



Narragansett Bay

Research Reserve

Technical Report

2012:1

Prudence Island Salt Marsh Restoration Initiative: Mill Creek and T-Wharf Geologic Analysis

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PRUDENCE ISLAND SALTMARSH RESTORATION INITIATIVE



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Mill Creek and T-Wharf Geologic Analysis
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Geologic and sedimentologic analyses were performed in Mill Creek and T-Wharf wetland areas on Prudence Island. Results reveal a saltmarsh existed in what is now a *Phragmites* dominated stand at Mill Creek. There is no evidence of a previously existing extensive saltmarsh at T-Wharf.

Prudence Island Saltmarsh Restoration Initiative

MILL CREEK AND T-WHARF GEOLOGIC ANALYSIS

| MOTIVATION

Prudence Island, situated in Narragansett Bay, Rhode Island, has several wetland areas currently dominated by the invasive species, *Phragmites australis*. A goal of the Narragansett Bay National Estuarine Research Reserve (NB-NERR) is to decrease or eliminate the encroachment of this invasive species on the island. Two areas currently under surveillance and control of *Phragmites* are the small wetland watersheds near Mill Creek and T-Wharf. Both wetland areas are the receiving basins of small streams that drain upland areas of the island. Tidal restriction has occurred in both locales by the creation of roads across the outlets of these two streams during the past century.

The goal of this project was to analyze the underlying stratigraphy in the two wetland areas, Mill Creek and T-Wharf, in order to determine if saltmarshes once occupied these regions prior to tidal restriction and *Phragmites* invasion. Results from this study will help identify potential future saltmarsh restoration sites.

| METHODS

A series of core transects was performed at both the Mill Creek and T-Wharf study areas in mid-June 2012. Three cores were extracted from each location (total of 6) using a half-cylinder gouge auger system (locations in Figs 1 and 2). Both a large- and small-diameter auger was used (8 cm and 4 cm, respectively), depending upon the ease of core extraction. Care was taken to prevent compaction of the core before and during extraction; any cores exhibiting compaction were replaced. Cores were measured, described for sedimentology and rooting present with depth, photographed, and sampled in the field at 2 cm intervals every 10 cm. Samples were transported to the lab at Boston University for root identification analysis, and upon completion of the project will be returned to the NB-NERR for permanent storage and any future analyses. For many of the core locations, it was necessary to dig below the *Phragmites* root zone with a shovel prior to core extraction. Core descriptions include notation on depths extracted with each auger, and digging depths required.

Core locations were flagged for GPS and elevation surveying using a real-time kinematic (RTK) system. This field work was performed at a later date, and data were provided by NB-NERR personnel (Robin Weber, personal communication; see Appendix A).

Two samples from Mill Creek were subsequently analyzed for foraminiferal assemblage. This was performed to confirm the existence of an earlier saltmarsh in the area. These samples were washed through a 500 micron



Figure 1 – Mill Creek core locations for this study (in red). RTK points collected by NB-NERR are also shown in yellow. Image courtesy of R. Weber at NB-NERR.

sieve stacked on top of a 63 micron sieve. Material trapped in the 63 micron sieve was analyzed under the microscope, and any forams characteristically found in New England saltmarshes noted (dominate species include *Jadammina macrescens*, *Trochammina inflata*, *Tiphotrecha comprimata*, and *Arenoparella mexicana*; Scott and Leckie, 1990; de Rijk and Troelstra, 1997).

| RESULTS

Core descriptions for individual cores are summarized in Appendix B. Photographs located in Appendix C.

| Mill Creek

Cores taken at Mill Creek reveal that organic-rich, fine-grained saltmarsh sediments are present at depth overlying coarse-grained glacial till and fluvial/tidal creek sediment (Fig 3). This sediment has evidence



Figure 2 – T-Wharf core locations for this study (in red). RTK points collected by NB-NERR are also shown in yellow. Image courtesy of R. Weber at NB-NERR.

of high marsh (*Distichlis* sp.) rooting and saltmarsh forams (*J. macrescens*, *T. inflata*, and *T. comprimata*). Overlying these saltmarsh sediments is a relatively thick (~50 cm), well-sorted, coarser-grained (medium sand) bed that is interpreted as an overwash storm deposit (presumably from a powerful hurricane or Nor'Easter). *Phragmites* roots penetrate most of this sand layer. Core MC-2 did not penetrate this coarser-grained facies, but it is interpreted that saltmarsh sediment may similarly be present at depth in this location following the rules of original horizontality.

At the surface (<10 cm), organic-rich mud is found with freshwater *Phragmites* vegetation and roots (Fig 3). Results from the RTK survey reveal these cores are approximately situated 1 m above NAVD 88, and the surface gradients are shallow.

| T-Wharf

The core transect at T-Wharf was taken along a much steeper gradient (ranging from <1 to >2 m above NAVD88), and cores reveal coarse-grained glacial till at relatively shallow depths (cores TW-2 and TW-3;

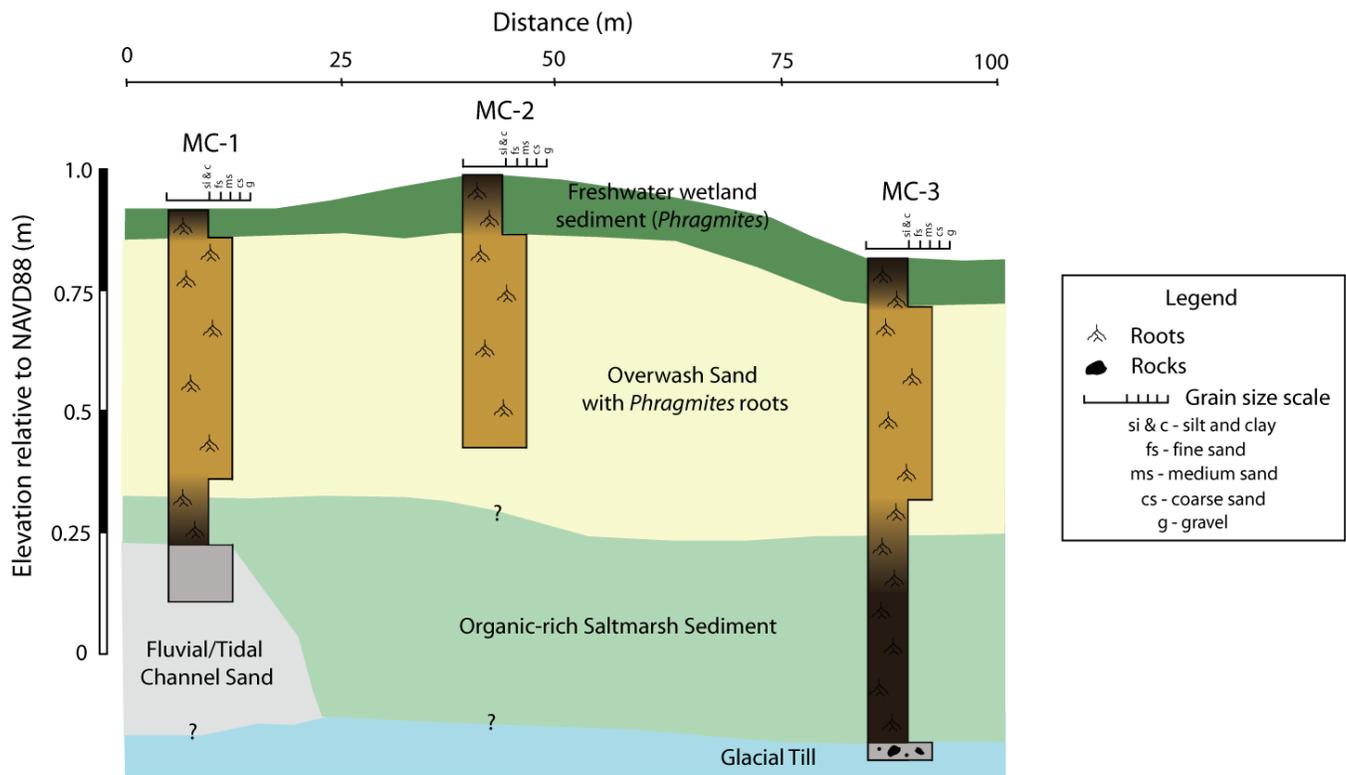


Figure 3 – Stratigraphic cross-section of Mill Creek cores and geologic interpretation. Grain size is indicated by the thickness of the section (scale bar located above each core). Distances are approximate. Elevation provided by R. Weber at NB-NERR.

Fig 4). A relatively thick (>50 cm), well-sorted, coarser-grained (medium sand) storm deposit is also found at this location in the core closest to the marine outlet (TW-1), and this layer thins inland (to TW-2). A thin (~ 10 cm) saltmarsh facies exists at the surface of the lowest core (TW-1), containing *Phragmites* and *Spartina patens* vegetation and roots. A characteristic soil profile horizon (including O, A, E and B layers) is present in the surface of TW-2 (Fig 4). Organic-rich mud is found with freshwater *Scirpus* vegetation and roots at the surface of the upland core (TW-3).

| IMPLICATIONS FOR FUTURE WORK

Results from this study reveal that a small saltmarsh once existed in the low-lying wetland watershed near Mill Creek. Overwash sand, presumably from a hurricane or Nor’Easter storm event, completely blanketed the saltmarsh, raising the elevation above tidal elevation. *Phragmites* vegetation subsequently recolonized the area. Further analysis could involve radiocarbon dating the saltmarsh sediment located immediately below the overwash sand horizon to determine the age of the saltmarsh and when the storm event occurred. Saltmarsh restoration in this area would have to involve: 1) determining the average elevation of present-day saltmarshes on Prudence Island relative to NAVD88, 2) adjusting the surface elevation of this area accordingly, and 3) assuring adequate tidal exchange underneath the road.

At T-Wharf, a small saltmarsh is present today near the outlet of the freshwater stream. There is no evidence with depth that a more extensive saltmarsh existed in this area in the past. It is possible that the present-day

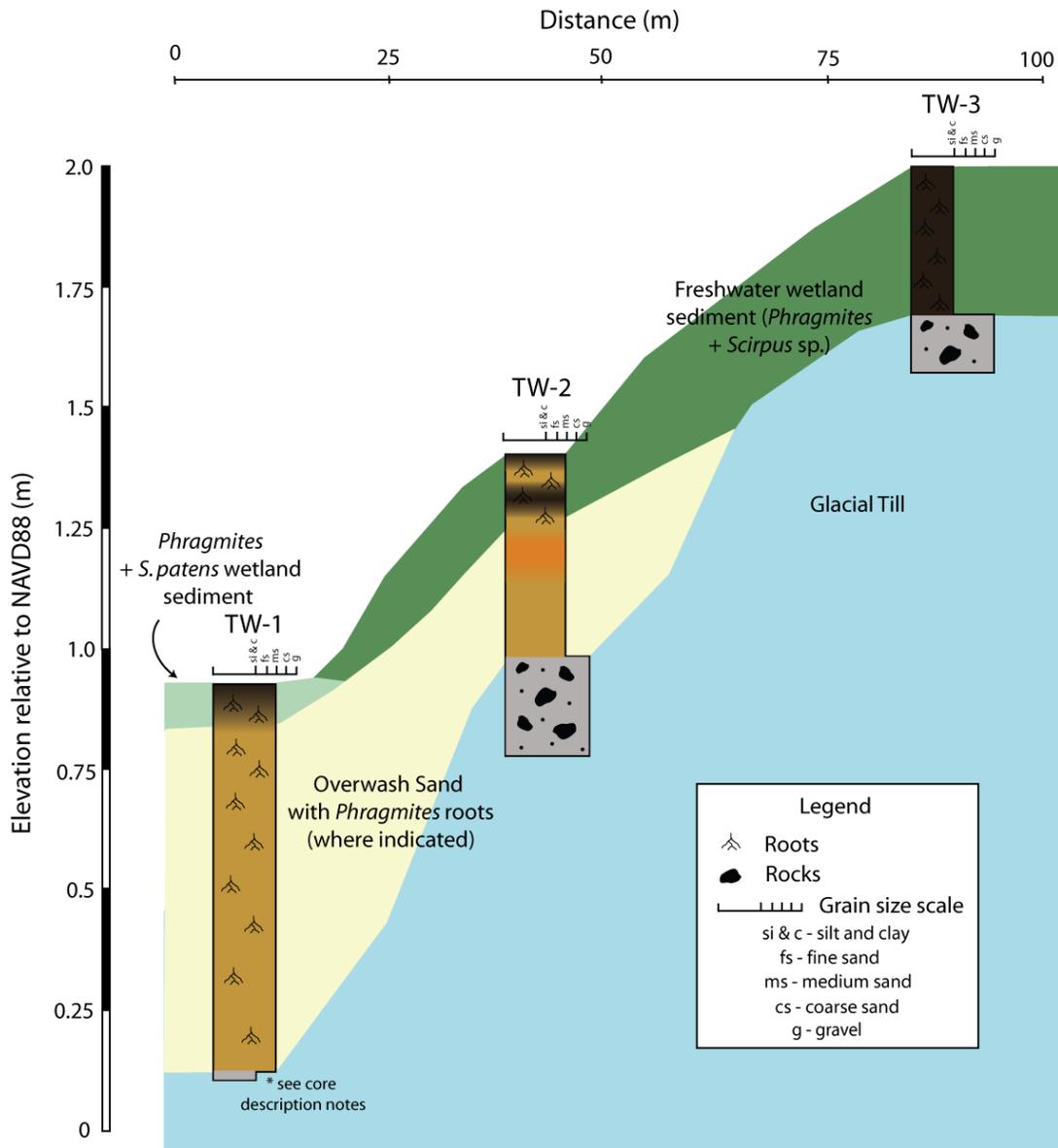


Figure 4 – Stratigraphic cross-section of T-Wharf cores and geologic interpretation. Grain size is indicated by the thickness of the section (scale bar located above each core). Distances are approximate. Elevation provided by R. Weber at NB-NERR.

saltmarsh once extended offshore some distance and has since been eroded and/or covered by the road built in the last century, however confirmation would require coring through road base material and in the nearshore environment. In general, however, this is not as ideal a saltmarsh restoration site as Mill Creek.

| REFERENCES

de Rijk, S., and Troelstra, S.R., 1997. Salt marsh foraminifera from the Great Marshes, Massachusetts: environmental controls. *Palaeogeography, Palaeoclimatology, Palaeoecology* 130, p. 81-112.

Scott, D.K., and Leckie, R.M., 1990. Foraminiferal zonation of Great Sippewissett salt marsh (Falmouth, Massachusetts). *Journal of Foraminiferal Research* 20(3), p. 248-266.

| ACKNOWLEDGEMENTS

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APPENDIX A | CORE LOCATIONS

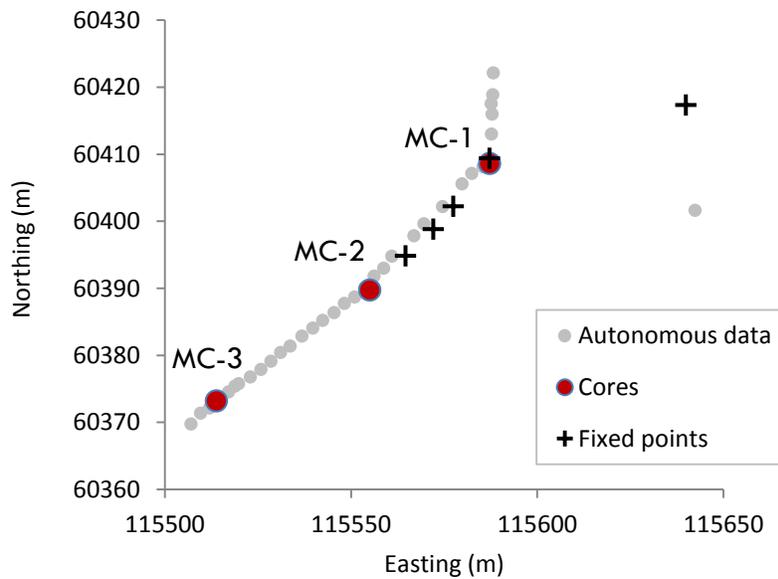
<i>Core</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Elevation relative to NAVD88 (m)</i>
MC-1	41.627108	-71.312951	0.925*
MC-2	41.626939	-71.313337	0.983*
MC-3	41.626791	-71.313832	0.828*
TW-1	41.581525	-71.322117	0.883
TW-2	41.581579	-71.322592	1.423
TW-3	41.581702	-71.322922	2.145

* approximate elevation (see text for details)

MC = Mill Creek

TW = T-Wharf

GPS and elevation data courtesy of R. Weber at NB-NERR. Elevations for Mill Creek core locations are approximate as it was difficult to receive fixed GPS location in this area of the island. Elevation of MC-1 and MC-2 are taken from relatively close (<3m distance) fixed locations along the transect. Elevation of MC-3 was estimated from a reasonably close autonomous point (see image below).



APPENDIX B | CORE DESCRIPTIONS

Mill Creek Area

MC-1

Date Sampled: 6/19/12

Core Type: Auger; Large core 0-27 cm, dug to 39 cm, small core 39-79 cm.

<u>Depth from Surface (cm)</u>	<u>Description</u>
0 – 5	Dark brown mud with <i>Phragmites</i> (<i>Phrag.</i>) roots
5 – 14	Medium brown medium sand with <i>Phrag.</i> roots
14 – 62	Tan medium sand with <i>Phrag.</i> roots
62 – 69	Dark brown peat (saltmarsh forams present), sharp contact with:
69 – 79	Grey medium sand, with few roots

MC-2

Date Sampled: 6/19/12

Core Type: Auger; Small core 0-54 cm.

<u>Depth from Surface (cm)</u>	<u>Description</u>
0 – 10	Dark brown mud with <i>Phrag.</i> roots, some sand
10 – 17	Medium brown medium sand with <i>Phrag.</i> roots
17 – 54	Tan medium sand with <i>Phrag.</i> roots

MC-3

Date Sampled: 6/19/12

Core Type: Auger; Large core 0-39 cm, small core 39-103 cm.

<u>Depth from Surface (cm)</u>	<u>Description</u>
0 – 9	Dark brown mud with <i>Phrag.</i> roots
9 – 16	Medium brown medium sand with <i>Phrag.</i> roots
16 – 52	Tan medium sand with <i>Phrag.</i> roots
52 – 99	Dark brown peat with <i>Distichlis</i> sp. roots (saltmarsh forams present)
99 – 103	Grey glacial till (rock fragments, sand and mud mixture)

T-Wharf Area

TW-1

Date Sampled: 6/19/12

Core Type: Auger; Large core 0-16 cm, dug to 55 cm, small core 55-92 cm.

<u>Depth from Surface (cm)</u>	<u>Description</u>
0 – 4	Medium brown organic-rich medium sand with <i>Spartina patens</i> and <i>Phrag.</i> roots
4 – 9	Black organic-rich peat (saltmarsh forams present) with medium sand
9 – 82.5	Tan medium sand with <i>Phrag.</i> roots, decreasing root content below 39 cm, sharp contact with:
82.5 – 83	Dense grey clay layer, sharp contact with:
83 – 84	Brown organic-rich peat (saltmarsh)
84 – 92	Tan medium sand with <i>Phrag.</i> roots

**Took another core and also had dense clay at base. It is probable that the last two stratigraphic layers indicated here are slough in the core barrel from extraction through above layers. For this reason, the last two layers are excluded in core diagram.

TW-2

Date Sampled: 6/19/12

Core Type: Auger; Large core 0-39 cm, small core 34-62 cm.

<u>Depth from Surface (cm)</u>	<u>Description</u>
0 – 2	Dark brown medium sand with <i>Phrag.</i> roots (O layer)
2 – 5	Medium brown medium sand with few <i>Phrag.</i> roots
5 – 10	Black medium sand with few <i>Phrag.</i> Roots (A layer)
10 – 17	Tan medium sand with few <i>Phrag.</i> Roots (E layer)
17 – 21	Orange medium sand (B layer—Fe accumulation)
21 – 23	Brown medium sand
23 – 40	Tan medium sand, mottled with brown and orange, sharp contact with:
40 – 62	Grey glacial till (rock fragments, sand and mud mixture), mottled with orange (oxidized clay)

TW-3

Date Sampled: 6/19/12

Core Type: Auger; Large core 0-41 cm.

<u>Depth from Surface (cm)</u>	<u>Description</u>
0 – 8	Dark brown organic rich mud with thick brackish marsh roots, most notably <i>Scirpus</i> sp.
8 – 32	Dark brown organic rich mud with roots
32 – 41	Grey glacial till (rock fragments, sand and mud mixture), no evidence of oxidation

APPENDIX C | CORE PHOTOGRAPHY

Mill Creek





T-Wharf



