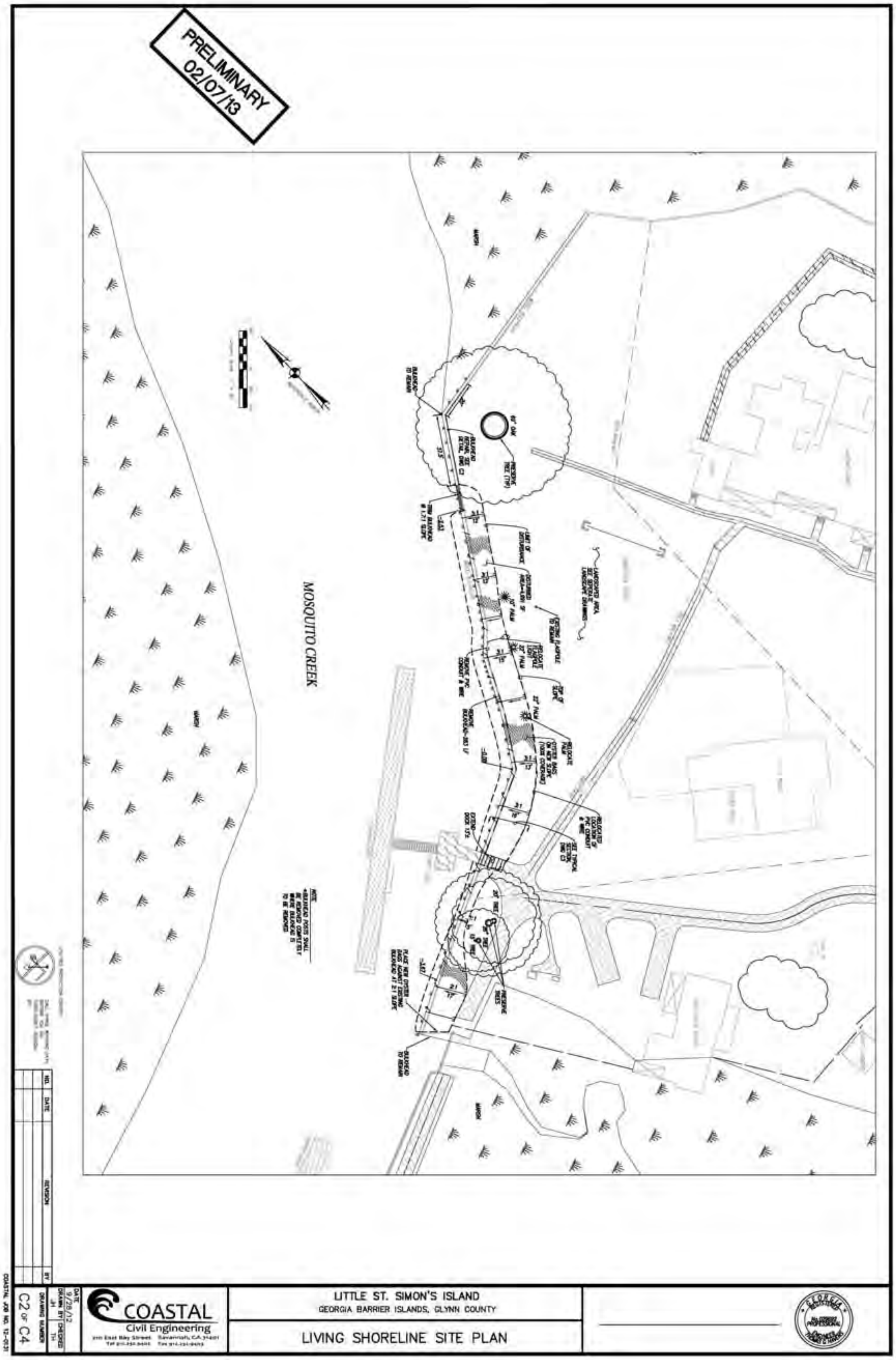
Appendices

Appendix I. Little St. Simons Island Living Shoreline Plans

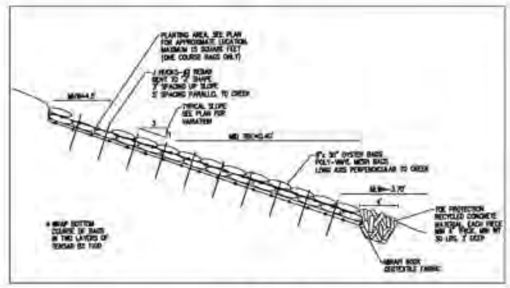



PRELIMINARY
02/07/13
MOSQUITO CREEK
COASTAL
Civil Engineering
LITTLE ST. SIMON'S ISLAND
GEORGIA BARRIER ISLANDS, GLYNN COUNTY
LIVING SHORELINE SITE PLAN
C2 OF C4

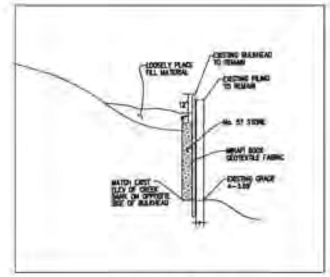
GENERAL NOTES

1. OYSTER SHELLS HAVE A NOMINAL SIZE OF 2.5" IN LENGTH
2. THE TOE OF SLOPE ELEVATION WILL VARY ALONG THE LENGTH OF THE BANK. THE EXISTING GRADE IS IRREGULAR ALONG THE FACE OF THE EXISTING BULKHEAD TO BE REMOVED.
3. OYSTER SHELLS SHALL BE PLACED IN 8"x30" OYSTER BAGS. THE BAGS WILL THEN BE PLACED IN EVEN ROWS UNTIL THE AREA TO BE STABILIZED IS COMPLETELY COVERED. ONCE OYSTER SHELLS ARE IN PLACE, STAKE IN PLACE WITH J HOOKS.
4. UTILITIES MAY EXIST WHICH ARE NOT SHOWN ON THE PLANS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACTING ALL UTILITY COMPANIES HAVING UTILITIES WITHIN OR ADJACENT TO THE WORK AREA. THE CONTRACTOR SHALL HAVE THE UTILITIES FIELD LOCATED AND COORDINATE WITH UTILITY COMPANIES TO HAVE THEM RELOCATED AND/OR ADAPTED FOR THE TIE-INS. IN ADDITION, CONTRACTOR IS REQUIRED TO CONTACT THE UTILITIES PROTECTION CENTER OF GEORGIA AT 1-800-282-7411 PRIOR TO ANY CLEARING OR EXCAVATION.
   ALL VEGETATION (UNLESS OTHERWISE NOTED), ORGANICS AND UNSUITABLE BEARING SOILS SHALL BE STRIPPED FROM THE SURFACE WITHIN THE CONSTRUCTION LIMITS AND DISPOSED OF LEGALLY OFFSITE
5. ALL VEGETATION, ROOT SYSTEMS, TOPSOIL, REFUSE AND OTHER DELETERIOUS, NON-SOIL MATERIAL, AND CLEAN TOPSOIL MAY BE STOCKPILED AND REUSED LATER IN LANDSCAPED AREAS.
6. CONTRACTOR SHALL HAVE THE LIMITS OF CLEARING AND ALL BUFFERS STAKED WITH FLAGGING STRUNG AT CLEARING LIMITS TO ENSURE THE PROPER LOCATION OF TREE SAVE FENCE AND PROPOSED IMPROVEMENTS.
7. ALL NECESSARY PERMITS FOR DEMOLITION SHALL BE OBTAINED BY THE CONTRACTOR PRIOR TO BEGINNING WORK.
8. THE CONTRACTOR SHALL LEAVE THE SITE IN A CLEAN AND NEAT CONDITION. ALL DEBRIS, VEGETATION WHICH HAS BEEN REMOVED, LUMBER, CONCRETE, AND WASTE FROM DEMOLITION ETC. SHALL BE REMOVED FROM THE SITE AND PROPERLY DISPOSED.
9. CONTRACTOR SHALL PROTECT ALL ADJACENT LANDS FROM DAMAGE DURING DEMOLITION WORK. ANY OFFSITE AREAS DISTURBED SHALL BE RETURNED TO A CONDITION EQUAL TO OR BETTER THAN THE EXISTING CONDITION
10. ALL STRUCTURES NOT LABELED FOR DEMOLITION SHALL BE PROTECTED FROM DAMAGE DURING ALL PHASES OF CONSTRUCTION. ANY STRUCTURES THAT ARE TO REMAIN THAT ARE DAMAGED SHALL BE REPAIRED BY THE CONTRACTOR TO A CONDITION EQUAL OR BETTER THAN THE EXISTING CONDITION AT NO ADDITIONAL COST.
11. FILL MATERIAL SHALL BE NATIVE MATERIAL EXCAVATED FROM THE PROJECT SITE.
12. MAX CUT OR FILL SLOPES SHALL BE 1:1 (H:V).
13. EQUIPMENT, MATERIALS AND CONSTRUCTION VEHICLES SHALL BE PLACED IN AREAS DESIGNATED BY THE OWNER CONSTRUCTION AND STORAGE AREAS SHALL BE KEPT NEAT AND CLEAN. TREE SAVE AREAS SHALL NOT BE USED FOR STORAGE OR PARKING.
14. ALL BACKFILL MATERIAL SHALL BE COMPACTED BY TRACKING TO APPROXIMATELY 90% R.C. MATERIAL SHALL BE CLEAN AND FREE OF ROOTS, ROCK OR DELETERIOUS MATTER.
15. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES BETWEEN PLAN AND FIELD CONDITIONS PROMPTLY UPON DISCOVERY. ANY CONFLICT OR DISCREPANCIES DISCOVERED WITHIN THE CONSTRUCTION PLANS SHALL BE REPORTED IMMEDIATELY TO THE ENGINEER FOR CLARIFICATION.
16. LIMIT THE LENGTH OF EXISTING STREAM BANK THAT IS EXCAVATED TO PROPOSED GRADE TO THAT WHICH CAN BE STABILIZED IN ONE DAYS WORK (8 HRS.)
17. TIDAL FLUCTUATION AVERAGES 8.2 FEET.
18. ANY BARGES LEFT IN THE CREEK ADJACENT TO THE PROJECT SITE SHALL BE LIT TO BE VISIBLE AT NIGHT WHEN APPROACHED FROM ANY DIRECTION.

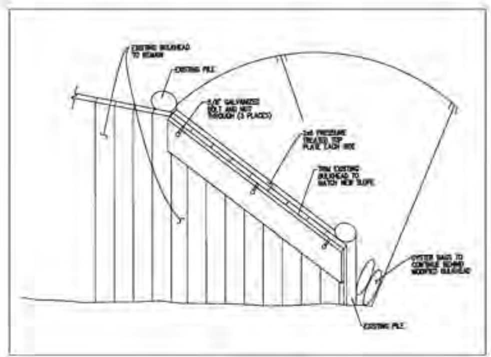
PRELIMINARY
02/07/13



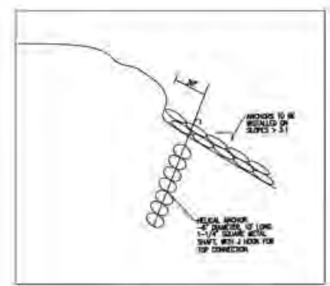
LIVING SHORELINE
TYPICAL SECTION
NO SCALE



BULKHEAD REPAIR
NO SCALE



TRIM BULKHEAD
NO SCALE



STEEP SLOPE ANCHOR
NO SCALE

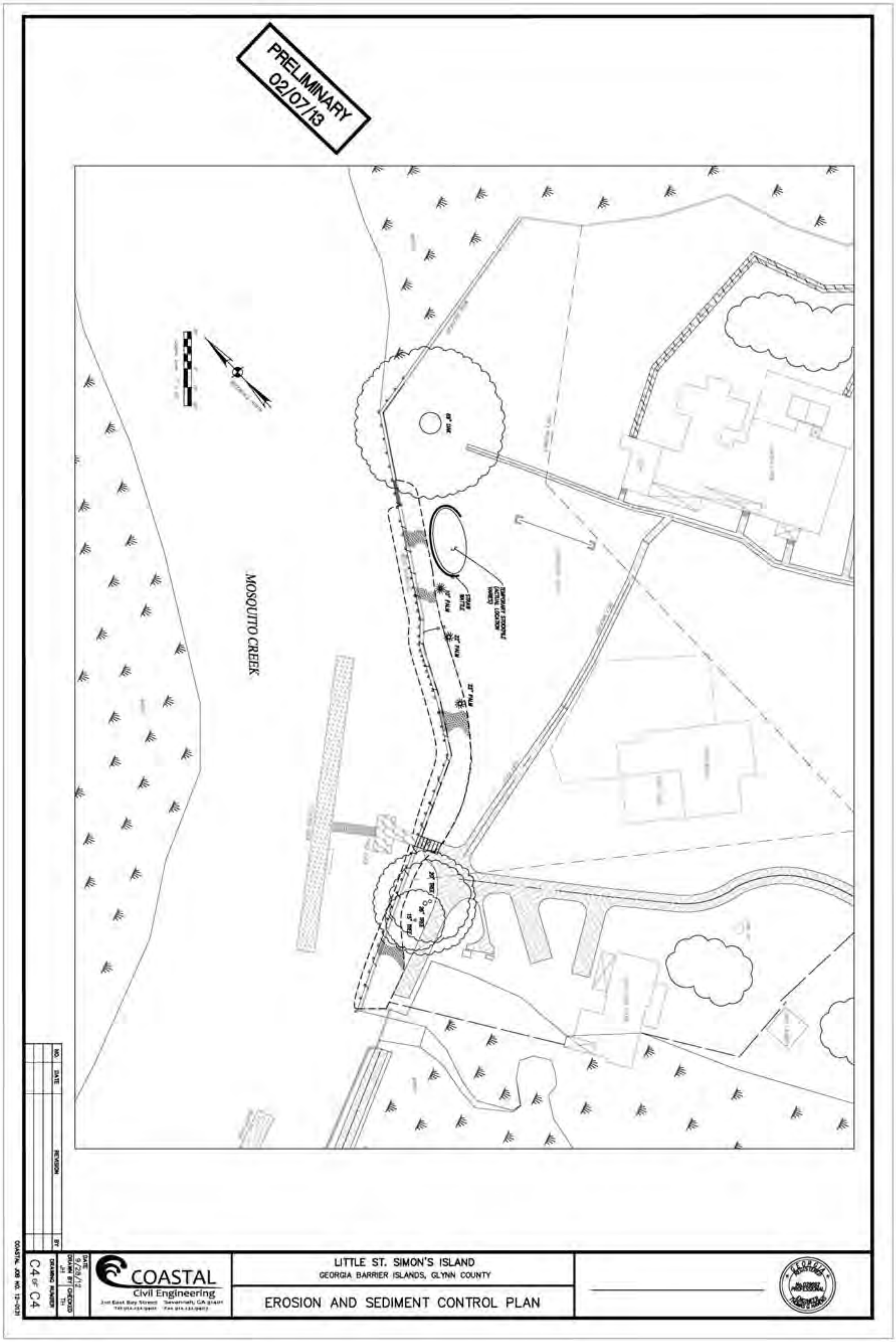
NO.	DATE	REVISION	BY

LITTLE ST. SIMON'S ISLAND
GEORGIA BARRIER ISLANDS, GLYNN COUNTY

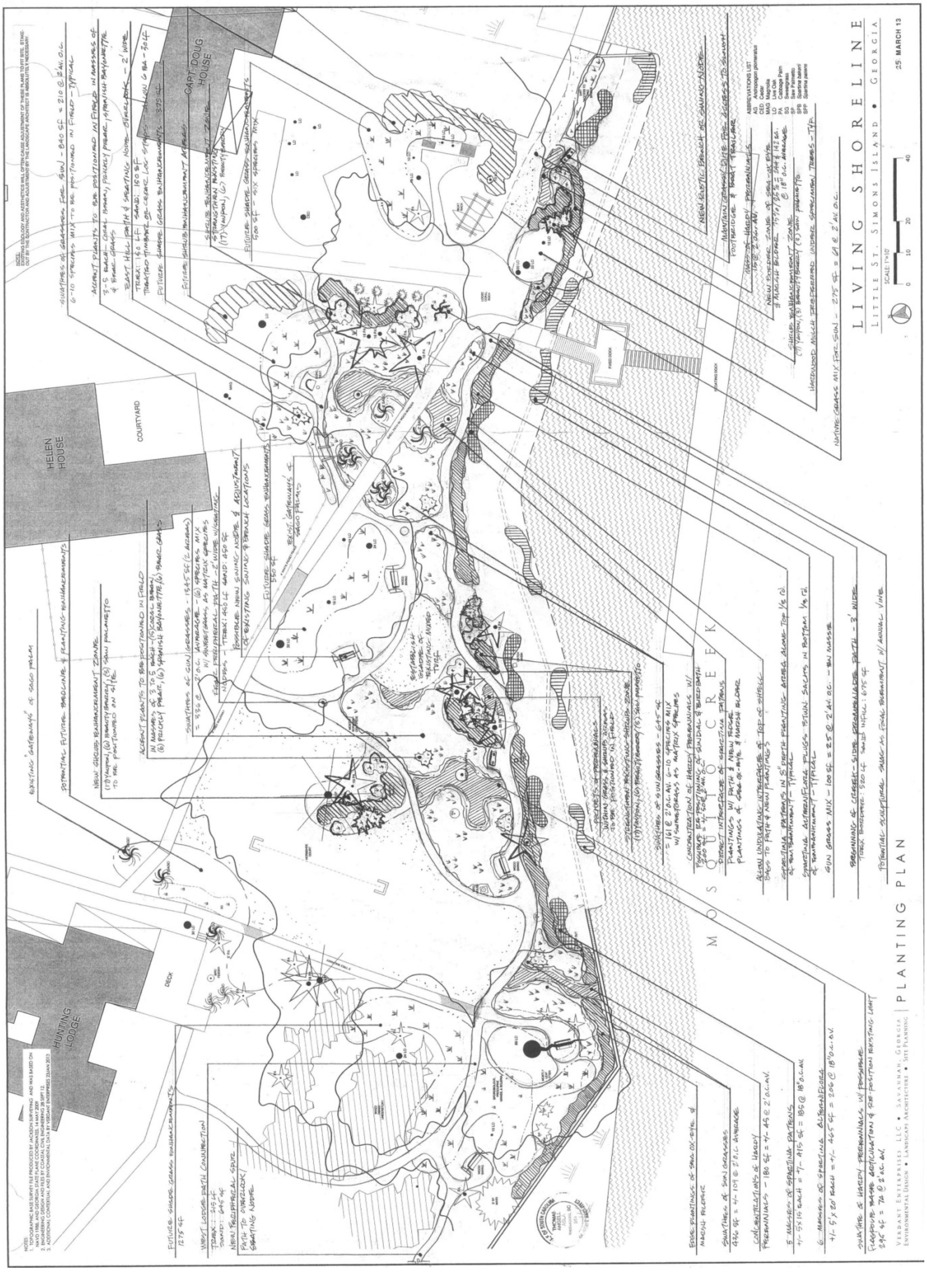
MISCELLANEOUS DETAILS

COASTAL Civil Engineering

DATE 9/28/12
DRAWN BY JH | CHECKED TH
DRAWING NUMBER C3 OF C4
COASTAL JOB NO: 12-0131


PRELIMINARY
02/07/13
MOSQUITO CREEK
COASTAL
Civil Engineering
LITTLE ST. SIMON'S ISLAND
GEORGIA BARRIER ISLANDS, GLYNN COUNTY
EROSION AND SEDIMENT CONTROL PLAN
C4 OF C4

Appendix II. Landscape Architecture Plan



Appendix III. AmeriCorps NCCC Service Project Concept Application Form

AmeriCorps NCCC
Service Project Concept Form
STEP 1

This form will help AmeriCorps NCCC determine if the organization's project concept meets the basic criteria for a service project. Upon review, the regional Program Office will notify the organization of its status and the next steps in the Project Application process. **IMPORTANT: PLEASE TYPE.**

1. Organization Name: Board of Regents of the University System of Georgia on behalf of the University of Georgia - Marine Extension Service
   Organization Representative: Thomas Bliss
   Mailing Address: 20 Ocean Science Circle
   City/State/Zip: Savannah, GA, 31411
   Telephone:912-598-2348 Fax: 912-598-2399 Email: tbliss@uga.edu
   Website: http://www.marex.uga.edu/shellfish/

2. Provide a brief description of your organization's mission.

   The Marine Extension Service is a Public Service & Outreach unit of the University of Georgia. Programs of applied research, advisory services and education are coordinated from facilities in Athens, Savannah and Brunswick to preserve and enhance coastal natural resources and to foster sustainable economic and social growth in the coastal community, and throughout the state and region.

3. Provide a brief description about the service activities for which your organization is requesting a NCCC team. Please conclude your statement with the desired outcome expected from the involvement of NCCC.

   The Eastern Oyster is a keystone species in coastal Georgia, playing a vital role in maintaining healthy estuarine ecosystems. In the early 1900's, oysters were overharvested resulting in the loss of the oyster industry, and more importantly, the ecological benefits these oyster reefs provide (e.g. water filtration, essential fish habitat, and erosion control from boat wakes and waves). The Marine Extension Service implemented GEORGIA (Generating Enhanced Oyster Reefs in Georgia's Inshore Areas), a community-based oyster restoration program to return shell to coastal waters as cultch to regenerate new oyster beds. Shell is collected from private roasts and restaurants and brought to a shell recycling center to cure. Shell is cured for 3 months, and volunteers place shell in plastic mesh bags, for future use in oyster reef building. In the spring 2013 we are undertakeing construction of living shoreline, comprised of oysters shell, on Little St. Simons Island and is being built as part of the Little St. Simons Island coastal environmental education program. We have previosuly hosted three different Americorps NCCC groups to assist with our restoration efforts, and without whom we could not have accomplished our goals. The NCCC team would again be a very critical component in the success of this undertaking by bagging the oyster shell that needed for success of this project. Additionally, we need help, and not just because of the scale of the living shoreline, but because no longer have a GEORGIA coordinator position due to budgetary shortfalls. While we still have volunteer support and thriving new community partnerships with the Georgia Department of Natural Resources, the Coastal Conservation Association, The Nature Conservancy, and Little St. Simons Island, we need the consistent, dependable and hard work of the Americorps NCCC to see this project through to fruition. Through the restoration of oyster habitat we expect to increase essential fish habitat, provide stabilization of the salt-marsh against erosion, and enhance coastal stewardship.

4. Provide the address where the service activities will take place if different from the organization address above.
   Address: Little St. Simons Island, GA Mailing address: PO Box 21078, 1000 Hampton Point Drive
   City, State, & Zip Code: St. Simons Island, GA, 31522

5. Check the box for the primary issue area that the project will address.
   - ☐ Natural and Other Disasters
   - ☐ Infrastructure Improvement
   - ☐ Urban and Rural Development
   - ☒ Environmental Stewardship and Conservation
   - ☐ Energy Conservation

6. How many teams are being requested? 1
   How many weeks will it take a team of 8 to 12 members working full-time to complete this project? 4-5 weeks
   Proposed Beginning Date: March 13, 2013 Proposed End Date: April 17, 2013

These dates are ☐ Fixed or ☒ Flexible

7. What is your organization type? Check all that apply.
   ☐ National Non-Profit ☐ Local Municipality ☐ National or State Park
   ☐ Community or Faith-Based ☐ Indian Tribe ☐ Federal Government
   ☐ School ☒ State Government
   ☐ Other (please specify): ______

8. Projects within a reasonable driving distance from the campus will not need to provide housing for the team. If your project site(s) is beyond a reasonable driving distance, briefly describe the housing arrangements you are exploring for the team.

   We are exploring a variety of housing options at different facilities in the Brunswick and St. Simon's area. Currently facilities we are looking into a youth hostel (Hostel in the Forest), vacation rentals in Brunswick and St. Simons Island, extended stay hotels, Epworth by the Sea (a Methodist retreat center), and housing at the College of Coastal Georgia.

9. Have you worked with a NCCC team previously? ☒ Yes ☐ No
   How many teams have served your organization? Three (3)
   When did a team most recently work with your organization? 2010

10. How did you find out about the NCCC? (check all that apply)
    ☐ NCCC Staff Member ☐ NCCC Alumni ☐ Outreach Presentation
    ☐ State CNCS Office ☒ Previous NCCC Project Sponsor
    ☐ State Commission Community Service Office ☐ Current NCCC Member
    ☐ Other (please list): ______

Thomas H. [signature]
Signature

10/12/2012
Date

Appendix IV. AmeriCorps Joint

A detailed work plan is an essential element of successfully conducting a project. The project must engage all team members in meaningful service throughout the duration of the project. Members must be engaged a minimum of 40 hours a week to complete their service obligation. A final, comprehensive and detailed work plan will be required before the project is approved and a team assigned.
Inclement weather can shut down scheduled project activities. The sponsor is required to have a work plan for inclement weather. The inclement weather plan may include service opportunities with other sponsors such as eligible non-profits, schools or local government agencies within a reasonable driving distance.

PROJECT PLAN

1. MISSION AND OBJECTIVES OF YOUR ORGANIZATION

a) Describe the overall mission of your agency. This should include a brief history of the organization, an explanation of the organization's mission and how it fulfills this mission through its various programs, census information and other statistics that assist in demonstrating the need.

Since its inception in 1970, the Marine Extension Service has worked to identify and address problems related to Georgia's coastal and marine resources, and to generate and disseminate information pertaining to coastal issues through its applied research and communications programs. The coordinated programs of applied research, advisory services and education carried out from offices in Athens and Atlanta and from facilities on Skidaway Island, Savannah and Brunswick extend economic and cultural benefits throughout the state and region

b) What community needs will be addressed by this project?

GENERAL

The Georgia Coast is alive with valuable and celebrated natural resources, and steeped in rich culture and history. Much of those celebrated resources, are found among the 14 barrier islands that lie between the mainland and the Atlantic Ocean. Only four of those islands are accessible by car and are largely developed. The other 10 islands are accessible only by boat, kayak or canoe, are sparsely populated and several are open to the public by invitation only. The Golden Isles includes St. Simons Island, Little St. Simons Island, Sea Island and Jekyll Island.

This project involves several parts, all focused on environmental stewardship and conservation.

Part ONE of this project is a multi-faceted project involving several coastal organizations and agencies. The goals of PART ONE are to restore habitats necessary for keystone species (like the oyster), protect marshlands from erosion, remove exotic invasive species that inhibit natural communities from thriving, restore native plant communities, and establish public spaces and demonstration sites where coastal residents and visitors can experience the unique attributes of the GA Coast. The service activities being requested will significantly advance these efforts to conserve the natural communities of the Georgia Coast.

The living shorelines have been successful in terms of recruiting oysters and to further the impact that living shorelines a project was undertaken to install a living shoreline on Little St. Simons Island. This project is a partnership between TNC, the State of Georgia, NOAA, SARP, SINERR, Little St. Simons Island, and UGA. This project will restore 0.10 acres of oyster habitat which is essential fish habitat on Little St. Simons Island where a bulkhead is currently located. This site will create an additional demonstration site in Georgia and will be an important component of coastal education to visitors to the island. The living shoreline will enhance awareness for oyster reef restoration, protection and conservation; and will provide essential fish habitat and promote recreational fishing opportunities.

c) Describe how the proposed project will help to meet these needs. What will be the final outcome(s) of services provided?

Part ONE - Living Shoreline
Georgia once had extensive oyster acreage; however, overharvesting, disease and changes in hydrology and water quality have had significant impacts. The University of Georgia's Marine Extension Service began a community-based oyster restoration project called G.E.O.R.G.I.A. (Generating Enhanced Oyster Reefs in Georgia's Inshore Areas) in 2003. Since the program's inception, it has generated considerable amount of public interest through educational and outreach events about the importance of oyster reefs. Ultimately, the state of Georgia is interested in using Living Shoreline techniques for coastal stabilization instead of structures such as bulkheads, and the public is interested in creating new reefs from recycled shell to protect their coastal ecosystem. We require assistance from the NCCC to bag the recycled shell material and to help plant it along the creek banks of Little St. Simons Island. Once in place the new oyster reefs will provide enhanced essential fish habitat, stabilize the shoreline where a bulkhead is failing, and provide an educational resource for eco-tourism, the general public, planners, and resource managers.

Part TWO – Cannon's Point Recreation and Protection The NCCC team will create a recreational path to open Cannons Point, the largest protected area of wilderness on St. Simons Island to the public and the eliminate exotic invasive species that are threatening historic features on the property.

Part THREE – Jekyll Island and DNR Natural area protection
The NCCC team will assist Jekyll Island staff and volunteers to create safer public access to one of Georgia's most visited barrier island and protection of the native flora of the Georgia Coast.

d) What is your sustainability plan for the project? How can a NCCC team assist in this?

Part ONE - Living Shoreline
Once the living shoreline is established the site should be self sustaining and staff from MAREX and Little St. Simons Island will continue to monitor the site. No further assistance from an NCCC is expected.

Part TWO – Cannon's Point

Part TWO of this project focuses on providing public access and recreational opportunities on St. Simons Island, the second largest and most populated barrier island with 13,000 residents. The St. Simons Land Trust in partnership with The Nature Conservancy and several other partners recently purchased a 600-acre area of undeveloped maritime forest and marshland on the north end of the island known as Cannon's Point. It will be preserved for perpetuity and is being established as a passive recreation area for residents of the island. (See Attached Map of Cannon's Point.)

Part THREE of this project focuses on conserving the native plant species and maintaining public areas on Jekyll Island, the most popular vacation and convention island in the Golden Isles, and several wildlife management areas on the mainland around the city of Brunswick.

Living Shoreline Project

The Eastern Oyster is a keystone species in coastal Georgia, playing a vital role in maintaining healthy estuarine ecosystems. In the early 1900's, oysters were overharvested resulting in the loss of the oyster industry, and more importantly, the ecological benefits these oyster reefs provide (e.g. water filtration, essential fish habitat, and erosion control from boat wakes and waves). The Marine Extension Service implemented GEORGIA (Generating Enhanced Oyster Reefs in Georgia's Inshore Areas), a community-based oyster restoration program to return shell to coastal waters as cultch to regenerate new oyster beds. Shell is collected from private roasts and restaurants and brought to a shell recycling center to cure. Shell is cured for 3 months, and volunteers place shell in plastic mesh bags, for future use in oyster reef building. The program has been increasing the scale of its restoration projects in recent years and to date has restored approximately 2 acres of oyster habitat. In spring 2013 we are adding approximately 0.10 acre of new habitat on Little St. Simons Island, Georgia. We have previously hosted three different Americorps NCCC groups to assist with our restoration efforts, and without whom we could not have accomplished what we have. This year more than ever we need help, and not just because of the scale of the project but because we no longer have a GEORGIA coordinator position due to budgetary shortfalls. While we still have volunteer support and thriving new community partnerships with the Georgia Department of Natural Resources, the Coastal Conservation Association, and The Nature Conservancy, we need the consistent, dependable and hard work of the Americorps NCCC to see this project through to fruition. Through the restoration of oyster habitat we expect to increase essential fish habitat, provide stabilization of the salt-marsh against erosion, and enhance coastal stewardship.

With recent pressures due to coastal economic and residential development, the State has seen record numbers of permits for shoreline developments and has also seen increased numbers of individual shoreline structures and project such as bulkheads. One result of this increased shoreline development has been a decline in the quality and quantity of living shoreline habitat. In 2009 a Living Shoreline project on Sapelo Island was undertaken that was a partnership between The Nature Conservancy (TNC), the State of Georgia, NOAA, the EPA, SINERR, and the University of Georgia. There were three long term goals of this project to help the state meet the challenges of preserving Georgia's future living shoreline: 1) To create a successful, highly visible demonstration site for living shoreline restoration and stabilization; 2) To explore and communicate effective techniques for shoreline stabilization and the benefits of living shorelines in Georgia, and 3) To build capacity through partnerships and stakeholder involvement for shoreline habitat restoration.

As part of the protection of Cannon's Point nature preserve, the St. Simons Land Trust, with assistance from the Nature Conservancy convened local conservation experts to form the Cannon's Point Conservation Task Force. This Task Force prepared an Ecologial Management Plan for the site in September 2012 which includes long-term goals, needs and programs to ensure Cannon's Point retains the unique features of its cultural and natural history, yet remains accessible to the public for recreation and educational purposes. (see Attachment X – "Excerpt from Ecological Management Plan for Cannon's Point." *Assistance may be needed from NCCC in future years of maintenance work and repairs on the trail and recreational structures and in the continued fight against invasive exotic plants.*

Part THREE – Jekyll Island and DNR Natural area protection
Jekyll Island is one of the most visited islands in Georgia. As such, much attention has been paid to the need for balance of natural resources and economic development opportunities. In March 2012, the JIA solicited the assistance of the University of Georgia Fanning Institute to develop the Jekyll Island Master Plan 2012. The Master Plan is built on a long-term conservation plan with the mission to "Preserve, maintain, manage, and restore Jekyll Island's natural communities and spaces diversity while providing nature-based educational and recreational opportunities for the general public."
http://www.jekyllmasterplan.org/taskforce.html *Assistance may be needed from NCCC in future years of maintenance work in the continued fight against invasive exotic plants on Jekyll Island and the fulfillment of the conservation plan developed for the site.*

2. PROJECT WORK PLAN AND TASKS

A detailed work plan is an essential element of successfully conducting a project. The project must engage all team members in meaningful service throughout the duration of the project. Members must be engaged a minimum of 40 hours a week to complete their service obligation. A final, comprehensive and detailed work plan will be required before the project is approved and a team assigned.

Inclement weather can shut down scheduled project activities. The sponsor is required to have a work plan for inclement weather. The inclement weather plan may include service opportunities with other sponsors such as eligible non-profits, schools or local government agencies within a reasonable driving distance.

a) List the specific tasks and activities that the team will perform.

Part ONE - Living Shoreline
Oyster shell is collected from local restaurants and private roast events and stored in one of the five publicly accessible Shell Recycling Centers that are located on Skidaway, Tybee and Jekyll Islands and in Darien and Brunswick. After a period in which the shell is cured to rid it of pathogens, meat, and potential hitchhikers, volunteers shovel the shell into mesh bags. Bagging the shell is necessary to retain the oyster reef as it prevents Georgia's strong tides from scattering the shell. In the spring, the bagged oyster shell will be planted on Little St. Simons Island.

Oyster shell has been delivered to Hampton Marina on St. Simons Island and will need to be bagged. We estimate that 8,000 bags of shell are needed for the living shoreline. Once oyster shell has been bagged the bags will need to be loaded onto boats and shipped over to Little St. Simons Island and unloaded.

Additionally, natural plantings at the living shoreline site on Little St. Simons Island will need to be dug up and saved prior to removal of the bulkhead and re-planted with additional plantings after the bulkhead is removed.

Part TWO – Cannon's Point
The NCCC team will assist in: (1) establishing a system of recreational hiking trials through the upland 400 acres in Cannon's Point (see attached Map). SSLT will sponsor a trail expert to train and lead the AmeriCorps in the trail construction and installation efforts; (2) removing exotic invasive plants – lantana is prevalent- lantana, from the historic tabby ruins located in a remote section of Cannon's Point. This work will include the use of hand-tools and possibly chainsaws.

Part THREE - Jekyll Island and DNR Natural area protection
The NCCC team will assist the DNR and JIA staff with 1) invasive Water Hyacinth removal in the Altamaha River delta, 2) Vegetation clearing in active invasive *Phragmites australis* control areas. 3) control activities for the Canary Island Tamarisk at the coastal DNR headquarters. The NCCC team will also assist Jekyll Island staff and volunteers in a number of possible projects, including: 1) administering control activities for Chinese Tallow and other high priority invasive plants. 2) removing dilapidated boardwalk debris, 3) removing marine debris from the high marsh along the north side of the Jekyll Island causeway, and 4) clearing public recreational trails and safety firebreaks.

b) Provide a project work plan including:

- The tasks to be accomplished during each week of the service project.
- An estimate of the number of members required to complete each task.
- A calendar that shows the sequence of activities throughout the duration of the project.

Because much of the work in Part ONE of the project are affected by the local tides, the duties described for Parts ONE and TWO will be alternated and arranged so as to coincide with the relevant tidal stages during the first 4 week period. All members will be needed to complete these tasks. Once the dates are confirmed we will consult the projected tides for the project area and plan the days as either bagging (no workable tide), moving (good high tides), or planting (good low tides).

Part ONE - Living Shoreline
Week 1 will begin with an orientation and training,

Weeks 1, 2, 3: NCCC group will spend their time between bagging shell material, transporting bagged shell to Little St. Simons Island, and digging up plantings.

Exotic invasives are out-competing native plants in many areas throughout the Golden Isles. The success of this part of the project will be measured in acres cleared and treated for exotic invasives of concern. Additionally, the success of the work on Jekyll Island can be measured in the pounds of dangerous debris removed from areas open to the public or in footage of boardwalk and trail improved.

d) Provide an inclement weather work plan that includes:

- Inclement weather service tasks in the sequence in which they will be addressed.
- The address, phone number and site supervisor at the inclement weather project site (if different than regular project site address).

Should extreme weather conditions inhibit field activities the team will regroup at the St. Simons Island homebase where options will be discussed. Options include assisting with projects and operations at the following non-profit organizations:
- Jekyll Island 4-H Center (http://www.jekyll4h.org) a
- Tidelands 4-H Center on Jekyll Island (http://www.tidelands4h.org)
- Sparrow's Nest Food Bank (http://www.homelessshelterdirectory.org/cgi-bin/id/foodbank.cgi?foodbank=4284)
- Boys and Girls Club of Southeast Georgia (http://www.apositiveplace.net)

3. COMMUNITY INVOLVEMENT

Leveraging and working cooperatively with community volunteers is a national service priority. Project Applications with a strong community involvement component will be given priority.

a) Describe how the community is already involved in helping to meet the stated needs of the organization. Please describe all current forms of support including funding, volunteers, donation of materials, and government or private grants that contribute to your program's operations.

MAREX

Specific to living shorelines, during the last funded restoration project period (2006-2009) our outreach efforts included the following: information brochures about GEORGIA and animal waste stewardship were designed and disseminated; a children's poster competition was launched; Artist Buddy Hale was contracted to create an oyster reef moongate exhibit at the Tidelands Nature Center to represent oyster's keystone role in maintaining healthy coastal ecosystems. Several news media stories were printed and broadcasted that related to activities associated with this project (19 newspaper articles, 9 newsletters, 2 television stories). Various festivals were attended that provided great outreach opportunities to approximately 30,000 coastal citizens. Forty-three presentations were also offered throughout the coastal community to a total of 1,112 attendees. Periodically, volunteers were assembled at each of the shell collection centers and the recycled shell was placed into plastic mesh bags. Volunteers prepared a total of 15,922 shell bags at 76 different sessions, representing a total of 9,043 volunteer hours. For this project we had employed two full-time staff members through an EPD 319 grant.

For this project funding was received from a NOAA/SARP Community Restoration Grant, but the only covers supplies and does not provide monies to for a dedicated staff person for this effort.

ST SIMONS LAND TRUST

b) How many volunteers support your organization on a weekly basis? Please describe your volunteer outreach efforts.

MAREX Shell bagging events are held roughly bi-monthly at one of the five shell recycling centers coast-wide. In October 2012 we had 2 bagging events and 1 is scheduled for November 2012. Additional dates are being scheduled with Little St. Simons Island to bag shell that has been delivered to a marina on St. Simons Island. While the NCCC group is her volunteer bagging events will also be hosted for the general public and everyone will also be invited to participate on the planting dates. Volunteers are recruited and informed about events through a list serve, through local media advertising, and through the efforts of project partners

ST SIMONS LAND TRUST

c) Describe the current capacity of your organization to manage additional community volunteers.

The University of Georgia Marine Extension service is capable to manage additional community volunteers. Besides the volunteer efforts to collect and bag oyster shell for the GEORGIA program we have volunteers that help with Adopt-A-Wetland Program (a water quality monitoring program), phyto-plankton monitoring, aquarium husbandry, and environmental education.

4. ACCOMMODATIONS

If the project site is beyond a reasonable driving distance, as determined by the campus, the project sponsor must provide, and pay for if necessary, lodging for the team. This is what is called a "spike" project. An application is considered incomplete and a team can not be assigned until appropriate housing has been identified. Providing food and/or meals is encouraged, but not required in order to receive a team.

Accommodations should be responsive to the following requirements:

- Adequate space for 8-12 members with separate female and male sleeping facilities
- Access to bathroom, shower, and laundry facilities
- Availability of cooking and food storage facilities or meals provided by sponsoring agency
- Possible special dietary arrangements that may accommodate vegetarians, if food will be prepared for the team (many members do not eat meat or dairy products)
- Safety and security of members, their personal belongings, and equipment

a) Please provide a detailed explanation of the provided accommodations addressing the requirements above and including:

- Type of housing, i.e. house, apartment, church, camp, etc.
- Number of sleeping rooms, including the number of beds in each room if applicable
- Number of bathrooms
- Location of laundry facilities (onsite or laundry mat)

Team members will be housed at Demere Landing a multi-family condominium comoplex on St. Simons Island. Two condos will be provided offering separate female and male sleeping quarters, two kitchens, and bathrooms including a shower, and laundry facilities. Each building is secure. The work site for Part ONE is located on Little St. Simons Island, accessible by ferry 7 mile drive from the condos. The work site for Part TWO of the project is located 6 miles from the condo.
http://www.hodnettcooper.com/rental/house.html?ID=561&User=alpha

For Part THREE of the project, team members will be camping. The campsite is located on the North end of Jekyll Island. The facilities have full bathrooms and laundry. Cooking and food storage should be provided by the team.
http://www.jekyllisland.com/stay/campground/

b) Are there additional cultural, recreational, educational experiences and/or options for physical training that your organization can make available to the members during the course of the service project? If so, please specify.

The Golden Isles are considered the eco-tourism capital of the Georgia Coast. There are many opportunities to bike, hike, and paddle along the salt marshes and freshwater systems of the GA Coast. Also the historical significance of the area provide many opportunities to experience cultures of the past and enjoy southern hospitality.

- Howfyl Broadfield Plantation is located on the mainland and provides a glimpse of life on the farm - http://www.gastateparks.org/HofwylBroadfield
- Sapelo Island is a fantastic get-away and educational opportunity for team members - http://www.gastateparks.org/SapeloReynolds
- Many trails and parks to visit - http://www.goldenisles.com/trails-parks
- In addition to the natural areas, the Golden Isles is full of muesums, national monuments, historic sites and theatres - http://www.goldenisles.com/attractions
- Okefenokee Swamp is only two hours away and provides a great weekend adventure – http://www.fws.gov/okefenokee/
- Historic Savannah is an hour north of the project sites. This incredible city is a must-see and a great opportunity to learn about the history of the settlements on the GA Coast. – http://www.savannah.com
- Cumberland Island National Seashore – is only one hour south of the project sites. Visiting this remote island is like stepping back in time. It is home to the largest tract of intact virgin maritime forest on the East Coast. - http://www.nps.gov/cuis/index.htm

5. MEMBER DEVELOPMENT

It is intended that through orientation, training and the project tasks, members will acquire an in-depth understanding about what they are doing and why it is important to the community. This methodology is called *service-learning*. Project sponsors work closely with NCCC staff and members in the design, support and implementation of training, orientation, and other service-learning opportunities. At least one full day should be dedicated to project orientation.

If members are required to operate dangerous tools and equipment such as skillsaws, chainsaws, augers, forklifts, tractors and other construction machinery to achieve project goals, then training must be provided by the project sponsor. NCCC staff will work with the project sponsor to develop and coordinate special training requirements before team deployment.

a) Pre-Project Training: Describe the necessary pre-project training that the members should receive at the NCCC regional campus before arrival at the project.

First aid, CPR/AED, boating safety certification (if possible)
Chain-saw certified team members will be welcome, but not necessary.

b) On-Site Orientation and Training: Provide a comprehensive and detailed development and training plan regarding on-site orientation and training that the members will receive at the project. Orientation and training should include:

- Overview of your organization and the project
- Goals and objectives of the project
- Introductions of the team to the staff of the sponsor organization
- Tour of the work site(s) and the community
- Safety orientation and training, including a statement regarding how the project will meet the Occupational Safety and Health Administration (OSHA) standards

Part ONE - Living Shoreline – (Rough idea)
8.30am: Meet & greet.
8.45 am: Introduction to the Georgia Golden Isles and Project Leaders.
9.30 am: St. Simons Island Tour
10.30 am: MAREX/SSI overview through powerpoint presentation
Noon: Lunch
1 pm: .Oyster restoration program presentation1.45pm Safety issues
2 pm: Sampling gear orientation
3.30 pm: Task assignments and scheduling for upcoming week
4 pm: Oyster shell recycling center visit and bagging demonstration

Part TWO
8.30 am: Gathering
8.45 am: Introduction the St. Simons Land Trust, Cannon's Point and chiggers
9.30 am: Discussion regarding the conservation plan and recreational plans (fundamentals emphasized)
10:30 am: Safety issues
12:00 pm: Lunch & Tour of Cannon's Point
1:30 pm: Orientation to trail construction, equipment, and techniques
1.45 pm
2:30 pm: On site training and skill tests
4:00 pm: Task assignments and scheduling for upcoming weeks

Part THREE
12:00 noon : Lunch at DNR headquarters
1:00 pm : Introduction the DNR, JIA and guiding plans
1.30 am: Discussion regarding the danger of exotic invasive plants and techniques used to eradicate them
2:30 pm : Safety issues
3:00 pm: Task assignments and scheduling for upcoming weeks
3:30 pm: Tour of Jekyll Island
4:30 pm: Settle into Camp Site

c) **Other Service-Learning Opportunities: Describe other learning opportunities related to the project work that could help members enhance their overall knowledge, acquire life skills, and help them acquire an in-depth understanding about what they are doing and why it is important to the community. This could include guest speakers, videos, community events, background documents, discussion of the mission of your organization, information about the larger social issues associated with the project, and new skills the team members will likely develop.**

6. TOOLS, EQUIPMENT, AND PERSONAL GEAR

Project sponsors are primarily responsible for providing the items necessary for the success of the project. Teams will provide their own steel-toed boots, ear and eye protection and work gloves. The NCCC does not provide chainsaws and large equipment. These types of tools and equipment must be provided by the Project Sponsor. However, NCCC staff will work with the organization to define minimum standards and expectations.

a) **What equipment, tools, and storage facilities will your organization provide?**

Part ONE – Living Shoreline. Equipment, tools, and storage facilities provided by MAREX and Little St. Simons Island, LLC

Part TWO – Cannon's Point. St. Simons Land Trust will provide some tools and equipment needed for trail construction and exotic invasive removal. Back-up equipment.

b) **What equipment and tools are requested from the NCCC to supplement the local supply?**

NCCC will need to provide trail building tools:
- lopers for cutting vegetation
- Pulaski tools
- Gloves for team members
-

c) **Please identify any safety hazards associated with the tools and equipment that will be used on the project. Be sure to provide details of any safety training that will be provided and by whom in the overall orientation and training plan. (Section 6 paragraph b.)**

None known.

d) What personal equipment and clothing should the team bring? *(For example, cooking gear, sleeping bags or other bedding, inclement weather gear, boots, sun protection, hats and gloves).*

Sleeping bags and mats, tents, cooking gear for camping, inclement weather gear, rain boots, sun protection, hats and gloves. outdoor clothing and footwear, raingear, old trainers to wear in the mud, hats, working gloves, cooking gear and tents.

7. SECURITY, SAFETY, AND MEDICAL CONSIDERATIONS

The Corporation, with the assistance of the U.S. Office of Personnel Management Federal Investigative Services Division, conducts criminal background checks on all NCCC members.

The NCCC has safety guidelines that address member safety on the project site. Copies of these guidelines are available from the regional campus. The site supervisor should be present on-site with the team daily during the team's working hours. The site supervisor should possess the awareness, experience, and technical competence to address the project's safety and technical issues.

Appropriate personal protective equipment (respirators, gloves, goggles, etc.), as well as a properly trained and certified on-site supervisor must be provided by the project sponsor.

a) Will members be subjected to any additional background checks? Yes [x] No

If yes, please specify what additional background checks are required, as well as how these requirements will be satisfied.

No – only if the members volunteer with the Girls and Boys Club as a side project.

b) Does this project include possible exposure of members to asbestos, lead paint, hazardous waste, or any other safety hazards? Yes [x] No

If yes, please provide required documentation to ensure the project meets OSHA standards as related to asbestos, lead paint, lead removal, hazardous waste, and other potential safety hazards.

No dangerous exposure apart from natural dangers (such as sun, heat, mosquitoes, chiggers and snakes)

c) Will members be required to work with potentially hazardous chemicals such as solvents, acids, pesticides, herbicides, adhesives, etc.? Yes [x] No

If yes, the Material Safety Data Sheets (MSDS) for each chemical should be available on-site.

No.

d) Many cleaning solvents and commonly used construction materials such as adhesives, oil-based paints, brush cleaners, and thinners have hazardous components. Even though the product itself is not considered toxic or hazardous, these components can give off fumes, irritate skin, or cause other uncomfortable conditions. Please describe such products here.

No such products will be used in the project.

e) Are there other situations that could result in difficult or uncomfortable conditions for members such as extreme weather, allergies, phobias, ticks, poison ivy or poison oak, etc.? ☒ Yes No

If yes, please specify and include reference information that will prepare members to work safely in that environment

Yes, the project will involve work in some of the Georgia Coast's remote areas. Given the warm season of the work, NCCC members should be prepared to encounter poison ivy, ticks and chiggers, mosquitoes, gnats (aka no-see-ums), snakes and alligators.

The Coastal GA Blueway plan is a good resource for dealing with these often difficult situations. http://www.crc.ga.gov/docs/bluewayplanfinal.pdf

f) Are there any common health conditions that might preclude an NCCC member from fully participating based on project location or project conditions? Yes ☒ No

If yes, please specify those health conditions.

No.

g) List any required or recommended immunizations.

Tetnanus vaccination recommended.

h) Identify local medical facilities, including address, telephone number, hours of operation, distance from the project site, and team lodging and local emergency response procedures (i.e. 911 response).

Southeast Georgia Health System-Brunswick Campus□Hospital 2415 Parkwood Drive, Brunswick, Georgia 31520

Emergency phone: 911
Main Phone: 912-466-7000
Includes 24-hour emergency Room
Distance from site: 15 miles from Cannon's Point

Glynn Immediate Care Center 3400 Parkwood Drive at Glynn Avenue Brunswick, GA 31520

Phone: 912-466-5800

Hours: 8am to 7:30 pm (Mon-Friday); 8am to 5:30pm (Sat) and 12pm to 5:30 pm (Sunday)

Distance from work site: 13 miles from Cannon's Point

St. Simons Immediate Care Center 5000 Wellness Way St. Simons Island, GA 31522

Phone: 912-466-5900

Hours: 8am to 7:30 pm (Mon-Friday); 8am to 5:30pm (Sat) and 12pm to 5:30 pm (Sunday)

Distance from work site: 8 miles from Cannon's Point

i) **Identify any other potential safety considerations associated with the project.**

8. PERMITS

a) **Have work permits and other legal permissions specific to the project been secured?**
Yes ☒ No N/A

If no, please indicate the date they will be obtained.

For Part ONE of the project requires permit. Permits with the State of Georgia under the Marshlands Protection Act and the Army Corps of Engineers Nationwide Permit 13 have been filed. We anticipate having permits by January.

9. PROJECT SUMMARY

Please provide a concise summary of this project in 250 words or less, including the need(s) to be addressed, the tasks to be accomplished, and the expected benefits to the community and to the NCCC members. This response should summarize information already found in other parts of the application. If a team is assigned to the project, this summary may be used for internal and external purposes such as websites or media materials.

Part ONE of the project involves creating a "living shorelines," on the Georgia Coast. Living shorelines are alternative techniques to traditional hardening in tidal wetlands and shorelines. NCCC will undertake bagging oyster shell and use the bagged shell to install a large-scale demonstration site on Little St. Simons Island (LSSI). This part will restore oyster habitat that will increase fish habitat, provide stabilization of the marsh, and enhance stewardship opportunities.

Part TWO will create a recreational path for the puble and remove exotic invasive plants threatening to historic features on Cannon's Point, a new conservation ara on St. Simons Island. NCCC will establish a system of recreational hiking trials through the uplands and remove exotic invasive plants, lantana, from the historic tabby ruins located in a remote section of the area.

Part THREE will provide safer public access to Jekyll Island, one of Georgia's most visited barrier islands, and protection of the native flora of the Georgia Coast. will occur in and around Brunswick, GA, and on Jekyll Island. NCCC will help GA DNR remove invasive Water Hyacinth in the Altamaha River delta, clear invasive Phragmites australis in control areas, and eliminate Canary Island Tamarisk. . The NCCC team will also help Jekyll Island staff control Chinese Tallow; remove boardwalk debris, remove marine, and clear public recreational trails and safety firebreaks.

Appendix V. Living shoreline sign for display on Little St. Simons Island

Appendix VI. Living shoreline rack card

LIVING SHORELINES

Living shorelines are a method to protect some parts of the upland from shoreline erosion. The use of bulkheads removes the intertidal habitat causing a break between the marsh and upland habitats.

Bulkhead

Failed bulkhead

In Georgia, living shorelines are engineered to stabilize banks using native plants and recycled oyster shells. Bagged oyster shell provides habitat for oysters to settle and grow upon and plant roots help anchor inter-tidal sediments. Tidal creeks are constantly changing and living shorelines blends into the natural environment and allows the marsh and upland to remain connected.

Bagged oyster shell

***Spartina* sp.**

Advantages of Living Shorelines

- Engineered approach to shoreline erosion that uses native plants and oyster shells
- Creates an inter-tidal zone that helps absorb and disperse wave energy
- Creates habitat for aquatic plants and animals
- Allows animal access between upland, marsh and aquatic habitats
- Mimics natural shorelines
- Provides aesthetic value

Oyster growth on bagged shell

Plant growth at a living shoreline

LIVING SHORELINES IN GEORGIA

In Georgia, three experimental living shorelines have been created; two on Sapelo Island and one on Little St. Simons Island. The two on Sapelo Island were on a tidal creeks that had eroding banks, while the one on Little St. Simons Island replaced a failing bulkhead, all with the goal of controlling erosion and providing habitat.

CONSTRUCTION

Construction of living shorelines is done in sections to keep erosion from occurring before oyster bags are in place. Installation occurs in late winter and spring so that oyster shell bags are in place when oysters begin to spawn to provide habitat for oyster spat.

Living shoreline construction

Oyster spat on bagged shell

BENEFITS TO SPECIES

On Little St. Simons Island, research using bottomless lift nets (pictured below) found an increase in the abundance of ecologically important species and the presence of important recreational sport fish, like sheepshead, that were not observed before installation of the living shoreline. Similarly, recruitment of oysters was observed on bagged shell soon after the living shoreline was completed.

Bottomless lift net

Sheepshead

Research and monitoring is ongoing at the site on Little St. Simons Island to understand the impact of living shorelines in Georgia.

For more information on living shorelines in Georgia, please visit

marex.uga.edu/living-shorelines/