Saltmarsh Restoration Regional Technical Workgroup (RTW): Final Report

The Nature Conservancy

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Saltmarsh Restoration Regional Technical Workgroup

Executive Summary

December 2018

Salt marshes provide multiple benefits to both human and natural communities in Suffolk County, such as recreational and educational opportunities, wildlife habitat, carbon sequestration and risk reduction from coastal storms. However, like most coastal areas, Suffolk County has lost a large fraction of its historic coastal wetlands. By 1972 Suffolk County had lost almost 40% of the wetlands that were present in 1954 (RMRC, 1973; O'Connor and Terry, 1972). In addition, in the time between when the Tidal Wetlands Act was put into effect in 1974 to stop the dredge and fill activities and 2005/8, Long Island lost more than 13% of the tidal wetlands that were still present in 1973 (CEA, 2015). Loss of high marsh habitat within those wetlands during this later time period has occurred at an even greater rate than overall marsh loss (27% island wide) (CEA, 2015). Remaining marshlands are vulnerable to further loss during this coming century due to sea level rise and other factors such as poor water quality, insufficient sediment supply, and lingering impacts from the linear grid ditching completed in the 1930s (e.g. NYSERDA 2018).

In order to improve the long-term viability of these marshes, Suffolk County sought funding through the National Fish and Wildlife Foundation ("NFWF") Hurricane Sandy Coastal Resiliency Competitive Grant program to restore up to 400 acres of tidal wetlands along the south shore of Suffolk County and build the capacity to eventually rehabilitate up to 1500 acres.

As a key component of this project, Suffolk County partnered with The Nature Conservancy (TNC) to assemble and lead a Regional Technical Workgroup (RTW) of saltmarsh restoration practitioners across the Sandy-impacted region to provide a forum for the exchange of ideas, experiences and best practices regarding saltmarsh restoration. The lessons learned and shared here will inform the design, implementation and monitoring of Suffolk County's wetland restoration projects as well as other projects across the region to improve overall marsh health and resilience in the face of climate change. The RTW is an unprecedented collaboration of regional experts discussing the best available restoration methods for individual on-the-ground projects, as well as a forum for creation and application of new methods, thereby advancing restoration science to future circumstances. This Final Report captures the collective lessons learned from across the region.

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Background

In the fall of 2015 Suffolk County, NY (the County) was awarded a National Fish and Wildlife Foundation ("NFWF") Hurricane Sandy Coastal Resiliency Competitive Grant titled: Coastal resiliency via integrated salt marsh management. The overall purpose of the award was to build on the County's use of Integrated Marsh Management (IMM) techniques as applied to 80 acres of the Wertheim NWR to restore up to 400 acres of tidal wetlands along the south shore of Suffolk County in the short term and build capacity to eventually rehabilitate up to 1500 acres.

A key component of this project was the formation of the Regional Technical Workgroup (RTW) led by The Nature Conservancy (TNC). TNC assembled and led a group of saltmarsh restoration experts from across the Sandy-impacted region (from VA-ME) and provided a forum for these practitioners to discuss the best available restoration methods and share lessons learned in order to improve the success of coastal wetland restoration projects both within Suffolk County and across the larger region.

Introduction

The Regional Technical Workgroup (RTW) is an unprecedented assembly of the leaders of marsh restoration projects across the region including representatives from federal, state and local agencies, coastal managers and vector control agencies as well as academics and NGOs with expertise in conducting and evaluating these types of projects. Vector control agencies bring valuable experience to these conversations and they need to be more commonly involved in marsh restoration and marsh management discussions. Restoration science is still a developing field and there is incredible value to be derived from creating a forum for the exchange of ideas and lessons learned that will help to reveal important similarities as well as differences in short-term ecosystem response to management and restoration efforts. This exchange will lead to a greater understanding of how we can more effectively restore and increase the overall health and resilience of our coastal salt marshes.

Goals of the Regional Technical Workgroup

Overarching Goal:

The overarching goal of this Regional Technical Workgroup (RTW) is to provide a forum to improve the exchange of ideas and information among saltmarsh restoration practitioners across the region as we all work to improve the overall health and resilience of our coastal wetlands. Coastal managers and restoration practitioners from local state and federal agencies as well as conservation organizations have a lot to bring to this exchange and a lot to gain from it. The more immediate goal of the forum was to support the County's restoration efforts by providing timely information to advise the design, implementation and monitoring of Suffolk County's wetland restoration projects to maximize their impact on overall marsh health, public health concerns about vectors of disease, and resilience to climate change. This exchange of

practical, hands-on experience can improve the efficiency and cost-effectiveness of restoration efforts by disseminating the kinds of operational details that never make it to written reports or presentations but play a big role in actually executing projects on the ground.

More specific goals included:

- To convene a forum of coastal managers and restoration practitioners across the Sandy-impacted region for the purpose of improving the exchange of ideas and information;
- To bring together technical experts to enhance projects and to improve management techniques;
- To facilitate an increased understanding of patterns of salt marsh change and conditions especially in response to the common restoration and adaptation approaches of hydrological amendment and elevation enhancement.
- To document the collective short-term ecosystem responses to restoration strategies implemented across the region;
- To compile and disseminate the "lessons learned" across the region;
- To guide adaptive management of restoration projects;
- To advise the site selection, design and implementation of restoration projects on Long Island and beyond;
- To encourage the use of standardized monitoring metrics across the Sandy-impacted region;
- To produce a summary report that will be a useful resource for restoration practitioners moving forward.

Participation and Membership

The Nature Conservancy assembled members of this workgroup based on strategic engagement with people and projects across the Sandy-impacted region as well as those with relevant Long Island marsh experience. Determining membership was an iterative process with involvement of Suffolk County personnel and trusted restoration practitioners. Members drew from a wide-ranging group of about 50 very skilled restoration practitioners, managers and regulators. Active membership in the workgroup grew and shrank over the course of the project timeline as members' availability changed and as their expertise and interest intersected with the objectives of each scheduled meeting and field trip. Each participant had valuable contributions to make to the effort and lots to gain from participating. Additional practitioners agreed to participate in the workgroup in a more limited capacity to contribute whenever they were available.

A full list of participants can be found at this link:
https://tnc.box.com/s/th0hee5bntecu0qckb9dou0mwi36w8mj

Restoration Approaches Examined

Workgroup discussions focused primarily on two types of restoration approaches: restoring hydrology and restoring elevation.

Restoring hydrology: Many of the marsh restoration projects addressed in this effort included restoration of hydrology and increased drainage through shallow creek or runnel excavation to reverse the negative consequences of linear mosquito ditching. These restoration approaches strive to return the natural rise and fall of the tides and thereby restore healthy native marsh vegetation to the unvegetated pannes that are also the mosquito breeding hotspots targeted by vector control agencies.

Restoring elevation: The second major restoration approach examined in this effort addressed the use of sediment (both beneficial use of dredge material and purchased clean sand) to restore elevation within unvegetated marsh pannes or larger subsided areas of marsh to the elevations at which they could support marsh vegetation and become self-sustaining. Elevation enhancement is an approach that is not yet widely used in Suffolk County, but is of interest for future projects.

Recommendations and Lessons Learned by Category

These recommendations and lessons learned are organized as bullet points by category to present them in an easily useable format. This list attempts to capture and summarize the numerous valuable recommendations from the workgroup to share with the Suffolk County Team.

GENERAL:

- Learning never ends! It is important to experiment and measure to observe marsh responses and determine which methods are most successful.
- Every marsh restoration project should be viewed as an opportunity to learn how these dynamic systems respond to our restoration and management techniques. We need to experiment, and measure, learn, and communicate what is learned with others in the restoration and management community.
- We have repeatedly learned that we need to correct past marsh practices that have had unintended consequences (e.g. linear and grid mosquito ditches, ditch plugs, OMWM, etc.)
- We would all benefit from having access to data from a greater network of reference marshes to which we could compare our restoration efforts. In particular, we don't have enough true reference sites that have been unaltered by past management activities available for comparison.

- Recognize that all sites are have their differences. Consider which treatments are feasible and advisable for each site.
- Although each marsh is unique in many ways, we can learn a lot from examining the responses in other marsh systems.
- Practitioners all benefit from staying in contact with a network of coastal managers and restoration practitioners who provide a valuable resource to one another.
- Vector control and marsh restoration practitioners have a lot to learn from one another as each set adds value to the work and thinking of the others. Each group should try to participate in each other's regional meetings and include each other on joint projects.
- Practitioners need guidance on how to determine which treatment to use (runnels or sediment enhancement) since it is not prescriptive yet – the group agreed that we need to experiment, and measure, and learn.
- If the opportunity presents itself, it would be interesting to compare marsh responses between runnel and elevation enhancement treatments in a single system to learn when one approach might be advisable over the other under similar circumstances.
- When implementing designs on site, be aware of the direction in which water wants to drain and be ready to adjust the design plans accordingly.
- We are just about at the high point of the lunar 18.6yr metonic cycle now (2018). Even though sea level is continuing to rise, we may see marshes respond to the reduction in tidal ranges during this part of the metonic cycle. It will be interesting to see how tidal marshes respond to this cycle.
- Utilize the informative resource available in historic imagery. www.historicalaerials.com is available to view historic drainage including agricultural modifications. Use that historic information to guide thinking about restoration designs.
- The situation is urgent. Our marshes do not have a lot of elevation capital to spare. Major changes are happening even over the course of a single growing season, so we need to act now to secure their long term viability.
- Even though we don't know everything about how marshes will respond to restoration techniques, marshes are changing too rapidly for us to delay taking restoration action. That said, proceed with caution and use each opportunity to learn more about marsh response to restoration efforts.
- Even if we have not collected all of the relevant field data that we think might be of interest (e.g. modeling compaction likelihood of existing peat etc.), there will be times when we need to act to restore sooner rather than later, before it is too late, even if we don't have all the information in hand.
- Suffolk County should prioritize restoring the marsh at Gardiner County Park over the marsh at Timber Point County Park because it has room to migrate and it is not as far deteriorated as Timber.
- Even though funds are available now, don't be tempted to rush and push to implement the whole plan everywhere all at once. Try the proposed approach in some sections and

learn from those efforts how the marsh responds – then adapt if necessary, before implementing those same plans in other areas.

- When implementing restoration plans, be mindful and learn from how the first site responds and use that to inform how to implement subsequent sites.
- Be cautious when advancing restoration strategies at scale; be mindful of the fact that a lot of the restoration work that we find the need to do now is a result of ill-advised marsh management practices in the past (e.g. linear drainage ditches, ditch plugs, OMWM).
- As an example to illustrate the last bullet, contrary to earlier recommendations, FWS now discourages ditch plugging as a restoration strategy because it degrades the marsh peat. We now realize that we need to help water get off the marsh at low tide, not the reverse (holding water on the marsh at low tide).
- Be mindful to complete these projects with more environmental benefit than disturbance. Consider this question: How should we measure net benefit?
- Interpretive signage should be prominently used to educate the public about the value of wetlands, the benefits of restoring them, and what to expect in the process and timeline of restoration.
- Suffolk County should require future contractors to be directly engaged in learning exchanges and field trips (such as those conducted by the RTW) so that they can participate in the discussion of lessons learned and recommendations directly rather than relying on that information to be passed along as a subsequent step.

<u>PARTNERS and STAKEHOLERS:</u>

- Assemble and involve all project partners and stakeholders early in the project process. It is easier to change projects earlier in the design phase than later.
- Develop a site plan review committee/team to review projects with stakeholders, regulators and resource managers.
- Consider developing a general permit to cover common restoration techniques.
- Secure early input and ideally active participation from regulators in project design.
- It is crucial to have the regulators on the front lines and actively learning through the projects (e.g. NJ-DEP).
- Include a broad spectrum of biologists in project design discussions.
- There is a valuable opportunity when marsh restoration scientists and vector control management agencies are better connected. We have a lot to learn from one another. We share similar objectives, designs and approaches. If we collaborated more regularly, we could better connect our experiences and lessons learned. We should regularly attend each other's meetings and make a habit of collaborating on projects.
- Organize a team within the state or region to set regional restoration policy and strive to work together towards common goals.

- Conduct site visits with partners, stakeholders, and regulators to align goals, roles, and expectations of projects.

COIR LOGS and COIR MATERIAL:

- Many members advise avoiding the use of coir logs if at all possible.
- Coir logs have air spaces imbedded between their fibers that make them buoyant and likely to float.
- Even if coir logs have been out in the weather and are water logged, they still have air spaces between fibers that will be problematic.
- If using coir logs and stakes, position stakes as 45-degree angle spikes in order to hold the logs down. Frequently stakes are insufficient, and cables are necessary.
- Instead of using the coir logs themselves, consider cutting them open and using their stuffing. Hold that stuffing down in place with long lateral twine.
- Another alternative: use rolled up coir mats to fill spaces in linear ditches instead of solid coir logs so that those fibrous lines trap sediment and form peat.
- Leave coir fibers exposed to the tide rather than covering them with sediment (from ditch levees or anywhere else). These fibers will act as filters and trap sediment to fill the void spaces between them naturally and keep the coir material in place. If the coir fibers are covered with sediment, air spaces are trapped in the void spaces between fibers and make the logs buoyant.
- NYC Parks says that at their Sherman Creek project coir logs only stabilized the edge for less than a year. In the future, they will either use coir mat instead of coir logs or use oyster castles in addition to coir logs.
- Based on Delaware's experience with coir logs they only use them on very small-scale projects where they are able to highly manage the site post-installation.
- A lesson learned at Wertheim NWR and numerous other places: Because coir logs float, they don't stay place unless they are cabled down in place (really cabled, not just staked). Logs can float on the rising tide, rip out stakes and float out of the ditches to become deposited in new positions on the marsh. These new positions can be detrimental to the marsh by disrupting natural marsh processes such as sediment and water movement.

EQUIPMENT OPERATION:

- Equipment needs to be operated differently in marsh environments than it is in upland areas to avoid damage such as leaving deep rutted tracks. At Seatuck NWR some of the track marks were too big and required remediation.
- Use the right equipment; use it the right way. Don't maneuver over the same place too many times.
- Make sure that equipment operators understand the delicacies of the project goals.

- Moving greater amounts of material or achieving greater amounts or rates of drainage may seem to be beneficial from an equipment operator's perspective, but they are not necessarily in the best interest of restoring the marsh system.
- It would be helpful to have a handy resource to see the specs on different machines so that teams can choose the appropriate equipment and operate it without causing marsh damage.

REVEGETATION:

- Expect different vegetation responses at different sites.
- Let the sediment chemistry settle out before investing in planting to avoid severe plant losses soon after sediment placement.
- Finer sediments can be challenging; plants grow better in coarser sediments with better drainage.
- Nursery plants are especially vulnerable to predation. Consider the use of orphan plants or plants grown in conditions that more closely resemble the field (eg. higher sulfide conditions).
- Orphaned plants (e.g. clumps that have sluffed off eroding marsh edges) come with peat around their roots also bring the infaunal and mycorrhizal community.
- Plants grown in clumps rather than regular grid spacing can facilitate better plant survival and revegetation because they benefit from the greater oxidation of soils from nearby roots.

GEESE:

- NYC has found goose fencing to be essential to prevent plants from being dug up and consumed by geese.
- Some suggest that greenhouse grown plants are more tender and more tempting to geese than plants grown in natural field conditions.

SEDIMENT PLACEMENT:

- It's hard to keep fine sedimentary material in the locations where it is placed.
- Containment of sediment can cause unintended consequences by blocking water movement and causing unintended impoundments.
- Be willing to change restoration design plans if you learn that the characteristics of the sedimentary material are different than anticipated.
- Let geochemistry of sediments settle before investing in planting. Many have experienced die-offs after sediment placement when sediment went anoxic/acidic: "wonky chemistry".
- If we successfully couple our dredging and marsh restoration needs we could address two problems simultaneously – but prioritize marsh health over dredge need.

- Beware of tensions between dredge contractor and restoration team. Motivations and goals may not be completely aligned. In bid requests, ask if the dredging contractor is willing to collaborate on experimentation and adaptation. If a project team were to own their own dredge, then the goals would be in alignment.
- Project leads cautioned that although contractors present themselves as EXPERTS when seeking a contract, beware because they can reveal themselves to be inexperienced when they arrive on site!
- Expect that frequently fewer acres will be implemented than initially planned.
- Monitor elevation changes! Marsh surface elevation can change with compaction of belowground peat, dewatering of added material etc.
- Consider whether some advanced "waffles" (levees around pannes) could be beneficial for containing sediment placed there.
- Beware of crab response to disturbed areas. Crabs like to live and burrow in areas with less dense belowground roots and rhizomes where it is easier for them to move around.
- Even if all the potentially relevant field data have not been collected (e.g. modeling compaction likelihood of existing peat), there are times when there is urgency to act to restore the system before it is too late, even if we don't have all the information in hand.
- Expect lots of delays with dredging and sediment placement projects.
- Course corrections happen and when they do, they benefit from constant communication among the project partners and regulators.
- It can prove very beneficial when the regulators are active project partners.
- Some practitioners are exploring an alternative to purposefully placing sediment: they are exploring the idea of introducing sediment into the system and using nature (e.g. water currents on an incoming tide) to let it settle out in the right place.

<u>RUNNELS:</u>

- Runnels are not a new idea, but a newly rediscovered idea.
- Use natural marsh cycles (levee-basin system examples) to inform restoration practices so that we can mimic those natural processes when we proactively reconnect hydrology. Cutting runnels into pooled areas simulates the natural processes that we have seen in historic photos.
- When levees naturally breach, sediment accumulation rates inside basins can be double that of sea level rise. Runnels cut through levees are designed to mimic this natural phenomenon and return sedimentation and vegetation.
- Interior water logging in the marsh peat can lead to vegetation die-offs and interior ponds.
- Runnels can relieve the root zone flooding at low tide & reverse marsh drowning.

- Simply by losing live plant growth, we lose 8-20 cm in actively growing biomass and elevation.
- Runnels should be just deep enough to drain water off of the surface. These are not new channels/ditches.
- Prioritize the marsh upper edges which need to be in good shape for the marsh to migrate landward. These have also shown the greatest revegetation rates.
- Runnels that relieve standing water in upper marsh habitats also commonly relieve mosquito breeding hotspots.
- When pools are too deep to revegetate with drainage, consider leaving them as pools or sites for future elevation enhancement. The levees around those pannes could be beneficial for containing sediment placed there eventually.
- Designs for putting in new creeks or runnels should be mindful of the idea to connect low areas to other low areas rather than cutting across areas of higher marsh elevation to drain water.
- When implementing restoration designs on site, be aware of the direction in which water wants to flow/drain.
- Look for signs of historic agricultural drainage systems and work with the system as it is inclined to move water rather than re-engineering the system to resemble what we think it should look like.
- Make sure that each runnel connects to some sort of drainage.
- Monitor elevation changes! Marsh elevation can drop with big changes in hydrology. The example from RI's Prudence Island site suggests that excavating too wide a creek and/or draining the marsh too aggressively –especially if the marsh is already degraded, can lead the whole marsh surface to drop in elevation.
- Prevent further "pool creep" by using runnels to drain parts of pannes that are more shallow than others (usually along the leading edges).
- Runnels do not need to extend all the way to ditches or creeks or marsh edges; they can go only as far as the regularly flooded and drained section of the marsh covered in *S. alterniflora.*
- Sometimes spoil piles from runnel construction can be placed together on areas of low marsh vegetation to create local high spots instead of always placing spoils in low bare areas.
- Don't want to be too prescriptive about how to distribute the material generated from runnel construction. Sometimes it may seem advisable to make little islands in the middle of stunted *S. alterniflora* instead of grading the material across the surface. As long as those piles of peat don't block water movement, they can be mini high marsh refuge spots. When RI tried this, these local high spots revegetated with high marsh species.
- Be careful not to impound water with placement of runnel spoils

- Maintenance of runnels is necessary –visit them at least once a year to see if they have achieved adequate drainage or if there is still impounded water. Adjust if necessary. If water is not impounded, no maintenance is required. They likely need to be maintained every 2-3 years. However, if the runnels have served their purpose and no water is being retained on the marsh surface, it may be fine to leave the system alone.
- Usually the runnels at lower elevations have enough water flowing through them to keep themselves open. The runnels positioned higher in the tidal prism are the ones that tend to need more maintenance.
- Shallower runnels do fill up and require maintenance. This is easier to do on smaller complexes than larger marsh systems. They do require more maintenance than deeper mosquito ditches.
- Maintenance is commonly done by hand with shovels, which is difficult to do "at-scale" on larger projects.
- The marsh restoration community in New England is looking to retrofit equipment to make something more like a handheld roto-tiller to replace maintenance by hand with shovels.
- Be mindful that we should watch and see how things develop. We don't need to drain all of the water off of the marsh –we still want to maintain a mosaic of habitats.
- When cleaning out runnels by hand, it can be hard to figure out when to stop. Further runnel maintenance guidance is needed.
- Minimize excavation by designing runnels to connect from pool to pool and connect low spot to low spot.
- If there is already a depression such as a deer path that works with the drainage pattern, they can be incorporated into the designs because deer paths are about the right size for runnel drainage. Although many times they do not run in the right places or connect appropriate areas to provide drainage.
- General size guidelines for runnels used in RI at sites that resemble the Suffolk County sites: smaller runnels were no deeper than 10-12" & no wider than 6"; the larger runnels were 12" wide by 12" deep. Although these sizes may vary with tidal range.
- Prioritize addressing issues at the upper edges of marshes where we want them to re-vegetate and be in good shape to migrate landward. Don't spend too much energy trying to re-sculpt the outer edges of the marshes that are more vulnerable to sea level rise.
- At upper marsh edges where there is shallow standing water, runnels can be used effectively to lower those water tables and facilitate marsh migration.
- Runnels in upper marsh habitats and in marsh migration corridors have shown the greatest vegetation recolonization rates.

- Digging a runnel into the upper edge of the marsh (high marsh into salt scrub transition habitat) where there is standing water and degrading peat (*Iva, Bacharus, D. spicata*) can also many times alleviate a mosquito breeding hotspot.
- Marsh peat is "gold", so be cautious when installing drainage in highly degraded areas and don't allow water to flow out too quickly. That risks losing the accumulated loose sediment from peat decomposition and widening the small runnels with large volumes of fast flowing water. Start cautiously with some narrow and shallow runnels with sills at the mouths and then come back after the peat has solidified a bit and then dig runnels deeper if necessary. Use shallow sills at the end of runnels to prevent all of the loose sediment formed from degrading peat from flowing off of the surface of the marsh.
- Ideally, conduct projects in phases, to allow the marsh to revegetate and stabilize unconsolidated sediments. Observe marsh and water responses before taking additional steps.
- If marsh elevation within accumulated pools is too low to support vegetation, the marsh is unlikely to revegetate in response to runnels. Furthermore, scouring could result in additional elevation loss due to large volumes of water flooding and draining through runnels over the course of tidal cycles. This can be especially true in the outer reaches of highly grid-ditched marshes where the marsh are well established and they are "below peat level" perhaps even bottom out in sand. Perhaps those are better to be left as pools without drainage runnels. Evaluate if they are good habitat or degraded habitat with algal mats etc. If you don't have the option of adding sediment to increase elevation within those cells, and you are not confident the pools will revegetate, especially if there is not additional pool creep from the edges, consider leaving those pools as they are. Or – if there is pool creep (expanding bare areas on the outer rim of the pools) and the depth is too deep to revegetate, consider shallow runnels from the edges into the center of the pool to prevent further pool creep but without fully draining the pool and risking loss from scour.
- It is worth trying runnels at the rectangular pools in the outer section of Timber Point which are sitting higher in elevation than the aerial imagery suggests. If possible, carve three or four runnels so the entire volume of impounded water does not drain through a single runnel where the large volume of water would risk widening the runnel.
- Runnels that improve drainage and lower the water table in the marsh peat at low tide increase 'Tidal Efficiency'.
- RTW member Beth Watson introduced us to the work of Groundwater Hydrologist, Alesha Wilson. Wilson et al. Ecology (2015) (https://doi.org/10.1890/13-2183.1) contrasted groundwater response between channel edge dynamics that go up and down a lot in response to the rise and fall of the tide, and marsh interior areas where

the changes are not so great. These interior areas are more susceptible to high water tables which can lead to the formation of the interior ponds and vegetation die-offs.

- After runnels are installed in situations like the one described above, groundwater levels drop in response to low tide, (similar groundwater levels remain at high tide), and the plants can revegetate (Watson et al. unpublished data).
- Installing runnels and relieving the root zone flooding that is causing plant death in these impounded areas can reverse this marsh drowning!
- Runnels are not a new idea; vector control has been using them for decades. In Suffolk County, they did this a lot especially when they had an abundance of employees. There might have been a team assigned to each marsh and when they saw water accumulating, they would dig little hand-dug runnels. This was done up until the 1980's. If there were a dedicated group of people assigned to marsh complexes, perhaps those watchgroups could take responsibility for keeping the drainage working.
- We need an established set of monitoring and adaptive management guidelines for these projects. The guidelines could address questions such as: When we monitor and clean out runnels by hand – how much? When to stop?

<u>DITCH REMEDIATION:</u>

- The idea of "Ditch Remediation" is to build up fibrous organic material and sediment in the linear ditch to replace the peat that was once there. As this process happens, that material will be turned into peat. When the peat reaches the right elevation, plants will naturally colonize.
- Importantly, practitioners caution that we can't skip to the endpoint of ditch remediation by just putting peat on the top of coir filling, because air spaces would be trapped and the sediment would be unstable.
- Even if the coir logs have been out in the weather and are water logged, they still have air spaces that will be problematic.
- Another alternative would be to use rolled up coir mats in linear ditches so that those fibrous lines could trap sediment.
- There is concern that scraping down peat from the ditch levees (to use as fill) would remove the last higher marsh patches from the marsh platform and still not be enough material to fill the deeper ditches.
- The paradox of bringing the marsh elevation down (by scraping ditch levees to fill linear mosquito ditches) in an attempt to get the marsh surface to go back up was noted on the field trip to Gardiner and Timber Point marshes. This approach is in contrast to restoration efforts using sediment to provide direct elevation enhancement.
- Along some small ditch levees, there is very little elevation (vegetation along the ditch edges in some places is *S. alterniflora*, low marsh vegetation). In those places scraping that material into the adjacent ditch may not add to eventual marsh elevation.
- Experimenting with remediation is OK as long as it does not involve digging up stable marsh peat or leave insufficient drainage. Be sure to leave some ditches open.

- Some RTW members were concerned about the initial proposal in Suffolk County to "naturalize" so many linear ditches into creeks. They did not agree that there would be enough habitat gain with those plans and they did not believe that the sinuosity introduced would be sufficient to achieve the natural erosional and depositional nature of natural sinuous creeks. They suggested that more sinuosity could be introduced with the construction of shallow runnels.
- Extensive ditch filling and ditch naturalization looks like a lot of disturbance. It could be OK to experiment with filling excessive ditches (as long as sufficient drainage was maintained) but it would be best not to dig up stable marsh. Consider filling only a few of the ditches and monitoring marsh response in treatment and control areas.
- There was concern about scraping down the peat from the mini levees along ditches to use as fill (with or without the additional fill of coir logs) because we don't want to see the loss of elevation along the ditch edges. This might be the last breeding ground for obligate saltmarsh breeding birds such as saltmarsh sparrows.
- Need to keep some open ditches so that there is meaningful tidal flow. Tie runnels into an open tidal system. Water has to come in and it has to go out with the tide.
- Multiple runnels or drainage channels should feed into the same nearby ditch (all drainage into 1 ditch not 3 separate ditches) such that the force of those combined flows will help to keep that channel or ditch open.
- Use minimal runnels to connect existing grid ditches. Soften some hard angles to facilitate water movement, but don't "naturalize linear ditches into creeks".
- One approach suggested to the Suffolk County Team in order to avoid crossing the NY State sediment movement threshold requiring sediment toxicity testing was that they don't scrape down all of the mini ledges along each mosquito ditch. Without this sediment movement, the designs would not exceed the soil movement threshold (1500 cu yds) beyond which sediment toxicity testing would be required.
- There does not seem to be enough volume of sediment in the mini-levees along ditch edges to fill and level these ditches.
- Leave as much high elevation as possible for sparrows -they have high site fidelity and will return to the same marshes to breed year after year.

<u>OBLIGATE SALT MARSH NESTING BIRDS (specifically saltmarsh sparrows)</u>

- Leave as much high elevation as possible; sparrows have high site fidelity and will return to the same marshes to breed year after year.
- Sparrows return to within a few meters of successful nests in successive years. If a previous nest was not successful, they choose alternate locations within the same marshes, but farther from the location of the failed nest site.
- Sparrows need the existing refugia in our marshes. They can't wait for the marsh to rebound.
- When distributing spoils from runnel or small fish pool construction, consider creating local high spots for high marsh plants and nesting birds like saltmarsh sparrows instead of using that material to always fill in low lying bare areas.

ADAPTIVE MANAGEMENT:

- Projects should be conducted in phases such that minimal manipulations are made, and the responses of the marsh can be observed for a few tidal cycles to determine if more aggressive or different manipulations are required.
- Projects should be designed with budgets and timelines to allow for adaptive management and long term monitoring.
- Take an adaptive management approach to these plans. Start filling in some of the ditches; make sure each runnel connects to some sort of drainage; monitor and adapt.
- Be on site as the project is being implemented in order to guide adaptive management approach.

MONITORING:

- Long term monitoring is essential both for implementing adaptive management and for evaluating ultimate restoration success.
- Grant cycles and project designs should accommodate long post-implementation monitoring opportunities.
- Use of consistent and standardized metrics would facilitate the comparison of responses in different systems so that we could learn about similarities and differences in both short term and long term responses.
- Use of consistent and standardized metrics could enable the formation of a long-term wetland restoration study.
- This forum and the projects discussed here could become the basis for a long-term wetland restoration study in a future analysis.

Continuing the exchange (TNC's Box links and NEERS Google Group)

RTW members expressed an interest in continuing their exchange of lessons learned and restoration discussions around the region. While the RTW itself will close, members are encouraged to utilize the Google Group established by The New England Estuarine Research Society (NEERS). NEERS is a non-profit organization with a wide-ranging membership from scientific and educational institutions, federal, state, and municipal agencies, and nonprofit organizations. The mission of NEERS fits perfectly with the goals of our RTW effort because it is "to bring together persons actively engaged in estuarine and coastal research and management for informal discussion and exchange of ideas". The Society website is: http://neers.org/ . NEERS hosts two Google groups (you do not need a Google account to participate), one of which is "a general list for facilitating communication among estuarine scientists and other interested parties". This forum could be a very valuable resource to seek consultation on projects into the future. The instructions for joining and posting to the group can be found here: http://neers.org/MEMBERS/GetConnected.html

Our more southern RTW members would be advised to join or participate in the Atlantic Estuarine Research Society (AERS, https://aers.info/) that covers the states of DE, MD, NC, NJ, PA, and VA and Washington, DC.

Additionally, TNC will leave the shared box folder open as a repository for papers and PPTs where members can continue to share and download relevant resources with one another: https://tnc.box.com/s/mdfrzjztxk0blqmltfsds3e2k61v4bka

Summary:

This forum provided Suffolk County with the opportunity to share and test ideas in a format similar to the exchanges common at regional or national scientific and restoration meetings. Vector control agencies bring valuable experience to these conversations. Greater effort should be made to encourage vector control agencies and marsh restoration practitioners to collaborate to learn from one another by attending one another's regional meetings and partnering on projects. By learning from other marsh restoration experts, Suffolk County is improving the approaches that they use for designing, implementing and monitoring marsh and mosquito management projects. This will maximize their likelihood of restoration and management success for overall marsh health and resilience to climate change.

Suffolk County employees should be given the support to attend, present, and interact in scientific and restoration meetings such as the New England Estuarine Research Society (NEERS): http://www.neers.org/home.htm ; The Atlantic Estuarine Research Society (AERS): https://www.aers.info/; Restore America's Estuaries (RAE): https://www.estuaries.org/ and others. By regularly attending these meetings, County employees will be able to maintain and build new relationships with practitioners across the region and stay current on the latest thinking in restoration science. These scientific meetings are also valuable opportunities to to leverage resources for greater restoration and management outcomes. Regular participation in these meetings may also prove to be more cost effective than contracting for the formation of a forum like the RTW to reproduce those experiences.

Learning never ends. The exchange of practical, hands-on experience through this effort will improve the efficiency and cost-effectiveness of marsh restoration efforts across the whole region by disseminating the kinds of operational details that never make it to written reports or presentations but play a critical role in actually executing projects on the ground. We hope that this workgroup will have a long-lasting impact both in Suffolk County and beyond because it has connected practitioners across the region to become a ready resource to one another. These connections of practitioners and projects also have the potential to eventually form the basis for a long-term wetland restoration study.

References:

Cameron Engineering and Associates (CEA). 2015. Long Island tidal wetland trends analysis. Prepared for the New England Interstate Water Pollution Control Commission, 207 pp. http://www.dec.ny.gov/lands/5113.html

New York State Energy Research and Development Authority (NYSERDA). 2018. "Integrating SLAMM Results and Stakeholder Priorities to Define Marsh Adaptation Strategies," NYSERDA Report Number 18-04. Prepared by Warren Pinnacle Consulting, Inc. Waitsfield VT. nyserda.ny.gov/publications

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Regional Marine Resources Council (RMRC). 1973. Guidelines for Long Island Coastal Management. Nassau-Suffolk Regional Planning Board. Hauppauge, NY.

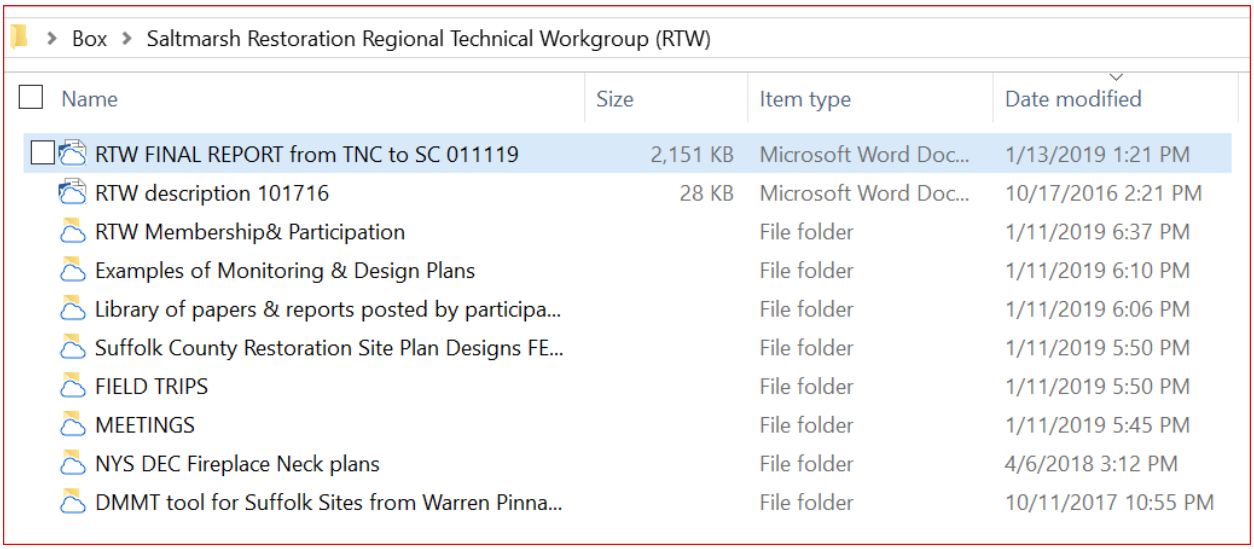
Wilson, AM., T. Evans, W. Moore, CA. Schutte, SB. Joye, AH. Hughes, JL. Anderson. 2015. Groundwater controls ecological zonation of salt marsh macrophytes. Ecology 96(3) p.840-849.

Appendices:

RTW Meeting and Field Trip Materials

All RTW meeting and field trip materials: agendas, meeting notes, audio recordings if available, PPT files, photographs, handouts and shared resources can be found on TNC's shared box folder: https://tnc.box.com/s/mdfrzjztxk0blqmltfsds3e2k61v4bka

The file structure looks like this:



Additional resources available and soon to be available:

The following collection represents some nationally and regionally-implemented protocols and guidance as well as some that were called out by RTW members at our meetings. Notably, this list also includes resources that are on the horizon or soon to be available. When they are officially released, TNC will send notification to RTW members and post them on our shared Box folder.

- New England Estuarine Research Society (NEERS): http://www.neers.org/home.htm
- NERRS Sentinel Site and System-wide Monitoring programs: http://nerrs.noaa.gov/research/
- Atlantic Estuarine Research Society (AERS): https://www.aers.info/
- Restore America's Estuaries (RAE): https://www.estuaries.org/
- Salt Marsh Habitat and Avian Research Program (SHARP): http://www.tidalmarshbirds.org/
- NYS DEC's New York State Salt Marsh Restoration and Monitoring Guidelines. Niedowski (2000) (http://www.dec.ny.gov/docs/wildlife_pdf/saltmarsh.pdf)
- New NYS DEC Rapid Tidal Assessment Protocol. PPT from July 2018 available on TNC's Box drive: https://tnc.box.com/s/2uqrcjg0z240d1z28nc0fz0ff1sq8cbu For additional info and updates contact: Alexa M Fournier alexa.fournier@dec.ny.gov
- Taylor, Peter H. 2008. Salt Marshes in the Gulf of Maine: Human Impacts, Habitat Restoration, and Long-term Change Analysis. Gulf of Maine Council on the Marine Environment. iv+42 p. http://www.gulfofmaine.org/2/wp-content/uploads/2014/06/Salt_Marshes-2008.pdf
- USGS Patuxent Wildlife Research Center Publications list: https://www.usgs.gov/centers/pwrc

- USFWS Salt Marsh Integrity (SMI) Index: Neckles, H.A., G.R. Guntenspergen, W.G. Shriver, N.P. Danz, W.A. Wiest, J.L. Nagel, and J.H. Olker. 2013. Identification of metrics to monitor salt marsh integrity on National Wildlife Refuges in relation to conservation and management objectives. Final report to U.S. Fish and Wildlife Service, Northeast Region. USGS Patuxent Wildlife Research Center, Laurel, MD. 226 pp. (https://pubs.er.usgs.gov/publication/70046960)
- The Department of the Interior (DOI) Metrics Expert Group (June, 2015) Report for the Department of the Interior Recommendations for assessing the effects of the DOI Hurricane Sandy Mitigation and Resilience Program on ecological system and infrastructure resilience in the Northeast coastal region: https://www.doi.gov/sites/doi.gov/files/migrated/news/upload/Hurricane-Sandy-project-metrics-report.pdf and on TNC's shared Box folder.
- The State of Rhode Island has released their Salt Marsh Monitoring and Assessment Program (SMMAP), a three-tiered framework for assessing salt marsh condition. Of note, Tier 2 presents a rapid assessment protocol, and Tier 3 details metrics suitable for monitoring specific projects and management actions, such as enhancing marsh drainage with runnels or building marsh elevation with sediment placement. http://www.crmc.ri.gov/news/pdf/SMMAP_RI_Strategy.pdf
- Coastal Wetland Restoration Strategy for the State of Rhode Island (Chaffee et al. in prep.)
- Tom Kutcher (Wetlands Scientist, Rhode Island Natural History Survey) is developing a faster vegetation sampling method (especially suitable for smaller runnel projects) so that responses can be measured without the more labor and time intensive Roman et al. method. He has modified the RISMA rapid salt marsh assessment method to make it even more rapid and achieve greater spatial coverage. Posted to the shared Box folder: https://tnc.box.com/s/mdfrzjztxk0blqmltfsds3e2k61v4bka
- New England Rapid Assessment Method (NERAM; Wigand et al. 2011)
- Rhode Island Salt Marsh Assessment (RISMA, Cole Ekberg et al. 2015)
- Historic imagery to reveal historic drainage including agricultural modifications that could guide thinking about project design is available at: www.historicalaerials.com.
- NYC Parks released new Saltmarsh Monitoring Guidelines: http://naturalareasnyc.org/content/3-in-print/3-partner-publications/nycparks_monitoringguidelines_oct-2018-appendices.pdf
- NYC Parks released Saltmarsh Restoration Design Guidelines: http://naturalareasnyc.org/content/3-in-print/3-partner-publications/nycparks_saltmarshrestorationdesignguidelines.pdf
- Both of these NYC Parks documents are available on the Natural Areas Conservancy (NAC) website: http://naturalareasnyc.org/in-print#research and saved in our TNC Box folder: https://tnc.box.com/s/huv7hqh1zmjc3fi7s5lfwfjwegworwe8

- NJ DEP is soon to release a Lessons Learned document specific to beneficial use for salt marsh restoration (mostly saltmarsh elevation enhancement but also dune, beach and elevated nesting habitat for beach nesting bird habitats). The title is: “Beneficial Use of Dredged Material to Enhance Salt Marsh Habitat in New Jersey: Early Lessons Learned” and it it’s expected release date is sometime in 2019.
- NJ DEP is also developing a drone program to for application in beneficial use and other marsh restoration applications.
- NDJEP is also finalizing a “project siting tool” that aims to match restoration and dredge projects with opportunity. TNC-NJ initiated the development of this tool but NJDEP is finishing it. The final product should be available from NJDEP at some time soon.
- Ron Rozsa shared a draft of a paper he submitted to Coastal Management Journal – CT Marsh Restoration Approach: https://tnc.box.com/s/ccvxbxhscqounogalv4xmrafnh7h8ykp