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Mattanock Town Restoration Plan

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A capstone project in partial fulfillment of the requirements for the degree of Master of Arts in Marine Science at the Virginia Institute of Marine Science, William & Mary

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Capstone Products:

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Additional Files:

Mattanock Town Past Present and Future ArcGIS Map Data Summary: https://doi.org/10.25773/4am6-wm18

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Using Mattanock Town's historical land use to understand the property's current conditions to implement a holistic approach to restoration.

Introduction

Mattanock Town's Restoration Plan is a science-based restoration process that evaluates the site's history, the tribal history, and the most current research to maximize native habitats, enhance coastal resilience, and reconnect the Nansemond people to the local river. Restoration priorities include increasing native plant species, incorporating oyster habitat, and addressing erosion. This plan details how synthesizing existing and new physical, biological, and cultural information can help the Nansemond Indian Nation prioritize projects that benefit their community and the surrounding environment.

History

The story of Mattanock Town is one of productivity, hardship, and revitalization that has unfolded, in one way or another, because of the historical use of the land and its naturally occurring habitat. The sections below detail some pivotal moments in the property's history that have shaped the current conditions, thus impacting the Tribe's future restoration efforts.

To help characterize and provide further context to the below sections, *Historical Indigenous Communities and Shell Middens on the Nansemond River* and *Mattanock town Historical Maps 1919 to 1949* were created (Grigsby, 2022; Grigsby, 2023). View these maps while reading through the following material.

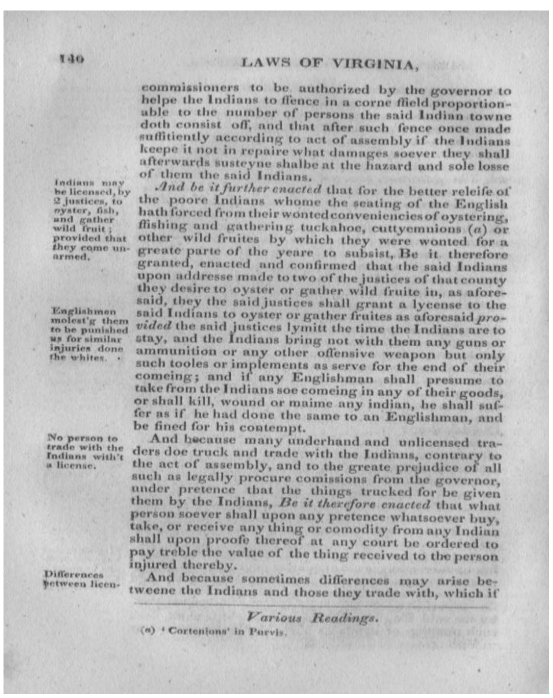
Nansemond Indian Nation:
For over a thousand years, the Nansemond people have been stewards of the Nansemond River (Bass, 2021). Evidence of their community and record of their culture are found in shell middens. Shell middens are archeological sites containing oyster shells, fish bones, animal bones, artifacts, and skeletal remains (Bottoms, 1983). Thirty shell middens have been discovered along the banks of the Nansemond River, including Holladay's Point, one of the oldest confirmed Nansemond villages, and Dumpling Island (Bass, 2021). These shell middens accurately explain how oysters, mussels, clams, and scallops were used in the indigenous population's day-to-day village life.

History proves that economic prowess is prioritized over the impact of land disturbance on local communities, as in the case of the Grand Coulee Dam in Seattle, WA, where the construction of the dam not only disrupted the salmon migration but also destroyed local tribal burial sites (Lake Roosevelt, n.d.). To date, there is no archaeological record to characterize the Nansemond people's relationship with the Mattanock Town site. Shell middens at Holladay's Point and numerous other Woodland Period sites prove that the tribe lived in the direct vicinity and along both banks of the Nansemond River (Bottoms, 1983). Based on the archaeological record and documented history, it is not unreasonable to assume that the indigenous community used the land for food harvest or was once an extension of the adjacent settlement located on Holladay’s Point. However, because the mine operation highly modified the site, archeologists may never be able to fully characterize the site’s precolonial history. That said, *Chesapecten jeffersonius* fossils are found along the shoreline at

Mattanock Town. Archeologists have indicated that *C. jeffersonius* were potentially used as bowls and scraping tools by various tribal communities up and down the Chesapeake Bay (Ferguson, 1998).

When colonists settled in Jamestown in 1607, their food supply was insufficient, and famine threatened to decimate the settlement's population (Neal, 1959). With the threat of starvation, John Smith sent Capt. John Martin and 60 colonists to trade for food from the local indigenous people (Dumpling Island, 2007). After Martin's advance party failed to return, the colonists responded aggressively (Neal, 1959). This initial confrontation sparked a tumultuous relationship between the two communities and resulted in wars from 1610 to 1646 (Mark, 2021). These wars resulted in unfulfilled peace agreements, significant land loss, and the dissolution of centralized leadership among the coastal Algonquin communities (Bass, 2021).

As displacement continued throughout the 1600s, the enmity of the indigenous community towards the colonists increased. The colonists reasoned that cutting the native people off from the resources within the tidal waterways (particularly oysters) would make them weaker and easier to control (Wharton, 1957). This strategy was so effective that it was later reasoned that a complete cutoff was no longer necessary, and that issuing licensing would provide enough limitation (Wharton, 1957). This law was the first oyster licensing law recorded in *Hening's Statutes at Large* (Hening, 1823) (Figure 1). The deliberate and inhuman act of disconnecting the native communities from their culture forever changed the Nansemond people's lives. It set a course for how our society interacts with the natural environment. However, despite the forced disconnect and the cruelty displayed by colonists and their descendants, the Nansemond people have never stopped seeking reconnection with local waterways and have always advocated for resources in jeopardy.



140 LAWS OF VIRGINIA,

commissioners to be authorized by the governor to helpe the Indians to ffence in a corne ffield proportionable to the number of persons the said Indian towne doth consist off, and that after such fence once made suffitiently according to act of assembly if the Indians keepe it not in repaire what damages soever they shall afterwards susteyne shalbe at the hazard and sole losse of them the said Indians.

Indians may be licensed, by 2 justices, to oyster, fish, and gather wild fruit; provided that they come unarmed.

And be it further enacted that for the better releife of the poore Indians whome the seating of the English hath forced from their wonted conveniencies of oystering, ffishing and gathering tuckahoe, cuttyemnions (*a*) or other wild fruites by which they were wonted for a greate parte of the yeare to subsist, Be it therefore granted, enacted and confirmed that the said Indians upon addresse made to two of the justices of that county they desire to oyster or gather wild fruite in, as aforesaid, they the said justices shall grant a lycense to the said Indians to oyster or gather fruites as aforesaid *provided* the said justices lymitt the time the Indians are to stay, and the Indians bring not with them any guns or ammunition or any other offensive weapon but only such tooles or implements as serve for the end of their comeing; and if any Englishman shall presume to take from the Indians soe comeing in any of their goods, or shall kill, wound or maime any indian, he shall suffer as if he had done the same to an Englishman, and be fined for his contempt.

Englishmen molest'g them to be punished as for similar injuries done the whites.

No person to trade with the Indians with't a license.

And because many underhand and unlicensed traders doe truck and trade with the Indians, contrary to the act of assembly, and to the greate prejudice of all such as legally procure comissions from the governor, under pretence that the things trucked for be given them by the Indians, *Be it therefore enacted* that what person soever shall upon any pretence whatsoever buy, take, or receive any thing or comodity from any Indian shall upon proofe thereof at any court be ordered to pay treble the value of the thing received to the person injured thereby.

Differences between licen-

And because sometimes differences may arise betweene the Indians and those they trade with, which if

Various Readings.

(*a*) 'Cortenions' in Purvis.

"*And be it further enacted* that for the better releife of the poore Indians whome the seating of the English hath forced from their wonted conveniencies of oystering, ffishing and gathering tuckahoe, cuttyemnions or other wild fruites by which they were wonted for a greate parte of the yeare to subsist, Be it therefore granted, enacted and confirmed that the said Indians upon addresse made to two of the justices of that county they desire to oyster or gather wild fruite in, as aforesaid, they the said justices shall grant a lycense to the said Indians to oyster or gather fruites as aforesaid *provided* the said justices lymitt the time the Indians are to stay..."

Figure 1: William Waller Hening, ed., *The Statutes at Large; Being a Collection of All the Laws of Virginia from the First Session of the Legislature in the Year* 1619 (New York: R. W. & G. Bartow, 1823), 2:140. https://encyclopediavirginia.org/4613hpr-73b50d1ab8d2224/

***Chesapecten jeffersonius*:**
The Suffolk Scarp is a predominant feature in Suffolk, VA, due to its stark contrast in geomorphology compared to the Churchland Flats, just east of the Scarp. The Suffolk Scarp is a paleoshoreline formed during the Pliocene period and marked the continental shelf when seas were 12-15 meters above current sea level (Johnson & Hobbs, 1990). Terraces, such as the Churchland Flats, flank paleo shorelines and are often underlain with lagoonal-estuarine sediments (Allen, 2022). Mattanock Town's current location is within the Churchland Flats.

Chesapecten jeffersonius, a scallop species, dominated the Churchland Flats during the Miocene into the Pliocene period (23.03 to 2.58 million years ago) (Donohue, 2016). *Chesapecten jeffersonius* fossils are found along the shoreline at Mattanock Town and are so common in the tributaries of the Chesapeake Bay watershed that they are now Virginia's state fossils (Donohue, 2016) (Figure 2).

Chesapecten jeffersonius and other bivalve species that lived during the Miocene and Pliocene period provided the calcium-rich soil needed to create Tertiary shell beds or "marls" (Eckel, 1913). These shell beds are significant in connection with the development of the Portland Cement industry in Virginia (Eckel, 1913). Although their composition is not as desirable as some other marl materials found along the east coast, these shell beds were attractive to the Portland Cement industry mainly because they were easily accessible, as in the case of Mattanock Town (Eckel, 1913).

Figure 2: *Chesapecten jeffersonius* found along the shoreline at Mattanock Town. K. Grigsby, 2021

Lone Star Cement Corporation:

"In the 1920s, the marl industry became a lucrative business venture for Suffolk locals such as Miss Lucy Upshur, who was known to "pit mine" marl and sold it as fertilizer high in nitrogen" (Rose, 2011). In 1926, she sold the land and the mine operation to Lone Star Cement Corporation to make Portland Cement (Rose, 2011).

Historical maps show that Lone Star Cement Corporation constructed 11 mine spoil pits that paralleled a single-track rail system that ran from the Nansemond River inland roughly two and a half miles (Figure 3). Three of the 11 mine pits and the only two ports were located within Mattanock Town's property limits.

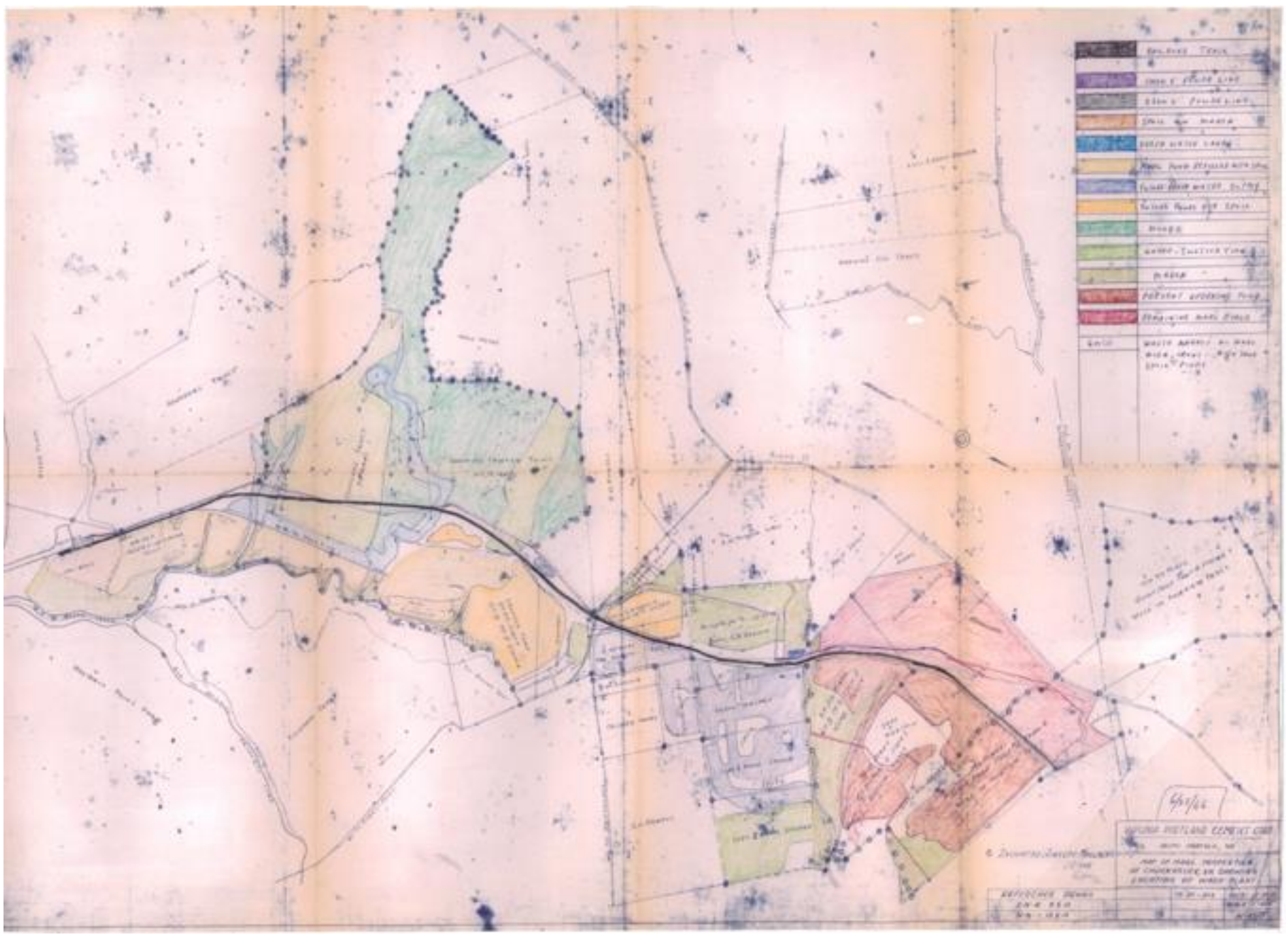


Figure 3: 1966 hand-drawn map of Lone Star Cement Corporation's mine operation at Mattanock Town and adjoining Lone Star Lakes Park. Retrieved from K. Smith with the Nansemond River Preservation Alliance by K. Grigsby, 2022.

In 1971, the EPA shut down the mine operation due to its unregulated and dangerous practices (Drex, n.d.). Once Lone Star shut down, the City of Suffolk took possession of the property and turned a portion of it into a public park. However, the city did little mitigation to remedy the impacts on the land and the surrounding waterway. Because of this, evidence of the historical land use (both positive and negative) can still be seen upland and along the shoreline (Figure 4).

Figure 4: The remaining harbor and pilings from the Lone Star Cement Corporation. K. Grigsby, 2022

Land Rehabilitation of Mattanock Town by the Nansemond Indian Nation:

It was not until 1985 when the tribe received state recognition, that the Commonwealth of Virginia upheld their rights as original stewards of the land and acknowledged the tribe's sovereignty (Bass, 2021). In 1988, the Nansemond Indian Tribal Association (NITA) hosted its first homecoming at Lone Star Lakes Park, and in 2013 the City of Suffolk deeded 71.153 acres of the property to the tribe (Bass, 2021). This deed included a rescission clause that required the tribe to construct a reenactment village by 2018 that would operate “solely as a tourist attraction primarily for the benefit of the residents of Suffolk, the surrounding communities, and tourists visiting the region” (Development Agreement, 2013). The development agreement associated with the deed stated, "NITA will accept the property in an "AS IS, WHERE IS, WITH ALL FAULTS" condition and will be responsible for conducting the appropriate environmental due diligence" (Development Agreement, 2013). Failure to complete the reenactment of the village within five years would result in repossession of the property (Deed of Gift, 2013). The tribe spent several years planning and fundraising to uphold its commitment to creating a lucrative tourist attraction for the city while continuing to serve its citizens and advocate with other Virginia Indian tribes for federal recognition.

After decades of collective advocacy, in 2018, the Nansemond Indian Tribal Association (now the Nansemond Indian Nation) was one of six tribes to receive federal recognition under the Thomasina E.

Jordan Indian Tribes of Virginia Federal Recognition Act of 2017. Federal recognition was a turning point for the Nansemond people since the federal government acknowledged their autonomy and formalized an intergovernmental relationship (Bass, 2021). In addition, it also gave them access to funding sources that were not available under state recognition (Salazar, 2016).

In the first years of federal recognition, the Tribe prioritized governance and program development for its citizens. In addition to establishing a tribal health program through Indian Health Services and a tribal housing program through Housing and Urban Development, the Tribe established a tribal environmental program through the Environmental Protection Agency's Indian Environmental General Assistance Program (Environmental Protection Agency, 2022) (Bolden, 2020). At the start of this program, the tribe collected data for an environmental baseline of Mattanock Town (analyzing the air, soil, water quality, and land condition) and immediately realized the urgency of restoring the site. After years of externally driven focus on tourism, this information catalyzed an internally driven focus on healing the land and water at a time that coincided with the Nation healing its citizens through the coronavirus pandemic (Gooding, 2013).

Amid the Tribe's emergency response, Nansemond leadership researched opportunities to support its citizens and update facilities at Mattanock Town, which were small, outdated, and inadequate for social distancing. Toward this goal, the Tribe applied for the Indian Community Development Block Grant-American Rescue Plan of 2021 (ICDBG-ARP) to "expand and renovate their community center [at Mattanock Town], which provides services to the Tribal members" (Indian Community Development Block Grant, 2021; U.S. Senator Tim Kaine, 2022). As public health risks forced the cancellation of large gatherings like the Tribe's annual powwow, the Tribe supported cultural resilience through smaller gatherings like outdoor tribal meetings, oyster gardening with the Chesapeake Bay Foundation, and volunteering with partners throughout Suffolk who shared their environmental goals.

Since the City of Suffolk's five-year deadline passed, the Tribe has increased its capacity to serve its citizens, continued to expand its tribal environmental program, was awarded $998,250 to renovate its community center at Mattanock Town, and is eligible for numerous new grants to restore and revitalize the 70+ acre site. Despite historic progress for the Nansemond people, unresolved negotiations with the City of Suffolk remain an obstacle to Mattanock Town’s restoration.

This restoration plan underpins the NIN's commitment to invest in and improve the site for its citizens and the community in the spirit of the original agreement while prioritizing its environmental needs. The Tribe has emphasized that restoration does not preclude future public engagement with the site for outdoor recreation, education, and eco-tourism; rather, it is a prerequisite for the site's sustainable growth as a tribal and community resource.

Data Analysis

Lone Star Cement Corporation played a significant role in the degradation of the shoreline and the decline of the natural habitats at Mattanock Town. In addition, the lack of mitigation done to the property after the EPA closed the mine has exasperated the adverse effects. These impacts have had physical, biological, and cultural ramifications beyond Mattanock Town's parcel boundary.

This restoration plan considers Mattanock Town's entire landscape, from subtidal waters to the riparian upland (Figure 5). It also spans large time scales using historical data to inform the current site conditions and incorporates considerations for future habitat shifts under climate change on the property. Although the sections below are presented separately, it is essential to note that this plan considers them as one interconnected unit since, as the research below shows, impacting one habitat has a ripple effect that extends to the surrounding ecosystems. Furthermore, climate change will blur the lines between vegetation zones, and eventually, those zones will migrate landward and phase into each other (Bilkovic et al., 2016). To help display their interconnectivity, the *Mattanock Town Past Present and Future* map was created (Grigsby, 2023). This ArcGIS Online map contains all historical, current, and future data layers analyzed for this restoration plan. Overlaying these data layers and analyzing them together allows for a restoration approach that considers information on the natural land, existing habitats, and the distributions of invasive species to identify restoration priorities. In addition, it allows the NIN to incorporate cultural initiatives that ensure future generations have a place to connect with the local waterways.

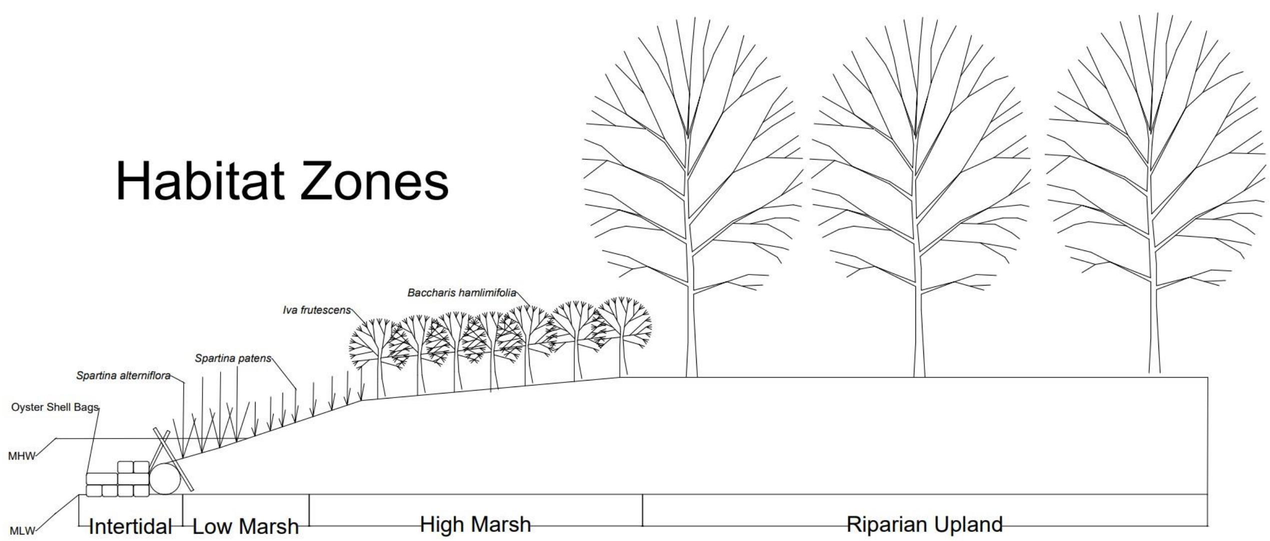


Figure 5: Cross section depicting the various habitat zones referenced in the data analysis. K. Grigsby, 2023

Mattanock Town Past Present and Future ArcGIS Map was created by synthesizing existing data such as historical maps, shoreline changes, existing and historical tidal marsh inventories, erosion rates, elevation, and various current site conditions that could impact future restoration activities (Grigsby, 2023). In addition, field data was completed using an ESRI RTK BadElf Flex Plotter and DJI Phantom 4 RTK drone to gain higher resolution elevation and vegetative information. All the various data layers were first analyzed using ArcGIS Pro for a more in-depth review. It was later transferred to the online platform and published using ArcGIS WebApp to allow public viewing and data sharing. The data summary for the individual layers can be found on the *Mattanock Town Past Present and Future* map's contents page or in the appendix associated with this document.

Riparian Upland:

The riparian upland consists of trees and shrubs growing adjacent to streams, rivers, and wetlands (USDA National Agroforestry Center, 2012). This vegetative zone is often called a riparian forest buffer.

It is considered the first line of defense in protecting local water bodies from agricultural and industrialized areas' stormwater runoff (USDA National Agroforestry Center, 2012). Knowing that the mine operation impacted this critical habitat at Mattanock Town, the NIN worked with the Department of Forestry to develop an *Urban Forest Management Plan* for the site (Topping, 2021). This plan focused on analyzing the forest's health by taking an inventory of the native and invasive plant population, the age of the trees, and the tree size. In addition, it identified any potential fire hazards and future issues that could occur if not adequately addressed. Once an inventory of the site was complete, borders were drawn using ArcGIS around similar vegetative types. These zones are called stands, and the *Urban Forest Management Plan* uses them to organize the recommended approach for restoration. This data analysis will focus primarily on Stands 1, 3, and 6c due to their vulnerability to sea level rise, the high invasive plant population and the most opportunity for cultural engagement (Grigsby, 2021, VA DOF Stands) (Figure 6).

Figure 6: Overview map of Stands 1, 3, and 6c that Mattanock Town's Restoration Plan focuses on (Grigsby, 2021, VA DOF Stands).

Stand 1 is 15.4 acres and consists of native trees such as *Liriodendron tulipifera*, *Platanus occidentalis*, *Acer floridadum*, and *Ulmus americana* (Topping, 2021). A. *floridadum* and U. *americana* are rare in our region (Topping, 2021). In addition, a *Quercus rubra*, with a "diameter of 57" at breast height," is the largest observed tree on the entire property (Topping, 2021). Although the canopy is relatively healthy in Stand 1, the vegetation at the ground level and in the understory consists mainly of invasive plant species such as *Ligustrum sinense*, *Vinca minor*, and *Microstegium vimineum* (Topping, 2021). Although *L. Sinense*, V. *minor*, and M. *vimineum* are found throughout Stand 1, the highest invasive plant densities are in areas where the marl pits were dug out and filled in (Grigsby, 2021, VA DOF Invasive Species Map; VIMS, 2017; U.S. Geological Survey, 1949) (Figure 7). This information demonstrates that anthropogenic disturbance and land transformation can play a significant role in the propagation of invasive plant species (Lemke et al., 2012).

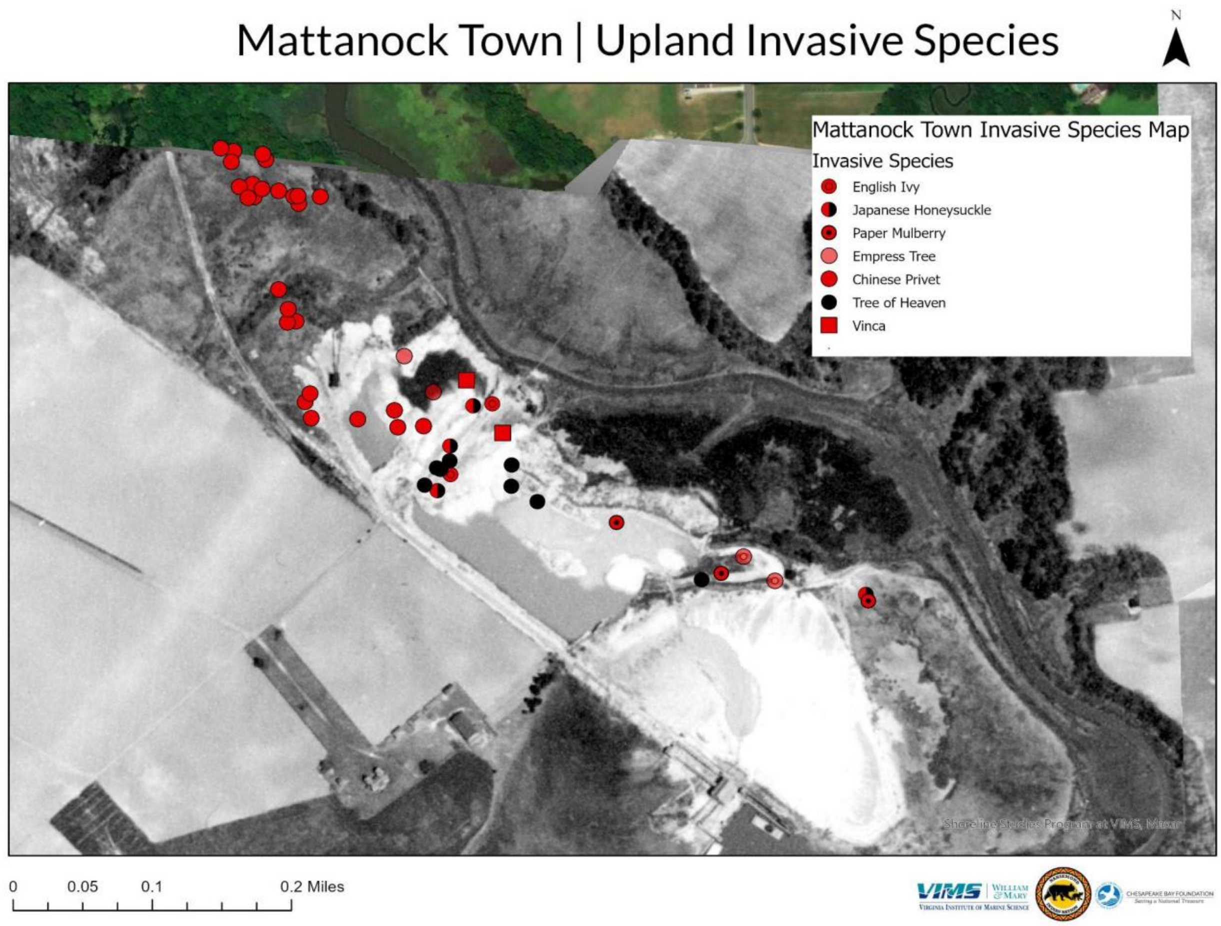


Figure 7: Map demonstrating the correlation between the invasive plant species and the land disturbance by the mine operation (Grigsby, 2021, VA DOF Invasive Species Map; VIMS, 2017; U.S. Geological Survey, 1949).

The topography within Stand 1 showcases one of the most apparent land transformations from the mine operation (US Geological Survey, 2022). The rough square shape is a relic mine pit with an average bank height of 4.5 m above Mean Low Water (MLW) and an average elevation within the basin of 1.875 m above MLW. The 1966 hand-drawn map from a Lone Star employee confirms that this area was once a marl pit the mine operation later filled in. This data is consistent with the soil quality data within the *Urban Forest Management Plan* (Topping, 2021).

Within the basin and adjacent to the berm that parallels Cedar Creek is a large population of *A. floridadum* and *U. americana*. *Q. rebra* is also located at the crest of the northwestern bank (Figure 8). Comparisons of elevation, upland plant species, and sea level rise scenarios indicate that the basin of the marl pit may start to experience prolonged inundation with a meter of sea level rise (US Geological Survey, 2022; Grigsby, 2022, Upland Plants Species Along Berm; HRPDC, 2018). At the current state, the impacts of sea level rise will affect A. *floridadum* and U. *americana* within the next 30 years (Sweet et al., 2022). Sea level rise modeling also shows that Q. *rebra* is at a high enough elevation that even a meter of sea level rise will not reach the base of the tree. Q. *rebra's* canopy radius is 15-17 meters (Angstadt, 2022, Spring Drone Orthoimagery), and the roots extend approximately two to three times the radius of the canopy (Deep Green Permaculture, 2022). Research shows that Q. *rebra* is tolerant to saltwater (Gilman & Watson, 1994), putting it at low risk for damage with future sea level rise scenarios (HRPDC, 2018). Q. *rebra's* proximity to the channel and the eroding berm edge is more concerning. The current grade from the base of the tree to MLW is one of the steepest sections along the berm, and the nearshore depth does not allow for building out channelward if a living shoreline project were to take place (US Geological Survey, 2022). A critical restoration goal is figuring out the balance between protecting Q. *rebra* while enhancing coastal resilience.

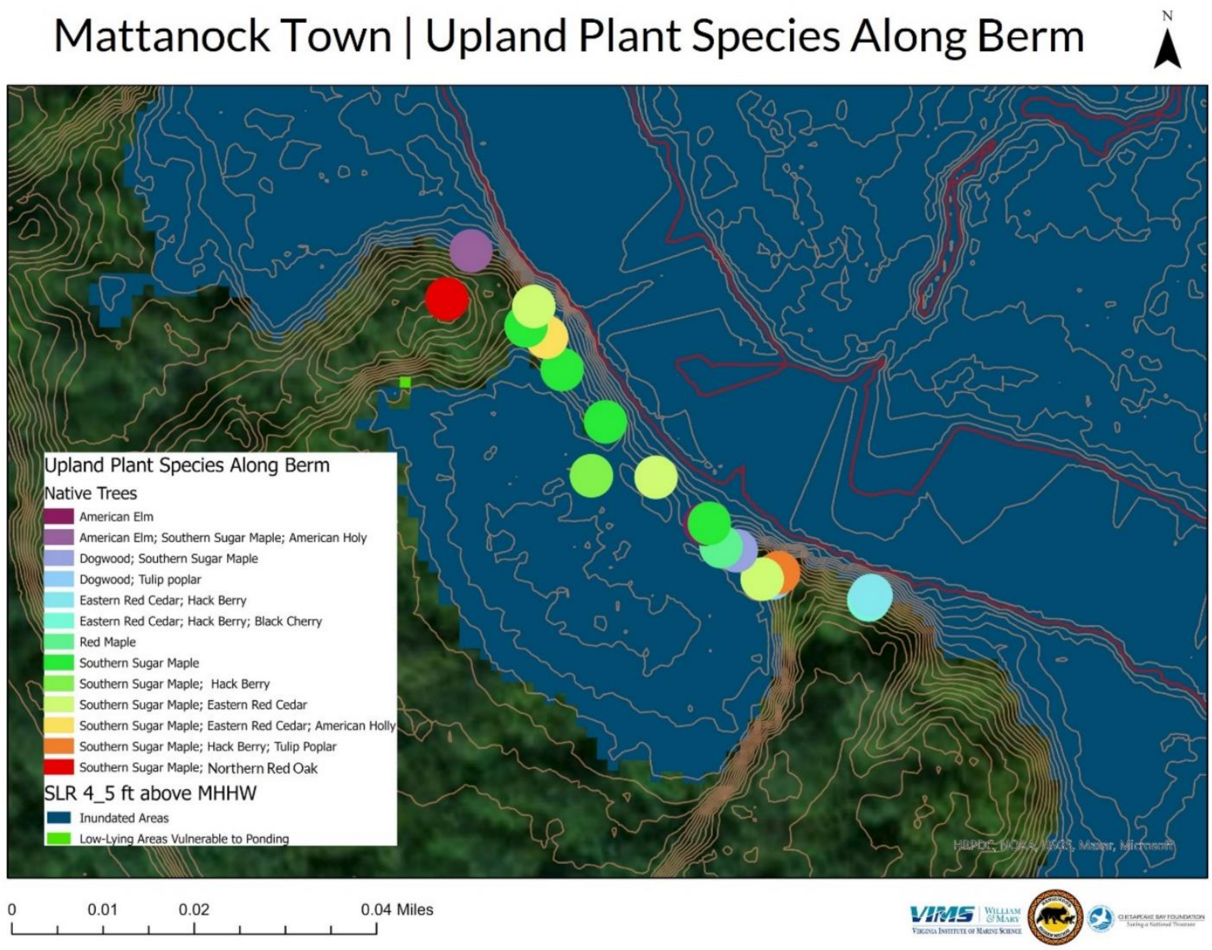


Figure 8: Map demonstrating the proximity of the native tree species identified in the Urban Forest Management Plan to the eroding berm as well as future sea level rise predictions will impact these species. (US Geological Survey, 2022; Grigsby, 2022, Upland Plants Species Along Berm; HRPDC, 2018).

Stand 3 is 2.4 acres and has many of the same physical characteristics as Stand 1. However, Stand 3 has a minimal canopy, and L. *sinense* dominates the plant population (Topping, 2021). Within the *Urban*

Forest Management Plan, the density of *L. sinense is* described as a “public safety hazard and recommended that a professional remove it” (Topping, 2021). DOF proposes to clear-cut this section (and other sections of the property not reviewed in this document) and replant trees with a broader, shallower root system due to the poor soil conditions remaining from the mine operation (K. Topping, personal communication, March 2023).

Stand 6c is 2.3 acres and consists of native trees labeled in the *Urban Forest Management Plan* as a "wooded marsh border" (Topping, 2021). The native canopy consists of *Juniperus virginiana*, *Liriodendron tulipifera*, *Plantanus occidentalis*, *Liquidambar styraciflua*, *Ulmus americana*, and *Celtis occidentalis* (Topping, 2021). The understory has native shrubs such as *Baccharis halimifolia*, *Prunus serotina*, *Rhus*, and *Cornus florida* (Topping, 2021). However, invasive plant species such as *L. sinense*, *Elaeagnus umbellate*, *Ailanthus altissima*, *Paulownia tomentosa*, and *Morus alba* dominate (Topping, 2021). As data analyzed for Stand one and three shows, anthropogenic disturbance and land transformation create a suitable habitat for invasive plant species to take root (Lemke et al., 2012). Without the proper mitigation done after the closing of the mine operation, this is likely what happened at Stand 6c.

An inventory of the various plant species along the upland zone in Stand 6c still needs completion. However, a meter increase in sea level will start to penetrate the upland zone (HRPDC, 2018). Also, a 1.5-meter rise will likely impact the upland vegetation to the 1.75-meter grade (HRPDC, 2018; US Geological Survey, 2022).

The current path to the floating dock on Cedar Creek, the main entrance to the new trail system, and the main road in and out of Mattanock Town follow the mine’s old rail cart path (U.S. Geological Survey, 1949; VIMS, 2017; US Geological Survey, 2022). These routes will be maintained, and where they intersect with the adjacent water body are restoration priority areas for this proposal.

High Marsh:

Tidal flooding and varying salinity tolerances determine salt marshes' vegetation zones (Raposa et al., 2020). The high marsh area is only flooded during extreme high tides and storm events, allowing greater plant biodiversity than the low marsh habitat zone (VIMS CCRM, 2023). Unfortunately, these growing conditions are also suitable for non-native species. This vegetative zone is a critical habitat for the surrounding ecosystem with the added co-benefit of protecting upland infrastructure from large storms and acts as an additional measure for absorbing stormwater runoff (VIMS CCRM, 2023). Some benefits of the high marsh vegetation zone may be lost if non-native plant species dominate marshes.

The invasive strain of *Phragmites australis* is present within the high marsh zone at Mattanock Town. “The dense monoculture of the non-native *P. australis* decreases biodiversity resulting in minimal habitat benefits for the surrounding ecosystem” (Allen & Strain, 2013). In addition, the prolific rhizomes outcompete the roots of native wetland grasses, and tall stalks shade out any potential regrowth of native plant species (Meyerson et al., 2009). However, research shows that the extensive amount of biomass produced by the non-native *P. australis* contributes to soil accretion and increases elevation within sections of the marsh where *P. australis* is present (Michigan Department of Natural

Resources, 2020). The increased elevation can make P. *australis* more resilient to rising sea levels. In situations where P. *australis* is removed without adequate replanting of native wetland vegetation, an increase in shoreline erosion can occur (Michigan Department of Natural Resources, 2020).

Phragmites have existed in North America since the Pliocene period (Meyerson et al., 2009). "The rapid expansion over the past century followed the introduction of a strain from Europe that likely was carried over by ballast water in the 1800s" (Allen & Strain, 2013). This strain effectively and rapidly displaced the native P. *australis* to near eradication (Allen & Strain, 2013). Differentiating between the native and non-native strains is difficult. The visual cues are slight and are often interpreted inaccurately. However, The Michigan Department of Natural Resources developed a chart that compares the characteristics of the two strains side by side (Figure 9). Further data is needed to determine if the native P. *australis* is present at Mattanock Town.

Characteristic	**Native**	**Nonnative (Invasive)**
Density	Sparse or co-occurring with other plants. Stems often break down each season and allow undergrowth to occur.	Dense, near monoculture. Young stands look similar to native but lack seed heads. Stems persist from year to year.
Size	Grows to 6.5 feet high.	Grows to 20 feet high.
Stems	Can be shiny and red near the base. May have small black dots.	Dull and tan/green. Horizontal stems (stolons) can appear red.
Leaves	Pliant yellow-green with sheaths that readily fall away (absent in winter).	Bluish-green leaves that ae flat and somewhat stiff with sheaths that remain close to the stem and persist through winter.
Ligules (membrane that connects leaf sheath to stem)	Frays and sheds by midsummer, measures 0.4-1.0 mm.	Narrow and sturdy measuring 0.1-0.4 mm.
Seed head plumes	Brown in color and appearing much less dense than nonnative.	Purple-brown or silver, appear early and develop more branching. Dense.
Glumes (bracts at base of spikelets)	Long lower glumes measuring 4-7 mm.	Shorter glumes measuring 2.6-4.2 mm.

Figure 9: Michigan Department of Natural Resources (2014). Figure page 11. http://lakestatesfiresci.net/docs/deq-ogl-ais-guide-phragbook-212418_7_0.pdf. Accessed and transcribed by K. Grigsby, 2023.

In 1977, VIMS conducted its first tidal marsh inventory (TMI) for Suffolk, VA. The report concluded that most marshes were healthy and had few invasive plant species (Moore, 1991). The circumstances where invasives were present were due to soil disturbance by human activities (Moore, 1991) and fallen trees during large storm events (Virginia Department of Conservation & Recreation, 2007). The area circled in Figure 10 shows a complete removal of the tree canopy (VIMS, 2017; Grigsby, 2022, Mattanock Town Tidal Marsh Inventory). The 1966 hand-drawn map by a Lone Star employee refers to these sections as "marl ponds refilled with spoil" and "marsh." Since the map was hand-drawn, it is hard to determine how this information correlates to *P. australis*. However, the population of *P. australis* is centralized in the area where the tree canopy was eradicated (VIMS, 2017; Grigsby, 2022, Mattanock Town Tidal Marsh Inventory).

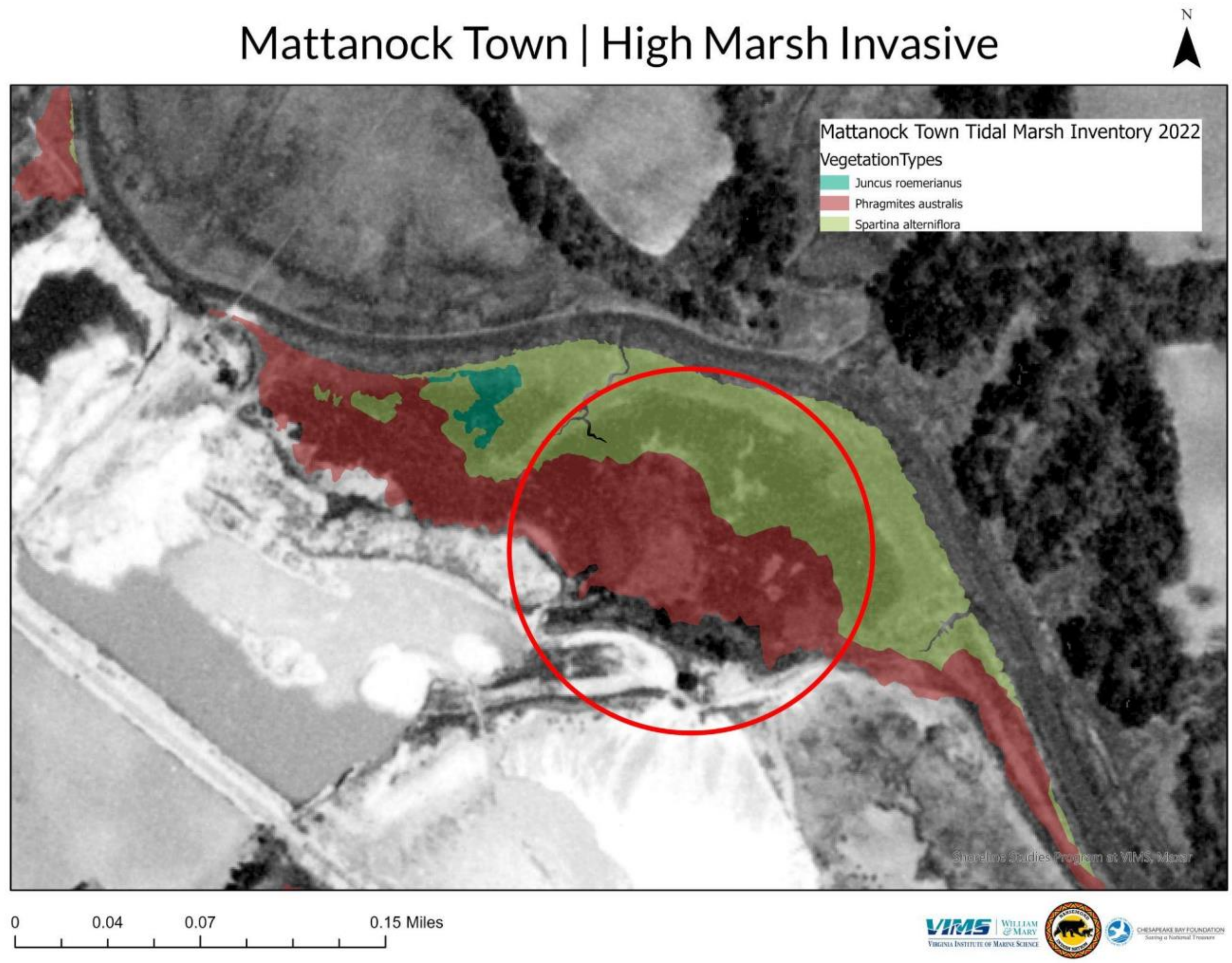


Figure 10: Map shows two data layers, a 1937 aerial imagery and a tidal marsh inventory of Mattanock Town that was done in 2023. The area shows a *P. australis* dominant marsh that was once forested. (VIMS, 2017; Grigsby, 2022, Mattanock Town Tidal Marsh Inventory).

Two data sources were used to analyze the rate of the expanse of *P. australis* within the property boundary (VIMS, 2017; Grigsby, 2022, Mattanock Town Tidal Marsh Inventory). In 2013 *P. australis* was the dominant species on 2.06 acres (Berman et al., 2015). 14.16 acres had *P. australis* present, but the percentage was less than fifty. In 2022 *P. australis* was the dominant vegetation type on 10.20 acres (Grigsby, 2022, Mattanock Town Tidal Marsh Inventory). From 2013 to 2022, *P. australis* increased in area by roughly 0.90 acres per year. The rapid expanse is concerning and will make removal cumbersome. In addition, seed banks of *P. australis* are present in the adjacent marshes along Cedar Creek and throughout the Nansemond River, making the complete removal of *P. australis* from Mattanock Town unlikely.

Low Marsh:
The mean tide range determines the low marsh zone. The vegetation that dominates this area tolerates twice daily inundation from the adjacent waterbody (VIMS CCRM, 2023). “During low tide, the marsh is exposed, providing food and cover for wetland and terrestrial animals” (VIMS CCRM, 2023). Tidal wetlands are amongst the most valuable ecosystem on earth and are currently under threat due to sea-level rise (Kirwan et al., 2010). Maintaining and growing this habitat is essential to Mattanock Town’s shoreline stability.

Mattanock Town has over a mile of shoreline and 21.81 acres of tidal wetlands (Grigsby, 2022, Mattanock Town Tidal Marsh Inventory). The physical removal of soil and the infrastructure installed by Lone Star's mining operation impacted most of the stability of Mattanock Town's marshes. However, two sections of the shoreline display the most evidence of anthropogenic disturbance and land transformation within the low marsh zone (Grigsby, 2022, Mattanock Town Tidal Marsh Inventory, 2015; VIMS, 2017). Various historical maps show that one site was once a marl pit, and both were once the only ports on the property used to load marl onto barges (VIMS, 2017; U.S. Geological Survey, 1949). Evidence of the infrastructure needed for these ports and marl pits, such as bulkheads, docks, mooring pilings, harbors, and berms, are still present and still play a role in the instability and stability of the shoreline.

For the remainder of the section, "Site 1" will reference the site adjacent to Cedar Creek, and "Site 2" the area adjacent to the Nansemond River (Figure 11).

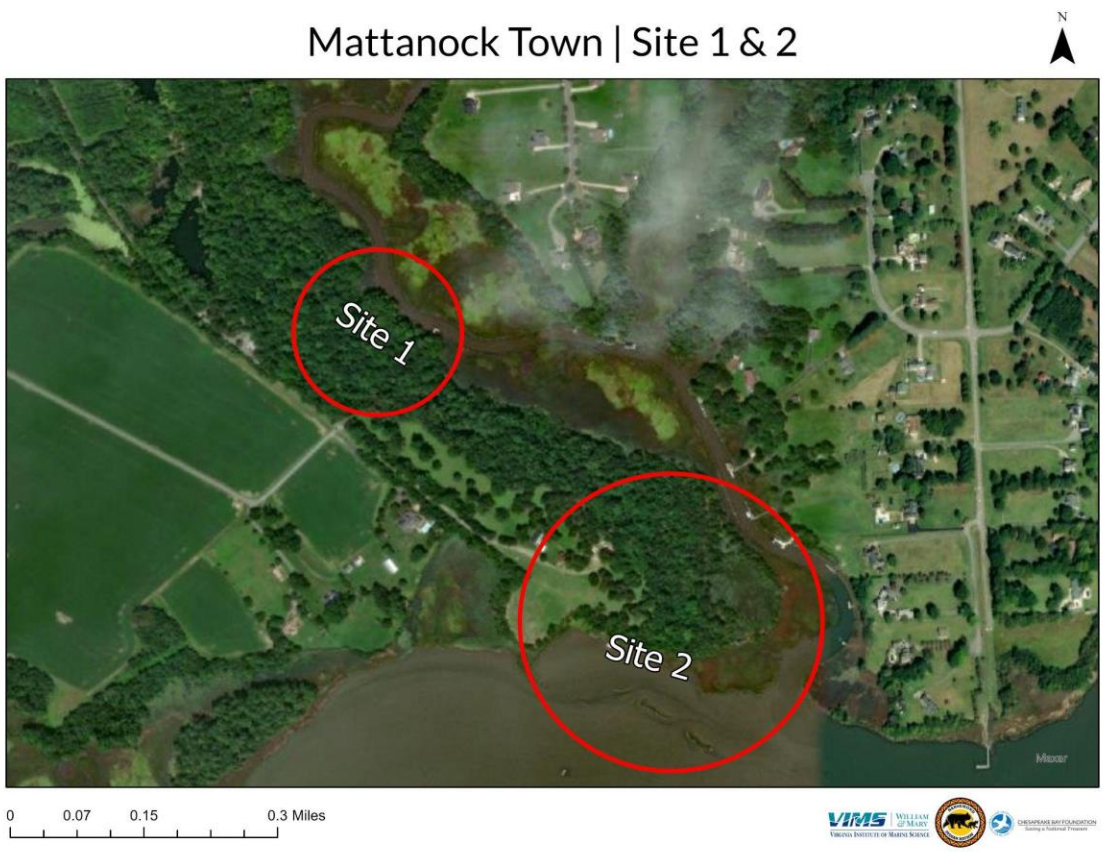


Figure 11: Overview map of Sites 1 and 2 at Mattanock Town. K. Grigsby, 2023.

Due to C. *jeffersonius* layered within the berm's sediment and secondary successional growth on top of the berm's ridge, Lone Star Mining Company likely dug out the pit and left the edge to create a natural barrier. Historical maps show that tidal wetlands present at Site 1 were relatively narrow even before Lone Star (Marshau et al., 1919). The increased activity and potential dredging of Cedar Creek by the mine operation likely eradicated the wetland vegetation along this stretch of shoreline. The lack of fringe marsh made the berm more susceptible to erosion and compromised the stability of the tree roots, which increased their likelihood of falling during storm events. As the trees fall, the root ball dislodges a large chunk of the bank, causing erosion along the berm (Figure 12).

Figure 12: Fallen tree along the eroding mine berm at Site 1. K. Grigsby, 2021.

In addition to the increased erosion rate, the fallen trees also shade out this section of shoreline and cause a steep grade to form along the berm (US Geological Survey, 2022). Most native and non-native plants within tidal wetlands require full sun exposure and a gradual slope to prosper. *Spartina alterniflora*, the most common salt marsh plant species in the low marsh zone, has a growing range determined by tidal inundation and by the slope of the shoreline. The growing range is typically from above MLW to Mean High Water (MHW) (Smith et al., 2015), and the target grade is 3:1 or flatter (Hardaway et al., 2017). Site 1's suitable growing range for S. *alterniflora* is 0.5 meters to 2.99 meters above MLW (US Geological Survey, 2022; VIMS, 2021). However, the area is completely shaded (Angstadt, 2022, Spring Drone Orthoimagery).

At Site 2, a dilapidated bulkhead still exists, and although it is currently stabilizing the bank, it has gone without routine maintenance since the closing of Lone Star in 1971. Without regular maintenance, bulkheads develop pits on the landward side of the structure. These pits result from the bulkhead deflecting the wave energy, causing undercutting at the base, which leads to holes at the bottom of the structure. As these holes become more prominent, water erodes the land behind the bulkhead, causing pits to form (Figure 13). These pits will become more prominent with an increase in sea-level rise, and Site 2 will start to see impacts to the shoreline with just a meter increase (HRPDC, 2018).


1

Figure 13: Pit that formed behind the dilapidated bulkhead at Site 2. K. Grigsby, 2022.

However, a S*partina cynosuroides* dominated marsh has formed channelward, stabilizing the shoreline and is likely slowing down the bulkhead's degradation (Grigsby, 2022, Mattanock Town Tidal Marsh

Inventory 2022; VIMS, 2017). Although S. *cynosuroides* is growing within the high marsh vegetation zone, this plan evaluates it in conjunction with an adjacent offshore S. *alterniflora* marsh islands since the sediment accretion along Site 2 relies on the presence of these marsh islands (VIMS, 2017). These marsh islands likely act as a natural offshore breakwater and stabilize the shoreline directly adjacent to Site 2, thus giving it the appropriate elevation for S. *cynosuroides* to grow. The movement and formation of the islands correlate with the channelward side of the harbor constructed by the mine operation (VIMS, 2017). Site 2 was also the primary location for loading and unloading the marl material (VIMS, 2017). Although the marsh islands act as a natural barrier to the adjacent shoreline, they are actively eroding (VIMS, 2017). Stabilizing the marsh islands must be prioritized to maintain a stable shoreline at Site 2.

Intertidal:

The intertidal habitat zone encompasses the area within the high, middle, and low tides (National Geographic Society, 2022). This data analysis section will focus on the middle and low tide region, "which provides more favorable conditions for organisms that cannot tolerate long periods of air exposure" (National Geographic Society, 2022). Two such species are the Eastern oyster, *Crassostrea virginica*, and the Ribbed Mussel, *Geukensia demissa*. This restoration proposal significantly focuses on C. *virginica* and will discuss opportunities and limitations with G. *demissa* in restoration design. Physically incorporating C. *virginica* into the restoration design and incorporating restoration practices that are proven to promote G. *demissa* natural recruitment will strengthen the interconnectivity between habitats, enhance shoreline stability, and strengthen the cultural connection for the Tribe.

Oysters are the architects of the marine environment. In addition to ecosystem services associated with water quality, oyster reefs can be used as a tool to stabilize shorelines and provide essential habitats for juvenile finfish and other bivalve species (Morris, Bilkovic, Boswell, et al., 2019). The name "Chesapeake" is an Algonquin term that roughly translates to "Great Shellfish Bay" (MPNCC, 2016). Colonists used this term for the robust oyster population within Chesapeake Bay. Ironically, they had no idea that the oysters described as "lay[ing] on the ground as thick as stones" and depicted in later journals as navigational hazards were a potential food source (MPNCC, 2016). Today, the oyster population is roughly one percent of the historical population due to disease, over-harvesting, and lack of suitable substrate (NOAA Fisheries, 2023).

Suitable site conditions for an oyster sill structure (constructed of bagged oyster shell or concrete reef structures) include salinity above eight PPT, a firm bottom, adequate inundation, and low to moderate energy settings (Chesapeake Bay Foundation, 2020). However, the presence of an existing oyster population is the best determinant of oyster viability (Chesapeake Bay Foundation, 2020). A small wild oyster population is present within Cedar Creek adjacent to the floating dock, where large stones are present along the shoreline (Figure 14). While there is little evidence of an oyster population directly along the shoreline at Site 1, the lack of substrate for oysters to settle on could be a limiting factor since they are present directly downstream.

Figure 14: Benthic biomass present along Cedar Creek at Mattanock Town. K. Grigsby, 2022

At Site 2, oysters are all along the shoreline and can be seen in aerial imagery (Angstadt, 2022, Fall Drone Orthoimagery).

Salinity measures within the Nansemond River show downstream salinity ranges of 16-24 PPT (station 06J03) and upstream salinity ranges of 9-15 PPT (station 06J03) (McCarter, 2022). Although no station is directly offshore from Mattanock Town, Site 2's salinity range is likely similar to the neighboring stations. However, Site 1 will need further testing to ensure the median salinity is above eight PPT.

Oysters cannot survive when completely buried in "muddy” conditions, and the sediment type factors into the oyster sill structure used to stabilize the shoreline (Chesapeake Bay Foundation, 2020). Although the sediment at Site 2 is "mud," a quick determinant for the oyster viability and the appropriate substrate is the ability to walk along the shoreline (Chesapeake Bay Foundation, 2020; State of Maryland, 2015). It is relatively easy to maneuver along the shoreline directly adjacent to Site 2. However, additional data is needed to understand the sediment type bordering the marsh islands. At Site 1, sections of shoreline are relatively easy to walk along, but some areas are not.

A critical threshold for intertidal oyster reef establishment is 50% inundation duration (Morris et al., 2021) (Figure 15). Studies show that as freeboard decreases, wave attenuation decreases (Morris et al., 2021). In this case, compensating crest height with crest width may provide the requisite wave attenuation goals (Morris et al., 2019). Additional research is needed to determine the ratio between the wave crest height and the width of the sill structure. The marsh islands adjacent to Site 2 may be suitable for gathering this information. However, the nearshore depth and sediment composition are still needed to determine if this is an appropriate test site.

Figure 15: Showing the threshold of oysters growing range between MLW and MHW. This image was taken on the Lynnhaven River. K. Grigsby, 2023.

In low-energy environments, such as Site 1, achieving the target inundation is attainable since the goal of the sill structure is to mimic the natural environment rather than attenuate the wave energy. *Spartina alterniflora*'s lowest elevation in the adjacent marsh or along the existing shoreline determines the crest height of sill structures in low-energy environments. The mean tide range is slightly over a meter above MLW (VIMS, 2021). To achieve target inundation, the sill height at Site 1 should not exceed 0.5 meters, and S. *alterniflora*'s lowest average growing elevation is 0.5 meters above MLW (US Geological Survey, 2022; VIMS, 2021). Based on these calculations, the shoreline at Site 1 can reach target inundation while simultaneously stabilizing the shoreline.

Geukensia demissa mutualistic relationship with S. *alterniflora* (Bilkovic et al., 2021) and its cultural significance to the Tribe (Bass, 2021) makes this organism an important species to explore in this restoration plan. However, research shows that the recruitment of G. *demissa* in constructed wetlands is not as robust as in naturally fringing marshes (Bilkovic et al., 2021). The traditional approach to constructing wetlands uses coarse sand and plants in grid patterns. The sand often lacks organic matter, and the grid pattern leaves large gaps between plugs (Bilkovic et al., 2021; Hardaway et al., 2017). The result is a delay in ecosystem development, affecting the survivability of G. *demissa* in restoration projects (Bilkovic et al., 2021). Although further research is needed to understand the issues with sediment quality, studies have shown that planting S. *alterniflora* in clusters (or clumps) has resulted in a higher yield in marsh establishment and productivity (Silliman et al., 2015). Using

Sites 1 and 2 to compare the recruitment of *G. demissa* in various planting configurations is an opportunity worth exploring in the final design.

Conceptual Design

Lone Star Cement Corporation's activities fractured the connection between the upland forest, the high marsh, the low marsh, and the intertidal habitat zones. The Tribe can re-establish these relationships by implementing restoration activities that focus on maximizing native habitats and enhancing coastal resilience. In addition, incorporating various plant and animal species that are important to the Tribe's culture will strengthen their connection to traditions lost due to greed and cruelty. A direct correlation exists between healing the land and strengthening the Tribe's connection to their heritage. Enhancing this symbiotic relationship is the key to restoring Mattanock Town.

In July 2020, Virginia passed Senate Bill 776 instructing the Virginia Marine Resources Commission (VMRC) "to approve only living shoreline approaches to shoreline stabilization unless the best available science shows that such approaches are not suitable" (S.B. 776, 2020). Living shorelines are a proven approach for protecting low-energy, tidal shorelines from erosion by planting native wetland plants (Mitchell & Bilkovic, 2019). Often these natural shoreline designs need some additional protection along the marsh toe. Bioengineered structures such as oyster reefs and coconut fiber logs add additional wave/tidal engineering damping (Chesapeake Bay Foundation, 2020).

The data analysis in the previous section identified two sites prioritized for restoration at Mattanock Town. The conceptual design section will focus on a proposed living shoreline and riparian buffer restoration project for Site 1. Although Site 2 is equally a priority, additional information, such as sediment type and depth offshore of the marsh islands, is needed before a proposed design can be developed.

JPA Group 2 Permit Maps and Cross Section for Site 1:
Figures 16 - 24 were created using the data layers analyzed in the *Mattanock Town Past Present and Future* map (Grigsby, 2023). The below maps and cross-sections are designed for a living shoreline Group 2 Joint Permit Application (JPA) and are based on the criteria needed for the permit submission (Virginia Marine Resources Commission, 2022). The current site conditions provide information that permit writers can use to determine the proposed project's impact on existing habitats and be a baseline for monitoring project success. Practitioners can also use the current site conditions data to read the land and determine the best approach for implementing project goals. Success metrics and goals vary with each project and are up to the property owner to determine. In the case of the Site 1 living shoreline and riparian buffer project, the NIN has determined that a successful project will protect and enhance existing native vegetation, remove invasive vegetation, and incorporate oyster habitat. Figure 16 highlights current site conditions.

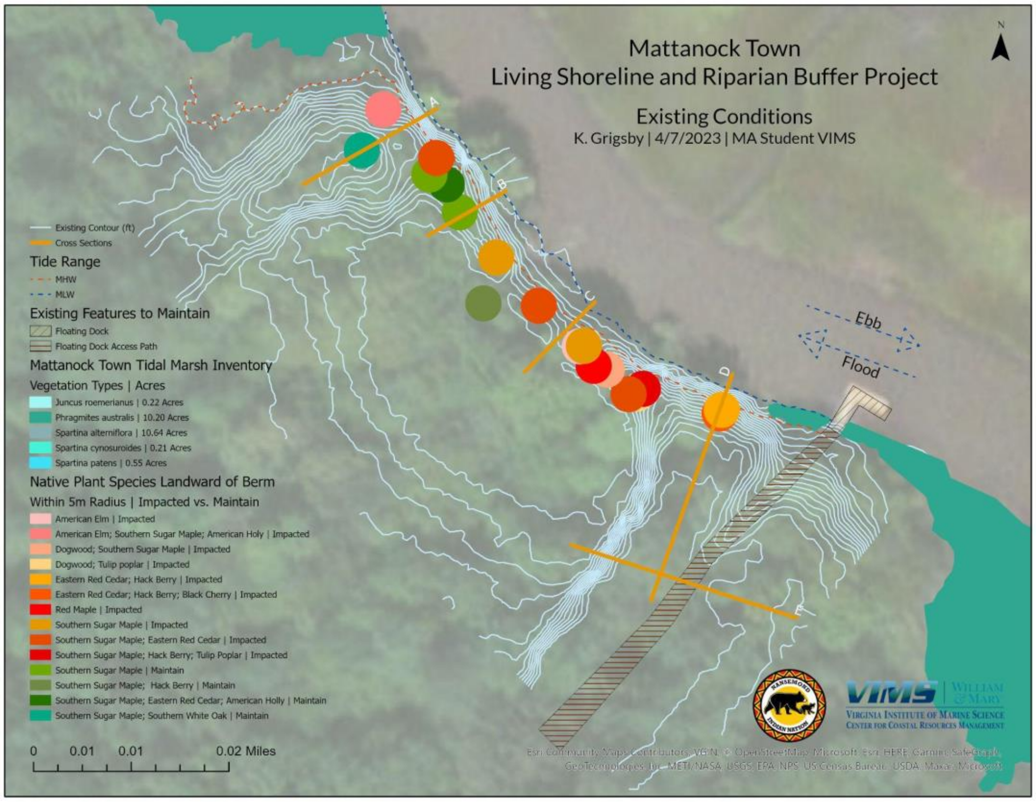


Figure 16: Map created to demonstrate the existing conditions at Site 1 for the proposed restoration project. K. Grigsby, 2023.

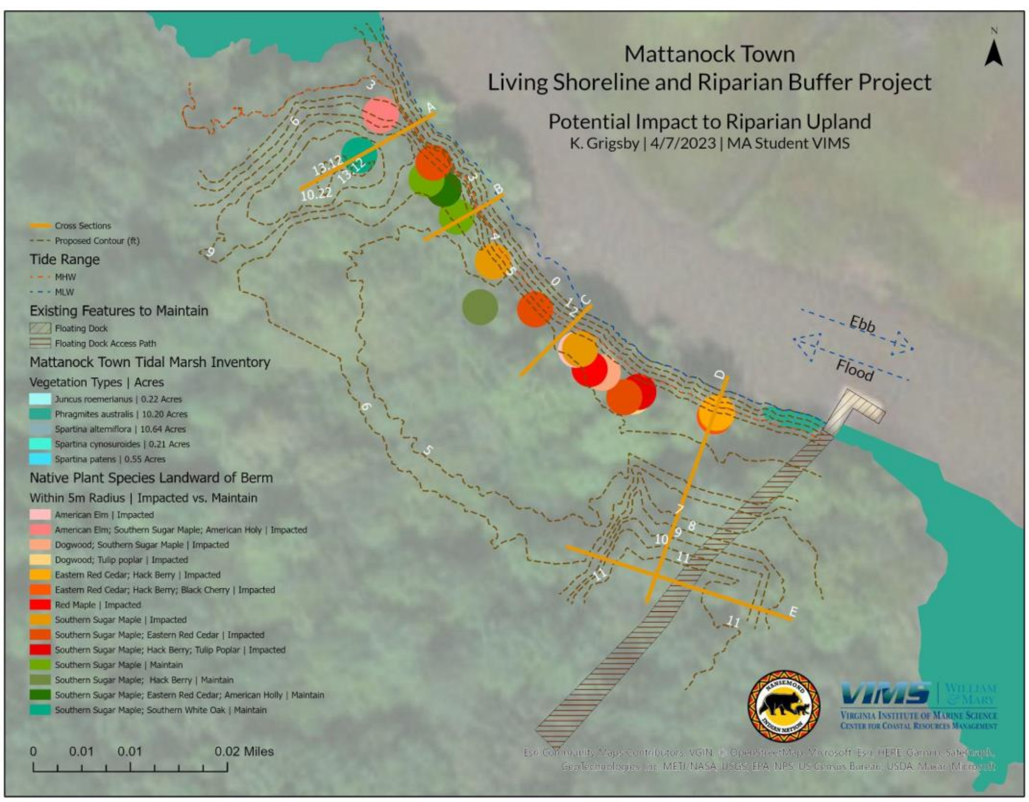


Figure 17: Map created to demonstrate the impact on upland vegetation with the proposed grade. K. Grigsby, 2023.

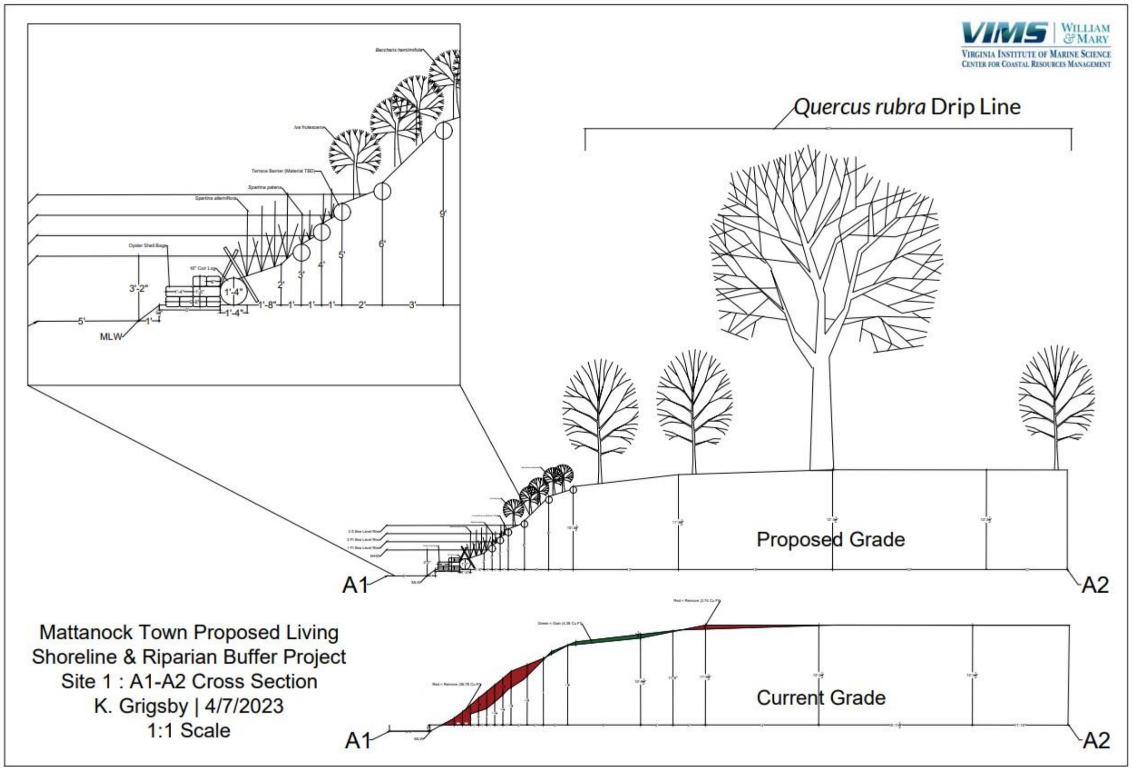


Figure 18: Cross-section A1-A2 created to illustrate the proposed grade and combining two shoreline stabilization practices is the best way to protect Q. *rubra*. K. Grigsby, 2023.

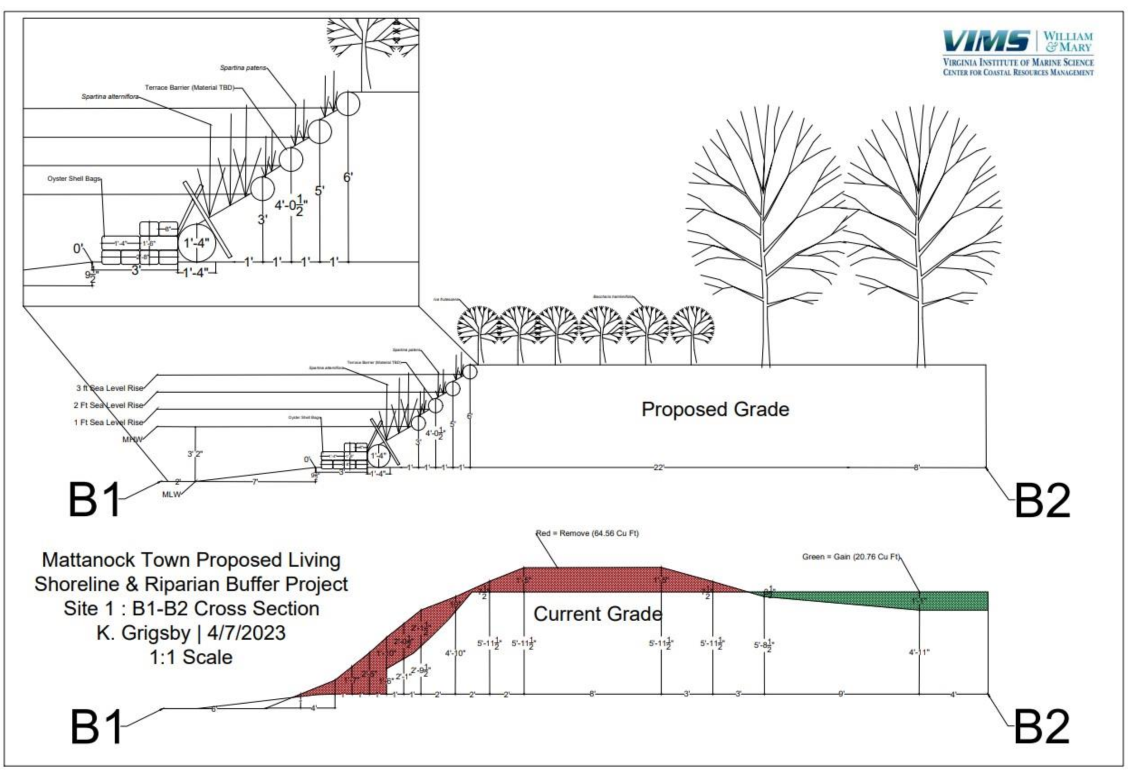


Figure 19: Cross-section B1-B2 created to illustrate the proposed grade and how combining two shoreline stabilization practices is the best way to protect Q. *rubra*. K. Grigsby, 2023.

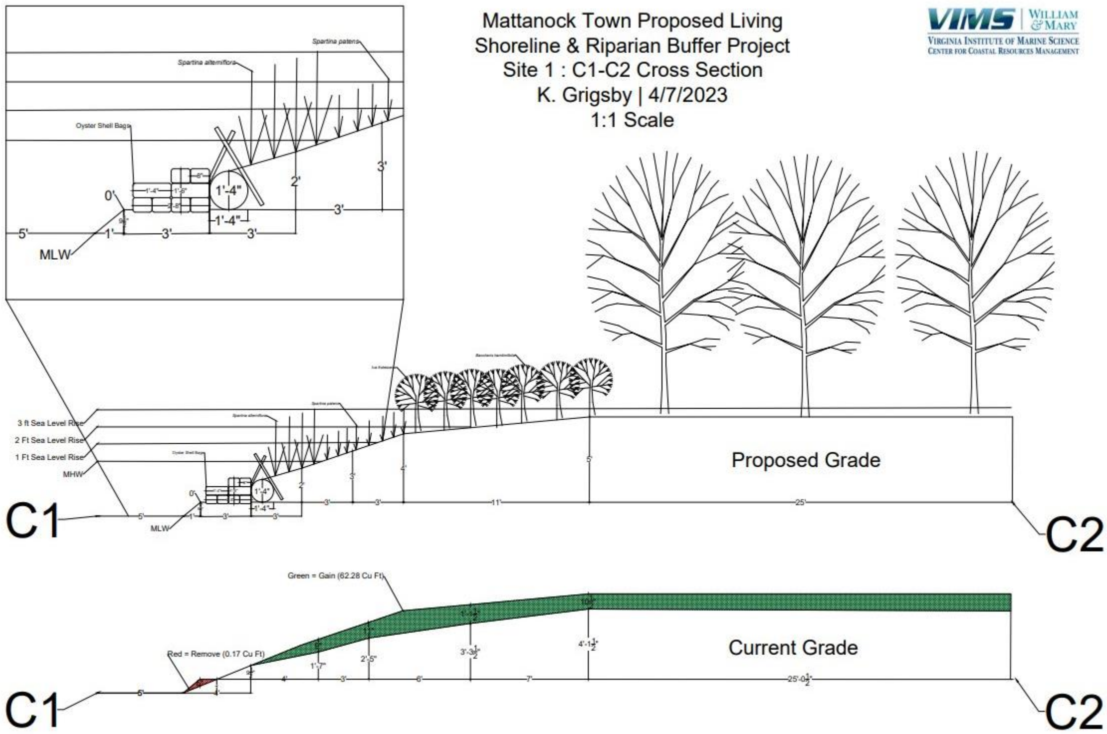


Figure 20: Cross-section C1-C2 created to illustrate the proposed grade and in this case, the additional soil needed to achieve the desired elevations. K. Grigsby, 2023.

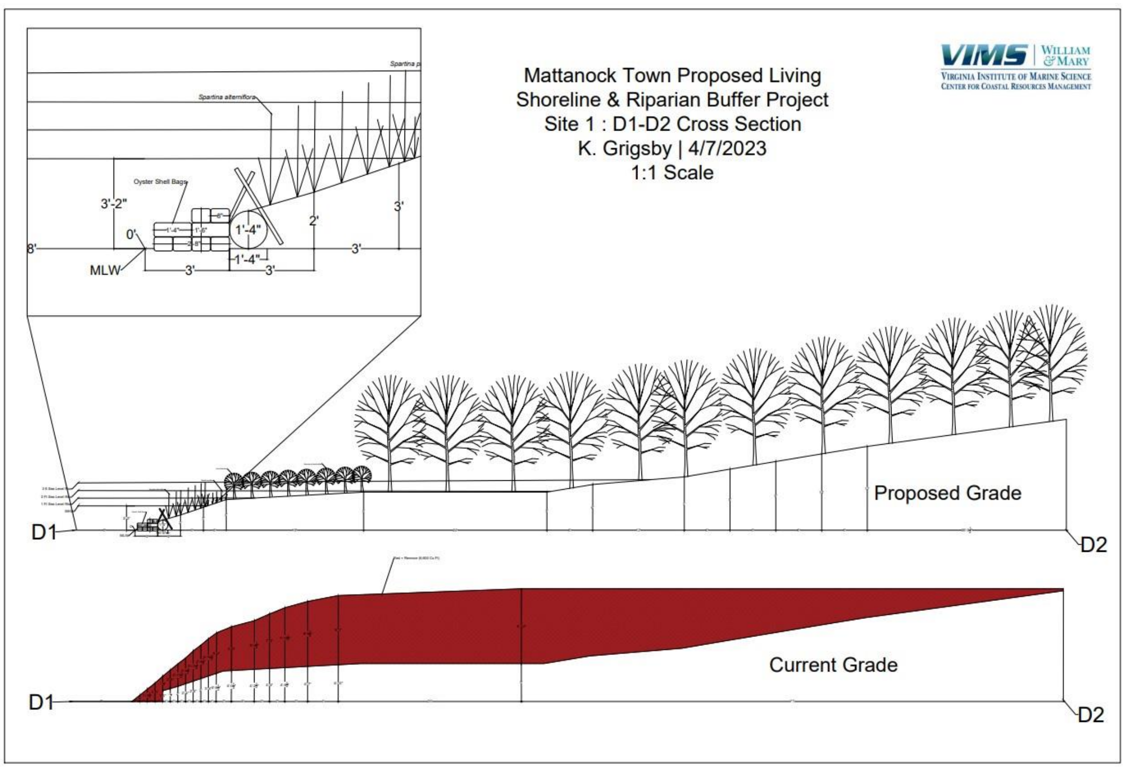


Figure 21: Cross-section D1-D2 created to demonstrate the proposed grade. This section of shoreline requires the most considerable amount of earth moving/removing to achieve the desired grade. K. Grigsby, 2023.

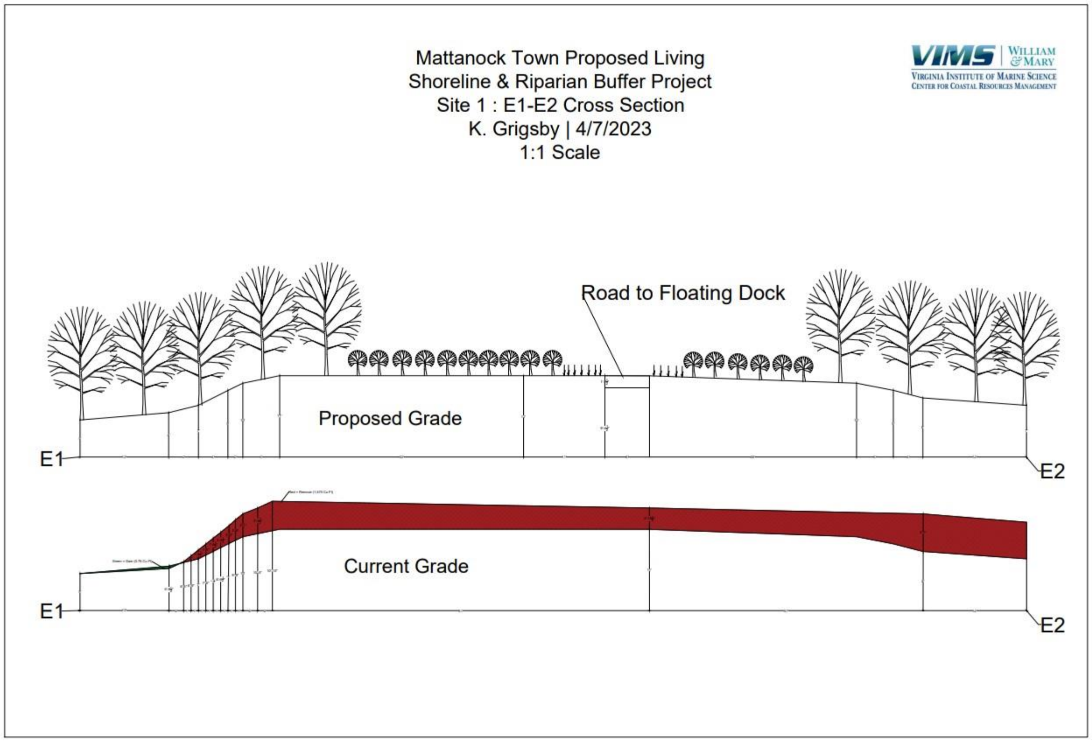


Figure 22: Cross-section E1-E2 created to illustrate how the proposed grade at cross-section D1-D2 would tie back into the access road to the shoreline. K. Grigsby, 2023.

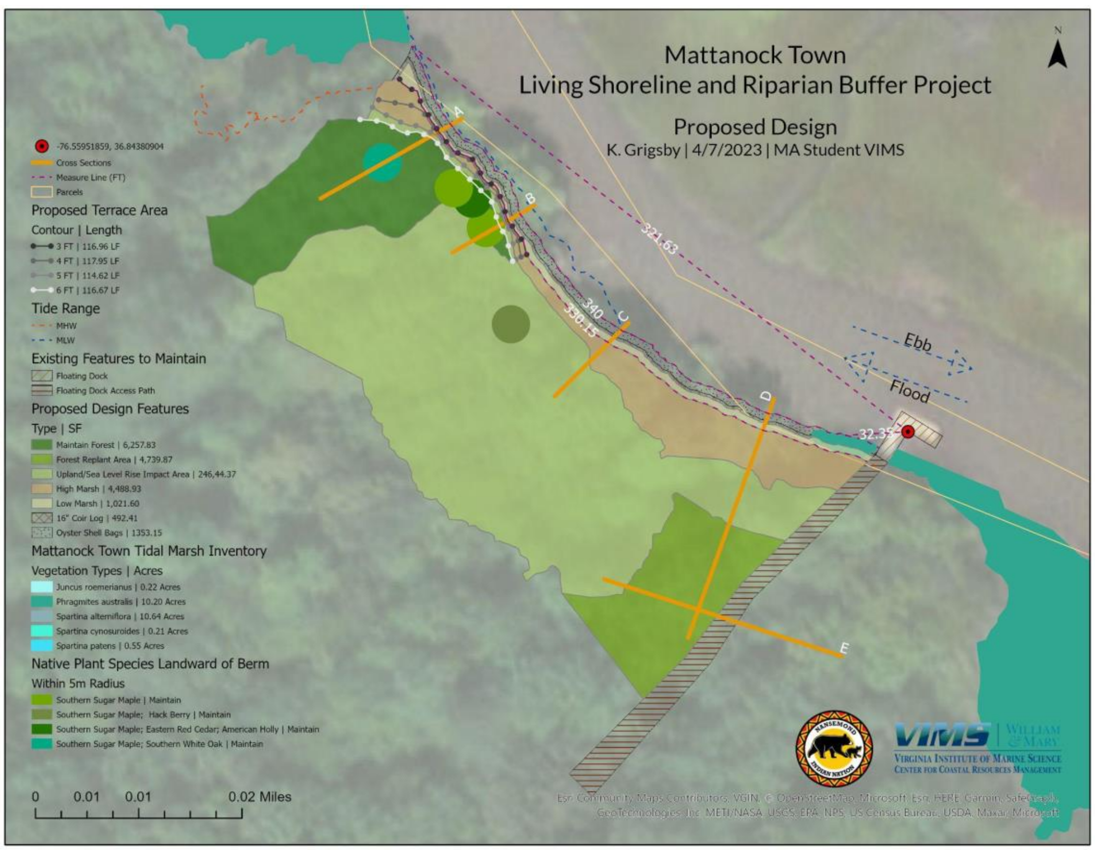


Figure 23: Map created to illustrate the proposed project design. K. Grigsby, 2023.

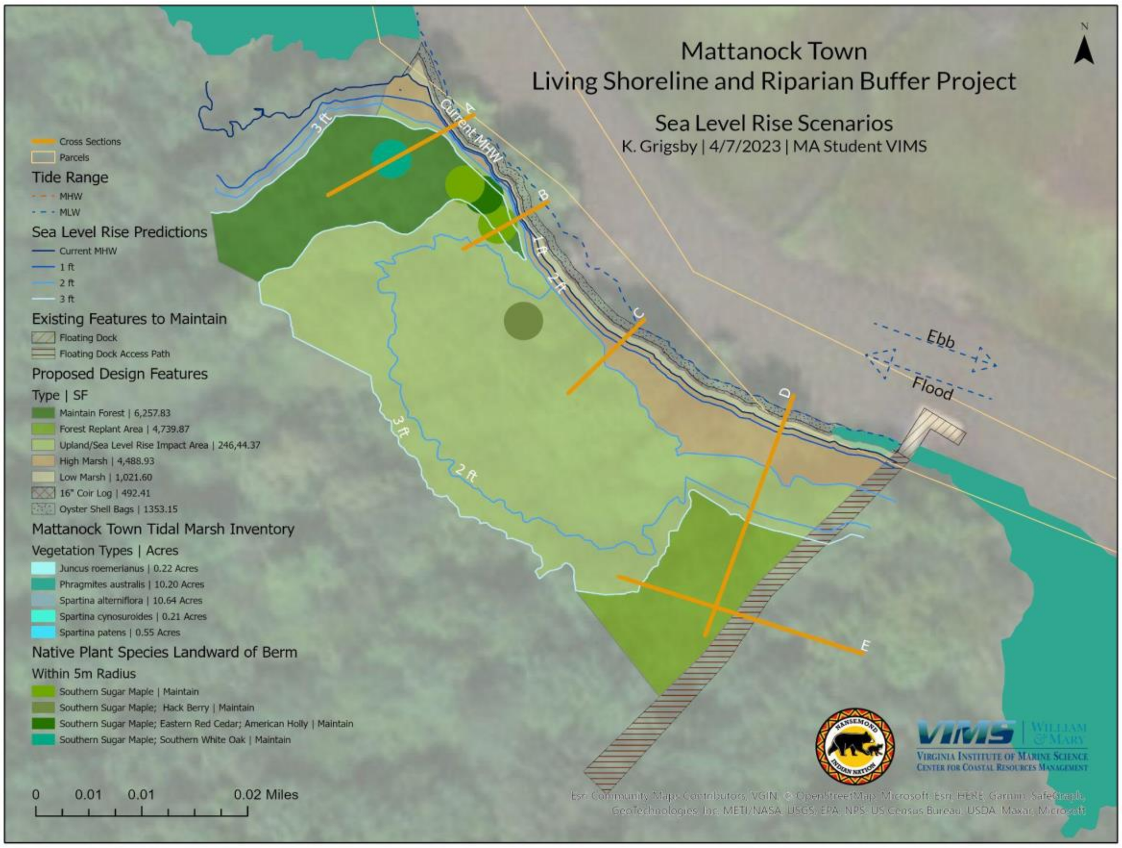


Figure 24: Map created to illustrate the proposed project design and how sea level rise will impact the upland with the proposed elevations. K. Grigsby, 2023.

Remove Invasives:
Phragmites australis dominated marshes flank either side of the proposed project area (Figure 16). Although the fallen trees are shading out the native wetland grasses, they also keep *P. australis* from migrating into this section of the property. For this project to succeed, removing these trees and grading must occur. However, suitable growing conditions for native grasses also mean appropriate growing conditions for *P. australis*. Completely eradicating *P. australis* from Cedar Creek will be nearly impossible. Keeping them from dominating this section of the shoreline will be a constant battle after the project is complete due to the adjacent seed banks. A robust removal, maintenance, and monitoring plan should be discussed and agreed upon with the contractor installing the shoreline or an outside resource specializing in *P. australis* management. When applying for funding, the Tribe should include maintenance for several years post-construction within the budget for *P. australis* (Maryland Department of Natural Resources, 2020). This time frame allows native shrubs and small trees, such as *Iva frutescens*, *Baccharis halimifolia*, *Myrica cerifera*, and *Myrica pensylvanica*, to establish and outcompete *P. australis* for resources (Maryland Department of Natural Resources, 2020; Michigan Department of Natural Resources, 2014).

The Michigan Department of Natural Resources management strategy for large, dense stands of *P. australis* is pairing Herbicide treatment with prescribed fire (Michigan Department of Natural Resources, 2014). “In situations where prescribed fire can be implemented safely and effectively, it is a cost-effective and ecologically sound tool to help control *P. australis*" (Michigan Department of Natural Resources, 2014). Historically, fire has been used by tribal communities to manage and revitalize land (Long et al., 2017; Long et al., 2020). The Karuk Tribe Department of Natural Resources developed a Climate Adaptation Plan highlighting fire's importance in shaping ecosystem function and diversity (Long et al., 2017; Karuk Tribe, 2019). Many tribes in California have "fire-dependent" cultures that rely on cultural burning to increase the quality and quantity of plants (Long et al., 2020). In 2021, the Chincoteague National Wildlife Refuge implemented a control burn on the dead stalks of *P. australis* and paired the burn with herbicide treatment (Shore Daily News, 2021). Additional research is needed to determine if conducting a controlled burn within sections of shoreline where *P. australis* is present should be considered at Mattanock Town. However, due to the lack of infrastructure adjacent to the project and the cultural symbolism of fire to tribal communities, the *P. australis* dominant marshes directly adjacent to the proposed project area may be a place to study and test the practice in the local watershed.

Protecting Existing Native Vegetation:
Historically, marshes were present on the shoreline at Site 1, which is an indication that a living shoreline that restores marsh ecosystems is suitable and appropriate (Marshau et al., 1919). The data analysis section identified this area as a mine spoil berm and concluded that the primary source of erosion was fallen trees due to the lack of fringe marsh protecting the bank. Figure 17 showcases the proposed grade based on data layers within the *Mattanock Town Past Present and Future* map (Grigsby, 2023; US Geological Survey, 2022). Figures 18-22 are cross-sections that showcase the potential volume of material that would need removing or adding to achieve the recommended 3:1 grade (Hardaway et al., 2017).

However, achieving a 3:1 grade along the northwestern section of the shoreline is impossible due to *Q. rubra*'s proximity to the eroding bank edge and the inability to build the shoreline out channelward due to the depth in the nearshore (Grigsby, 2022, Upland Plants Species Along Berm; US Geological Survey, 2022). Terracing this section of shoreline would balance the need for shoreline protection and saving the existing vegetation. "Terraces are created by installing short walls of wood, stone, or other materials, which hold a soil platform, and planted" (Florida Living Shorelines, 2023). Figures 18 and 19 demonstrate the proposed terrace design. At both A1-A2 and B1-B2 cross sections, the first terrace starts at a little over a meter (or 3' 9 1/2" as indicated in the drawing) above MLW. A terrace should be installed roughly every 0.30 meters of elevation gain after that until the current grade does not require additional stabilization. These cross-sections are conceptual drawings and could change once the Tribe consults with a contractor.

Currently, the cross-sections indicated the terrace material as "to be determined." Tree trunks have been used for the terrace edge (Stross, 2023). Repurposing the trees removed during the shoreline project would cut down on the cost and would embody the tribal culture of reuse and repurpose. However, the feasibility of reusing the tree trunks must be discussed with the contractor hired to install the project.

The data analysis showed that no trees growing directly on the berm are healthy, and the surviving ones are mostly seedlings that can be transplanted (Grigsby, 2022, Upland Plants Species Along Berm;

Topping, 2021). However, rare native trees are landward of the berm and within the project footprint (Grigsby, 2022, Upland Plants Species Along Berm; Topping, 2021). The proximity to the proposed project area and grading could negatively impact the health of these tree species (Figure 17). Permitting agencies will require contractors to implement practices to ensure minor damage. That said, most species marked “Impacted” will be damaged or removed during grading (Figure 17). In that case, mitigation measures will be required by the Suffolk Wetlands Board. Since this is a likely scenario if a living project occurs, a replanting area is proposed in the final conceptual design (Figure 23).

Incorporate Oyster Habitat:

The Nansemond Tribe and other tribal communities were the original oyster farmers and had mastered the fragile balance of meeting community needs while maintaining a healthy oyster population (Bass, 2021). Research shows tribal members would "seed" intertidal oyster reefs with oysters from subtidal parent reefs (Bass, 2021). The mutualistic relationship between the tribe and the surrounding ecosystem stems from their spiritual connection with these habitats (Bass, 2021; Long et al., 2020). Rather than consider these ecosystems as a resource to use, they were part of their community, even family, in some circumstances (Bass, 2021; Long et al., 2020). This perspective and bond instilled a need to implement harvesting practices that promoted the health and productivity of these habitats.

Current oyster restoration efforts, in some ways, embody the same reverence and care that tribes once bestowed on all habitats. Various levels of restoration have been implemented, from the construction of extensive reefs by the State to community members growing oysters for restoration in their backyards with oyster gardening programs (Chesapeake Bay Foundation, 2023). In 2020, the NIN started oyster gardening with the Chesapeake Bay Foundation (CBF) and has contributed roughly 1,300 adult oysters to the local reef population since beginning the program (Chesapeake Bay Foundation, personal communication, 2020). Each year, the NIN returns their fostered oysters, and CBF then plants them on sanctuary reefs in other sections of the Nansemond River. Once constructed, the NIN could place the oysters they grow through the oyster gardening program on the oyster sill at Site 1, establishing their sanctuary reef at Mattanock Town.

Shell recycling is another form of oyster restoration that involves volunteers retrieving used oyster shells from restaurants and festivals. Shell recycling is the backbone for many restoration activities, including living shoreline projects. These shells are bagged and cured for six months to a year. Once cured, they are placed in setting tanks for Spat-On-Shell production or along shorelines for stabilization and habitat restoration. There are also community bins all over Hampton Roads to allow residents to recycle their shells. One of these bins is located at Mattanock Town. The shells collected in this bin will be used for the oyster sill at Site 1. The final proposed design has a total length of 103.6 meters (Figure 23), a maximum height of 0.5 meters, and a width of 0.85 meters (Figures 18-22). The cross sections also indicate that the channelward row is only two shell bags tall, and both rows are stacked in an alternating pattern to allow for a more uniform configuration (Figures 18-22). There are ten shell bags every 0.46 meters, which will require 2,266 shell bags to complete the project. CBF staff also estimate that roughly 275 shells are within each bag (Luecke, personal communication, 2023). If this project were to proceed, the NIN would return over six hundred thousand oyster shells to the local ecosystem.

Shell bags also have the potential to adapt to climate change (Milligan et al., 2018). Further research is needed to understand the best practices to consider during project planning to enable adaptation. The alternating stacking would easily allow for additional bags in the future to be placed on top, but other configurations could be more effective. The living shoreline project at Site 1 would be suitable for gathering this information (Figure 24).

Summary

The restoration of Mattanock Town is a challenge for the ages because it embodies the nearly universal historical, social, and environmental challenges of a troubled past and a precarious future. This plan set out to identify restoration priority areas on the property and develop actionable restoration projects that embodied the Nansemond Indian Nation’s thoughtful and caring culture. This plan also sought to understand the best methods and protocols for implementing a restoration approach that incorporates tribal heritage. In fact, this plan demonstrates that as long as the overall goal is to restore native habitats, a scientific approach and a tribal approach are more alike than different. This plan identified many opportunities that are transferable to other tribal lands and can serve as a blueprint for developing a holistic approach to restoration that embodies both tribal heritage and the need for habitat restoration.

Adaptive management is a term that has become popular and is often associated with restoration projects. However, this idea of learning from the land has always been apart of indigenous cultures. This restoration plan highlights several opportunities to strengthen our knowledge on best practices for climate adaptation and habitat restoration. Currently, one third of land cover is occupied by native or indigenous communities and “91% of that land is in good or fair ecological condition” (Einhorn et al., 2023). Although Mattanock Town is far from a blank slate, it is an opportunity to learn from our mistakes and, as research shows, indigenous stewardship is effective in managing complex natural environments (Einhorn et al., 2023).

This plan also demonstrated that the NIN faces hurdles, past and present, that prevent them from implementing any future projects. Recently, the City of Suffolk refused to write a letter of support to enable the Tribe to get community input on some of the proposed suggestions in this plan. Although this development is discouraging and disheartening, it teaches perseverance lessons and in the long history of Mattanock Town, this is one small obstacle. There will be others. It is important to learn from the setbacks and remember to stay focused on the future. And that future is bright as long Mattanock Town is under the Nansemond Indian Nation’s care.

Acknowledgements

To the Nansemond Indian Nation, thank you for the opportunity to work alongside your community members and for trusting me to tell the story of Mattanock Town, a responsibility I do not take lightly. In particular, Nikki Bass for teaching me how to be a better steward for our local environment.

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