
BAR BEACH SALT MARSH RESTORATION HEMPSTEAD HARBOR, NEW YORK

FIRST YEAR MONITORING REPORT

Submitted to:

National Oceanic and Atmospheric Administration
New York, New York



Prepared by:

The Louis Berger Group, Inc.
East Orange, New Jersey



February 2005



THE LOUIS BERGER GROUP, INC.

100 Halsted Street, East Orange, New Jersey 07018
Tel (973) 678-1960 Fax (973) 672-4284 www.louisberger.com

February 14, 2005

Ms. Lisa Rosman
National Oceanic and Atmospheric Administration
Coastal Protection and Restoration Division
290 Broadway, Rm 1831
New York, New York 10007

Mr. James Turek
National Oceanic and Atmospheric Administration
Office of Habitat Conservation
28 Tarzwell Drive
Narragansett, Rhode Island 02882

Re: Bar Beach Salt Marsh Restoration First Year Monitoring Report

Dear Ms. Rosman and Mr. Turek:

Enclosed are four hard copies of the final Bar Beach Salt Marsh Restoration First Year Monitoring Report, as well as two electronic copies. We have incorporated comments and suggestions from NOAA's review of the draft report. Should you have any questions or require additional information, please do not hesitate to call me at extension 485, or Tom Shinsky at extension 480.

Sincerely,

THE LOUIS BERGER GROUP, INC.

Mark Renna
Vice President of Environmental Sciences

TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	i
1.0 INTRODUCTION	1
2.0 VEGETATION MONITORING	3
3.0 FISH MONITORING	8
4.0 BENTHIC MACROINVERTEBRATE MONITORING	11
5.0 AVIAN MONITORING	14
6.0 SUMMARY	15
7.0 REFERENCES	17

LIST OF TABLES

Table 1	Vegetative Species Observed.....	3
Table 2	Summary of Vegetative Ground Cover.....	6
Table 3	Summary of Fish Sampling Results.....	9
Table 4	Summary of Benthic Macroinvertebrate Sampling Results.....	12
Table 5	Summary of Avian Sampling Results.....	14
Table 6	Summary of Monitoring Results.....	15

LIST OF FIGURES

Figure 1	Site Location Map.....	2
Figure 2	Vegetation Transect Map	4
Figure 3	Vegetation Sampling at the Restoration Site	5
Figure 4	Mean <i>Spartina alterniflora</i> Height by Ground Elevation	6
Figure 5	Throw Trap Sampling for Fish	8
Figure 6	Fish Length Frequency Distributions	10
Figure 7	Benthic Macroinvertebrate Quadrat Sampling.....	11

APPENDICES

Appendix A	Vegetation Quadrat Locations and Elevations
Appendix B	Vegetation Field Data
Appendix C	Site Photographs
Appendix D	Fish Field Data
Appendix E	Benthic Macroinvertebrate Field Data
Appendix F	Avian Field Data
Appendix G	NOAA 2002 Pre-Restoration Monitoring Data

EXECUTIVE SUMMARY

In 2003, The National Oceanic and Atmospheric Administration (NOAA), New York Department of Environmental Conservation, U.S. Fish and Wildlife Service, and the Town of North Hempstead restored the salt marsh in Bar Beach Lagoon, North Hempstead, New York, as part of a Superfund settlement addressing natural resource damages that had occurred as a result of the release of contaminants into Hempstead Harbor. Restoration activities included the removal of substantial volumes of fill consisting of sand, gravel, concrete, and solid waste debris from the site, as well as the physical removal of approximately 0.2 acres of common reed (*Phragmites australis*). Each of the fill removal areas was excavated to sub-grade, backfilled with clean soils, and planted with native wetland and coastal upland plant species.

The Louis Berger Group, Inc., conducted the first year monitoring of the five year monitoring program from September 27th to October 1st of 2004. This event consisted of biological monitoring of vegetation, fish, and macroinvertebrates at the restoration site and at a nearby reference site. Avian monitoring was conducted by an experienced birder (volunteer) arranged by NOAA staff. In addition to the above-mentioned biological data, marsh elevation data were also gathered to investigate potential fill compaction at the restoration site. The monitoring program was developed in collaboration with NOAA staff, and in accordance with the Final Restoration Plan (NOAA *et al.* 2002).

After the first year of monitoring, the restoration site has nearly met the 85 percent native species vegetative cover requirement and the re-establishment of *Phragmites* and other undesirable invasive species has been limited to 10 percent or less of the total restored area, as set forth in the restoration plan. Quadrat sampling revealed that an average of 83.4 percent of the restoration site was covered with native vegetation. Ground cover by *Phragmites* was limited to 0.5 percent of the restoration site.

Monitoring results indicate that the fish community of the restoration site is as diverse as that of the reference site. Monitoring results also suggest that the restoration site supports more diverse benthic macroinvertebrate and avian communities than the reference site. Species richness of fish at the restoration site was equal to that of the reference site. Species richness of benthic macroinvertebrates and birds at the restoration site was greater than that of the reference site. Fish density and abundance at the restoration site were greater than that of the reference site. Benthic macroinvertebrate abundance at the restoration site was considerably lower than that of the reference site, but this is to be expected in Year 1, as the establishment of beds of the ribbed mussel, the most abundant species found at both sites, may take years. Avian abundance at the restoration site was considerably higher than the reference site, and is probably due to differences in the surrounding habitats of each site.

The first year monitoring results indicate that restoration efforts to date have been successful in establishing a diverse population of salt marsh plant and animal species. The planted salt marsh grasses are well established, and Berger recommends that the goose exclusion fence be removed. However, there is still bare ground in areas of the coastal shoreline zone and the silt barrier is holding back several inches of sediment in some areas, so Berger recommends that the silt barrier remain in place at least through the next growing season.

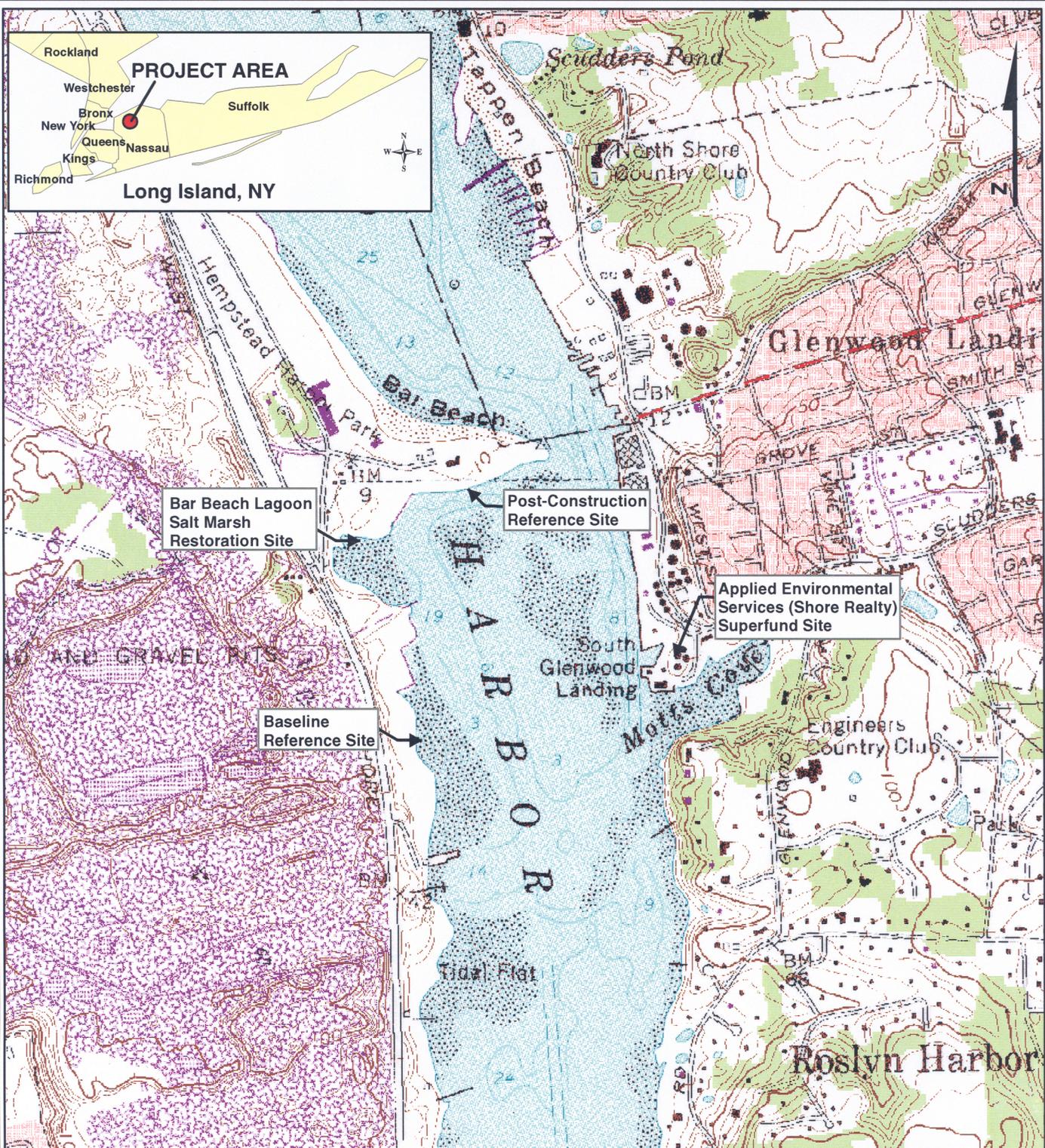
1.0 INTRODUCTION

In 2003, The National Oceanic and Atmospheric Administration (NOAA), New York Department of Environmental Conservation, U.S. Fish and Wildlife Service, and the Town of North Hempstead restored the salt marsh in Bar Beach Lagoon (also known as Hempstead Harbor Cove, see Figure 1), North Hempstead, New York, as part of a Superfund settlement addressing natural resource damages that had occurred as a result of the release of contaminants into Hempstead Harbor. Prior to restoration activities, Bar Beach Lagoon consisted of a mosaic of intertidal mudflat, sandflat, patchy low salt marsh, and shellfish beds. Restoration activities included the removal of substantial volumes of fill consisting of sand, gravel, concrete, and solid waste debris from the site. Removal of common reed (*Phragmites australis*) was also a component of the project, and involved physical removal of approximately 0.2 acres. Each of the fill removal areas was excavated to sub-grade, backfilled with clean soils, and planted with native wetland and coastal upland plant species.

Smooth cordgrass (*Spartina alterniflora*) was planted in the intertidal zone at elevations from 2.5 to 4 feet National Geodetic Vertical Datum (NGVD). Salt marsh cordgrass (*Spartina patens*) and spikegrass (*Distichlis spicata*) were planted in the high marsh at elevations from 4 to 5 feet NGVD. Between the high marsh and the upland, a coastal shoreline community consisting of marsh elder (*Iva frutescens*), groundsel-bush (*Baccharis halimifolia*), perennial ryegrass (*Panicum amarum*), and seaside goldenrod (*Solidago sempervirens*) was planted. Upland areas adjacent to the restoration site were seeded with a native warm season grass mixture and various native shrubs were planted in the upland periphery. Additional plantings in 2004 augmented the 2003 plantings where mortality, erosion, and fill compaction occurred. Virginia creeper (*Parthenocissus virginiana*) was initially planted in the upland area, but because its survival was poor and the primary purpose was stabilization of soils, it was not replanted.

As part of the Superfund settlement, a monitoring program was implemented to assess the extent of success of the restoration project. The performance criteria for the restoration project requires 85 percent vegetative cover of the restoration area (marsh and stabilized coastal shoreline) within 5 years of initial planting and minimal re-establishment of *Phragmites* and other undesirable invasive vegetation to 10 percent or less of the total restored area. Performance criteria also included 90 percent survival of *Spartina alterniflora* and shoreline vegetation after two full growing seasons, which was independently evaluated by NOAA and not discussed in this report. In addition, fish, benthic macroinvertebrate, and avian species abundance, richness, and composition must demonstrate a strong positive trend toward and not significantly differ from that of a reference marsh. The reference marsh, located 600 feet to the northeast of the restoration site, is also a fringing marsh and was selected to serve as the reference site for this monitoring program. The baseline reference marsh originally used by NOAA during pre-restoration monitoring, located approximately half a mile south of Bar Beach Lagoon, was not selected as the reference site for post-construction monitoring because of the ease of access to the closer site and because it was no more similar in habitat. The restoration and reference sites are similar in size, each consisting of approximately 0.75 acres.

On behalf of NOAA, The Louis Berger Group, Inc. conducted the first year of monitoring from September 27th to October 1st of 2004. This event consisted of monitoring of vegetation, fish, and macroinvertebrates at the restoration site and the nearby reference site. Avian monitoring was conducted by an experienced birder (volunteer) arranged by NOAA staff. In addition to the above-mentioned biological data, marsh elevation data were also gathered to investigate potential fill compaction at the restoration site. The monitoring program was developed in collaboration with NOAA staff, and in accordance with the Final Restoration Plan (NOAA *et al.* 2002).



National Oceanic and Atmospheric Administration	
Bar Beach Salt Marsh Ecological Restoration Monitoring Site Location Map	
Location: Hempstead Harbor, Long Island, NY	
Date: FEB 2005	ID: JR 5110
 The Louis Berger Group, Inc. 100 Halsted Street East Orange, NJ 07018	Figure 1

SOURCES:
 Base Mapping: USGS 7.5 Minute Topographic Map,
 Sea Cliff Quadrangle.

2.0 VEGETATION MONITORING

2.1 Methodology

Plant cover at the restoration site and reference site was measured within one-meter square quadrats placed along permanently established transects. The restoration site was sampled along seven transects composed of forty quadrats. Six of these transects were oriented from the upland to the lower edge of the marsh, while the seventh transected the peninsula area from southwest to northeast. The reference site was sampled along three transects composed of ten quadrats, also oriented from upland to the lower edge of the marsh. At NOAA's request, quadrats were arranged so that the first quadrat was positioned in the coastal shoreline zone (above 5 feet NGVD), the second quadrat was placed in the high marsh (4 to 5 feet NGVD), and subsequent quadrats were placed in the low marsh (2.5 to 4 feet NGVD). NOAA initially estimated the number of vegetation quadrats required to sample the restoration and reference sites at 20 and 10 respectively, but the number of quadrats at the restoration site was increased to 40 to accommodate the requested sampling in the coastal zone and high marsh and still adequately assess overall vegetative cover at this site.

The elevation of the center point of each quadrat was determined using a Leica Geosystems Rugby 100 laser level. The ends of each transect were marked in the field with PVC pipes driven into the substrate and were surveyed with a Trimble Pro XRS Global Positioning System (GPS) with Asset Surveyor. The distance of each quadrat along the transect was measured and recorded to ensure that the same quadrats will be sampled each year. The locations of the vegetation transects appear in Figure 2, and the positions of the transect ends and quadrats are presented in Appendix A.

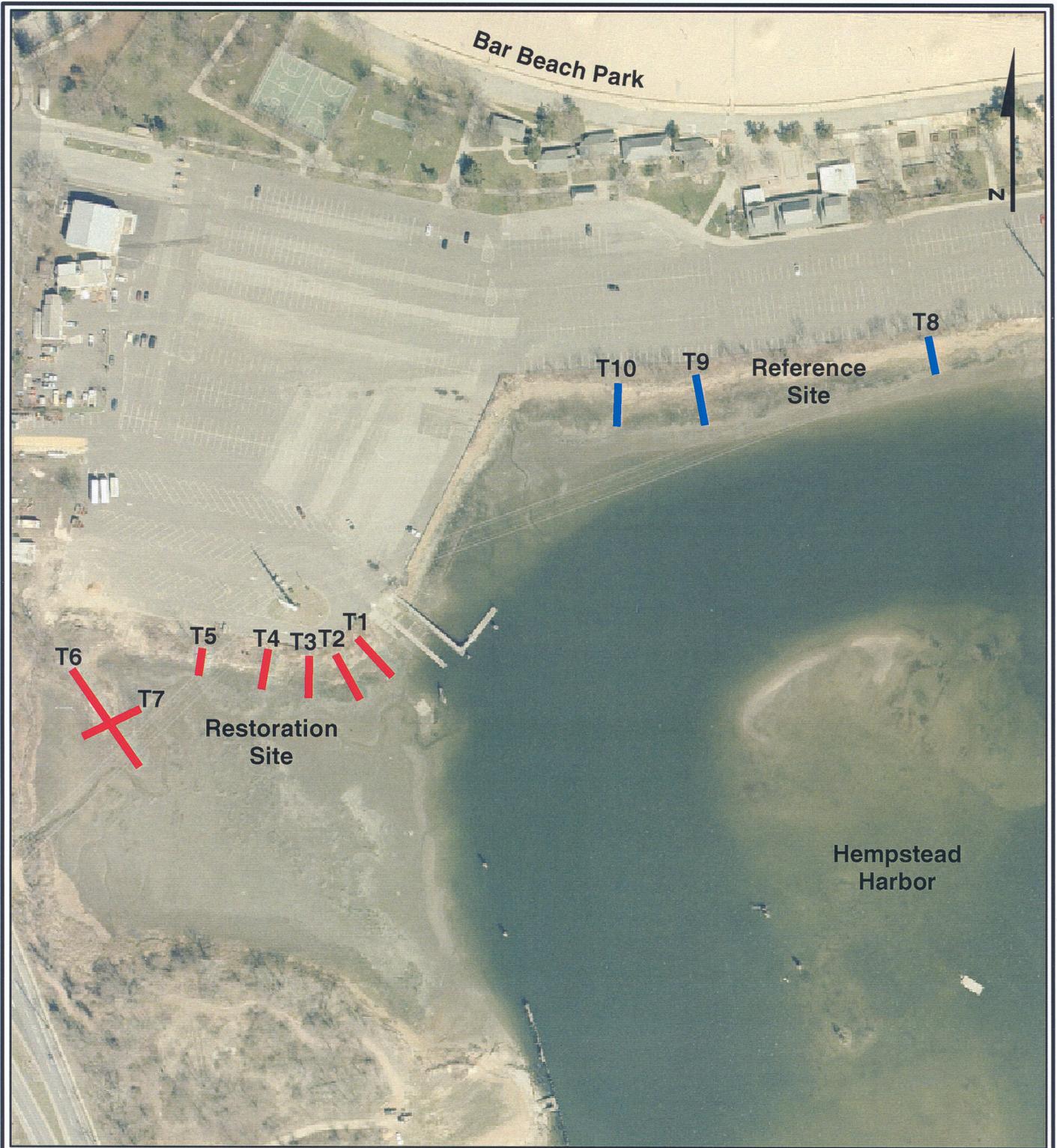
2.2 Results

A summary of vegetation observed at the restoration and reference sites is presented in Table 1. A total of 12 species were present within the sampled quadrats at the restoration site, seven of which were planted and five which volunteered, including *Phragmites*. The coastal shoreline zone at the restoration site was dominated

Table 1. Vegetative Species Observed.

Common Name	Scientific Name	Restoration Site	Reference Site
marsh orach	<i>Atriplex patula</i>	✓	
groundsel tree*	<i>Baccharis halimifolia</i>	✓	
spike grass*	<i>Distichlis spicata</i>	✓	
high tide bush*	<i>Iva frutescens</i>	✓	✓
perennial ryegrass*	<i>Panicum amarum</i>	✓	
Virginia creeper*	<i>Parthenocissus cinquefolia</i>		✓
common reed	<i>Phragmites australis</i>	✓	✓
pearlwort	<i>Sagina procumbens</i>	✓	
glasswort	<i>Salicornia europa</i>	✓	
seaside goldenrod*	<i>Solidago sempervirens</i>	✓	✓
smooth cordgrass*	<i>Spartina alterniflora</i>	✓	✓
salt meadow grass*	<i>Spartina patens</i>	✓	
sea blite	<i>Sueda linearis</i>	✓	

*Species planted or seeded at the restoration site



Legend

- Vegetation Transects
- █ Restoration Site
- █ Reference Site



SOURCES:
 Base Mapping: New York State DOQQs,
 Nassau County, 2000.

National Oceanic and Atmospheric Administration	
Bar Beach Salt Marsh Ecological Restoration Monitoring Transect Location Map	
Location: Hempstead Harbor, Long Island, NY	
Date: FEB 2005 ID: JR 5110	
	The Louis Berger Group, Inc. 100 Halsted Street East Orange, NJ 07018
Figure 2	

by the planted species *Iva frutescens*, *Panicum amarum*, *Solidago sempervirens*, and *Spartina patens*, while the marsh vegetation consisted almost entirely of *Spartina alterniflora*, *Spartina patens*, and *Distichlis spicata*. Only five species were present within the sampled quadrats at the reference site. Vegetation in the coastal shoreline zone of the reference site was dominated by *Phragmites*, *Spartina alterniflora*, *Parthenocissus quinquefolia*, and *Iva frutescens*, while marsh vegetation consisted exclusively of *Spartina alterniflora* and *Phragmites*.

Figure 3. Vegetation Sampling at the Restoration Site.



Table 2 presents a summary of vegetative ground cover, including cover by *Phragmites*, for each transect in the restoration and reference sites, as well as the mean value for these parameters across all transects at each site. Quadrat sampling indicates that total vegetative cover of the restoration site was 83.9 percent, with *Phragmites* accounting for 0.5 percent of cover. Total vegetative cover of quadrats at the reference site was 83 percent, with *Phragmites* covering 11.5 percent of ground. Plant field data documenting the ground cover estimates for the restoration and reference sites, as well as *Spartina alterniflora* height measurements, are presented in Appendix B. Photographs taken along each transect at the restoration site appear in Appendix C.

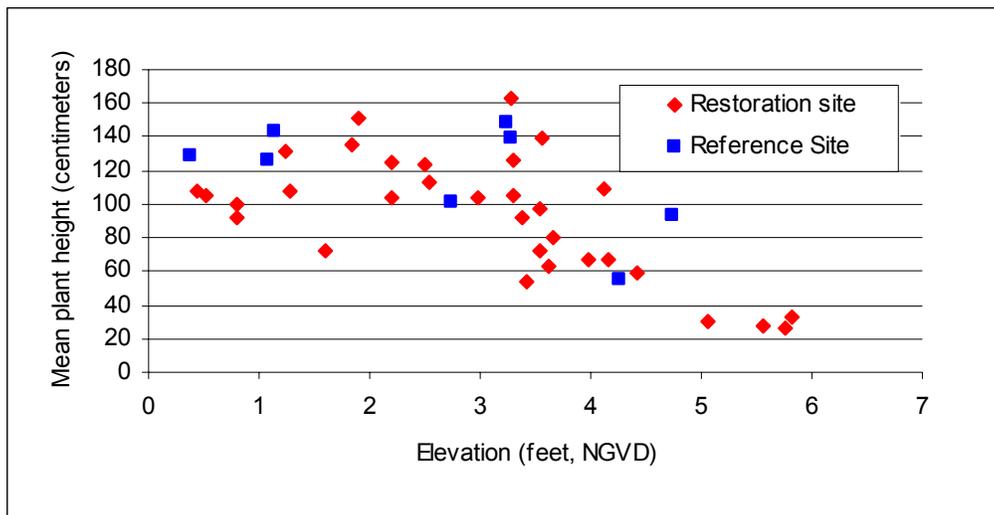
Prior to restoration activities, the upper elevations of the restoration site were dominated by *Phragmites*, while lower elevations were either unvegetated, or contained some *Spartina alterniflora*. Sampling conducted by NOAA in 2002 before the restoration indicated that total plant cover of the restoration site was approximately 47 percent, with *Spartina alterniflora* covering 22.5 percent of sampled quadrats and *Phragmites* covering 14.5 percent of quadrats sampled. High tide bush, spikegrass, poison ivy (*Toxicodendron radicans*), mugwort (*Artemisia vulgaris*) sea lavender (*Limonium* sp.), and glasswort were also present, but accounted for relatively little cover. Appendix G contains NOAA pre-restoration monitoring of percent plant cover by species at the restoration site.

Table 2. Summary of Vegetative Ground Cover

Transect	Number of Quadrats	Mean Percent Vegetative Ground Cover for All Species Excluding <i>Phragmites</i>	Mean Percent Vegetative Ground Cover of <i>Phragmites</i>	Mean Total Percent Cover
Restoration Site				
1	5	82	0	82
2	5	86	1	87
3	5	89	0	89
4	5	80	0	80
5	5	79	3	82
6	10	82	0	82
7	5	87	0	87
Mean (all quadrats)		83.4	0.5	83.9
Reference Site				
8	3	82	8	90
9	4	56	23	79
10	3	82	0	82
Mean (all quadrats)		71.5	11.5	83.0

Vegetation quadrat elevation data are presented in Appendix A. As this is the first year of monitoring, it represents the baseline conditions with which future elevations will be compared to assess potential fill compaction. *Spartina alterniflora* height was closely tied to elevation at both the restoration and reference sites. Figure 4 presents mean plant height by elevation for both sites. Plant height was greatest at elevations of approximately two to four feet NGVD, decreasing both above and below this range.

Figure 4. Mean *Spartina alterniflora* Height by Ground Elevation.



Mean *Spartina alterniflora* height within quadrats at the restoration site was 93 cm, while the mean height of plants in quadrats at the reference site was 117 cm. At both sites, *Spartina alterniflora* had flowered and contained seedheads, however, this parameter was not measured and quantified but will be so noted in the future. In 2002, prior to the restoration, NOAA staff measured *Spartina alterniflora* height at the restoration site and reference site, finding the mean height of the remnant plants in the lower tidal elevations of the restoration site to be 116 cm, while mean plant height at the original reference site was 136 cm. Pre-restoration plant height measurements were taken from different locations than those sampled for this Year 1 monitoring.

In September 2004, NOAA and Berger staff determined the elevations of high and low marsh habitat boundaries at the restoration and reference sites. At the restoration site, *Spartina alterniflora* existing prior to the restoration occurred at elevations from 0.8 feet to 1.8 feet NGVD, and the planted *Spartina alterniflora* was found at elevations from 1.8 feet to 3.9 feet NGVD. The high marsh (from the upper limit of the low marsh to the observed high tide line) occurred at elevations from 3.9 feet to 6.6 feet NGVD. At the reference site, the low marsh occurred from elevations of 0.4 to 3.9 feet NGVD, and the high marsh occurred from 3.9 feet to 5.3 feet NGVD.

3.0 FISH MONITORING

3.1 Methodology

Fish use of the restoration and reference sites was investigated by means of throw trap sampling conducted around the time of high tide. Fifteen stations were determined as the number of stations to sample the fish communities at the restoration and reference sites based on the funds available for this monitoring contract. Ten stations were sampled at the restoration site, and five were sampled at the reference site. The throw locations ranged from high marsh to low marsh. The throw trap consisted of an open-ended one-meter square polycarbonate box measuring 75 cm in height. Sampling was conducted by throwing the trap onto the flooded marsh surface so that the open end fully contacted the substrate, preventing any fish escape. Sampling locations were limited to areas of relatively flat substrate where *Spartina alterniflora* growth was not so dense as to prohibit the trap from fully contacting the substrate. Fish and invertebrates were removed from the trap by passing a meter-wide net of 0.25-inch mesh through the trap. Repeated passes of the net through the trap were made until three successive passes failed to produce any fish. All fish were identified to species and measured before being released. Invertebrates were identified to species and counted. NOAA's pre-restoration monitoring efforts included seining for fish in unvegetated low marsh areas, but the soft bottom sediments made this difficult, and the method does not adequately characterize fish use of vegetated marsh habitats, so NOAA recommended the use of a throw trap for the post-construction monitoring.

Figure 5. Throw Trap Sampling for Fish.



3.2 Results

Table 3 presents the species richness, abundance, diversity, and density for fish collected in the throw traps at the restoration and reference sites. Fish field data are provided in Appendix D. A total of three fish species were caught at the reference and restoration sites: mummichog (*Fundulus heteroclitus*), striped killifish (*Fundulus majalis*), and Atlantic silverside (*Menidia menidia*). All three of these species were caught by NOAA during pre-restoration monitoring, however no quantitative comparisons can be made with this Year 1 data, as the NOAA data does not contain fish counts or lengths.

Overall fish abundance, as measured by the mean number of fish per trap throw, was 21.6 fish at the restoration site, which was slightly higher than the abundance of 15.4 fish at the reference site. Fish density for the restoration site, with a mean of 40.8 fish per cubic meter of water, was markedly higher than the density of 23.3 fish at the reference site. Fish diversity, as measured by the Shannon-Weaver Diversity Index, was 0.337 at the restoration site, which was essentially identical to the reference site diversity index of 0.339. An attempt was made to measure the weight of the fish caught in each throw using the volume of water displaced by the catch, but a number of throws caught volumes of fish which were too small to be measured accurately under field conditions. The grass shrimp (*Palaemonetes vulgaris*) was caught in every throw at the restoration and reference sites, and the mean abundance and density were higher at the restoration site than at the reference site. At the restoration site, mean abundance of the shrimp was 52.3 shrimp per throw, and the density was 98.7 shrimp per cubic meter of water. At the reference site, mean shrimp abundance was 33 shrimp per throw, and the density was 50 shrimp per cubic meter of water.

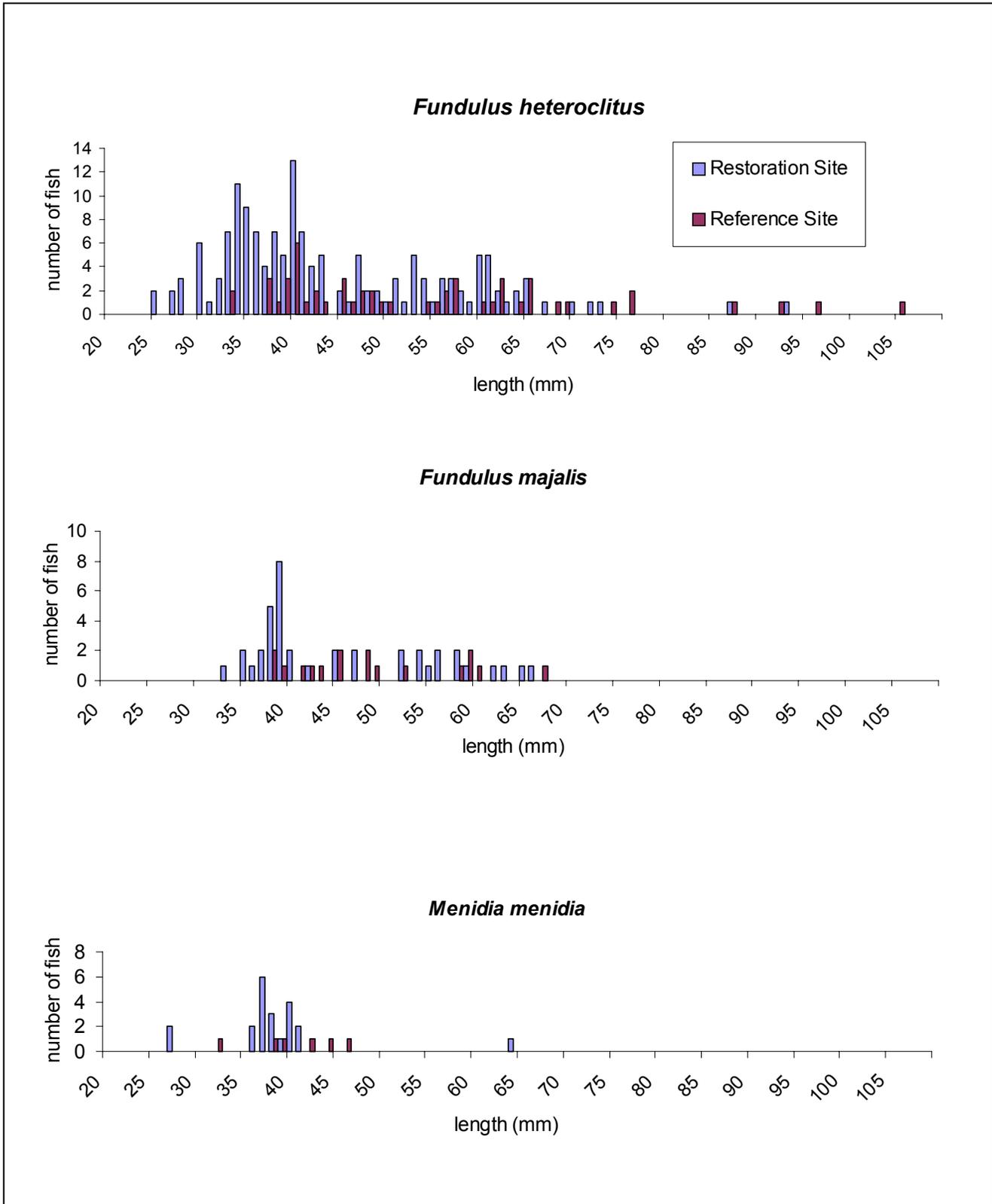
The percentage of the total catch by each species was nearly identical at the restoration and reference sites, with *Fundulus heteroclitus* at the reference and restoration sites making up 71 and 70 percent of the catch respectively, *Fundulus majalis* representing 19 and 22 percent, and *Menidia menidia* representing 10 and 8 percent.

Table 3. Summary of Fish Sampling Results.

Species		Restoration Site (10 throws)		Reference Site (5 throws)	
Common Name	Scientific Name	Number Caught	Mean Abundance	Number Caught	Mean Abundance
Mummichog	<i>Fundulus heteroclitus</i>	155	15.5	54	10.8
Striped killifish	<i>Fundulus majalis</i>	40	4	17	3.4
Atlantic silverside	<i>Menidia menidia</i>	21	2.1	6	1.2
All Species		216	21.6	77	15.4
Species Richness		3		3	
Diversity Index		0.337		0.339	
Mean Density (fish per m ³)		40.8		23.3	

The length frequency distributions of each of the three species appear in Figure 6. Lengths from all trap throws within the restoration sites were pooled, as were all throws within the reference site. Both sites contained the same age classes of all three species. Members of the 2004 and 2003 year classes of both *Fundulus* species were found at the restoration site and reference site, with these classes consisting of peaks at approximately 40 mm and 60 mm, respectively. *Fundulus heteroclitus* individuals of a third age class also appear to be present at both sites, with lengths ranging from approximately 85 to 105 mm. Members of the 2004 year class of *Menidia menidia* were also found at both the restoration site and reference site, consisting of a peak at approximately 40 mm.

Figure 6. Fish Length Frequency Distributions.



4.0 BENTHIC MACROINVERTEBRATE MONITORING

4.1 Methodology

Benthic macroinvertebrate monitoring was conducted using 0.25-meter square quadrats randomly laid on the marsh surface. All macroinvertebrates observed within the quadrats were identified and recorded. In the case of fiddler crabs, burrows were counted. At NOAA's request, quadrat sampling was stratified in order to sample both high marsh and low marsh habitats. The initial NOAA sampling ratio of 2:1 was slightly adjusted to accommodate the stratified sampling and still obtain the majority of samples from the low marsh, which accounts for most of the area of both sites. Twenty-five quadrats were sampled at the restoration site (five in the high marsh and twenty in the low marsh), and fifteen quadrats were sampled at the reference site (three in the high marsh and twelve in the low marsh).

Figure 7. Benthic Macroinvertebrate Quadrat Sampling.



4.2 Results

Table 4 presents macroinvertebrate species composition, abundance, richness, and diversity for the restoration and reference sites from the quadrat sampling. Macroinvertebrate field data are provided in Appendix E. Six macroinvertebrate species were found in quadrats at the restoration site, while five species were observed at the reference site. Ribbed mussels (*Geukensia demissa*) and mud snails (*Nassarius obsoletus*, also known as *Ilyanassa obsoleta*) dominated the macroinvertebrate communities at both sites. Burrows of the mud fiddler crab (*Uca pugnax*) were present at both sites, but were much more abundant at the restoration site. Individuals of several other crab species and a snail were also observed. In addition, several green crabs (*Carcinus maenas*) were caught at the restoration and reference sites

during fish throw-trap sampling, but were not included in the benthic macroinvertebrate analysis because of differences in methodology and the time of sampling relative to high tide.

Macroinvertebrate abundance in the high marsh was low, relative to the low marsh. At the restoration site, the high marsh was nearly devoid of macroinvertebrates, with only six fiddler crab burrows observed within the five sampled high marsh quadrats. However, the silt fence in the high marsh area may be functioning as a barrier to some invertebrate species. No macroinvertebrates were found within the three high marsh quadrats at the reference site.

Mean macroinvertebrate abundance at the restoration site overall was 77 individuals per quadrat, which is substantially lower than the mean of 123 individuals per quadrat at the reference site. This difference is primarily due to ribbed mussels, as most other macroinvertebrates occurred at the restoration and reference sites in relatively similar abundances. Ribbed mussels were the most abundant macroinvertebrate observed at both sites, but were nearly twice as abundant at the reference site than at the restoration site. Ribbed mussel distribution at the restoration site was generally limited to the lower edge of the low marsh, where *Spartina alterniflora* existed prior to the restoration. The extremely dense mussel beds observed at the reference site take years to become established, so it is likely that this species will continue to colonize the restoration site in subsequent monitoring years. Macroinvertebrate diversity, as measured by the Shannon-Weaver Diversity Index, was 0.349 at the restoration site, which was higher than the reference site diversity index of 0.285.

NOAA pre-restoration monitoring estimated the average densities of ribbed mussels and mud snails at the restoration site to be 19.9 and 18.6 per $\frac{1}{4}$ square meter, respectively (Appendix G). Both of these densities are lower than observed densities of these invertebrates during this Year 1 monitoring, however the NOAA benthic invertebrate quadrats were co-located with plant quadrats, some of which were too high in the intertidal zone to support macroinvertebrates. NOAA pre-restoration benthic invertebrate monitoring reported only one crab species, whereas Year 1 monitoring found three crab species at the restoration site.

Table 4. Summary of Benthic Macroinvertebrate Sampling Results.

Species		Restoration Site (25 quadrats)		Reference Site (15 quadrats)	
Common Name	Scientific Name	Number of Individuals	Mean Abundance	Number of Individuals	Mean Abundance
Mud fiddler crab	<i>Uca pugnax</i>	55	2.2	6	0.4
Asian shore crab	<i>Hemigrapsus sanguineus</i>	15	0.6	26	1.7
Green crab	<i>Carcinus maenas</i>	1	0.04	0	0
Mud crab	<i>Neopanopeus sayi</i>	0	0	1	0.1
Ribbed mussel	<i>Geukensia demissa</i>	1213	48.5	1348	89.9
Mud snail	<i>Nassarius obsoletus</i>	636	25.4	459	30.6
Rough periwinkle	<i>Littorina saxatilis</i>	1	0.04	0	0
All Species		1921	76.8	1840	122.7
Species Richness		6		5	
Diversity Index		0.349		0.285	

Differences between the physical conditions at the restoration and reference sites may be responsible for some macroinvertebrate species distributions. For example, the greatest density of fiddler crab burrows

was in the peninsula area of the restoration site, where the substrate is relatively flat, whereas the reference site has a relatively uniform slope. The reference site is also more exposed to wave energy than the restoration site. In particular, the upper elevations of the reference site differ from that of the restoration site, and probably make the high marsh zone there less favorable for macroinvertebrates: vegetative cover in the upper elevations of the reference site is generally more sparse; spikegrass and salt meadow hay are not present; the sediments appear to be more coarse; and there is heavy cover of wrack and debris.

5.0 AVIAN MONITORING

5.1 Methodology

Avian monitoring was conducted by an ornithologist from the North Shore Audubon Society arranged by NOAA. During 2004, monitoring was conducted on nine occasions from October through early December, generally conducted on a weekly basis. The ornithologist spent 20 minutes at the restoration site and 20 minutes at the reference site, and noted the bird species present within each site, their numbers and activity, as well as the weather and tide conditions. Birds within 100 yards of the restoration and reference sites were also noted, but not included in the analysis, as they were generally flying through the area, or were between the sites in the parking lot or on the power lines or towers.

5.2 Results

Table 5 presents avian species abundance, richness, composition, and diversity for the restoration and reference sites. Avian monitoring data are provided in Appendix F. Eight avian species were observed at the restoration site, while five were observed at the reference site. Mean avian abundance per observation at the restoration site was 4.9, which was considerably higher than the mean of 0.7 birds per observation at the reference site. Avian diversity, as measured by the Shannon-Weaver Diversity Index, was 0.771 at the restoration site, which was slightly higher than the reference site diversity index of 0.678. Eighty percent of birds observed at the restoration site were songbirds, while waterbirds dominated the bird community of the reference site. The greater avian species richness and diversity of the restoration site as compared to the reference site and the difference in species composition are likely due to habitat differences. The waters adjacent to the restoration site are less exposed to wind and waves than the reference site and the restoration site is nearly surrounded by densely forested habitat providing a close source of food and shelter. In addition, a feral cat was observed at the reference site on several occasions, and may be adversely affecting bird use of this area.

Table 5. Summary of Avian Monitoring Results.

Species		Restoration Site		Reference Site	
Common Name	Scientific Name	Number of Individuals	Mean Abundance	Number of Individuals	Mean Abundance
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	15	1.7	0	0
Great Egret	<i>Ardea alba</i>	0	0	1	0.1
Great Blue Heron	<i>Ardea herodias</i>	0	0	1	0.1
House Finch	<i>Carpodacus mexicanus</i>	5	0.6	0	0
Mute Swan	<i>Cygnus olor</i>	7	0.8	0	0
Yellow-rumped Warbler	<i>Dendroica coronata</i>	5	0.6	0	0
Herring Gull	<i>Larus argentatus</i>	0	0	2	0.2
Song Sparrow	<i>Melospiza melodia</i>	8	0.9	0	0
Northern Mockingbird	<i>Mimus polyglottos</i>	1	0.1	1	0.1 Top of Form Bottom of Form
Double-crested Cormorant	<i>Phalacrocorax auritus</i>	2	0.2	0	0
Eastern Phoebe	<i>Sayornis phoebe</i>	1	0.1	0	0
Starling	<i>Sturnus vulgaris</i>	0	0	1	0.1
All Species		44	4.9	6	0.7
Species Richness		8		5	
Diversity Index		0.771		0.678	

6.0 SUMMARY

After the first year of monitoring, the restoration site has nearly met the 85 percent native species vegetative cover requirement and re-establishment of *Phragmites* and other undesirable invasive species has been limited to 10 percent or less of the total restored area, as set forth in the restoration plan. Quadrat sampling revealed that an average of 83.4 percent of the restoration site was covered with native vegetation. Ground cover by *Phragmites* was limited to 0.5 percent of the restoration site. Comparisons with NOAA pre-restoration monitoring indicate substantially greater coverage of the restoration site with native wetland vegetation, and the near-total eradication of *Phragmites*. In 2002, prior to the restoration, only 47 percent of the site had vegetative cover, nearly a third of which consisted of *Phragmites*. Table 6 summarizes the monitoring results for all parameters investigated at the restoration and reference sites.

Table 6. Summary of Monitoring Results

Resource	Monitoring Result	Restoration Site	Reference Site Top of For Bottom of Form	Restoration Site compared to Reference site
Vegetation	Percent Ground Cover (excluding <i>Phragmites</i>)	83.4	71.5	+
	Percent Cover by <i>Phragmites</i>	0.5	11.5	+
	Species Richness	12	5	+
Fish	Mean Abundance	21.6	15.4	+
	Species Richness	3	3	=
	Diversity Index	0.337	0.339	=
	Mean Density (fish per m ³)	40.8	23.3	+
Benthic Macroinvertebrates	Mean Abundance	76.8	122.7	-
	Species Richness	6	5	+
	Diversity Index	0.349	0.285	+
Avian	Mean Abundance	4.9	0.7	+
	Species Richness	8	5	+
	Diversity Index	0.771	0.678	+

Monitoring results indicate that the fish community of the restoration site is as diverse as that of the reference site. Monitoring results also suggest that the restoration site supports more diverse benthic macroinvertebrate and avian communities than the reference site. Species richness of fish at the restoration site was equal to that of the reference site. Species richness of benthic macroinvertebrates and birds at the restoration site was greater than that of the reference site. Fish density and abundance at the restoration site were greater than that of the reference site. Benthic macroinvertebrate abundance at the restoration site was considerably lower than that of the reference site, but this is to be expected in Year 1, as the establishment of beds of the ribbed mussel, the most abundant species found at both sites, may take years. Avian abundance at the restoration site was considerably higher than the reference site, and is probably due to differences in the surrounding habitats of each site.

Although the methodologies and areas sampled were different, comparisons between NOAA's 2002 pre-restoration monitoring and this Year 1 monitoring of the fish and benthic macroinvertebrate communities also demonstrates the progress of the restoration effort. The Year 1 monitoring caught the same three fish species as were caught during the pre-restoration monitoring, but caught them in vegetated areas of both the low and high marsh, demonstrating that vegetation in the restored marsh is functioning as fish habitat. The Year 1 monitoring also found greater densities of ribbed mussels, fiddler crabs, and mud snails at the

restoration site than found in 2002. The Year 1 monitoring also found several crab species not seen by NOAA in 2002.

Management Recommendations

The first year monitoring results indicate that restoration efforts to date have been successful in establishing a diverse population of salt marsh plant and animal species. The planted salt marsh grasses are well established, and Berger recommends that the goose exclusion fence be removed. However, there is still bare ground in areas of the coastal shoreline zone and the silt barrier is holding back several inches of sediment in some areas. Berger recommends that the silt barrier remain in place through the next growing season and will reevaluate its removal following the Year 2 monitoring. Additionally, removal of the feral cat(s) which frequent the reference site would allow a better comparison of avian use of the sites.

7.0 REFERENCES

- Gleason, H.A. and A. Cronquist. 1991. *Manual of vascular plants of Northeastern United States and adjacent Canada*, second edition. New York: New York Botanical Garden. 660; 783; 794-5.
- Gosner, K.L. 1978. *A field guide to the Atlantic seashore*. Houghton Mifflin Co., Boston, MA. 329 pp.
- National Oceanic and Atmospheric Administration, U.S. Fish and Wildlife Service, and New York State Department of Environmental Conservation. 2002. *Final Restoration Plan and Environmental Assessment-Applied Environmental Services (Shore Realty) Superfund Site*. September 2002.
- Shannon, C.E. and W. Weaver. 1949. *The Mathematical Theory of Communication*. The University of Illinois Press, Urbana, IL.
- Weiss, H.M. 1995. *Marine animals of Southern New England and New York: Identification Keys to common nearshore and shallow water macrofauna*. State Geological and Natural History Survey of Connecticut. Bulletin 115.

APPENDICES

APPENDIX A
VEGETATION QUADRAT LOCATIONS AND ELEVATIONS

Vegetation Quadrat Locations and Elevations

Restoration Site					
Transect and Quadrat position (transect lengths and quadrat locations as measured along a tape measure laid between the end pipes)					
End	northing	easting	Quadrat	2004 Elevation (feet, NGVD)	Distance from lower pipe (m)
T1up	240496.692	1079543.771	1	5.76	21.0
T1low	240443.858	1079592.021	2	5.05	18.3
T1 total length 22.07 m			3	4.15	13.8
			4	3.29	7.7
			5	0.44	0.9
T2up	240473.546	1079513.559	1	5.81	21.0
T2low	240411.422	1079547.602	2	4.84	18.4
T2 total length 21.95 m			3	4.41	15.8
			4	1.89	7.7
			5	0.51	0.5
T3up	240471.818	1079476.992	1	5.56	17.6
T3low	240413.046	1079475.841	2	4.75	15.2
T3 total length 17.95 m			3	4.11	9.8
			4	2.2	4.9
			5	0.8	0.6
T4up	240481.267	1079420.387	1	5.86	15.1
T4low	240425.061	1079411.027	2	4.76	12.6
T4 total length 17.50 m			3	3.3	7.8
			4	2.5	5.4
			5	0.8	0.5
T5up	240482.271	1079329.557	1	5.57	9.9
T5low	240444.181	1079324.130	2	4.39	7.7
T5 total length 12.1 m			3	3.41	5.3
			4	2.2	2.9
			5	1.28	0.7
T6up	240451.950	1079149.276	1	5.39	47.4
T6low	240317.391	1079242.701	2	4.62	46.8
T6 total length 50.1 m			3	3.98	42.4
			4	3.65	37.8
			5	3.61	30.8
			6	3.53	23.4
			7	3.38	17.4
			8	3.28	11.5
			9	2.55	5.8
T7west	240359.023	1079164.397	1	1.24	26.7
T7east	240397.675	1079243.907	2	2.97	21.9
T7 total length 27.3 m			3	3.53	11.8
			4	3.55	6.7
			5	1.83	0.7

Reference Site					
Transect and Quadrat position (transect lengths and quadrat locations as measured along a tape measure laid between the end pipes)					
End	northing	easting	Quadrat	2004 Elevation (feet, NGVD)	Distance from lower pipe (m)
T8up	240917.997	1080339.707	1	5.89	14
T8low	240865.224	1080350.428	2	3.23	6.1
T8 total length 16.0 m			3	1.07	0.7
T9up	240863.950	1080015.822	1	6.08	18.5
T9low	240794.065	1080028.913	2	4.74	14.8
T9 total length 21.6 m			3	2.74	6.7
			4	0.37	0.5
T10up	240851.720	1079907.820	1	4.25	12.3
T10low	240792.253	1079905.867	2	3.27	5.6
T10 total length 19.0 m			3	1.14	0.6

APPENDIX B
VEGETATION FIELD DATA

Vegetation Field Data

Restoration Site	Transect 1					Transect 2					Transect 3					Transect 4					Transect 5					Transect 6										Transect 7									
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5					
Quadrat	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
<i>Spartina alterniflora</i>	15	5	85	100	70	10	0	90	100	95	5	+	100	80	100	0	0	95	90	60	+	0	80	85	70	0	0	65	70	65	70	85	100	90	85	80	95	75	90	95					
<i>Spartina patens</i>	10	0	0	0	0	5	0	0	0	0	10	80	0	0	0	20	65	0	0	0	0	0	0	0	0	5	50	0	0	0	0	0	0	0	0	0	0	0	0	0					
<i>Distichlis spicata</i>	5	70	0	0	0	15	85	0	0	0	10	20	0	0	0	+	20	0	0	0	5	100	0	0	0	10	40	0	0	0	0	0	0	0	0	0	0	0	0	0					
<i>Salicornia europa</i>	0	10	5	0	0	0	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
<i>Atriplex patula</i>	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
<i>Sueda linearis</i>	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	15	0	0	0	0	0	0	0	0	0	0	0					
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
<i>Iva frutescens</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
<i>Phragmites australis</i>	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
<i>Panicum amarum</i>	30	0	0	0	0	15	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
<i>Solidago semipervirens</i>	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
<i>Sagina procumbens</i>	5	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
<i>Parthenocissus cinquefolia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
% dead vegetation	0	0	0	0	0	5*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
% open/mud/water	35	15	10	0	30	55	0	5	0	5	35	0	0	20	0	30	15	5	10	40	25	0	20	15	30	30	10	20	15	35	30	15	0	10	15	20	5	25	10	5					
% vegetative ground cover	65	85	90	100	70	45	100	95	100	95	65	100	100	80	100	70	85	95	90	60	75	100	80	85	70	70	90	80	85	65	70	85	100	90	85	80	95	75	90	95					

Reference Site	Transect 8			Transect 9				Transect 10		
Quadrat	1	2	3	1	2	3	4	1	2	3
<i>Spartina alterniflora</i>	0	100	100	0	15	90	90	65	85	95
<i>Spartina patens</i>	0	0	0	0	0	0	0	0	0	0
<i>Distichlis spicata</i>	0	0	0	0	0	0	0	0	0	0
<i>Salicornia europa</i>	0	0	0	0	0	0	0	0	0	0
<i>Atriplex patula</i>	0	0	0	0	0	0	0	0	0	0
<i>Sueda linearis</i>	0	0	0	0	0	0	0	0	0	0
<i>Baccharis halimifolia</i>	0	0	0	0	0	0	0	0	0	0
<i>Iva frutescens</i>	35	0	0	0	0	0	0	0	0	0
<i>Phragmites australis</i>	25	0	0	40	50	0	0	0	0	0
<i>Panicum amarum</i>	0	0	0	0	0	0	0	0	0	0
<i>Solidago semipervirens</i>	5	0	0	0	0	0	0	0	0	0
<i>Sagina procumbens</i>	0	0	0	0	0	0	0	0	0	0
<i>Parthenocissus cinquefolia</i>	5	0	0	30	0	0	0	0	0	0
% dead vegetation	0	0	0	30**	35**	0	0	0	0	0
% open/mud/water	30	0	0	30	35	10	10	35	15	5
% vegetative ground cover	70	100	100	70	65	90	90	65	85	95

+ = present, but covers less than 1 percent of quadrat

* = dead planted vegetation

** = dead *Phragmites*

Spartina alterniflora height (in centimeters)

Restoration Site

Quadrat

Transect 1					Transect 2					Transect 3					Transect 4					Transect 5					Transect 6										Transect 7									
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5
68	76	72	11	74	30		37	185	30	63		15	31	45			95	96	27			52	58	31			77	63	83	92	24	156	182	22	18	186	58	21	60					
55	49	66	14	88	76		31	162	82	41		19	24	54			82	103	32			41	98	35			57	48	91	94	15	169	37	19	13	161	106	53	34					
52	18	46	139	26	26		79	186	76	29		59	13	41			84	87	21			63	69	12			42	68	123	86	52	157	156	50	10	153	130	123	110					
59	21	21	122	82	26		74	154	85	32		36	17	17			96	88	21			88	41	14			62	52	135	96	101	148	53	89	67	90	84	184	104					
36	18	11	127	72	34		91	137	39	30		80	79	22			102	34	28			47	44	60			65	75	109	100	87	205	123	15	114	159	111	174	168					
18	11	42	125	16	22		52	153	34	14		102	81	70			88	118	25			38	25	19			49	42	79	121	114	211	72	20	183	141	114	182	152					
23	16	75	120	84	11		103	147	102	12		125	159	84			82	92	39			80	97	102			110	17	62	107	120	182	146	9	94	140	148	182	163					
37		111	129	94	17		66	165	122	14		112	155	56			99	192	53			51	70	105			53	70	40	117	131	180	157	14	143	123	76	176	198					
19		103	141	107	23		71	146	115	27		126	157	55			76	129	21			65	45	140			96	87	58	119	154	147	51	14	77	112	30	138	158					
15		78	107	141	40		49	161	124	22		173	181	49			79	140	33			54	37	139			75	96	62	59	116	126	98	31	42	104	121	137	146					
25		77	150	106	78		67	181	122	32		138	144	31			80	114	161			69	142	164			77	95	108	49	132	123	129	34	176	119	124	152	98					
23		63	165	126	27		69	147	136	33		131	156	150			141	167	228			46	145	129			60	91	43	76	141	158	130	67	149	21	100	143	193					
11		49	121	131	16		47	154	90	19		141	163	133			145	120	134			68	151	162			74	90	68	87	176	191	133	57	161	27	157	99	126					
19		86	139	134	44		61	172	123	13		138	175	152			103	160	102			77	158	151			83	129	30	36	82	38	55	28	174	62	21	171	164					
6		57	152	147	57		38	146	137	44		140	146	152			105	142	156			89	157	122			25	99	43	25	94	29	19	137	207	48	120	149	141					
21		87	148	148	28		65	139	108	37		131	145	139			154	125	218			51	148	167			54	104	23	10	109	212	127	192	181	59	58	117	184					
21		51	147	141	23		60	151	137	44		133	155	146			133	139	149			19	161	160			41	102	21	58	66	205	143	122	186	97	87	143	166					
8		62	160	145	49		29	146	143	22		143	174	153			127	155	194			14	147	164			92	103	14	61	44	232	151	170	224	91	109	145	145					
14		102	156	151	18		15	179	148	8		116	163	138			121	124	185			18	126	118			66	131	33	33	40	230	135	176	220	88	104	119	50					
8		79	146	146	16		81	22	145	7		129	172	151			119	157	166			39	163	165			88	30	36	10	53	147	151	173	180	89	88	176	144					

Reference Site

Quadrat

Transect 8			Transect 9				Transect 10		
1	2	3	1	2	3	4	1	2	3
	55	56		66	63	27	129	27	12
	15	48		68	14	13	63	39	15
	182	45		65	35	29	43	50	56
	203	86		70	69	73	36	68	93
	186	37		13	17	58	28	97	101
	181	145		61	23	170	26	47	52
	207	190		63	83	180	38	190	146
	190	184		80	175	154	14	178	175
	188	153		54	122	174	25	179	155
	166	163		55	108	127	55	178	200
	193	172		109	70	161	72	181	172
	18	168		145	150	143	53	142	185
	169	129		85	93	124	97	166	197
	70	153		135	150	138	82	190	172
	161	187		153	161	154	48	134	190
	155	64		141	142	167	72	183	191
	194	175		148	135	175	51	202	201
	157	122		155	137	152	100	186	190
	155	103		101	137	170	36	182	181
	134	145		92	142	179	38	164	178

APPENDIX C
SITE PHOTOGRAPHS



Restoration site-view of transect 1 from upland end.



Restoration site-view of transect 2 from upland end.



Restoration site-view of transect 3 from upland end.



Restoration site-view of transect 4 from upland end.



Restoration site-view of transect 5 from upland end.



Restoration site-view of transect 6 from upland end.



Restoration site-view of transect 7 from west end.



Restoration site-view of peninsula area at high tide.



Restoration site, view at high tide from boat ramp.



Restoration site, view at low tide from boat ramp



Reference site-view at low tide from parking lot.



Reference site-view at high tide from parking lot.

APPENDIX D
FISH FIELD DATA

2004 Bar Beach Fish Data	Location	Date	Water Depth (cm)	Time of High Tide	Sample Time
Restoration site throw 1	Restoration, near T4, high marsh	9/28/04	52	12:03 PM	11:30 AM
Species	<i>Fundulus heteroclitus</i>	<i>Fundulus majalis</i>	<i>Menidia menidia</i>	<i>Palaeomonetes vulgaris</i>	
Total Caught	22	9	1	128	
Volume (mL)	63				
Length (mm)					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32	1				
33					
34	1				
35					
36					
37			1		
38	1				
39		2			
40	3				
41	1				
42	2				
43					
44					
45					
46					
47	1				
48					
49					
50					
51	1				
52	1	1			
53	2				
54	2	1			
55					
56	2	1			
57					
58	2	2			
59	1				
60					
61					
62					
63					
64					
65		1			
66		1			
67					
68					
69					
70					
71					
72					
73					
74					
75					
76					
77					
78					
79					
80					
81					
82					
83					
84					
85					
86					
87	1				
88					
89					
90					
91					
92					
93					
94					
95					
96					
97					
98					
99					
100					
101					
102					
103					
104					
105					
106					
107					
108					
109					

2004 Bar Beach Fish Data	Location	Date	Water Depth (cm)	Time of High Tide	Sample Time
Restoration site throw 2	Restoration, near T5, high marsh	9/28/04	57	12:03 PM	10:30 AM
Species	<i>Fundulus heteroclitus</i>	<i>Fundulus majalis</i>	<i>Menidia menidia</i>	<i>Palaeomonetes vulgaris</i>	
Total Caught	28	5	0	19	
Volume (mL)	50				
Length (mm)	21				
	22				
	23				
	24				
	25				
	26				
	27				
	28				
	29				
	30				
	31				
	32				
	33	1			
	34				
	35				
	36	1			
	37				
	38				
	39	1	1		
	40	1	1		
	41	1			
	42				
	43	2			
	44				
	45	2			
	46	1			
	47	2			
	48				
	49				
	50				
	51	1			
	52		1		
	53	2			
	54	1			
	55	1	1		
	56				
	57				
	58				
	59				
	60	1			
	61	3			
	62	1	1		
	63				
	64	2			
	65	2			
	66				
	67	1			
	68				
	69				
	70				
	71				
	72				
	73	1			
	74				
	75				
	76				
	77				
	78				
	79				
	80				
	81				
	82				
	83				
	84				
	85				
	86				
	87				
	88				
	89				
	90				
	91				
	92				
	93				
	94				
	95				
	96				
	97				
	98				
	99				
	100				
	101				
	102				
	103				
	104				
	105				
	106				
	107				
	108				
	109				

2004 Bar Beach Fish Data	Location	Date	Water Depth (cm)	Time of High Tide	Sample Time
Restoration site throw 3	Restoration, on T5, high marsh	9/28/04	66	12:03 PM	11:00 AM
Species	<i>Fundulus heteroclitus</i>	<i>Fundulus majalis</i>	<i>Menidia menidia</i>	<i>Palaeomonetes vulgaris</i>	<i>Carcinus maenas</i>
Total Caught	11	14	2	34	1
Volume (mL)	25				
Length (mm)					
21					
22					
23					
24					
25	1				
26					
27					
28					
29					
30					
31					
32					
33					
34	1				
35		1			
36	2		1		
37		1	1		
38		3			
39	1	2			
40	1	1			
41					
42		1			
43	1				
44					
45		1			
46					
47	1	2			
48	1				
49					
50					
51					
52					
53					
54		1			
55					
56					
57	1				
58					
59		1			
60	1				
61					
62					
63					
64					
65					
66					
67					
68					
69					
70					
71					
72					
73					
74					
75					
76					
77					
78					
79					
80					
81					
82					
83					
84					
85					
86					
87					
88					
89					
90					
91					
92					
93					
94					
95					
96					
97					
98					
99					
100					
101					
102					
103					
104					
105					
106					
107					
108					
109					

2004 Bar Beach Fish Data	Location	Date	Water Depth (cm)	Time of High Tide	Sample Time
Restoration site throw 4	Restoration, between T4 and T5, low marsh	9/29/04	40	12:43 PM	3:35 PM
Species	<i>Fundulus heteroclitus</i>	<i>Fundulus majalis</i>	<i>Menidia menidia</i>	<i>Palaeomonetes vulgaris</i>	<i>Carcinus maenas</i>
Total Caught	14	4	2	76	1
Volume (mL)	12.5				
Length (mm)	21				
	22				
	23				
	24				
	25				
	26				
	27				
	28	1			
	29				
	30				
	31				
	32				
	33	1			
	34	1			
	35	2			
	36		1	1	
	37		1	1	
	38	1			
	39	1	1		
	40	3			
	41				
	42	1			
	43				
	44				
	45				
	46				
	47	1			
	48				
	49	1			
	50				
	51	1			
	52				
	53				
	54				
	55				
	56				
	57				
	58				
	59				
	60				
	61				
	62				
	63				
	64				
	65				
	66				
	67				
	68				
	69				
	70				
	71				
	72	1			
	73				
	74				
	75				
	76				
	77				
	78				
	79				
	80				
	81				
	82				
	83				
	84				
	85				
	86				
	87				
	88				
	89				
	90				
	91				
	92				
	93				
	94				
	95				
	96				
	97				
	98				
	99				
	100				
	101				
	102				
	103				
	104				
	105				
	106				
	107				
	108				
	109				

2004 Bar Beach Fish Data	Location	Date	Water Depth (cm)	Time of High Tide	Sample Time
Restoration site throw 5	Restoration, near T5, low marsh edge	9/29/04	60	12:43 PM	3:15 PM
Species	<i>Fundulus heteroclitus</i>	<i>Fundulus majalis</i>	<i>Menidia menidia</i>	<i>Palaemonetes vulgaris</i>	<i>Carcinus maenas</i>
Total Caught	12	0	1	63	2
Volume (mL)	NA				
Length (mm)	21				
	22				
	23				
	24				
	25				
	26				
	27				
	28				
	29				
	30	3			
	31	1			
	32	2			
	33	1			
	34				
	35	1			
	36				
	37		1		
	38	1			
	39				
	40	1			
	41				
	42				
	43	2			
	44				
	45				
	46				
	47				
	48				
	49				
	50				
	51				
	52				
	53				
	54				
	55				
	56				
	57				
	58				
	59				
	60				
	61				
	62				
	63				
	64				
	65				
	66				
	67				
	68				
	69				
	70				
	71				
	72				
	73				
	74				
	75				
	76				
	77				
	78				
	79				
	80				
	81				
	82				
	83				
	84				
	85				
	86				
	87				
	88				
	89				
	90				
	91				
	92				
	93				
	94				
	95				
	96				
	97				
	98				
	99				
	100				
	101				
	102				
	103				
	104				
	105				
	106				
	107				
	108				
	109				

2004 Bar Beach Fish Data	Location	Date	Water Depth (cm)	Time of High Tide	Sample Time
Restoration site throw 6	Restoration, near T3, low marsh, unvegetated	9/29/04	35	12:43 PM	3:55 PM
Species	<i>Fundulus heteroclitus</i>	<i>Fundulus majalis</i>	<i>Menidia menidia</i>	<i>Palaeomonetes vulgaris</i>	<i>Carcinus maenas</i>
Total Caught	15	1	0	29	3
Volume (mL)	NA				
Length (mm)					
21					
22					
23					
24					
25	1				
26					
27	2				
28					
29					
30	1				
31					
32					
33	3				
34	2				
35	2	1			
36	1				
37					
38					
39					
40					
41	1				
42					
43					
44					
45					
46					
47					
48					
49	1				
50					
51					
52					
53					
54					
55					
56					
57	1				
58					
59					
60					
61					
62					
63					
64					
65					
66					
67					
68					
69					
70					
71					
72					
73					
74					
75					
76					
77					
78					
79					
80					
81					
82					
83					
84					
85					
86					
87					
88					
89					
90					
91					
92					
93					
94					
95					
96					
97					
98					
99					
100					
101					
102					
103					
104					
105					
106					
107					
108					
109					

2004 Bar Beach Fish Data	Location	Date	Water Depth (cm)	Time of High Tide	Sample Time
Restoration site throw 7	Restoration, between T1 and T2, low marsh edge	9/29/04	20	12:43 PM	4:15 PM
Species	<i>Fundulus heteroclitus</i>	<i>Fundulus majalis</i>	<i>Menidia menidia</i>	<i>Palaeomonetes vulgaris</i>	
Total Caught	4	1	0	82	
Volume (mL)	NA				
Length (mm)	21				
	22				
	23				
	24				
	25				
	26				
	27				
	28				
	29				
	30				
	31				
	32				
	33				
	34				
	35	1			
	36				
	37	1			
	38				
	39				
	40	1			
	41	1			
	42				
	43				
	44				
	45				
	46				
	47				
	48				
	49				
	50				
	51				
	52				
	53				
	54				
	55				
	56	1			
	57				
	58				
	59				
	60				
	61				
	62				
	63				
	64				
	65				
	66				
	67				
	68				
	69				
	70				
	71				
	72				
	73				
	74				
	75				
	76				
	77				
	78				
	79				
	80				
	81				
	82				
	83				
	84				
	85				
	86				
	87				
	88				
	89				
	90				
	91				
	92				
	93				
	94				
	95				
	96				
	97				
	98				
	99				
	100				
	101				
	102				
	103				
	104				
	105				
	106				
	107				
	108				
	109				

2004 Bar Beach Fish Data	Location	Date	Water Depth (cm)	Time of High Tide	Sample Time
Restoration site throw 8	Restoration, peninsula T6, outer	9/30/04	50	1:20 PM	2:55 PM
Species	<i>Fundulus heteroclitus</i>	<i>Fundulus majalis</i>	<i>Menidia menidia</i>	<i>Paraeomonetes vulgaris</i>	
Total Caught	32	0	4	34	
Volume (mL)		50			
Length (mm)	21				
	22				
	23				
	24				
	25				
	26				
	27				
	28	1			
	29				
	30	1			
	31				
	32				
	33	1			
	34	3			
	35	2			
	36	3			
	37	1			
	38	4	1		
	39	2			
	40	1	2		
	41	2	1		
	42				
	43				
	44				
	45				
	46				
	47				
	48	1			
	49				
	50				
	51				
	52				
	53	1			
	54				
	55				
	56	1			
	57				
	58				
	59				
	60	3			
	61	2			
	62	1			
	63				
	64				
	65	1			
	66				
	67				
	68				
	69				
	70	1			
	71				
	72				
	73				
	74				
	75				
	76				
	77				
	78				
	79				
	80				
	81				
	82				
	83				
	84				
	85				
	86				
	87				
	88				
	89				
	90				
	91				
	92				
	93				
	94				
	95				
	96				
	97				
	98				
	99				
	100				
	101				
	102				
	103				
	104				
	105				
	106				
	107				
	108				
	109				

2004 Bar Beach Fish Data	Location	Date	Water Depth (cm)	Time of High Tide	Sample Time
Restoration site throw 9	Restoration, peninsula on TG inner end	9/30/04	75	1:20 PM	1:25 PM
Species	<i>Fundulus heteroclitus</i>	<i>Fundulus majalis</i>	<i>Menidia menidia</i>	<i>Palaeomonetes vulgaris</i>	
Total Caught	12	3	4	49	
Volume (mL)	25				
Length (mm)					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33	1				
34	2				
35	1				
36					
37	2				
38		1			
39		1			
40	2		2		
41	1		1		
42	1				
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57	1				
58					
59					
60					
61					
62					
63		1			
64			1		
65					
66					
67					
68					
69					
70					
71					
72					
73					
74					
75					
76					
77					
78					
79					
80					
81					
82					
83					
84					
85					
86					
87					
88					
89					
90					
91					
92					
93	1				
94					
95					
96					
97					
98					
99					
100					
101					
102					
103					
104					
105					
106					
107					
108					
109					

2004 Bar Beach Fish Data	Location	Date	Water Depth (cm)	Time of High Tide	Sample Time
Restoration site throw 10	Restoration, peninsula T7	9/30/04	75	1:20 PM	2:35 PM
Species	<i>Fundulus heteroclitus</i>	<i>Fundulus majalis</i>	<i>Menidia menidia</i>	<i>Paralichthys oblongus</i>	
Total Caught	5	3	7	9	
Volume (mL)		12.5			
Length (mm)					
21					
22					
23					
24					
25					
26					
27			2		
28	1				
29					
30	1				
31					
32					
33					
34	1				
35					
36					
37			2		
38		1	2		
39		1	1		
40					
41					
42					
43					
44					
45		1			
46					
47					
48					
49					
50	1				
51					
52					
53					
54					
55					
56					
57					
58					
59					
60					
61					
62					
63	1				
64					
65					
66					
67					
68					
69					
70					
71					
72					
73					
74					
75					
76					
77					
78					
79					
80					
81					
82					
83					
84					
85					
86					
87					
88					
89					
90					
91					
92					
93					
94					
95					
96					
97					
98					
99					
100					
101					
102					
103					
104					
105					
106					
107					
108					
109					

2004 Bar Beach Fish Data	Location	Date	Water Depth (cm)	Time of High Tide	Sample Time
Reference site throw 1	Reference, near T8, low marsh	9/30/04	55	1:20 PM	10:20 AM
Species	<i>Fundulus heteroclitus</i>	<i>Fundulus majalis</i>	<i>Meridia menidia</i>	<i>Palaeomonetes vulgaris</i>	
Total Caught	6	7	5	55	
Volume (mL)	NA				
Length (mm)	21				
	22				
	23				
	24				
	25				
	26				
	27				
	28				
	29				
	30				
	31				
	32		1		
	33				
	34				
	35				
	36				
	37				
	38				
	39		1		
	40				
	41	1			
	42	1	1		
	43	1			
	44		1		
	45				
	46	1	1		
	47				
	48	1			
	49				
	50				
	51				
	52	1			
	53				
	54				
	55				
	56				
	57	1			
	58	1			
	59				
	60	1	1		
	61				
	62				
	63				
	64				
	65				
	66				
	67				
	68				
	69				
	70				
	71				
	72				
	73				
	74	1			
	75				
	76	2			
	77				
	78				
	79				
	80				
	81				
	82				
	83				
	84				
	85				
	86				
	87				
	88				
	89				
	90				
	91				
	92				
	93				
	94				
	95				
	96				
	97				
	98				
	99				
	100				
	101				
	102				
	103				
	104				
	105				
	106				
	107				
	108				
	109				

2004 Bar Beach Fish Data	Location	Date	Water Depth (cm)	Time of High Tide	Sample Time
Reference site throw 2	Reference, between T8 and T9 low marsh	9/30/04	65	1:20 PM	10:35 AM
Species	<i>Fundulus heteroclitus</i>	<i>Fundulus majellii</i>	<i>Menidia menidia</i>	<i>Palaeomonetes vulgaris</i>	
Total Caught	3	2	1	32	
Volume (mL)	NA				
Length (mm)	21				
	22				
	23				
	24				
	25				
	26				
	27				
	28				
	29				
	30				
	31				
	32				
	33	1			
	34				
	35				
	36				
	37	1			
	38		1		
	39		1		
	40				
	41				
	42				
	43				
	44				
	45				
	46				
	47				
	48				
	49				
	50	1			
	51				
	52				
	53				
	54				
	55				
	56				
	57				
	58				
	59		1		
	60				
	61				
	62				
	63				
	64				
	65				
	66				
	67				
	68				
	69				
	70				
	71				
	72				
	73				
	74				
	75				
	76				
	77				
	78				
	79				
	80				
	81				
	82				
	83				
	84				
	85				
	86				
	87				
	88				
	89				
	90				
	91				
	92				
	93				
	94				
	95				
	96				
	97				
	98				
	99				
	100				
	101				
	102				
	103				
	104				
	105				
	106				
	107				
	108				
	109				

2004 Bar Beach Fish Data	Location	Date	Water Depth (cm)	Time of High Tide	Sample Time
Reference site throw 3	Reference between T8 and T9 mid marsh	9/30/04	50	1:20 PM	10:50 AM
Species	<i>Fundulus heteroclitus</i>	<i>Fundulus majalis</i>	<i>Menidia menidia</i>	<i>Palaeomonetes vulgaris</i>	<i>Carcinus maenas</i>
Total Caught	12	0	0	21	1
Volume (mL)	NA				
Length (mm)	21				
	22				
	23				
	24				
	25				
	26				
	27				
	28				
	29				
	30				
	31				
	32				
	33				
	34				
	35				
	36				
	37	1			
	38	1			
	39				
	40	2			
	41				
	42	2			
	43				
	44				
	45	1			
	46				
	47	1			
	48				
	49	1			
	50				
	51				
	52				
	53				
	54				
	55				
	56	1			
	57	1			
	58				
	59				
	60				
	61				
	62	1			
	63				
	64				
	65				
	66				
	67				
	68				
	69				
	70				
	71				
	72				
	73				
	74				
	75				
	76				
	77				
	78				
	79				
	80				
	81				
	82				
	83				
	84				
	85				
	86				
	87				
	88				
	89				
	90				
	91				
	92				
	93				
	94				
	95				
	96				
	97				
	98				
	99				
	100				
	101				
	102				
	103				
	104				
	105				
	106				
	107				
	108				
	109				

2004 Bar Beach Fish Data	Location	Date	Water Depth (cm)	Time of High Tide	Sample Time
Reference site throw 4	Reference between T9 and T10 mid/high marsh	9/30/04	40	1:20 PM	11:10 AM
Species	<i>Fundulus heteroclitus</i>	<i>Fundulus majalis</i>	<i>Menidia menidia</i>	<i>Palaeomonetes vulgaris</i>	<i>Carcinus maenas</i>
Total Caught	13	4	0	28	1
Volume (mL)	NA				
Length (mm)	21				
	22				
	23				
	24				
	25				
	26				
	27				
	28				
	29				
	30				
	31				
	32				
	33	1			
	34				
	35				
	36				
	37				
	38		1		
	39				
	40	2			
	41	1			
	42				
	43	1			
	44				
	45		1		
	46				
	47				
	48				
	49				
	50				
	51				
	52				
	53				
	54				
	55				
	56				
	57	1			
	58				
	59		1		
	60				
	61	1			
	62				
	63				
	64				
	65	1			
	66				
	67		1		
	68				
	69	1			
	70				
	71				
	72				
	73				
	74				
	75				
	76				
	77				
	78				
	79				
	80				
	81				
	82				
	83				
	84				
	85				
	86				
	87	1			
	88				
	89				
	90				
	91				
	92	1			
	93				
	94				
	95				
	96	1			
	97				
	98				
	99				
	100				
	101				
	102				
	103				
	104				
	105	1			
	106				
	107				
	108				
	109				

2004 Bar Beach Fish Data	Location	Date	Water Depth (cm)	Time of High Tide	Sample Time
Reference site throw 5	Reference between T9 and T10 high marsh	9/30/04	45	1:20 PM	11:30 AM
Species	<i>Fundulus heteroclitus</i>	<i>Fundulus majalis</i>	<i>Menidia menidia</i>	<i>Palaeomonetes vulgaris</i>	
Total Caught	20	4	0	29	
Volume (mL)	25				
Length (mm)					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37	1				
38		1			
39	3				
40	2				
41					
42					
43					
44					
45	2	1			
46					
47	1				
48	2	1			
49		1			
50					
51					
52					
53					
54	1				
55	1				
56	1				
57					
58					
59					
60					
61					
62	2				
63					
64	1				
65	2				
66					
67					
68	1				
69					
70					
71					
72					
73					
74					
75					
76					
77					
78					
79					
80					
81					
82					
83					
84					
85					
86					
87					
88					
89					
90					
91					
92					
93					
94					
95					
96					
97					
98					
99					
100					
101					
102					
103					
104					
105					
106					
107					
108					
109					

APPENDIX E
BENTHIC MACROINVERTEBRATE FIELD DATA

Benthic Macroinvertebrate Data

Restoration site																										
Quadrat	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total
Stratum	high	high	high	high	high	low																				
<i>Geukensia demissa</i>						245	298	336	177	42									5	109			1			1213
<i>Uca pugnax burrows</i>	6								8	7	18	5	2	8											1	55
<i>Hemigrapsus sanguineus</i>						3	6	3	2											1						15
<i>Carcinus maenas</i>																							1			1
<i>Neopanopeus sayi</i>																										0
<i>Nassarius obsoletus</i>						1	11	39	6	41	3	2		7	53	59	58	64	123	36	61	17	12	17	26	636
<i>Littorina saxatilis</i>																			1							1
Total abundance	6	0	0	0	0	249	315	378	193	90	21	7	2	15	53	59	58	64	129	146	61	17	14	17	27	1921

Reference Site																
Quadrat	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	Total
Stratum	high	high	high	low												
<i>Geukensia demissa</i>				192	176	315	233	50	132	72	40	15	56	27	40	1348
<i>Uca pugnax burrows</i>														6		6
<i>Hemigrapsus sanguineus</i>				9	4	5	6		2							26
<i>Carcinus maenas</i>																0
<i>Neopanopeus sayi</i>						1										1
<i>Nassarius obsoletus</i>				38	12			15	63	38	25	97	51	8	112	459
<i>Littorina saxatilis</i>																0
Total abundance	0	0	0	239	192	321	239	65	197	110	65	112	107	41	152	1840

APPENDIX F
AVIAN FIELD DATA

MONITORING INFORMATION

Date of Monitoring

9/30/04

Time of Monitoring

Began: 1:30 pm

Concluded: 2:15 pm

(for both sites)

Tide

(please circle one)

High Tide / Ebbing / Low Tide /
 Flooding

Predicted low and high tides:

Time of tidal measurements:

Nearest tidal station:

Weather

(temperature, wind,
precipitation)

65° / light wind @ 5 / rain

Monitor(s)

(name, affiliation)

M. Normandia, AUDUBON

Type of Monitoring

(please circle one)

Pre-Construction

As-built (4-5 weeks)

Annual Post-Construction: Year 1 / 2 / 3 /
4 / 5

Parameters Measured

(please circle all that apply)

Vegetation

Sediment

Benthic Invertebrates

Birds

Other (please describe):

FIELD NOTES

9/30/07

feral cat colony in ~~the~~ reference site
area. may have impact on study.

* Feeding station
along fence line

MONITORING INFORMATION

Date of Monitoring 10-5-04

Time of Monitoring Began: 9:30 A.M.
Concluded: 10:15 A.M.

Tide High Tide / Ebbing / Low Tide
(please circle one) Flooding

Predicted low and high tides:

Time of tidal measurements:

Nearest tidal station:

Weather 58°/strong wind @ 20/clear
(temperature, wind, precipitation)

Monitor(s) M. NORMANDIA, AUDUBON
(name, affiliation)

Type of Monitoring Pre-Construction
(please circle one) As-built (4-5 weeks)
Annual Post-Construction: Year 1 / 2 / 3 / 4 / 5

Parameters Measured Vegetation
(please circle all that apply) Sediment
Benthic Invertebrates
Birds ✓
Other (please describe):

MONITORING INFORMATION

Date of Monitoring 10/17/04

Time of Monitoring Began: 8:30 A.M
Concluded: 9:15 P.M

Tide (please circle one) High Tide / Ebbing / Low Tide
Flooding

Predicted low and high tides:

Time of tidal measurements:

Nearest tidal station:

Weather (temperature, wind, precipitation) 56° / strong wind @ 20+ / clear

Monitor(s) (name, affiliation) M. Normandia, AUDUBON

Type of Monitoring (please circle one) Pre-Construction
As-built (4-5 weeks)
Annual Post-Construction: Year 1 2 / 3 / 4 / 5

Parameters Measured (please circle all that apply) Vegetation
Sediment
Benthic Invertebrates
Birds ✓
Other (please describe):

MONITORING INFORMATION

Date of Monitoring 10/20/04

Time of Monitoring Began: 3 pm
Concluded: 3:45 pm

Tide (please circle one) High Tide Ebbing / Low Tide / Flooding

Predicted low and high tides:

Time of tidal measurements:

Nearest tidal station:

Weather (temperature, wind, precipitation) 54° / 15 mph / cloudy

Monitor(s) (name, affiliation) M. Normandia, Audubon

Type of Monitoring (please circle one) Pre-Construction
As-built (4-5 weeks)
Annual Post-Construction: Year 1 / 2 / 3 / 4 / 5

Parameters Measured (please circle all that apply) Vegetation
Sediment
Benthic Invertebrates
Birds ✓
Other (please describe):

MONITORING INFORMATION

Date of Monitoring 10/26/04

Time of Monitoring Began: 3:15 p.m.
Concluded: 3:50

Tide High Tide / Ebbing / Low Tide
(please circle one) Flooding

Predicted low and high tides:

Time of tidal measurements:

Nearest tidal station:

Weather 59°/mod @ 13/clear
(temperature, wind, precipitation)

Monitor(s) M. Normandia, NSAS
(name, affiliation)

Type of Monitoring Pre-Construction
(please circle one) As-built (4-5 weeks)

Annual Post-Construction: Year 1 / 2 / 3 / 4 / 5

Parameters Measured Vegetation
(please circle all that apply) Sediment

Benthic Invertebrates

Birds ✓

Other (please describe):

MONITORING INFORMATION

Date of Monitoring 11/2/05

Time of Monitoring Began: 1:15 pm
Concluded: 1:45 pm

Tide (please circle one) High Tide / Ebbing / Low Tide / Flooding

Predicted low and high tides:

Time of tidal measurements:

Nearest tidal station:

Weather (temperature, wind, precipitation) 53°/SW@12/cloudy

Monitor(s) (name, affiliation) M. Normandia, Audubon

Type of Monitoring (please circle one) Pre-Construction
As-built (4-5 weeks)
Annual Post-Construction: Year 1 / 2 / 3 / 4 / 5

Parameters Measured (please circle all that apply) Vegetation
Sediment
Benthic Invertebrates
Birds
Other (please describe):

MONITORING INFORMATION

Date of Monitoring

11/10/04

Time of Monitoring

Began: 12:30 p.m.
Concluded: 1:15 p.m.

Tide
(please circle one)

High Tide / Ebbing / Low Tide /
Flooding

Predicted low and high tides:

Time of tidal measurements:

Nearest tidal station:

Weather
(temperature, wind,
precipitation)

42° / light North / Clear

Monitor(s)
(name, affiliation)

M. Normandia / NSAS

Type of Monitoring
(please circle one)

Pre-Construction

As-built (4-5 weeks)

Annual Post-Construction: Year 1 / 2 / 3 /
4 / 5

Parameters Measured
(please circle all that apply)

Vegetation

Sediment

Benthic Invertebrates

Birds ✓

Other (please describe):

MONITORING INFORMATION

Date of Monitoring 11/16/04

Time of Monitoring Began: 3:15 pm
Concluded: 3:45

Tide (please circle one) High Tide / Ebbing / Low Tide / Flooding

Predicted low and high tides:

Time of tidal measurements:

Nearest tidal station:

Weather (temperature, wind, precipitation) 56° / light ~~S~~^S mph / clear

Monitor(s) (name, affiliation) M. Normandia, NSAS

Type of Monitoring (please circle one) Pre-Construction
As-built (4-5 weeks)
Annual Post-Construction: Year 1 / 2 / 3 / 4 / 5

Parameters Measured (please circle all that apply) Vegetation
Sediment
Benthic Invertebrates
Birds
Other (please describe):

MONITORING INFORMATION

Date of Monitoring

12/2/04

Time of Monitoring

Began: 3pm
Concluded: 3:30pm

Tide
(please circle one)

High Tide / Ebbing / Low Tide /
Flooding

Predicted low and high tides:

Time of tidal measurements:

Nearest tidal station:

Weather
(temperature, wind,
precipitation)

48°/W Moderate / clear to cloudy

Monitor(s)
(name, affiliation)

M. NORMANDIA, NSAS

Type of Monitoring
(please circle one)

Pre-Construction

As-built (4-5 weeks)

Annual Post-Construction: Year 1 / 2 / 3 /
4 / 5

Parameters Measured
(please circle all that apply)

Vegetation

Sediment

Benthic Invertebrates

Birds

Other (please describe):

FIELD NOTES

12/2/04

- Barge with what appears to be dredger attached parked at base of pier in Harbor.
- Several skids of metal "I" beams in parking lot near gazebo.
- Construction project?

No coverage w/E 11/27

LISA

QUESTION:

Will 2005 turn year of "Annual Post-Construction" to year 2? (re: under 'type of monitoring')

APPENDIX G
NOAA 2002 PRE-RESTORATION MONITORING DATA

NOAA 2002 Pre-Restoration Monitoring Data

Restoration Site																																																			
Vegetative Cover (percent)																																																			
Species	Transect 1						Transect 2						Transect 3						Transect 4						Transect 5						Transect 6						Transect 7						Average (square meter)								
	Q1	Q2	Q3	Q4	Q5	Q6	Q1	Q2	Q3	Q4	Q5	Q6	Q1	Q2	Q3	Q4	Q5	Q6	Q1	Q2	Q3	Q4	Q5	Q6	Q1	Q2	Q3	Q4	Q5	Q6	Q1	Q2	Q3	Q4	Q5	Q6	Q1	Q2	Q3	Q4	Q5	Q6									
<i>Spartina alterniflora</i>	0	0	1	90	90	40	0	0	0	35	18	0	0.5	0	85	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	85	80	3.5	25	0	0	80	60	35	0.5	22.5%
<i>Phragmites australis</i>	37	7	0	0	0	0	45	0	1	0	0	0	0	7	0	0	0	0	0	15	20	30	20	25	5	37	0	5	100	0	0	0	0	0	100	100	70	0	0	0	0	15	15	0	0	0	0	0	14.5%		
<i>Iva frutescens</i>	0	65	0	0	0	0	0	0	60	50	0	0	0	0	0	0	0	0	0	40	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.1%		
<i>Distichlis spicata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	60	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14.1%	
<i>Artemisia vulgaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	
<i>Limonium sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0	47	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.2%		
<i>Toxicodendron radicans</i>	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7.7%	
<i>Salicornia europaea</i>	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	
Total Plant Cover																															46.6%																				

Invertebrates	Macroinvertebrate density (individuals per square meter)																															Average (1/4 square meter)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30	Q31		Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40	Q41	Q42	Q43	Q44	Q45	Q46	Q47	Q48	Q49	Q50	Q51	Q52	Q53	Q54	Q55	Q56	Q57	Q58	Q59	Q60	Q61	Q62	Q63	Q64	Q65	Q66	Q67	Q68	Q69	Q70	Q71	Q72	Q73	Q74	Q75	Q76	Q77	Q78	Q79	Q80	Q81	Q82	Q83	Q84	Q85	Q86	Q87	Q88	Q89	Q90	Q91	Q92	Q93	Q94	Q95	Q96	Q97	Q98	Q99	Q100	Q101	Q102	Q103	Q104	Q105	Q106	Q107	Q108	Q109	Q110	Q111	Q112	Q113	Q114	Q115	Q116	Q117	Q118	Q119	Q120	Q121	Q122	Q123	Q124	Q125	Q126	Q127	Q128	Q129	Q130	Q131	Q132	Q133	Q134	Q135	Q136	Q137	Q138	Q139	Q140	Q141	Q142	Q143	Q144	Q145	Q146	Q147	Q148	Q149	Q150	Q151	Q152	Q153	Q154	Q155	Q156	Q157	Q158	Q159	Q160	Q161	Q162	Q163	Q164	Q165	Q166	Q167	Q168	Q169	Q170	Q171	Q172	Q173	Q174	Q175	Q176	Q177	Q178	Q179	Q180	Q181	Q182	Q183	Q184	Q185	Q186	Q187	Q188	Q189	Q190	Q191	Q192	Q193	Q194	Q195	Q196	Q197	Q198	Q199	Q200	Q201	Q202	Q203	Q204	Q205	Q206	Q207	Q208	Q209	Q210	Q211	Q212	Q213	Q214	Q215	Q216	Q217	Q218	Q219	Q220	Q221	Q222	Q223	Q224	Q225	Q226	Q227	Q228	Q229	Q230	Q231	Q232	Q233	Q234	Q235	Q236	Q237	Q238	Q239	Q240	Q241	Q242	Q243	Q244	Q245	Q246	Q247	Q248	Q249	Q250	Q251	Q252	Q253	Q254	Q255	Q256	Q257	Q258	Q259	Q260	Q261	Q262	Q263	Q264	Q265	Q266	Q267	Q268	Q269	Q270	Q271	Q272	Q273	Q274	Q275	Q276	Q277	Q278	Q279	Q280	Q281	Q282	Q283	Q284	Q285	Q286	Q287	Q288	Q289	Q290	Q291	Q292	Q293	Q294	Q295	Q296	Q297	Q298	Q299	Q300	Q301	Q302	Q303	Q304	Q305	Q306	Q307	Q308	Q309	Q310	Q311	Q312	Q313	Q314	Q315	Q316	Q317	Q318	Q319	Q320	Q321	Q322	Q323	Q324	Q325	Q326	Q327	Q328	Q329	Q330	Q331	Q332	Q333	Q334	Q335	Q336	Q337	Q338	Q339	Q340	Q341	Q342	Q343	Q344	Q345	Q346	Q347	Q348	Q349	Q350	Q351	Q352	Q353	Q354	Q355	Q356	Q357	Q358	Q359	Q360	Q361	Q362	Q363	Q364	Q365	Q366	Q367	Q368	Q369	Q370	Q371	Q372	Q373	Q374	Q375	Q376	Q377	Q378	Q379	Q380	Q381	Q382	Q383	Q384	Q385	Q386	Q387	Q388	Q389	Q390	Q391	Q392	Q393	Q394	Q395	Q396	Q397	Q398	Q399	Q400	Q401	Q402	Q403	Q404	Q405	Q406	Q407	Q408	Q409	Q410	Q411	Q412	Q413	Q414	Q415	Q416	Q417	Q418	Q419	Q420	Q421	Q422	Q423	Q424	Q425	Q426	Q427	Q428	Q429	Q430	Q431	Q432	Q433	Q434	Q435	Q436	Q437	Q438	Q439	Q440	Q441	Q442	Q443	Q444	Q445	Q446	Q447	Q448	Q449	Q450	Q451	Q452	Q453	Q454	Q455	Q456	Q457	Q458	Q459	Q460	Q461	Q462	Q463	Q464	Q465	Q466	Q467	Q468	Q469	Q470	Q471	Q472	Q473	Q474	Q475	Q476	Q477	Q478	Q479	Q480	Q481	Q482	Q483	Q484	Q485	Q486	Q487	Q488	Q489	Q490	Q491	Q492	Q493	Q494	Q495	Q496	Q497	Q498	Q499	Q500	Q501	Q502	Q503	Q504	Q505	Q506	Q507	Q508	Q509	Q510	Q511	Q512	Q513	Q514	Q515	Q516	Q517	Q518	Q519	Q520	Q521	Q522	Q523	Q524	Q525	Q526	Q527	Q528	Q529	Q530	Q531	Q532	Q533	Q534	Q535	Q536	Q537	Q538	Q539	Q540	Q541	Q542	Q543	Q544	Q545	Q546	Q547	Q548	Q549	Q550	Q551	Q552	Q553	Q554	Q555	Q556	Q557	Q558	Q559	Q560	Q561	Q562	Q563	Q564	Q565	Q566	Q567	Q568	Q569	Q570	Q571	Q572	Q573	Q574	Q575	Q576	Q577	Q578	Q579	Q580	Q581	Q582	Q583	Q584	Q585	Q586	Q587	Q588	Q589	Q590	Q591	Q592	Q593	Q594	Q595	Q596	Q597	Q598	Q599	Q600	Q601	Q602	Q603	Q604	Q605	Q606	Q607	Q608	Q609	Q610	Q611	Q612	Q613	Q614	Q615	Q616	Q617	Q618	Q619	Q620	Q621	Q622	Q623	Q624	Q625	Q626	Q627	Q628	Q629	Q630	Q631	Q632	Q633	Q634	Q635	Q636	Q637	Q638	Q639	Q640	Q641	Q642	Q643	Q644	Q645	Q646	Q647	Q648	Q649	Q650	Q651	Q652	Q653	Q654	Q655	Q656	Q657	Q658	Q659	Q660	Q661	Q662	Q663	Q664	Q665	Q666	Q667	Q668	Q669	Q670	Q671	Q672	Q673	Q674	Q675	Q676	Q677	Q678	Q679	Q680	Q681	Q682	Q683	Q684	Q685	Q686	Q687	Q688	Q689	Q690	Q691	Q692	Q693	Q694	Q695	Q696	Q697	Q698	Q699	Q700	Q701	Q702	Q703	Q704	Q705	Q706	Q707	Q708	Q709	Q710	Q711	Q712	Q713	Q714	Q715	Q716	Q717	Q718	Q719	Q720	Q721	Q722	Q723	Q724	Q725	Q726	Q727	Q728	Q729	Q730	Q731	Q732	Q733	Q734	Q735	Q736	Q737	Q738	Q739	Q740	Q741	Q742	Q743	Q744	Q745	Q746	Q747	Q748	Q749	Q750	Q751	Q752	Q753	Q754	Q755	Q756	Q757	Q758	Q759	Q760	Q761	Q762	Q763	Q764	Q765	Q766	Q767	Q768	Q769	Q770	Q771	Q772	Q773	Q774	Q775	Q776	Q777	Q778	Q779	Q780	Q781	Q782	Q783	Q784	Q785	Q786	Q787	Q788	Q789	Q790	Q791	Q792	Q793	Q794	Q795	Q796	Q797	Q798	Q799	Q800	Q801	Q802	Q803	Q804	Q805	Q806	Q807	Q808	Q809	Q810	Q811	Q812	Q813	Q814	Q815	Q816	Q817	Q818	Q819	Q820	Q821	Q822	Q823	Q824	Q825	Q826	Q827	Q828	Q829	Q830	Q831	Q832	Q833	Q834	Q835	Q836	Q837	Q838	Q839	Q840	Q841	Q842	Q843	Q844	Q845	Q846	Q847	Q848	Q849	Q850	Q851	Q852	Q853	Q854	Q855	Q856	Q857	Q858	Q859	Q860	Q861	Q862	Q863	Q864	Q865	Q866	Q867	Q868	Q869	Q870	Q871	Q872	Q873	Q874	Q875	Q876	Q877	Q878	Q879	Q880	Q881	Q882	Q883	Q884	Q885	Q886	Q887	Q888	Q889	Q890	Q891	Q892	Q893	Q894	Q895	Q896	Q897	Q898	Q899	Q900	Q901	Q902	Q903	Q904	Q905	Q906	Q907	Q908	Q909	Q910	Q911	Q912	Q913	Q914	Q915	Q916	Q917	Q918	Q919	Q920	Q921	Q922	Q923	Q924	Q925	Q926	Q927	Q928	Q929	Q930	Q931	Q932	Q933	Q934	Q935	Q936	Q937	Q938	Q939	Q940	Q941	Q942	Q943	Q944	Q945	Q946	Q947	Q948	Q949	Q950	Q951	Q952	Q953	Q954	Q955	Q956	Q957	Q958	Q959	Q960	Q961	Q962	Q963	Q964	Q965	Q966	Q967	Q968	Q969	Q970	Q971	Q972	Q973	Q974	Q975	Q976	Q977	Q978	Q979	Q980	Q981	Q982	Q983	Q984	Q985	Q986	Q987	Q988	Q989	Q990	Q991	Q992	Q993	Q994	Q995	Q996	Q997	Q998
<i>Geukensia demissa</i>	0	0	0	200	600	1500	0	0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															

NOAA 2002 Pre-Restoration Monitoring Data

<i>Spartina alterniflora</i> height (first number is feet, second number is inches)																								
Restoration Site														Reference Site										
T1	T1	T2	T2	T3	T3	T4	T5	T5	T5	T5	T6	T6	T6	T7	T7	T7	T7	R1	R1	R1	R1	R1	R1	
Q4	Q5	Q4	Q5	Q2	Q3	Q8	Q3	Q4	Q5	Q6	Q4	Q5	Q7	Q3	Q4	Q5	Q6	Q1	Q3	Q5	Q7	Q9	Q11	
4.5	4	4.8	5.10	6	2.5	3	2.1	5	4.5	2	4	4	3.3	5.4	6	5.3	2.3	4.3	4	4.4	4.1	6	4.5	
4	3	3.11	5.9	4.5	3.25	3.5	2.5	5	2.5	1.5	3.1	2.65	2	4.9	5	4.3	4.4	5.8	4	3.10	5	6.7	4	
4	2.5	6.4	4.11	2	1.5	6	2.2	4.5	2	3	4.2	5	3	5.3	5.3	5		4	4.2	4.3	5.7	5.6	5.5	
2	3	5	6.4	4.25	2.5	4	4	3	2.1	2.2	4.5	2.6	3.1	4.6	5.10	4.5		3.5	4.7	3	5.1	5.3	5	
3	3	5.1	6.5	5.5	3	6	3	2	3	2	4.5	5	2.5	4.7	5.5	4.11		4.11	4	4.1	5.3	5	4.4	
4.5	4	4.6	4.4	5	3	4.5	2.5	2.2	4.5	3	5	3	3	4.10	5.9	5.6		3	3.11	4.4	5.6	6.5	5.5	
5	4.5	3.10	3.8	5.5	3.25	5.75	2.3	2.4	3.1	3.1	6	1.5	3.5	4.7	5.10	5.6		2.5	3.6	4.6	5.3	4.1	4	
4	3.5	4.6	2.10	2.5	2.5	4	4.6	2.5	3	3.5	3.2	4.5	1	5.2	6.3	4.8		5	4.5	4	6	5.4	4.7	
5.5	3.5	3.9	5.4	6.1	2.25	6.25	5	3	3	4	4.3	4	3.2	4.5	5.3	5.4		3.7	3.10	3.10	8	6.1	4.9	
3	5	4.5	6.1	5	1.75	3.5	3.2	1.6	2.1	3.7	5	4.2	1.5	4.2	5.5	5.3		4.6	4.5	6.1	5.10	3.7	4.2	
4.5	5	4.5	1.8	6.25	2.75	5.5	6	3	3.5	3.8	3.1	4	1.8	4.8	5.7	5.4		4.5	4.5	3	5.4	6	4.10	
4	4.5	4.6	1.5	5.2	2	5	5.2	5.5	3.8	3.6	4.5	3.5	1.6	4.5	4.10	4.10		3.4	4.2	4.1	5	5.3	4.10	
4	3	3.11	1.6	5.75	2.5	5	5	3	3.2	4	6	4.5	1.8	5.5	5.2	4.9		3.4	4.4	4.6	4.8	4.7	3.5	
4	4	3.7	3.7	6.5	2	3.25	5.5	3	2.2	4.1	5.8	4.2	1.9	5.4	4.8	4.9		4.7	3.10	3.4	5.3	5.11	5	
3	4	3.3	2.2	5.5	1.5	5.75	6.1	6	3	4.2	4.2	4.1	2	5.10	5.3	5		3.6	3.2	4.8	4.5	5.1	4.11	
4.5	4	3.2	0.83	4.5	2.5	5.5								2.8	5.15	5.4	4.9		3.10	3.5	3.7	3.6	4.7	5.1
4.5	5	3.2	1.4	6.5	1.75	3.5								3	5.1	5	4.10		4.10	4.11	3	5.2	6.2	4.4
4	3.5	2.4	0.91	6.25	2.25	3.75								1.7	5.15	5	4.7		4.5	3.7	4.6	5.3	5	5.5
5	3	3.2	0.83	6	3	4								6	5.15	5	4.7		4.3	4.4	4.3	4.2	6.4	4.11
4.5	3	4	4.9	5.25	2.5	5.5								1.7	5.1	4.10	4.9			4.10	4.1	5.5	5.9	5.5

The reference site is not the same as the reference site used in the 5 year post-construction monitoring program.

Heights in bold font are flowering plants.