

The Sustainability of a Tidal Salt Marsh Restoration Effort in Jamaica Bay, New York

National Conference on Ecosystem Restoration 2011
Baltimore, Maryland
02-August-11

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Overview

- History of Jamaica Bay
- General Background
- Restoration of Elders East and Elders West
- Monitoring Results of Elders East
 - Topography
 - Vegetative Analysis
- Conclusions



History of Jamaica Bay

- ▶ Covering 67.3 km² (6,730 ha/16,630 ac) and opens into the Atlantic Ocean via Rockaway Inlet.
- ▶ In the early 1900's it was an extensive estuarine ecosystem that sustained large expanses of tidal salt marsh.

Over the last century, urban and industrial development has modified the natural environment surrounding the marsh islands through activities such as dredging and filling, construction, pollution, and over-harvesting or eradication of native plant and animal species.



New York



New Jersey

Passaic Co.

Essex Co.

Union Co.

Middlesex Co.

Monmouth Co.

STATEN ISLAND

Passaic River

Kill Van Kull

Arthur Kill

Raritan River

Raritan Bay

Lower Bay

Sandy Hook Bay

Newark Bay



QUEENS

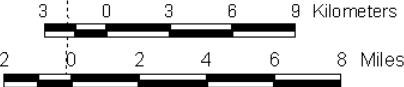
BROOKLYN

Jamaica Bay

Nas

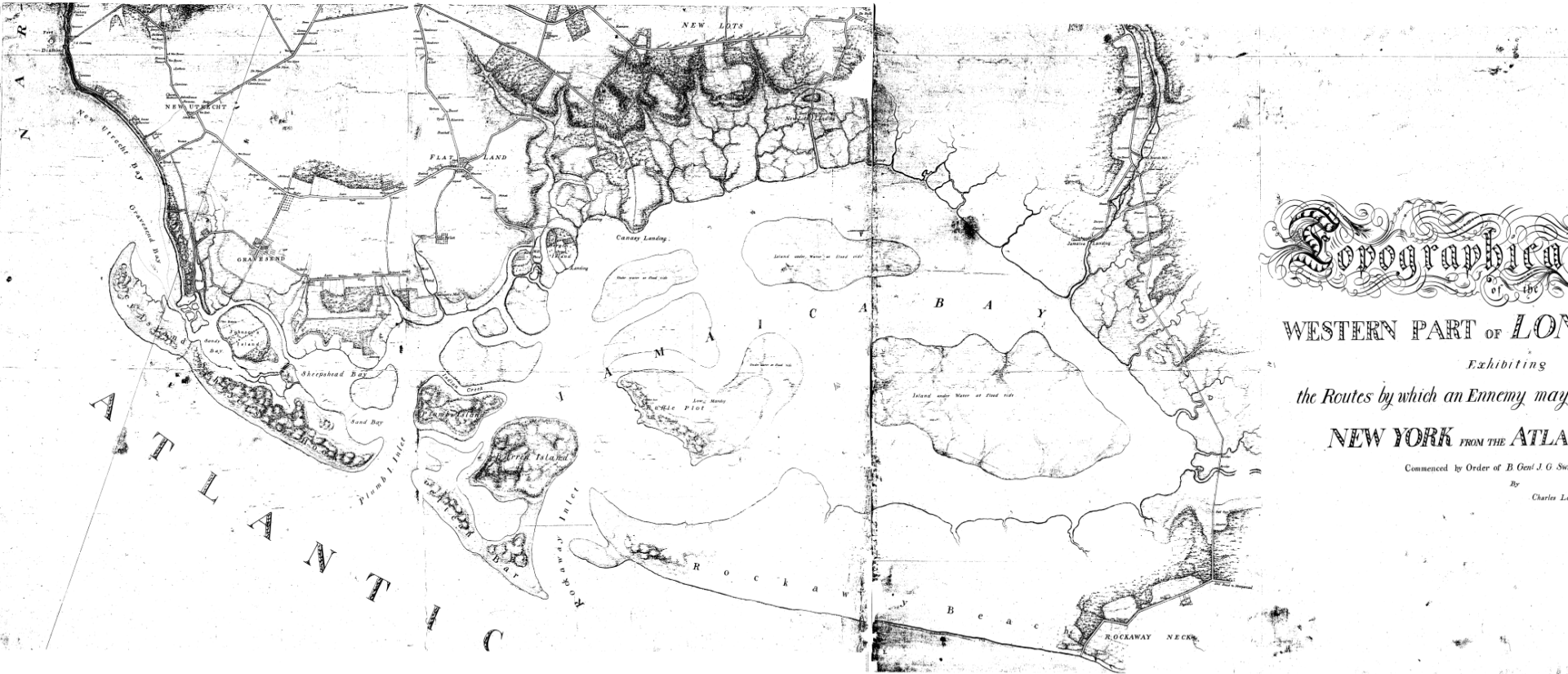
NY Bight Apex

ATLANTIC OCEAN

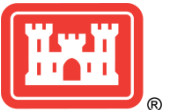


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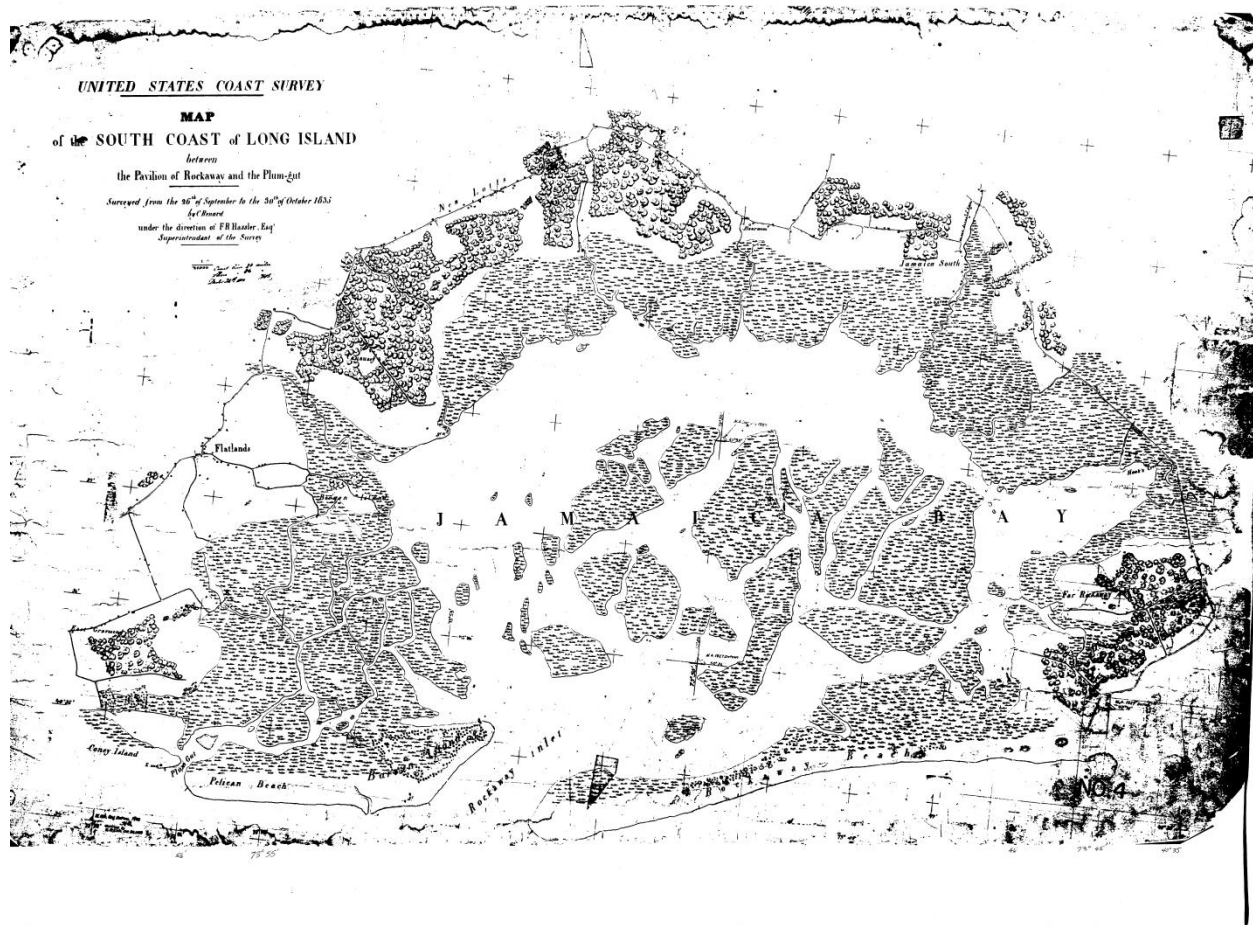
History of Jamaica Bay



1818

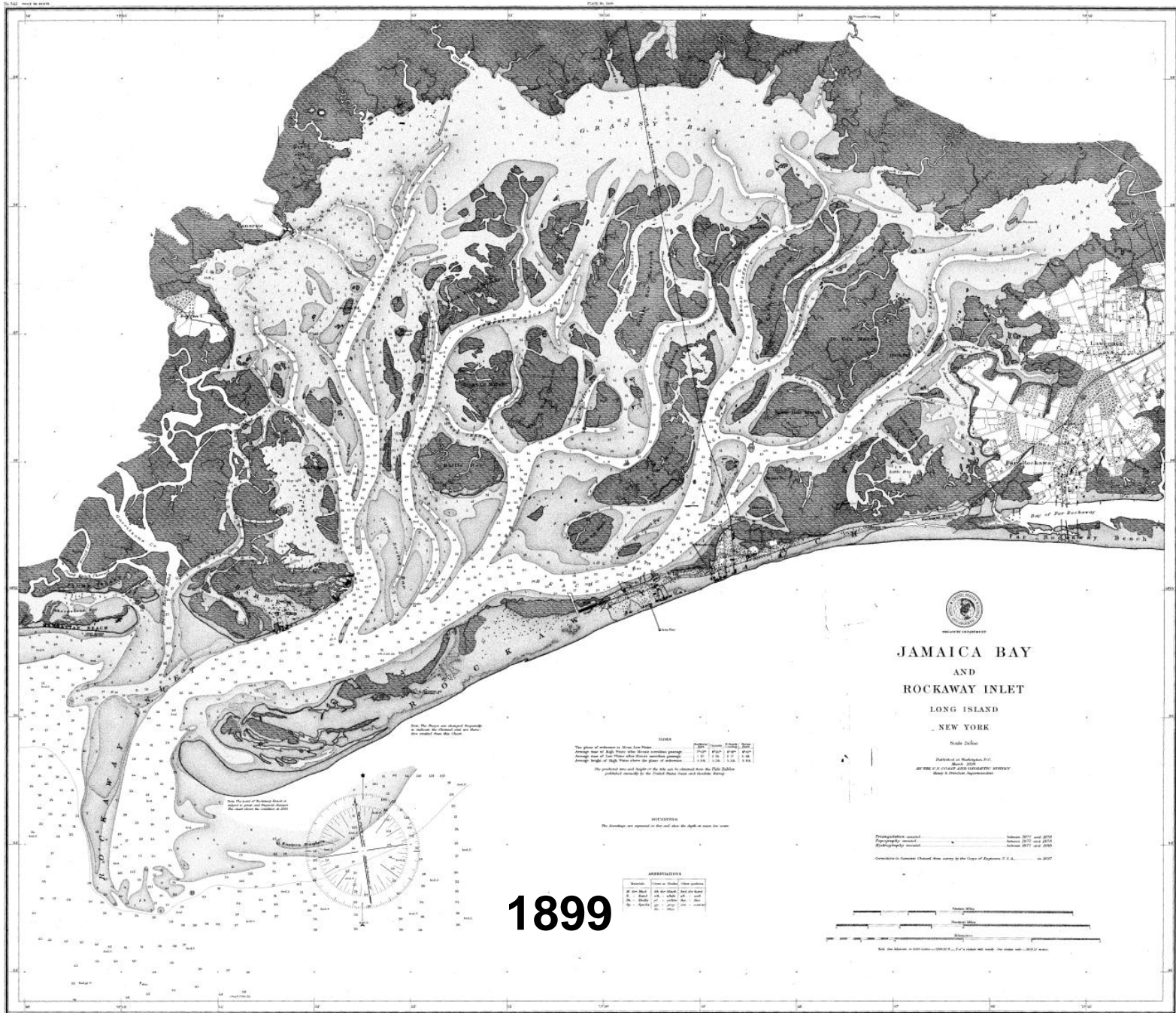



History of Jamaica Bay



1835






JAMAICA BAY
 AND
ROCKAWAY INLET
 LONG ISLAND
 NEW YORK
 Scale 1:50,000
 Published at Washington, D.C.
 March, 1899.
 BY THE U.S. COAST AND GEODETIC SURVEY
 Office of American Hydrography

Note: The Places are situated according
 to the latest observations and
 corrected from the Coast
 and Geodetic Survey.

TIDES

The height of water at Mean Low Water
 Average height of High Water above Mean Low Water during
 Average height of High Water above the plane of mean low
 The predicted time and height of the tide can be obtained from the Tide Tables
 published annually by the United States Coast and Geodetic Survey.

Month	Spring	Neap	Spring	Neap
Jan	1.1	1.4	1.4	1.1
Feb	1.1	1.4	1.4	1.1
Mar	1.1	1.4	1.4	1.1
Apr	1.1	1.4	1.4	1.1
May	1.1	1.4	1.4	1.1
Jun	1.1	1.4	1.4	1.1
Jul	1.1	1.4	1.4	1.1
Aug	1.1	1.4	1.4	1.1
Sep	1.1	1.4	1.4	1.1
Oct	1.1	1.4	1.4	1.1
Nov	1.1	1.4	1.4	1.1
Dec	1.1	1.4	1.4	1.1

MISCELLANEOUS

The numbers are reported in feet and show the depth of water in feet.

MAGNETIC VARIATION

Year	Declination	Inclination	Dip angle
1899	11° 15'	75° 15'	75° 15'
1900	11° 15'	75° 15'	75° 15'
1901	11° 15'	75° 15'	75° 15'
1902	11° 15'	75° 15'	75° 15'
1903	11° 15'	75° 15'	75° 15'
1904	11° 15'	75° 15'	75° 15'
1905	11° 15'	75° 15'	75° 15'
1906	11° 15'	75° 15'	75° 15'
1907	11° 15'	75° 15'	75° 15'
1908	11° 15'	75° 15'	75° 15'
1909	11° 15'	75° 15'	75° 15'

Photographic copies: 1899 and 1900
 Original copies: 1899 and 1900
 Photographic copies: 1899 and 1900
 Original copies: 1899 and 1900



1899

JAMAICA BAY TO BE A GREAT WORLD HARBOR

The New York Times

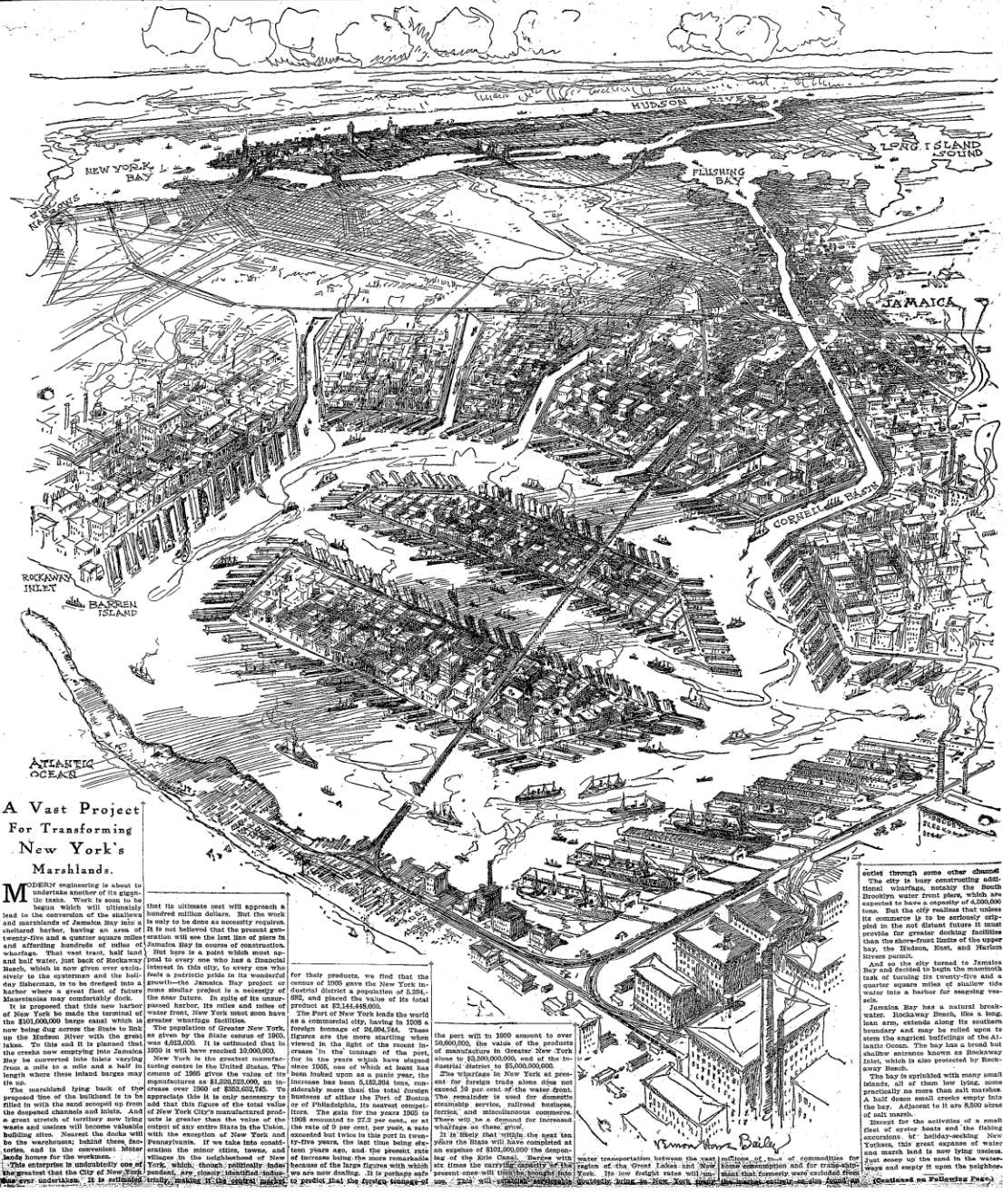
Published: March 13, 1910

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Jamaica Bay to Become a Great World Harbor

“Modern engineering is about to undertake another of its gigantic tasks. Work is soon to be begun which will ultimately lead to the conversion of the shallows and marshlands of Jamaica Bay into a sheltered harbor. . . .”

. . . which will ultimately lead to the destruction of a vast tidal salt marsh that is vital to the ecology of Jamaica Bay and surrounding upland areas.



A Vast Project For Transforming New York's Marshlands.

Modern engineering is about to undertake another of its gigantic tasks. Work is soon to be begun which will ultimately lead to the conversion of the shallows and marshlands of Jamaica Bay into a sheltered harbor. . . .

that its ultimate cost will approach a hundred million dollars. But the work is only to be done as necessity requires. It is not believed that the present generation will see the last line of piers in an affecting building of miles of wharves. That vast tract, half land and half water, just back of Rockaway Beach, which is now given over exclusively to the fishermen, is to be dredged into a harbor where a great fleet of future Massachusetts may conveniently dock.

It is proposed that this new harbor of New York be made the terminal of the \$100,000,000 barge canal which is now being dug across the State to link up the Hudson River with the great lakes. To this end it is planned that the creek now emptying into Jamaica Bay be converted into a waterway varying from a mile to a half in length where these inland barges may tie up.

The marshland lying back of the proposed line of the bulkhead is to be filled with the sand scoured from the deepened channels and locks. And a great extent of the water and waste will become valuable building sites. . . .

For their products, we find that the census of 1900 gave the New York industrial district a population of 5,294,000, and placed the value of the total product at \$2,144,448,000.

The port of New York leads the world as a commercial city, having in 1909 a foreign tonnage of 24,694,764. These figures are the more startling when viewed in the light of the recent increase in the tonnage of the port, for in the years which have elapsed since 1905, one of which at least has been looked upon as a panic year, the increase has been 5,132,394 tons, considerably more than the total foreign business of either the Port of Boston or Philadelphia, its nearest competitor.

There will be a demand for increased wharves as these grow. It is likely that within the next few years the city will have completed an expense of \$100,000,000 in the deepening of the Erie Canal. . . .

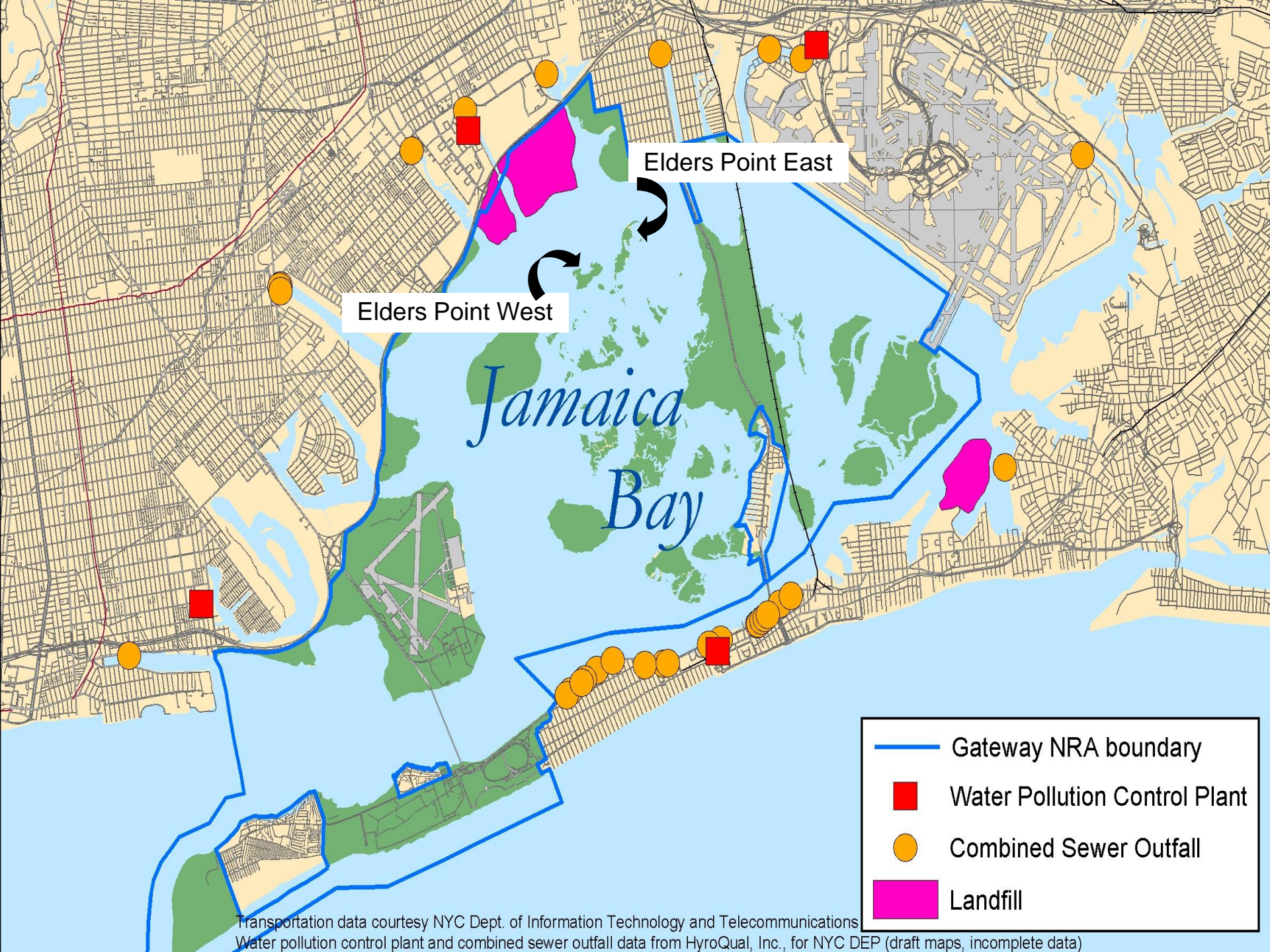
water transportation between the vast junction of two of commodities for the Great Lakes and New York. The low freight rates will undoubtedly bring in New York goods, the market, receive, and also . . .



General Background

- Elders Point currently comprised of two separate islands, Elders Point East (Elders East) and Elders Point West (Elders West).
- Approximately 4.9 ha of salt marsh prior to USACE project in 2006.
- Historically one island, 53.4 ha but over the last 80+ years, marsh loss in the center of the island severed the connection creating two distinct islands connected only by mud flat.
- In 1907 6,549 ha consisted of salt marsh islands with most of the wetland loss in the Bay prior to early 1970's attributed to human activity such as dredging/filling and anthropogenic input.





Transportation data courtesy NYC Dept. of Information Technology and Telecommunications
Water pollution control plant and combined sewer outfall data from HyroQual, Inc., for NYC DEP (draft maps, incomplete data)

General Background

Environmental Stresses

- Water logging (subsidence, lack of sediment accretion)
- Increase in tidal prism as a result of marsh loss
- Water fowl predation (i.e., goose grazing)
- Sea level rise (2.7 mm yr⁻¹)
- Alteration of sediment availability, distribution, and accumulation
- Nitrogen (eutrophication) and Sulfide inputs
- Various other anthropogenic input and contaminants from CSO discharge



General Background

Table 1. Total area of vegetated marsh islands in Jamaica Bay (GATE and JBWPAC 2007).

	Time Period			
	1951*	1974	1989	2003
Vegetated Marsh (ha)	950	652	539	355

Table 2. Rate of loss of vegetated marsh islands in Jamaica Bay (GATE and JBWPAC 2007).

	Time Period		
	1951-1974	1974-1989	1989-2003
Avg. Rate of Loss (ha/yr)	6.9	7.3	13.4



Jamaica Bay Tidal Wetlands

Elders East

Elders West

1985



Jamaica Bay Tidal Wetlands

An aerial photograph of Jamaica Bay, New York City, showing tidal wetlands. The wetlands are highlighted in a light tan color against the dark blue water. The surrounding urban areas are visible in shades of grey and brown. The map is overlaid with white text labels for specific wetland areas and the year 2024.

Elders East

Elders West

2024

Elders East

Jamaica Bay Tidal Wetlands

Elders West

Grassy Bay

John F. Kennedy
Airport

JoCo

Yellow Bar

Big Egg

Little Egg

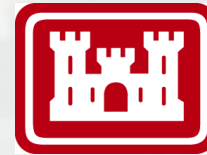
1974 saltmarsh extents

2003 vegetation map:

- Fully vegetated
- Fragmenting vegetation
- Tidal creek
- Mudflat

Restoration of Elders East and Elders West

Restoration of Elders Point, Jamaica Bay, an interagency project:
USACE, NPS, NY/NJ Port Authority, NYS DEC, and NYC DEP



Restoration of Elders East and Elders West

Design Fill Templates

Elders West

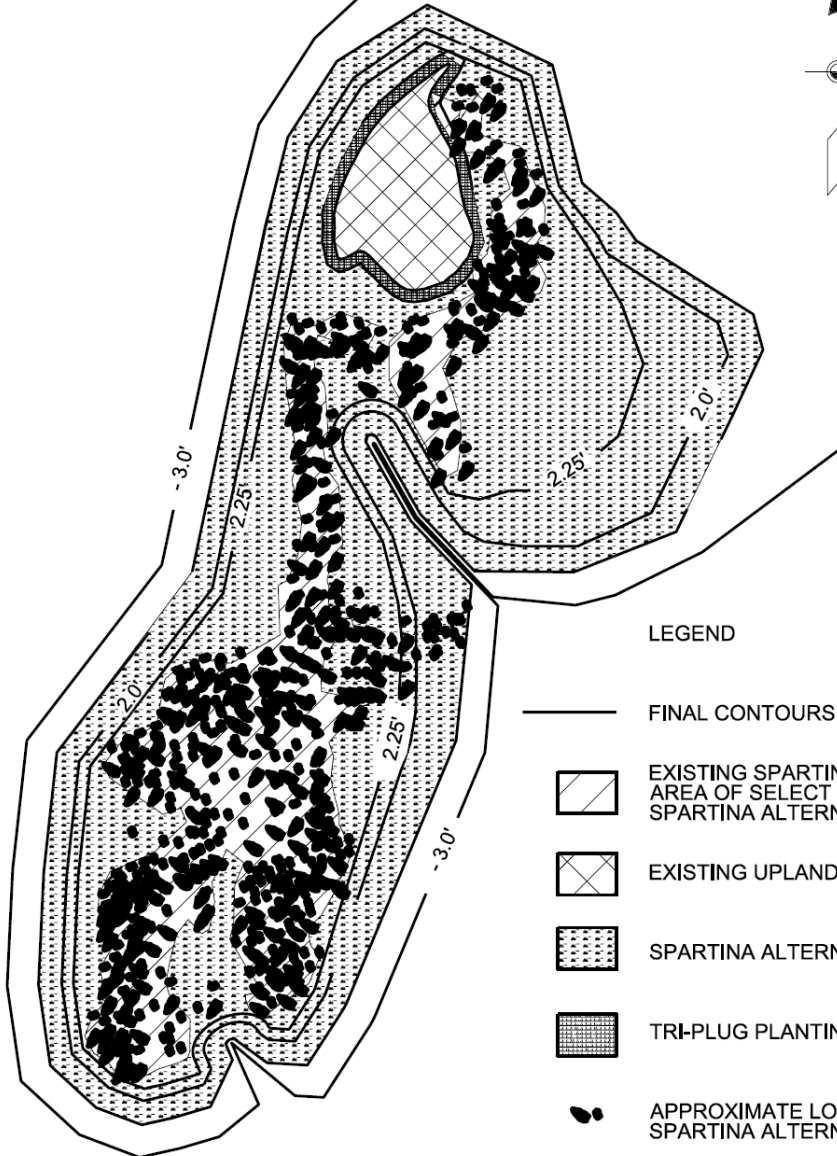
Elders East








LEGEND

- PROPOSED LOW MARSH AREA (+1.5 - +2.25)
- HISTORIC 1974 SHORELINE
- GEOTEXTILE TUBE PLACEMENT

Restoration of Elders East



LEGEND

- FINAL CONTOURS
-  EXISTING SPARTINA ALTERNIFLORA
AREA OF SELECT FILL PLACEMENT AND
SPARTINA ALTERNIFLORA PLANTING
-  EXISTING UPLAND
-  SPARTINA ALTERNIFLORA PLUGS
-  TRI-PLUG PLANTINGS
-  APPROXIMATE LOCATION OF EXISTING
SPARTINA ALTERNIFLORA (HUMMOCKS)



Restoration of Elders East

Fill Material:

Maintenance dredging of the Rockaway Inlet	158,000 yd ³
Dredging Ambrose Navigational Channel	46,000 yd ³
Purchased material to complete the design fill	<u>45,000 yd³</u>
Total	249,000 yd³

Vegetation:

Mixture of *Spartina alterniflora*, *Spartina patens*, and *Distichlis spicata*

Spartina alterniflora plugs 580,000

Spartina alterniflora pots 45,876

Tri-plugs (*S. alterniflora*, *Distichlis spicata*, and *S. patens*) were planted over a total of 16.2 ha (40.0 ac). 33,640

Most of the project (i.e., > 95%) was planted with *S. alterniflora*.



Restoration of Elders East

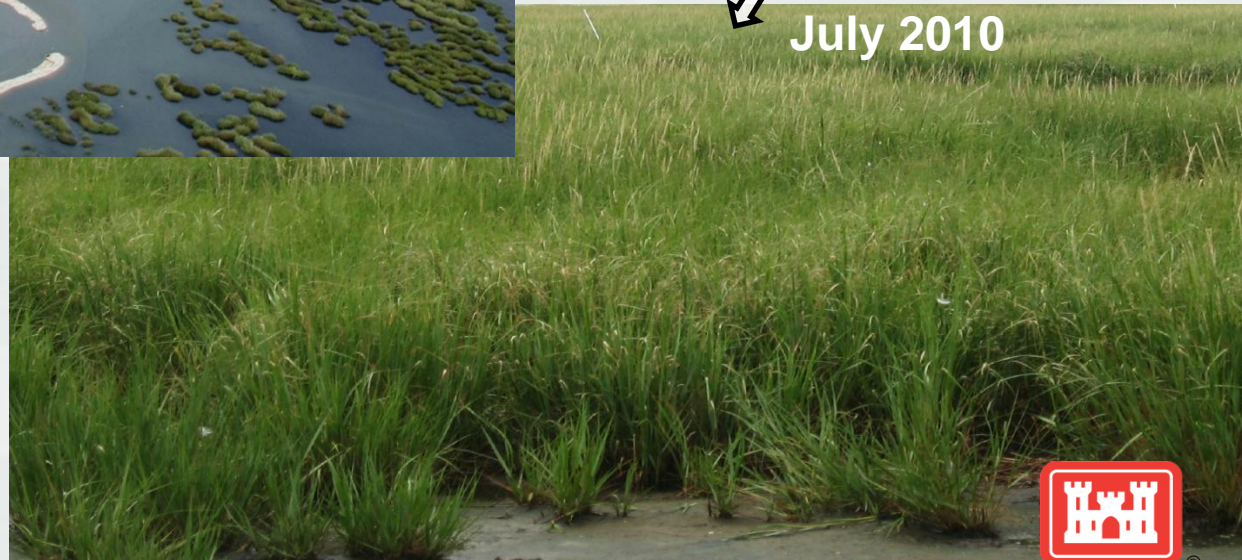
October 2006



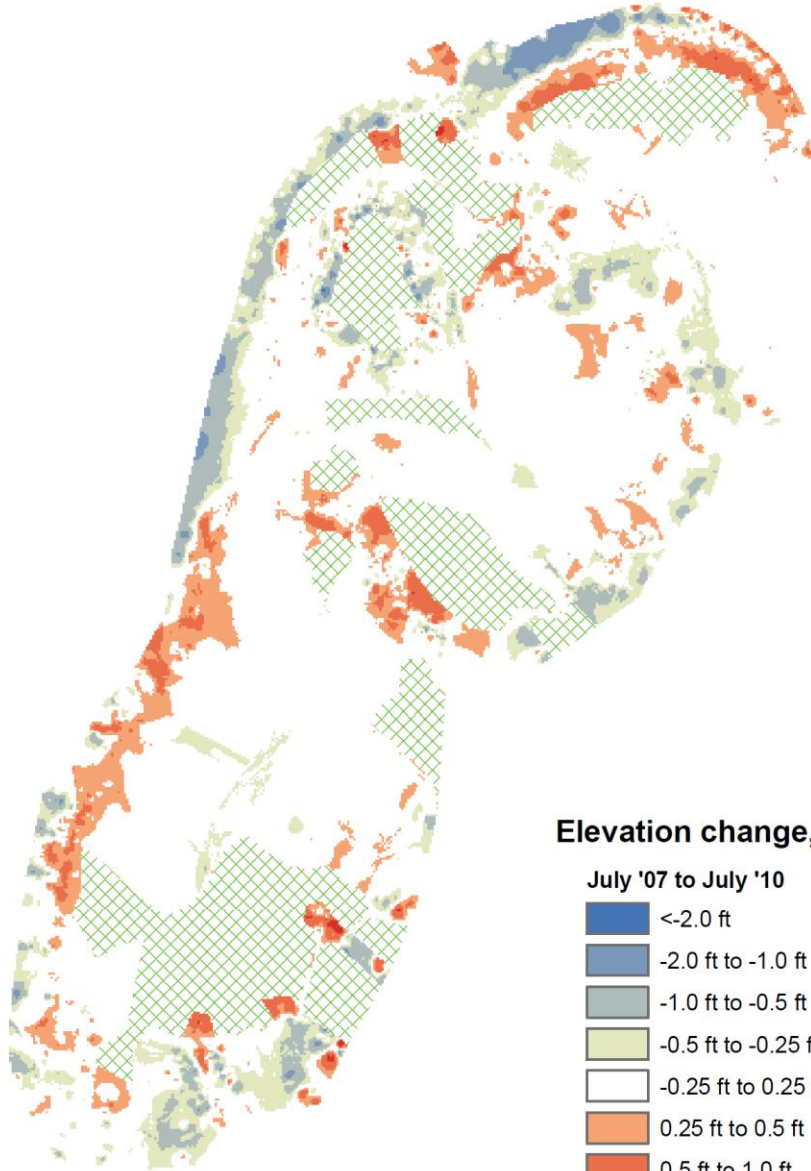
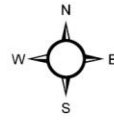
October 2006



July 2010

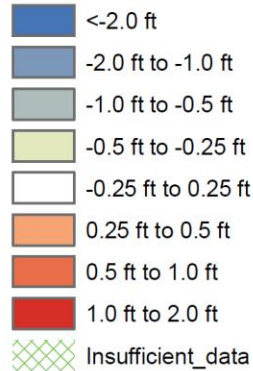


Elders East Elevation Changes July 2007 to July 2010

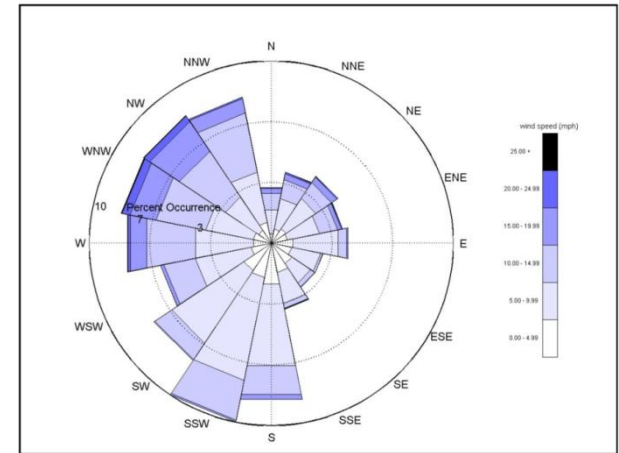


Elevation change, ft.

July '07 to July '10



Restoration of Elders East



Wind Rose Plot of Resultant Wind Speed and Direction for JFK Wind Data (1984 – 2006)

Restoration of Elders West

Fill Material:

Maintenance dredging of the Rockaway Inlet	0 yd ³
Dredging Ambrose Navigational Channel	301,976 yd ³
Purchased material to complete the design fill	<u>0 yd³</u>
Total	301,976 yd³

Vegetation:

No *Spartina alterniflora* plugs or pots, all the low marsh plants were relocated *Spartina* hummocks from the project site which covered approximately 7.0 ha (7.2 ac)

High marsh transition planting 85,580
covering approx. 1.6 ha (4 ac)



Restoration of Elders East and Elders West

An aerial photograph of a wetland restoration site. The image shows a complex network of water channels and land areas. The water is a light, milky brown color, while the land is a mix of green and brown. The text 'Elders West' is overlaid on the left side, and 'Elders East' is overlaid on the right side. The year '2009' is in the bottom left corner.

Elders West

Elders East

2009

Restoration of Elders West

July 2010



Restoration of Elders East and Elders West

Elders East and West Restoration/Mitigation Costs

Construction

Summaries	ha (ac) Restoration	Total Cost GE	Total Cost A Bid	Cost/ha A Bid
Elders East	15.86 (39.20)	\$10,097,128	\$12,949,569	\$830,100
Elders West	11.45 (28.30)	\$8,419,866	\$5,742,100	\$501,493

Monitoring

- \$2 Million for 5 years, includes Elders Point West Island as well



Restoration at Elders East

Vegetation Analysis

Table 3. 2008 average point-intercept values and percent of total (in parentheses) per 1m² plot for vegetation covers. Number of plots (n). “–” indicates cover not present.

Species/cover name	Common Name	Elders East n = 32	JoCo n = 28	X Fertilizer n = 33	X No Fertilizer n = 30	JUN06	OCT06
						XRelocation Area I n = 12	XRelocation Area II n = 12
Bare ground	bare ground	4.4 (8)	4.8 (10)	7.1 (14)	17.1 (34)	2.8 (5)	40 (78)
<i>Distichlis spicata</i>	spikegrass	–	5.6 (7)	–	–	–	–
→ <i>Spartina alterniflora</i>	saltmarsh cordgrass	√43.5 (72)	√35.2 (62)	42.9 (86)	32.9 (66)	47 (80)	11 (22)
<i>Spartina patens</i>	saltmeadow cordgrass	–	14.5 (20)	–	–	–	–
Total vegetative cover		√ 91	√ 90	86	66	95	22

Note:

Fertilizer: Osmocote® slow release [18:6:11 (N:P:K)] 15 g per plug.

Point intercept method following Roman *et al.* (2001).

Two-tailed paired/unpaired t-Test was used for statistical evaluations



Restoration at Elders East

Vegetation Analysis

Table 4. 2008 average (standard deviation) live stem density (count 0.25m²) and number of plots (n) for live vegetation. “-” indicates stems not present.

Species	Common Name	Elders East		JoCo		Fertilizer		No Fertilizer		JUN06	OCT06
		n = 32	n = 28	n = 28	n = 28	n = 30	n = 30	Relocation Area I n = 12	Relocation Area II n = 12		
<i>Distichlis spicata</i>	spikegrass	-	52 (152)	-	-	-	-	-	-	-	-
<i>Spartina alterniflora</i>	salt marsh cordgrass	√81 (45)	√143 (186)	X87 (29)	X57 (44)	X96 (44)	X2 (4.8)	-	-	-	-
<i>Spartina patens</i>	saltmeadow cordgrass	-	417 (754)	-	-	-	-	-	-	-	-



Restoration at Elders East

Vegetation Analysis

Table 5. 2008 average height (cm \pm standard deviation) and number of plots (n) for *Spartina alterniflora* within 1m² vegetation plots.

Species	Common Name	✗ Elders East n=31	JoCo n=25	✗ Fertilizer n=33	No Fertilizer n=30	JUN06	OCT06
						✗ Relocation Area I n=12	Relocation Area II n=7
<i>Spartina alterniflora</i>	salt marsh cordgrass	109 (39)	66 (27)	105 (20)	86 (35)	118 (17)	72 (30)

Table 6. 2008 average total (live + dead) standing biomass (g m⁻² \pm standard deviation) and number of samples (n).

Biomass	Elders East n = 15	JoCo n = 13	✓ Fertilizer n = 16	✓ No Fertilizer n = 13
Aboveground	✓ 867 (626)	✓ 822 (282)	448 (428)	213 (216)
Belowground 0-15 cm	✗ 2121 (1789)	✗ 7001 (3329)	572 (500)	430 (614)
Belowground 15-30 cm	✗ 544 (1739)	✗ 6684 (3628)	91 (152)	68 (90)

Restoration at Elders East

Vegetation Analysis

Table 7. 2008 average net annual belowground production ($\text{g m}^{-2} \pm$ standard deviation) and number of samples (n).

	✓ Elders East	✓ JoCo
Biomass	Total	Total
Belowground 0-10 cm	274±229 (10)	262±224 (10)
Belowground 10-20 cm	123±146 (10)	90±193 (11)
Belowground 20-30 cm	14±20 (9)	20±41 (11)

Table 8. 2008 average net annual belowground production ($\text{g m}^{-2} \pm$ standard deviation) and number of samples (n) for fertilizer treatments.

	Fertilizer	No Fertilizer
Biomass	✓ Total	✓ Total
Belowground 0-10 cm	413±424 (14)	392±394 (10)
Belowground 10-20 cm	376±335 (14)	201±244 (10)
Belowground 20-30 cm	70±86 (14)	95±128 (9)



Restoration at Elders East



In the summer of 2010, Melissa D. Alvarez, a Senior Project Biologist with the US Army Corps, NY District, was inspecting the island:

“I found a nest of Diamondback Terrapins, a New York State protected species. This represents the success we’ve had at Elders Point East and will soon have at Elders Point West”



Conclusions

- ▶ *Spartina alterniflora* has exhibited a growth rate consistent with the control.
- ▶ No appreciable sediment transport (loss/gain) has occurred.

On the west side of Elders East there is some decrease in elevation likely a result of the historic patterns of sediment transport occurring in a northerly direction of the accreting sand spit.



Conclusions

- ▶ By the end of the second growing season (2008), the restored marsh achieved 50% vegetative cover, with *S. alterniflora* the dominant species.

For the *S. alterniflora* plugs the plant communities in the restored (Elders East) and reference marsh (JoCo) have converged with respect to total canopy cover, stem density, total standing aboveground biomass, and annual net belowground production.

- ▶ Project has provided much of the anticipated ecological benefits.
- ▶ The sustainability of Elders East and West serve as a benchmark for future projects within Jamaica Bay (e.g., Yellow Bar).



Acknowledgements

The authors would like to acknowledge the U. S. Army Corps of Engineers, New York District, for the lead role in this multi-agency project in cooperation with:

U. S. National Parks Services (Gateway) (USNPS),
Port Authority of New York and New Jersey (PANY/NJ),
New York City Department of Environmental Protection (NYCDEP),
New York State Department of Environmental Conservation (NYSDEC),
New York State Department of State (NYDOS),
National Oceanic and Atmospheric Administration (NOAA),
National Marine Fisheries Program (NIMFP),
NOAA Fisheries: Office of Protected Resources,
National Resources Conservation Service (NRCS), and
U. S. Fish and Wildlife Services (USFWS).



The End



Questions ?



The Beginning

Elders Point



The Beginning



Thank you for your attention