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

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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

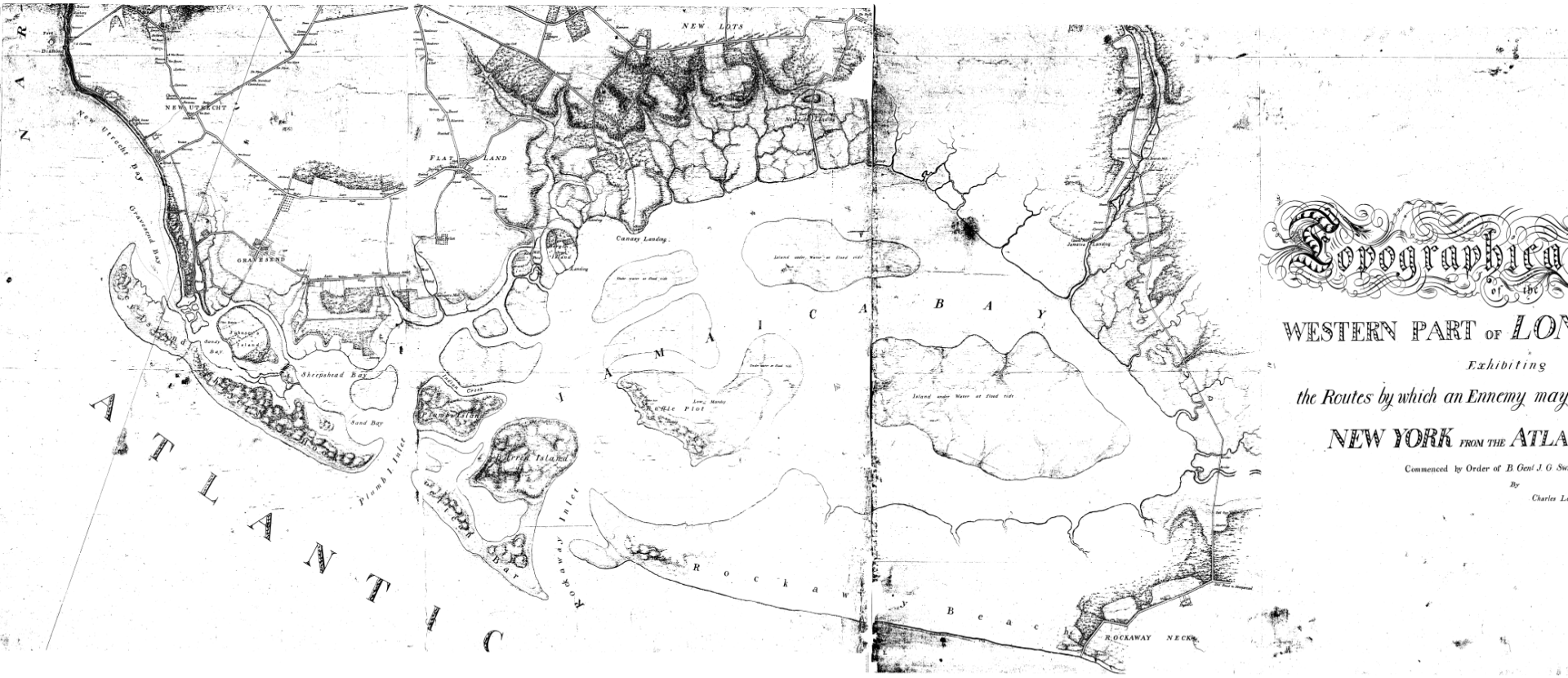
► Covering 67.3 km^2 (6,730 ha/16,630 ac) and opens into the Atlantic Ocean via Rockaway Inlet.

► 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.

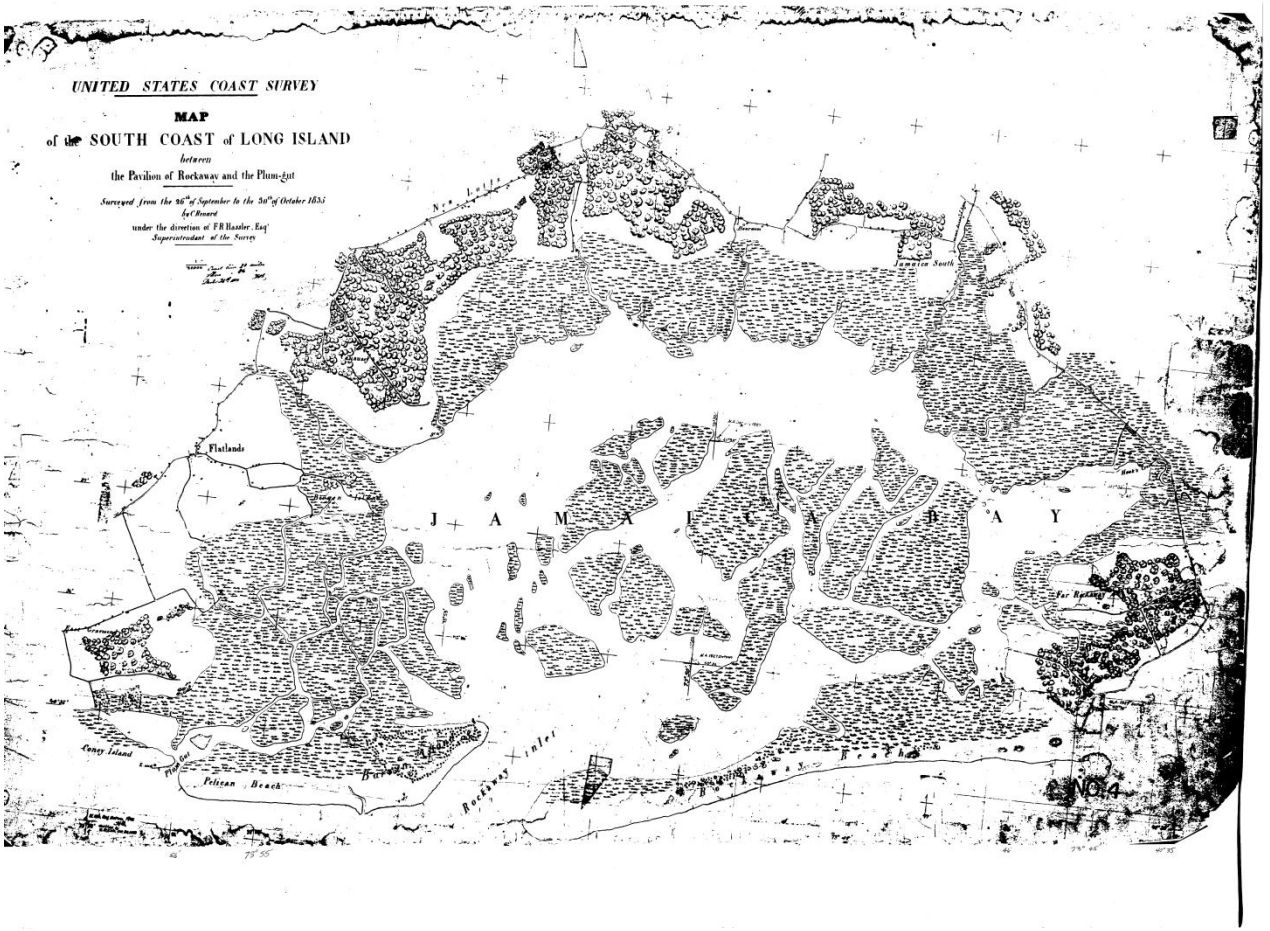

New York
New Jersey
QUEENS
BROOKLYN
Jamaica Bay
Passaic Co.
Essex Co.
Union Co.
Middlesex Co.
Monmouth Co.
Passaic River
Newark Bay
Kill Van Kull
Arthur Kill
Raritan River
Raritan Bay
STATEN ISLAND
Lower Bay
Sandy Hook Bay
NY Bight Apex
ATLANTIC OCEAN
3 0 3 6 9 Kilometers
2 0 2 4 6 8 Miles

History of Jamaica Bay



1818

History of Jamaica Bay



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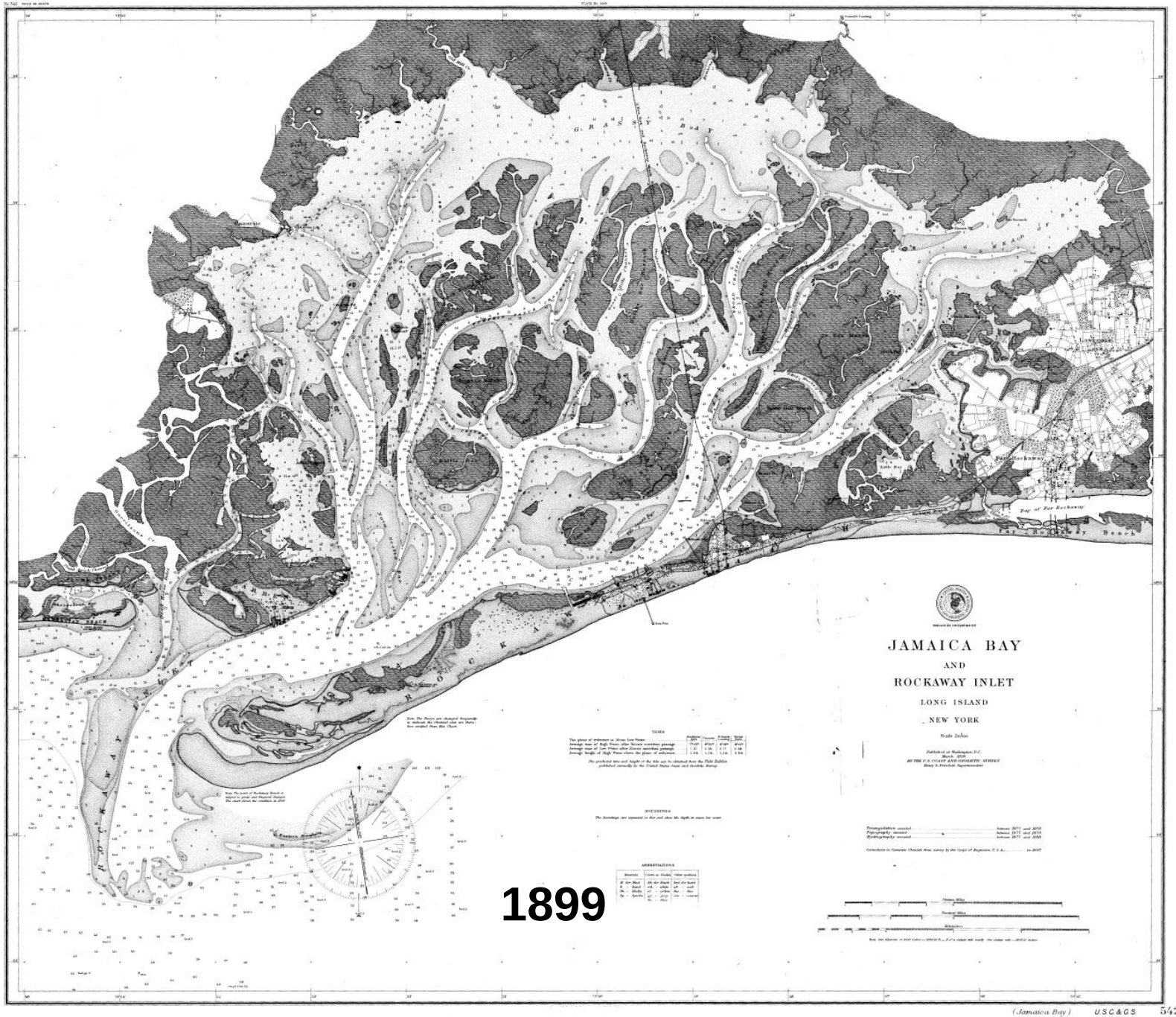
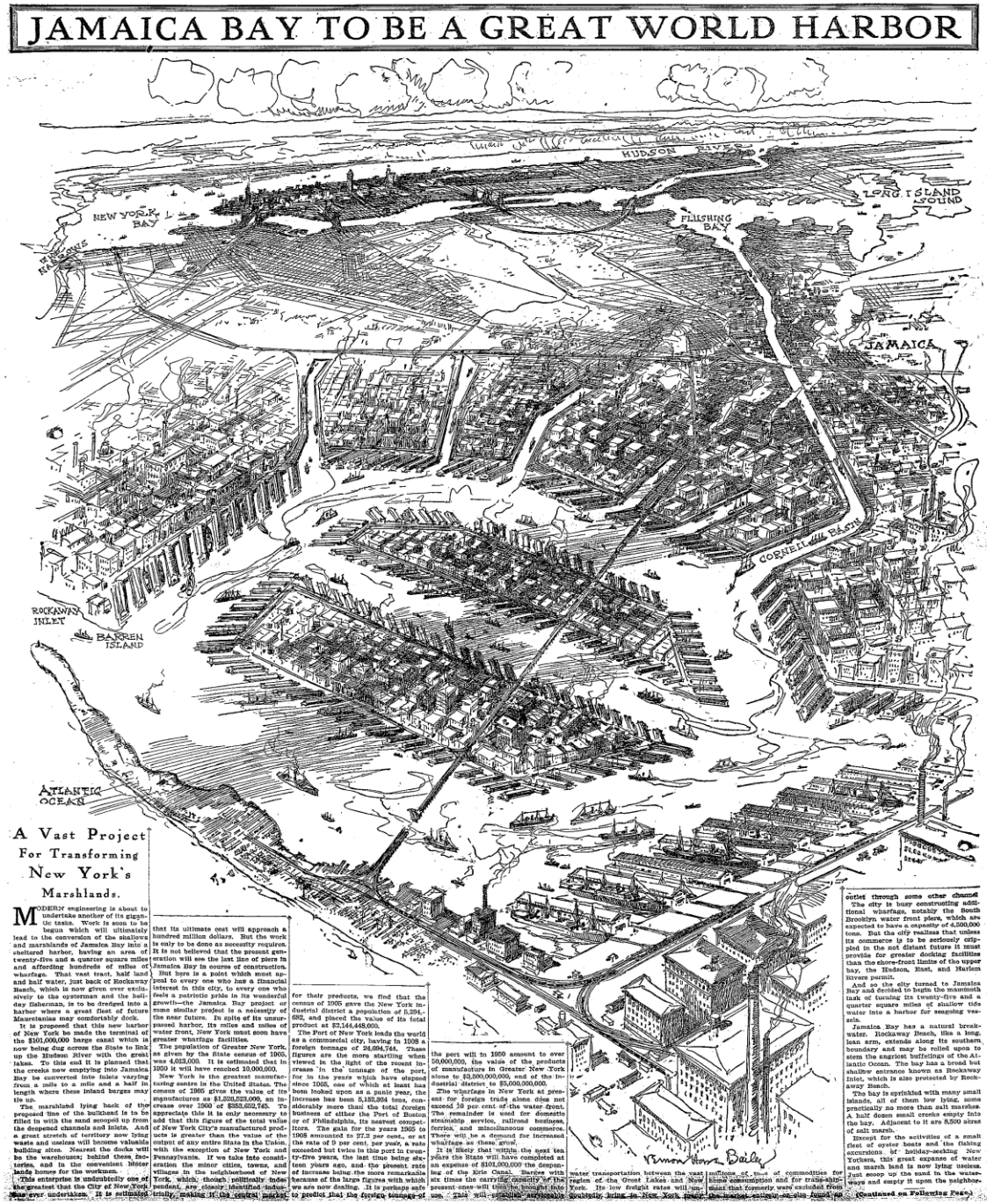




The New York Times
Published: March 13, 1910

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.

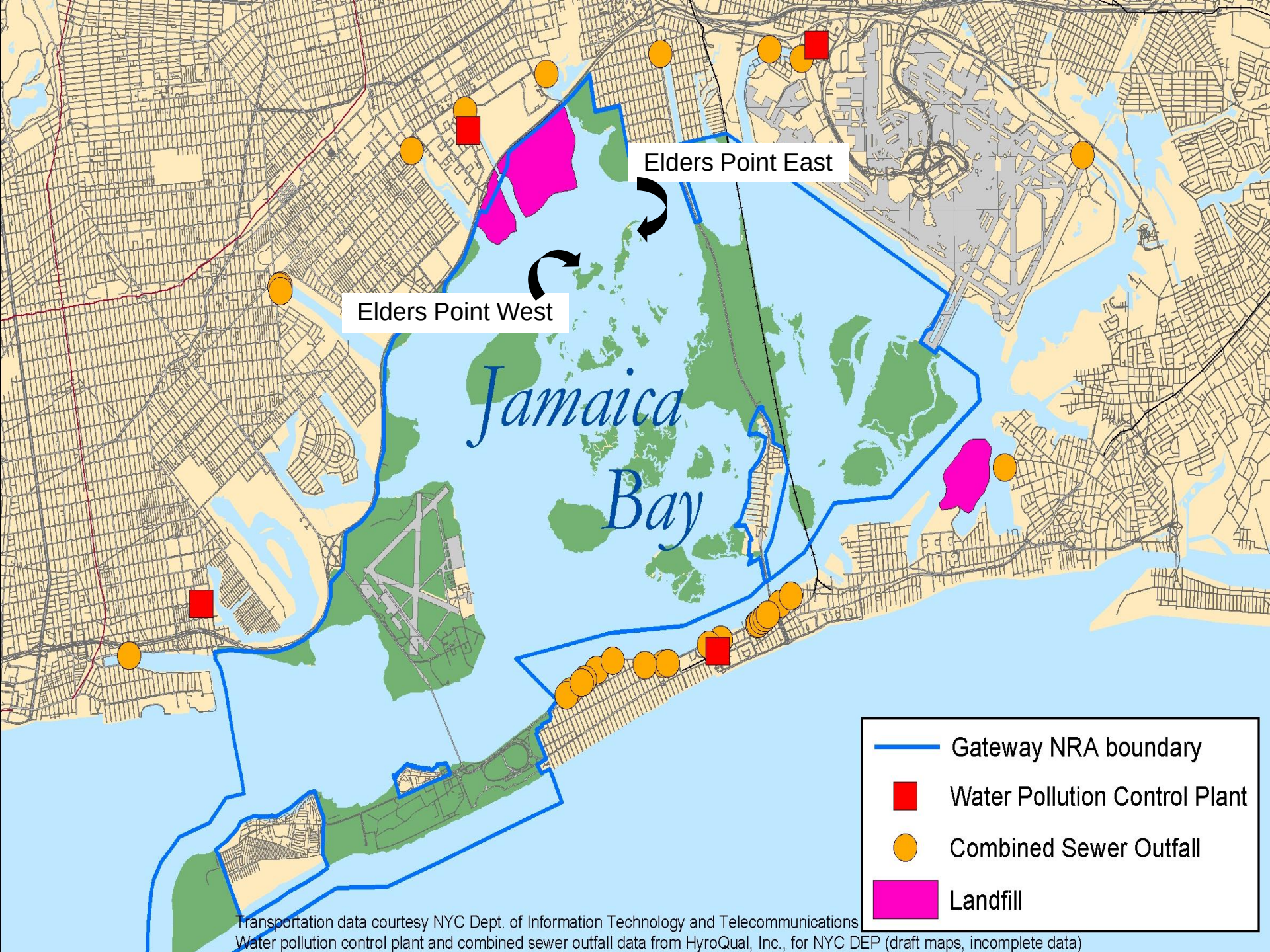
General Background

- 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.


Elders Point East
Elders Point West
Jamaica Bay
Gateway NRA boundary
Water Pollution Control Plant
Combined Sewer Outfall
Landfill
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).

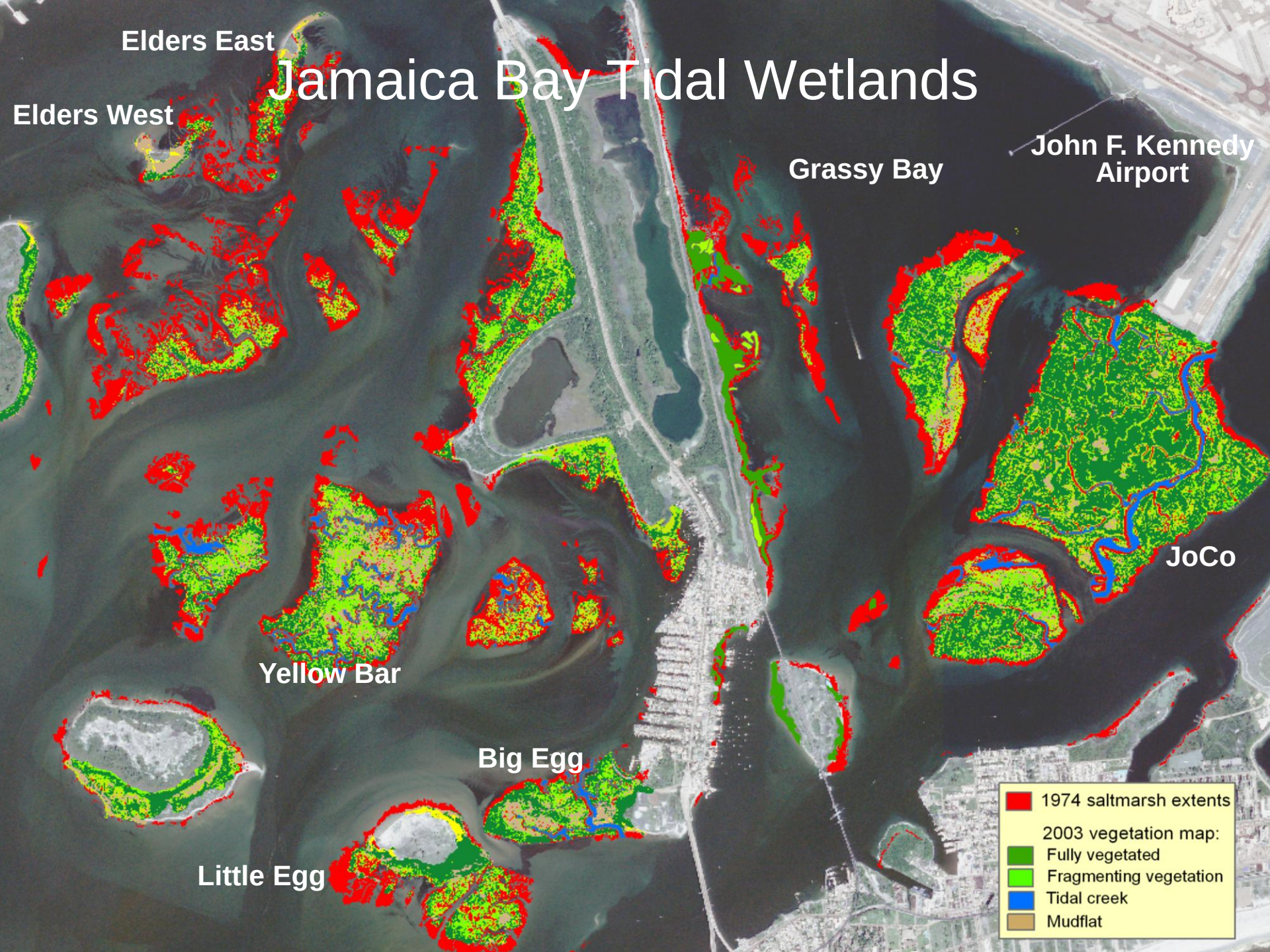
	Time Period			
	1951*	1974	1989	2003
Vegetated Marsh (ha)	950	652	539	355

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
Elders East
Elders West
2024


Jamaica Bay Tidal Wetlands
Elders East
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

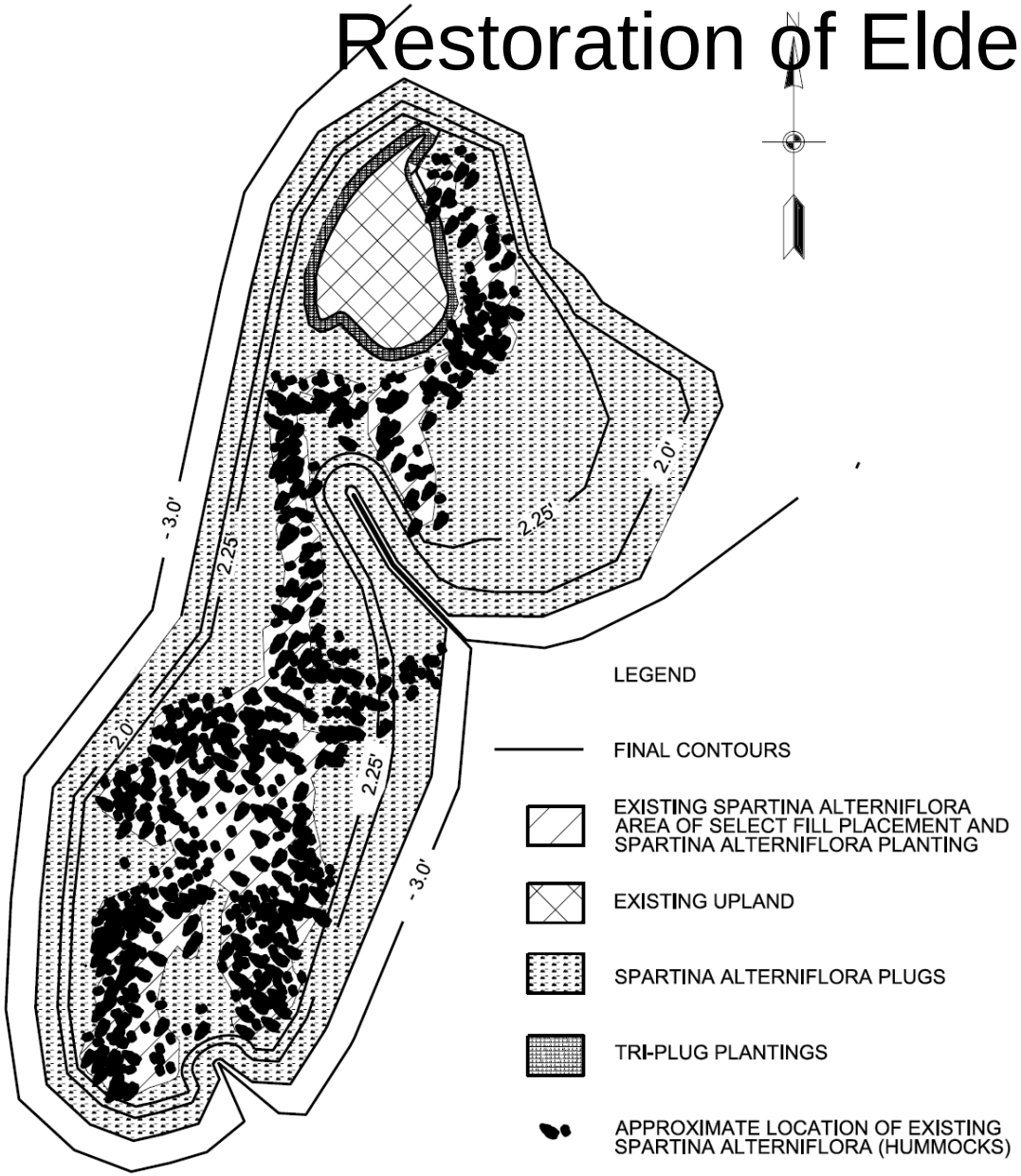
Restoration of Elders East and Elders West

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

Restoration of Elders East



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	45,000 yd^3
Total	249,000 yd^3

Vegetation:

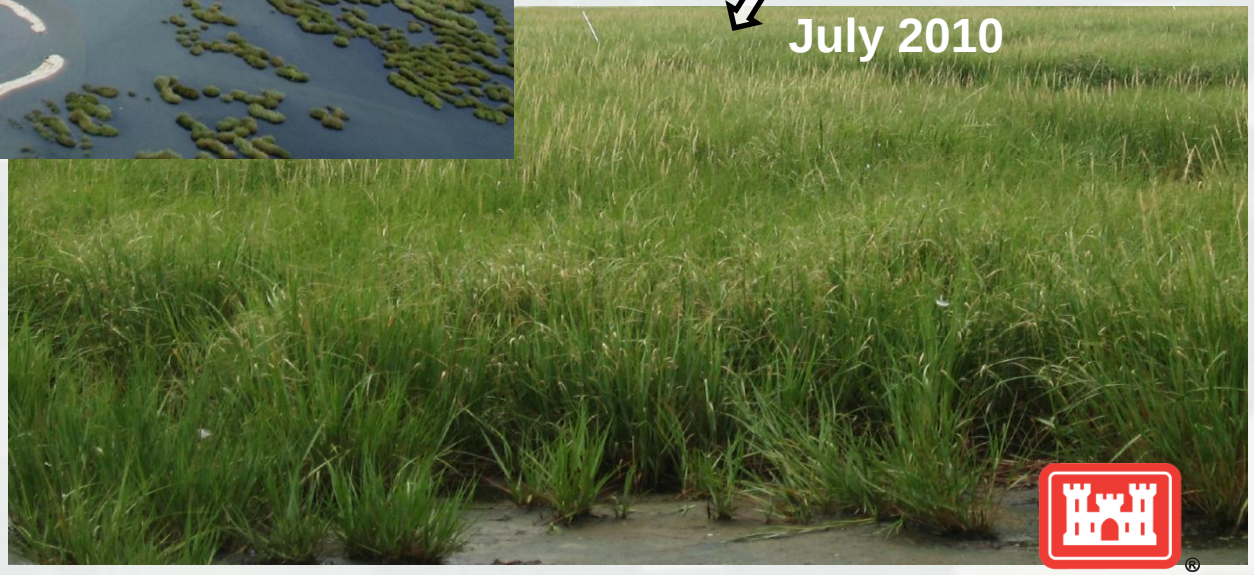
Mixture of *Spartina alterniflora*, *Spartina patens*, and *Distichlis spicata*

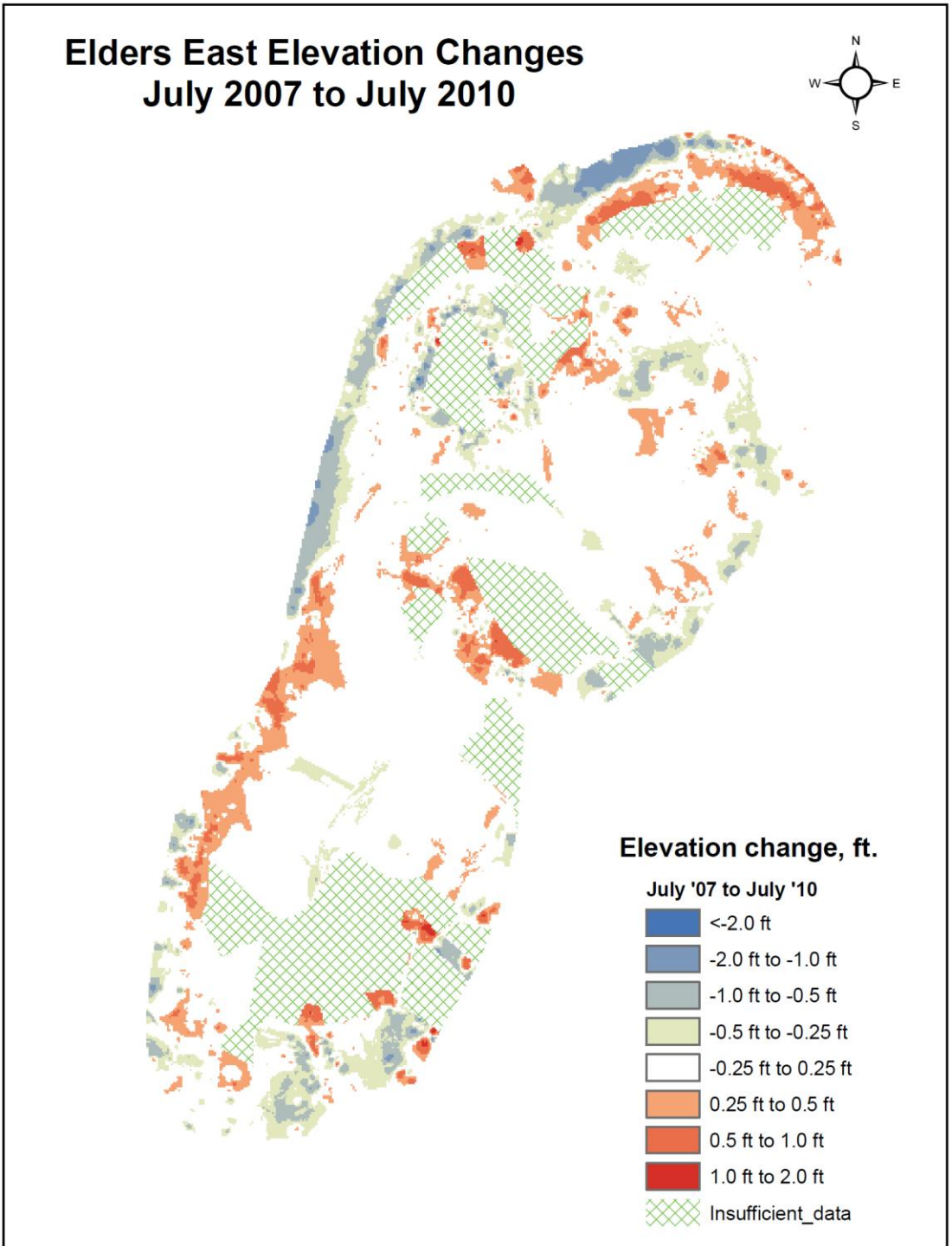
Spartina alterniflora plugs	580,000
Spartina alterniflora pots	45,876

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

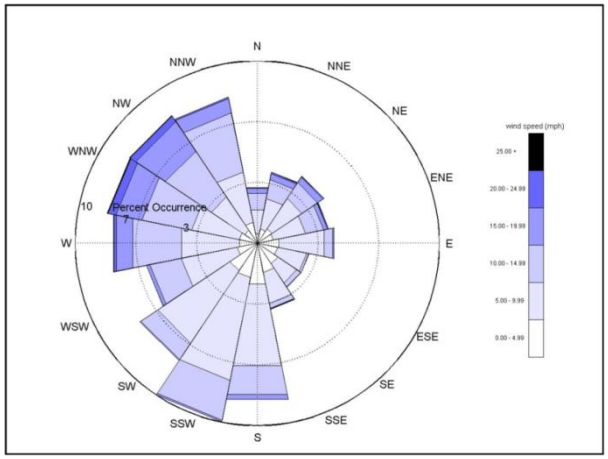
Most of the project (i.e., > 95%) was planted with *S. alterniflora.*

Restoration of Elders East





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	0 yd^3
Total	301,976 yd^3

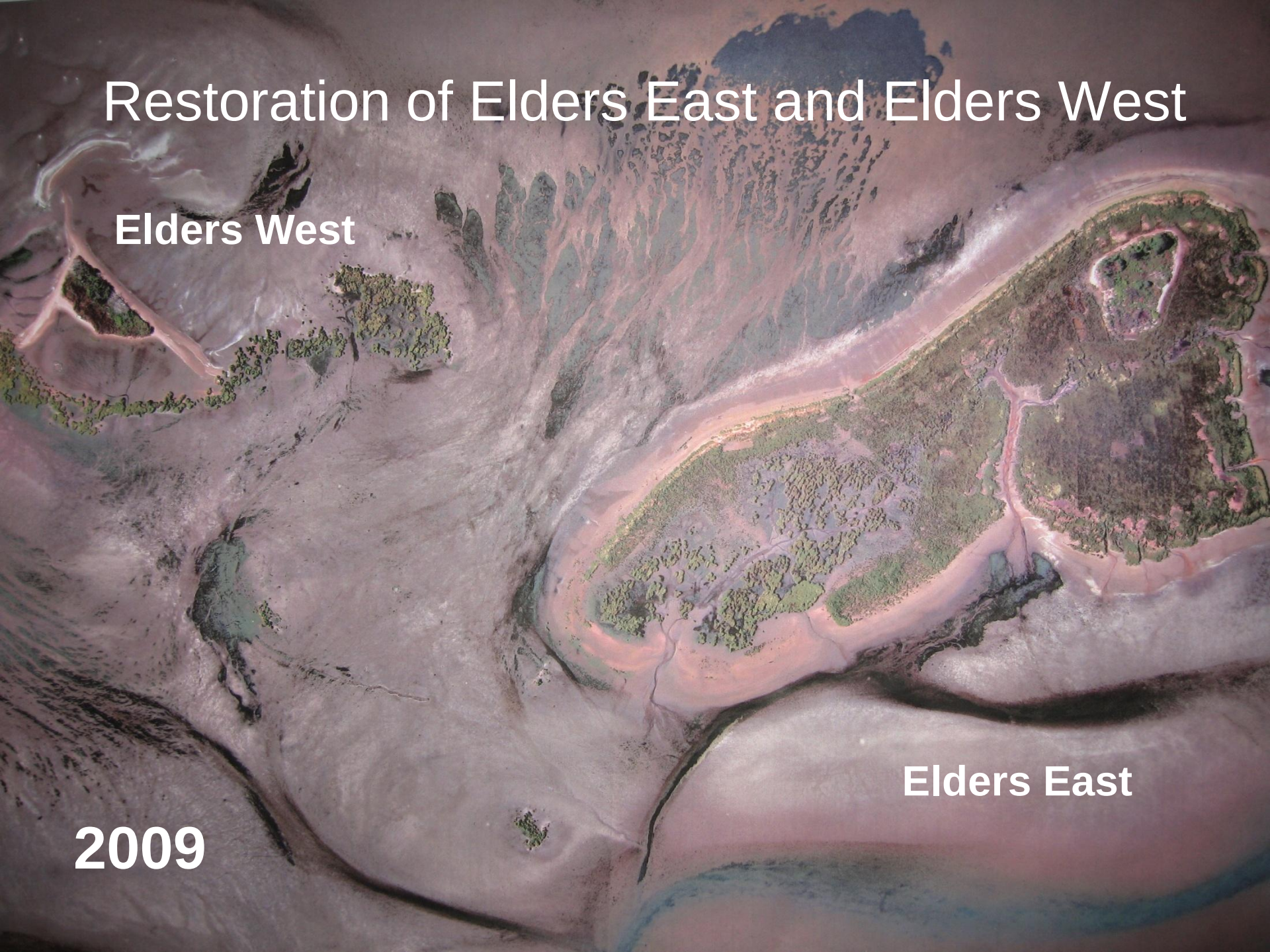
Vegetation:

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



Restoration of Elders West

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 $1m^2$ plot for vegetation covers. Number of plots (n). "–" indicates cover not present.

						JUN06	OCT06
		Elders East	JoCo	X Fertilizer	X No Fertilizer	X Relocation Area I	X Relocation Area II
Species/cover name	Common Name	n = 32	n = 28	n = 33	n = 30	n = 12	n = 12
Bare ground	bare ground	4.4 (8)	4.8 (10)	7.1 (14)	17.1 (34)	2.8 (5)	40 (78)
Distichlis spicata	spikegrass	–	5.6 (7)	–	–	–	–
Spartina alterniflora	saltmarsh cordgrass	√43.5 (72)	√35.2 (62)	42.9 (86)	32.9 (66)	47 (80)	11 (22)
Spartina patens	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 0.25m^{-2}) and number of plots (n) for live vegetation. "–" indicates stems not present.

						JUN06	OCT06
Species	Common Name	Elders East n = 32	JoCo n = 28	Fertilizer n = 33	No Fertilizer n = 30	Relocation Area I n = 12	Relocation Area II n = 12
Distichlis spicata	spikegrass	–	52 (152)	–	–	–	–
Spartina alterniflora	salt marsh cordgrass	√ 81 (45)	√ 143 (186)	X 87 (29)	X 57 (44)	X 96 (44)	X 2 (4.8)
Spartina patens	saltmeadow cordgrass	–	417 (754)	–	–	–	–

Restoration at Elders East

Vegetation Analysis

Table 5. 2008 average height (cm ± standard deviation) and number of plots (n) for *Spartina alterniflora* within 1m^2 vegetation plots.

						JUN06	OCT06
Species	Common Name	X Elders East	JoCo	X Fertilizer	No Fertilizer	X Relocation Area I	Relocation Area II
		n=31	n=25	n=33	n=30	n=12	n=7
Spartina alterniflora	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}± standard deviation) and number of samples (n).

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

Restoration at Elders East

Vegetation Analysis

Table 7. 2008 average net annual belowground production (g m^{-2} ± 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 (g m^{-2} ± 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 northernly 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 restorted (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:

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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