SCOPE OF WORK

STATE: New Jersey

PROJECT TITLE: Vegetation Monitoring at Beneficial Use of Dredged Material to Enhance Salt Marsh Pilot Projects

JOB TITLE: Vegetation, Epifaunal Macroinvertebrate, and Bearing Capacity Monitoring

JOB OBJECTIVES: Determine if vegetation and epifaunal macroinvertebrates are recovering at enhancement sites.

JOB 1A: Monitoring permanent plots during peak growing season of 2021
JOB 1A OBJECTIVE: Monitor vegetation, bearing capacity and epifaunal macroinvertebrates following established protocols with as much consistency with previous years as possible. Monitoring in enhancement sites will be compared with control sites and previous years of monitoring to determine if the project is meeting its goals.

NEED:
In 2017, NJDEP completed a project to trial the beneficial use of dredged material to enhance salt marshes that benefit coastal communities in advance of the widespread use of this practice in the state. This practice combines salt marsh enhancement with routine and post-storm dredging required to keep waterways navigable. Enhancement is accomplished by placing dredged material on a salt marsh site at different locations in Middle Township, Avalon and Fortescue, NJ at varying depths to increase marsh elevation according to the specific site characteristics and enhancement objectives. Placement of material is accomplished through direct pumping or broadcasting, depending on the desired result. The enhancement objective of the pilot projects is to increase the elevation of the marsh plain such that the elevation increase improves local coastal community resiliency and provides ecological uplift.

Monitoring NJDEP's beneficial use of dredged material pilot projects is needed to determine how long it takes for the projects to meet their goals. The long-term success criteria for the marsh enhancement components of the pilot projects were to (1) increase and then maintain the optimal tidal elevation (flooding and flushing) for native salt marsh species, (2) increase the cover and robustness of native salt marsh vegetation and (3) return all other metrics to baseline conditions unless they were expected to decline due to habitat conversion.

APPROACH:

- Three project sites and their associated control sites will be monitored. They are located in Fortescue, Avalon, and Middle Township, NJ. **All sites require a boat for access.**
- Monitor previously established 177 permanent 1 m^2 plots by the end of the second week of September 2021 following a standard protocol (see SOP at end of RFP) and in a constant manner with previous years. Plots are located in placement and control areas at three project sites. Plots will be monitored for the following metrics:

    - Total vegetation cover
    - Invasive species cover
    - Vegetation species composition
    - Dominant plant species
    - Habitat characterization of the plot (vegetated, bare or pool)
    - Photographic documentation
    - Qualitative plot observations
    - Bearing capacity
    - Abundance of epifaunal macroinvertebrates (1/4 m^2)
- Enter data into standardized field data sheets (included in SOP below), QC data, provide appropriate metadata and submit electronic and scans of field data sheets and photos to DEP.
- Prepare a manuscript for peer reviewed publication based on permanent plot monitoring from 2014 through 2021 including multivariate analysis of vegetation recovery covariates conducted on the 2019 vegetation data with assistance from NJDEP. NJDEP will be listed as a co-author.

PROJECT TIMEFRAME:
The Division of Science and Research seek to complete the tasks/deliverables identified above by January 31, 2022.

PROPOSAL REQUIREMENTS:
All proposals in response to this Request for Proposals must be submitted via email to Metthea Yepsen at Metthea.Yepsen@dep.nj.gov by 5:00 PM EST on **March 3, 2021**.

PROPOSAL SPECIFICATIONS:
All proposals should include:
- Project timeline
- A basic statement of qualifications, including experience, background, skills, and degree of expertise in the specific areas outlined in this RFP.
- Applicants must have a minimum of two years of experience conducting vegetation monitoring, bearing capacity monitoring, epifaunal macroinvertebrate monitoring, and data analysis.
- Financial proposal for the project, up to $25,000 including total work hours and hourly rate schedule to perform this work must be submitted using the PB-120 Form.
- Any other relevant contractual language. The successful applicant's final proposal will become part of any signed agreement.

This request for proposals does not commit the State of New Jersey to engaging the services of any firm for any of the items either within or outside the outlined scope of work.

Schedule for Selection of Consultant
1. Deadline for receipt of proposals: March 3, 2021.
2. Applicant notified of selection: By March 10, 2021.

3. Work will commence upon execution of a purchase order.

Please note: applicants must be registered in NJSTART and the winner bidder must complete the DPA paperwork before the execution of the purchase order. If you are a new grantee (not in the State's Treasury system) or an existing grantee with a new payment address or wish to receive direct deposit, you must register/update information at www.njstart.gov in order to process a purchase order.

Excerpt from Project Monitoring Protocols

Developed by The New Jersey Chapter of The Nature Conservancy
Developed: September 2015
Updated: October 2017

Project Title: The Beneficial Use of Dredged Material to Enhance Salt Marshes
Project Sponsor: New Jersey Department of Environmental Protection (NJDEP)

Monitoring Plan Title: Vegetation, Biomass, and Epifaunal Macroinvertebrate Monitoring

List of metrics

1. Vegetation metrics:
    - Species richness
    - Percent cover by species
    - Average stem height of dominant plant species
2. Epifaunal macroinvertebrates (EMI) metrics:
    - Species richness
    - Species abundance
    - Species density
3. Physical metrics:
    - Elevation (taken during a separate topographic survey)

B. Monitoring design

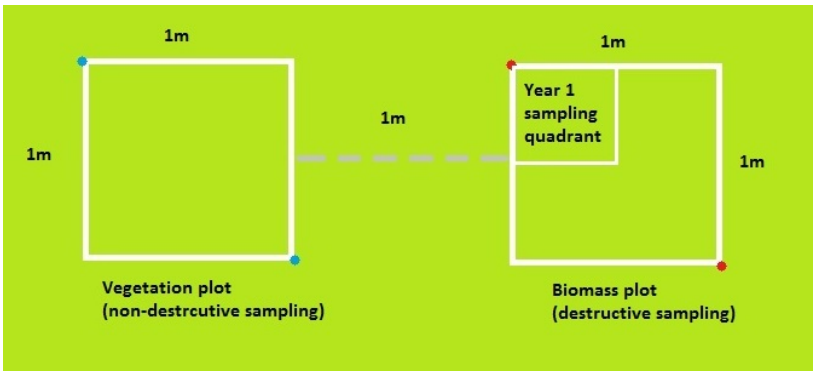
1. Spatial design: Vegetation, EMI, and physical metrics will be monitored at permanent 1 m^2 plots located within placement and control areas at each of the three sites. Biomass metrics and EMI species density will be monitored in 0.25 m^2 plots adjacent to a subset of these permanent monitoring plots. All plots will be marked in the field and all project team members and contractors will be told about the markers and asked to avoid disturbing these plots. Locations of the permanent monitoring plots depend on individual site characteristics and enhancement project design. At some areas of Avalon and Ring Island, plots were established along transects that run perpendicular to channel banks and into the marsh interior following a systematic random approach. At other areas of Avalon and Ring Island, and at all sites at Fortescue, plots were established so they were distributed proportionally among habitat types and elevation zones following a stratified random approach. Habitat types include low marsh, high marsh, and pools. Important site-specific spatial design considerations include variation in habitat types, marsh condition, and elevation. Plots were initially established prior to placement. After placement, plots that were in “Placement” areas that did not receive any placement were removed from subsequent monitoring, and some additional plots were established to replace them.
2. Temporal design: Monitoring will follow a BACI design. Monitoring will be conducted during peak biomass (mid-July to mid-September) prior to placement and once per year post-placement, continuing as funding allows. Monitoring will be conducted when there is little to no water on the marsh surface and monitoring at each site will occur during the same approximate time of the season.

C. Detailed methods

1. Field methods per permanent 1 m^2 plot (annual non-destructive sampling):
    - Metrics:
        - Vegetation metrics: Species richness, percent cover by species, average stem height of dominant plant species
        - EMI metrics: Species richness, relative abundance, and species density
        - Physical metrics: Pre-placement and post-placement elevation (taken during a separate topographic survey)
    - Equipment/Supplies:
        - Garmin GPS unit
        - Maps of plot locations
        - 1m^2 quadrat
        - PVC quadrat markers
        - Digital camera
        - Meter stick (mm)
        - Ruler (mm)
        - Flashlight
        - Compass
        - Stopwatch
        - Data sheets and pencils
        - Rugged field tablet (beginning 2017)
    - Procedures:
        - Locate plot; record start time.
        - Carefully slide a 1mx1m PVC quadrat down over vegetation as far as possible; place ½" PVC markers in two corners of quadrat; mark a waypoint at center of plot.
        - Beginning from one corner of the quadrat (corner will be rotated on a yearly basis), conduct a 3-minute timed systematic search from a crouched position for EMI species within that ¼ m^2 subset of the quadrat, gently moving aside vegetation and probing the sediment/dredged material for mussels. Record the number of snails (by species), ribbed mussels, and crabs (by species) within a ¼ m^2 subset of the quadrat. As of 2017, categorical abundances will be used when there are > 11 individuals of a given species, and crab burrows will be used to quantify crab abundances rather than actual crabs.
        - Take a photo from above the marsh surface to capture entire quadrat and record photo number. As of 2017, photos will be taken with the NE corner of the plot in the bottom left corner of the photo.
        - Record the presence of each distinct plant species (*Genus species*).
        - Estimate percent cover of each plant species and other cover types (i.e. litter, dead standing vegetation, water, etc.) using Braun-Blanquet (BB) cover classes.
        - Beginning from the same corner of the quadrat as the EMI count, measure the heights of the first 15 stems of the dominant plant species you encounter.
        - If unable to identify a species (EMI or vegetation) in the field, collect a single specimen in a labeled zip locked bag for identification upon return to the office.

- Note: Elevations of these plots will be taken during separate topographic surveys. Coordinates of the permanent $1m^2$ plots will be given to the surveyors, who will report back to TNC with the elevation data.

- Procedures:
  - Place at 1x1m PVC quadrat over the plot that has been marked with 2 PVC stakes; place the 0.25 m^2 quadrat in the designated quadrant of the $1m^2$ quadrat.



  - Take a photo of the plot; record photo number.
  - Conduct a timed (3 minute) search for all EMI species, counting all individuals of each distinct EMI species seen or felt when probing the surface of the plot. Count and record densities by species.

D. Data management and quality assurance/quality control

1. Data collection: Data from vegetation metrics and EMI metrics measurements will be recorded on standardized datasheets or on a rugged field tablet (as of 2017). Coordinates of the locations of sampling plots will be recorded in a GPS unit in the field. The number of all photos taken in the field will be recorded on data sheets.
2. Data storage: Field datasheets will be scanned. Data will be transferred from the datasheets or tablet into Excel worksheets. QA/QC for data entry will be accomplished by random checks by the principal investigator, comparing datasheet entries with electronic file entries. Photos will be uploaded and labelled. The resulting digital copies of field datasheets, Excel worksheets, shapefiles and photos will be stored in a cloud storage location that is shared by the project team (DEP OneDrive).
3. Data analysis:
   - Vegetation metrics: Vegetative species richness will be calculated for each permanent plot and on each site as the total number of native species occurring in that space. A mean of the number of species found per plot per site will also be calculated. Vegetative percent cover by species, per plot, per habitat type (e.g. high marsh, low marsh, pool), and per site will be evaluated using the midpoint of the BB cover classes. The average stem height of dominant plant species will be calculated for each permanent monitoring plot and means will be calculated for each site.
   - EMI metrics: EMI species richness will be calculated for each permanent plot and on each site as the total number of native species occurring in that space. Relative abundance of EMI by species will be calculated for each permanent plot using exact counts (when $\leq$ 11 individuals) or the midpoints of the categorical abundance classes (when > 11 individuals).

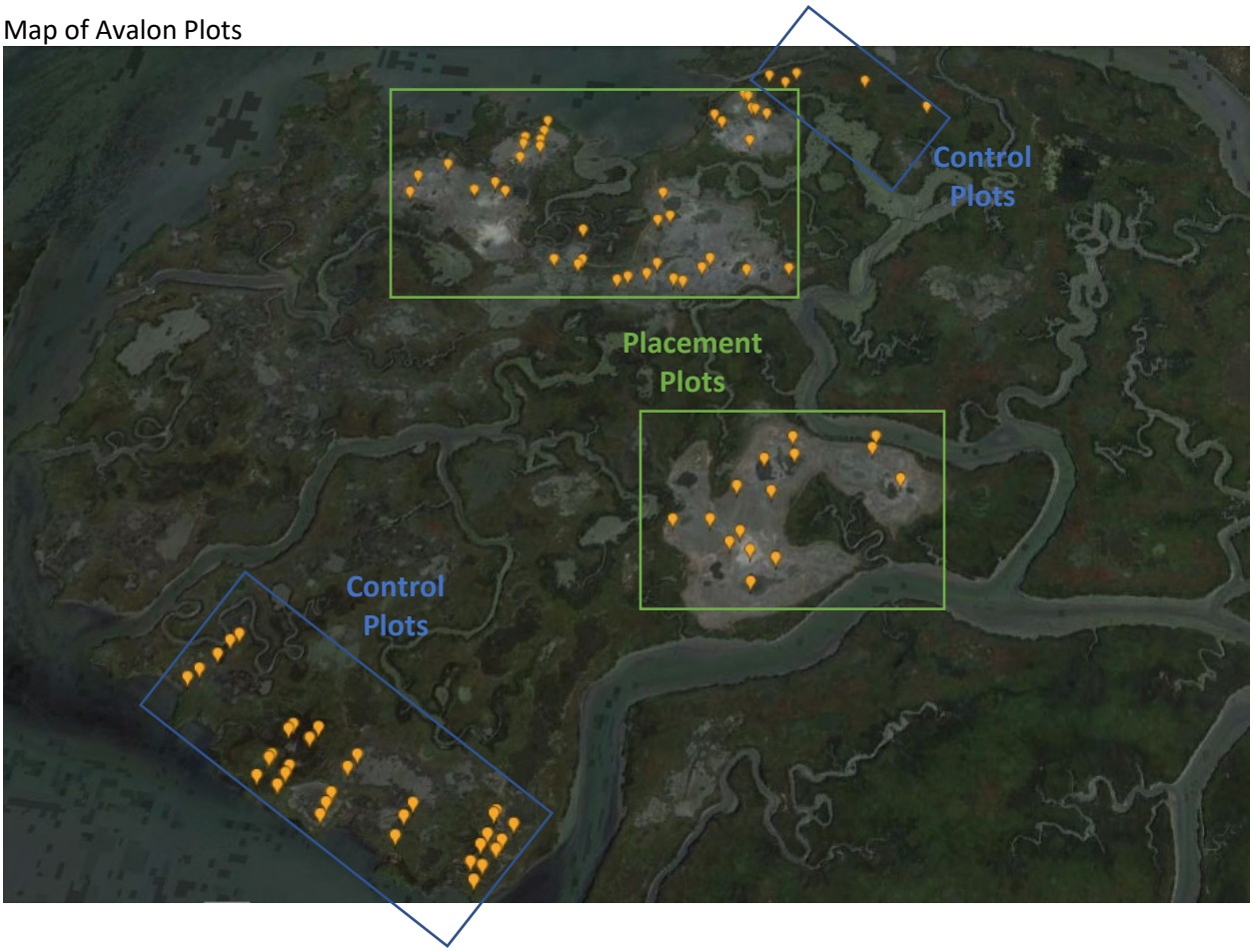
- All individual metrics (including elevation) will be analyzed for significant differences between placement sites and control sites within years, and within placement/control sites between years. ANOVAs and t-tests will be used where datasets are normal and homogeneous; otherwise non-parametric equivalents will be used.
- Individual metrics will be analyzed for relationships to depth of placement for each site (see Bearing Capacity and Sediment Observations Monitoring Plan). ANOVAs will be used where datasets are normal and homogeneous; otherwise non-parametric equivalents will be used.
- Individual metrics will be analyzed for relationships to elevation for each site. ANOVAs will be used where datasets are normal and homogeneous; otherwise non-parametric equivalents will be used.

E. References

1. Braun-Blanquet, J. 1932. Plant sociology. The study of plant communities. McGraw-Hill, New York, NY, US.
2. Vegetation monitoring adapted from Diers, T. and Roman, C. 2000. Ecosystem indicator: vegetation. p 12-14 in H.A. Neckles and M.Dionne Editors. Regional standards to identify and evaluate tidal wetland restoration in the Gulf of Maine. Wells National Estuarine Research Reserve Technical Report, Wells, ME.

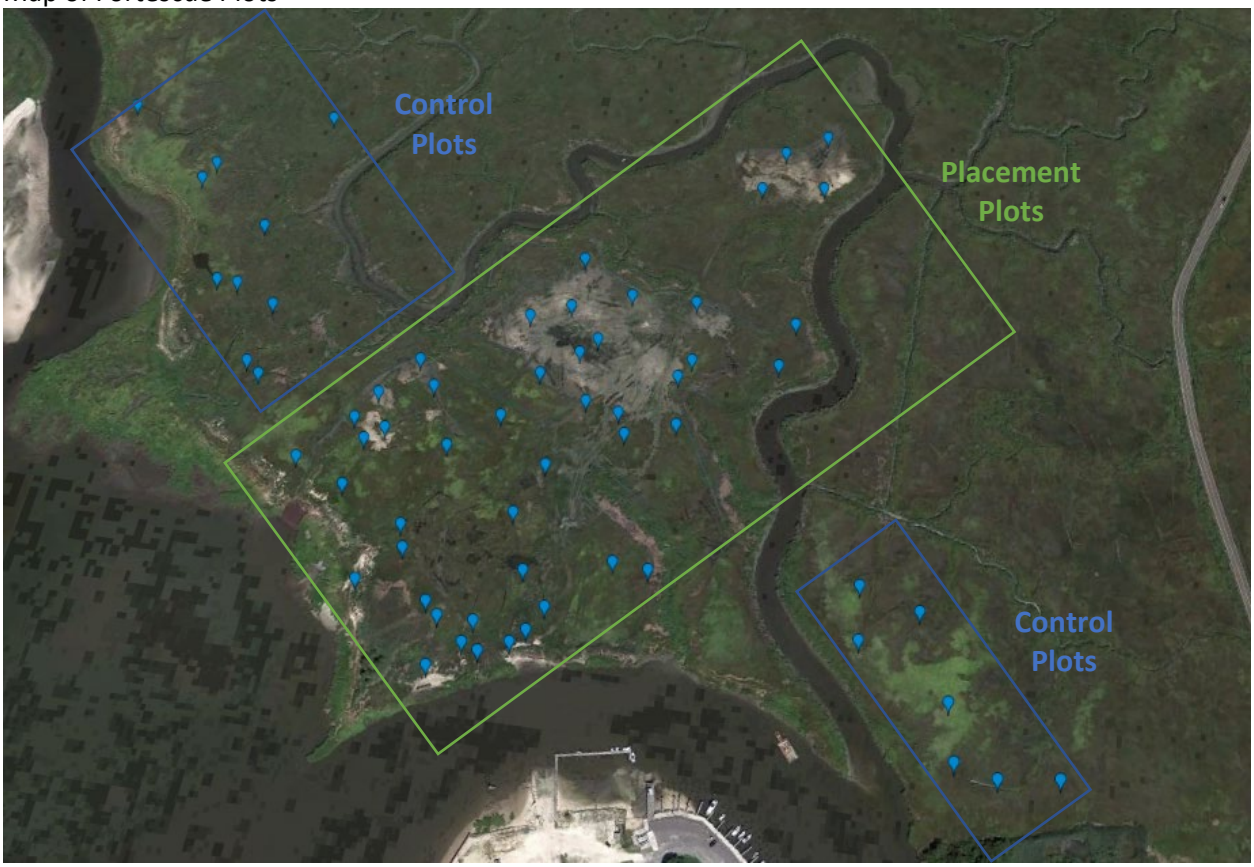
F. Appendix (see next page)

1. Map of Avalon Plots



2. Map of Ring Island Plots

3. Map of Fortescue Plots



4. Data Sheet Template:

Date: ______________________________

Field Crew: ___________________________

Site: _________________________________

Control/Placement (circle) Polygon/Area:_________

Tide: L- -H

Quadrat #			
Latitude/ Longitude (dd)			
Photo #			
Waypoint			
Biomass (y/n)			

Cover type/Species: Bare (includes wash/placement), wrack/litter, water, rock, trash, large macroalgae, dredge material

Spa alt	*Spartina alterniflora*
Spa pat	*Spartina patens*
Sal spp	*Salicornia species*
Dis spi	*Distichlis spicata*
Lim car	*Limonium carolinianum*

Braun-Blanquet cover scheme:

- +: Less than 1% (only 1 specimen in plot)
- 1: 1% to 5% cover
- 2: 6% to 10% cover
- 3: 11% to 25% cover
- 4: 26% to 50% cover
- 5: 51% to 75% cover
- 6: 76% to 100% cover

Crab Burrows

None	0
Low	1-10
Medium	11-20
High	21+

Expected EMI Species

Mel bid	Melampus bidentatus
Ily obs	Ilyanassa obsoleta
Ova myo	Ovatella myosotis
Lit lit	Littorina littorea
Ses ret	Sesarma reticulatum
Uca pug	Uca pugnax
Geu Dem	Geukensia Demissa

	EMI				Percent Cover		1st 15 Stem Heights of Dominant Species (cm)			Bearing Capacity							
										Mark Depth (cm)							
Q#	Species	Count or Presence	Ribbed Mussel Lip Count	Quadrat Observations/Salinity	Cover Type/Species	BB Class				Water Depth	Initial Depth	Blow 1	Blow 2	Blow 3	Blow 4	Blow 5	Blow 5-Initial
					TOTAL Veg Cover												
										Sediment Depths (cm)							
										Soil/Sediment Notes:							
					TOTAL Veg Cover												
										Sediment Depths (cm)							
										Soil/Sediment Notes:							
					TOTAL Veg Cover												
										Sediment Depths (cm)							
										Soil/Sediment Notes:							

Monitoring Plan Title: Bearing Capacity and Sediment Observations
Monitor: The Nature Conservancy

A. List of metrics

1. Bearing Capacity
2. Loading Response
3. Depth of Standing Water
4. Placement depths
5. Soil Observations

B. Monitoring design

1. Spatial design: Bearing capacity will be taken at each permanent vegetation quadrat (see Vegetation, Biomass, and Epifaunal Macroinvertebrate Monitoring Plan) within a 25 cm radius outside a given corner of the quad (see Figure 1 below). In the first year, bearing capacity will be measured in the southeast corner. In subsequent monitoring, bearing capacity will be measured clockwise around the quadrat so that readings are not impacted by the previous year's compaction or penetration. Depths of placed dredged material are taken in all 4 corners and in the center of the quadrat. Sediment observations include the entire quadrat and the bearing capacity area.
2. Temporal design: Bearing Capacity, placement depths, and sediment observations will be taken at the same time as vegetation metrics annually during the peak growth period (mid-July to mid-September; see Vegetation, Biomass, and Epifaunal Macroinvertebrate Monitoring Plan).

C. Detailed Methods

- **Equipment/Supplies:**
  - Datasheet
  - Compass

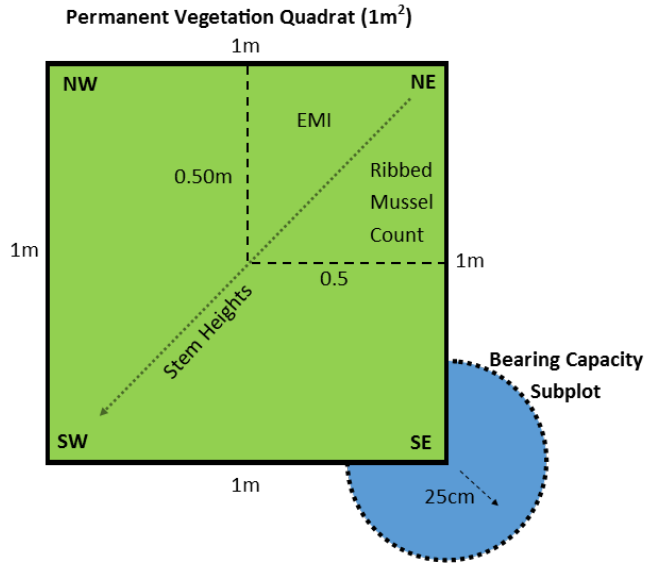


Figure 1 Diagram of monitoring quadrat set-up

Figure 2 Slide hammer on top of graduated PVC measuring bearing capacity

  - 1 m^2 PVC quadrat

- Slide Hammer with PVC cap
    - The slide hammer is the top, weighs eighteen pounds and is attached to a PVC ring with a 5/8th inch bolt
    - The base of the instrument is a 2-inch capped PVC tube with a centimeter scale marked on its side. The PVC pipe is one-meter-long and has a flat cap on the bottom (makes total diameter 2.5“).

- **Procedure:**
    1. Fill out datasheet
    2. At each permanent vegetation 1 m^2 quadrat, use a compass to find the southeast corner (or given corner for that year). Take the bearing capacity within a 25 cm radius outside of that corner of the permanent quadrat. (In subsequent monitoring bearing capacity will be measured clockwise around the quadrat)
        i. If plot does not seem suitable in best judgement (bird nest, containment, previous biomass samples taken etc.) or is drastically different from conditions within the vegetation plot, move the subplot to another corner. Make note of why the subplot was moved.
        ii. If vegetation is present, move it gently out of the way so that the PVC cap is resting on as much bare ground as possible.
    3. Measure and record the depth of surface water at each sub-plot in centimeters.
    4. Measure bearing capacity:
        i. Assemble the PVC tube and the slide hammer together first and then place gently on wetland surface at determined location.
        ii. Measure initial compaction by recording how deep the PVC penetrates into the ground without exerting any force, using the centimeter scale on the PVC pipe. Record this as ‘Initial Depth’. Note: if there is water on the marsh, take readings at the surface of the water, not at the surface of the marsh.
        iii. Lift and extend the slide hammer fully. Release the hammer and allow it to fall freely with gravity.
        iv. Without moving the slide hammer, measure compaction by reading where the marsh or water surface aligns with the centimeter scale on the PVC pipe. Record the depth as ‘Blow 1’.
        v. Repeat steps c and d for Blows 2-5.
        vi. In the office, subtract initial depth from final depth to calculate penetration depth.
    5. Measure placement depths:
        i. In each corner and in the center of the permanent quadrat, gently but firmly insert the meter stick until it meets a point of resistance which can be hard soil beneath placement or plant matter.
        ii. Record the placement depth in centimeters.
    6. Record sediment observations:
        i. Make a note of surface sediment grain size/texture (i.e., sand, fine sediment, or organic material), color, and presence of roots, algal mats, anoxic sediment, iron, etc. If the substrate or vegetation cover are different between plot and subplot, make a note.

D. Data management and quality analysis/quality control

1. Data collection: Data will be collected manually on datasheets or a rugged field tablet (as of 2017) in the field.

2. Data storage: Data will be transferred to Excel spread sheets and then quality assured by a secondary person. The digital data workbooks and scanned field datasheets will be stored on the TNC server.
3. Data analysis: Average placement depths will be calculated for each plot. ANOVAs will be used where datasets are normal and homogeneous; otherwise non-parametric equivalents will be used to relate Bearing Capacity and placement depths to other metrics including vegetation cover (see Vegetation, Biomass, and Epifaunal Macroinvertebrate Monitoring Plan)

A. References

1. Bertness MD, Miller T (1984) The distribution and dynamics of Uca pugnax burrows in a New England salt marsh. Journal of Experimental Marine Biology and Ecology 83:211–237
2. Mid-Atlantic Tidal Wetland Rapid Assessment Method Version 3.0 (http://www.dnrec.delaware.gov/Admin/DelawareWetlands/Documents/Tidal%20Rapid_Protocol%203.0%20Jun10.pdf)