Savin Hill Cove Salt Marsh Restoration Project

Picture taken by Danielle Hughes

University of Massachusetts Boston

Environmental, Earth, & Ocean Sciences Department

A Capstone Project by Danielle Hughes and William Baker,

Dr. Anamarija Frankic Dec 2011

Table of Contents

Introduction

Salt marshes are extremely diverse habitats that we have lost through the years. In the beginning there were only 1185 arches of dry land in Boston, but by filling in salt marshes and lowlands we gained 2055 acres of dry land, creating the 3240 acres of land that Boston now sits upon (John and Mildred Teal). Salt marshes have an incredible healing ability to filter out pollutants, and create nurseries for birds, reptiles, crustaceans , and insects. They create buffer zones along the coastline that protect the land inland from storm damage, protect the coastline from erosion, and helps trap sediment. In the past they were thought of as breading grounds for mosquitoes and therefore had no value. Now that the salt marshes are struggling to come back to our coastlines we understand their value and are trying to help them to flourish. However, without man stepping in to help the salt marsh take hold, it would take years for it to establish itself. Even with man's help it will still take years for a salt marsh to grow into a healthy thick marsh. This is why it is important to help restore salt marshes along our coasts.

Background

The Savin Hill Cove area is located on the back side of the Vietnam Veteran's Memorial, bordered by UMass Boston and Morrissey Boulevard. (See Appendix Fig. 1). The Savin Hill Yacht Club has to sail their boats out of this cove area to get to the shipping channel. In the past this was one lush, large salt marsh and ran the length of the coast connecting Savin Hill to Malibu Bay and UMass (See Appendix, Fig.2). Based on the core sample documentation from the pamphlet "Campus by the Sea", this marsh had 7 to 8 feet of peat.

In Dorchester, during the early 20th century, the building of the old colony parkway (now called Morrissey Boulevard) went underway filling a large amount of salt marsh and

lowlands. "The construction of the parkway followed the old colony rail road, and was intended as an automobile road between the end of Columbia point and the Neponset bridge (Seashole, 343)." Filling continued from Columbia road to Fox Point. Fill in these areas were "coal ashes, trash, and dirt from construction sites (Seashole, 343)." By 1925 most of this section was filled and a bridge across Patten's cove next to Savin Hill was created by fill. Next MDC filled in two arms crossing Savin Hill Bay, building a draw bridge. "In contrast to the ashes and trash used to fill the area north of Fox Point and across the Calf Pasture, the fill across the mouth of Savin Hill Bay was to be material dredged from Dorchester Bay (Seashole, p.343)". The construction was finished with the completion of the draw bridge in 1928 (See appendix, Fig.3). With the construction of the parkway came the destruction of the "one healthy marsh" into fragmented flow constricted areas of salt marsh. In 1956 the MDC created the present "bump" on which the Vietnam Vet Memorial sits today. It is not told why the Metropolitan District Commission Construction Division created the "bump" but it seems it was to create a park recreational area. They used tunnel rock spoil to fill in this area, which may explain why the *Spartina alternatflora* (salt marsh) has not come back all along this area (Maguire). In the early 1970's construction began for UMass Boston, they built granite bulk heads and filled in the marsh area creating the straight shoreline you see today. The Savin Hill Cove, once a thriving healthy marsh, has now been dismantled and cut off from the natural flow of sediment and water.

Issues

Pollution

Changing the shoreline changed the flow of water and sediment turning this cove into a collection pond for debris, pollution, and sediment. Columbia Point was previously inhabited by the "Main Drainage" sewer pump-out facility, The Bay State Gas Company. It then turned into

the Boston Consolidated Gas Company and a trash dump known as the Coleman Dump. All of which added acres onto the calf pasture and marsh land, polluting untold amounts of water, sediment, and land (Seashole, p.346). In 1929 the storm water drainage pipe was installed in Patten's Cove (Caitlyn Mello and Gwendolyn Richards, p.7) (See appendix, Fig.4), and once UMass built the granite wall they also installed storm water drainage out flow in this wall that drain the pollutants from the campus parking lots right into this cove.

Storm water and Sediment runoff

The Neponset River flows directly out into this shipping channel area and from talking with Phil McMann, the commodore of the Savin Hill Yacht Club, and Chris Sweeney, the head of Marine operations at Umass Boston, the consensus is that the sediment travels in this path flowing through the shipping channel and then swirls into the cove where it settles (See appendix, Fig.5). Chris Sweeney has estimated that the sediment accumulation in this area is about an inch a year (Although there is no map of currents in this area, having the word of experts in their field is better than a map). UMass's storm water is flowing into the site and will be carrying a small amount of sediment due the paved surfaces.

Concern for UMass and Morrissey Boulevard's storm water runoff is the chemicals from the cars in the parking lots and street flowing into the site. Not to mention oil and gas pollution from the shipping channel and yacht club, and any chemical pollution from boat cleaners.

Debris

Large amounts of debris are found at the site from floating trash and broken down docks that have washed up onto the marsh and seem to crush the *Spartina alternatflora* stocks with

every high and low tide (See appendix, Fig. 6). Once the debris floats up into this area it seems to rest and travel further into the marsh, from what has been observed over the course of a semester. Ownership of this area is confusing and makes it hard to figure out who is responsible, because we have unclaimed property (docks) between UMass Boston's property and the Savin Hill Yacht Clubs property (See Appendix, Fig.7,8,9,10). Also, the road is owned by DCR where it may travel in the next flood tide.

Public Access

Another issue is public access, the beach area is a rocky path and because of all the debris along the beach it looks like a polluted site, no one really walks down along the top of the marsh. If there was a walkway, the community would be able to walk and enjoy this area. It would also be better for the marsh, without the foot traffic it might help the marsh grow (see appendix, Fig.11).

Goals/Vision

The ultimate goal is to have this fringe salt marsh return to a healthy thriving marsh that can give back the habitat the ecosystem lost so long ago. Our goals for this project are to create a path for the next capstone generation and take our research to further the restoration of the salt marsh, so that one day we can reach our ultimate goal. By continuing this research a community is starting to care about this forgotten spot, and through communicating with others we are creating awareness and a sense of place. We are hoping to inspire the community, the University, and the marsh to make a change.

Objectives

Our social objectives are to create social awareness of this site by creating an interactive website where students, teachers, researchers, yacht club members, and the community can post their ideas, questions, stories, artwork, and data about the site, creating a hub of information and inspiration about the salt marsh. Our biological objective is to gather as much data on our site as possible, and help gather our own data when we can. Creating a vision and protocol of what needs to be done in order to reach our ultimate goal. Our legal objectives are to create a form of all the policies and regulations that new students can follow in the future.

With the involvement of the University and the community, this document is prepared in such a way to allow the access to applicable legal objectives. This document is to serve the community in creating an aware and informed public. In any environmental restoration process there are many laws, legislations, and contingency plans that must be followed. This is an overview intended as a framework for future groups and project representatives within the community to use as a preliminary measure. In this particular case we are looking at the restoration of a salt marsh and coastal region that has many impacts on the surrounding community. With the in depth knowledge of licensing agreements, costal protection, and water front acts we can create better structured and efficient plans in the future.

Within federal and state laws there are many strict regulations that take place due to the historical nature and negative impacts we have inflicted on our coastal systems. Compliance with Federal laws is of some importance; however the main focus of many of these zoning and rehabilitation regulations is done on a state level. This is because the federal laws cover a broad spectrum and each specific location is different, therefore the state regulations cover these specific areas of interest.

Methodology

Overview

Our methodology was to first learn all we could about the site. We visited our site several times at low tides, high tides, and even at flood tide observing the life that was here and observing the obstacles the salt marsh is facing (See appendix, Fig. 12). After our initial observations we had a meeting with John O'Donnell, an environmental consultant for the Commonwealth of MA, at the site. We discussed some of the policy and regulations, and some of the biological data we would need to restore the site. This is when we (Bill and Danielle) decided to split the work load with Bill taking the policy side of restoring the salt marsh and Danielle took the biological side.

Legal objectives

Extensive research on many individual licenses, acts, and plans was necessary to compile a document that will inform people who are interested in the project. Many people were consulted who work for a number of different agencies and organizations. The idea is to create a framework on which future mediators of this project can build upon to better the Savin Hill Cove ecosystem and community.

Community

We have contacted several researchers in order to collect past data on the site and are currently looking for a way to create a space where the community, students, teachers, and researchers can add data, comments, and ask questions. We took every aspect that we wanted to further investigate and evaluate history, Native American history, steps to restoring the salt marsh, sediment, and water data. We also contacted people within those fields. This created a

chain of people who were excited to help; they would then suggest talking to another person, and then that person would suggest more people. We have been creating a network of people that can help further the project along. We have contacted the stake holders, and have met with Chris Sweeney and Phil McMann. Meeting with both the stake holders really helped us understand the complexity of the issues at hand.

The key to this whole concept is community and public involvement. The way to do this is to integrate them into the research and study of the area. If they have access to materials and research data, as well as the legal and planning side of things, people will become more informed. As people become more informed they will gain interest and become more involved. Instead of making this a semester project for a University class the objective is to make this a lasting project within the community. The access of information holds the key to success.

Site Research

We both researched other sites with similar issues to understand what the options are. One of these sites was the "Save the Bay" project where they took an area of shoreline that was armored land fill and excavated the middle of the coastline, added sand and secured both the upper edge and lower edge of the coastline with rocks. The blend of hard and soft structures to restore a coastline that had similar issues was interesting. Danielle has also been investigating unconventional methods of cleaning up a coastal area.

Protocol Research

Danielle started gathering as many resources as possible to help understand how you restore a salt marsh. Reading the protocol from "Restoration of the Salt Marsh and Dredging in Savin Hill Cove" gave her an understanding on the complexity of steps that need to be followed. She then contacted a friend of Anamarija Frankic's, Susan Redlich, to help her further

understand what needed to be done. Susan Redlich is the former manager of the MA-Corporate Wetlands Restoration Partnership at UMASS-Boston Urban Harbors Institute. Ms. Redlich was a wonderful resource of information and had extensive information on protocol and budget planning.

Oysters

While Danielle was trying to find an organism that might be able to help clean up the site, Anamarija found oysters in the Savin Hill Cove. It was a remarkable find, because oysters like to have a hard sub-straight to attach to and the cove is full of silt sediment that would normally choke the oysters. This is when she met Kim Rich, another capstone student that is working on the oysters and sediment data in the lab. Kim, Anamarija, and Danielle went down to the site to take some measurements, collect some sediment, and count the oysters. It was an exciting discovery since the past dredging team had dug up the 2006 environmental assessment that was completed for Bourne Consulting Engineering, hired for the 2006 dredge at Savin Hill Cove. "This environmental assessment points out that habitat quality at Savin Hill Cove has time and again been evaluated as the poorest of any station in the Massachusetts Water Resource Authority (MWRA) study (Normandeau Associates, 2006). The simple fact that dredging, a process usually thought of as environmentally destructive, could be more helpful than harmful to this environment was a key indicator that this ecosystem was severely suffering (Caitlyn Mello and Gwendolyn Richards, p.10)." However, now that we have found oysters there is a red flag, since oysters are a keystone species it shows us that the environment is improving and dredging in this area would kill the oysters, even the shifting of sediment could kill them. Therefore we need to find another solution to dredging, discussed further in results section. Other oyster data

has been collected from Dr. Sarmad Saman, Professor of Microbiology at Mass Bay Community College. He has taken five oysters and dissected them to run analysis on their tissues (results are in the results section).

Lab work

Danielle has been helping Kim in the lab with the sediment data and helped polish the oysters for analysis. In the lab Danielle helped monitor sediment through drying process and measure sediment into smaller containers. She observed Kim Rich, and Jeremy Williams in the acid digestion process, which is a trace clean process, diluting the sediment samples down to make them ready for the instrument. The instrument measures trace, minor elements, and metals through ionization. Interestingly, Malibu Beach was tested for the same major and minor elements; therefore we can compare the data to see if there are any similarities. Kim Rich is currently working on analyzing the oyster shell slides to find out how old the oysters were and where they might have come from. Note: The oyster shells were collected from dead oysters in Savin Hill Cove. The sediment analysis and oyster shell data is currently pending analysis due to broken instruments in the lab. These results will be made available to you in the spring time.

Field Surveying

Danielle helped Timothy Maguire take field survey measurements in order for Timothy to create a contour map. They used traditional methods of field surveying using a tape measure, level, and measuring poll. Measurements were taken along the top of the high marsh at every twenty five feet and from the top of the shore line down to the water's edge every ten feet. They also took note to where the salt marsh growth started and ended. Note: excluded are the two

small stretches of *Spartina alternatflora* that are located by the road on either side of the walkway up to the Vietnam Veteran Memorial.

Data Collection

Danielle pulled out the data from the MWRA website for the Savin Hill Cove area on bacteria count (fecal coliform count), water clarity, nutrients, water temperature, and dissolved oxygen. The data was for years ranging from 1989 to 2010; however it is not complete. Some years only one measurement was taken and others there are many in one month, making it hard to compare. Anamarija had mentioned, however, that Party Slatery had taken water samples at Patten's Cove during the summer and noticed a trend in the data; after it rained there was a significant increase in fecal coliform counts. Therefore, the years that seemed to have had the most complete sets of data was taken and compared by taking the monthly average of fecal coliform counts and comparing them (results in results section).

Results

Stake Holder Ideas

Our results revealed that there is a large community of people interested in the restoration of this site, however when it comes down to money it becomes a much more complicated issue. Meeting with the stake holders of this site both Chris Sweeney, and Phil McMann revealed that they would both like to see this area cleaned up.

Chris Sweeney wrote a proposal to have the broken down docks removed from the salt marsh. His proposal "Savin Hill Cove Marine Debris Removal Project" was written about five years ago and reviewed what equipment, staff, and permits would be needed and how much it

would cost, in order to undertake this project. After totaling all of the costs and having UMass supplement some of this the project would cost $44,407.15. Needless to say the project was turned down for funding by the "Community-based Marine Debris Prevention and Removal Project Grants Competition". The letter states, "Many of the proposals received were of high quality and deserving support, and were not recommended for awards simply due to a lack of funds available for this purpose," another loss for the struggling salt marsh, since NOAA did not view this site as worthy for funding. Note: If you were going to resend this proposal you would need to estimate in the increase in gas prices and salary wages.

Phil McMann, the commodore of the Savin Hill Yacht Club, had a similar vision of this area. He would like to see the area cleaned up and have the S*partina alternatflora* fill in along the road by Morrissey Boulevard in the stretch of area raging from the yacht club to the boat ramp. He would also like to see the site on the other side of the yacht club cleared of debris so that the salt marsh can grow back full and healthy. When asked about what he will be doing about the erosion at the end of his property, he responded by saying he would love to have a similar riprap to the University's harbor walk around his club. He is interested in the aesthetics of the yacht club and the biodiversity the salt marsh will bring to this area.

As we were chatting for hours in the quiet yacht club a flock of cormorants swam into the cove and turned in unison into this stretch of salt marsh along Morrissey between the club and the boat ramp. They were beautiful swimming and diving so sleek in the water; he explained to me that they were fishing and most likely chasing a school of fish. This is when he explained that the salt marsh restoration would clean up the area bringing back the fish and shellfish into this area. This whole community and wildlife both have the same desire and vision. We told him about our discovery of Oysters in the cove and he was happy to hear that, with his

background as an environmental police officer he understood that this meant the site is improving. He then started talking about how some of the members of the yacht club used to collect clams back in the day. They would go down and collect them and bring them home and cook them up for dinner, we immediately regretted telling him about the oysters and started worrying for their safety.

Note: Phil is a wonderful man with a busy family life, retired but it may be hard to meet with him. Danielle had called the yacht club but because it is going into the winter there are not as many people around and the phone just kept ringing. She also called his wife who disregarded her call because she hadn't prepared what she was going to say. For future students, prepare what you are going to say and be clear that you are only a student. She was lucky since it just so happened Chris Sweeney docks his boat at the yacht club and is friends with Phil, Chris mentioned that Phil should contact her. Also, the yacht club is locked and you should make a meeting with Phil since he is retired he is not always there.

Oyster Discovery

In the field Kim, Anamarija, and Danielle counted three native oysters *(Crassostrea virginica),* and 21 European oysters (*Ostrea edulis) (*See appendix, fig.13, 14). Our results showed that the two places where the oysters were found were both in areas where at low tide the water continuously flows out of the hill (See Appendix, fig.15). At first Danielle thought the water must be ground water because it continuously flows until high tide comes back in. However, Anamarija had it tested with a refractometer and it was salt water. After researching the documents from UMass construction sediment cores it revealed that under Umass there is "a layer of blue clay ranges from 0-175 ft deep" (Campus by the sea, P.4). Comparing this data to old maps provided by the Dorchester Historical Society it revealed this marsh was "one" marsh

in 1875 (See appendix, fig. 2). Therefore we are drawing the conclusion that this same blue clay is under the tunnel rock fill at the Vietnam Veteran Hill and it creates a barrier filling at high tide and slowly flowing out at low tide. The clear water flows out of the hill at such a rate it moves the silt sediment creating a channel that then flows down into the main channel. By clearing this path it reveals a hard sub straight of rocks and shells which the oysters prefer (See appendix, fig.16).

This environment is not the best for the oysters since they are laying on this sub straight, it would be easy for the sediment to flow over them and kill them. Note: When you walk into the channel you need to be careful where you step, try walking to the side of the channel as to not disturb the sediment or crush the oysters, which gets tricky since every step creates murky water. Go with only two people and give yourself some time for carful stepping, and keep in mind the tide. Do not walk into the muck you will get stuck, you need boots knee height or higher.

Oyster Tissue Data

Mass Bay College collected five oysters and tested their tissues to see what contaminants were in the tissues, and on the shells of the oysters. Their results were: "The oyster samples total bacterial count ranged between 225 to 284 organisms per ml of oyster fluid. *Listeria sp* over 163 per ml and we also found levels of *Vibrio sp* of around 25 per ml. There were low levels *Salmonella*, and very low levels of *Bacillus* around 5 per ml. On the out cover of the Oyster we found mostly the same as the above but in numbers ranging from 118-150 per ml of the growth solution. I think to make this into a paper we need sampling over a period of time taking into account temperature, water salinity, pH and climatic factors (Dr. Sarmad Saman, Professor of

Microbiology at Mass Bay Community College). "*Listeria*, and *Salmonella* are bacterial pathogens frequently associated with fecal pollution (Bacterial and viral Pathogens, p.1)." Therefore, further investigation into sewage pollution is necessary. Regular monitoring of the fecal coliforms in the Patten Cove area and near the Umass storm water runoff out falls could help pinpoint the source of the pollution. Note: We have been working on Boston Water and Sewer to give us information they have collected from the area between Patten's Cove and Savin Hill Cove (the green box at the entrance of Umass), we are still waiting.

Dock Removal

Results from reviewing the debris removal project and talking with the stake holders made us realize that removing debris from this area would not be easy and we started wondering if we could instead use these docks as sediment anchors for the salt marsh grasses to grow on. The problem with this idea is wood floats, so as the tide would come in and out the wood would float and sink ever uprooting the peat. We visited the marsh several weeks in a row and observed this happen (see appendix, Fig.6). One week the salt marsh was lush and auburn, and then this dock crushed and snapped the stocks of *Spartina alternatflora* with the ebb and flow of the tide. We have come to the conclusion the docks need to be removed because if you try to drag them out of tidal range to stop the rise and fall, they will crush the salt marsh grasses either way. Also by removing them you will be making the site more ascetically pleasing and this would draw awareness and community to the site.

Protocol and Neponset Dam Removal

After researching the source of sediment mentioned in the previous dredging team's report we realized that the main sediment comes from Neponset River and with the removal of the Baker Dam and the T&H Dam the increase in sediment will greatly affect the cove (See

appendix, 17). Since these sediments are known to have pollutants (PCB's) in them the process in which they clean up these sediments and remove these dams greatly affects our plans for the salt marsh restoration. Steve Pearlman, who is part of the Neponset River Association, has said that the dams will be removed no sooner than 5 years but most likely it will be more. Due to this fact the next steps in the restoration plans should be gathering baseline data and monitoring the site, so that we can understand the effects the dam removal will have on the cove (Before and After data).

After discovering the oysters we have realized that this area must be improving. The previous thoughts of dredging in this cove behind the Savin Hill Yacht Club would not be acceptable, since you would be destroying a species that could greatly improve the sites water and sediment quality. One adult oyster can filter up to Fifty gallons of water a day which is why they are a keystone species (Chesapeake bay.com). Wherever the oysters go biodiversity is bound to follow. Therefore instead of listing protocol for restoration of the marsh, we first need to collect our baseline data and arrange a monitoring system, monitoring for base line data includes: tidal hydrology, salinity, plants, birds, fish, and invertebrates.

MWRA

What we found was similar to patty's findings. There was a higher fecal coliform count during May, June, July and August. Of course the trend wasn't the same every year because weather will change from month to month, but you can see a similarity in data (See appendix, Fig.18, 19). These results make me wonder if the CSO in Patten's cove is closed or not. If you look at their map of open and closed, CSO's Patten's Cove does not say if it is opened or closed, which is interesting (See appendix, Fig.4).

Field Surveying

The results from surveying the area produced a contour map that helps us see and understand the elevation of the marsh. The map points out where the salt marsh is growing and where potential salt marsh growth could be in the future (See Appendix, Fig.20). Understanding the elevation of the current salt marsh is one of the baseline data that we will need in order to plan the restoration project. In order to create a more accurate map you can use GIS software to plot the points using a satellite to get an exact match to the salt marsh. This would be a great opportunity for the GIS classes to learn how to plot their own points and would help monitor the salt marsh growth every semester creating a season long history of growth.

Community Involvement

We are currently working with Lisa Greber to create a mock wiki (an informational website) for Savin Hill Cove. This wiki is a way for all of the people we have contacted over the course of the semester to stay informed and in touch with this area. They will be able to monitor progress and even have opportunities to provide their expert expertise in their fields. This will also be a great way for the community to feel joined with the University in a group effort to help heal this cove. By creating a website the community can provide their expert knowledge alongside researchers. All who have accessed the site will be able to post their questions, observations, stories, data, and art work about the cove. With awareness brings inspiration and motivation, creating a strong community willing to lend a hand when needed.

Public Access

A long-term goal for the site is community interaction and the construction of a boardwalk would allow for this to be possible. The placement and location of the boardwalk is still in question however it would provide direct access to the marsh without damaging it over time. The boardwalk could be constructed before the restoration of the marsh to allow for the marsh not to be partially destroyed or damaged during the construction.

At the current state of the cove there is no access during storm or high tide events, a small path between the low marsh and high marsh has formed over the years, however this path becomes submerged during such events. As the community and university become more involved it may become clear on the wants and needs that the boardwalk may need to fulfill. There are examples of such boardwalks in Minute Man National Historic Park in Concord MA. Structures like these are a great way to integrate and educate the community on salt marsh ecosystem benefits. It also allows a place for recreation and leisure activities that benefit everyone.

Due to the new oyster discoveries in the cove before breaking ground on the walkway you will fist need to assemble an erosion and sediment control plan. Since the slightest displacement of sediment could roll over the oysters and kill them this step is very important. Using silt fencing you can close off your construction site in the high marsh area and protect the delicate oyster habitat (See appendix, Fig21). The walkway will need to be raised off the ground so that high salt marsh plants can receive the light they need. There are regulations as to the height and width of the walkway and spacing between the boards. Further investigation to exactly where the walkway will be placed is important because depending on the high marsh plants growing underneath it there are different height suggestions. For example, " spike grass was largely unaffected by a dock of ~70 cm in height; salt meadow cordgrass required a dock

height of ~85 cm to remain unaffected; smooth cordgrass required a dock height of ~200 cm to reach no effect status(habitat.noaa.gov)."

A better sidewalk along Morrissey boulevard has been proposed by last year's dredging team by using bio retention boxes along the road way to catch excess sediment and storm water. We agree this would help with the flooding and storm water issues. We proposed that the walk way be raised slightly off the ground since the side walk is eroding and giving way to the water, if they do not raise the road it would be useless to pave over just to have the same issues. If you raised the walkway slightly and used bio retention boxes along the road and along the walkway framing the walkway it would help with the flooding problems. Including in this design is a railing along the walk way for safety (Caitlyn Mello and Gwendolyn Richards, p.18).

Permits and Licensing

Applicable Federal Wetland Permits, Requirements and Licensing

Clean Water Act, Section 404:

All projects involving a discharge of fill or dredged materials into the Water of the United States, including wetlands, require a federal permit from the U.S. Army Corps of Engineers. In Massachusetts, major projects or projects with more than minimal impacts to aquatic resources require an Individual Permit, with extensive public review and comment provisions. Simple minimal impact projects may be permitted under the existing General Permit for Massachusetts without direct federal review, once they have received the local and state approvals. Intermediate projects, as defined in categories set forth in the terms of the General Permit, are individually screened by the federal natural resource agencies and, based on project purpose and overall project impact, may either be approved under the General Permit without

further review or required to obtain an Individual Permit. Wetland restoration projects involving increase in culvert size or some change in tide gate will be likely to be screened under General Permit but may require Individual Permit review due to secondary impacts. Since Section 404 wetland permitting is triggered by the placement of fill or other discharge to waters of the United States, projects involving only careful removal of the dredge spoil may not be subject to Section 404 permit review depending on how the work is conducted. However, a Section 10 permit review will be required if work is proposed in navigable/tidal waters.

In the case of the Savin Hill Cove salt marsh this is the first step towards a requirement that will be needed. Depending on the size of the project and how the salt marsh will be restored or reconstructed will depend on which variant of permit required. Since Savin Hill Cove is potentially navigable/ tidal water additional Section 10 permit review will be necessary. Ample time should be allowed for these proposals to get reviewed and approved, because this is at a federal level and may take longer than a localized government review. Once obtained, these permits will allow for the focus to shift to the state regulations (See appendix, Fig.22).

Applicable State Wetland Permits, Requirements and Licensing

<u>401 Water Quality Certification/ Water Quality Standards:</u>

Any project requiring a federal wetlands permit under S.404 (for discharge to waters of the United States, including wetlands) also requires a 401 Water Quality Certification (WQC) from the MA Department of Environmental Protection (DEP). Through the 401 WQC process, the DEP essentially 'certifies' to the federal government that the proposed discharge will not degrade the quality of the resource as determined by the state's approved Water Quality Standards. Certifications typically include provisions, which condition the way in which work

can be done (i.e., requirements for erosion/sediment control Best Management Practices) and how dredged material shall be handled (i.e., removed, dewatered, dispose). Many wetland restoration projects will be eligible for WQC under the routine provisions of the permit process and regulation. However, under MA Water Quality Standards, all public water supplies, their tributaries, some Areas of Critical Environmental Concern (ACEC's), and certified vernal pools are designated as Outstanding Resource Waters. New or increased discharges to Outstanding Resource Waters are prohibited unless (1) the discharge "is determined by the Director to be for the express purpose and intent of maintaining or enhancing the resource for its designed use a variance from this regulation is granted" or (2) " the discharge is dredged or fill material for qualifying activities in limited circumstances". Wetland restoration projects in Outstanding Resource Waters must be carefully designed to meet these provisions in order to be eligible for WQC. Even in the absence of any other state or federal permit, the requirement for a Section 401 Water quality Certification may also trigger MEPA review for projects about certain regulatory thresholds.

The Savin Hill Cove does, in fact, provide an outlet for a large storm water drainage system. This is a new system that was recently constructed and when old sewer systems become overrun in the event of a significant storm, the safeguards that have been implemented across the majority of the City of Boston in the last decade allow for excess water to be diverted into the harbor. This system is to discourage the overflow of storm and sewer systems containing harmful human waste and is an input into the cove. This overflow water is closely monitored. This discharge would have to be reviewed under the 401 WQC.

A process like this one can be very lengthy, it is important that the certification is filed for at the beginning of the restoration process. If there is a future need for dredging in the area,

which is highly likely in order to create a navigable channel for the University of Massachusetts Boston vessels to access the campus dock, there will have to be additional water quality tests done to deal with the disruption and displacement of sediment. With the amount of testing and approval that is needed this whole certification can take up to a year to complete.

Wetlands Protection Act, MGL c.131, s.40 and 310 CMR 10.00:

Any project that will "dredge, fill, alter or remove" any wetland resource area, as defined in the statute or regulations, requires an Order of Conditions (permit) from the municipal Conservation Commission or upon appeal, the MA Department of Environmental Protection (DEP). The Notice of Intent (permit application) is submitted jointly to the local Commission and the DEP and a public hearing is held on each application. Work in each wetland resource area (wetland type) is governed by performance standards intended to protect the public interest in wetland areas, and disturbance in many resource areas is strictly limited by regulation. Projects that disturb less than these threshold impacts may be permissible at the discretion of the local Commission or, upon appeal, the DEP. Wetland restoration projects disturbing wetland areas larger than the regulatory thresholds are required to comply with specific inland (310 CMR 10.53(4)) or coastal (310 CMR 10.32(5)) regulatory requirements. Adverse impact to rare species habitat is prohibited. Other potential impacts that are to be reviewed include impacts to public and private water supplies, impact to fisheries and shellfish beds, impacts to on-site or nearby septic systems, and storm damage prevention and flooding issues.

This is an act that covers the vast itinerary of our Savin Hill Cover salt marsh. In specific we are looking at the coastal dimensions of this act (310 CMR 10.32(5)). Depending on the size of the project there will once again be different levels of certification. If the marsh is

dredged and/or re-graded in order to create an optimal environment that will promote salt marsh growth within the inter-tidal areas, specifically if there was marsh and buffer zones added within the cove to limit the damage of storm surges and flooding events.

Since there has been recent discovery of oysters in the cove, the potential impacts on this species with the change of environment, is to also be explored. These particular wetlands are very sparse and therefore some of these threshold impacts bay are insignificant and may be permissible.

Coastal Wetlands Restriction Act, MGL c. 130, s.105:

Activities in specifically mapped coastal wetlands are restricted according to the provisions of orders recorded at the county Registry of Deeds on the deeds of individual landowners. Wetland Restriction Orders vary from town-to-town but generally prohibit many activities necessary for restoration work in salt marshes and other coastal resource areas, including a prohibition against substantially altering existing patterns of tidal flow, unless the work is for mosquito control, which is exempt by statute. Where salt marsh restoration can only be accomplished by improving tidal flow, a new restriction order may be required. There are 64,148 acres of coastal wetland (including barrier beaches) under restriction orders in 47 coastal communities.

Chapter 91, Waterfront Protection Act:

MGL Ch. 91 protects the public rights of fishing, fowling, navigation, and access to "trust lands", ensuring that such lands are reserved for water-dependent uses or otherwise serve a

public purpose. Jurisdiction generally includes areas now or formally below mean high water in coastal and inland waterways, including Great Ponds. The act requires a license for the placement of fill or structures, or the alteration of existing licensed structures (such as culverts and tide gates), in flowed or filled tidelands or land beneath most rivers and perennial streams. A large number of wetland restoration projects involve such structures. Under certain circumstances the DEP waterways program may handle projects as minor modifications (310 CMR 9.22(3)) to existing licensed structures (pre-1984), minor modifications to qualified public service projects (310 CMR 9.05(3)), or simplifies processes. Some inland projects may be exempt, such as placement of fill or structures in non-tidal river, which does not reduce the space available for navigation and for which a final Order of conditions has been issued under the Wetlands Protection Act (319 CMR 9.05(3) (g)). In addition to submittal of the application, licensing fees, and various public notice requirements, licensing requires the preparation of mylar plans stamped by a registered professional engineer. Municipal and state agency projects are exempt from Ch. 91 licensing fees (See appendix, Fig.23)

There are many small regulations that are included in Chapter 91, one of which states that public access to the waterway but be implemented. In our case of Savin Hill Cove this is not entirely the case. The public can access the cove from Morrissey Boulevard, but there is no direct access for the campus of the university.

The current condition and the use of riprap are in potential violation of Ch. 91. This protection act also comes with a fee and they may range from anywhere to $5,000 for smaller projects and much more for larger ones. This is a cost that the university and community need to consider. The process is another situation that can be drawn out over a long period of time. It may take up to a year to get approval under the Ch. 91 Waterfront Protection Act.

MA Environmental Policy Act (MGL Ch. 30, ss.61-62H):

The MA Environmental Policy Act (MEPA) requires that all agencies of the commonwealth engage in a public review process to determine the impacts on the natural environment of all works, projects, or activities conducted by the. MEPA applies to projects directly undertaken by state agencies and to private projects, for which state permits are required, state funding or land transfer is involved and environmental impacts are above certain thresholds specified in the regulations. For a project requiring MEPA review in accordance with 301 CMR 11.00 and Environmental Notification Form ENF is filed to describe the project, identify its potential environmental impacts, and to determine if additional review is necessary to avoid, minimize, or migrate those impacts. If additional environmental review is required, a full Environmental Impact Report (EIR) must be prepared for public review in draft and final forms.

The Savin Hill Cove project will have been reviewed and all impacts of the salt marsh restoration processes will have to be taken into consideration. However with the current condition of the cove it should not be of high concern. The current degraded state of the marsh will allow for future proposals to be of greater importance with greater public demand to be more highly considered by the MEPA. The involvement of the university and the community is critical within the Savin Hill Cove ecosystem. As the conditions in the cove become improved the MEPA will become much more compliant with the environmental concerns and improvement requests. This act is one of the shorter approvals; at most this approval should take a couple of months.

Coastal Zone Consistency:

While the Massachusetts Coastal Zone Management Office (MCZM) is not a permitting agency, it does have the authority to review federal activities in the Massachusetts coastal zone to ensure that they are consistent with MCZM program policies. Consequently, any coastal project that requires a federal license, is implemented by a federal agency, or is carried out with federal funds must be approved by MCZM before the federal activity can take place. Overall, MCZM's Federal Consistency Review gives the Commonwealth the power to ensure that the proposed activity is consistent with enforceable MCZM program policies.

-HABITAT POLICY #1 – Protect coastal resource areas including salt marshes, shellfish beds, dunes, beaches, barrier beaches, salt ponds, eelgrass beds, and fresh water wetlands for their important role of natural habitats.

-HABITAT POLICY #2 – Restore degraded or former wetland resources in coastal areas and ensure that activities in coastal areas do not further wetland degradation but instead take advantage of opportunities to engage in wetland restoration.

The Habitat Policy #2 directly responds to the current condition at Savin Hill Cove. To ensure that the cove projects makes it to these stages and federal review, all of the other state environmental licenses but be completed before the federal review takes place. If a project proposal for Savin Hill Cove salt marsh restoration makes it to this point it is subject to review, however at this stage the majority of licensing and regulation should be completed.

Solid Waste Management:

In some instances, materials to be removed from a wetland for the purpose of wetland restoration may meet the definition of solid waste (MGL Ch. 111 s. 150a, regulations at 310 CMR 16.00 and 19.00) and must be managed at a solid waste management facility, e.g., a

licensed landfill. Management of such solid waste at an offsite, non-landfill location may trigger a requirement for permission from DEP Solid Waste (disposal site assignment). Under certain limited circumstances, and with advance notification to the DEP, such material may be managed on site to create upland habitats. Off-site management is more likely to be necessary for larger projects.

If material is to be dredged at the Savin Hill location it may be used at the same location for a different purpose. Such as in the upper marsh or used to create a grade of land in which the salt marsh could thrive. This instance is specifically applicable to the cove because it does need to be dredged and the material from that event could be used to restore or rebuild the marsh. The transportation and disposal of this dredged material is extremely expensive and it would be most cost effect if possible, to use this at different locations around the cove.

Ch. 21E/MA Contingency Plan (MCP):

In some instance, dredge spoils or materials to be removed from a wetland for the purpose of wetland restoration may have been contaminated with oil or hazardous materials (MGL Ch.21E, s.2) and must be managed in accordance with the MCP (310 CMR 40.0000). The MCP requires notification to DEP of releases or threats of release of oil or hazardous material into the environment. Notification is required when a person obligated to report obtains sufficient knowledge through direct evidence (e.g., visual observation, soil analysis) that a reportable quantity has been released or reportable concentrations have been found. Excavation of potentially contaminated fill or dredge spoils from a wetland for restoration purposes could trigger costly clean up requirements under MGL 21E if there is evidence of contamination. Even conformation that there are reportable concentrations present in the material can trigger

assessment and remediation. As a result of these requirements, the issue of potentially contaminated dredge spoils or fill materials needs to be closely evaluated in the development of any wetland restoration project.

If sediment in the cove contains high levels of contaminants then this contingency plan will be addressed. However if the sediment samples support insufficient levels of contaminants and barring any accidental sediment contamination during restoration, then there should be no need to consult this particular plan.

Vision

Short term vision

Floating salt marshes are a tool that could help us clean the water that comes out of the Neponset River and help filter out suspended solids (See appendix, Fig 24). By putting these floating salt marshes at the corners of the Neponset River and around the riprap coast where the multi colored gas tank is it could be a less expensive option (see appendix, fig 5). These floating salt marshes could be used throughout the cove. For example, in the shallow cove near the yacht club docks, since it is too shallow for the boats to travel in this area it could help clean some of the pollutants from the boats and improve biodiversity.

Another idea is to monitor small areas of planted *Spartina alternatflora* on the cove beach to see their progress. This way we can help to clean up the habitat without spending a lot of money and collect data on these patches of salt marsh to get a basic understanding of what this particular salt marsh needs. With these smaller salt marshes there is a huge opportunity for the University to create a living lab in this area. These salt marshes will need to be monitored every season and baseline data will need to be collected. In this way we can collect the baseline data needed to create a vision and protocol for the larger salt marsh restoration that can then take place after the dam removals.

There are educational opportunities in every step of this restoration process. Another idea we had is by designating this site as a living lab. We could then use some of the ingenious ideas students have come up with. For example, the system that cleans debris out of the storm water and then kills off bacteria using a UV light. Theses could be fitted to all the storm water drainage pipes and then students could monitor the environmental affects. It could even become a competition like the biomimicry design competition, where the winner could actually have their object built and placed into the lab and monitor the progress. Giving students an opportunity to see their ideas through and it would be great publicity for the school.

Long Term Vision

Our long term vision is to see this whole cove fill in as a salt marsh with the channels cut through it for the oysters and to keep the flow through Patten's cove (see appendix, fig.25). Creating a beautiful landscape full of biodiversity and being actively monitored by the University. This salt marsh would purify the water and create a place for the sediment to accumulate, leaving the shipping channels open without the need for dredging. The community could then enjoy this area as a pristine salt marsh where you could sit on the Vietnam Veterans Memorial and bird watch , have art painting classes or morning yoga, creating a spot for recreation, relaxation, and education.

Discussion and Questions

The proposed dam removal will greatly affect the cove; we are recommending that no expensive and intensive restoration be started until after we have monitored the effects the dam removal will have on the site.

Questions for further investigation are: Is Patten's cove not considered a CSO and is that why it is not on the MWRA map? Is it a closed CSO and the fecal coliform data are coming from storm water drainage or from past pollution buried in the sediment? If Patten's cove is a CSO that should be closed could the sealant be broken?

If dock removal is too expensive is there a way to secure the docks and use them as a medium for planting *Spartina alternatflora?* If so do the chemicals leaking from the old pressure treated wood effect the growth of the *Spartina alternatflora?* When doing our research we came across old pictures from Chris Sweeney's Dock removal proposal, these pictures showed extensive docks and tons of debris on the property but there are not as many now. Where did the docks go? Was there a community clean up? Did they float away or are the buried at the site?

What will happen when the Neponset dams are removed will the flow of water improve the biodiversity in the cove? Or will the sediment rush out and severely destroy any live that is currently in the cove? Is there a noninvasive way to control all of that sediment that will be released with the dam removal (i.e. pneumatic barriers)?

Conclusion

Our conclusion from this report is that all people involved with our site from our stake holders to the community would like to see this site healthy and beautiful. It seems like it is only a matter of money and time needed to reach this goal. However, with having so many students excited and willing to get their hands dirty for a good cause it would be a great way to teach students and the community about the salt marsh. Giving them the knowledge and the skills they may need in the future and help make the restoration very cheap. It would give the University great publicity and help mend fences between the community and the school. The community

would have a beautiful spot for recreation, and a clean coastal system. The yacht club will no longer have an erosion problem and the beauty would bring in new members. A happy marsh brings in biodiversity and cleans up the pollutants. This project could be a huge opportunity for Umass to use the resources it has and move into the future of education.

Acknowledgments

We would like to thank everyone who helped guide us through this project. Thank you for giving us your time and your knowledge, it was a gift. Without you this project would not have moved along so effortlessly, and hopefully someday because of the knowledge you shared we will be able to restore the Savin Hill Cove into a clean, beautiful marsh.

.

- Susan Redlich, former manager of the MA-Corporate Wetlands Restoration Partnership, at UMASS-Boston Urban Harbors Institute.
- Chris Sweeney, Director of Marine Operations at Umass Boston.
- Phil McMann, the commodore of the Savin Hill Yacht club.
- Timothy Maguire, Development of a salt marsh restoration site selection method for urban harbors.
- Lisa Greber, Graduate student of Dr. Anamarija Frankic.
- John O'Donnell, an environmental consultant for the Commonwealth of MA
- Russell Hopping, ecology program Director for the trustees of reservations.
- Brian DeGasperis, coastal ecologist for the trustees of reservations

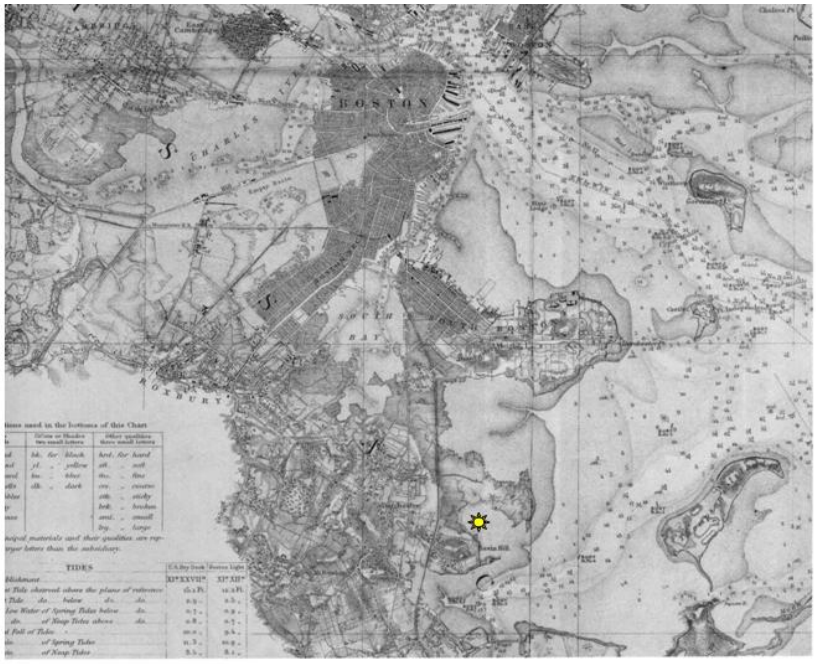
Finally, we could not have done this project without the continuous guidance from Dr.Anamarija Frankic, Professor of UMB's Environmental, Earth, and Ocean Sciences Department. Thank you for putting up with all my continuous questions with a smile and never once turning your back on us.

Appendix

Figure 1

Figure 1 is a GIS map of Savin Hill Cove

Figure 2



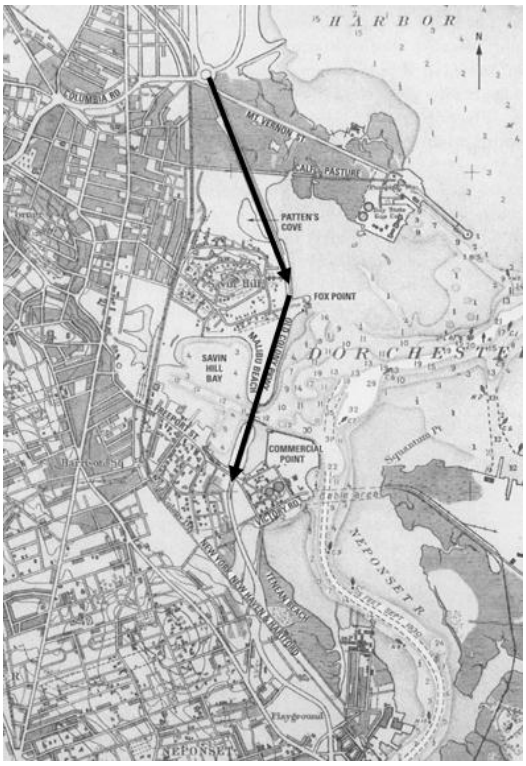
U.S. Coast Survey, *Boston Harbor, Massachusetts* ([Washington], 1857).

Map of U.S. Coastal Survey, Boston Harbor 1857

Map of U.S. Coastal Survey, Boston Harbor 1857

Figure 2 is a map from the Book "Mapping Boston" p.65, Showing how Savin Hill Cove used to look in 1857.

Figure 3



Map is from Seashole's gaining ground.

Figure 3 Is a map highlighting the Old Colony parkway construction In the early 20th century.

Figure 4

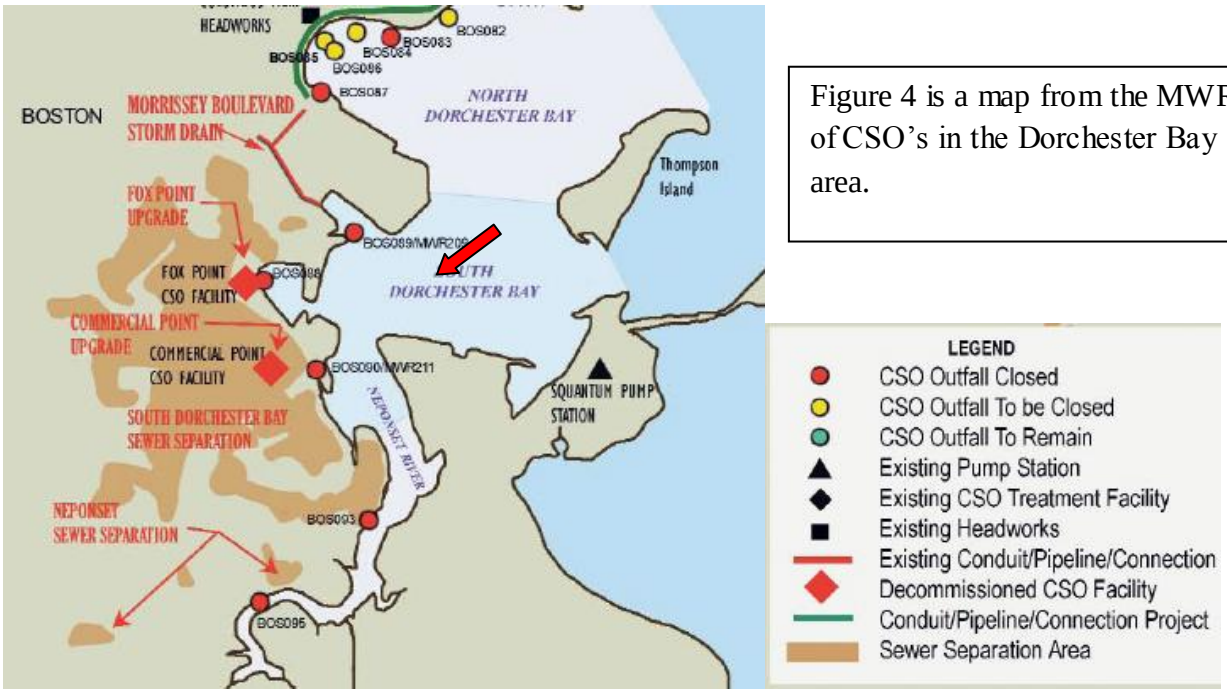
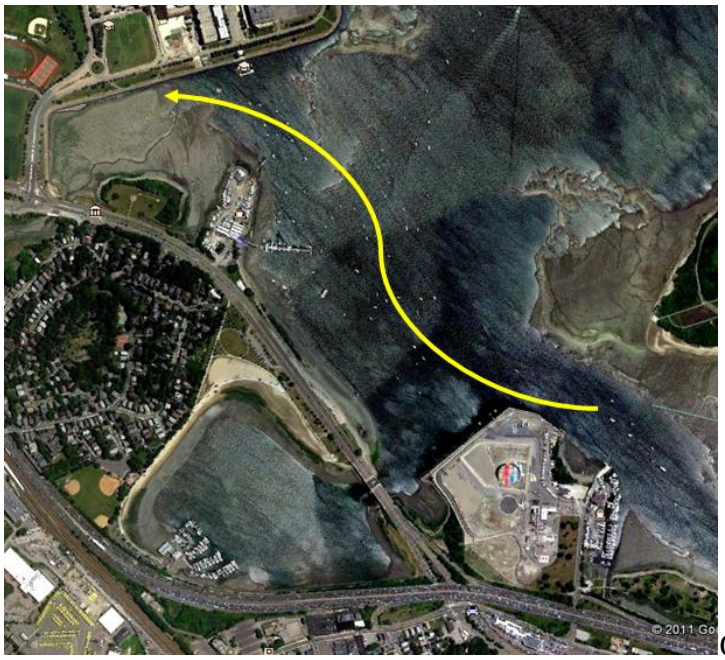


Figure 4 is a map from the MWRA of CSO's in the Dorchester Bay area.

http://www.mwra.state.ma.us/cso/csomap.htm

Figure 5



Google Earth

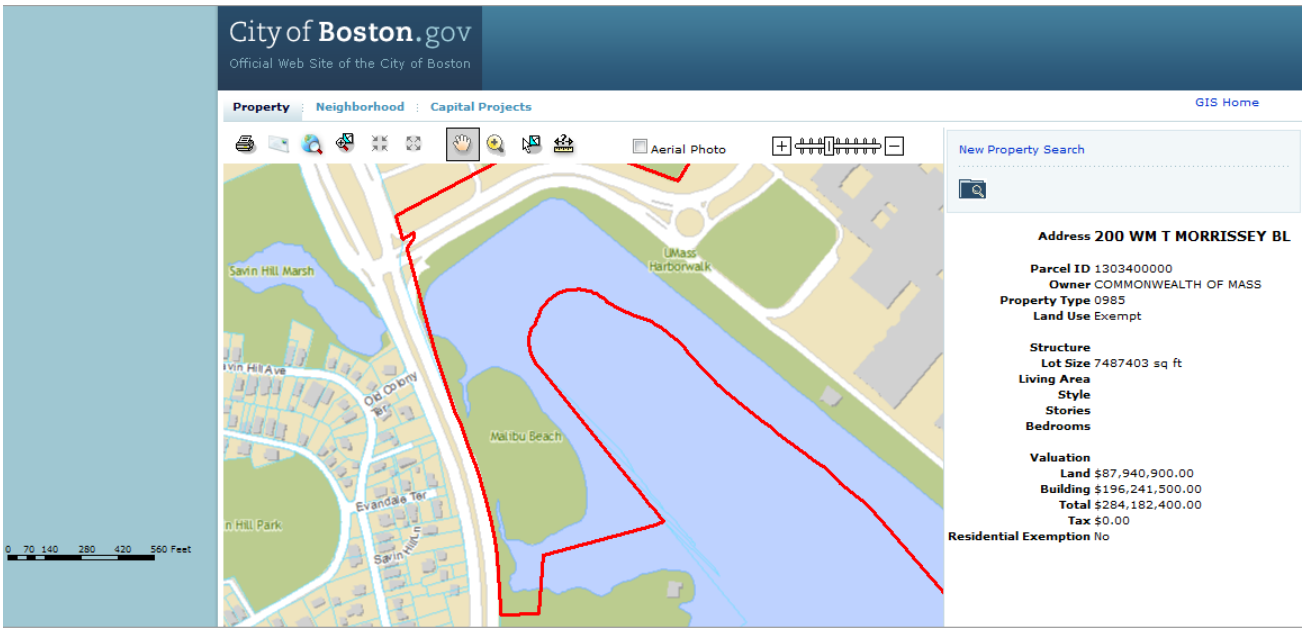
Figure 5 is a GIS map of the showing the sediment path from the Neponset river collecting in the Savin Hill Cove.

Figure 6

Picture taken by Danielle Hughes

Figure 6 is a picture showing the broken down docks resting on the salt marsh.

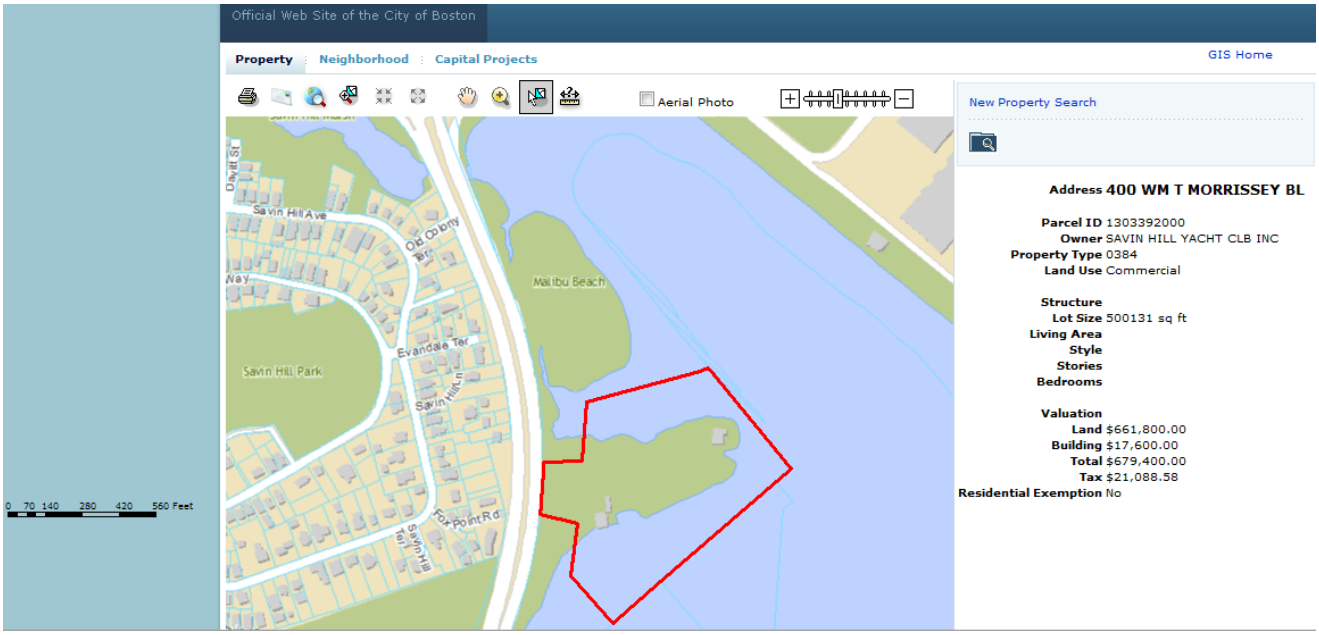
Figure 7



http://hubmaps1.cityofboston.gov/egis/Map.aspx?PropertyID=2100194000

Figure 7 is a parcel map of Umass Boston property

Figure 8



http://hubmaps1.cityofboston.gov/egis/Map.aspx?PropertyID=2100194000

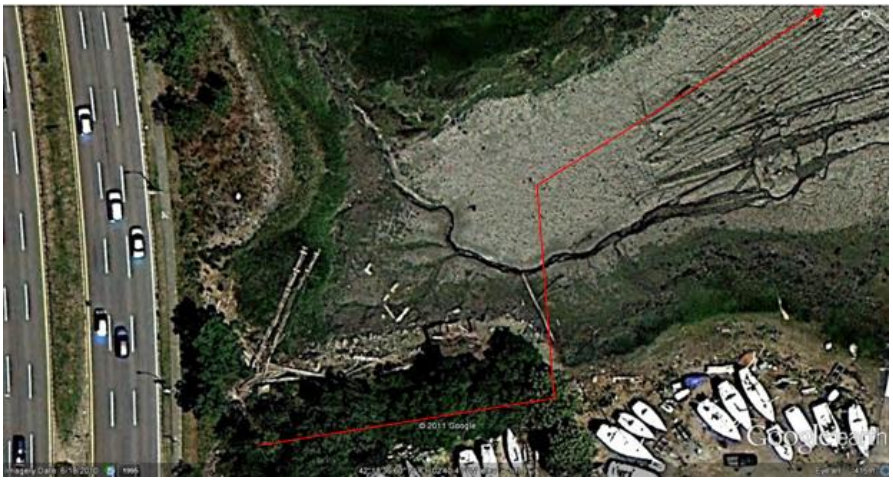
Figure 8is a parcel map of Savin Hill Yacht Club

Figure 9

Google Earth map

Figure 9 is a GIS map of the broken down docks at the site which appear to be on UMASS property when looking at the above parcel map.

Figure 10



Google Earth map

Figure 10 is a GIS Map of the broken down docks. In red is the approximate UMASS/ Savin Hill Yacht club property line, highlighting that indeed these docks are on UMASS's property.

Figure 11

Picture taken by Danielle Hughes

Figure11 is a picture showing the rough terrain that is the walkway around the Vietnam veteran's memorial.

Figure 12

Picture taken by William Baker

Figure 12 is highlighting the flood tide at Savin Hill Cove.

Figure 13

Picture taken by Anamarija Frankic

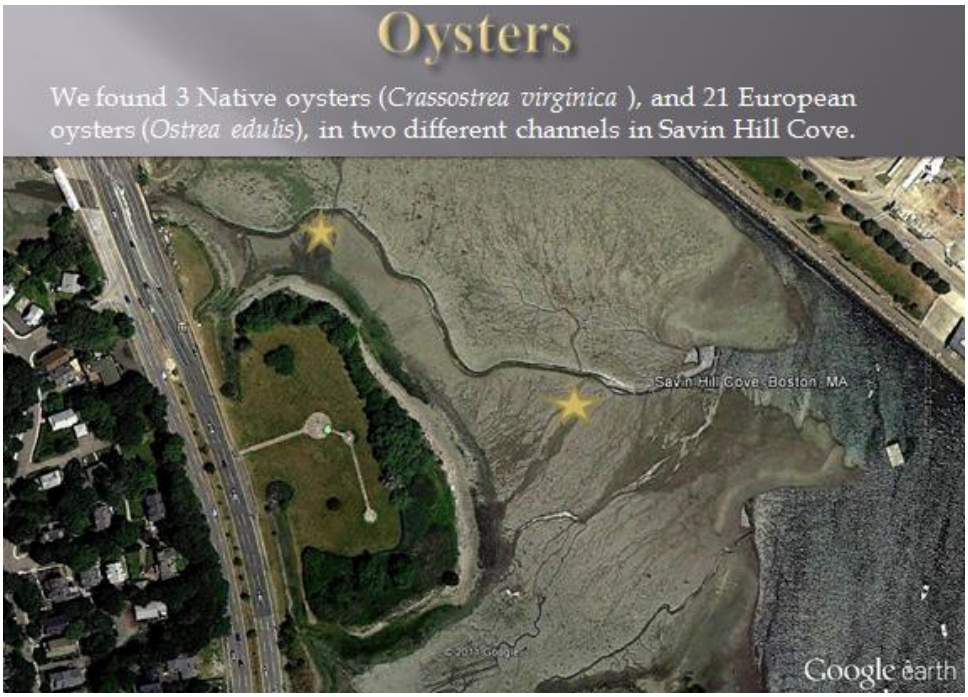
Figure13 is of 2 European oysters (*Ostrea edulis*) highlighting the size of the oysters found at the Savin Hill Cove

Figure 14

Picture was taken by Anamarija Frankic

Figure 14 is a picture of a Native oyster (*Crassostrea virginica).*

Figure 15



Google Earth

Figure 15 is of a GIS map of the two channels the oysters where found.

Figure 16

Picture taken be Anamarija Frankic

Figure 16 is highlighting the sub straight that the oysters are growing on

Figure 17

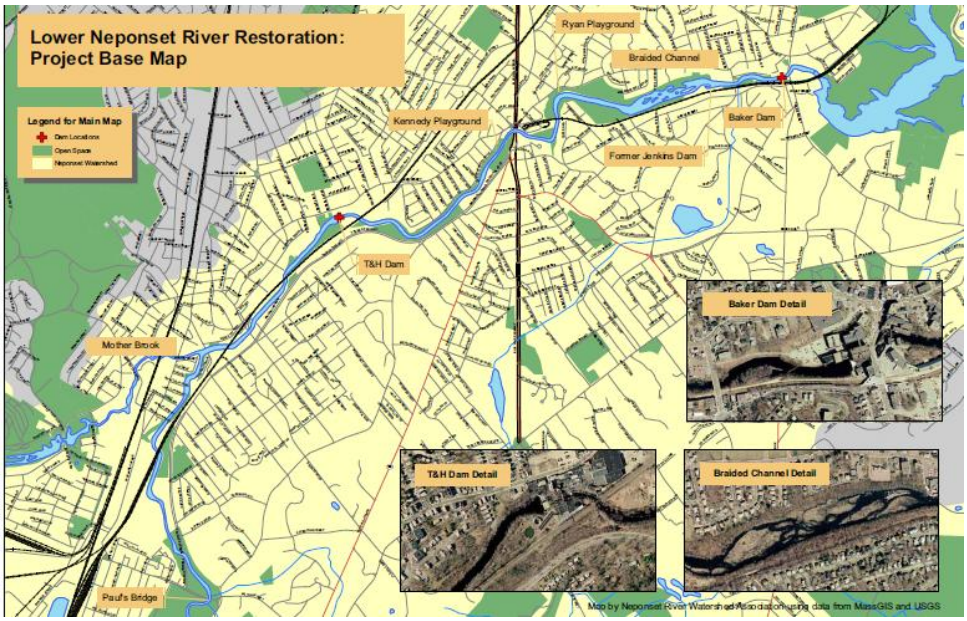
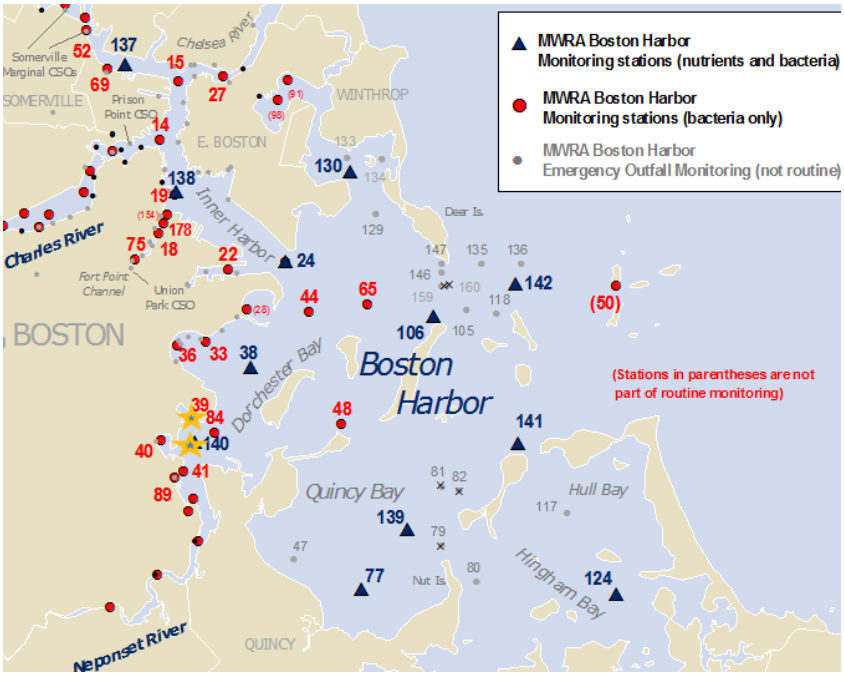


Figure 17 is a map of the Neponset river highlighting where the dams that will be removed.

Figure 18



Map from the MWRA website

Figure 18 is a map from the MWRA website highlighting the sites where the measurement stations for Savin hill cove are.

Figure 19

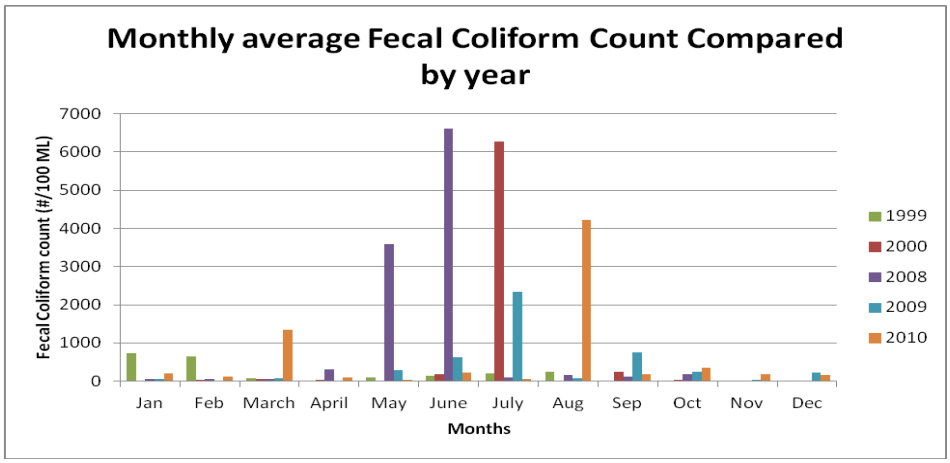
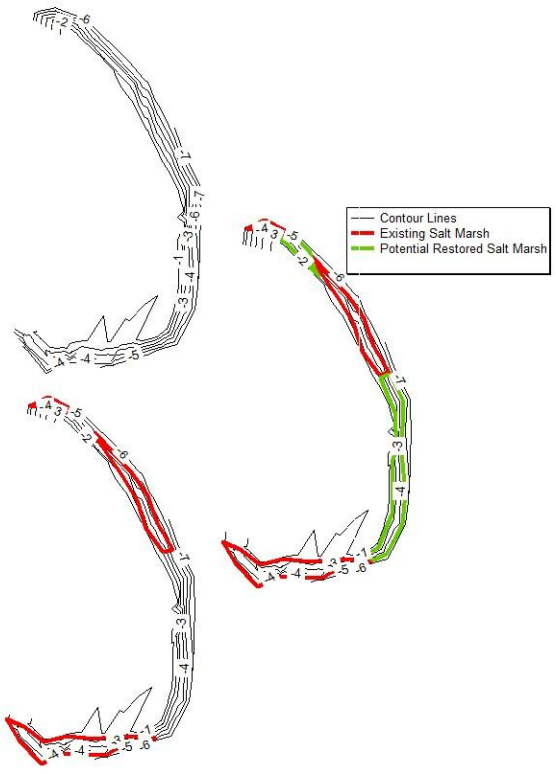


Chart made by Danielle Hughes.

Figure 19 is a chart made from the MWRA Fecal Coliform count data.

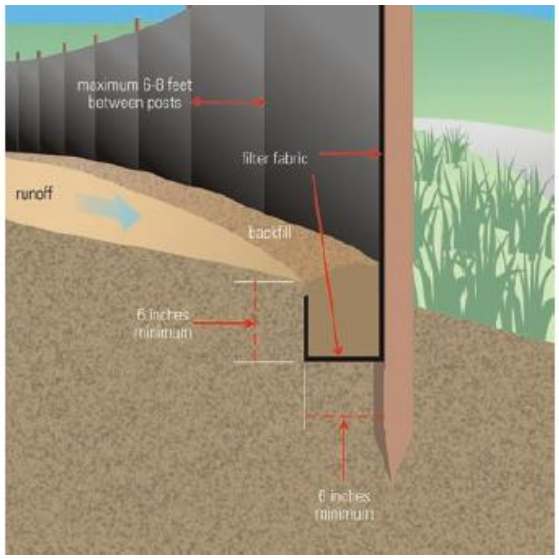
Figure 20



Map made by Timothy Maguire

Figure 20 is a contour map highlighting current and potential areas of salt marsh growth.

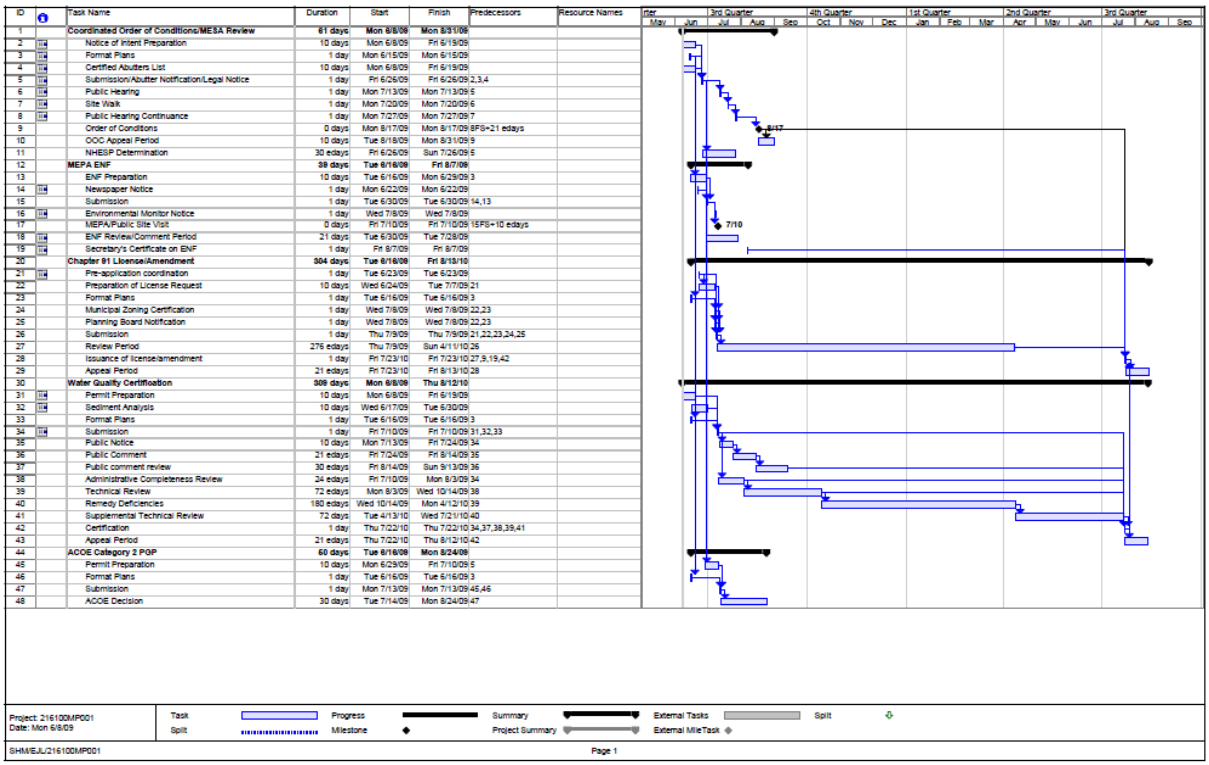
Figure 21



http://www.epa.gov/npdes/pubs/sw_swppp_guide.pdf

Figure 21, Illustrating the proper techniques to installing a silt fence

Figure 22



ID	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1	**Coordinated Order of Conditions/MESA Review**	**61 days**	**Mon 6/8/09**	**Mon 8/31/09**		
2	Notice of Intent Preparation	10 days	Mon 6/8/09	Fri 6/19/09		
3	Format Plans	1 day	Mon 6/15/09	Mon 6/15/09		
4	Certified Abutters List	10 days	Mon 6/8/09	Fri 6/19/09		
5	Submission/Abutter Notification/Legal Notice	1 day	Fri 6/26/09	Fri 6/26/09	2,3,4	
6	Public Hearing	1 day	Mon 7/13/09	Mon 7/13/09	5	
7	Site Walk	1 day	Mon 7/20/09	Mon 7/20/09	6	
8	Public Hearing Continuance	1 day	Mon 7/27/09	Mon 7/27/09	7	
9	Order of Conditions	0 days	Mon 8/17/09	Mon 8/17/09	8FS+21 edays	
10	OOC Appeal Period	10 days	Tue 8/18/09	Mon 8/31/09	9	
11	NHESP Determination	30 edays	Fri 6/26/09	Sun 7/26/09	5	
12	**MEPA ENF**	**38 days**	**Tue 6/16/09**	**Fri 8/7/09**		
13	ENF Preparation	10 days	Tue 6/16/09	Mon 6/29/09	3	
14	Newspaper Notice	1 day	Mon 6/22/09	Mon 6/22/09		
15	Submission	1 day	Tue 6/30/09	Tue 6/30/09	14,13	
16	Environmental Monitor Notice	1 day	Wed 7/8/09	Wed 7/8/09		
17	MEPA/Public Site Visit	0 days	Fri 7/10/09	Fri 7/10/09	16FS+10 edays	
18	ENF Review/Comment Period	21 days	Tue 6/30/09	Tue 7/28/09		
19	Secretary's Certificate on ENF	1 day	Fri 8/7/09	Fri 8/7/09		
20	**Chapter 91 License/Amendment**	**304 days**	**Tue 6/16/09**	**Fri 8/13/10**		
21	Pre-application coordination	1 day	Tue 6/23/09	Tue 6/23/09		
22	Preparation of License Request	10 days	Wed 6/24/09	Tue 7/7/09	21	
23	Format Plans	1 day	Tue 6/16/09	Tue 6/16/09	3	
24	Municipal Zoning Certification	1 day	Wed 7/8/09	Wed 7/8/09	22,23	
25	Planning Board Notification	1 day	Wed 7/8/09	Wed 7/8/09	22,23	
26	Submission	1 day	Thu 7/9/09	Thu 7/9/09	21,22,23,24,25	
27	Review Period	276 edays	Thu 7/9/09	Sun 4/11/10	26	
28	Issuance of license/amendment	1 day	Fri 7/23/10	Fri 7/23/10	27,9,19,42	
29	Appeal Period	21 edays	Fri 7/23/10	Fri 8/13/10	28	
30	**Water Quality Certification**	**309 days**	**Mon 6/8/09**	**Thu 8/12/10**		
31	Permit Preparation	10 days	Mon 6/8/09	Fri 6/19/09		
32	Sediment Analysis	10 days	Wed 6/17/09	Tue 6/30/09		
33	Format Plans	1 day	Tue 6/16/09	Tue 6/16/09	3	
34	Submission	1 day	Fri 7/10/09	Fri 7/10/09	31,32,33	
35	Public Notice	10 days	Mon 7/13/09	Fri 7/24/09	34	
36	Public Comment	21 edays	Fri 7/24/09	Fri 8/14/09	35	
37	Public comment review	30 edays	Fri 8/14/09	Sun 9/13/09	36	
38	Administrative Completeness Review	24 edays	Fri 7/16/09	Mon 8/3/09	34	
39	Technical Review	72 edays	Mon 8/3/09	Wed 10/14/09	38	
40	Remedy Deficiencies	180 edays	Wed 10/14/09	Mon 4/12/10	39	
41	Supplemental Technical Review	72 days	Tue 4/13/10	Wed 7/21/10	40	
42	Certification	1 day	Thu 7/22/10	Thu 7/22/10	34,37,38,39,41	
43	Appeal Period	21 edays	Thu 7/22/10	Thu 8/12/10	42	
44	**ACOE Category 2 PGP**	**60 days**	**Tue 6/16/09**	**Mon 8/24/09**		
45	Permit Preparation	10 days	Mon 6/29/09	Fri 7/10/09	5	
46	Format Plans	1 day	Tue 6/16/09	Tue 6/16/09	3	
47	Submission	1 day	Mon 7/13/09	Mon 7/13/09	46,46	
48	ACOE Decision	30 days	Tue 7/14/09	Mon 8/24/09	47	

Figure 22 is a salt marsh permitting schedule.

Figure 23

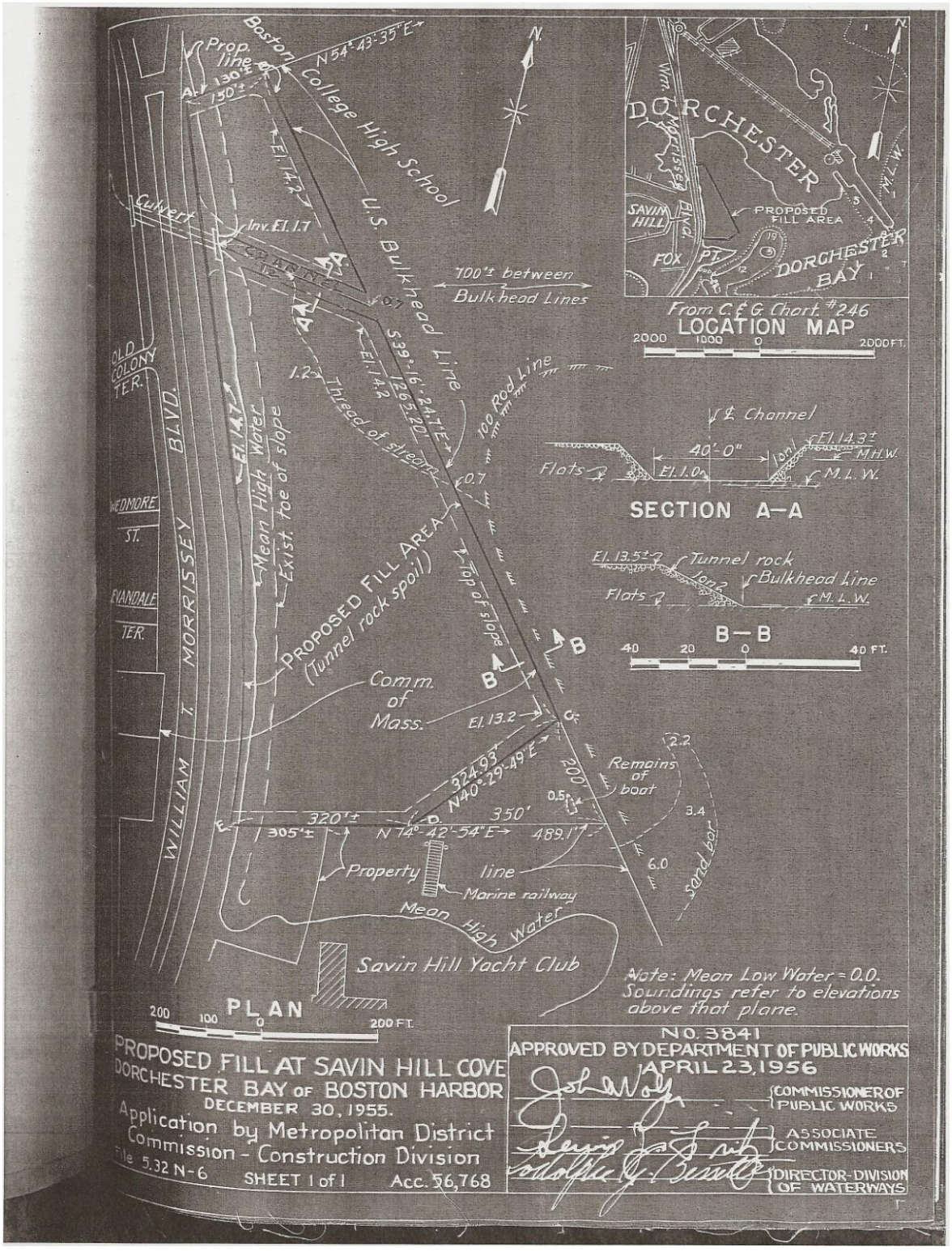


Figure 23 is a map of the proposed plans to fill Savin Hill Cove.

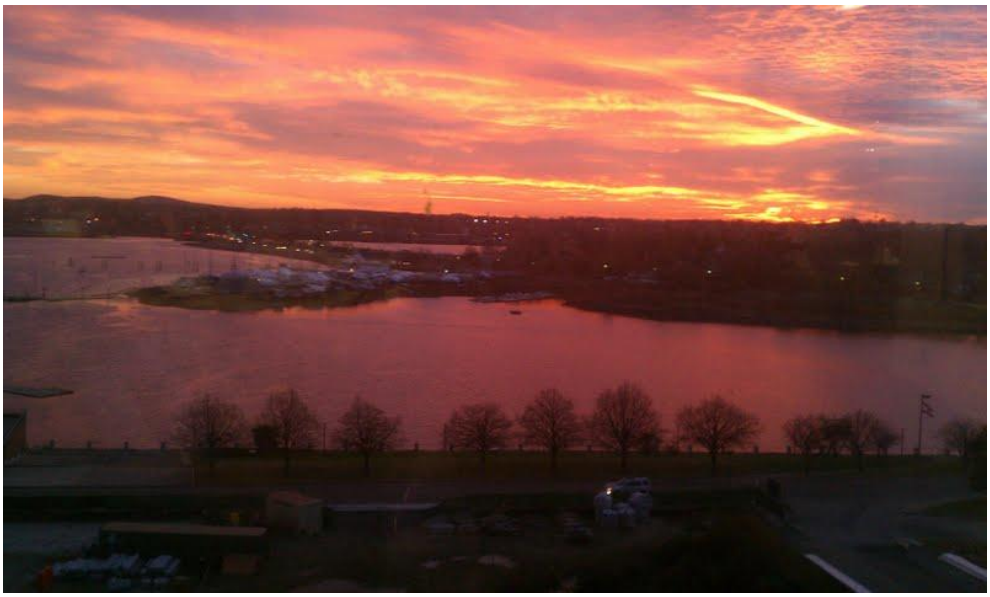
Figure 24

Figure 24 is a picture of a floating salt marsh.

Figure 25

Picture taken by Danielle Hughes and merged with a picture from www.lftantillo.com.

Figure 25 is a picture of our vision of a healthy salt marsh.



Picture taken by Danielle Hughes, Sunset in the Cove.

The End

References

"Bacterial and Viral Pathogens in Live Oysters: 2007 United States Market Survey." *Applied and Environmental Microbiology*. Web. 13 Dec. 2011. <http://aem.asm.org/content/76/9/2754.full>.

Carlisle, B.K., A.M. Donovan, A.L. Hicks, V.S. Kooken, J.P. Smith, and A.R. Wilbur. 2002. *A Volunteer's Handbook for Monitoring New England Salt Marshes.* Massachusetts Office of Coastal Zone Management, Boston, MA.

Chesapeake Bay Program - A Watershed Partnership. Web. 14 Dec. 2011. <http://www.chesapeakebay.net/>.

Commonwealth of Massachusetts. Regulations, Compliance and Assistance. Energy and Environment 2011. http://www.mass.gov/portal/energenvironment/compliance/ November 23, 2011.

"Developing Your Stormwater Pollution Prevention Plan." *US Environmental Protection Agency*. Web. 13 Dec. 2011. <http://www.epa.gov/>.

Gulf of Maine Council on the Marine Environment. Gulf of Maine Salt Marsh Monitoring Protocol. Gulf of Maine Salt Marsh Monitoring Protocol. (PDF)

Hardiman, Alyssa, and Nicole Proia. *Savin Hill Cove Salt Marsh Restoration. EEOS Capstone Projects*. WWW.gbh.umb.edu, May 2011. Web.

Massachusetts Environmental Policy Act. Executive Office of Energy and Environmental Affairs. MEPA regulations. 2009. http://www.env.state.ma.us/mepa/home.aspx December 2, 2011

Massachusetts DCR. Areas of Critical Environmental Concern (ACEC). ACEC Program Home. 2011. http://www.mass.gov/dcr/stewardship/acec/ November 4, 2011.

Mello, Caitlyn, and Gwendolyn Richards. *Savin Hill Cove Dredging. EEOS Capstone Class*. Www.gbh.umb.edu, May 2011. Web.

NY State Saltmarsh Restoration and Monitoring Guidelines (PDF) http://www.habitat.noaa.gov/pdf/saltmarsh1.pdf

Pleasant bay resource management alliance guidelines for private walkways and stairways in fresh and marine resource areas in pleasant bay(PDF) http://72.232.2.118/~pleasant/wp-content/uploads/walkguidelines.pdf

Massachusetts Department of Environmental Protection. Permits, Certifications & Reporting Forms. Service Center. 2011. http://www.mass.gov/dep/service/online/forms.htm December 1, 2011.

Massachusetts Department of Environmental Protection. Water, Wastewater & Wetlands. Wetlands and Waterway Forms. 2011. http://www.mass.gov/dep/water/approvals/wwforms.htm#c91g November 4, 2011.

Massachusetts Office of Coastal Zone Management. Public Waterfront Act (Chapter 91). Mass.gov. Fall 2003. http://www.mass.gov/czm/permitguide/regs/chapter91.htm October 30, 2011.

Save The Bay. Web. 13 Dec. 2011. <http://www.savebay.org/Page.aspx?pid=278>.

Seasholes, Nancy S. *Gaining Ground: a History of Landmaking in Boston*. Cambridge, MA: MIT, 2003. Print.

Maguire, T. (2012). Development of a salt marsh restoration site selection method for urban harbors. (Unpublished Masters of Liberal Arts). Harvard University Extension School, Cambridge.

U.S. Army Corps of Engineers. Water Resources Development act of 2007. Legislative Links. Public Law 110-114, 121 Stat 1041. November 15, 2007. http://www.usace.army.mil/CECW/PlanningCOP/Pages/legislinks.aspx November 20, 2011

Contact List