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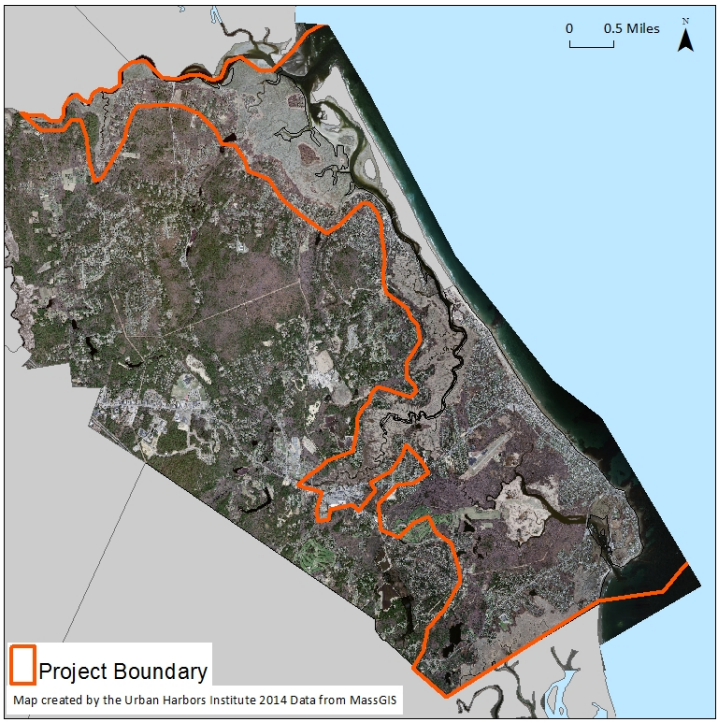
MARSHFIELD HARBOR, RIVERS, AND WATERWAYS MANAGEMENT PLAN



December, 2014

Marshfield Waterways Committee

with the

Urban Harbors Institute
University of Massachusetts Boston

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Section 1: Purpose, Scope and Authority of the Plan

This Waterways, Rivers and Harbors Plan is an initiative of the Marshfield Waterways Committee (the Waterways Committee) whose mission is to "recommend procedures, policies and regulations to the Board of Selectmen of the Town of Marshfield on matters affecting the safety, navigation, recreational activities, fishing interests, natural resources and the planning and management of Marshfield's waterways."

This plan provides recommendations to address safe navigation, natural resource protection, improvements to public access, safe recreational boating, protection of working waterfronts and related infrastructure, improvements to water quality, preparation for impacts from changes in sea level and climate, opportunities for collaboration, and clarification on fiscal issues with regard to waterways management.

As a municipal harbor plan, the Waterways Committee will work with those entities identified in the plan to implement the recommendations, and will provide annual progress reports to the Board of Selectmen. An implementation matrix has been developed to help the Waterways Committee track progress on each recommendation.

This plan has been developed with the intent that it will be updated every five years.

Section 2: The Planning Area

The planning area encompasses all of the coastal waters within Marshfield's municipal boundary as well as the Town's three main rivers – the North River, the South River, and Green Harbor River – and a great number of their tributaries. The northern boundary of the planning area primarily follows the municipal border between Scituate and Marshfield in the North River. This municipal boundary extends down a portion of the South River as well, creating a segment of the eastern boundary of the planning area. The southern portion of the eastern boundary extends into the coastal waters, consistent with the Town's authority over coastal waters. The southern boundary of the planning area primarily follows the municipal border between Marshfield and Duxbury. The western boundary of the planning area encompasses Marshfield Center and is based upon a 1,000 foot buffer around marsh, wooded swamp, cranberry bog, salt marsh, tidal flats, rocky shore, beach, and dune (as defined by MassGIS) which (1) are coastal, (2) border rivers and streams, or (3) are contiguous with other wetlands that boarder rivers and streams.

While the planning boundary was developed in order to encompass all major resources addressed by the policies and recommendations of this plan, the boundary is not intended to serve as a geographical limit to the issues or impacts of the plan, nor is it intended to exclude stakeholders from assisting with plan implementation. This boundary was developed to help focus planning efforts, but it should be understood that some issues and some impacts of the plan will be felt beyond the plan boundary.

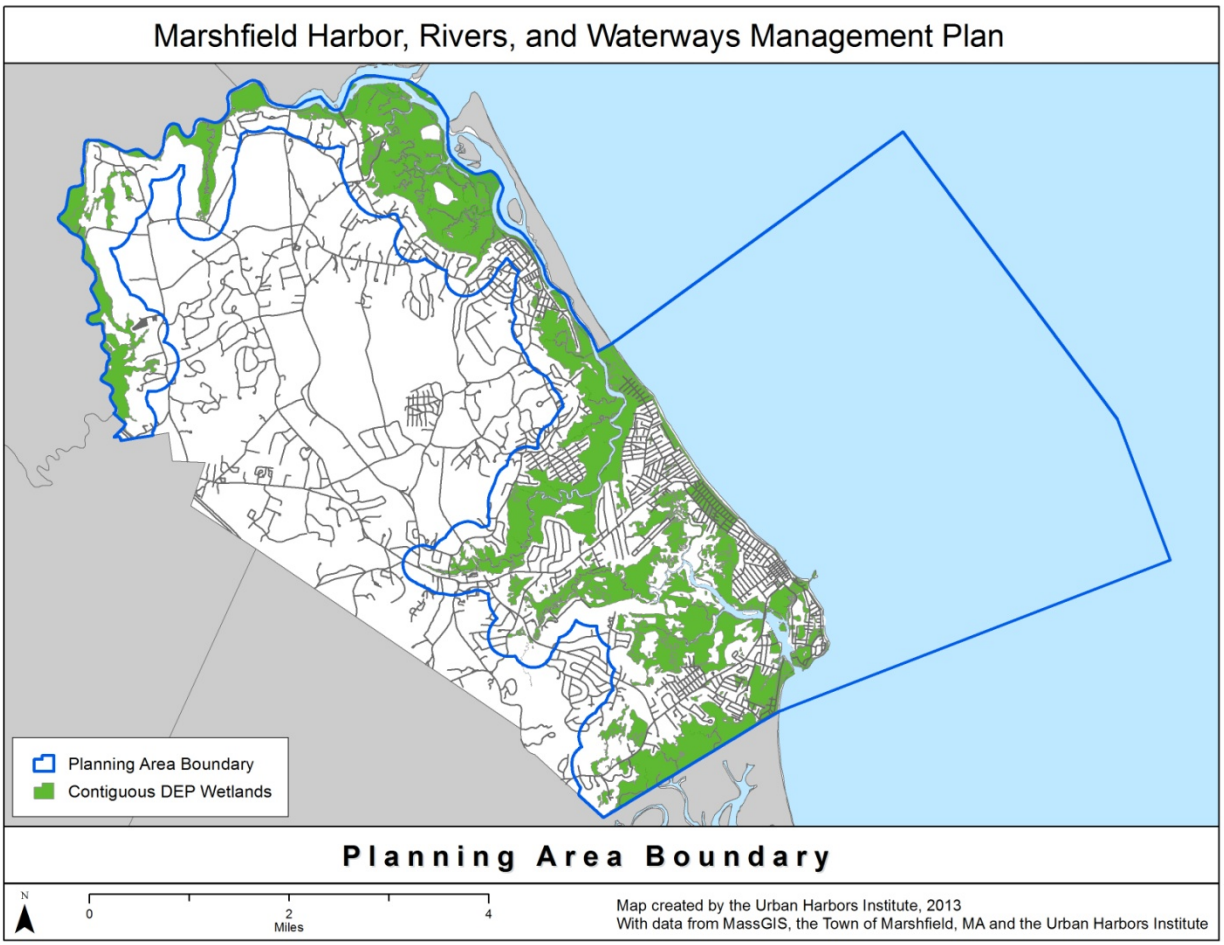

Figure 1: The Planning boundary for the Marshfield Harbor, Rivers, and Waterways Management Plan

Section 3: The Planning Process

The planning process and development of the Marshfield Harbor, Rivers and Waterways Management Plan was led by the Marshfield Harbor Planning Committee (HPC), which was established by the Waterways Committee at its June 6, 2012 meeting. The HPC consists of the Waterways Committee members and the Harbormaster. Members included: Michael McNamara, Chair; Steven Carver; Michael Duane, William Kerrigan; Charles Naff; Michael DiMeo, Roger Fosdick, Joe Hackett, Dave Suffredini (alternate), Steve Sinclair (alternate), and the late Steve James. The Urban Harbors Institute at the University of Massachusetts Boston (specifically Jack Wiggin, Kristin Uiterwyk, and Allison Novelly) was contracted by the Town to assist the HPC with Plan development. Jason Burtner of the Massachusetts Office of Coastal Zone Management also regularly attended HPC meetings, and contributed greatly to the development of this report.

A representative from the Planning Board, Conservation Commission and the Board of Selectmen were invited to serve as non voting members of the HPC. HPC meetings coincided with the monthly meetings of the Waterways Committee.

Members of the public were encouraged to participate in the planning process, which included three meetings specifically focused on obtaining public input. The public was notified of these meetings through announcements in the newspaper; and emails were sent to those on the Waterways Committee's mailing list. All other HPC meetings were also open to the public during the planning process, giving the public ample opportunities to engage. A list of meetings for this planning process, including preliminary meetings to discuss the feasibility of developing a plan, is below:

- January 4, 2012 – Waterways Committee voted to prepare a comprehensive Harbor Plan
- February 22, 2012 – Meeting of multiple Town boards and committees to discuss development of the Waterways Plan
- April 9, 2012 – Joint meeting of Waterways Committee and Planning Board to discuss incorporating the Harbor, Rivers and Waterways Management Pan in the Town's updated Master Plan
- June 6, 2012
- July 9, 2012
- August 1, 2012
- September 5, 2012
- October 3, 2012 – Public Meeting: Recreational Boating
- November 7, 2012 – Public Meeting: Commercial and Charter Fishing
- December 5, 2012 – Public Meeting: General Input
- January 7, 2013
- January 9, 2013
- February 2, 2013
- March 6, 2013
- April 24, 2013
- May 8, 2013
- June 5, 2013
- July 10, 2013
- August 7, 2013
- August 19, 2013
- October 2, 2013
- November 6, 2013
- December 4, 2013
- March 5, 2014
- May 7, 2014
- June 4, 2014
- July 9, 2014
- September 10, 2104
- October 1, 2014 – Public Meeting
- November 5, 2014

This Waterways Plan was developed during the same time the Planning Board was preparing a new Town Master Plan. Though this plan is prepared as a free-standing document, by agreement between the

Committee and Board, content from the Waterways Plan will be incorporated into the Master Plan. Future updates to the Master Plan should include updates to the Harbor Plan as well. Regular communication with the Planning board, Town Planner, and the Board's consultant helped to ensure that the two planning efforts were not redundant or contradictory.

Section 4: Inventory and Analysis of Natural Resources and Uses

The following sections provide details about the natural resources and associated uses of the Town's waterways. These descriptions focus on providing a general sense of the planning area in order to provide context for the recommendations. Detailed descriptions of the issues can be found in the *Issues, Goals, Objectives, and Recommendations* Section.

4.1 Beaches

The more than 200 acres of beaches in Marshfield (based on calculations of state-identified barrier beaches and beach systems) are important not only for their value as a natural resource, but also as an attraction that contributes significantly to the Town's economy and culture.

As a natural resource, beaches provide important habitat for shorebirds, crabs, and insects that live and feed along the coast.

During storms, beach faces, dunes, and offshore sand bars help to absorb, dissipate, and redirect wave energy and storm surge, providing important protection (both for the natural and for the built environments) against coastal storms. Recognizing this, the Town has engaged in dune restoration activities, including projects at Green Harbor and Rexhame Beaches where 8th graders from the Furnace Brook Middle School helped install poles, fencing, and dune grass.

Additionally, beaches are part of a conveyor belt of sand that moves sediment to other areas of the coast. This movement of sand in Marshfield can be seen at the inlet to Green Harbor, where the localized reversal in the littoral drift from south to north (rather than from north to south, as is predominantly the case along the shore of Marshfield (Arpin, no date)), along with the sand that is blown into the federal entrance channel, contributes to the sedimentation of the channel.

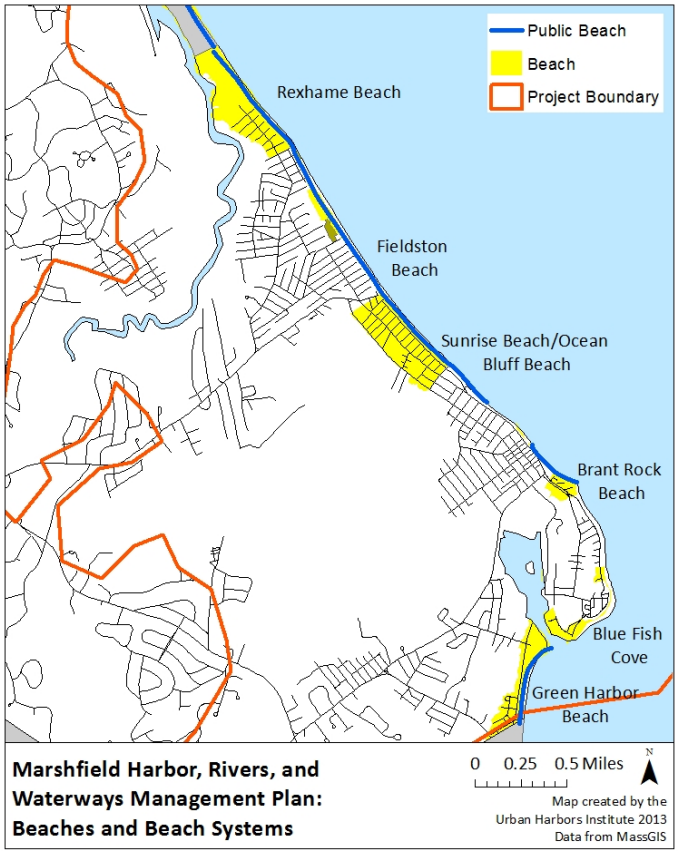

Figure 2: Beaches in Marshfield.

The movement of sand can be a natural phenomenon (e.g., a storm event), or can be impacted by human behavior (e.g., dredging, the installation of a seawall) and may result in changes to the shape of beach faces, dunes, and offshore sand bars.

To better understand how beaches are changing in Massachusetts, the Massachusetts Office of Coastal Zone Management (CZM) conducted a Shoreline Change Project that included a statistical analysis of long-term shoreline change from the mid-1800s to 1978 for ocean-facing coastline. These maps were updated several times, using 1994 NOAA aerial photographs of the Massachusetts shoreline, 2008/2009 aerial orthoimagery, and 2007 LIDAR datasets also from NOAA. The data show an actively changing shoreline in Marshfield, with a

general inland migration of the high water shoreline, as seen in Figures 4 and 5. In some cases, the migration of the shoreline is impeded by structures such as sea walls and revetments.

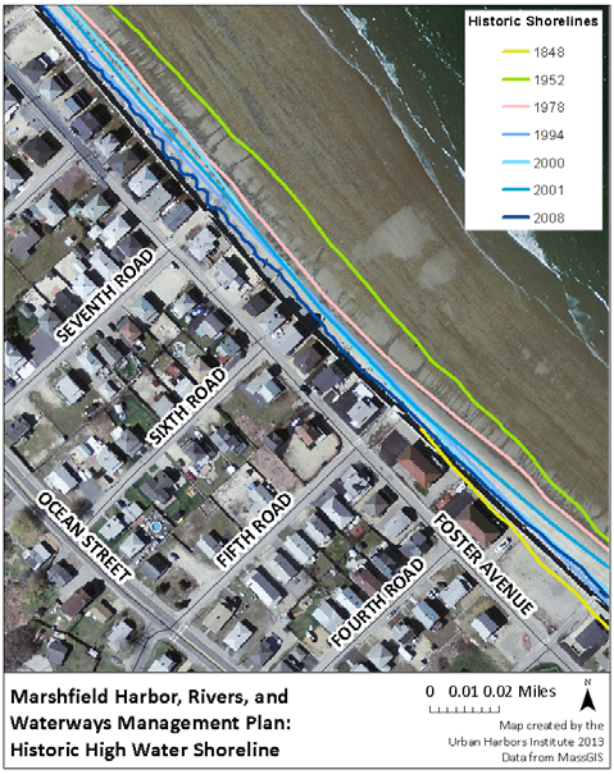

Figure 3: The area around Sunrise Beach showing the landward migration of the shoreline over time

Figure 4: The area around Green Harbor Beach, showing a general loss of beach as the shoreline migrates inland

The specific causes of erosion and movement of the high water shoreline have not been identified by the Shoreline Change Project, yet if the trend continues, the Town may experience loss of important habitat and storm buffering services, and may experience increased erosion with the impacts of climate change (i.e., increased sea levels and more intense storms).

The loss of beach and the related services not only has impacts on natural resources, it also translates into an economic loss for the Town. Though data are not available to quantify the value of loss due to changes in beach shape or size, the following figures provide some context for the scale of impact with regard to damage to coastal property and impacts on tourism:

- The loss of coastal property – Between January 1978 and January 2014, 1,476 “losses” have been filed with the Federal Emergency Management Agency (FEMA) for properties damaged in Marshfield following natural and man-made disasters. FEMA has paid out $16,531,313.50 to cover a portion (approximately 1,220) of these losses (compared to $59,808,495.56 in Scituate and $4,911,694.21 in Duxbury) (FEMA, 2014).
- The loss of tourism dollars – The population of Marshfield almost doubles in the summer, increasing by approximately 20,000 people (Town of Marshfield, 2005). Many of these people come to enjoy the Town’s coastal resources, including the beaches. With an increase in population comes summer employment opportunities (e.g., lifeguards, marina staff, summer wait staff), and a large summer rental market where proximity to beaches is featured.

- The loss of residents – in a Town-wide survey, 24.2% of respondents (81 out of 335) indicated that the Town's waters/beaches are what originally attracted them to Town (Moakley Center for Public Management, 2013). Should these resources become compromised, it may impact the Town's growth. Slowed development and loss of residents can have financial impacts on the community, including less spending on/demand for goods and services (e.g., groceries, education, health care, construction).

The beach is managed by the Beach Administrator working out of the Town Police Department. The Beach Administrator is responsible for managing public beach operations, including issues related to parking, seaweed accumulation, appropriate signage, beach closures due to high bacteria levels, snow fence requirements, and debris removal.

Rules and regulations for beach activities ban smoking and the consumption of alcoholic beverages, and encourage safe use of the water by establishing rules to separate swimmers from boats and jet skis. A more complete list of regulations is available in the *Management and Regulatory Authorities* section of this plan.

Table 1: Beach Amenities in Marshfield (Most information taken from the Town Website: http://www.marshfieldpolice.org/Pages/MarshfieldPD_Beaches/beaches)

Beach Name	Amenities	Parking/Access
Rexhame Beach	Lifeguards; Snack Bar; Restrooms; Basketball Courts	Resident parking: $30/sticker prior to May 1. $35/sticker as of May 1 Non-resident parking: $15 daily, $20 weekends & holidays; and $5 after 5 PM every day
Fieldston Beach	Lifeguards	Resident parking only: $30/sticker prior to May 1. $35/sticker as of May 1
Sunrise Beach	Lifeguards	No parking (Town is currently looking to purchase land to accommodate parking)
Brant Rock	Lifeguards; Restrooms	Resident parking only (9-5). $30/sticker prior to May 1. $35/sticker as of May 1 Non-resident parking: $10 daily, $15 weekends & holidays
Green Harbor	Lifeguards; Porta-potties	Resident Stickered Parking: $30/sticker prior to May 1. $35/sticker as of May 1. Parking available at Beach Street extension, Post office (dirt lot), and Avon Street. The beach is accessible via the Beach Street extension boardwalk

4.2 Marshes and Wetlands

As the Town's name suggests, salt marsh is abundant in Marshfield. The salt marshes (as defined by the DEP in their *DEP Wetlands (1:12,000)* GIS datalayer), primarily located along the North and South Rivers, Green Harbor, and the southern edge of Town, cover approximately 2,889 acres (see Figure 5). Salt marshes are a significant component of the coastal ecosystem, serving as spawning, nursery and/or foraging ground for

many fish, shellfish, birds, and insects. In addition to their habitat functions, the network of roots and rhizomes binds sediments together, forming a layer of peat that can absorb floodwaters, remove pollutants, and prevent erosion.

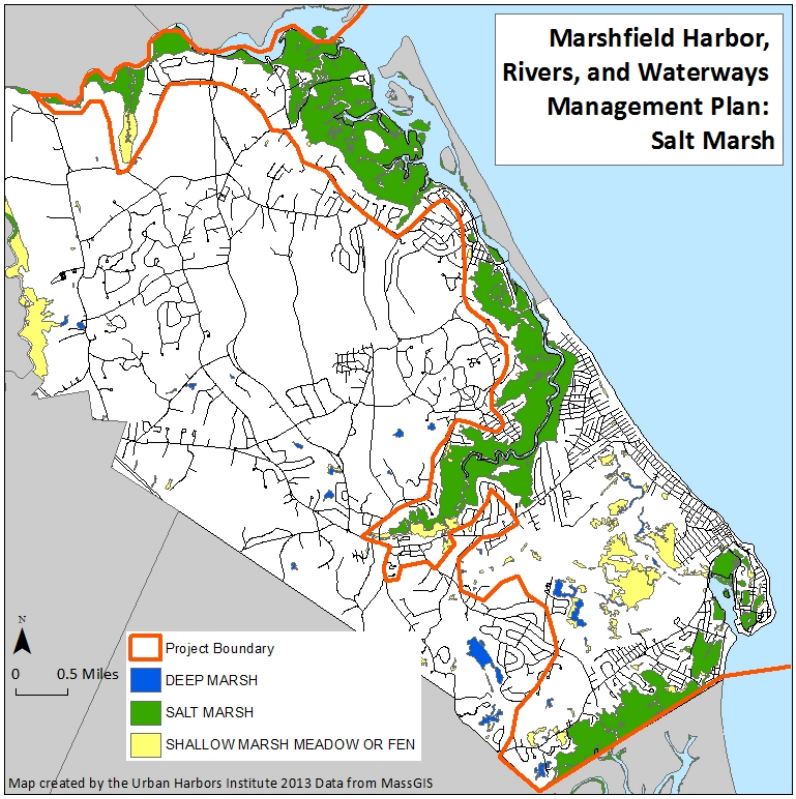

Figure 5: Extensive salt marsh in Marshfield.

The Massachusetts Department of Environmental Protection documented a series of statewide changes (gains and losses) in wetlands using aerial photographs from 2001/2003, 2005, and 2008-2009 (see *DEP Wetlands 1:12,000 Change* GIS datalayer). The results of DEP's analyses indicate that there have been no major coastal gains or losses in Marshfield salt marsh since 2001. It is worth noting, however, that the construction of the Green Harbor dyke in 1872, and the various updates (in the 1920s and 1960s) all but eliminated tidal flow to the marsh above the dyke (Louis Berger Group, 2006), an area now considered a "shallow marsh meadow or fen", according to the Office of Coastal Zone management. Current efforts to restore some tidal flow upriver from the dyke (see the Water Quality section of this report for more detail) may help restore portions of the salt marsh.

4. 3 Tidal Flats

Much like the marshes of Marshfield, tidal flats – which are exposed at low tide and submerged at high tide – also provide critical habitat for a variety of species including crabs, worms, migratory birds, and shellfish. The Town has an extensive system of approximately 510 acres of tidal flats (as defined in the *DEP Wetlands 1:12,000* GIS Datalayer from MassGIS) within the planning area of this plan. The majority of these tidal flats are on the North and South Rivers; and additional tidal flats extend into the Scituate portion of the North River, as shown in Figure 6. There are no tidal flats in Green

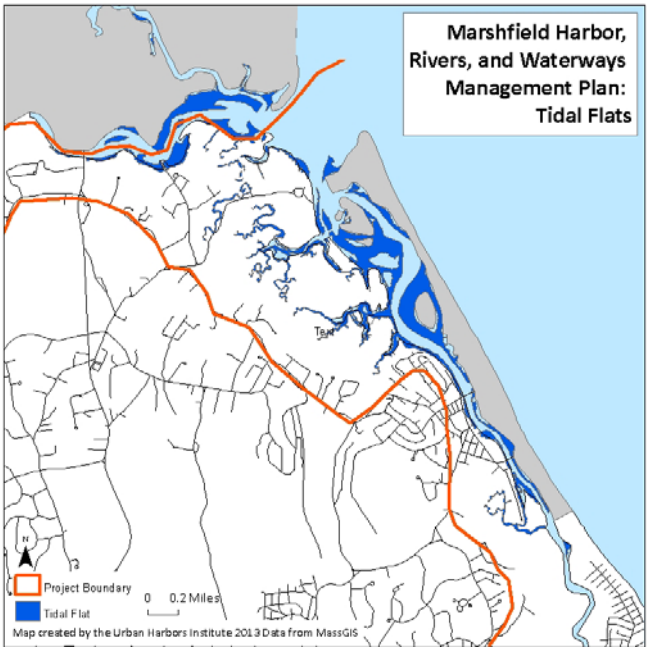

Figure 6: Tidal flats along the North and South Rivers

Harbor or along the Atlantic shoreline of Marshfield.

4.4 Shellfish

The waters of Marshfield are habitat for a variety of shellfish including American oysters, bay scallops, blue mussels, quahogs, razor clams, soft shell clams, and surf clams (see Figures 8 and 9). While much of the current shellfishing in Marshfield is conducted for recreational purposes, shellfish have historically supported commercial activity.

Shellfishing is prohibited in Green Harbor, in various locations along the Atlantic shoreline, and in portions of the South River, the North River, and its tributaries, as indicated in Figure 7. In 2011, the northern portion of the South River, which had been closed to shellfishing for twenty years, was re-opened due to demonstrated improvements in water quality (see the *Water Quality* section in this report for more information). In addition, the clam flats in the North and South Rivers were opened on November 1st in 2013. This represents one extra month of shellfishing compared to years past, when the beds were not opened until December. The Town is working with the Division of Marine Fisheries to explore the possibility of extending the season even further, with a target opening date of September 1. The Town is also beginning to explore the possibility of having Green Harbor opened for shellfishing, which will require coordination with the Massachusetts Division of Marine Fisheries to ensure that adequate water quality data are available to support opening the area.

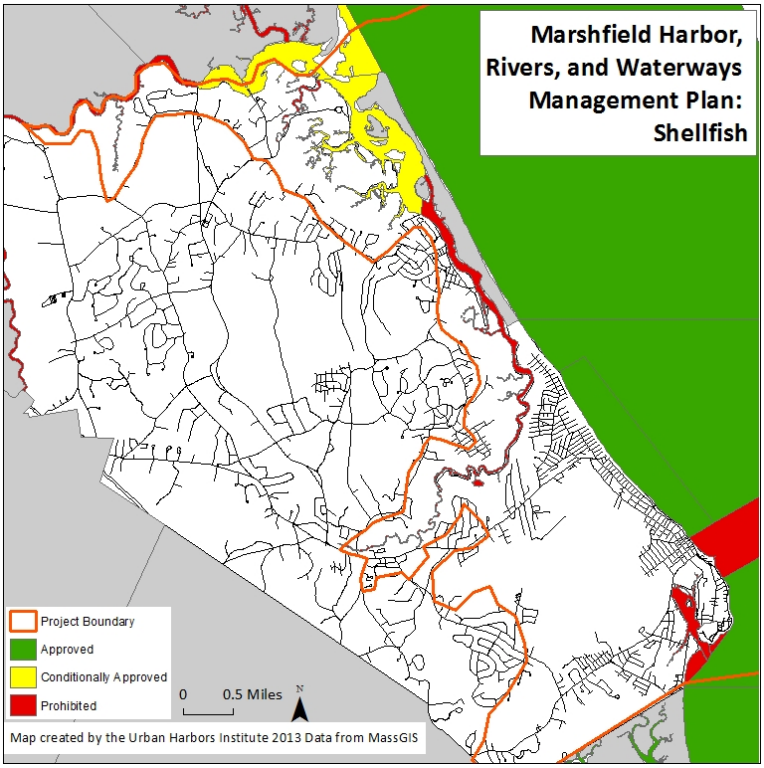

Figure 7: Shellfishing status in Marshfield waters

While Marshfield's natural set of shellfish appears to be adequate to support the existing local recreational fishery, the NSRWA, working with the Towns of Scituate and Marshfield, is planning to conduct a pilot mussel growing project to explore the possible enhancement of the natural stock of mussels in the river. Pending the approval by the Division of Marine Fisheries, this project (slated for the summer of 2014) will entail collecting and growing native spat, as well as purchased stock, and monitoring such factors as growth, predation, and survivability. The Town has conducted shellfish propagation since 2007/2008 (though none was conducted in 2013). This propagation involves broadcasting adult quahogs from Taunton River into the North River (at a cost of $19/bushel). The Town has also taken steps to enhance the shellfish population by adding 140,000 10 mm steamers in the North River in June of 2013 as part of their mitigation requirements for work on the North Pier. In 2011, the Town also placed 50 bushels of quahogs in the North River. These efforts have not been monitored, but the hope is that they have contributed to the local population of shellfish while also providing important ecosystem services such as water filtration.

The South River is slated to receive 126,000 three-quarter quahogs as part of the mitigation for the Winter 2014/2015 dredging project in the South River (from the Sea Street Bridge to the Marshfield Yacht Club).

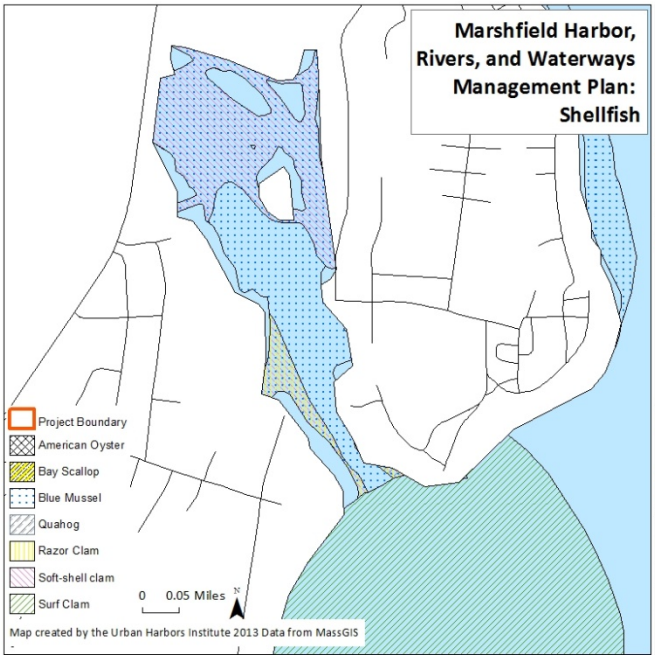

Figure 8: Shellfish habitat in Green Harbor

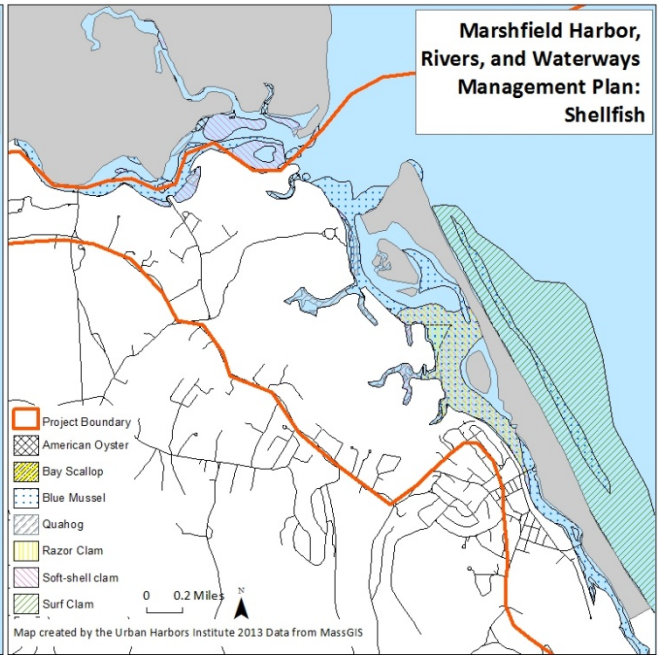

Figure 9: Shellfish habitat in the North and South Rivers

4. 5 Threatened, Rare, and Endangered Species

Marshfield is home to five endangered species, three threatened species, and seven species of special concern, as listed by the Massachusetts Natural Heritage and Endangered Species Program (detailed in Table 2). Among these are the piping plover, which nests on the sand spits near the mouth of the North River (Town of Marshfield, 2005).

The habitats and estimated habitats of these species have been identified and mapped (see Figure 10). Projects proposed within the defined Priority Habitat areas (based on observations documented within the last 25 years) may require review by the Natural Heritage and Endangered Species Program to ensure compliance with the MA Endangered Species Act. Projects and activities within the Estimated Habitats of Rare Wildlife that require a Notice of Intent under the Wetlands Protection Act also require review by the Natural Heritage and Endangered Species Program.

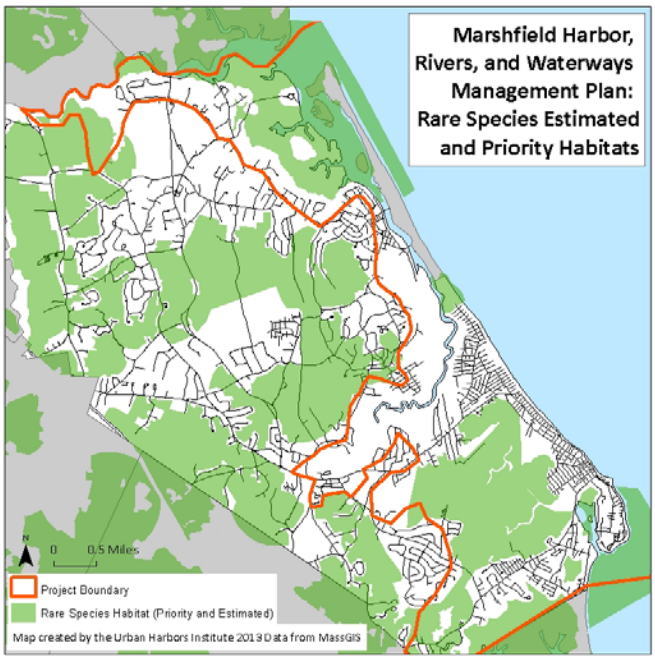

Figure 10: Marshfield's Priority and Estimated Habitats

Table 2: Species listed as Endangered, Threatened, or of Special Concern

Taxonomic Group	Scientific Name	Common Name	Status	Most Recent Observation
Bird	Bartramia longicauda	Upland Sandpiper	Endangered	1978
Vascular Plant	Bidens hyperborean	Estuary Beggar-ticks	Endangered	1998
Vascular Plant	Cardamine longii	Long's Bitter-cress	Endangered	2009
Vascular Plant	Eriocaulon parkeri	Parker's Pipewort	Endangered	1998
Bird	Ixobrychus exilis	Least Bittern	Endangered	2007
Bird	Accipiter striatus	Sharp-shinned Hawk	Special Concern	1982
Bird	Gallinula chloropus	Common Moorhen	Special Concern	1987
Fish	Notropis bifrenatus	Bridle Shiner	Special Concern	1959
Vascular Plant	Panicum philadelphicum ssp. Philadelphicum	Philadelphia Panic-grass	Special Concern	1944
Bird	Sternula antillarum	Least Tern	Special Concern	2010
Vascular Plant	Suaeda calceoliformis	American Sea-blite	Special Concern	1896
Reptile	Terrapene Carolina	Eastern Box Turtle	Special Concern	2013
Vascular Plant	Aristida tuberculosa	Seabeach Needlegrass	Threatened	2009
Bird	Charadrius melodus	Piping Plover	Threatened	2011
Vascular Plant	Linum medium var. texanum	Rigid Flax	Threatened	1898

4. 6 Anadromous Fish Passages

Anadromous fish are those that begin their lives in freshwater, migrate to the ocean where they spend most of their lives, and then return to freshwater rivers or brackish estuaries to spawn and lay eggs. In Marshfield waters, anadromous species include River herring, American shad, smelt, and trout (Reback, et al. 2004).

Dam at Veteran's Park

Statewide, over the last several hundred years, populations of anadromous fish have diminished in part due to a loss of habitat caused by the construction of dams, the use of water

(e.g., for drinking and irrigation) which causes low water levels, and other habitat disturbances. Examples of habitat loss are present in Marshfield along the South River, where the fish ladder at Veteran's Park is in need of improvements, and where water levels at the end of May have been shown to be a limiting factor for blueback herring in some years (Watershed Action Plan, 2006). The dyke at Green Harbor has also created a barrier to fish migration in the past; but a herring run did reestablish itself during a time when one of the gates was broken and would not fully close (Watershed Action Plan, 2006), and the current structure includes a special gate that does allow for fish passage.

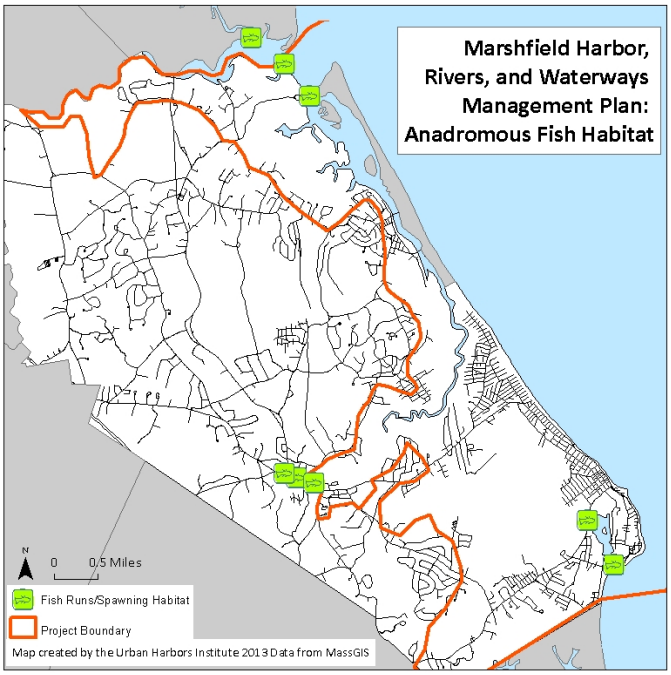

Figure 11: Fish runs and spawning habitat identified by the Massachusetts Division of Marine Fisheries

4.7 Water Quality

The quality of water - both surface water and groundwater – is critically important to the wellbeing of Marshfield residents and the natural resources that help define the Town. Examples of human impacts on water quality include the introduction of bacteria and nutrients from failing septic systems and pet waste; and pollution (e.g., trash, fertilizers, pesticides, nutrients) from stormwater runoff.

Marshfield is actively working at the municipal level to improve and protect water quality. Their by-laws include many requirements and guidelines pertaining to wetland protection, sewering, water conservation and water restrictions, and municipal storm drains. The Town also has several overlay districts intended to protect water quality (e.g., the inland wetlands district, coastal wetlands district, water resource protection district, and storm water management overlay district).

Federally, Marshfield – including the South River to the Willow Street Bridge, the North River to the Columbia Road Bridge, and Green Harbor south of the Route 139 Causeway – has been part of a No Discharge Area (NDA) since May 23, 2008. This designation prohibits the discharge of treated and untreated boat sewage in navigable waters, requiring boaters to discharge outside of the NDA or to pump-out the contents of their marine sanitation devices (MSDs) at a shoreside or vessel-based pump-out facility. Presently, there are 3 pump-outs available to boaters to legally discharge their waste in and around Marshfield.

In addition to these municipal and federal examples of regulatory measures to protect water quality, Marshfield has also been actively engaged in restoration and monitoring efforts. For example, in 2009 a tide gate was installed in the Green Harbor River dyke. The gate was gradually opened between February and March 2010 (to 10 inches) to increase tidal flow into the upper Green Harbor River. Monitoring shows improved water quality in the form of dissolved oxygen and reduced turbidity. The stands of Phragmites, an invasive species, were reportedly receding in the area just above the dyke (Town of Marshfield, 2010), though more recent accounts show that the Phragmites is expanding just north of the gate and receding in other locations upriver as the hydrology changes (Grady, 2014).

Water quality is also improving in the harbor itself. Data from the Division of Marine Fisheries, which intermittently samples seven locations throughout the harbor, shows a decline in fecal coliform from levels in September and August 1993 ranging from 65-266 to levels in June and July 2013 ranging from 0.9 to 19.

The Town, the North and South Rivers Watershed Association, and the Massachusetts Bays Program have also been working to address water quality issues on the South River through the South River Bacteria Assessment Project. Together with consultants CEI, the team has identified sources of stormwater pollution and has developed alternatives for treatment. Of the sites that the team reviewed, they have designed and constructed a project at Road to Responsibility (which involved a swale, a constructed wetland, and a sediment forebay), and have completed full design of a project at the Marshfield Library (a filtering bioretention area), with funding from a Coastal Pollution Remediation grant.

These plans for water quality improvements come several years after the Town of Marshfield expanded its sewer system from downtown Marshfield to Rexhame Beach (in 2005), redirecting the wastewater previously treated by 600 septic systems. This sewering project had significant improvements on water quality in the South River, as seen in Figure 12, which shows water quality monitoring results at six locations along the South River. The data show significant improvements in water quality before and after the Rexhame Beach sewering project. 2005a and 2005b were two separate sampling events, and the 1999 data represents the geometric mean of three sampling events. (Image and data from the North and South Rivers Watershed Association.)

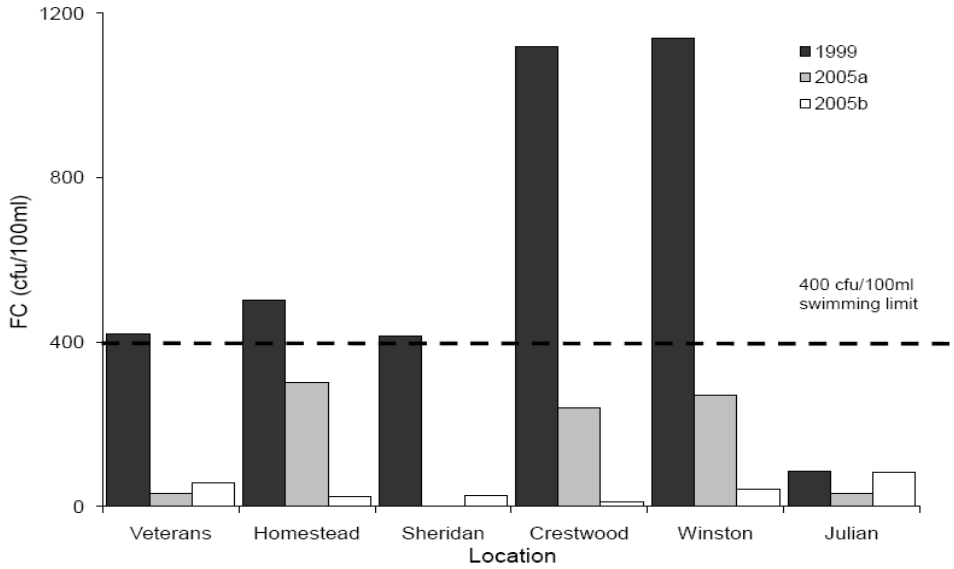

Figure 12: Water quality monitoring results along the South River

The North River has also seen water quality improvements stemming in large part from the NSRWA's efforts to bring the Scituate wastewater treatment facility into compliance in the early 1990s as well as efforts by the NSRWA and the Town to improve stormwater runoff; specifically from Union Street Bridge and Riverside Circle where stormwater improvements were made.

The efforts of the Town and its partners have led to water quality improvements, as evidenced by the fact that more than 300 acres of clamming beds in the South River were seasonally opened for recreational harvesting in 2011 – a designation based on improved water quality. (The State's fecal coliform threshold for shellfishing is a geometric mean of 14 organisms/100 ml, or 10% of samples exceeding a geometric mean of 28 organisms/100 ml.) Work is also being done to try and extend the shellfishing season, with the end goal of having a 9-month shellfishing season (Sept-May) (Dimeo, 2014). Extending the season will require continued water quality monitoring and additional enforcement of shellfish regulations. The Division of Marine Fisheries

already monitors Marshfield waters for shellfishing purposes during the existing shellfish season, taking samples both from shore and from the water. Extending the season will require the Division of Marine Fisheries to expand their monitoring season to include the proposed additional months.

Though the Town and its partners have been actively engaged in addressing water quality and quantity issues, Marshfield is still dealing with impaired water quality in some locations. The Massachusetts Bureau of Environmental Health, with assistance from the Town Board of Health, monitors water quality (specifically enterococci) during the beach season at Brant Rock, Fieldston (at 2 separate sites), Green Harbor, and Rexhame Beach to ensure that water quality is safe for swimming and boating. Between 2008-2012, there have been 14 closures due to high bacteria levels (Massachusetts Department of Public Health, see reports from 2009-2013). The threshold for high enterococci concentration is 104 CFU per 100 ml for a single sample and 35 CFU per 100 ml for the geometric mean of the five most recent non-storm event samples (Massachusetts Department of Public Health, 2013).

Table 3: Number of closures due to high bacteria counts at the five marine sites monitored by the State during the bathing seasons between 2008-1012.

Site	2008	2009	2010	2011	2012
Brant Rock	0	1	0	1	0
Fieldston (9th Rd.)	0	1	2	0	0
Fieldston (Hartford Rd.)	0	1	2	0	1
Green Harbor	1	3	1	0	0
Rexhame Beach	0	0	0	0	0

Additional summer water sampling (for fecal coliform) conducted by the North and South Rivers Watershed Association along the South River and the North River and tributaries shows that, with two exceptions, the bacteria levels are often below the State's swimming threshold for fecal coliform (400+ per ml). As shown in Table 4, the two sites that most often exceed that standard are the Willow Street Bridge in Marshfield (on the South River), and the Washington Street Bridge in Hanover (on the North River). Their tests also indicate, however, that summertime fecal coliform counts are above shellfishing standards.

Table 4: NSRWA Water quality data for swimming. (Numbers indicate colonies of fecal coliform bacteria per 100 ml of water. Red bolded numbers exceed the State swimming threshold for fecal coliform. Data from North and South Rivers Watershed Association.)

	North River								South River	
	Washington St. Bridge	Cornhill Lane	Union St. Bridge	Scituate Outfall Pipe	Driftway Park	North River Marina	Damon's Point	North River Mouth	Julian St. Bridge	Willow St. Bridge
6/3/2010	120	61	37	1	35	24	16	1	65	**400**
6/17/2010	**400**	66	63	33	52	39	24	4	100	**1100**
7/1/2010	93	99	84	0	19	20	16	0	31	**500**
7/19/2010	230	160	48	4	33	42	28	7	82	**500**
8/3/2010	300	32	7	33	6	4	1	0	10	280
8/17/2010	**400**	59	11	1	18	14	9	8	34	**800**
8/31/2010	170	130	79	0	17	22	14	4	58	**400**
6/9/2011	190	39	38	0	22	53	20	0	98	**1200**
6/23/2011	**1200**	75	73	34	**600**	64	76	7	250	**2000**
7/7/2011	120	23	11	0	110	12	19	0	36	**1900**
7/21/2011	230	37	5	0	7	3	10	0	18	**800**
8/8/2011	**1000**	19	45	22	37	8	9	13	38	**1100**
8/22/2011	280	88	43	1	52	29	38	0	33	**700**
6/12/2012	34	37	14	0	10	6	8	0	9	93
6/27/2012	210	120	97	21	150	36	34	0	150	180
7/10/2012	94	34	15	0	3	5	9	1	20	170
7/26/2012	**400**	130	34	79	53	18	16	4	52	190
8/9/2012	110	48	25	2	16	8	7	1	23	270
8/23/2012	260	59	24	0	22	13	24	1	56	230
6/17/2013	31	110	120	0	63	97	42	14	140	75
7/1/2013	270	250	170	9	220	74	60	0	120	290
7/16/2013	290	180	89	49	100	16	18	0	63	**4700**
7/30/2013	110	77	36	0	33	24	25	0	30	120
8/13/2013	280	120	90	3	44	43	31	3	28	100
8/27/2013	310	13	20	86	18	6	11	1	26	290

Many of the NSRWA's sampling sites are along stretches of "impaired" rivers. As required under Section 303(d) of the Clean Water Act, Massachusetts has identified five sites within this plan's boundary as Category 5 waters, meaning they were identified as "impaired (i.e., not supporting one or more intended use), the impairment was related to the presence of one or more "pollutants," and the source of those pollutants was not considered to be natural." (Massachusetts Division of Watershed Management Watershed Planning Program, 2013). This designation as a Category 5 water requires the development of a Total Maximum Daily Load (TMDL) for each site. The TMDL calls for a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards, along with measures to meet those limits. As described by the Massachusetts Division of Watershed Management Watershed Planning Program (2013), the five sites identified in 2012 include:

- *Green Harbor* (segment ID MA94-11, Class SA): "From the tidegates at Route 139, Marshfield to the mouth of the harbor at Massachusetts Bay/Cape Cod Bay, Marshfield Green Harbor." Impairment: fecal coliform
- *Green Harbor River* (segment ID MA94-10, Class B): "Outlet Black Mountain Pond, Marshfield to the tidegate at Route 139, Marshfield." Impairments: Fish-Passage Barrier, Other flow regime alterations, Excess Algal Growth, and Turbidity
- *North River* (segment MA94-05, Class SA): "Confluence of Indian Head River and Herring Brook, Hanover/Pembroke to Route 3A (Main Street), Marshfield/Scituate." Impairments: Fecal Coliform, Mercury in fish tissue
- *North River* (segment MA94-06, Class SA): "Route 3A (Main Street), Marshfield/Scituate to confluence with South River/Massachusetts Bay, Scituate." Impairment: fecal coliform.
- *South River* (segment MA94-09, Class SA): "From dam at Main Street, Marshfield to confluence with North River/Massachusetts Bay, Marshfield/Scituate." Impairment: fecal coliform

The State has developed a Draft Pathogen TMDL for the South Coastal Watershed, which includes these impaired sites.

4. 8 Commercial and Recreational Fishing

Marshfield's waterfront and waterways support vibrant commercial and recreational fisheries. Commercial fishing activity is primarily based in Green Harbor (which is home to 45 year-round lobstermen, some of whom scallop in the winter) and the North and South Rivers (which is home to six year-round lobstermen). In the off-season, some commercial vessels from Scituate, Duxbury, and Plymouth fish out of Green Harbor. The commercial fishermen target species including American lobster, Atlantic cod, striped bass, spiny dogfish, winter flounder, blue fin tuna, mackerel, yellowtail flounder, and blue mussels. Recreational fishing is more dispersed throughout Town and includes shellfishing (predominantly clamming), lobstering, and finfishing from vessels as well as from the shore.

Lobster traps on the dock at Green Harbor

Permits and Regulations

Permission to shellfish recreationally in Marshfield is granted by the Town (see Section 5 for more detail), while the Massachusetts Division of Marine Fisheries (MA DMF) issues licenses for recreational lobstering and finfishing.

Those who wish to fish commercially in state waters must obtain a fishing permit from the Massachusetts Division of Marine Fisheries. Commercial permits from the state include coastal lobster permits, offshore lobster permits, seasonal lobster permits, boat permits, individual permits, shellfish permits, and rod and reel permits. The permits are described in Table 5. Permit holders must seek permit endorsements for any of the following specific fisheries (list taken from DMF, 2014):

- American Eel
- Bay Scallop Shucking
- Black Sea Bass
- Black Sea Bass (Fish Pot)
- Bluefin Tuna Seine
- Bluefish Gillnet
- Coastal Access Permit (Mobile Gear)
- Conch Pot
- Dogfish
- Fish Weir
- Fluke
- Gillnet
- Horseshoe Crab
- Inshore Net
- Northern Shrimp
- Ocean Quahog
- Quahog Dredge
- Scup
- Scup (Fish Pot)
- Sea Herring
- Sea Scallop Diving
- Sea Scallop Shucking
- Sea Urchin Diving
- Sea Urchin Dredge
- Shellfish
- Striped Bass
- Surf Clam
- Surf Clam (Contaminated)
- Surface Gillnet
- Statewaters Groundfish

Table 5: State fishing permit descriptions and number issued (2012). (Taken from: http://www.mass.gov/eea/agencies/dfg/dmf/commercial-fishing/fishing-permits/ and from data provided by DMF.)

State Permit Type	Description	Number Issued 2012[1]
Coastal Lobster Permit	Allows the taking, landing and sale of lobsters (to a licensed dealer) harvested from within the coastal waters of the Commonwealth. There is a maximum of 800 lobster pots per vessel that may be set in state waters. The permit may be endorsed to take and sell shellfish and finfish at no additional cost. In the case of skin or scuba divers, only the permit holder is covered under the permit.	64
Offshore Lobster Permit	Allows the landing and sale of lobsters (to a licensed dealer) taken outside of the coastal waters of the commonwealth only; pursuant to a federal lobster permit. The permit may be endorsed to take and sell shellfish and finfish at no additional cost.	1
Seasonal Lobster Permit	Is issued to full-time students only (verification required), and allows the licensee only to take and sell lobsters (to a licensed dealer) from June 15 - Sept. 15. A maximum of 25 pots may be used. Diving is not permitted, sale of fish and/or shellfish in not permitted. Seasonal Lobster permit applicants must submit verification of full-time student status (letter attesting to full time status on school letterhead) & parental consent if under the age of seventeen.	2
Boat Permits	Allows the taking, landing and sale of fish (to a licensed dealer) and may be endorsed for shellfish. The permit covers everyone aboard the vessel. Price varies with vessel size. No lobsters may be taken.	76
Individual Permit	Allows the holder only to take, land and sell fish (to a licensed dealer) and may be endorsed for shellfish. No lobster may be taken.	6
Shellfish Permit	Allows an individual to take, land and sell (to a licensed dealer) shellfish and seaworms. A shellfish ID card, from the Division, and a Town-issued permit are also required.	1
Rod & Reel Permit	Allows the holder only, to catch and sell finfish (to a licensed dealer) caught by rod & reel only. No other gear types may be used.	6

In addition to obtaining a permit, when fishing in State waters, commercial fishermen must also abide by species-specific State regulations on seasons, size limits, and possession limits as described in Table 6.

[1] These numbers are based on data from people who list their homeport or residence as Green Harbor, MA or Marshfield, MA. Some people hold more than one permit.

Table 6: State regulations regarding the fishing season, size limits, and harvest limits within State waters (Updated as of July 1, 2013 (from: http://www.mass.gov/eea/agencies/dfg/dmf/laws-and-regulations/commercial-regulations/)

Species	**Fishery**	**Season** (Open - Close)	**Size Limit**	**Possession Limit**
Cod[2]	North of Cape Cod	Jan 01 - Dec 31	19 in	800 lb
	East & South of Cape Cod	Jan 01 - Dec 31	19 in	1,000 lb
Haddock[2]	All	Jan 01 - Dec 31	16 in	No Limit
Spiny Dogfish	All	May 01 - Quota Dep.	No Limit	4,000 lb
Striped Bass[3]	Sunday	July 14 - Quota Dep.	34 in	5 fish
	Tuesday, Wednesday, Thursday	July 14 - Quota Dep.	34 in	30 fish
Winter Flounder[4]	Gulf of Maine	Jan 01 - Dec 31	12 in	500 lb
	Southern New England	Jan 01 - Dec 31	12 in	50 lb
Yellowtail Flounder	All	Jan 01 - Dec 31	12 in	250 lb

Commercial fishermen must also obtain federal fishing permits if targeting fish beyond state waters. In 2012, NOAA reported a total of 141 vessels with federal permits in the Town of Marshfield (i.e., 141 vessels listed Marshfield, Green Harbor, or Brant Rock as the principle port on their permits). The vast majority of permits (N=114) are for tuna, with more than half of those (N=62) permitted as a charters or headboats – though only a small percentage of those boats operate as charter/headboats. Vessels may have permits for more than one species; and in Marshfield, the number of boats with federal permits for specific species ranges from 114 to 2, as shown in Table 7.

[2] Groundfish species regulated under the federal Northeast Multispecies Fishery Management Plan are subject to area and season specific groundfish closures in both state and federal waters. It is illegal to harvest cod from a portion of Massachusetts Bay (Winter Cod Conservation Zone) between November 15 and January 31 and in the Spring Cod Conservation Zone between April 16 and July 21.

[3] Commercial fishermen may fish for striped bass only on Sundays, Tuesdays, Wednesdays and Thursday within the commercial season. Striped bass May be taken by hook and line only; spearing, netting, snagging are prohibited. Note: Permitted party/charter vessel operators may fillet striped bass for their customers. See 322 CMR 6.07 (4)(g) for details.

[4] Winter flounder cannot be taken inside the spawning closure area or the inshore net areas between Feb 1 and May 31. It is unlawful for commercial fishermen to take winter flounder from Mount Hope Bay and its tributaries

Table 7: Number of federal permits issued, by species, for boats listing Marshfield, Brant Rock, or Green Harbor as their Principal Port (Data from NOAA).

Species	# of Federal Permits (2012)
Tuna	114
Northeast Multi-Species	49
Bluefish	41
Squid/Mackerel/Butterfish	31
Spiny Dogfish	30
Monkfish	25
American Lobster	24
Herring	22
Black Sea Bass	21
Scup	21
Summer Flounder	20
Skate	20
Tilefish	19
Atlantic Deep Sea Red Crab	16
Ocean Quahog	2
Surf Clam	2

Recreational fishing activities are also subject to regulations, and those wishing to fish recreationally for lobster, shellfish, and finfish need to obtain permits as described in Table 8.

Table 8: Recreational fishing permit information

	Recreational Shellfishing	Recreational Fin fishing (saltwater)	Recreational lobstering
Regulated by	Town of Marshfield	MA Division of Marine Fisheries	MA Division of Marine Fisheries
Gear	Limited to tined tools. No shovels or power assisted apparatuses	Gear types are species specific. Information can be found at: http://www.mass.gov/eea/docs/dfg/dmf/recreationalfishing/2013-rec-guide.pdf	Pots/traps and diving
Catch Limit	8 quarts/1 peck per week, per household. Catch may have a combined harvest **NOT** to exceed the weekly 8 quart limit. One peck is equivalent to 8 quarts.	Catch limits are species specific. Information can be found at: http://www.mass.gov/eea/agencies/dfg/dmf/laws-and-regulations/recreational-regulations/	15 lobsters/day
# Licenses	59 resident, 12 non-resident (for 2014, as of May 7, 2014)	996 (2013)	207 (2010 - No data available for more recent years)
For more Information	www.marshfieldpolice.org	http://www.mass.gov/eea/docs/dfg/dmf/recreationalfishing/2013-rec-guide.pdf	http://www.mass.gov/eea/docs/dfg/dmf/recreationalfishing/2013-rec-guide.pdf

Recreational shellfishing is allowed in Marshfield's approved coastal waters year round. The clam flats in the North and South Rivers are open to shellfishing from November 1 – May 31. Shellfish may be conducted on Wednesdays, Fridays, Saturdays, and Sundays. Shellfishing is allowed from 30 minutes before sunrise to 30 minutes after sunset. As mentioned in the Water Quality section, efforts are underway to expand the shellfishing season to run from September 1 - May 31.

Recreational lobstering is a very popular activity in Marshfield and is allowed year-round from 30 minutes before sunrise to 30 minutes after sunset. On average, more than 200 Marshfield residents obtain permits annually (see Table 9).

Recreational finfish seasons are species-specific, with some (e.g., striped bass, winter flounder, and yellow tail flounder) having year-long seasons. A comprehensive listing of recreational fishing seasons is available at: http://www.mass.gov/eea/agencies/dfg/dmf/laws-and-regulations/recreational-regulations/.

Table 9: Estimated number of State-issued recreational lobster and saltwater fishing licenses issued for Marshfield residents (based on the following Marshfield zip codes: 02065, 02059, 02051, 02050, 02047, 02041, 02020) (McAfee, 2014).

. Year	Lobster	Saltwater Fishing
1999	210	no data
2000	228	no data
2001	220	no data
2002	220	no data
2003	210	no data
2004	207	no data
2005	225	no data
2006	221	no data
2007	237	no data
2008	257	no data
2009	229	no data
2010	207	no data
2011	no data	978
2012	no data	1,056
2013	no data	996

Though regulations dictate fishing seasons, fishing activity also depends on factors such as whether or not target fish are present in abundant numbers, what the market is demanding, and whether other more valuable species are also abundant. As such, commercial fishing has informal seasons where haddock are caught in early spring; cod are targeted mid-May/June; stripers are targeted mid-May-early July; tuna are targeted in July and August; and sharks are targeted in late summer (James, personal communication).

Landings

In dollar value of landings, one of the most significant species commercially landed in Marshfield's ports is the American lobster, as shown in Figure 13.

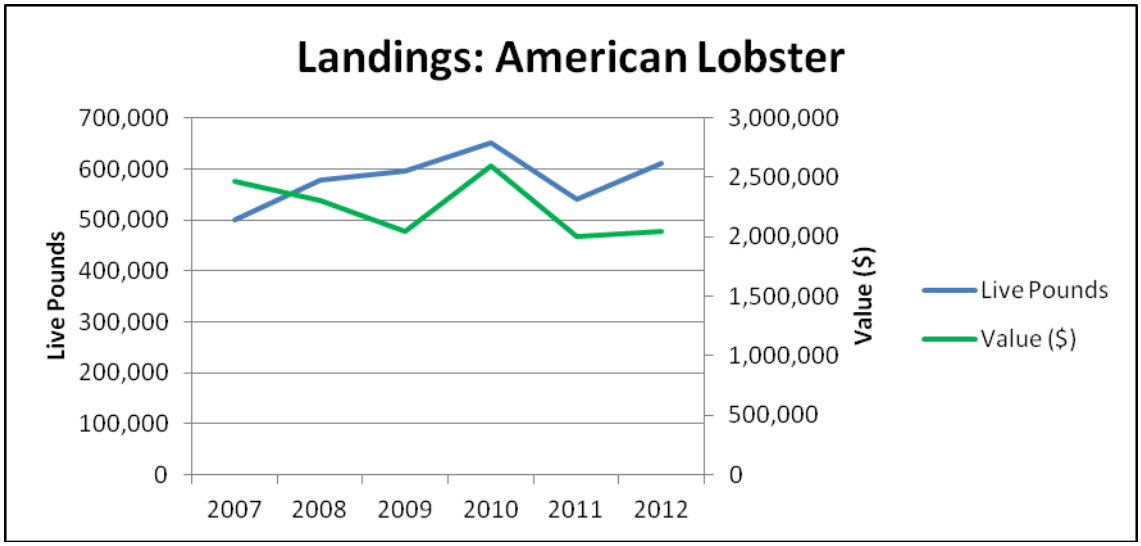

Figure 13: American Lobster landings data (Data: ACCSP 2013)

Data are not available for commercial landings of spiny dogfish for many of the recent years due to confidentiality reasons[5], however, the fishery is the largest in the Town in terms of pounds, with fishermen landing 1,830,727 live pounds in 2012 – approximately three times as many pounds as lobster, as shown in Table 10. Though spiny dogfish is not popular on domestic menus (and therefore sells for only 20-40 cents/pound on average),it is widely used throughout Europe; and efforts are being made to increase its consumption in the United States, with some fishermen going so far as to encourage the U.S. Department of Agriculture to consider buying spiny dogfish to use in federal food programs such as school lunches (http://www.boston.com/news/local/connecticut/2013/07/05/fishermen-ask-fed-regulators-boost-dogfish/QWIHiArLjrvbiuwKlO4xfK/story.html). Data are also unavailable for commercial tuna landings in Marshfield, due to confidentiality restrictions, but the commercial tuna fishery is a significant fishery for Marshfield (McAfee, 2013, Personal communication).

Though mussels were historically commercially harvested on the South River, only five individuals hold commercial shellfishing licenses, and little, if any, commercial shellfishing is conducted in Town waters (Woods, 2013, personal communication).

[5] For confidentiality reasons, data can only be reported for a species if there are at least three harvesters, three vessels, and three dealers for that species in the harbor(s) of interest. When those criteria are not met, data cannot be released. Therefore, certain species, such as spiny dog fish and tuna, have been commercially landed in Marshfield, but data cannot be reported.

Table 10: Landing data from the Atlantic Coastal Cooperative Statistics Program (ACCSP) and the Division of Marine Fisheries (DMF) showing similar trends in landings in terms of value and pounds landed within Marshfield. Where data were not available, cells are marked with "n/a". The species listed in this table were limited due to the confidentiality requirements explained in footnote 5.

Year	Species	ACCSP Data		DMF Data	
		Live pounds	Value ($)	Live pounds	Value ($)
2007	Cod, Atlantic	43,585.07	$89,314.42	n/a	n/a
2007	Lobster, American	499,927.15	$2,467,397.94	496,148	$2,448,234
2007	Other Species	288,281.82	$158,925.38	n/a	n/a
2007 Total		831,794.04	$2,715,637.74	870,173	$2,695,222
2008	Bass, Striped	3,606.50	$5,105.16	n/a	n/a
2008	Cod, Atlantic	49,146.44	$84,711.99	n/a	n/a
2008	Lobster, American	577,655.86	$2,309,698.79	577,656	$2,309,698
2008	Other Species	441,373.42	$201,132.39	n/a	n/a
2008 Total		1,071,782.22	$2,600,648.33	1,078,044	$2,600,164
2009	Bass, Striped	4,060.50	$11,367.40	n/a	n/a
2009	Cod, Atlantic	25,208.19	$31,153.44	n/a	n/a
2009	Lobster, American	595,259.00	$2,046,891.53	595,259	$2,047,020
2009	Other Species	11,620.80	$20,298.25	n/a	n/a
2009 Total		636,148.49	$2,109,710.62	643,211	$2,109,839
2010	Bass, Striped	4,592.00	$13,148.45	n/a	n/a
2010	Cod, Atlantic	65,659.77	$111,227.20	n/a	n/a
2010	Lobster, American	651,723.26	$2,591,775.92	651,307	$2,589,935
2010	Other Species	210,326.39	$76,474.49	n/a	n/a
2010 Total		932,301.42	$2,792,626.06	939,128	$2,790,788
2011	Bass, Striped	2,039.50	$5,578.00	n/a	n/a
2011	Cod, Atlantic	76,124.38	$166,050.17	n/a	n/a
2011	Flounder, Winter	1,075.00	$1,650.05	n/a	n/a
2011	Flounder, Yellowtail	3,663.00	$4,717.71	n/a	n/a
2011	Lobster, American	541,058.54	$2,007,370.88	541,475	$2,009,284
2011	Other Species	83,327.02	$37,131.74	n/a	n/a
2011 Total		707,287.44	$2,222,498.55	707,145	$2,223,187
2012	Cod, Atlantic	32,714.66	$77,880.53	n/a	n/a
2012	Dogfish, Spiny	1,830,727.00	$413,474.54	n/a	n/a
2012	Lobster, American	611,407.90	$2,051,756.12	n/a	n/a
2012	Other Species	30,322.01	$136,615.02	n/a	n/a
2012 Total		2,505,171.57	$2,679,726.21	n/a	n/a

Once the fish are caught, they are brought to the Town pier, Ridge Road (South River) and Damon's Point (North River). Lobsters are sold to local dealers and to two dealers located in Boston. These two dealers bring refrigerated trucks to the wharf in the afternoon during the lobster season, and load the catches directly

from the vessels into the trucks. A small number of lobstermen have also purchased their own refrigerated trucks and act as their own dealers. Tuna buyers are on call and will pick up catches by truck as the fish are landed. Other groundfish are sometimes picked up by truck, however, fishermen also deliver the catches to processors in their own trucks. There are no local groundfish processors in Marshfield. Scallops are also landed in Marshfield, including those landed by some scalloping vessels from neighboring communities.

Recreationally, Green Harbor is listed as the largest recreational bluefin tuna port in Massachusetts in terms of the number of fish landed. Listed as a separate port, "Marshfield" is the 4th largest port in terms of recreational bluefin tuna landings.

Fishing Locations

Marshfield's location is critical to its success as a hub for commercial and recreational fishing activity, with relatively quick access to prime fishing grounds such as Stellwagen Bank and the waters surrounding Provincetown.

Groundfish are commonly commercially fished around Stellwagen Bank, while tuna can be fished from 2 miles off shore to as far as George's Bank. During the Atlantic tuna season, approximately 70 vessels from Marshfield target the species. Lobster are generally harvested between 8 and 30 miles offshore, while bluefish and bass are typically targeted by Race Point and Provincetown.

Many people recreationally fish from their vessels, targeting species near shore and at Stellwagen Bank. Recreational fishing is especially popular on the North and South Rivers. A survey of river users along the North and South Rivers in 2012 indicated that approximately half of them (just under 30 of the 56 respondents) have fished on the North and/or South Rivers (North and South Rivers Watershed Association, 2012). Bass fishing is also a popular activity in the rivers from May through October. Some surfcasting is done near 4th Cliff, Rexhame Beach, and Bluefish Cove.

Recreational shellfishing is prohibited in Green Harbor itself, but is approved to the east and west of the mouth of the Harbor as well as most other portions of the Atlantic. Shellfishing in much of the North and South Rivers is also prohibited, though there are some Conditionally Approved areas near the mouth of the rivers, where clamming is a popular recreational activity. Additionally, the northern portion of the South River (313 acres) was recently (April 20, 2011) conditionally approved for shellfishing. Water quality improvements along the South River, due largely to sewering from Rexhame Beach to the Corner Café (Marine St.), made it possible to open the area (Grady, no date).

4. 9 Navigation

Green Harbor

Green Harbor is the lower portion of the Green Harbor River, which at one time was a tidal stream meandering through salt marshes for a distance of about six miles. The harbor today can be considered the portion of the river (about 2/3 of a mile) below a dyke constructed in 1872 to reclaim the marsh lands above the dyke for agriculture. A road was built over the dyke in 1879 connecting the villages of Green Harbor and Brant Rock. Due to protection by natural features and proximity to prime fishing grounds, Green Harbor serves as a harbor of refuge for both recreational boats and commercial fishing vessels. Presently, Green Harbor is home to 47 moorings used year-round by commercial vessels.

Though the entrance to Green Harbor has shifted over time, historical records indicate that the mouth of the river has been at approximately its present location since about 1810. Shoaling at the entrance has been a perennial problem. Alongshore currents moving from the south deposit material at the river mouth, and the ebb from the harbor is not strong enough to keep the entrance open.

Two jetties extend from the mouth of Green Harbor. The east jetty is 645 feet long and the west jetty is 850 feet long. The original rubble-mound jetties were constructed by the Commonwealth in 1898-1899. A 196-foot concrete wall was added by the state at the east jetty's landward end in 1931. Until 1968 the state maintained the jetties and performed periodic maintenance dredging of the entrance channel and anchorage basin. The federal government adopted the project in 1965 under authority of the Rivers and Harbors Act. The Army Corps of Engineers modified the jetties and sealed and lengthened the west jetty by 200 feet on the seaward end, and raised the east jetty to 14 feet above mean low water.

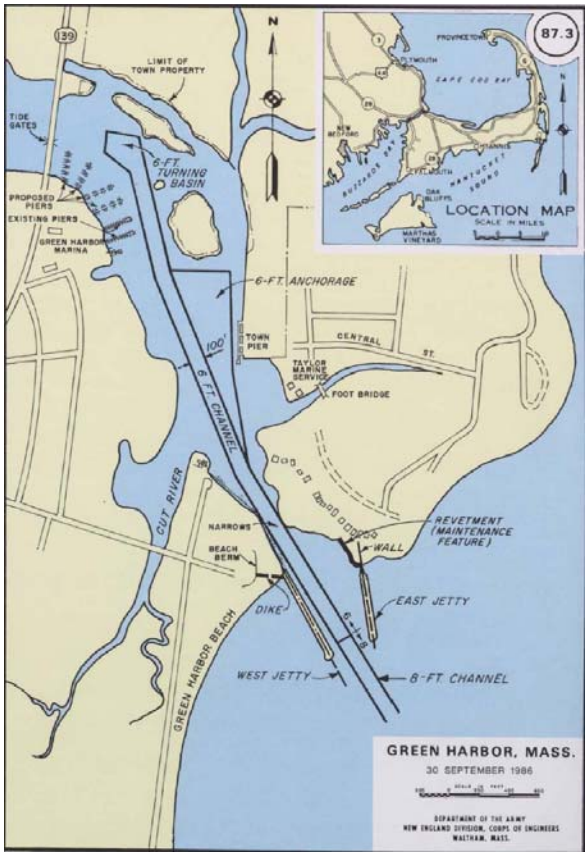

Figure 14: Green Harbor Navigation Project (taken from http://www.nae.usace.army.mil/Portals/74/docs/Navigation/MA/GRE/GREmap.pdf)

The federal navigation project in Green Harbor, originally completed in 1969 under Section 107 of the Continuing Authorities Program, consists of:

- A channel extending 4,000 feet from deep water to a six-foot deep turning basin located below the Route 139 Bridge. The channel design is six feet deep (MLW) from just inside the outer end of the jetties to the turning basin and eight feet deep (MLW) from deep water to just the inside jetties, and 100 feet wide.
- An anchorage six feet deep and five acres in area adjacent to the Town Pier.
- Rehabilitation of the existing state-built west jetty at the harbor entrance. This work included raising the jetty and extending it by 200 feet.
- Raising the existing state-built east jetty.

The Corps of Engineers' July 2013 Update Report noted damage to the east and west jetties at the mouth of the harbor as a result of Hurricane Sandy and subsequent nor'easters. The Disaster Relief Appropriations Act of 2013 included $3.3 million to restore the Green Harbor jetties to their pre-Sandy conditions. Construction is underway as this plan is being written, and is more fully described in the Recommendations section of this document.

Shoaling and Dredging in Green Harbor

There is a long history of sedimentation problems in the harbor, particularly at the outer end and in the throat of the jetties. As is well documented in studies and the record of past dredging (Table 11), there has been a continuous need to perform maintenance dredging to keep the channel and harbor navigable. At least some of the chronic shoaling is attributed to the design of the jetties. This issue has been the subject of several studies, the most recent ones in 1980, *Coastal Zone Management Feasibility Studies Related to Channel Shoaling, Town Pier Facilities and Town Pier Access*, and in 1988, *Inlet Hydraulics at Green Harbor, Marshfield, Massachusetts*, prepared for the Army Corps of Engineers. The following is a brief overview of the

recommendations made by these two studies. A more thorough summary of these studies is in Appendix A of this plan along with a chronology of Green Harbor shoaling and dredging.

Both the 1980 and 1988 studies focused at least in part on the shoaling at the entrance channel caused primarily by the combination of wave/tidal action transporting sand into the channel and harbor. The 1980 report evaluated the idea of a training structure parallel to and equal in length to the west jetty, and indicated that the training structure would increase flushing of the harbor to the point where maintenance dredging would not be needed. In contrast, the 1988 report refutes this, concluding that a training structure may slightly increase flushing of the harbor but not to the point where it justifies its construction. The 1988 report also evaluates a proposal to build a pile jetty at the mouth of the Cut River, but concludes it would have a negligible effect on shoaling. The 1988 report makes several recommendations, including raising and tightening the east jetty to minimize sand flowing through and waves overtopping during storms, and recommends eliminating the length difference between the jetties.

The most recent assessment by the New England District of the U.S. Army Corps of Engineers reported considerable shoaling in the authorized 6- and 8-foot deep entrance channel at the "Narrows." Funding for maintenance dredging was appropriated in the Disaster Relief Appropriations Act of 2013, and emergency dredging of the channel was carried out with the federal government-owned, special-purpose dredge Currituck in May 2013.

Table 11: Green Harbor, Marshfield, History of Navigation Project Construction and Maintenance (Data: U.S. Army Corps of Engineers)

Work Dates	**Work Accomplished**	**Quantities**
July 1968 – Aug 1969	Raise to +12 Feet MLW and Extend the West Jetty (Total – 875 LF) and Connect to Shore with 175 LF Gravel Dyke	14,800 Tons Stone and 50 cy Gravel
July 1969 – Oct 1969	Rebuild and Raise the East Jetty to +14 Feet MLW	Included in Above
Oct 1969 – Dec 1969	Improvement Dredging of the 8-Foot Entrance Channel and 6-Foot Inner Channel, Turning Basin and Anchorage, with Disposal at Gurnet Point	35,984 cy Plus ??? Hard Material
Nov 1970 – Jan 1971	Maintenance of the East Jetty and New Revetment to Tie Jetty to Shore	3,332 Tons Stone
July 1973 – Oct 1973	Maintenance Dredging of the 8-Foot Entrance Channel, 6-Foot MLW Inner Channel, Turning Basin and Anchorage Basin, with 2-Foot Overdepth in Entrance Channel	65,700 cy
Feb 1975 – March 1975	Repairs to the West Jetty - New Stone Placed and Resetting Displaced Stone	800 Tons Stone Estimated
June 1977 – July 1977	Maintenance Dredging of the 8-Foot Entrance Channel and Lower End of 6-Foot MLW Inner Channel, both to –6 Feet MLW	24,000 cy
March 1980 – FY 1981	Maintenance Dredging of the 8-Foot Entrance Channel and Lower End of 6-Foot MLW Inner Channel, both to –6 Feet MLW	75,000 cy
FY 1983	Hydraulic Maintenance Dredging of the 8-Foot Entrance Channel and Lower End of 6-Foot MLW Inner Channel	45,384 cy

October 1985	Maintenance Dredging of the 8-Foot Entrance Channel (Contract Terminated)	30,000 cy
Feb 1987 – July 1987	Maintenance Dredging of the 8-Foot Entrance Channel	36,000 cy
May 1990	Maintenance Dredging of the 8-Foot Entrance Channel by U.S. Hopper Dredge *Currituck*	21,875 cy
April 1991 – June 1991	Maintenance Dredging of the 8-Foot Entrance Channel by U.S. Hopper Dredge *Currituck*	34,740 cy
May 1992	Maintenance Dredging of the 8-Foot Entrance Channel by U.S. Hopper Dredge *Currituck*	35,600 cy
May 1993 – June 1993	Maintenance Dredging of the 8-Foot Entrance Channel by U.S. Hopper Dredge *Currituck*	51,800 cy
May 1994 – June 1994	Maintenance Dredging of the 8-Foot Entrance Channel by U.S. Hopper Dredge *Currituck*	30,101 cy
May 1995	Maintenance Dredging of the 8-Foot Entrance Channel by U.S. Hopper Dredge *Currituck*	21,060 cy
May 1996	Maintenance Dredging of the 8-Foot Entrance Channel by U.S. Hopper Dredge *Currituck*	33,000 cy
May 1997	Maintenance Dredging of the 8-Foot Entrance Channel by U.S. Hopper Dredge *Currituck*	19,000 cy
May 1998	Maintenance Dredging of the 8-Foot Entrance Channel by U.S. Hopper Dredge *Currituck*	20,340 cy
April 1999 – May 1999	Maintenance Dredging of the 8-Foot Entrance Channel by U.S. Hopper Dredge *Currituck*	36,005 cy
May 2000	Maintenance Dredging of the 8-Foot Entrance Channel by U.S. Hopper Dredge *Currituck*	33,360 cy
May 2001 – June 2001	Maintenance Dredging of the 8-Foot Entrance Channel by U.S. Hopper Dredge *Currituck*	29,100 cy
May 2002	Maintenance Dredging of the 8-Foot Entrance Channel by U.S. Hopper Dredge *Currituck*	16,070 cy
May 2003	Maintenance Dredging of the 8-Foot Entrance Channel by U.S. Hopper Dredge *Currituck*	23,890 cy
May 2004	Maintenance Dredging of the 8-Foot Entrance Channel by U.S. Hopper Dredge *Currituck*	26,260 cy
May 2005	Maintenance Dredging of the 8-Foot and 6-Foot Entrance Channel Reaches by U.S. Hopper Dredge *Currituck*	25,500 cy
April 2007 – June 2007	Maintenance Dredging of the 8-Foot Entrance Channel in the Inlet Narrows by Bucket Dredge (Burnham Assoc.) with Nearshore Disposal off Green Harbor Beach	35,697 cy

Nov 10 2009 – Feb 4 2010	Maintenance dredging of the inner and outer harbor	60,000 cy $1.86 million
Jan 8 – Feb 2 2010	Maintenance dredging of area around Town docks	4,500 cy Town funds
April 2010 – May 2010	Maintenance Dredging of the 6-Foot Inner Harbor Channel and Anchorage by Mechanical Dredge with Nearshore Disposal off Green Harbor Beach	15,464 cy
May 2011	Maintenance Dredging of the 8-Foot and 6-Foot Entrance Channel Reaches by U.S. Hopper Dredge *Currituck* with Nearshore Disposal off Green Harbor Beach	19,631 cy
May 2012	Maintenance Dredging of the 8-Foot and 6-Foot Entrance Channel Reaches by U.S. Hopper Dredge *Currituck* with Nearshore Disposal off Green Harbor Beach	10,565 cy
May 2013	Maintenance Dredging of the 8-Foot and 6-Foot Entrance Channel Reaches by U.S. Hopper Dredge *Currituck* with Nearshore Disposal off Green Harbor Beach	
May 2014	Maintenance Dredging of the harbor	

The North and South Rivers

The North and South Rivers are highly trafficked during the boating season, and include canoes and kayaks in addition to motorized vessels. The spit is a popular boating destination, contributing to the congestion at the mouth of the rivers. The swiftly moving water at the mouth of the rivers, near the spit, can be dangerous for inexperienced boaters and those using non-motorized vessels.

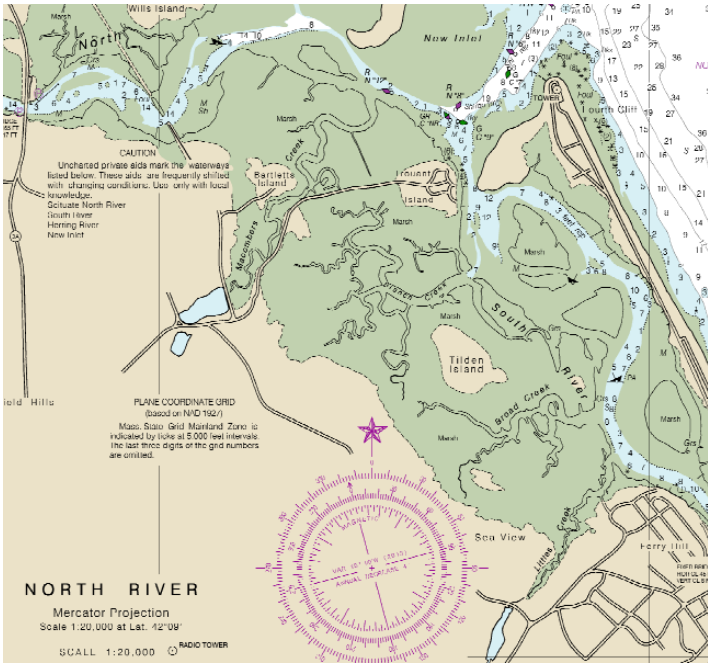

Figure 15: North and South Rivers, portion of NOAA Chart 13267 (Current as of Sept. 2013; www.charts.noaa.gov)

Periodic dredging for navigational improvements is necessary at various sites along the rivers, though annual dredging has not been required. Generally, the swift moving waters at the mouth of the two rivers prevents sediment from accumulating; however annual erosion at Fourth Cliff (a loss of about a foot of shore each year) does bring sediment into the rivers, and can create hazards to navigation. The most recent proposed dredging project would have involved dredging portions of the South River from Sea Street Bridge to the mouth of the River, addressing particular hot spots where the depth of the channel would be increased from two feet to six feet (Trufant, 2014). This project would have removed about 60,000 cubic yards of sand and sediment from the channel to be used for

shoreline restoration at the Fourth Cliff Air Force Recreational Area and along the isthmus of North Humarock Beach, Scituate. Currents would carry some of the sand to the south, replenishing beaches along the Marshfield shoreline. The proposal was not funded, but the project remains important to safe navigation along the South River.

4.10 Shoreside Infrastructure and Public Access

The shoreside infrastructure in Marshfield includes commercial and recreational boat berthing, launch facilities, diesel and gas fuel, gear and bait sales, space to accommodate buyers, space and equipment to accommodate commercial fishing activities, tow and repair services, gear suppliers, and pump-out services. For the most part, these services meet the needs of waterways users, though the Town lacks an ice house (Scituate is installing an ice house, which may or may not meet local needs) and local life raft service and repairs (a Rhode Island-based company currently services many Marshfield boats).

On the North River, Roht Marine offers limited berthing space at its docks, and manages 66 moorings. Across the River, in Scituate, North River Marina offers dock space and 19 moorings. On the South River, Bridgewaye Inn and Marina offers approximately 50 slips. Whites Ferry Marina also offers berthing, but the facility recently sold, and exact services for the new business are unknown; however the properties can accommodate approximately 41 vessels. In Green Harbor, Green Harbor Marina and Taylor Marine offer slips (approximately 180 and 160 slips, respectively). The Town manages approximately 300 moorings on the North and South Rivers and in Green Harbor. All of the aforementioned marinas can accommodate transient dockage. Boating access is also available at the Green Harbor Yacht Club and the Marshfield Yacht Club. Boating facilities are shown in Figure 16.

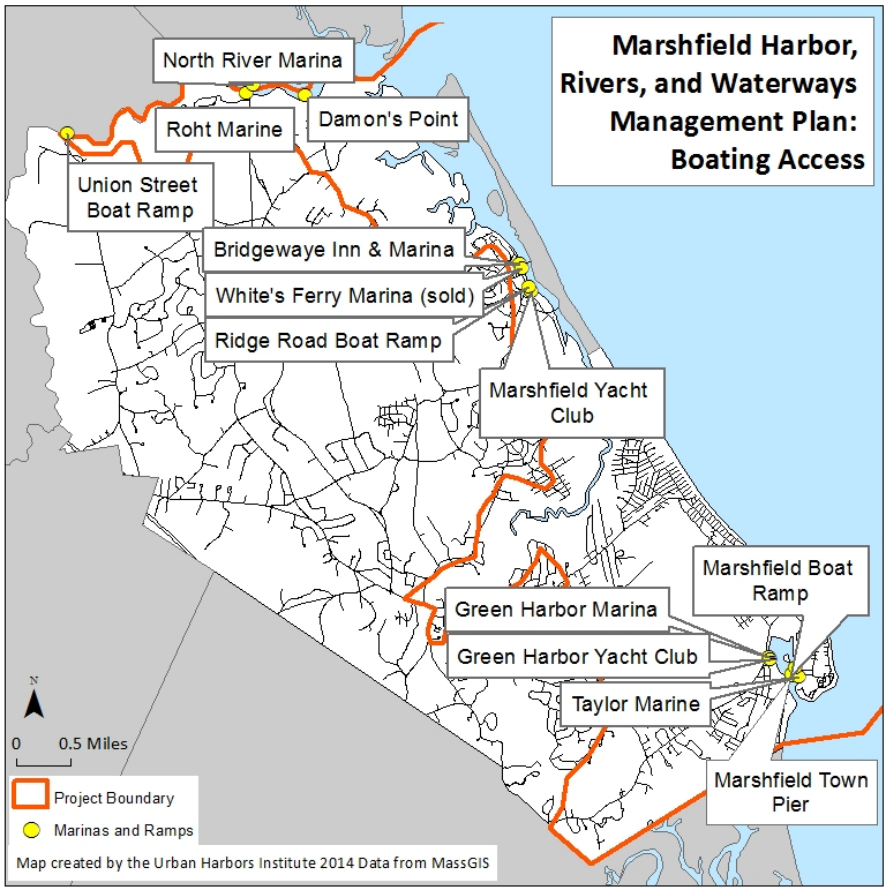

Figure 16: Boating facilities servicing Marshfield

Six boat ramps provide launch access, including two locations along the North River in Scituate. Launch locations include the Town Ramp in Green Harbor (daily rate: $7 for in-state users, and $21 for out-of-state users, annual rate: $75 for in-state users and $225 for out-of-state users), the ramp at Ridge Road daily rate: $7 for in-state users, and $21 for out-of-state users, annual rate: $75 for in-state users and $225 for out-of-state users), Green Harbor Marina (for private use only), Roht Marine ($20 to park and launch; $15 for parking only), North River Marina (for private use only) and a canoe/kayak launch at the Union Street Bridge (free parking and launching). Additional and less formal access for canoes and kayaks is available at the Southeast side of the Route 3A Bridge near Veteran's Memorial Park, at the northwest

corner of the Willow Street Bridge, at Rexhame Beach, and Damon's Point. Canoes and kayaks can also be launched from any of the Town beaches.

Fuel (diesel and gas) is offered at Green Harbor Marina, Taylor Marine, and Roht Marine (gas only). Each marina and yacht club offers water, and all offer 30 and 50 amp electricity, except for Roht Marine. With the exception of Bridgewaye Marine, all marinas and yacht clubs have upland storage. North River Marine, Roht Marine, and Taylor Marine have dockside ice available. A list of these amenities along with other services can be found in Tables 12 and 13.

Businesses available to service moorings in Marshfield include Humarock Mooring Service, North River Marine, Stephen Lynch Marine Services. Scituate mooring service is available from Harbor Mooring Service, Offshore Marine, Pirate's Cove, and Waterline Mooring Service.

Boat sales and service is provided by North River Marine, Erickson Marine Service, South Shore Stern Drive, McShane Yacht Sales, South Shore Dry Dock Marine, Inc., Simms Brothers Marine Services, Inc., and Sea Tow South Shore.

Bait is available at Green Harbor Bait and Tackle and Grumpy's Bait and Tackle.

Three pump-outs currently operate in Marshfield waters. They include Harbor Mooring (a pump-out boat operating out of Damon's Point), Riverways Marina, and the Marshfield Town Dock. Roht Marine will be installing a pump-out in the near future. In 2010, Harbor Moorings implemented a flag system for pumpouts in the North and South River, whereby pink pennants were distributed to all vessels with holding tanks on the rivers. Every Monday, weather permitting, Harbor Mooring will pump-out any vessel on the North or South Rivers displaying the flag. The range of their services is from King's Landing in the North River to the mouth of the South river, and in the South River from the mouth of the river to the Marshfield Yacht Club. Emergency pump-outs are also possible by calling. Pump-outs are at no cost to the boat owner; the program is partially funded by the state.

The North Pier at the Town Wharf in Green Harbor serves the commercial fishing fleet, with 96 feet of unloading wall space to load and unload vessels, town-owned boom, and parking for the seafood buyers. Much of the commercial fishing fleet is moored in Green Harbor during the summer months, but moves onto docks at Taylor Marine and Green Harbor Marina during the winter months.

A new multi-use maritime facility has been proposed to replace the existing harbormaster trailer in Green Harbor. The Massachusetts Seaport Council awarded the Town $1.075 million, 75 percent of the facility's $1.425 million cost. The local cost-share of $350,000 was allocated at the 2011 Annual Town Meeting. The building will be approximately 3,700 square feet with handicapped-accessible public restrooms and showers, a garage and a large storage space that can also be used for meeting space, including for courses on safety and boating. Consideration is also being given to add a harbor walk that would pass in front of the new building, down to Taylor Marine; and plans include the installation of a new pump-out which replaces the previous system with a more accessible option that includes improved pumping capabilities.

Table 12: Boating facilities and amenities

Marinas												
Facility	**Slips (#)**	**Ramp (# Lanes)**	**Transient Accommoda-tions**	**Upland Storage**	**Moorings**	**Fuel (Diesel, Gas)**	**Pump-out**	**Water**	**Electricity (amps)**	**Ice**	**Services**	**Other Amenities**
Green Harbor												
Green Harbor Marina	180	yes, private	Yes	Yes	No	D, G	No	Yes	Yes: 30, 50	Yes (at tac kle sho p)	Service outboards, stern drives, and inboards	Restaurant, McShane Yacht Sales; 10 charter fishing boats, Green Harbor Bait and Tackle; Tuna Club; Commercial fishing dockage
Taylor Marine	160	No	Yes	110	No	D, G	No	Yes	Yes: 30, 50	Yes	Boat hauling	Restaurant; Commercial fishing dockage
Town of Marshfield	0	3	Yes	No	300* (total for all harbors)	No	Yes	Yes	No	No	None	
North River												
Roht Marine (former Mary's Boat Livery)	440 feet of dock	1	Yes	Yes	66	G	Forth-coming	Yes	No	Yes	None	Adding pump-out services, showers, bathrooms, alcohol license, breakfast and lunch, boat rental
North River Marine (Scituate)*	Max. 28 broad-side slips	1, private	Yes	Yes	19	No	No	Yes	Yes: 30, 50	Yes	Engine service	
South River												
Bridgewaye Inn & Marina	50	No	Yes	No	No	No	Yes (private)	Yes	Yes: 30, 50	No	None	Restaurant, 4 hotel rooms for rent
White's Ferry Marina	Facility recently sold. Services to be determined. Can accommodate approximately 41 boats											

Table 13: Yacht clubs and amenities

Yacht Clubs												
Facility	**Slips (#)**	**Ramp (# Lanes)**	**Transient Accommodations**	**Upland Storage**	**Moorings**	**Fuel (Diesel, Gas)**	**Pump-out**	**Water**	**Electricity (amps)**	**Ice**	**Services**	**Other Amenities**
Green Harbor												
Green Harbor Yacht Club	56	No	Yes	Yes	No	No	No	Yes	Yes: 30, 50	Yes, at bar	None	Rental hall
South River												
Marshfield Yacht Club	80-90	No	No	Yes	No	No	No	Yes	Yes: 30, 50	Yes, at bar	None	Showers, rental hall, bar, kitchen for member use

4.11 Recreational Boating

Marshfield is a hub for recreational boating activity, with almost 1,400 recreational vessels identifying Marshfield as "home port" in the 2012 Massachusetts boat registration data base. Figure 17 shows the routes identified by a sample of recreational boaters during the 2012 season (Hellin *et al*., 2011), as well as the concentration of boating activity in the area. Not surprisingly, the map shows a heavy concentration of boating activity in and out of Green Harbor and the mouth of the North and South Rivers. In addition to local cruising, some popular destinations for boaters out of Marshfield include Stellwagen Bank and Provincetown.

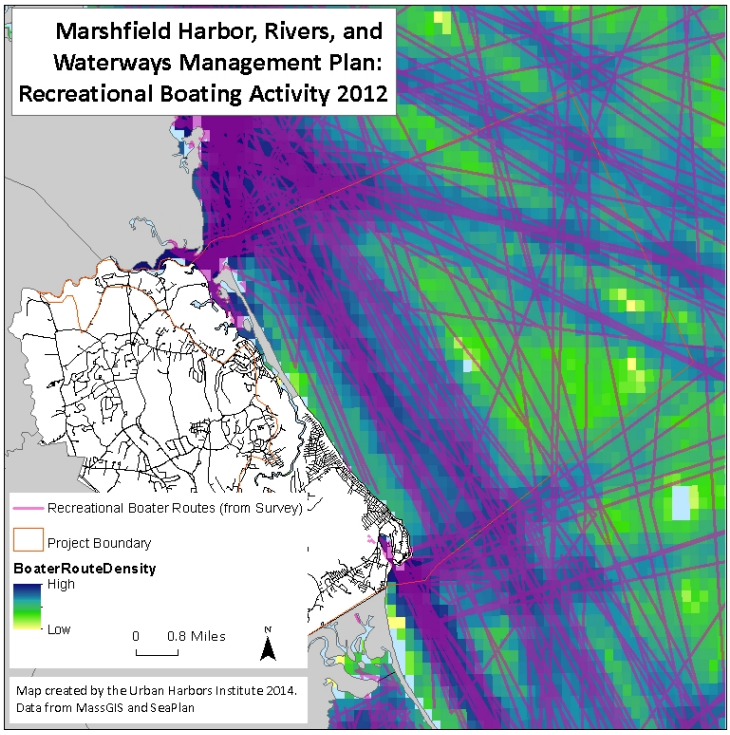

Figure 17: Recreational boating activity (route density) in Marshfield waters

As noted in the section on shoreside infrastructure, six marinas, two yacht clubs, and Town moorings provide berthing space for hundreds of recreational boats. Even with its current capacity, the Town's waitlist for moorings is 140 people. Many of these facilities offer services and amenities including dockside water and electricity, pump-out services, showers and restrooms, dining, and, boat repair services. Specific details about facilities and their amenities are available in Tables 12 and 13.

Many people also experience the Town's waterways via canoe and kayak, and to a lesser extent, via stand up paddleboards. As noted in the section on shoreside infrastructure, small boat launching is available at several sites along the North and South Rivers, in Green Harbor, and along the Town's Atlantic shore. While this access is available, many have noted the need for additional access, including sites with safe and ample parking. Residents have also identified a lack of local canoe and kayak rentals as an issue limiting enjoyment of the river via small boats. Paddling in the rivers can be limited by tides, and canoeists and kayakers are advised to take caution near the mouths of the North and South Rivers, where tides and currents can be extremely dangerous.

4.12 Changes in Sea Level and Climate

Sea level rise is projected to occur in Marshfield, and will likely have environmental and economic impacts on the Town. From an environmental perspective, sea level rise impacts will include the loss or migration of coastal natural resources such as wetlands and beaches – and related changes in species composition due to habitat loss or modification; changes in the extent of flood zones; and saltwater intrusion into groundwater resources and estuaries. From an economic perspective, sea level rise impacts will include increased expenses to repair/upgrade infrastructure that experiences or is at risk of experiencing damage due to flooding; potential loss of revenue generated by recreational uses of the waterways (e.g., fishing and shellfishing, boating, and beach-going); and potential impacts to the commercial fishery due to loss of infrastructure. Residents are concerned about the impacts of sea level rise, with 75% of those participating in a Town-wide survey (251/335) agreeing with the statement that "Sea level rise and climate change should be taken into

account in the Town's planning and land use decisions for the future" (Moakley Center for Public Management, 2013).

Sea level rise projections for the South Shore of Massachusetts differ, stemming from the fact that each model factors in a range of variables such as the expansion of the sea water as temperatures rise; the melting of polar ice, which contributes water to the ocean; and land subsidence (sinking) due to historical glacial activity. The range of projections is reflected in recent documents pertaining to sea level rise in and around Marshfield. Chase, et al., (2012) used the following projections, which do not take into consideration contributions to sea level rise stemming from ice melt:

- By 2020, sea level rise will be 5 inches higher than the average sea level calculated for the period of 1971-2000
- Sea level is projected to rise 12 inches over that same baseline (1971-2000 average) by 2050
- Sea level is projected to rise 24 inches over that same baseline (1971-2000 average) by the end of the century.

The end-of-the-century projection listed above is from the hazard adaptation report for the South Shore, conducted by the MAPC (2011). That report notes that the addition of water from melting ice might raise sea level as many as three feet above baseline levels by the end of the century.

Kleinfelder's recent report on sea level rise for Duxbury, Scituate, and Marshfield (2013) used sea levels in 2013 as their baseline, and projected the following sea level rises, taking into consideration contributions from melting ice:

- 1.08 feet by the year 2038
- 2.80 feet by the year 2063
- 5.16 feet by the year 2088

Kleinfelder's report uses projections based on NOAA's calculation of the worst possible scenario for sea level rise (selected based on "scientific evidence that suggests sea level is rising at a substantially higher rate than older historical records" (Kleinfelder, 2013)), taking into consideration local impacts of land subsidence.

While these reports present a wide range in predicted sea level change, they all suggest a significant rise in sea level in Marshfield which will have impacts on the Town's environment, infrastructure, and economy.

In addition to projections of sea level rise alone, Marshfield must also be concerned about increased wave height and storm surge (the water pushed onto land during a storm), which will have increased impacts as sea levels rise. Exact changes in wave height are unknown, but even small increases in wave height, coupled with storm surge and higher sea levels suggest that Marshfield can expect greater inundation and erosion stemming from larger waves that reach farther up onto shore.

Storm surge is already a problem for Marshfield, which experiences significant flooding during a 10-year storm, where the average storm surge is 9.2 feet (Chase, 2012). With sea level rise, this storm surge is predicted to increase, as is the frequency of these "10-year" storms (which are storms whose strengths have a 10% chance of occurring in any given year). The same can be said for the 100-year (i.e., 1% chance of occurring each year) and 500-year (i.e., 0.2% chance of occurring each year) storms, as outlined in Table 14 and Table 15. To put these numbers in context, maps produced by Chase, et al. (2012) show nearly all of Rexhame Beach inundated by storm surge in a 100-year storm in 2050, and show many of the properties surrounding Green Harbor inundated during a 100-year storm in 2025. Furthermore, this data suggest that by 2050, Marshfield will experience a storm almost equal in surge to our present 100-year storm every 3-6 years, rather than every 65-85 years.

Table 14: Projected rises in storm surge for the 10-year, 100-year, and 500-year storms (Data from Weiner, 1993, as cited in Chase, 2012)

	Current Storm Surge (ft)	Predicted storm surge in 2020 (ft)	Predicted storm surge in 2050 (ft)	Predicted storm surge in 2100 (ft)
10-Year Storm	9.2	9.7	10.2	12.2
100-Year Storm	10.4	10.9	11.4	13.4
500-Year Storm	11.2	11.7	12.2	14.2

Table 15: Changes in the expected frequencies of storm surge based on sea level rise (data from NPCC, 2009, as cited by Chase, et al. 2012)[6].

	2020s	Mid-Century	Late-Century
10-Year Storm	8-10 years	3-6 years	1-3 years
100-Year Storm	65-85 years	35-55 years	15-35 years
500-Year Storm	380-450 years	250-330 years	120-250 years

The Town already has some mechanisms in place to deal with storm surge, including 3.9 miles of public shoreline protection structures such as seawalls, rip rap, timber bulkheads, and jetties (CZM, 2007). As of a 2007 inventory conducted for the Office of Coastal Zone Management, these structures, categorized in Table 16, covered almost 1/3 of the Town's approximately 12 miles of ocean-exposed shoreline. If maintained and repaired, they can help mitigate some impacts of sea level rise and increased storm surge, but they will not provide long-term comprehensive protection and can be very costly to maintain[7].

Table 16: Results of a 2007 inventory of publicly-owned shoreline protection structures (data from CZM, 2007).

Primary Structure Type	Total Number	Total Length (ft)
Bulkhead/Seawall	18	14,820
Revetment	8	3,390
Groin/Jetty	6	2,640
Total	32	20,850

In addition to the shoreline structures in place, the Town has also been involved in planning processes to understand and address climate change and sea level rise, both as part of the Master Plan update (Chase, et

[6] A study of recent sea level anomalies resulted in an additional 100-year storm frequency projection for Boston, which puts the odds of a 100-year storm (from 2005) at <15 years by mid-century (Kirshen, et al, 2008).

[7] The study estimated that it would cost $22.4M to ensure that all of these structures could withstand a major coastal storm event without experiencing significant damage, approximately half of which ($12M) would go to repairing the 4 seawalls/bulkheads, 1 revetment, and 1 groin/jetty identified as being in "poor" condition (CZM, 2007).

al., 2012) and as part of a series of tri-town sea level rise studies along with Duxbury and Scituate (MAPC, 2011; Kleinfelder, 2013). These projects provide information on where the Town can anticipate the greatest impact from sea level rise and storm surge. For example, the Kleinfelder report (2013) shows inundation of the following roads in their 75-year scenario (excluding the effects of storm surge):

- Sections of Gurnet Road and Bay Avenue
- Dyke Road (Route 139)
- Ocean Street, Island Street and Cove Street in the Brant Rock area
- Town Pier Road and the Parking area at the Town Pier
- Plymouth Avenue
- Numerous streets in the Rexhame Beach Area
- Revere Street
- Macombers Ridge and Macombers Way
- Bartletts Isle Way

They also note potential damage to and limited access to shellfish beds in the North and South Rivers, loss of salt marsh and beach, and impacts to wildlife.

Additionally, the reports provide recommendations on how to address/avoid impacts from sea level rise. Some examples of adaptation and mitigation strategies include amending regulations to increase the minimum set-back with regard to developing near shoreline features; acquiring and/or conserving land that is vulnerable to sea level rise or that can mitigate impacts of sea level rise, implementing "soft" shoreline protection measures (e.g., beach nourishment, marsh creation, dune restoration/planting), building higher seawalls, exploring offshore structures to dampen wave action, improving floodplain maps, improving education about the risks of sea level rise, participating in the National Flood Insurance Program's Community Rating System, and raising roads prone to inundation.

The Town has also established a Coastal Advisory Committee (CAC) whose mission is to, "Advise the Town on sea level rise adaptation strategies that include but are not limited to protection, accommodation, or retreat so as to enable sustainable living in our coastal community" (Coastal Advisory Committee, 2013). Their mission statement also identifies 14 steps to accomplish their primary mission. Elements include a research-based approach to promoting adaptation strategies, improving public education, developing policies to minimize the Town's exposure to coastal storms, conducting cost-benefit analyses of adaptation measures, developing indicators to measure sea level rise and coastal storm frequency and intensity, collaborating with other Town entities to engage in long-range planning and coastal management issues, collaborating regionally to address coastal infrastructure management, securing funding to better understand and address sea level rise, and working with state legislators to address funding for coastal infrastructure management.

The CAC is comprised of members with backgrounds that make them well-positioned to understand and address the Town's needs with regard to sea level rise. Their establishment comes at a time when many residents are upset about the Federal Emergency Management Agency's redrawing of flood lines which would raise flood insurance costs for some homeowners, while requiring roughly 1,500 homeowners newly included in flood zones to obtain flood insurance (Barnes, 2013a). The Town is appealing these new FEMA maps on the grounds that the models used in their development "overstate[s] the base flood elevation along two lines of measurement…in the southern part of [T]own", and based on findings that, "FEMA did not make necessary adjustments to "stillwater" levels in a flood insurance study upon which the maps were based. Making those

adjustments would reduce base flood elevation by eight-tenths of a foot, according to the selectmen" (Barnes, 2013b). (See Section 5 for more information on the role of FEMA.)

In addition to concerns specific to sea level rise, climate change will also impact the distribution of species. In the marine environment, studies have already shown the migration of some species in accordance with shifts in water temperature. Such shifts in population can have many effects on the Town's marine living resources and the local fishing industry, such as (1) introducing non-native species (i.e., invasive species) which may out-compete or prey on native species, and (2) disrupting local fisheries by increasing the distance fishermen must go to catch their targeted species, and/or changing the composition of commercially harvested species – which would potentially require the purchase of new gear and the development of new markets.

Section 5: Management and Regulatory Authorities

Throughout this Plan, references are made to management and regulatory entities and authorities that are and/or should be involved in managing Marshfield's waterways and their uses. A description of the authorities and entities most relevant to this plan are described below.

5.1 Municipal

Waterways Committee

The Waterways Committee is responsible for initiation of this planning process, comprises much of the Marshfield Harbor Planning Committee, and will drive the implementation of this plan. Their mission is: In accordance with Article Thirty-two of the By-Laws of the Town of Marshfield, the Waterways Committee shall recommend procedures, policies and regulations to the Departments, Boards and Officials of the Town of Marshfield on matters affecting the safety, navigation, public's enjoyment, recreational boating activities, fishing interests, natural resources and the planning and management of Marshfield's waterways.

Municipal Harbor Plans

In September 1990 the Secretary of Environmental Affairs adopted regulations for "Review and Approval of Municipal Harbor Plans" (301 CMR 23.00). The regulations established a voluntary procedure by which municipalities could obtain state approval of a municipal harbor plan.

A municipal harbor plan is defined as a document setting forth the community's objectives, standards, and policies for guiding public and private use of the land and water areas of a harbor and an implementation program to achieve the desired plan. While some plans are only approved at the municipal level, greater influence over state decisions in a plan's planning area can be attained through state approval of a harbor plan. A plan prepared and approved in accordance with these regulations (301 CMR 23.00) serves to guide EEA agency actions, including the regulatory decisions of the MA Department of Environmental Protection (DEP) under M.G.L. Chapter 91. When a state-approved harbor plan exists, any project seeking a Chapter 91 permit from DEP must be in conformance with that plan. In essence, a municipality with a state-approved harbor plan utilizes the state regulatory authority to help implement its own objectives.

Through a locally-prepared state-approved harbor plan, a municipality has the ability to "substitute" local standards for certain state Chapter 91 requirements such as building height limits, and can "amplify" certain discretionary state standards.

The standards that can be substituted by a state-approved harbor plan apply only to non-water-dependent uses. Section 9.51(3) establishes minimum standards and limitations on building height, site coverage, waterfront setback, and encroachment into flowed tidelands. Section 9.53(2)(b)-(c) pertains to the provision of interior and exterior public space in a project. Section 9.52(1)(b)(1) is a requirement for a waterfront walkway with a minimum width of 10 feet to be included with any non water-dependent use. In those instances where non-water-dependent uses are allowed, this public access requirement exists, as does the ability to modify it through a municipal harbor plan.

The provisions of a state-approved municipal harbor plan can also be effective in providing guidance for DEP in applying the numerous *discretionary* requirements of the Chapter 91 regulations to projects under review.

Given this plan's scope and nature of recommendations, state-approval is not necessary for its implementation, and has not been sought. Nevertheless, this plan does meet the definition of a municipally-prepared harbor plan in that it sets forth the community's objectives, standards, and policies for guiding public and private use of the land and water areas and includes an implementation program.

Marshfield Zoning Bylaw

Most of the Town's zoning districts are present within the harbor planning area. These include:

- Business-Waterfront (B-4)
- Business-Mixed-use (B-1)
- Residential-Business (R-B)
- Business-Highway (B-2)
- Business-Neighborhood (B-3)
- Residential- Waterfront (R-3)
- Residential-Suburban (R-2)
- Residential-Rural (R-1)
- Airport (A)

The principal use in the residential districts is single-family detached dwellings. Open Space Residential Development and Age-restricted housing is also allowed by special permit.

Public parks and areas for passive recreation areas-of-right uses. Fishing and boating clubs are special permit uses.

Overlay Districts: the following zoning districts are superimposed over other districts and impose additional requirements in these areas (Articles XI, XIII and Article XV):

- Inland Wetlands Zoning District
- Coastal Wetlands Zoning District
- Storm Water Management Overlay District
- Flood Plain Zone

Marshfield Wetlands Protection

One of the primary responsibilities of the Marshfield Conservation Commission is the administration and enforcement of the Massachusetts Wetlands Protection Act (Mass. Gen. Laws ch. 131, § 40) along with the Town of Marshfield Wetlands Bylaws (Article 37). The purpose of the Town Bylaws is to "further protect and preserve the shores, ponds, rivers and wetlands and adjoining land areas in the Town of Marshfield by controlling activities deemed to have a significant impact upon wetland values. The interests protected by this Bylaw include but are not limited to the following: public water supply, private water supply, ground water, flood control, erosion control, sedimentation control, recreation, public safety, aquaculture, agriculture, fish, shellfish, wildlife (and related habitats of wildlife, fish, and shellfish), and prevention of storm damage and water pollution" (Article 37).

Under the Town of Marshfield Wetlands Protection Regulations, authorized by the Wetlands Bylaws (Article 37), the Conservation Commission has authority over any: bank; freshwater wetland; coastal wetland; beach; dune; flat; marsh; wet meadow; bog; swamp; lands adjoining the ocean or any: estuary; creek; river; stream; pond; lake; or any land under these waters; or any land subject to: tidal action; coastal storm flowage; or flooding (Area 1). In addition, the Commission has authority over any land at or below elevation 11 feet above mean sea level (Area 2). Activities within these resource areas subject to jurisdiction include any activity within 100 feet of these areas that will remove, fill, dredge, or alter any of these lands. The Commission requires a Notice of Intent and prior approval of any such activity. The Commission also retains authority over any activity which in its opinion will alter any of the previously specified wetlands areas.

In relation to Area 1 wetland resources, no disturbance or alteration is allowed within 50 feet and no building or structure is allowed within 75 feet. No activity, e.g., landscaping, mowing, or removal of vegetation, is allowed in the no disturbance zone. For existing lots with existing buildings, no disturbance or alteration is allowed within 25 feet of these Area 1 wetland resources. Examples of activities exempt from this setback

requirement include the following: docks, piers, or associated ramps; seawalls, bulkheads, revetments; and public open space nature trails, observation platforms, boardwalks, or footbridges.

Town Wetlands Protection Regulations also dictate the following: no disturbance or alteration is allowed within 100 feet of a vernal pool; no destruction or removal of woody vegetation, such as shrubs or trees, is allowed within 100 feet of an area subject to protection; and no removing, filling, dredging, or altering is allowed of isolated wetlands subject to flooding in the Polder, i.e., Green Harbor Reclamation Area.

Mooring Regulations

Marshfield's Mooring, Skiff Regulations & Specifications, authorized under the Town of Marshfield General Bylaws (Article 32), outline the procedures and rules regarding moorings, boat ramps, public landings, uses of the waterways, traffic, and safety.

No one can moor, anchor, or set any moored vessel or float in any harbor or waters within the Town of Marshfield without obtaining a permit from the Harbormaster. Permits are issued on a first come, first serve basis; however, preference is given to those without a mooring. The Harbormaster has the authority to reassign mooring locations of any permitted vessels at anytime. If there is no room for an applicant's vessel, the person's name will be put on a waiting list that is maintained by the Harbormaster.

No mooring is allowed in any navigational channel or where it might interfere with the public's rights of fishing, fowling and navigating on tidelands. No vessels greater than fifty feet in length without a Marshfield mooring are allowed to tie up to the Town piers or floats at any time without the permission of the Harbormaster.

It is the responsibility of the permit holder to register, install, and maintain appropriate mooring gear or tackle, according to criteria determined by the Harbormaster. The permit holder must submit a written request for any mooring tackle modification and must receive written approval from the Harbormaster.

All Marshfield moorings are inspected on a 3-year cycle based on location. Moorings must be inspected by a certified mooring company approved annually by the Harbormaster. The Harbormaster establishes the inspection schedule and may change the schedule at his discretion. Moorings not inspected within the assigned inspection year will be revoked.

Mooring fees, based on vessel length overall (LOA), are established by the Harbormaster and approved by the Board of Selectman. Moorings may be reassigned by the Harbormaster for non-payment, unauthorized loaning, renting, leasing of moorings, and non-use of mooring.

If an assigned mooring is not used for at least 30 days each 12-month mooring fee billing period, the mooring is considered abandoned and will be forfeited. The permit holder may apply for a one-year grace period to retain their mooring based on the purchase of a replacement vessel or significant mechanical difficulties to the current vessel. Prior written notification to the Harbormaster is required. Mooring holders may transfer their mooring permits only to a spouse or next of kin.

Harbor Safety and Navigation

The Town's By-Laws address general harbor safety and navigation in several Articles including Article 32, which specifies mooring regulations and outlines rules for safety on waterways and on Town-owned property along or in the water. Some specific waterways safety and navigation-related items from Article 32 include: establishing a speed limit of 6 nautical miles per hour in Green Harbor and the North and South Rivers and prohibiting disturbing wakes (which is reiterated in Article 58); prohibiting SCUBA diving and snorkeling in Green Harbor and navigable fairways (without permission from the Harbormaster); prohibiting swimming from public piers, floats, and launches in addition to swimming in fairways; establishing rules for the storage of

vessels and equipment at Town piers and floats; and prohibiting the use of jet skis, water bikes and other similar crafts on the rivers or within 300 feet of Marshfield beaches (also addressed in Article 64).

Shellfish Regulations

Under Massachusetts General Laws, Ch. 130, Sec. 52., coastal towns are authorized to control, regulate, or prohibit the taking of any and all kinds of shellfish within their jurisdiction. The Marshfield Shellfish Rules & Regulations, authorized by the Town of Marshfield General Bylaws (Article 10), are designed to ensure the continued sustainable management of the shellfish resource.

The Harbormaster is the designated Shellfish Warden and may appoint assistant shellfish wardens and establish regulations and fees for taking of shellfish.

Species harvested in Marshfield include soft shell clams (*Mya arenaria*), quahogs (*Mercenaria mercenaria*), sea clams (*Spisula solidissima*), razor clams (*Siliqua patula*), and blue mussels (*Mytelus edulis*). None of these species may be harvested or sold commercially under a recreational permit. Commercial mussel permits are available under a limited entry fishery.

The shellfish season in the North and South Rivers runs from November 1 to May 31. Marshfield shellfish flats are open on Wednesday, Friday, Saturday, and Sunday. Harvesting is authorized from one half hour before sunrise to one half hour after sunset. The weekly shellfish catch limit is 8 quarts/1 peck per week, per household. The following minimum legal size limitations apply to shellfish catch:

- Soft shelled clamed (Steamer) and Blue Mussels must measure at least 2 inches in length
- Razor clams must measure at least 4 inches in length
- Quahogs must measures at least 1 inch in width
- Sea clams must measure at least 5 inches in length

Herring Regulations

Under Massachusetts General Laws, Ch. 130, Sec. 95., coastal towns are authorized to control, regulate, or prohibit the taking of herring within their jurisdiction.

Marshfield Herring Regulations, authorized under the Town of Marshfield General Bylaws (Article 32, Section 6, Clause 17), prohibit the taking of river herring, defined as blueback (*Alosa aestivalis*) or alewives (*Alosa pseudoharengus*), from any river, stream, or estuary in Marshfield at any time. River herring may not be taken by any means, including any disturbance in the water; placement of any object, such as barriers or nets; or placement of any substance, such as chemicals, in the water. It is prohibited and unlawful for any person to harvest, possess, or sell any river herring, dead or alive, for any purpose.

Any who violates these regulates or otherwise takes, kills, hauls onshore, disturbs, injuries, or hinders or obstructs the passage of any river herring will be subject to a maximum of $50 for each offense. Each fish may be considered a separate offense.

Conservation Land Management

Under the authority of Mass. Gen. Laws ch. 40, §8C, the Marshfield Conservation Commission manages conservation land and implements rules and regulations in accordance with this management.

Work of any kind, e.g., trail clearing, trail maintenance, excavation, filling, building structures, and posting signs, requires prior written permission from the Commission.

Tampering with any fish ladder or interference with migrating herring or eels is not allowed. Wildlife, including vertebrates and invertebrates, must not be harassed, collected, removed, or fed.

Hunting, trapping, and discharge of firearms, paintball guns, and pellet guns, are prohibited. Additional prohibited activities include: use of any motor-powered vehicle, e.g., cars, trucks, dirt bikes, ATVs, snowmobiles, except in designated driveways and parking areas; dumping; littering; smoking; consumption of alcoholic beverages; and use of glass containers. All pets are required to be on a leash.

Beach Management

The Marshfield Beaches Rules & Regulations address the general safety and enjoyment of visitors to beaches, seawalls, or other public areas in Marshfield.

No motor vehicles are allowed on any beach or sand dune. Jet skis, water bikes, or similar watercrafts may not be operated on the North or South Rivers or within 300 feet of Marshfield beaches, including swimming areas.

Fires are not allowed on the beach or dunes without a written permit from the Fire Department. Smoking is prohibited within 25 feet of any public beach.

Alcoholic beverages, trash, and glass are prohibited from beaches, sea walls, and public areas. Camping, dressing, or undressed is not allowed on the beaches or in the beach areas. Diving off Town jetties is not allowed. All dogs must be on a leash.

5.2 Regional

North River Commission

The North River Commission (NRC) was established by the Massachusetts Department of Environmental Management (DEM), now the Department of Conservation and Recreation (DCR), under the authority of the Scenic and Recreational Rivers Act (Mass. Gen. Laws ch. 21, §17B) and the North River Commission Act (Acts of 1978, ch. 367, §62).

The North River Commission is a division of DCR and is comprised of representatives and alternates designated by the Board of Selectmen in each member town. The member towns are Scituate, Marshfield, Norwell, Hanover, Hanson, and Pembroke. Funding for the North River Commission is provided by the state and the funds are managed by the North and South Rivers Watershed Association (NSRWA). The NSRWA is a non-profit advocacy organization founded in 1970 with a mission to preserve, restore, maintain and conserve in their natural state, the waters and related natural resources within the watershed of the North and South Rivers.

The North River Commission administers the North River Protective Act. This Protective Order is a set of regulations adopted by the Massachusetts Legislature in 1978. The Protective Order acknowledges the significance and value of the North River as a recreational and scenic resource in Massachusetts and seeks to protect public and private property, wildlife, fresh and saltwater fisheries, and irreplaceable wild, scenic, and recreational river resources. The regulations designate a River Corridor area and establish allowed, permitted, special permitted, and prohibited uses within the Corridor. The Corridor includes the North River, parts of associated tributaries and marshes, and a 300-foot wide upland area on both sides of the River in the member towns. The North River is the only river in Massachusetts to be designated a scenic and recreational river and to be subject to a protective order.

To protect the River Corridor, the Protective Order restricts uses and land development in this area. Within 100 feet of each side of the riverbank, no new development and essentially no vegetative cutting is allowed.

From 100 feet to 300 feet from each side of the riverbank, development is permitted only if it meets specific design standards. The NRC issues determinations on the status of proposed activities; reviews applications; and grants, denies, or conditions Special Permits, among other actions.

5.3 State

MGL Chapter 91

Massachusetts' principal waterfront regulatory program in tidelands and other waterways is Massachusetts G.L. Chapter 91 (Public Waterways Act, 1866). Chapter 91 and the corresponding Waterways Regulations (310 CMR 9.00) are administered by the Division of Wetlands and Waterways of the Massachusetts Department of Environmental Protection (DEP).

Chapter 91 applies in tidelands, great ponds, and along certain rivers and streams. Tidelands refer to all land presently or formerly beneath the waters of the ocean, including lands that are always submerged as well as those in the intertidal area, i.e., below the mean high water mark. This area is governed by a concept in property law known as the public trust doctrine which establishes that all rights in tidelands and the water are held by the state "in trust" for the benefit of the public for the purposes of fishing, fowling, and navigation. The Waterways Act and its corresponding regulations codify the public trust doctrine in Massachusetts.

> The benefits that the Chapter 91 program can afford a town are best captured in the five basic objectives of the program:
>
> (1) ensure the waterfront is used primarily for water-dependent purposes;
>
> (2) provide public access;
>
> (3) facilitate other state programs related to shoreline use and conservation;
>
> (4) strengthen local controls and encourage harbor planning; and
>
> (5) ensure accountability to present and future public interests.

As clarified by the 1983 amendments to the waterways regulations, Chapter 91 jurisdiction extends landward to the historic high water line and seaward three miles to the limit of state jurisdiction. The historic high water line is the farthest landward tide line which existed "prior to human alteration" by filling, dredging, impoundment or other means (310 CMR 9.02). Thus, Chapter 91 applies to filled as well as flowed tidelands, so that any filled areas, moving inland to the point of the historic high tide line, are subject to Chapter 91 jurisdiction.

Chapter 91 authorization is generally required for any fill, structure, or use not previously authorized in tidelands, including any changes of use and structural alterations. Types of structures include: piers; wharves; floats; retaining walls; revetments; pilings; bridges; dams; and waterfront buildings (if located on filled lands or over the water).

For planning purposes, the location of the historic high water line, i.e., the upland limits of Chapter 91 jurisdiction, must be established through a review of maps that may reliably show the original natural shoreline or through engineering studies. Previously issued Chapter 91 licenses are also a source of information on the historic high tide line for specific parcels.

Wetlands Protection Act

Wetlands are protected under the Massachusetts Wetlands Protection Act (Mass. Gen. Laws ch. 131, § 40). The Act governs any person seeking to "remove, dredge, fill, or alter any bank, riverfront area, fresh water wetland, coastal wetland, beach, dune, flat, marsh, meadow, or swamp bordering on the ocean or on any

estuary, creek, river, stream, pond, or lake, or any land under said waters or any land subject to tidal action, coastal storm flowage, or flooding".

The Wetlands Protect Act identifies the following eight primary values of wetlands:

- public/private water supply
- groundwater supply
- flood control
- storm damage prevention
- prevention of pollution
- protection of land containing shellfish
- protection of wildlife habitat
- protection of fisheries

The Wetlands Protection Act, along with other relevant local and state laws governing wetlands, is administered by each municipal conservation commission under the authority of 310 CMR 10.00. Anyone seeking to do work in or near wetlands must obtain permission from the appropriate conservation commission. See the Municipal Regulations section for discussion of Marshfield's specific wetlands protection regulations.

Water Quality Certification

Any dredging, activity resulting in a discharge of a pollutant, or dredged material disposal of more than 100 cubic yards, and any project that requires a federal permit (such as a 404 permit from the Corps) must also obtain a Water Quality Certification (authority derives from Section 401 of the Clean Water Act). The DEP's Division of Wetlands and Waterways administers the program which seeks to ensure that a proposed project does not violate the Massachusetts Surface Water Quality Standards or the Massachusetts Wetlands Protection Act, and otherwise avoids or minimizes individual and cumulative impacts to Massachusetts waters and wetlands. If a project would result in minimal fill within wetlands, the Order of Conditions issued by the Conservation Commission can serve as the Section 401 Water Quality Certificate.

Massachusetts Ocean Plan

The Oceans Act of 2008 (2008 Acts 114) required Massachusetts to develop a comprehensive ocean management plan. The Massachusetts Ocean Management Plan was designed to protect critical marine resources and foster sustainable uses, including renewable energy, in the state's ocean waters. The four plan goals, derived from the Oceans Act, are:

- Balance and protect the natural, social, cultural, historic, and economic interests of the marine ecosystem through integrated management;
- Recognize and protect biodiversity, ecosystem health, and the interdependence of ecosystems;
- Support wise use of marine resources, including renewable energy, sustainable uses, and infrastructure;
- Incorporate new knowledge as the basis for management that adapts over time to address changing social, technological, and environmental conditions.

Overall this planning effort promotes integrated management of ocean space among all users and interests. The Massachusetts Ocean Management plan was incorporated into the current Massachusetts Office of Coastal Zone Management Policy Guide October 2011. As a result, the MA Ocean Plan is enforced through the state's regulatory and permitting processes, including Chapter 91 Waterways Regulations.

Massachusetts Ocean Sanctuary Program

In 1970, Massachusetts passed the Ocean Sanctuaries Act (Mass. Gen. Laws ch. 132A, § 12A) which applies to the area between the mean low water line and three miles offshore, except for the area between Lynn and Marshfield. The Ocean Sanctuaries Act is designed to protect coastal waters by prohibiting activities that could be environmentally or aesthetically damaging. The Act prohibits exploitation or development that would seriously alter or endanger the ecology or appearance of the ocean, seabed, or the subsoil. Prohibited activities include building on the seabed, drilling, dumping wastes, and commercial advertising; however, fishing, sand extraction, and special projects are still allowed under the act. The Department of Conservation and Recreation (DCR) has jurisdiction over the ocean sanctuaries and DCR must approve all activities that occur on, or in, these areas.

5.4 Federal

U.S. Army Corps of Engineers

The Corps of Engineers regulates work and structures that are located in, under or over navigable waters of the United States under Section 10 of the Rivers and Harbors Act of 1899; the discharge of dredged or fill material into waters of the United States under Section 404 of the Clean Water Act; and the transportation of dredged material for the purpose of disposal in the ocean under Section 103 of the Marine Protection, Research and Sanctuaries Act. "Waters of the United States" are navigable waters, tributaries to navigable waters, wetlands adjacent to those waters and/or isolated wetlands that have a demonstrated interstate commerce connection.

Clean Water Act

Section 404 of the Clean Water Act authorizes the Corps to regulate the discharge of dredged or fill material into "waters of the United States" which (as stated above) are all navigable waters, tributaries to navigable waters, wetlands adjacent to those waters, and other isolated wetlands that have a demonstrated interstate commerce connection. The limit of jurisdiction varies depending on the type of location: in tidal waters, the limit is the high tide line; in non-tidal waters, and in the presence of adjacent wetlands, the limit is the extent of the wetland; and in non-tidal waters, and in the absence of adjacent wetlands, the limit is the ordinary high water mark. Regulated activities include the placement of fill for construction, site-development fill, riprap, seawalls, and beach nourishment.

Rivers and Harbors Act of 1899

Section 10 of the Rivers and Harbors Act of 1899 authorizes the U.S. Army Corps of Engineers to regulate structures and other modifications of navigable waters of the U.S. Jurisdiction extends shoreward to the mean high water line in tidal waters, and to the ordinary high water line in non-tidal waters (fresh water). Regulated activities include construction of piers and wharves, permanent mooring structures such as pilings, intake and outfall pipes, boat ramps, beach nourishment, and dredging and disposal of dredged material, excavation, and filling.

The Corps' other major responsibility is to plan and carry out water resources projects such as improvements to navigation. Since 1986, the cost for such projects is shared between the federal government and the non-federal sponsors. An important consideration in the Corps' decision to undertake a project is that its benefits

exceed the cost. For projects such as dredging of harbors and navigation channels, highest priority goes to projects that benefit maritime industry, such as shipping and fishing.

The Main Channel into Green Harbor is a federally-authorized and maintained navigation channel.

Federal Emergency Management Agency (FEMA)

The National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRMs) are the official maps of a community on which FEMA has delineated both the special hazard areas and the risk premium zones applicable to the community. The majority of the planning area, including all properties along the water's edge, is in zones AE, AO, VE, or X. The following provides a further description of the zone designations:

- Zone AE: Areas subject to inundation by a 100-year flood (1-percent-annual-chance flood event). Base Flood Elevations (BFEs) are provided.
- Zone AO: Areas subject to inundation by a 100-year shallow flood (1-percent-annual-chance shallow flood event), usually sheet flow on sloping terrain, where average depths are 1-3 feet. Average depths are provided.
- Zone VE: Areas subject to 100-year flood (1-percent-annual-chance flood event) and additional velocity hazards (storm-induced wave action). Base Flood Elevations (BFEs) are provided at selected intervals.
- Zone X (unshaded): Areas outside the 500-year flood plain (less than 0.2 percent-annual-chance flood event). These are areas of minimal flood hazard from the principal source of flood in the area.
- Zone X (shaded): Areas within the 500-year flood plain (0.2 – 1.0 percent-annual-chance flood event). These are areas of moderate flood hazard from the principal source of flood in the area.

On the FIRM, the land area covered by the floodwaters of the base flood, i.e., the flood having a one percent chance of being equaled or exceeded in any given year (also referred to as the "100-year flood"), is the Special Flood Hazard Area (SFHA). The SFHA includes Zones A, AO, AH, A1-30, AE, A99, AR, AR/A1-30, AR/AE, AR/AO, AR/AH, AR/A, VO, V1-30, VE, and V. Within the Special Flood Hazard Areas (SFHA), flood insurance is required for mortgages from a federally regulated lender if a structure is located in a flood zone.

On June 6, 2013, the Federal Emergency Management Agency (FEMA) issued new draft Flood Insurance Rate Maps. The areas of Marshfield that are in the flood zones or SFHA have increased significantly on the new draft maps. FEMA has established procedures for an appeals process by which a community may compile appropriate data and request a map revision. Further, if an individual homeowner has technical information to indicate that his or her home has been inadvertently shown within the Special Flood Hazard Area on a Flood Insurance Rate Map, the homeowner may submit that information to FEMA and request that FEMA remove the flood zone designation from the home by issuing a Letter of Map Amendment (LOMA) or a Letter of Map Revision Based on Fill (LOMR-F). Requests for LOMAs/LOMR-F must include the surveyed elevation of the lowest grade adjacent to the structure or the lowest enclosed level of the structure, along with certain other information.

The draft maps for most of Massachusetts were previously scheduled to take effect in July 2014. In January 2014, however, FEMA announced that implementation of the new maps in Plymouth County would be delayed by at least one year until an undetermined date in 2015 while the agency addresses the numerous appeals from residents in Marshfield and Scituate. In addition, in March 2014 President Obama signed the Homeowner Flood Insurance Affordability Act of 2014 into law. The legislation slows down the rate of increase in insurance premiums by requiring FEMA to increase premiums for a majority of subsidized properties by at least 5 percent but not more than 18 percent annually. Among other provisions, the

legislation also requires the design of more accurate flood maps, provides reimbursement of overcharged premiums since 2012, and suggests a new appeals process. For the applicable properties, the new insurance rates will take effect in October 2014. In addition, Marshfield participates in the National Flood Insurance Program's (NFIP) Community Rating System (CRS). CRS is a voluntary program that provides incentives to encourage community floodplain management that exceed the minimum NFIP requirements. The three goals of the CRS are: (1) Reduce flood damage to insurable property; (2) Strengthen and support the insurance aspects of the NFIP; and (3) Encourage a comprehensive approach to floodplain management.

These CRS goals are designed to reduce overall flood risk. A community therefore may earn discounted flood insurance premium rates through management actions that meet these goals.

Environmental Protection Agency (EPA) Phase II NPDES Storm Water Program

The U.S. Environmental Protection Agency (EPA) storm water management program, initiated in 1990 under the Clean Water Act, is aimed at preserving, protecting and improving the nation's water resources from polluted storm water runoff. The first phase of the program focused on using the National Pollutant Discharge Elimination System (NPDES) permits to address storm water runoff from larger storm sewer systems serving populations of 100,000 or more and construction activities disturbing five acres or more and certain industrial activities. Phase II, which began in 1999, extended the NPDES permit coverage for storm water discharges from smaller storm sewer systems (under 100,000 population) in urbanized areas and smaller construction sites (activities disturbing between one and five acres of land).

Phase II is an attempt to further reduce adverse impacts to water quality and aquatic habitat through the use of controls such as public educational programs, storm sewer inspections for illegal connections, and ordinances to control construction site runoff.

Magnuson-Steven Fishery Conservation and Management Act

The Magnuson-Steven Fishery Conservation and Management Reauthorization Act of 2006, signed into law on January 12, 2007, governs the commercial and recreational harvesting of fish in federal waters. Currently undergoing reauthorization (the Act of 2006 was authorized to run from 2006-2013), the management of fisheries is conducted through the development and implementation of regional fisheries management plans. Marshfield is part of the New England Fisheries Management Council, which has fisheries management plans for northeast multispecies, scallops, monkfish, herring, small mesh multispecies, dogfish, red crab, skates, and Atlantic salmon. These science-based plans detail limits on harvest amounts; the numbers of fishermen that can participate in a fishery; how fish can be harvested; and where and when fish can be harvested.

Section 6: Issues, Goals, Objectives and Recommendations

The following section presents the issues, goals, objectives, and recommendations of this plan. The issues, goals, objectives, and recommendations are ordered according to broad themes which include navigable waterways; natural resources; public access; recreational boating; working waterfronts and infrastructure; water quality; administration/finance; collaboration; and climate change and sea level rise. The material was developed through a series of public meetings, targeted interviews, and Committee meetings. A rough implementation schedule can be found in Appendix B.

6.1 Navigable Waterways

Marshfield has five waterways of importance to recreational boaters and recreational and commercial fishermen: Green Harbor, the North River, the South River, and the portions of Massachusetts and Cape Cod Bays within the jurisdictional limits of the Town. The use of these waterways by vessels is regulated by several Town by-laws (see Section 5 for details). Safe navigation depends largely on maintenance of the channels, as described below.

The Green Harbor Navigation Channels and Anchorage, Jetties, and Dredging

As mentioned in Section 4 of this report, the federal navigation project in Green Harbor, originally completed in 1969 under Section 107 of the continuing Authorities Program, consists of:

- A channel extending 4,000 feet from deep water to a six-foot deep turning basin located below the Route 139 Bridge. The channel design is six feet deep (MLW) from just inside the outer end of the jetties to the turning basin and eight feet deep (MLW) from deep water to just the inside jetties, and 100 feet wide.
- An anchorage six feet deep and five acres in area adjacent to the Town Pier.
- Rehabilitation of the existing state-built west jetty at the harbor entrance. This work included raising the jetty and extending it by 200 feet.
- Raising the existing state-built east jetty.

Since 1969, several dredging operations have taken place to maintain the channel; and the jetties have sustained storm damage, including from Hurricane Sandy. In February 2014, the U.S. Army Corps of Engineers, New England District issued a $1,177,400.00 contract for repair of the Green Harbor east and west jetties. Construction began in May 2014 and is expected to take approximately four months to complete. The work involves conducting maintenance repairs to bring the structures back to their authorized dimensions and full functionality (i.e., restoring the west jetty to its 14-foot height), repairing damage sustained during Hurricane Sandy and subsequent nor' east storms. The repairs include a combination of acquiring and placing new stone, reusing some displaced stone, and installing sheet piling to sand-tighten a section of the landward end of the east jetty. Mesh matting will also be installed to help decrease the amount of sand that comes through the jetty and accumulates in the channel. Approximately seven separate areas of the east and west jetties will be repaired.

While the repairs will restore conditions at the jetties, consistent with the funding requirements, the Harbormaster is requesting that the Corp use a portion of the original $3.3 million jetty repair and dredging funding to conduct a formal study on the jetties, including tides and current flows in the channel, which can be used to inform their redesign.

In addition to the jetty repairs, the Corps will be conducting dredging the harbor in May 2014. Aside from the federal project, there is some interest in dredging a portion of Green Harbor to the east of the small island for purposes of improving water circulation and canoe/kayak access.

Navigation in the Rivers

The currents in the North and South rivers generally maintain water depths suitable for navigation, though maintenance dredging is necessary periodically in areas where sand accumulates. Once such area is under the Sea Street Bridge where pilings and debris left over when the new bridge was completed in 2010 trap sediments. In the Fall 2013, Marshfield completed a $400,000 dredging project under the Sea Street Bridge to alleviate this problem. Funding came from the state's Department of Transportation, Department of Conservation and Recreation, Scituate, and Marshfield.

In Spring 2014, Marshfield and Scituate jointly applied for a $4.8 million grant from the National Fish and Wildlife Program to dredge the channel of the South River from the Sea Street Bridge to the Spit where it meets with the North River. Each town is providing a match of $260,000. This project will remove about 60,000 cubic yards of sand and sediment from the channel to be used for shoreline restoration at the Fourth Cliff Air Force Recreational Area and along the isthmus of North Humarock Beach, Scituate. Currents will carry some of the sand to the south, replenishing beaches along the Marshfield shoreline.

Issues

There are several opportunities to improve navigation with in Town waters.

1. The Narrows at the entrance channel at Green Harbor is subject to frequent filling in with sediment which results in navigational and safety problems for recreational boats and commercial fishing vessels. Due to the inadequate design of the existing jetties, a large amount of sediment is carried into the harbor from offshore and alongshore sources. Regular dredging provides a short-term solution, but is costly and temporary. Redesign and reconstruction of the jetties should be undertaken as a long-term and cost-effective solution. Funding for this project s the major barrier.
2. Dredging is needed for safe navigation in parts of the North and South Rivers. Specific locations include the South River at the Sea Street Bridge and spots at the mouth of the North and South Rivers.
3. A plan needs to be developed for maintenance dredging, including the beneficial reuse of dredged materials.
4. Dredging of the Narrows, Green Harbor, and the Rivers is costly and dependent on securing sufficient funds. The Town has considered participating in a shared dredging program with other communities in Plymouth County to reduce the costs of dredging projects, but the model that was discussed (where each town contribute annually to the program) is not optimal for Marshfield.

Recommendations

Goal 1: Maintain Marshfield's waterways in a safe navigable state for all users.

Objective I – Ensure adequate dredging to promote safe navigation.

a. Create and update a long-term maintenance dredging plan for critical points in Green Harbor and the North and South Rivers. Work with the state and federal agencies on a 10-year comprehensive maintenance dredging permit for all Town waterways, based on the maintenance dredging plan.

Working with the Harbormaster, the Committee should compile dredge and permit histories for the Town's navigable waterways as the foundation for a future maintenance dredging plan. The plan should identify and prioritize efforts required for permitting and funding future dredging projects.

Funding: The implementation of this recommendation should not require any additional funding.

- Harbormaster
- Waterways Committee

b. Immediately undertake dredging the entrance channel at Green Harbor to a navigable depth of eight feet for a width of 100 feet, and maintain these dimensions by dredging as needed.

As noted above, emergency dredging to remove shoaling in the entrance channel resulting from Hurricane Sandy was conducted in May 2013 with funding provided by the Disaster Relief Appropriations Act of 2013. The after-dredge survey conducted in June 2013 indicated the design depth of the 8-foot deep channel was restored for the entire 100-foot width of the channel. The 6-foot channel was dredged to an average of -4.0 MLW.

The Corps is scheduled to conduct additional dredging the harbor in 2014.

Funding: Much of the dredging activities in Town are conducted with federal or grant funds. Efforts to maintain and seek new sources of funds should be ongoing in order to ensure that necessary dredging activities are conducted.

- Harbormaster
- U.S. Army Corps of Engineers
- Waterways Committee

c. Complete dredging of the South River from the Sea Street Bridge to the south, and north to the Spit..

In the Fall of 2013, Marshfield completed a $400,000 dredging project under the Sea Street Bridge. Another 60,000 cubic yards of sand and sediment needs to be removed from the South River from the reach of channel from the Sea Street Bridge to the Spit where it meets the North River, and additional dredging is needed south of the Sea Street Bridge. The dredged sand can be used for shoreline restoration. A joint application submitted in Spring 2014 by Marshfield and Scituate for $4.8 million from the National Fish and Wildlife Program to dredge this section of the channel was not successful.

Funding:

Massachusetts Environmental Bond Bill (Ch. 286 Acts of 2014) includes $5.2 million for South River dredging

Marshfield Annual Town Meeting: seek approval of $200,000 cost share

Responsible parties:

- Harbormaster
- Waterways Committee

d. Share all future costs for permitting and dredging in the North and South Rivers equitably with the towns that share the waterway. This arrangement should be in the form of a Memorandum of Understanding (MOU) with Scituate, approved by the respective Boards of Selectmen.

Increasingly, Marshfield and Scituate have been working cooperatively on dredging of shared waterways and other marine-related matters. It would be mutually beneficial and potentially cost effective in the long term for the two towns to agree on the principles that will guide future collaborations on improvements to and management of shared waterways.

Funding: Developing this arrangement should not require any additional funding.

Responsible parties:

- Waterways Committee
- Boards of Selectmen
- Harbormasters

Objective II – Develop a long-term, cost-effective solution to improve safe navigation and reduce the frequency and severity of shoaling in Green Harbor.

a. Petition the U.S. Army Corps of Engineers to address the shoaling at the jetties due to their design and configuration, taking into consideration the studies conducted in 1980 and 1988, for the purposes of ensuring long-term, safe navigation.

Under Section 216 of the Flood Control Act of 1970 (P.L. 91-611, 33 U.S.C. §549a), the U.S. Army Corps of Engineers (USACE) has the authority to review operations of a completed project. To initiate such a review of the jetties at Green Harbor, the Town via the Board of Selectmen, or other local sponsor that would assume financial responsibility, should send a letter requesting this review to the USACE. This §216 review by the USACE planning department is a quick, initial appraisal to determine whether further study is warranted. This review would include an economic cost-benefit evaluation and also would review prior studies, such as those conducted in 1980 and 1988. This review potentially could be completed in Fall 2014.

If the review recommends further study, then a Continuing Authorities Program (CAP) Small Navigation Project Study for the project can be initiated under Section 107 of the Rivers and Harbors Act. To initiate a CAP study, the project must be included in the USACE budget and therefore competes for funding with approximately 100-200 other CAP projects around the country. The FY2016 USACE budget is the next available budget in which a CAP project for the Green Harbor jetties could be included.

The first step in project development and construction is a feasibility study to identify solutions to existing problems that are consistent with federal policy and the needs of the waterway. The first $100,000 of cost for the feasibility study is covered by the federal government, and any additional costs are shared on a 50-50 basis with the Town or local sponsor. Design plans and construction costs are shared, with 80 percent paid by the federal government and 20 percent paid by the Town or local sponsor. Specifically, for projects with a design depth of 20 feet or less, the Town or local sponsor is responsible for 10 percent of costs up-front during construction and 10 percent after construction over a time period of up to 30 years. Overall each project must be economically justified, environmentally sound, and technically feasible. The USACE would continue to be responsible for future project maintenance.

Funding: Although funds remain from the $3.3 million appropriated in the Disaster Relief Appropriations Act of 2013 to restore the Green Harbor jetties after damage in Hurricane Sandy, these funds are authorized by Congress only for rebuilding purposes. The USACE therefore cannot independently redirect the funds for other purposes, such as study or redesign of the jetties. The Town will need to consider budget allocations, as well as contributions from the Waterways Fund, to meet their financial obligations under any potential cost-sharing agreement with the USACE.

Responsible parties:

- Waterways Committee
- Harbormaster

- Board of Selectmen/Town Administrator
- U.S. Army Corps of Engineers
- MA Office of Coastal Zone Management

b. Continue sand management activities to reduce the impact of aeolian sand transport in Green Harbor.

A portion of the sand that accumulates in the channel at Green Harbor is carried by the wind from adjacent upland beaches. Continue to implement measures, such as removing excess sand and installing snowfence to reduce the amount of sand reaching the dredged channels.

Funding: Funding for these efforts will vary according to the strategy being employed.

Responsible parties:

- Waterways Committee
- Harbormaster
- Conservation Commission
- Coastal Advisory Committee

c. Develop a plan to guide beach renourishment. As part of this plan, where feasible, use a dredging method that would allow dredge spoil to be used for beach renourishment. Pursue permitting for shoreward expansion of the existing dredge material placement site at Green Harbor Beach and identification of a new secondary site near Rexhame Beach. Particular locations for renourishment include Rexhame Beach, Hewitt's Point, and Burke's Beach.

The use of dredged material for beach renourishment is becoming increasingly important as a measure to protect coastal properties, shoreline protection structures, and wetlands resources from the effects of sea level rise and storm surges, as well as to support recreational use. Beneficial reuse should be the priority disposal option for dredged material from the Town's waterways, whether by hydraulic pumping directly onto the beaches or by barge to nearshore locations that will be a source of material for beaches.

The identification of a new placement site for dredge material or expansion of an existing site begins with a shellfish survey and lobster survey by the Massachusetts Division of Marine Fisheries (DMF) to identify the natural resources and habitat present at the site. If the area is acceptable to DMF, then a variety of other permitting actions can proceed, including permits from the USACE; under the Massachusetts Environmental Policy Act (MEPA), Clean Water Act Section 401, and M.G.L. Chapter 91 licensing; and potential federal consistency determination by the Massachusetts Office of Coastal Zone Management (CZM).

Pursue permitting for an expansion of the placement site off of Green Harbor Beach. The Town would prefer that material dredged from Green Harbor entrance channel be placed directly onto the beach (in 7-10 feet of water) rather than placing this sand 400-500 yards offshore of the beach. Permitting exists for the current site, but further study and permitting of the expanded area is needed. Of particular concern is the presence of cobble habitat, which is important in the life cycle of lobsters and various fish species.

DMF also recommends that the Town conduct a beach survey to determine what resources are present on the beach over time before and after any dredge material placement. DMF does not conduct these

surveys, therefore the Town would have to hire a private consultant. The Town hopes to move the sand as far up the beach as possible to prevent currents and tides from carrying sand around the west jetty and into the channel.

Pursue permitting of a near shore dredge material disposal site in the vicinity of Rexhame Beach for beach renourishment. Any material placed at this site will renourish Rexhame Beach and also will naturally flow south to renourish other Marshfield beaches. This additional area could provide a revenue opportunity by accepting clean and suitable dredged material from other towns. The Town should work with DMF to identify sandy bottom areas for DMF shellfish and lobster surveys.

Funding: Funding to pursue permits for the placement of dredged material at a new site near Rexhame Beach and an expanded site near Green Harbor Beach should be minimal and will come from Town funds.

Funding for the placement of sediment either onshore or at new or expanded placement sites should be built into the expected cost of federal dredging projects, which would address the specific equipment needs for onshore disposal. The role of the USACE is to maintain the navigation channel and, if possible and cost effective, they also can use dredge material to nourish beaches. Depending on where the Town wants the sand placed at Green Harbor Beach, the USACE may not cover all of these costs and the Town would be responsible for the cost of moving sand further up the beach.

Responsible parties:

- Waterways Committee
- Harbormaster
- U.S. Army Corps of Engineers
- MA Department of Conservation and Recreation, Office of Waterways
- MA Department of Environmental Protection
- MA Office of Coastal Zone Management
- Conservation Commission

d. Work with other relevant entities to complete an engineering and hydrodynamic study of the Brant Rock Dyke's effects on the harbor.

The study should determine potential reduction of the shoaling and sedimentation problems in Green Harbor, improve navigability, reduce existing flooding, and address anticipated problems stemming from sea level rise (e.g., the elevation of the gates, the height of the dyke, and drainage characteristics of low-lying areas). In particular, the study should examine the feasibility and effect of adding sluice gates to the existing flood gates in the dyke, which could allow greater control over the timing and volume of tidal flow. The study should examine methods to increase tidal flow strength and thereby improve sediment transport out of the harbor, but without creating a new source of sediment flowing into the harbor from the marsh areas behind the dyke, and eliminating the generation of foam. The study also should examine the feasibility of elevating the dyke as a flood prevention measure as well as reorienting and resizing the culvert to allow more efficient water flow into the harbor in times of flooding.

Funding: Possible grants to fund this work include:

- Massachusetts Division of Ecological Restoration – The DER can assist with project funding if a site is brought to their attention and added to their list of priority projects for restoration and revitalization, a competitive process which involves responding to a request for responses. A

project selected as a priority project has typically been "eligible to receive technical assistance from DER staff, technical services by qualified contractors paid for by DER, and/or direct grant funding. These projects will remain on the Priority Projects list and maintain eligibility for support in subsequent years until they are completed or new information warrants a revision of status." (Language taken from Fiscal Year 2014 announcement of forthcoming RFR at: http://www.mass.gov/eea/docs/dfg/der/pdf/der-201402a-pre-rfr.pdf).

- MassBays Program Research and Planning Grants – This annual opportunity provides funding for the planning phases of restoration projects that advance the goals of the MassBays Program – which include improving migratory fish habitat. (http://www.mass.gov/eea/agencies/mass-bays-program/grants/).
- FEMA Hazard Mitigation Grant Program – Through this program grants are provided to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration, with a goal of reducing loss of life and property due to natural disasters. (http://www.fema.gov/hazard-mitigation-grant-program).

Responsible parties:

- Waterways Committee
- Harbormaster
- Conservation Commission
- Marshfield Department of Public Works
- Massachusetts Office of Coastal Zone Management (CZM)

e. Explore cooperative dredging efforts with other communities.

The Town has discussed the possibility of participating in a Plymouth County shared dredge program, but the structure of that proposed program involved an annual contribution of funds by each participating town, thereby tying the success of the program to the continued participation of each community. An alternative, and more sustainable option for Marshfield might be to purchase, outright, a dredge with other nearby communities and develop a plan for sharing the use of the dredge. As part of this, the co-owning towns should consider the potential to generate revenue for the waterways by offering use of the dredge to other towns when appropriate.

Funding: Potential funding sources include: the Seaport Council, Municipal sources, and dredge-generated revenue.

Responsible parties:

- Waterways Committee
- Harbormaster
- Neighboring Towns

6.2 Natural Resources

Marshfield is fortunate to have natural beaches, abundant marshes, active migratory fish passages, generally good water quality, and a healthy shellfish population. Residents and visitors rely on these resources for recreational and commercial activities including fishing and shellfishing, boating, hunting, and swimming. Protecting natural resources while also allowing their use requires thoughtful planning and management, and

adherence to State and local laws. Issues of particular concern with regard to natural resources in Marshfield include the impacts associated with loss of beach, boating activities, coastal development, and dredging, as well as the potential to improve the local shellfish population and extend the shellfishing season.

Boating Activities

As mentioned in the Recreational Boating section of this Plan, Marshfield has a very active boating community, especially during the summer months. While some boaters use the various boat ramps to launch their vessels, others keep their boats at moorings, or on commercial or private docks. In doing so, many boaters are unaware of the impacts that docks and moorings can have on natural resources. The heavy chain used in traditional moorings can swing around the anchor as the boat moves, disturbing objects in its path and creating "scars" on the sediment. Additionally, the heavy chain's movement along the seafloor may stir up sediment, suspending it in the water column. This increased turbidity has been shown to slow rates of photosynthesis and impact marine organisms' functions and physiologies. Docks can also impact the seafloor and water column by disrupting water circulation patterns, shading portions of the seafloor (which limits the growth of submerged aquatic vegetation), and providing habitat for invasive species. Taken individually, a dock or a mooring is likely to have minimal impact on the surrounding natural resources; however if growth is left unchecked, the cumulative impacts of docks and moorings may significantly alter habitat and/or interfere with safe navigation. As part of this Plan, the Urban Harbors Institute mapped the locations of docks and moorings within the planning area. An example of this mapping is, shown in Figure 18, highlighting Green Harbor.

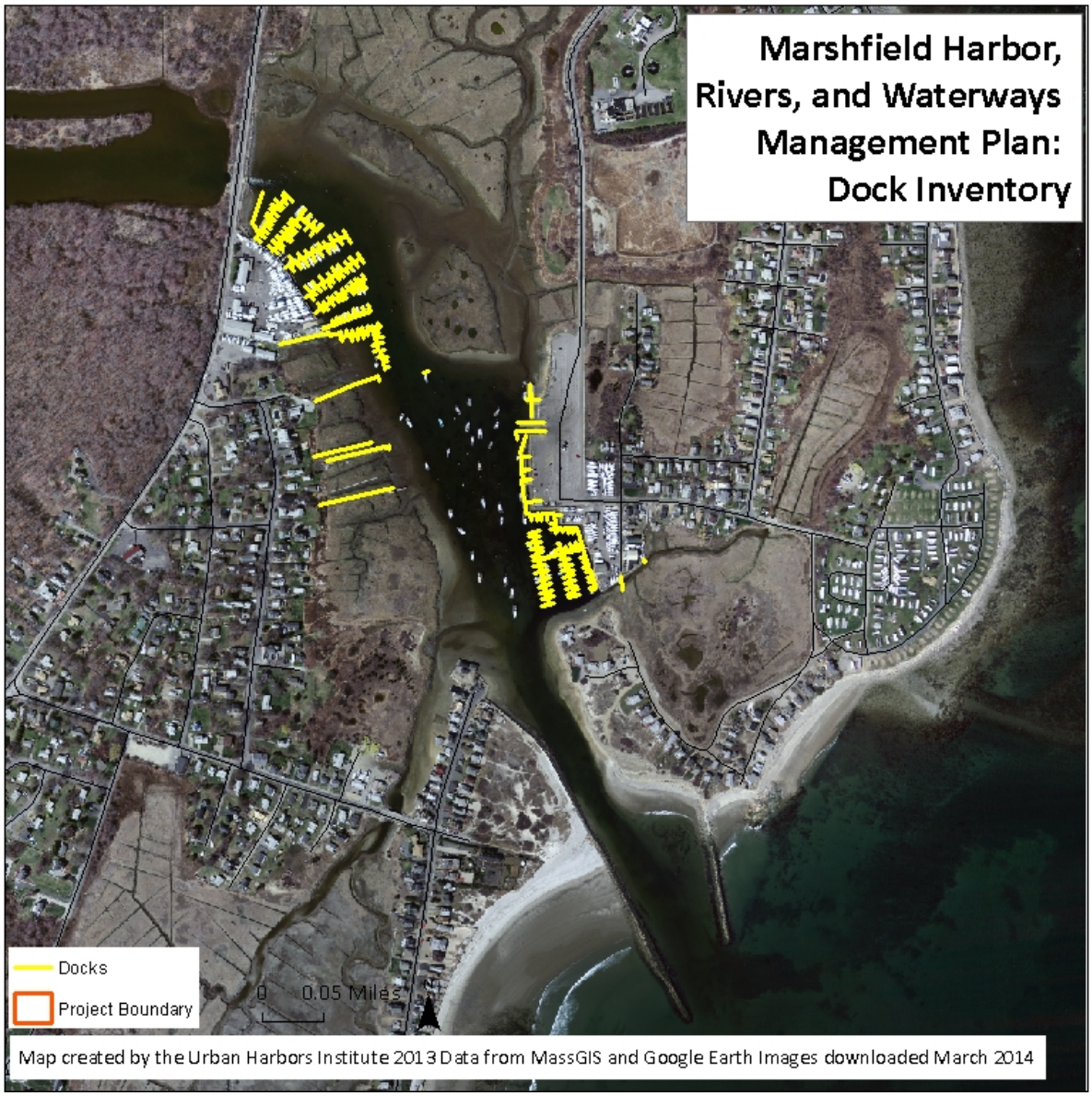

Figure 18: Docks in Green Harbor

Boating also has the potential to impact water quality through the discharge of waste into the water. A No Discharge Area (NDA) for the waters of Scituate, Cohasset, and Marshfield (including the South River to the Willow Street Bridge, the North River to the Columbia Road Bridge, and Green Harbor south of the Route 139 Causeway) was approved in May of 2008. The NDA prohibits the discharge of treated and untreated boat sewage within the NDA, requiring boaters to use vessel-based or shore-side pump-out facilities to offload their waste. At the time of the NDA designation, it was determined that the region had adequate pump-out facilities to meet the needs of the local boating community, however the operation of these pump-outs require that they have the necessary funding in place and be in good working condition – which is not always the case. If adequate pump-out service is not available, boaters may have difficulty complying with the requirements of the NDA.

Coastal Development

Among the many ways in which coastal development can impact natural resources is the issue of barriers to fish migration – specifically related to anadromous fish (those that begin their lives in freshwater, migrate to the ocean where they spend most of their lives, and then return to freshwater rivers or brackish estuaries to spawn and lay eggs). These fish rely on adequate water levels and barrier-free passage along the North, South, and Green Rivers and their tributaries for successful spawning each year, but migration in Marshfield is impacted by water management issues and dams. More specifically:

- The dam at Veteran's Park along the South River is in need of flow management improvements to enhance fish migration. The NSRWA is working with Marshfield to improve flow management during the spawning season.
- The dam at Chandler Pond is an impediment to fish migration. The owner is in the process of evaluating the option to remove the dam, which is structurally unsound and a potential liability. Neighbors are concerned about the impacts to their property value, the loss of an historic public asset, and the safety issues associated with the exposed mud that comes with draining the pond.
- The dam at Parsons Pond may be a barrier to fish migration, and the installation of a fish ladder may be appropriate.

Dredging

The Channel at Green Harbor was dredged 27 times by the Army Corps of Engineers between 1969 and 2012 (O'Donnell, 2013, personal communication). Permitting of dredging projects is intended to minimize disruptions to marine life, though some loss of life and disruption of habitat is inevitable. That aside, there is an opportunity to reuse the dredged material to help rebuild Green Harbor Beach. Dredging projects in 2007, 2011, and 2012 did just that by disposing of the dredged material in the nearshore environment, allowing it to become part of the local system which contributes sand to Green Harbor Beach (O'Donnell, 2013 personal communication). Most of the recent dredging of Green Harbor has been conducted by the Currituck, a hopper dredge equipped for nearshore disposal of sediment rather than for onshore disposal of sediment.

Shellfish

The shellfish in Marshfield waters – American oysters, bay scallops, blue mussels, quahogs, razor clams, soft shell clams, and surf clams – support a recreational fishery, help to filter water, and work to secure sediment which protects against erosion.

Recent efforts to extend the clamming season on portions of the North and South Rivers were successful, and in 2013, the season began on November 1st, rather than December 1st. Recreational shellfishing opportunities in Town also expanded due to recent water quality monitoring efforts which showed that water quality along the northern portion of the South River was suitable for shellfishing. As a result of these findings, shellfishing status in this portion of the river changed from "prohibited" to "conditionally approved."

Despite the recently increased shellfishing opportunities, little is known about the health of the shellfish stocks. The NSRWA has worked with The Nature Conservancy to identify suitable shellfish habitat, and if permits are secured, will be conducting a small-scale mussel growing pilot program in the summer of 2014. This project may provide some information about the mussel stock in that it will involve collecting natural seed. The Town has conducted limited seeding activities in the North River, but has not monitored its efforts to identify any impacts to the local stocks. And though anecdotal reports suggest that Green Harbor supports populations of blue mussels and steamers, a formal stock assessment has never been conducted.

Aquaculture

Commercial aquaculture siting guidelines require that operations be conducted in locations identified by the Massachusetts Division of Marine Fisheries as "approved" (and in rare cases, in conditionally approved) areas for shellfishing. These designations are linked to water quality, and are intended to protect the public's health by avoiding consumption of shellfish grown in areas with poor water quality. "Approved" shellfishing areas in Marshfield are on the open ocean, and are too exposed to host most types of commercial aquaculture. The North and South Rivers and Green Harbor provide more sheltered sites for growing shellfish, but their designations as "prohibited" and "conditionally approved" make it unlikely that any permits will be issued unless the designations are changed or a suitable plan is proposed that protects public health interests.

Despite the fact that Green Harbor and the rivers are not currently ideal sites for commercial aquaculture, approximately 5-6 parties have expressed interest in conducting some form of shellfish aquaculture in Marshfield waters. Some in Town have vocalized their opposition to any aquaculture in Marshfield waters, while others support it if conducted in the right locations at an appropriate scale.

Issues

Boating: Use of the Town's waterways and nearshore areas may have impacts that are intensified/worsened when considered along with other uses of the nearshore areas or waterways.

1. The cumulative impacts of boating activities (e.g., dock building, water quality issues from boat waste, erosion issues from boat wakes) can negatively impact the Town's natural resources.

Shellfish and Shellfishing: Marshfield used to have abundant shellfish resources, and interest exists to rebuild those resources for commercial and recreational harvesting purposes and for water quality and shore stabilization purposes.

1. The existing shellfishing season on the North and South Rivers is short, but expanding it will require more research and coordination with DMF. Expanding the season may also require the Town to provide additional monitoring and enforcement.
2. Shellfishing in Green Harbor is prohibited, but there is interest in working with MA DMF to have it re-opened. There is interest in re-planting some of the clam beds in Green Harbor.
3. Water quality and shore stabilization could be at least partially addressed by restoring shellfish beds and introducing a shellfish growing program.
4. Shellfish stocks are unknown. A stock assessment would provide useful information in terms of understanding the conditions of shellfish populations as well as the potential for harvesting.

Anadromous Fish: The Town's waterways have historically supported migratory fish spawning events, but some fish passages are now compromised by dams, poor water flow, and other impairments, affecting the ability of fish to spawn.

1. The dam at Veteran's Park impairs spawning for herring and shad, but is used to maintain water levels in the pond.
2. The dam at Chandler Pond impairs spawning and migration.

Beach Management: The beaches of Marshfield provide important recreational and natural resource benefits to the Town. Beach management planning could enhance this coastal resource.

Recommendations

Goal 1: Conserve, protect, and restore where appropriate, the valuable natural resources of Marshfield's shoreline, rivers and waterways.

Objective I – Minimize the impact of coastal and water-based activities on natural resources.

a. Conduct an inventory of docks and piers in waterways to understand the potential impacts of existing and additional docks and piers so as to adequately protect natural resources, navigation and public trust rights in the waterways.

Using Google Earth and Arc GIS, UHI has mapped the existing (summer, 2013) docks and moorings within the project area, and has provided it to the Committee and the Harbormaster. This file should be updated by the Harbormaster's office as the loss or addition of docks and moorings takes place. This map can be linked to permit information, and should be used to ensure that the cumulative impacts of docks and moorings do not negatively impact natural resources and/or safe navigation.

Funding: Implementation of this recommendation should not require additional funding.

Responsible parties:

- Harbormaster
- Waterways Committee

b. Develop criteria for assessing applications for new or expanded docks in the Town's waterways.

The Waterways Committee should meet with the Harbormaster and the Conservation Commission to better understand the criteria they currently used to approve or deny a permit for a new or expanded dock. Together, these entities should formalize the assessment criteria to ensure that it captures such things as impacts to natural resource (e.g., timing of installation, materials used, designs to minimize shading, etc.), hazards to navigation, and cumulative impacts to navigation and/or natural resources.

Funding: Implementation of this recommendation should not require additional funding.

Responsible parties:

- Waterways Committee
- Harbormaster
- Conservation Commission

c. Ensure adequate and convenient pump-out facilities to prevent water quality impairments resulting from vessel-based waste. Require all facilities with a vessel pump-out to certify annually that the equipment is operational and to provide the Harbormaster with the days and hours the pump-out is available. Each new boating facility should be required to provide a convenient public pump-out, as appropriate.

Prior to each boating season, the Harbormaster, with assistance from the Waterways Committee, should inspect all existing pump-out facilities to ensure that they are in working condition. If a facility is not in working condition, the reason should be documented, and steps should be identified to ensure that the pump-out will be operational by the beginning of boating season. As part of this inventory, details about the pump-outs (e.g., location, hours of operation, hailing information) should be made available online, and should be updated as needed.

The Waterways Committee should also reach out to those developing new boating facilities to ensure that they include plans for offering pump-out service, as appropriate. The State Division of Water Pollution Control licenses marinas, and requires that all licensed marinas provide "…adequate facilities for the collection, treatment and disposal of sewage or other sanitary waste, as said division may specify, including facilities for the purging out and cleaning of holding tanks, the contents of which shall

be then disposed of in such manner as not to be discharged into or near any waters of the commonwealth, unless such discharge is to a municipal sewerage system or to an adequate sewage treatment or disposal facility approved by the division of water pollution control…." (M.G.L. Ch 91, §59B)

Further, State regulations specify that, "Any project that includes a new marina, or any expansion thereof to ten or more berths greater than the number of berths existing on the effective date of 310 CMR 9.00, shall comply with the following design requirements…sewage pumpout facilities shall be provided as appropriate based on the number of berths and type of vessels at the marina, the availability of such facilities nearby, and environmental considerations including the water circulation patterns of the waterway and the proximity of shellfish resources; in general, there should be a sewage pumpout facility for marinas with more than 50 berths, or as otherwise specified in a municipal harbor plan; documentation shall be provided showing compliance with local, state, and federal requirements for said facilities" (310 MA Code of Regulations, 9.39(1)(a)(3)(b)).

Funding: While the inspection of existing pump-outs and outreach to developers of new boating facilities should not require additional funds, funding for new pump-outs is available through the State's Clean Vessel Act Program (http://www.mass.gov/eea/agencies/dfg/dmf/programs-and-projects/clean-vessel-act.html).

Responsible parties:

- Waterways Committee
- Harbormaster
- Pump-out operators

Objective II – Encourage the improved management of the Town's beaches.

a. The Town should explore the potential benefits of developing a beach management plan that will (1) comprehensively identify beach management needs and issues throughout the Town, and (2) provide recommendations to strategically address those needs and issues.

Beach management in Town is handled primarily by the Bach Manager, who is part of the police department. Management currently focuses on safety (e.g., provision of qualified lifeguards) and access (e.g., oversight of parking). Issues such as beach re-nourishment, access improvements, and dune re-construction are addressed on an as-needed basis, but the Town would benefit greatly from the development of a comprehensive beach management plan.

Funding: Funding for the development of this plan could come from grant or town sources.

Responsible parties:

- Beach Manager
- Community Preservation Committee
- Harbormaster

Objective III – Encourage the local re-use of dredged sediment.

a. Work with the Department of Public Works, the Conservation Commission, the Coastal Advisory Committee, the Beach Commission, the Harbormaster,and others as appropriate, to document and address the Town's beach nourishment needs.

The entities with interests in beach management should meet to identify those portions of the shoreline in need of nourishment, and to discuss opportunities for conducting nourishment. As part of this, the

Town should consider (1) the nourishment needs for each segment of beach; (2) the timeframes for nourishment; (3) any anticipated sources of sediment, including from dredging projects; (4) monitoring activities necessary to understand the impacts of nourishment projects and nourishment needs of the shoreline. This will require working with the Army Corps to make arrangements for onshore disposal of sediment when necessary (e.g., obtaining the necessary permits, ensuring that the dredge is capable of onshore disposal, rather than nearshore disposal); and identifying new offshore disposal sites, such as off of Rexhame Beach, that would assist with renourishment of Marshfield beaches.

Funding: This recommendation could be implemented at its most basic level at no additional cost; however, additional funding might be useful to hire consultants with expertise in beach assessment and renourishment planning. Several potential funding sources focus on shoreline vulnerabilities from climate change and sea level rise, and may serve as sources of funding for this work, including:

- Massachusetts Office of Coastal Zone Management (MA CZM): Coastal Community Resilience Grant Program – "This new grant program provides financial and technical resources to advance new and innovative local efforts to increase awareness of climate impacts, identify vulnerabilities, and implement measures to increase community resilience (i.e., the ability to endure impacts associated with coastal storms and the effects of erosion, flooding, and sea level rise and to respond, recover, and adapt to consequences)." See: http://www.mass.gov/eea/agencies/czm/program-areas/stormsmart-coasts/grants/.
- NOAA Climate Program Office – This office offers funding opportunities each year to address its research priorities pertaining to climate change. A list of2013 funding opportunities can be viewed at: http://cpo.noaa.gov/GrantsandProjects.aspx.
- The Massachusetts Emergency Management Agency (MEMA)/Department of Conservation and Recreation (DCR)/Federal Emergency Management Agency (FEMA) 2014 Pre-Disaster Mitigation (PDM) and Flood Mitigation Assistance (FMA) Program – Provides funding for projects including "storm-water, drainage and culvert improvements, property acquisition, slope stabilization, infrastructure protection, seismic and wind retrofits, structure elevations, hazard mitigation planning, etc." See: http://www.mass.gov/eopss/agencies/mema/hazard-mitigation/grants/

Responsible parties:

- Waterways Committee
- Department of Public Works
- Conservation Commission
- Coastal Advisory Committee
- Beach Administrator
- Harbormaster

Objective IV – Monitor long-term marsh health and movement.

a. In coordination with other Town departments, explore opportunities to engage a university in a long-term marsh monitoring program to track marsh health and movement.

Marshfield's marshes appear to be healthy, and according to aerial photographs interpreted by the Massachusetts Department of Environmental Protection, the Town experienced very little marsh loss between 2001-2009 (see http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/wetchange.html for details). Little is known,

however, about past losses or potential future impacts of sea level rise, climate change, and other likely stressors. While the State conducts aerial photo interpretation to track marsh loss, additional research should be conducted to establish baseline information about marsh health and location in Town. This data should be updated regularly to develop a long-term data set tracking marsh health and location.

Potential funding: Funding for this project should be sought through grant sources.

Responsible parties:

- Waterways Committee
- Conservation Commission
- University

Goal 2: Develop a sustainable shellfishery in all approved and conditionally approved Marshfield waterways.

Objective I – Expand shellfishing locations and duration in Marshfield waterways.

a. Take necessary measures to expand the duration and locations of shellfishing, with an ultimate goal of keeping shellfish beds open year-round.

Shellfishing beds in mouths of the North and South Rivers are currently conditionally approved, meaning that they are closed during the summer months when water quality is seasonally poor, but are open in the late fall, winter, and early spring when water quality is generally good. Shellfishing in Green Harbor is prohibited year-round due to past water quality concerns. Expanding the shellfishing season in the North and South Rivers would require 2 ½-3 years of additional water quality monitoring during the months targeted for expansion in order to show that water quality meets State standards during those months. Current monitoring by the NSRWA suggests that the water quality during summer months at many sites along the rivers does not meet the State's current water quality standards for shellfishing. The sources of contamination should be identified and remedied before DMF beings its water quality sampling[8].

Opening new areas to shellfishing would also require water quality tests, identification of the causes of impairment, work to address impairments, and additional water quality testing for 2 ½ - 3 years. In the case of Green Harbor, research showing the presence of shellfish might encourage DMF to conduct the required monitoring to open areas.

Extending the shellfishing season and/or opening new areas would also require additional patrols by the Harbormaster's office.

Funding: Additional water quality testing by the DMF at this time is unlikely due to the current shortage of funding and personnel. Staff is currently focused on meeting the testing requirements necessary to keep exiting shellfish areas opened. That being said, Marshfield should continue to maintain an open dialog with DMF to ensure that additional testing is conducted once DMF has the resources necessary to expand its testing. Funding will be required to address water quality impairments that prevent areas from meeting state standards for shellfishing. Additional funding may also be required to hire additional enforcement personnel to patrol the expanded shellfishing grounds, or to enforce regulations during the busy summer months.

Responsible parties:

[8] While DMF does not recognize non-DMF water quality data in its decision to open or close an area, they will review data collected by others to determine whether or not they should begin new testing.

- Massachusetts Division of Marine Fisheries
- Marshfield Harbormaster
- Scituate Harbormaster
- Waterways Committee

b. Evaluate the potential for expanded commercial shellfishing.

Five individuals currently hold permits to commercially shellfish. Demand for additional commercial permits does not presently exist, in part because the general feeling is that the local stock could not support a more robust commercial shellfishery. In order to evaluate the potential for expanding commercial shellfishing, a first step is to have a formal stock assessment conducted to identify whether or not the local population of shellfish could support a larger commercial fishery. If the results of the stock assessment indicate that the area could support increased commercial fishing effort, then the Committee, along with the Conservation Commission, the Harbormaster, the North and South Rivers Watershed Association, the Division of Marine Fisheries, and other stakeholders should discuss the costs and benefits of increased shellfishing effort to determine if steps should be taken to promote commercial shellfishing in Town waters. If the stock assessment shows that the local shellfish population would not support additional commercial fishing effort, the Committee should determine whether or not enough demand for licenses exists to justify conducting propagation activities that could enhance the local stock to the point of supporting a larger commercial shellfishery. (See Goal 2, Objective 2, Recommendation A of this section for more about stock assessments.)

Funding: Efforts should be made to partner with the Massachusetts Division of Marine Fisheries, an NGO, or a university to conduct a low-cost stock assessment. Alternatively, the Town could hire a private consultant to conduct the stock assessment at a higher cost.

Responsible parties:

- Waterways Committee
- Conservation Committee
- North and South Rivers Watershed Association
- Marshfield Harbormaster
- Massachusetts Division of Marine Fisheries
- Members of the shellfishing community

Objective II – Ensure that shellfishing is conducted in a manner that does not deplete the resource or impair the habitat.

a. Conduct an independent scientific shellfish stock assessment to determine harvesting yield potential.

The current belief is that present levels of harvesting are not depleting the shellfish stock; however no formal study has been conducted to test this hypothesis, and anecdotal reports suggest that the stock is too small to support an expanded commercial fishery. (See Goal 2, Objective 1, Recommendation C of this section for more on stock assessments and the commercial fishery.) The Committee should work with the Division of Marine Fisheries, or hire a local university or private consultant to obtain a stock assessment. Once the stock assessment is complete, the Committee should work with the Harbormaster, the Conservation Commission, and the local shellfishing community to identify a target yield. The target yield should be based on principals such as sustainability, maximization of recreational

use, maximization of economic benefit, etc. A plan should also be developed to repeat the stock assessment on a regular basis to capture any changes that would increase or lower the target yield.

Funding: Efforts should be made to partner with the Massachusetts Division of Marine Fisheries, an NGO, or a university to conduct a low-cost stock assessment. Alternatively, the Town could hire a private consultant to conduct the stock assessment at a higher cost.

Responsible parties:

- Waterways Committee
- Massachusetts Division of Marine Fisheries
- Conservation Commission
- Harbormaster
- Members of the shellfishing community

b. Work with the Harbormaster, DMF, and the NSRWA to enhance shellfish populations through the expansion of seeding and relay activities, both for harvesting and for natural resource improvements (e.g., water quality and shore stabilization).

The Waterways Committee should convene a working group comprised of the Massachusetts Division of Marine Fisheries, the NSRWA, the Scituate Harbormaster, the Marshfield Harbormaster, and the Marshfield and Scituate Conservation Commissions. Together, this group should develop a shellfish enhancement strategy that addresses both harvesting and natural resource protection. This strategy should include relay and seeding opportunities[9] and should identify appropriate locations, specific species, approximate quantities of animals needed, and a monitoring component to understand the impacts of seeding and relay activities. Once developed, the Waterways Committee should support efforts to obtain necessary permits and to identify funding for plan implementation and monitoring.

Funding: Initial seeding plan development should not require additional funding. Implementation of the seeding plan will require additional funding, and the amount will depend on the scale of the final seeding plan. Some funding may be available through mitigation requirements for projects or through the In Lieu of Mitigation Fund managed by the Massachusetts Division of Marine Fisheries.

Responsible parties:

- Waterways Committee
- Massachusetts Division of Marine Fisheries
- The North and South Rivers Watershed Association
- Marshfield Harbormaster
- Scituate Harbormaster
- Marshfield Conservation Commission
- Scituate Conservation Commission

Objective III – Determine the potential for establishing shellfish aquaculture in the Town's coastal waters.

[9] In this context, a relay involves transporting naturally occurring shellfish from one site to another, while seeding involves the introduction of small shellfish typically grown in a hatchery.

a. Explore the regulatory and technical opportunities and constraints and the benefits of shellfish aquaculture, including the use of upwellers.

Aquaculture, defined by the Massachusetts Division of Marine Fisheries as the "planting and raising of shellfish at a specific privately licensed location resulting in the commercial production of shellfish" (Hickey, et al. 2011) is not yet practiced in Marshfield waters; and there is a difference in opinion in Town as to whether or not aquaculture should be allowed.

The Massachusetts Division of Marine Fisheries has established guidelines for shellfish planting (available at: http://www.mass.gov/eea/docs/dfg/dmf/programsandprojects/shellfish-planting-guidelines-121611.pdf), which includes guidance on permitting and site selection. Using this document as a foundation, the Waterways Committee should meet with the Massachusetts Division of Marine Fisheries, the Harbormaster, and the Conservation Commission to identify their options with regard to different types of aquaculture activities in Marshfield waters (e.g., for rebuilding stock, for the harvesting and sale of shellfish, etc.). Specific topics should include site selection and related water quality issues, permitting requirements for different types of aquaculture (e.g., in upwellers, in cages, on lines suspended in the water column), and the constraints and benefits of different types of aquaculture (e.g., revenue for the local economy, hazards to navigation, impacts to natural resources).

Funding: Implementation of this recommendation should not require additional funding.

Responsible parties:

- Waterways Committee
- Massachusetts Division of Marine Fisheries
- Harbormaster
- Conservation Commission

Goal 3: Improve habitat for migratory fish.

Objective I – Restore tributaries to support natural spawning events in Marshfield's tidal rivers.

a. ***Working directly with the NSRWA and other partners, support efforts to improve migration in key tributaries of the North & South Rivers (e.g., at Veteran's Park, Parsons Pond, and Chandler Pond), and along the Green Harbor River (e.g., at the dyke).***

The NSRWA is already actively engaged in efforts to address the Town's water management to improve fish migration at Veteran's Park, but work to understand the potential for dam removal at Chandler's Pond, and to address water management at the Green Harbor dyke are ongoing. The Committee should regularly reach out to the Conservation Commission and the NSRWA to be informed of the progress at these sites, and should provide input as appropriate. Additionally, research should be conducted to identify whether or not the dam at Parsons Pond is a barrier to fish migration.

Funding: Funding for dam removal, fish ladder installation, and other improvements to migratory fish habitat can be costly. Funding for planning and implementation is available through a variety of sources including:

- MassBays Program Research and Planning Grants – This annual opportunity provides funding for the planning phases of restoration projects that advance the goals of the MassBays Program – which include improving migratory fish habitat. See: http://www.mass.gov/eea/agencies/mass-bays-program/grants/.

- Massachusetts Environmental Trust General Funding Opportunity—The once-a-year funding opportunity provides "funding to support programs, research, and other activities that promote the responsible stewardship of the Commonwealth's water resources." See: http://www.mass.gov/eea/grants-and-tech-assistance/grants-and-loans/mass-enviro-trust/met-grants.html.
- Massachusetts Division of Ecological Restoration – The DER can assist with project funding if a site is brought to their attention and added to their list of priority projects for restoration and revitalization, a competitive process which involves responding to a request for responses. A project selected as a priority project has typically been "eligible to receive technical assistance from DER staff, technical services by qualified contractors paid for by DER, and/or direct grant funding. These projects will remain on the Priority Projects list and maintain eligibility for support in subsequent years until they are completed or new information warrants a revision of status." Language taken from Fiscal Year 2014 announcement of forthcoming RFR at: http://www.mass.gov/eea/docs/dfg/der/pdf/der-201402a-pre-rfr.pdf.
- Office of Energy and Environmental Affairs Dam and Seawall Repair or Removal Fund – "The Dam and Seawall Repair or Removal Fund was established in 2013 by the Massachusetts Legislature to promote public health, public safety, and ecological restoration. Under the authority created by M.G.L. c. 29, §2IIII and regulations issued under 301 CMR 15.00, EEA will enter into contracts with qualified organizations to implement projects for the repair and removal of dams, levees, seawalls, and other forms of flood control." Information is available at http://www.mass.gov/eea/waste-mgnt-recycling/water-resources/preserving-water-resources/water-laws-and-policies/water-laws/draft-regs-re-dam-and-sea-wall-repair-or-removal-fund.html.
- Federal funding through grants and partnerships is also available. Potential funding agencies include NOAA's National Marine Fisheries Service and the U.S. Fish and Wildlife Service's National Fish Passage Program.

Responsible parties:

- Waterways Committee
- North and South Rivers Watershed Association
- Conservation Commission

6.3 Public Access

Background

The Town of Marshfield values and encourages recreational and commercial activities on Town waterways, which are for the benefit and use of all residents. Access to the coast and rivers can be challenging however, and at times public access sites lack appropriate amenities. The Town has several efforts underway to improve access, including securing easements from businesses along the South River. Several of the major public access points in Town are described below.

Peter Igo Park

The Park is located on Marshall Avenue and Dyke Road. Facilities include: 7 lighted tennis courts (2 are multi-use courts for inline skating and skateboarders), stadium lighting, fitness stations, a youth play area, a walking trail to the waterfront with access to a floating dock, off-street parking, and a shaded sitting area. Courts are lighted on summer nights and on Saturday evenings during the school year through Halloween. The park also offers unique non-tidal river frontage on the Green Harbor River. Canoeists and kayakers currently face significant challenges in order to access this waterway. Often paddlers will unload by the Dyke Road bridge where they can slide vessels and passengers under the guardrails and down an unstable, steep bank to access the river. This unloading process creates a traffic hazard and vehicles often park illegally. In the alternative, paddlers must begin at the park entrance and walk a sizeable distance along a trail to access the float. This is a long way to drag or carry a small boat, although it may work for a wheeled carrier. Recent trail improvements, including the widening of the path and the laying of woodchips, will make access easier.

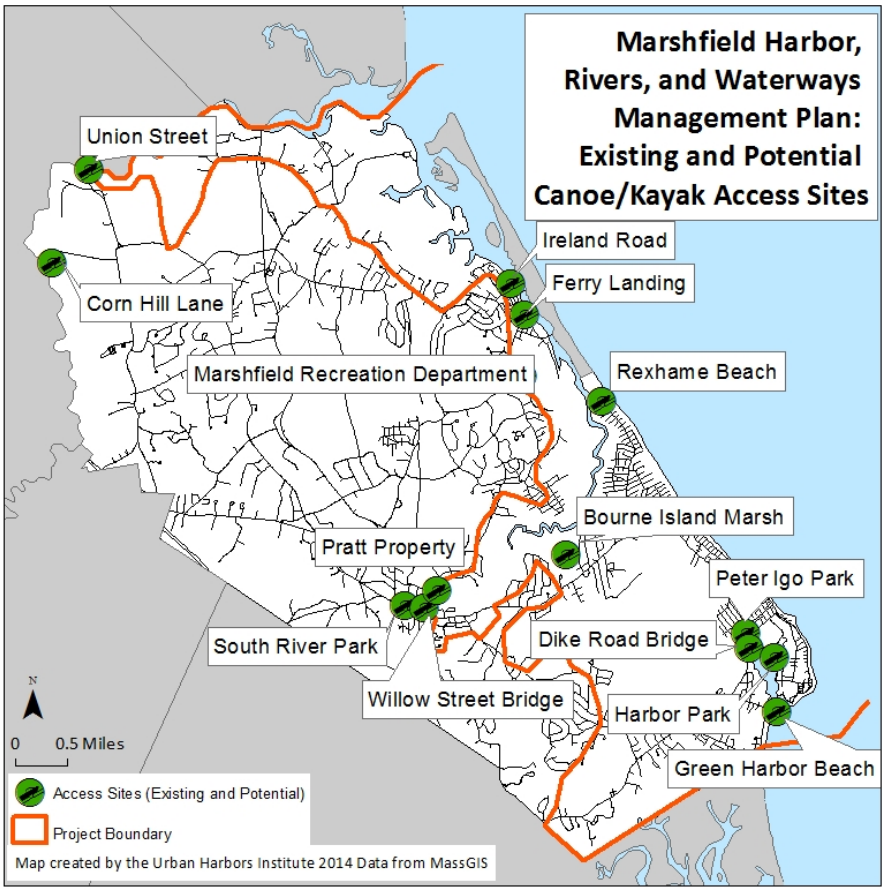

Figure 19: Existing and potential canoe/kayak access sites

Many of the park's features are the result of a redevelopment plan for approximately $500,000 worth of improvements to the park. In addition, canoes are currently stored in the maintenance building and could be incorporated in future recreation programs.

Harbor Park

At the most recent Town meeting in April 2014, voters approved the following measure: $450,000 for revitalization of Harbor Park at Green Harbor. Improvements include a 1,000-foot long stone-dust nature walking trail, playground, lounge seating, picnic pavilion, grass amphitheater area, and adjacent parking lot. Also included is $135,000 for engineering of a proposed 2,500-foot long boardwalk on Town Pier Road to increase safety for pedestrians and bicyclists.

Green Harbor Beach

The beach is located on Beach Street and Bay Avenue. A resident parking sticker is required. Parking also is available at Beach Street extension, Post Office dirt lot, and Avon Street. The beach also is accessible by Beach Street extension via boardwalk. Amenities include lifeguards.

Rexhame Beach

The beach is located on Standish Street, off of Ocean Street. A resident parking sticker is required. Non-residents must pay a daily fee for parking. Available amenities include: snack bar, bathrooms, basketball court, picnic tables, lifeguards, parking attendant, surf chair, and wheel chair for individuals with mobility impairments.

Issues

There is a need and many opportunities to create and/or enhance public access to and along the Town's waterways for recreational boaters and pedestrians.

1. Access along the South River should be enhanced. Possibilities include a walkway in the downtown area, the addition of parking and seasonal floats at Ireland Road and Ferry Street, and/or the addition of parking and a float near Rexhame Beach.
2. Public access along Joseph Driebeck Way is a concern. Pedestrian and road traffic are not adequately separated. Physical and visual access could be enhanced via the development of a walkway or boardwalk on the west side of the roadway from Dyke Road to the marina.
3. Additional launching sites for small (< 12') boats are needed, along with associated parking.
4. Access to the Green Harbor River could be improved in conjunction with restoration efforts at Peter Igo Park.
5. There are opportunities to increase access on the Town's waterways through the rental of canoes, kayaks, and stand-up paddle boards.
6. Residents may come to appreciate their waterfronts and water-dependent activities in Town if they had better access and a reason to come to the water (such as to witness the blessing of the fleet or a safety day or other activities scheduled along the shores).
7. Parking at Green Harbor Beach is limited.

Recommendations

Goal 1: Provide and promote public access points to Marshfield's waterways while maintaining a healthy ecology.

Objective I – Improve small boat (human-propelled craft) access to the Town's waterways

a. Improve existing launch facilities, including bathroom access and parking as appropriate. Potential locations: (1) Peter Igo Park; (2) Union Street; (3) Ferry Landing; (4) Corn Hill Lane.

The Waterways Committee should begin by cataloging the existing launch facilities and include site visits if possible to better understand the current conditions and needs in each location. Redevelopment plans are underway at Peter Igo Park and will include safe off-street parking and a safe pathway to the river for paddlers. Some ideas for improvements at other sites include:

- Debris should be cleaned up at the Union Street location.

- There is access at the end of Ireland Road at Ferry Street; however, better parking is needed and there is potential to add a float.
- The access at Corn Hill Lane is located on a cul-de-sac, with an undeveloped adjacent area that could be made into a parking lot.
- On the South River, access is limited at the Powers Bridge on Julian Street, where the area needs dredging and probably blasting. The Committee should examine whether to pursue opening up access in this location because it may encourage larger, faster boats on the river.

Funding: The Committee should work with the Recreation Commission and the North and South Rivers Watershed Association to determine if these entities have interest in investing together in improvements to launch facilities and, if so, what funding is available in their budgets or in the form of grants or other assistance from entities such as the Massachusetts Department of Conservation and Recreation (DCR).

Responsible Parties:

- Waterways Committee
- Recreation Commission
- North and South Rivers Watershed Association

b. Identify new launch facilities, specifying the potential amenities each site might offer (e.g., parking, restrooms, picnic tables). Potential locations include at the Rexhame Beach parking lot and the end of Ireland Road. Explore opportunities to improve recreational fishing access, including opportunities linked to State funds (e.g., MA DMF).

The Waterways Committee should leverage existing knowledge and resources at the Waterways Commission and the North and South Rivers Watershed Association to determine locations for new launch facilities, including potential amenities to be offered.

Planned improvements at Harbor Park, combined with the potential for dredging further north in Green Harbor, mean this park could serve as a new launch area for kayaks and canoes. Across the parking lot from Rexhame Beach also would be a good access point, although a float is needed. There is potential access at Willow Street, however, the current embankment is very steep and access likely would be limited to high tides. There is also potential access at Bourne Island marsh, although adequate parking is a concern and a path through the marsh would need improvement. In addition, the Recreation Department is located on the river and has the potential to develop an access point for a cost of approximately $500,000. Due to local conditions, it is likely that this access point would only be available at approximately half-tide.

The Town recently acquired the Pratt property (approximately 38 acres) at 172 South River Street for open space. This property is a potential site for a small boat launch. The NSWRA recently completed two improvement projects (an invasive species removal project and a boardwalk construction project) at South River Park at 2148 Ocean Street. This 1.7 acre park includes trails and access to the South River via a boardwalk and overlook. The NSRWA and the Town of Marshfield hope to use these parcels as part of a potential larger greenway along the South River in order to increase awareness of and access to the river, with the potential for additional launch sites.

Funding: The Committee should work with the Recreation Commission and the North and South Rivers Watershed Association to determine (1) if these entities have interest in investing together in improvements to launch facilities and, if so, (2) what funding is available in their budgets or in the form

of grants or other assistance from entities such as the Massachusetts Department of Conservation and Recreation (DCR), or the Division of Marine Fisheries (DMF).

In addition, funding for the South River Park project and other open space was obtained in part from allocation at a Town Meeting. The NSWRA also received a $10,000 grant from the Sheehan Family Foundation for the boardwalk construction and invasive species removal at the park. These may serve as sources of funds for future access projects.

Responsible Parties:

- Waterways Committee
- Recreation Commission
- Beach Administrator
- Town Harbormaster

c. Provide support and act as a liaison with Town officials to organizations whose purpose it is to advocate for waterways access.

The Waterways Committee should establish itself as an intermediary and the primary source of support between Town officials and organizations, such as the North and South Rivers Watershed Association, who advocate for waterways access. While the NSRWA may have established relationships with various Town officials, other similar organizations that are smaller or more recently established may need more assistance. The Committee should be a receptive and supportive audience to the concerns of these organizations, bring their messages to the appropriate Town officials, and provide feedback to the organizations about what actions will be taken.

Funding: These steps require the time and effort of the Waterways Committee members, but do not require an expenditure of funds.

Responsible Parties:

- Waterways Committee

d. Advertise and promote launch facilities by publishing a map of Town landings and launch facilities.

Once the Waterways Committee has compiled a comprehensive list of all launch facilities and amenities, the locations of these services can be mapped using GIS if available. The Committee should ensure they utilize several existing resources of compiled access points. In particular, the North and South Rivers Watershed Association created a *NSRWA Canoe and Kayak Guide to the North River, South River, and Indian Head River*. The latest edition was published in 1997 and may require updating. The Committee should work with the NSRWA to obtain all relevant information from this brochure and to update it if necessary. In addition, the Town of Marshfield Conservation Map indicates conservation land and other Town owned land bordering the coasts and rivers. Public access is available from any of these publicly owned properties and should be included in any inventory of launch locations.

Funding: Based on the existing resources, the Committee should create a collaborative mapping effort with the Recreation Commission and the North and South Rivers Watershed Association. Knowledge and funds from each of these entities could be leveraged to create a high quality map product for a shared price.

Responsible Parties:

- Waterways Committee

- Recreation Commission
- North and South Rivers Watershed Association

Objective II – Promote small boat use of the Town's waterways.

a. Encourage the establishment of a kayak/canoe rental facility on the Town's waterways. Explore the interest in and opportunities, benefits and liabilities of a publicly- vs. privately-operated facility.

The Waterways Committee should meet with the Recreation Commission and Planning Board to begin evaluation of the potential for a kayak/canoe rental facility on the Town's waterways. An informal survey of local relevant businesses might help to determine the level of interest in developing such a facility.

Funding: Exploring the feasibility of a facility and encouraging the development of a facility requires the time and effort of the Waterways Committee members and Town government employees, but does not necessarily require an expenditure of funds.

Responsible Parties:

- Waterways Committee
- Recreation Commission
- Planning Board

Objective III – Increase public access to Town beaches.

a. Support Town efforts to increase parking at Town beaches, as appropriate.

The Waterways Committee should support efforts to increase parking at Town beaches in a way that balances recreational needs and protection of natural resources. In particular, the Committee should consider supporting Town acquisition of the Green Harbor Lobster Pound to increase parking for Green Harbor Beach.

Objective IV – Increase public awareness of and participation in water related events.

a. Increase the coastal and marine programming and events for residents and visitors.

The Waterways Committee should catalog existing water-related events and collaborate with other Town departments and organizations, including the Conservation Commission, the Recreation Commission, and the North and South Rivers Watershed Association to develop new water-related events in Town. Events could include festivals similar to the New Bedford Working Waterfront Festival; educational events for families about the local environment, history, or fishing industry; a Seafood Throwdown cooking demonstration similar to those conducted by the Cape Ann Farmer's Market and the Northwest Atlantic Marine Alliance (NAMA); and water-based recreational sports.

The Massachusetts Office of Tourism and Recreation or the Department of Conservation and Recreation also may have knowledge of successful events in other towns, and can assist with event development and promotion.

Funding: Increasing public participation in water-related events and overall coastal tourism in Marshfield creates benefit for the entire Town. The Waterways Committee should seek funding through the Town budget process to develop and promote these water-related events. In addition, the Recreation Commission may have some funding available through existing water-based activities.

Responsible Parties:

- Waterways Committee
- Recreation Commission
- Massachusetts Office of Tourism and Recreation

b. Develop, maintain, and promote a Town calendar of water and beach related activities and events to draw people to the Town's waterfronts and waterways.

The Waterways Committee should work with the Recreation Commission to create and publicize a calendar of waterway events. The Recreation Department currently provides an online calendar of recreation events on its website. The Waterways Committee could create a similar online calendar or incorporate events into the Recreation Department's existing calendar. In paper format, this calendar could be printed on the back of the map of access points and launch facilities. Once a calendar is developed, the Committee could work with the Massachusetts Office of Tourism and Recreation or the Department of Conservation and Recreation to promote events at the state and regional levels to increase waterways tourism in Marshfield.

Funding: These steps require the time and effort of the Waterways Committee members and Town government employees, but do not necessarily require an expenditure of funds, or may be funded at low cost through standard budget procedures.

Responsible Parties:

- Waterways Committee
- Recreation Commission
- Massachusetts Office of Tourism and Recreation

c. Promote camping opportunities at specific river sites.

The Waterways Committee should work with the Recreation Commission to create a public education and media campaign to promote camping along the river. A guided tour of notable camping locations along the river or camping demonstrations or other educational events at a particular site along the river would increase public awareness of the available opportunities. A permit from the Conservation Commission may be required for camping in certain locations.

Funding: These steps require the time and effort of the Waterways Committee members and Town government employees, but do not necessarily require an expenditure of funds, or may be funded at low cost through standard budget procedures.

Responsible Parties:

- Waterways Committee
- Recreation Commission

d. Initiate a campaign to promote the North River as the only Designated Scenic Protected River in the Commonwealth of Massachusetts.

The Waterway Committee should work with the Conservation Commission, Recreation Commission, North and South Rivers Watershed Association, and the Massachusetts Office of Tourism and Recreation to promote the scenic designation of the North River. This Scenic Protected River designation is a significant achievement and could be a substantial tourism marketing feature if publicized effectively. Articles or letters to the editor in the local papers educating people about the importance of the designation would be an important first step in raising public awareness. Development of water-based

events, focused on promotion of this scenic designation, would engage residents to experience the river firsthand.

Funding: These steps require the time and effort of the Waterways Committee members and Town government employees, but do not necessarily require an expenditure of funds, or may be funded at low cost through standard budget procedures.

Responsible Parties:

- Waterways Committee
- Conservation Commission
- North and South Rivers Watershed Association
- Massachusetts Office of Tourism and Recreation

6. 4 Recreational Boating

Recreational boating is one of the Town's most important economic and recreational resources. The Town's three "harbors," Green Harbor, South River and North River provide protected environments for shoreside boating facilities and vessel mooring.

As noted in Section 4.11, there were almost 1,400 recreational vessels for which Marshfield was identified as home port in the 2012 Massachusetts boat registration data base. Many more recreational boats use Marshfield's waterways, boat launch ramps and boating support services, and in doing so, may contribute to the local economy. In addition to the dockage, mooring and launch fees, boaters may purchase maintenance and repair services, fuel, and supplies. Those vessels home ported in Marshfield also pay excise taxes to the Town.

Safety and natural resource protection related to recreational boating are also a concern in Marshfield waterways. The Massachusetts Department of Conservation and Recreation provides $30,000 in annual funding to the North River Commission to oversee implementation of the North River Protective Act. The funds are used in part to pay for a boat patrol in the North River during summer months. The patrol boat monitors activities that may cause damage to the natural environment and provides assistance to boaters. The Harbormasters of Marshfield and Scituate also provide patrols of the waterways; and the Town's by-laws (Article 32) establish a speed limit of 6 nautical miles per hour in Green Harbor and the North and South Rivers and prohibit disturbing wakes (which is reiterated in Article 58).

Issues

Boating is a primary activity along the Town's waterways, and opportunities exist to make boating activity safer while also minimizing its environmental impact.

1. There is a concern that funding for the existing patrols on the North River may be cut. The DCR currently provides approximately $30,000 for that patrol for safety and environmental reasons. In recent years, this funding has been cut or threatened to be cut as the state budget becomes tighter. Efforts to restore the funds have been successful recently, but the long-term viability of this funding source has been questioned. The North River Commission, the North and South River Watershed, and the towns must continue to document the value of the river's resources and the unique protective designation, and make these values known to the general public to broaden support for this commitment of state resources.

2. The "Spit" is a popular location for recreational boaters to congregate; but safety concerns are abundant. Increased patrols would require additional Town resources, and would benefit from coordination with Scituate.
3. Speed is a concern on the South River. The area is currently patrolled by the Town, but additional patrols and/or boater education would be helpful.
4. While pump-outs are available at the Town Pier, Green Harbor, and at private boating facilities and on the rivers, additional (and reliable) pump-out services are needed.

   Marshfield waters along with almost all of the state's coastal waters are designated a No Discharge Area. This designation is based on the availability and adequacy of boat pump-outs. Though equipment failure and occasional downtime is inevitable, existing equipment needs to be maintained in operational condition to ensure adequate capacity. Opportunities for additional installations should be considered during permitting of all new or expanded public and private boating facilities. The Harbormaster should initiate an annual review and certification of the operational condition of all pump-outs in the Town.
5. The locations of existing docks are unmapped, and there is no sense of the individual and cumulative impacts of those docks, nor is there any sense as to what the potential build-out of docks might be.

Recommendations

Goal 1: Support a safe and pleasurable recreational boating environment in Marshfield's navigable waters.

Objective I – Provide signage, training, and patrols to promote safe boating.

a. Work with the Harbormaster, the Recreation Department, and the Massachusetts Environmental Police to coordinate Town of Marshfield-sponsored Boating Safety training programs.

Safe boating courses are offered by several entities including the Boat and Recreation Vehicle Safety Bureau within the Massachusetts Executive Office of Energy and Environmental Affairs, the U.S. Power Squadron, Boatwise, the Town Harbormaster, the Town Recreation Department, and others. Improved coordination between the Harbormaster's office, the Department of Recreation, and the Massachusetts Environmental Police would allow the Town to provide programs that best meet the needs of interested students.

Funding: The cost of these programs could be covered by an enrollment fee. Depending on the nature of the training program, additional funding might be available through organizations such as the Boat US Foundation, which is interested in funding projects aimed at providing "creative and innovative projects that promote safe and clean boating" on local waterways (see: http://www.boatus.org/grants/).

Responsible parties:

- Waterways Committee
- Harbormaster
- Recreation Department
- Boat and Recreation Vehicle Safety Bureau
- Massachusetts Environmental Police

b. Ensure proper and sufficient regulatory signs are in place and maintained in key locations to promote safe navigation.

Educational materials geared toward responsible boating practices should be the primary means for addressing safe navigation, backed up with enforcement as necessary. Education materials, including, specifically, established speed limits in the Town's waterways should be available at all facilities from which boaters depart. Additional signage should be installed and maintained as needed, perhaps seeking input from the area's boaters.

Funding: The costs associated with the development of educational materials will vary, depending on the nature of the materials, and could come from existing budgets. Depending on the nature of the educational materials, additional funding might be available through organizations such as the BoatUS Foundation, which is interested in funding projects aimed at providing "creative and innovative projects that promote safe and clean boating" on local waterways (see: http://www.boatus.org/grants/).

Responsible parties:

- Waterways Committee
- Harbormaster

c. Increase law enforcement patrols to maintain the safe operation of recreational boats. Coordinate with Scituate in shared waters.

The increased communication and coordination between the marine departments and waterways committees of Marshfield and Scituate as recommended in this plan is the basis for increased monitoring of boating activity and enforcement in shared waters. The harbormasters of both towns should coordinate their activities and resources to achieve greater coverage.

Funding: Implementing this recommendation may require additional staff and equipment, which would likely necessitate adjustments to the harbormasters' budgets in Scituate and Marshfield.

Responsible parties:

- Marshfield Harbormaster
- Scituate Harbormaster
- Marshfield Waterways Committee
- Scituate Waterways Committee

d. Develop and maintain an inventory of permitted docks.

The Inventory and Analysis section of this plan includes maps of Town waters on which existing public and private docking facilities are depicted. These maps should be keyed to a data base that includes property location, permitting history and details on the structures and floats. This information will be useful for evaluating applications for new or expanded docks.

Funding: The implementation of this requirement should not be significant, and would likely be covered by existing budgets.

Responsible parties:

- Waterways Committee
- Harbormaster
- Conservation Commission
- Zoning Board of Appeals

6.5 Working Waterfronts and Infrastructure

The shoreside infrastructure in Marshfield includes commercial and recreational boat berthing, launch facilities, diesel and gas fuel, gear and bait sales, space to accommodate buyers, space and equipment to accommodate commercial fishing activities, tow and repair services, gear suppliers, and pump-out services. The Town and its marine businesses have made investments in and improvements to facilities that support commercial and recreational fishing and boating. The new harbormaster facility will be a major asset for the Town's marine-related activities.

The Town's fishing fleet is important to Marshfield's economy and culture. Beyond its direct and indirect economic benefits, the presence of the commercial fleet is an important factor in securing funding for maintenance dredging in Green Harbor. Similarly, recreational boating and fishing support a variety of associated businesses and is an important economic driver for the community. Commercial and recreational fishing and recreational boating take advantage of the Town's enviable location and natural resources.

Issues

Shoreside support infrastructure and access can be improved.

1. Additional parking (or management arrangements) and facilities are needed to support the multiple commercial and recreational water-dependent uses of Green Harbor.
2. The local fishing fleet does not have easy access to ice.
3. The current configuration of North Pier is not ideal for fishermen. The pier is too high and there is unused space that could be made usable.
4. With the filling in of the Narrows, access for fishing boats can become unreliable and may lead to unsafe conditions or the loss of time (and money) while waiting for passage to become safe.

Recommendations

Goal 1: Support water-dependent uses and businesses for their economic benefit to the Town of Marshfield.

Objective I – Maintain the infrastructure necessary to support Marshfield's commercial fishing fleet and charter boat operations.

a. Explore the feasibility of providing reliable high-capacity ice service for commercial and recreational fishermen.

Ice is a key commodity for commercial and recreational fishermen.The availability of ice would be an asset for recreational and commercial lobster fishermen and other fisheries that might develop out of the harbor, so exploring cost-effective ways to do that should continue.

Funding:

Responsible parties:

- Commercial fishing associations

b. Ensure that the public infrastructure and shoreside arrangements (e.g., parking/trailer space, dockage, moorings, unloading) are identified and planned for in terms of current and future needs.

The inventory of existing facilities and conditions in this plan provides a basis for public and private planning of future investments in waterfront infrastructure.

Funding:

Responsible parties:

Objective II – Promote and support marine-based activities at the Town's working waterfronts.

a. Develop a branding strategy to promote Marshfield's local waterfront businesses.

Green Harbor as well as the marinas on the North river and South River enjoy a far-reaching reputation as a destination for charter boat fishing. Recent public investments reinforce the importance of charter boat operations for both Marshfield residents and its visitors. The Green Harbor, North River and South river charter boat fishing industry should be promoted as part of an effort to grow the Town's visitor economy. Local businesses and municipal revenue would both benefit (much like the vineyards of Napa Valley benefit as much from the Napa Valley brand name as their own individual wine label).

Funding:

Responsible parties:

- Waterways Committee
- Harbormaster
- Chamber of Commerce

b. Create events for the public to become more aware of activities along the Town's waterfronts.

The Town already sponsors and hosts a number of activities to bring people to the waterfront and increase the public's appreciation of the Town's coastal and marine resources. Works with other committees and department of the Town, private businesses and nonprofit organizations to develop and populate a calendar of events centered on the waterways and beaches.

Funding: Town or private

Responsible Parties:

- Commercial Fishing Association
- Town of Marshfield
- Waterways Committee
- Harbormaster

c. Explore every opportunity to expand the use of Marshfield's working waterfronts to accommodate new uses (e.g., activities related to the Ocean Campus Center) and the growth of existing uses.

The establishment of the Ocean Campus Center, a school of higher education championed by the Marine & Environmental Education Alliance (MEEA), dedicated to the development of technical skills in the maritime and environmental technologies in Marshfield would not only produce in demand skilled employees for the Town's and region's marine and environmental businesses, it will raise the Town's profile as a center for marine-based activities. There will be mutually-beneficial partnering opportunities between the school and waterfront businesses in Marshfield.

Funding:

Responsible parties:

- Planning Board
- Waterways Committee

6.6 Water Quality

Water quality is highly influenced by human activities – both on land and on the water. As mentioned in Section 4 of this Plan, the Town's waterbodies typically meet the state standards for swimming, having experienced only 14 beach closure days due to elevated levels of enterococcus, between 2008-2012. (The threshold for high enterococcus concentration is 104 CFU per 100 ml for a single sample and 35 CFU per 100 ml for the geometric mean of the five most recent non-storm event samples (Massachusetts Department of Public Health, 2013).) Sampling data taken by the NSRWA association, however, shows that summertime water quality in the rivers is not suitable for shellfishing, a fact reflected by the closed summer shellfishing season. (The State's fecal coliform threshold for shellfishing is a geometric mean of 14 organisms/100 ml, or 10% of samples exceeding a geometric mean of 28 organisms/100 ml.)

The occurrences of enterococcus and fecal coliform indicate the presence of human and/or animal waste, and are generally linked to problems such as failing septic systems, storm water/runoff issues (whereby animal waste is transported into surface waters), and waste released by boaters. Additional water quality impairments stem from human activities such as (1) construction projects where sediment is transported into surface waters, reducing water clarity, and potentially conveying contaminants; (2) construction projects that create barriers to water circulation (e.g., under-sized culverts); (3) application of pesticides which can enter the water system and harm marine organisms ; and (4) over-fertilization which may cause excess fertilizer to be transported into the marine environment, leading to eutrophic conditions (i.e., increased plant growth which ultimately dies and decomposes, removing oxygen in the water that is critical to the survival of marine life such as fish).

The Town, along with Scituate, the NSRWA, the Conservation Commission, and MA CZM have conducted projects to address and monitor water quality, including the development of an NDA for Marshfield, Scituate, and Cohasset in 2008; improvements to the Scituate Wastewater Treatment Facility in the early 1990s; the expansion of Marshfield's sewer system from downtown Marshfield to Rexhame Beach in 2005; and ongoing work to improve stormwater management in the Town's center (see background section for more details on these projects).

While swimming and shellfishing are the primary concerns related to water quality, boaters at Green Harbor Marina are also dealing with a problem linked to water quality: A nutrient-rich foam has developed as a result of the manipulation of the tide gates at the Green Harbor dyke. The manipulation of the tide gates is intended to help restore water quality and habitat upriver from the dyke, but an unintended consequence has been the development of this foam, which can overwhelm vessels, and is very difficult to remove once it makes contact with a boat.

As the Town experiences continued development, increases to impervious surfaces and disruptions to wetlands should be minimized. Furthermore, it will be important to prevent water quality impacts from construction activities (such as sedimentation and leaching of chemicals from treated construction materials), and to ensure that adequate septic systems be installed and maintained.

Issues

1. Improvements in coastal water quality have been achieved, but the contributions of nonpoint sources need to be identified, assessed, and minimized.
2. A protein-rich foam, generated by the dyke, is impacting boaters in Green Harbor. The occurrence of the foam has been particularly noticeable during the 2013 summer, possibly related to heavy rainfall and a Conservation Commission project upstream of the dyke. The foam is problematic in that it is very

difficult to wash off of boats. Initial efforts to keep the foam away from and off of boats have not been successful.

Recommendations

Goal 1: Ensure that water quality and quantity is adequate to support healthy ecosystems and the various human uses of the Town's waterways.

Objective I – Improve coastal water quality testing and awareness of testing results.

a. Coordinate the synthesis and review of surface water quality testing information to identify and address potential sources of water quality impairment.

Several entities currently collect surface water quality data, including the NSRWA, the Marshfield harbormaster, The Massachusetts Bureau of Environmental Health, the Massachusetts Division of Marine Fisheries, and those engaged in water quality monitoring as a condition of a permit. Each collects data for its own uses, but no entity is currently synthesizing the data from all sources to develop a Town-wide analysis of surface water quality on an annual basis. Some monitoring data are available online (e.g., NSRWA, MA Bureau of Environmental Health). The Waterways Committee should obtain these data and reach out to obtain data from those whose information is not made available online. Once the data are in hand, the Waterways Committee can compile the information and review it to identify trends in water quality and potential sources of impairment.

Funding: This recommendation should not require additional funds.

Responsible parties:

- Waterways Committee
- North and South Rivers Watershed Association
- Marshfield Harbormaster
- Massachusetts Bureau of Environmental Health
- Massachusetts Division of Marine Fisheries
- Marshfield Board of Health
- Contractors

Objective II – Promote water quality improvements.

a. Monitor the outcomes of the 2014 shellfish growing program to better understand the potential for growing shellfish to improve the estuarine ecosystem.

As filter feeders, shellfish can remove nutrients, pathogens, and plankton from the water column, improving both water quality and water clarity. The NSRWA, in partnership with the towns of Marshfield and Scituate and the Massachusetts Bays Program, is developing a pilot program to grow blue mussels (*Mytilus edulis)* at two sites along the North River. The project will involve gathering local spat as well as purchasing a small amount of seed from a certified grower. The mussels will be grown and monitored during the summer of 2014 to "(a) explore the feasibility of raising mussels in culture in the North River, and (b) supplement the natural spat supply of the North River by increasing the abundance of adult mussels present in the system" (NSRWA, 2014). This project will provide important information about the barriers to and potential for growing mussels for local stock enhancement and estuarine ecosystem health improvement. The Waterways Committee should monitor the outcomes of this project and

discuss its implications for conducting additional ecosystem enhancement projects that involve shellfish growing.

Funding: The NSRWA, along with the towns of Marshfield and Scituate, have already secured funding for this effort.

Responsible parties:

- Waterways Committee
- North and South Rivers Watershed Association
- Marshfield Harbormaster
- Scituate Harbormaster
- Massachusetts Bays Program
- Massachusetts Division of Marine Fisheries

b. Ensure adequate functioning pump-out facilities to minimize vessel-related water quality impairments. Conduct a survey of operability each year at the start of the boating season. Establish a program to promote use of pump outs.

Within a No Discharge Area (NDA), boats with Type I and Type II Marine Sanitation Devices (MSDs), which discharge sewage into the water (some treatment is typically provided) must secure their systems to ensure that they are not discharging within the NDA. Type III MSDs, which act as holding tanks, are allowed to be used within the NDA but must be pumped-out. Through the NDA application process it was determined that the NDA region (Cohasset, Scituate, and Marshfield) had adequate pump-outs to meet the needs of the boating population; however the use of the pump-outs depends on funding and proper maintenance. If adequate pump-out service is not available, boaters may have difficulty complying with the requirements of the NDA. An inspection of each of the pump-out facilities and pump-out vessels prior to the beginning of the boating season would help to ensure the availability of properly functioning pump-outs. Additionally, a program to promote the use of pump-outs (e.g., signs at marinas and launches, information sent with marina mailings, greater distribution of the guide developed by the NSRWA – available at http://www.nsrwa.org/files/NDABrochureFinal.pdf?phpMyAdmin=1D-JAyGwdvm-KY87oAHL6qdji%2Cf) would help increase awareness of the NDA status, as well as provide information about the reasons behind the establishment of the NDA and the locations of pump-outs.

Funding: The inspection of pump-out services should not require any additional funding. Repairs to pump-outs may require additional funding, which should be provided by the entities responsible for the pump-out. Additional funding for new pump-outs might come from the State's Clean Vessel Act Program (http://www.mass.gov/eea/agencies/dfg/dmf/programs-and-projects/clean-vessel-act.html). Outreach costs will vary depending on the type of outreach conducted, and may include such things as the cost of printing and postage. Some of this money might already be incorporated into the budgets of those who will be implementing the outreach plan. Additional costs might be covered through small grants from foundations (e.g., BoatUS - http://www.boatus.org/grants/) or donations from local corporations (e.g., West Marine, local marinas, charter fishing operations, etc).

Responsible parties:

- Waterways Committee
- Marina owners

- Marshfield Harbormaster
- Scituate Harbormaster
- Massachusetts Office of Coastal Zone Management
- North and South Rivers Association

c. Work with the Conservation Commission, Green Harbor Marina, the Harbormaster and any other agencies or organizations to reduce impacts of foam to vessels docked at Green Harbor Marina.

Foam encroaching upon vessels at Green Harbor Marina (Summer 2013) (Photo: Joe Galgana)

As noted above, a nutrient-rich foam has developed in Green Harbor as a result of the manipulation of the tide gates at the dyke. The foam is difficult to get off of boats and is of particular concern to those whose boats are docked at Green Harbor Marina. Efforts have been made to use floats to intercept and redirect the foam away from the vessels, which works to an extent, but the foam becomes air-born in strong winds. A group of impacted boaters, staff from Green Harbor Marina, the Conservation Commissioner, a representative from the Waterways Committee, and the Harbormaster have started to work together to identify a solution to the foam issue, including the use of larger floats to intercept the foam, and should continue to meet as necessary.

Funding: The amount and sources of funding will depend on the solutions identified.

Responsible parties:

- Waterways Committee
- Green Harbor Marina staff
- Marshfield Harbormaster
- Conservation Commission
- Concerned boaters

6.7 Administration/Finances

Waterways related activities in Marshfield are managed and funded through a variety of mechanisms, including the Town's budget, Waterways Fund, and grants. These existing and potential mechanisms are described in the following section, with further detail available in Appendix C.

Waterways Fund

Under G.L. c.40, § 5G, a city or town may establish a municipal waterways improvement and maintenance fund to receive revenue from several sources, including (1) excise tax on boats, ships, and vessels (G.L. c.60B, § 2(i)), (2) fees from mooring permits (G.L. c.91, § 10A), and (3) sums received from the Commonwealth or the federal government. The Town of Marshfield has established a Waterways Fund and the Waterways Committee advises on the use of those funds.

The revenue in this fund may be used for (1) maintenance, dredging, cleaning, and improvement of harbors, inland waters and great ponds of the commonwealth; (2) public access to these areas; (3) breakwaters, retaining walls, piers, wharves, and moorings; and (4) law enforcement and fire prevention.

Other Funding Sources

In the past the Town has received grants from a variety of sources. The following summary is representative of the variety of grant opportunities, but is not a comprehensive list of all grants the Town has received.

The Town received a grant from the Seaport Advisory Council (SAC) for the North Pier Commercial Project in 2011 (SAC $425,000; Town contribution $85,000) and the Harbormaster Building Project in 2013 (SAC $1,075,000; Town contribution $350,000).

The Town also received a grant from the Department of Homeland Security for a new marine vessel through the Federal Emergency Management Agency's (FEMA) 2012 Preparedness Grant Program (DHS $290,006; Town contribution approximately $96,668 with approximately $30,000 offset by the sale of the existing boat).

Recently, Marshfield and Scituate applied for a $4.8 million grant through the Hurricane Sandy Coastal Resiliency Competitive Grants Program of National Fish and Wildlife Foundation for dredging the channel of the South River from the Sea Street Bridge to the entrance of the North and South Rivers up to Buoy 13 near the Spit in Scituate. In addition, dredge sediment would be re-used for shoreline restoration along the eroded bluff and barrier beach at the 4th Cliff Air Force Recreational Area and North Humarock Beach in Scituate. Marshfield would benefit from natural sediment transport from north to south, with the resulting sediment distribution going to Rexhame Beach and beaches to the south. Marshfield and Scituate would each contribute a $260,000 match to the grant. Marshfield's Capital Budget Committee recommended approval of Article 11 to transfer and borrow funds for the $260,000 at the Town Meeting. Voters approved the measure at the Town Meeting, however the grant application was not successful. Massachusetts legislators are currently working to have similar funding available in the final Environmental Bond Bill for this dredging and nourishment project.

Other funding sources include contribution from the U.S. Army Corps of Engineers for many years of dredging activities and jetty maintenance. In addition, the Town receives revenue from boat ramp user fees.

At the most recent Town meeting in April 2014, voters approved the following measures:

- $450,000 for revitalization of Harbor Park at Green Harbor. Improvements include a 1,000-foot long stone-dust nature walking trail, playground, lounge seating, picnic pavilion, grass amphitheater area, and adjacent parking lot. Also included is $135,000 for engineering of a proposed 2,500-foot long boardwalk on Town Pier Road to increase safety for pedestrians and bicyclists.
- $120,000 for new floats, docks, and gangways at Green Harbor
- $60,000 for dredging permits

Boat Excise Tax

In addition to valuing all real and personal property, Assessors also have responsibility for boat excise tax bills. All water craft vessels are assessed an excise tax for the privilege of using the Commonwealth's waterways. The tax is assessed annually on July 1 and is paid to the community where the boat or ship is usually moored or docked during the summer season, or otherwise principally situated during the calendar year.

Boats are taxed at a rate of ten dollars per one thousand dollars of value. The value of a vessel is the fair cash value as determined by the assessors of each city and town, but not to exceed the value based on the length

and age of the vessel as illustrated in Table 17, below. Based on this valuation method, the maximum excise tax for any boat is $500.

	Under 4 years of age			4 to 6 years of age			7 or more years of age			
Length of Vessel	**Excise Valuation***	**# of vessels**	**Est value of Excise Tax**	**Excise Valuation**	**# of vessels**	**Est value of excise tax**	**Excise Valuation**	**# of vessels**	**Est value of excise tax**	**Totals**
Under 16'	$1,000	33	$33,000	$700	50	$35,000	$400	363	$145,200	**$213,200**
16' but less than 17.5'	$1,500	4	$6,000	$1,000	6	$6,000	$800	169	$135,200	**$147,200**
17.5' but less than 20'	$3,000	8	$24,000	$2,000	20	$40,000	$1,500	149	$223,500	**$287,500**
20' but less than 22.5'	$5,000	6	$30,000	$3,300	18	$59,400	$2,500	236	$590,000	**$679,400**
22.5' but less than 25'	$7,500	5	$37,500	$5,000	13	$65,000	$3,800	126	$478,800	**$581,300**
25' but less than 27.5'	$10,500	0	$0	$7,000	8	$56,000	$5,300	100	$530,000	**$586,000**
27.5' but less than 30'	$14,000	1	$14,000	$9,300	2	$18,600	$7,000	20	$140,000	**$172,600**
30' but less than 35'	$18,500	1	$18,500	$12,300	1	$12,300	$9,300	28	$260,400	**$291,200**
35' but less than 40'	$24,000	0	$0	$16,000	0	$0	$12,000	8	$96,000	**$96,000**
40' but less than 50'	$31,500	0	$0	$21,000	0	$0	$15,800	9	$142,200	**$142,200**
50' but less than 60'	$41,000	0	$0	$27,300	0	$0	$20,500	0	$0	**$0**
60' or over	$50,000	0	$0	$33,000	0	$0	$24,800	0	$0	**$0**
Total taxes			**$163,000**			**$292,300**			**$2,741,300**	**$3,196,600**
Total boats		**58**			**118**			**1,208**		**1,384**

Table 17: Estimation of excise tax on vessels in 2012 State Boat Registration List with Marshfield as storage town. Valuation of vessels used to calculate excise tax (Taken from MGL CH 60B §2)

All excise tax revenue is paid into the treasury of the Town and 50 percent of this revenue is credited into the municipal waterways improvement and maintenance fund, as established under G.L. c.40, § 5G.

The Assessors' Office contacts local boat yards, marinas, and the Town Harbormaster to obtain listings of boat owners. Also, boaters must register every two years with the Massachusetts Environmental Police, which sends a list of registered boats each year to all local tax assessors. Before billing these boat owners, however, the Town must verify that the boat is moored or stored in Marshfield. In addition, Town may receive a list of documented boats (a national form of registration) from the U.S. Coast Guard. Once a list of applicable boats and owners is generated, then bills are printed and passed to the Town Collector for distribution.

Enterprise Fund

An enterprise fund (G.L. c.44, § 53F½) gives communities the flexibility to account separately for all financial activities associated with a broad range of municipal services. It establishes a separate accounting and financial reporting mechanism for municipal services for which a fee is charged in exchange for goods or services, i.e., water and sewer utilities, trash disposal, ambulance service, dock and wharf facilities, etc. Revenues and expenses of the service are segregated into a fund with financial statements separate from all other governmental activities, rather than comingled with the revenues and expenses of all other governmental activities.

A city or town may adopt an enterprise fund by vote of the legislative body, subject to the local charter, i.e., by vote of the city council with the approval of the mayor or by town meeting. Each enterprise fund must be adopted separately with its own vote so that the legislative body can identify and evaluate each enterprise on its merits.

The language of the vote should clearly state what the service is and when the fund will commence. Once adopted, the community begins the process of establishing the separate fund on its accounting records and identifying the assets (capital items and infrastructure), liabilities and equity in other funds if voted by the legislative body to be transferred to the enterprise fund. The community must operate the enterprise fund for a minimum of three years before the provisions may be rescinded like any local adoption law.

An enterprise fund may be self-sufficient, or it may budget a surplus or subsidy. The extent to which it is subsidized (generally by the General Fund) is a policy decision that should be clearly presented when the council or town meeting adopts the enterprise budget. A community may choose to recover total costs for a service through a partial subsidy from the tax levy. In the case of a subsidy, user charges and fees do not then fund total service costs.

In general, the advantages of an enterprise fund include that it:

- Identifies a total service cost - Consolidating direct operating, direct capital, and indirect costs helps a community to readily identify a total service cost and determine funding sources. The total service cost may also include a subsidy from the General or other fund or a reimbursement from the enterprise fund to other funds.
- Provides useful management information - Consolidating revenues, expenses and operating performance of the fund provides a community with useful decision making information regarding user charges and fees and a subsidy if necessary. The community can also include the enterprise fixed assets and infrastructure as assets and recognize the annual depreciation of these assets in audited financial statements.
- Retains investment income and surplus - All investment earnings and any operating surplus are retained in the enterprise fund rather than returned to the General Fund at fiscal year-end. These retained earnings require appropriation by the community's legislative body and may be appropriated only for expenditures relating to the enterprise fund, in addition to other restrictions.

Disadvantages of an enterprise fund will depend on the particular financial situation of the activities covered by the fund, the value of these activities to the town, and on the local political environment. Consolidation of all financial information related to an activity is useful in management, but also creates opportunity for increased scrutiny. In particular, if an enterprise fund remains dependent on the town for a subsidy, operations may be subject to increased oversight. Also, costs may increase unexpectedly and an enterprise that was formerly self-sufficient may require a subsidy, creating varying degrees of financial burden and political maneuvering in the town.

Issues

1. The Town has experienced success in securing funding for dredging and waterfront improvements. These efforts need to continue along with pursuing options for stable sources of revenue dedicated to the waterways.

Recommendations

Goal 1: Ensure adequate and stable funding for waterfront and waterway activities.

Objective I – Pursue funding to support management of the Town's waterways and waterfronts

a. Review, catalog, and assess the trends of existing sources of funding for harbor and waterways-related operations and capital improvements and increase efforts to secure new financial support, e.g., grants.

As a first step, the Waterways Committee should compile a list of all waterways-related operations and improvements, including both special projects and annual requirements. Such operations include dredging permits, harbor infrastructure, use of moorings and boat ramps, use of pump-out facilities, salaries of waterways-related employees, and others.

Once a list is compiled, the Committee can draw on the collective knowledge of its members, as well as contact relevant Town departments, to determine the sources and amounts of funding for these activities, as well as whether any generated fees go into the General Fund or the Waterways Fund. All applicable Town financial information should be either publicly available in annual Town reports, or available upon request from the particular department.

As part of this process, the Committee should learn about the different grant opportunities the Town has applied for and which of those have been awarded. It may benefit the Committee to appoint one or more members to be responsible for maintaining a current knowledge of typically available grant opportunities and their associated deadlines, as well as actively researching new grant opportunities.

Funding: These steps require the time and effort of the Waterways Committee members and Town government employees, but do not require an expenditure of funds.

Responsible Parties:

- Waterways Committee
- Finance Director
- Town Police Department
- Town Harbormaster
- Town Assessors Department
- Town Collector

b. Work with the Town to obtain a consolidated quarterly report of all Waterways income and expenses. Include information from all relevant accounts such as police salaries, capital expenses and state launch ramp income.

Waterways-related expenses and income are fundamental to the work of the Waterways Committee; therefore, as an extension of the previous recommendation to catalog the sources of funding, the Committee should engage the Finance Director and other relevant departments to establish a regular reporting schedule of all waterways-related income and expenses. The Committee should specify all relevant categories for reporting and work with departments to develop a template that can be easily filled in with the appropriate financial information.

Funding: These steps require the time and effort of the Waterways Committee members and Town government employees, but do not require an expenditure of funds.

Responsible Parties:

- Waterways Committee
- Finance Director

c. Explore establishing a separate account for all user fees and other existing and future revenue sources attributed to Waterways operations, the balance of which may be rolled over from year to year as retained earnings.

The Waterways Committee should educate themselves about the use of enterprise funds in general, and also about the current enterprise funds utilized in Marshfield for water, sewer, and trash operations. The reasoning behind establishing these current enterprise funds, as well as their successes and errors would be useful in the Committee's consideration of an enterprise fund for waterways-related activities. In addition the Committee should meet with representatives from other towns, such as Scituate, that have instituted a Waterways Enterprise Fund to learn about their experience and any guidance they can provide.

Funding: These steps require the time and effort of the Waterways Committee members and other Town government employees in Marshfield and Scituate, but do not require an expenditure of funds.

Responsible Parties:

- Waterways Committee
- Marshfield and Scituate employees knowledgeable about local enterprise funds

d. Explore the desirability and possibility of waterways-related expenses being paid for by existing and future waterways-related revenue

The previous recommendations outline necessary steps for the consideration of establishing a waterways enterprise fund in Marshfield. Once the Waterways Committee has gained concrete financial information about the waterways-related expenses and income and sources of funding for these activities, and knowledge about enterprise funds, including local examples and experiences, the Committee should have an in-depth discussion amongst its members about the desirability and feasibility of a waterways enterprise fund.

Accurate financial statements of waterways-related expenses and income are crucial for an honest assessment of whether a waterways enterprise fund is financially feasibility and whether it could be self-sufficient, i.e., function without the need for a subsidy from the Town. The Committee should consider not only current expenses and income, but also how those values may change over time.

Funding: These steps require the time and effort of the Waterways Committee members, but do not require an expenditure of funds.

Responsible Parties:

- Waterways Committee

Objective II – Ensure that the Town is capturing all revenue to which it is entitled from the economic value that is generated from the Town's waterways assets.

a. Work with the Assessor's office and boating businesses to ensure the Town is collecting excise taxes on boats in accordance with state law.

Information on boats and owners comes from a variety of sources, including local boating businesses, the Town Harbormaster, the Massachusetts Environmental Police, and the U.S. Coast Guard. The Waterways Committee should meet with the Town Assessors Department to ensure they obtain boat information from all of these sources. Local boating businesses could provide guidance on whether the list is an accurate representation of boats in Marshfield. The Committee also should meet with the Town Collector to determine if all of the bills generated by the Assessors are being paid, taking into account any abatements granted by the Assessors.

Funding: These steps require the time and effort of the Waterways Committee members, Town government employees, and boating business owners, but do not require an expenditure of funds.

Responsible parties:

- Waterways Committee
- Marshfield Assessors Department
- Town Harbormaster
- Town Collector
- Boating businesses

6.8 Collaboration

The goals and activities of the Waterways Committee naturally intersect with many Town committees and departments, State agencies, and non-profit organizations. A brief description follows of the entities with which the Committee is most likely to collaborate.

Town Committees and Departments:

Beach Administrator

The Beach Administrator works within the Town Police Department and has a mission to manage public beach operations, including issues related to seaweed accumulation, appropriate signage, beach closures due to high bacteria levels, snow fence requirements, and debris removal.

Board of Selectmen

The Board of Selectmen serves as the Executive Branch of Town government. The Board is comprised of three members, each elected to a three-year term. The Selectmen provide policy guidance for all Town departments except for the School Department. The Board of Selectmen, in conjunction with the financial

team, develops budget strategy and provides general oversight of the budget process. The Board of Selectmen holds public meetings once per week.

Coastal Advisory Committee

The five-member Coastal Advisory Committee was established in February 2013 with a mission to advise the Town on sea level rise adaptation strategies that include but are not limited to protection, accommodation, or retreat so as to enable sustainable living in the coastal community. The Town seeks effective management of its coastal resources in an effort to minimize loss of private property, protect the public safety, protect the public and private infrastructure, and minimize adverse impacts to the environment.

Among various pursuits, the Committee will promote a research-based approach to local decision-making; educate citizens about sea level rise and associated issues through a website and local seminars; develop policies to minimize the Town's exposure to coastal storms; perform a cost-benefit analysis of various adaptation measures; develop benchmark indicators of sea level rise and coastal storm frequency and intensity; and work with local committees, departments, and neighboring communities. The Committee holds public meetings as needed.

Conservation Commission

The five member Conservation Commission administers the Massachusetts Wetlands Protection Act and the Town of Marshfield's Wetland Protection Bylaw, helping to preserve and protect wetland resources within the Town. The Commission also manages over 2,500 acres of conservation land for wildlife and passive recreation. The Conservation Department is led by the Conservation Agent. The Commission holds two public meetings per month.

Department of Public Works

The Department of Public Works (DPW) is responsible for providing essential public works infrastructure support services for the citizens of the Town of Marshfield. Services provided by the DPW include the engineering design, construction, maintenance and repair of streets, sidewalks, sewer, water and storm drainage systems; maintenance of parks, cemeteries, athletic fields, beaches, public buildings and off-street parking facilities; public refuse collection and disposal; recycling; snow plowing and ice control; inspection of construction projects; and the operation of the Water and Sewer Treatment Plants. The DPW is organized into six divisions, each under the direct supervision of a division supervisor and the overall direction of the Superintendent of Public Works.

Department of Recreation

The seven member Recreation Commission is responsible for providing year round high quality indoor and outdoor recreational activities for Town residents. The Recreation Department plans, organizes, promotes, and provides worthwhile leisure programs and facilities to serve the physical, emotional, and social needs of the residents of the community, regardless of individual ability. The Commission meets regularly to review policy, programs and procedures.

Energy Committee

The seven member Energy Committee was established in 2008 with a mission to serve the residents by recommending energy and alternative energy policies that will reduce energy consumption and greenhouse gas emissions in the Town of Marshfield. Recently the Committee hosted information sessions about coastal planning and adaptation, and also about the joint sea level rise study conducted by Scituate, Marshfield, and

Duxbury. Other Committee projects include the development of a climate action plan; inventorying the energy consumption in all Town-owned buildings and vehicles; conducting a feasibility study for developing renewable energy sources; and educating residents about the benefits of emissions reductions.

Planning Board

The five member elected Planning Board is responsible for guiding land development within the Town to further the welfare of the community. Among many tasks, the Board reviews development proposals and issues decisions on these applications; conducts long-term planning for issues such as transportation, affordable housing, and open space and recreation; reviews and comments on Environmental Impact Reports for large scale development; and engages in general community planning efforts to improve the physical environment of the Town. The Planning Department is staffed by a Town Planner and Executive Assistant. The Board holds public meetings every other week and periodically conducts site visits on weekends.

Scituate Waterways Commission

The Scituate Waterways Commission is an advisory group to the Board of Selectmen and is comprised of volunteers from the community who take a sincere interest in the planning and growth of the Town harbor and waterways. The Commission holds one public meeting per month in collaboration with the Harbormaster to discuss initiatives to improve local waterways for the commercial fleet, recreational boaters, and everyone who takes advantage of local natural resources. The Commission is currently comprised of a Chairperson, Vice Chairperson, six full members, and ten associate members, in addition to the Harbormaster, Town Selectmen Liaison, Planning Board Liaison, and Recording Secretary.

Non-Profit Organizations:

North and South Rivers Watershed Association (NSRWA)

The North and South Rivers Watershed Association, Inc. (NSRWA) is a non-profit grassroots environmental organization located on the South Shore of Massachusetts. The NSRWA was founded in 1970 with a mission to preserve, restore, maintain and conserve in their natural state, the waters and related natural resources within the watershed. The goals of the NSRWA are to: (1) Protect the watershed and promote responsible growth by working in partnerships to preserve open space, scenic vistas and sensitive natural resources; (2) Educate and encourage stewardship of the watershed through public education, outreach and recreation programs; and (3) Restore the water quality of the rivers by identifying and correcting adverse impacts.

North River Commission

The North River Commission was established by the Massachusetts Department of Environmental Management (DEM), now known as the Department of Conservation and Recreation (DCR). The Commission administers the North River Protective Act, which acknowledges the significance of the North River as a recreational and scenic resource in Massachusetts and specifies allowed, prohibited, and special permitted uses in the area. The Protective Act aims to protect public and private property, wildlife, fresh and saltwater fisheries, and irreplaceable wild, scenic, and recreational river resources along the North River and parts of associated tributaries. The Commission is comprised of representatives and alternatives from each of the six towns on the North River (Pembroke, Hanover, Norwell, Marshfield, Hanson, and Scituate)

Massachusetts Bays National Estuary Program

The Massachusetts Bays Program is a U.S. Environmental Protection Agency (EPA) National Estuary Program dedicated to protecting, restoring, and enhancing the estuarine resources of Massachusetts and Cape Cod

Bays. The Program is a collaboration between the EPA, the Massachusetts Executive Office of Energy and Environmental Affairs (EEA), and the Massachusetts Office of Coastal Zone Management (CZM). The Program facilitates partnerships to prompt local, state, and federal action and stewardship; convenes stakeholders on the local and regional level; provides scientific basis for management decisions; and educates decision makers about problems and solutions. The North and South Rivers Watershed Association (NSRWA) is the South Shore Regional partner of the Massachusetts Bays Program.

State Agencies:

Massachusetts Office of Coastal Zone Management (CZM)

The Massachusetts Office of Coastal Zone Management (CZM) is a part of the Executive Office of Energy and Environmental Affairs (EEA). CZM seeks to balance the impacts of human activity with the protection of coastal and marine resources. As a networked program, CZM works with other state agencies, federal agencies, local governments, academic institutions, nonprofit groups, and the general public to promote sound management of the Massachusetts coast.

The Waterways Committee currently works with CZM via their Regional Program, which maintains regional offices in 5 areas of Massachusetts, including the South Shore from Hingham to Plymouth. In each area, a regional coordinator serves as a liaison between federal and state programs and municipal authorities on key initiatives within the coastal zone, provides technical assistance to coastal communities, facilitates local initiatives, and provides other key functions.

Issues

Many entities have interests in the Town's Waterways. Efforts to enhance communication, coordination, and collaboration will be important to the implementation of recommendations in this plan and will more broadly ensure better management of and access to the waterways.

A. The North River is shared by the towns of Marshfield and Scituate. Addressing many of the issues along the North River (e.g., improving public access, dredging, monitoring, pump-outs, and shellfishing activities) will be enhanced by (if not require) the collaboration of Scituate.

B. Greater coordination among local entities with interest in the Town's water resources (e.g., the North River Commission, the North and South River Waterways Association, and the Town Department of Recreation) would improve stewardship and management.

Recommendations

Goal 1: Communicate with other entities whose activities directly or indirectly impact the Town's waterways.

Objective I – Ensure regular meetings and outreach with other relevant organizations, committees, boards, and neighboring towns to improve management of the waterways and waterbodies.

a. Assign members of the Waterways Committee to represent the Committee to each Town board or commission having overlapping responsibilities with the Committee (e.g., the Conservation Commission, Coastal Advisory Committee, Beach Administrator, and Planning Board). Regularly share Waterways Committee agendas and approved minutes with these boards and commissions, as well as with the Board of Selectmen. Invite representatives from these groups to attend any or all Waterways Meetings of interest. Dedicate one Waterways Committee meeting per year to discussion of overlapping areas of concern with these boards and commissions.

The Waterways Committee should designate a primary and alternate representative for each of the four primary Town boards and commissions with which the Committee collaborates, as well as for the Board of Selectmen. These individuals should be the primary contacts with their respective entities and should be responsible for sharing Waterways minutes, inviting members from these groups to any Committee meetings of interest, attending all relevant meetings of these groups, and reporting back on relevant activities to the Committee. In addition, the Committee should dedicate one monthly meeting per year to the discussion of overlapping concerns among these entities. This meeting could be in a regularly scheduled timeslot or occur outside the regular meeting schedule based on the time constraints of everyone involved.

Funding: These steps require the time and effort of the Waterways Committee members, but do not require an expenditure of funds.

Responsible Parties:

- Waterways Committee
- Beach Administrator
- Board of Selectmen
- Coastal Advisory Committee
- Conservation Commission
- Planning Board

b. Dedicate one Waterways Committee meeting per year to gathering input from all waterways stakeholders on any and all waterways issues and concerns.

Although all meetings are open to the public, the Waterways Committee should designate a specific month every year for a meeting dedicated to hearing concerns from local stakeholders. This meeting should be well publicized and promoted and should occur during a time of year that would maximize attendance from local residents and waterways users. One possibility is for this meeting to be held in early to mid-fall, so that issues from the recent boating season can be raised and hopefully addressed before the following season commences. This meeting not only would provide a forum for stakeholders to voice their thoughts, but also it will provide a venue for the Committee to review the progress and achievements of the past year with the public.

Funding: These steps require the time and effort of the Waterways Committee members, but do not require an expenditure of funds.

Responsible Parties:

- Waterways Committee

c. Report annually to the Board of Selectmen on the progress of implementing the Town of Marshfield Harbor, Rivers and Waterways Management Plan.

The Waterways Committee should designate a specific month every year in which to report to the Board of Selectmen. This progress reporting should occur in written format as a brief report and also via an in-person meeting with the Board. This meeting could be held at the end of the calendar year, or the end of the Town fiscal year, or another time that would be best suited to the schedule of the Board and Committee. In scheduling this meeting, the Committee should take into consideration any potential waterways funding requests, so that the Board can be well informed of the Committee's latest achievements before any additional funding is requested.

Funding: These steps require the time and effort of the Waterways Committee members, but do not require an expenditure of funds.

Responsible Parties:

- Waterways Committee
- Board of Selectmen

d. Develop an email contact list of organizations and businesses for use in informing stakeholders of Waterways Committee activities. On that list would be marina owners, tackle shop owners, the North and South Rivers Watershed Association, the Ocean Campus Center staff, boards and officials from neighboring towns, the Massachusetts Office of Coastal Zone Management, etc.

The Waterways Committee should designate one member to be the primary organizer of the email contact list, as well as an alternate member to assist in this task as needed. The Committee should collectively determine the initial list of all groups and individuals to be included and share any known email addresses. The primary organizer then can gather any missing email addresses or make contact with unfamiliar groups and individuals. In addition, when the Committee receives input from the public at their meetings, they can ask if these stakeholders would like to be included on the Committee's email list.

Funding: These steps require the time and effort of the Waterways Committee members, but do not require an expenditure of funds.

Responsible Parties:

- Waterways Committee

e. Coordinate with the Town of Scituate on activities impacting shared waterways, e.g., dredging, shellfishing, patrols, pump-outs. Schedule one meeting each year with the Scituate Waterways Commission.

The Marshfield Waterways Committee should continue to enhance the positive relationship established with the Town of Scituate through regular communication and collaboration with the Scituate Waterways Commission, as well as through support of a Memorandum of Understanding between the Board of Selectmen of the two towns regarding waterways issues. The Waterways members of each town should regularly share their meeting minutes and discuss, in advance, plans and actions regarding activities on shared waterways. The Committee should initiate the scheduling of one meeting per year with the Scituate Waterways Commission. The meeting should be scheduled appropriately during the year based on ongoing related activities and the schedules of the Waterways members.

Recently, Marshfield and Scituate applied for a $4.8 million grant through the Hurricane Sandy Coastal Resiliency Competitive Grants Program of National Fish and Wildlife Foundation for dredging in portions of the North and South Rivers. Although this particular grant application was not successful, this type of collaborative effort should be encouraged and replicated where possible.

Funding: The coordination steps require the time and effort of the Waterways Committee members, but do not require an expenditure of funds. Shared funding sources or grant applications should be discussed between the Waterways members of each town.

Responsible Parties:

- Waterways Committee
- Scituate Waterways Commission

f. Collaborate with surrounding towns – Pembroke, Norwell, Hanover, Duxbury, and Scituate – on matters related to the health and enjoyment of the Town's waters, including water quality and quantity issues.

The Town's waters are impacted by activities in surrounding towns, including the input of pollutants such as fertilizers and pesticides, as well as water withdrawl which can impact water levels in Marshfield. The North and South Rivers Watershed Association already works to address water quality and quantity issues in the North and South Rivers. The Committee should support the activities of the North and South River Watershed as appropriate, and work to identify ways to address impacts to the Green Harbor River and other waterbodies in Town.

Funding: These steps require the time and effort of the Waterways Committee members, but do not require an expenditure of funds.

Responsible Parties:

- Waterways Committee
- North and South River Watershed Association
- Neighboring Towns

6.9 Climate Change and Sea Level Rise

Climate change and sea level rise are relatively new issues which many coastal towns have only recently begun to address in earnest. Marshfield has been part of at least three studies on sea level rise (Kleinfelder , 2013, Chase, et al., 2012; MAPC, 2011). These studies give the Town insight into potential impacts to specific portions of Town, and provide the community with some suggestions for addressing the anticipated impacts associated with sea level rise (see Section 4 of this plan for more detail). The Town also recently developed the Coastal Advisory Committee (CAC), which will advise the Town on sea level rise adaptation strategies. The information provided in the reports, along with the efforts of the CAC, will help the Town move forward on climate change and sea level rise planning, however additional work is needed to better understand and address local climate change and sea level rise issues.

As mentioned in the background section, sea level rise is projected to occur in Marshfield. The expected ranges of sea level rise vary depending on the models used to develop the projections (e.g., the consideration or non-consideration of ice melt, the date and mean sea levels used in models, etc.), but each shows a considerable (approximately 1 foot or greater) rise in sea level by the middle of this century. Additional and more frequent inundation can be expected from storm surge associated with coastal storms (see background section for more information about local detailed projections), and increased erosion, flooding, and damage to coastal areas can be expected from increasing wave height.

The potential economic and environmental impacts associated with sea level rise are significant, and will likely include the loss or migration of coastal natural resources such as wetlands and beaches; changes in species composition due to habitat loss or modification; changes in the extent of flood zones; saltwater intrusion into groundwater resources and estuaries; increased expenses to repair/upgrade infrastructure that experiences or is at risk of experiencing damage due to flooding; potential loss of revenue generated by recreational uses of the waterways (e.g., fishing and shellfishing, boating, and beach-going); and potential impacts to the commercial fishery due to loss of infrastructure.

Research also shows that as the climate changes, species distribution will be impacted. While studies specific to Marshfield are not yet available, the Town can expect the possible introduction of non-native species –

which may out-compete native species. Additionally, if commercially harvested species migrate with the changing climate, commercial fishermen may be impacted by having to increase the distance they must travel to catch the fish, resulting in increased travel costs; and/or fishermen may have to focus on new target species, which may result in increased costs of new gear and permits, and the need to develop new markets.

Given the wide range of potential impacts related to climate change and sea level rise, many different entities will be involved in research and planning activities at the Town (e.g., Board of Health, Planning Department, Conservation Commission), regional (e.g., neighboring towns, the Metropolitan Area Planning Council, Massachusetts Bays Program region), state (e.g., Massachusetts Office of Coastal Zone Management, Massachusetts Division of Marine Fisheries), and federal (e.g., Federal Emergency Management Agency, National Oceanic and Atmospheric Administration) levels. Efforts to be aware of the various planning and research activities will allow the Waterways Committee to contribute to projects as appropriate, and to apply the findings/conclusions to its future activities.

Issues

1. There is increasing concern among coastal communities about the impacts from climate change and sea level rise, including changes in storm intensity and frequency. Nearshore areas of Town may be vulnerable to flooding because of their low elevation and or/sea walls in poor condition. The potential risk to life, property, and natural resources need to be better understood.

Recommendations

Goal 1: Prepare for changes in climate and sea level.

Objective I – Increase understanding of the impacts of local changes in sea level and climate.

a. Work with the Coastal Advisory Committee, Town Planner, the Conservation Agent, the Massachusetts Division of Marine Fisheries, the Massachusetts Office of Coastal Zone Management, and others to explore climate change and sea level rise impacts in the Town and the region. Topics might include species migration and impacts on fisheries; increased storm inundation impacts on land value and public safety; land acquisition strategies to protect against sea level rise and storm inundation (e.g., allowing for upland migration of marshes); and strategies being explored in other locales to deal with impacts.

The Waterways Committee has the opportunity to help guide the Town's investigation into the potential impacts of changes to climate and sea level by identifying issues of particular concern (e.g., impacts to working waterfront infrastructure and species migration that may impact the commercial fishing fleet), and bringing them to the attention of the CAC, the Town Planner, the Conservation Agent, MA DMF, and MA CZM. Working with these entities already engaged in understanding and addressing impacts from climate change and sea level rise, the Committee can proactively explore and address issues pertaining to climate change and sea level rise.

Funding: Collaborating with the various entities engaged in climate change and sea level rise work should not cost additional funds. The Waterways Committee may assist with securing grants to study sea level rise and climate change impacts. Potential sources of funding will vary depending on the topics that arise. Some examples of types of funding/potential sources of funding include:

- MA CZM: Coastal Community Resilience Grant Program – "This new grant program provides financial and technical resources to advance new and innovative local efforts to increase awareness of climate impacts, identify vulnerabilities, and implement measures to increase community resilience (i.e., the ability to endure impacts associated with coastal storms and the effects of erosion, flooding, and sea level rise and to respond, recover, and adapt to

consequences)." Seehttp://www.mass.gov/eea/agencies/czm/program-areas/stormsmart-coasts/grants/.

- Massachusetts Environmental Trust General Funding Opportunity—The once-a-year funding opportunity provides "funding to support programs, research, and other activities that promote the responsible stewardship of the Commonwealth's water resources." They specifically mention climate change as a concern within the scope of their funding. See: http://www.mass.gov/eea/grants-and-tech-assistance/grants-and-loans/mass-enviro-trust/met-grants.html
- NOAA Climate Program Office – This office offers funding opportunities each year to address its research priorities pertaining to climate change. A list of 2013 funding opportunities can be viewed at: http://cpo.noaa.gov/GrantsandProjects.aspx.

Responsible parties:

- Waterways Committee
- Coastal Advisory Committee
- Conservation Agent
- Marshfield Harbormaster
- Marshfield Board of Health
- Marshfield Planning Department
- Metropolitan Area Planning Council
- Massachusetts Division of Marine Fisheries
- Massachusetts Office of Coastal Zone Management

Objective II – Protect existing and future waterfront infrastructure against sea level rise.

a. Work with other Town entities to make sure that Waterways Committee's interests are coordinated and represented in any appropriate climate change and sea level rise initiatives.

Climate change and sea level rise will have a variety of impacts in Marshfield, requiring the cooperation and coordination of efforts among various Town entities. The Waterways Committee should identify those issues most closely linked to their mission, and work with the appropriate Town entities (e.g., hold joint meetings, communicate priorities via phone/email, provide guidance/feedback on proposals and project ideas, etc.) to ensure that their issues and concerns are considered as the Town moves forward with any relevant projects.

Funding: Coordination with other Town entities should not cost additional funds. The Waterways Committee may wish to seek funding to advance some of its priority interests. Some potential funding sources include:

- Mass Bays Program Research and Planning Grants – This annual funding opportunity provides funding for the planning phases of restoration projects that advance the goals of the Mass Bays Program – which include addressing climate change. See: http://www.mass.gov/eea/agencies/mass-bays-program/grants/.
- The Massachusetts Emergency Management Agency (MEMA)/Department of Conservation and Recreation (DCR)/Federal Emergency Management Agency (FEMA) 2014 Pre-Disaster Mitigation

(PDM) and Flood Mitigation Assistance (FMA) Program – Provides funding for projects including "storm-water, drainage and culvert improvements, property acquisition, slope stabilization, infrastructure protection, seismic and wind retrofits, structure elevations, hazard mitigation planning, etc." See: http://www.mass.gov/eopss/agencies/mema/hazard-mitigation/grants/.

- MA CZM Coastal Community Resilience Grant Program – "This new grant program provides financial and technical resources to advance new and innovative local efforts to increase awareness of climate impacts, identify vulnerabilities, and implement measures to increase community resilience (i.e., the ability to endure impacts associated with coastal storms and the effects of erosion, flooding, and sea level rise and to respond, recover, and adapt to consequences)." See: http://www.mass.gov/eea/agencies/czm/program-areas/stormsmart-coasts/grants/.
- Massachusetts Environmental Trust General Funding Opportunity —The once-a-year funding opportunity provides "funding to support programs, research, and other activities that promote the responsible stewardship of the Commonwealth's water resources." The specifically mention climate change as a concern within the scope of their funding. See: http://www.mass.gov/eea/grants-and-tech-assistance/grants-and-loans/mass-enviro-trust/met-grants.html.
- NOAA Climate Program Office – This office offers funding opportunities each year to address its research priorities pertaining to climate change. A list of 2013 funding opportunities can be viewed at: http://cpo.noaa.gov/GrantsandProjects.aspx.

Responsible parties:

- Waterways Committee
- Coastal Advisory Committee
- Conservation Agent
- Marshfield Harbormaster
- Marshfield Planning Department
- Marshfield Board of Health

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Appendix A: Summary of Green Harbor Dredging Reports

The following is a review of Green Harbor Dredging reports along with a chronology of major events in channel shoaling, as detailed in the 1980 and 1988 studies

Summary of Green Harbor Dredging Reports

The following summaries are based on the material as it is presented in each report. The engineering studies, claims, and explanations have not been evaluated on their merit.

Green Harbor Project Design

- Depth of harbor entrance channel – 8 ft mean low water
- Depth of channel between the jetties and in the harbor – 6 ft mean low water
- Channel shoaling has continued to the extent that the effects of dredging have been generally short-lived
- Principal shoals are a bar at the outer ends of the jetties and a mound at the throat of the entrance channel

1980 Report

Title: Coastal Zone Management Feasibility Studies Related to Channel Shoaling, Town Pier Facilities and Town Pier Access

Date: June 1980

Authors: Tippetts-Abbett-McCarthy-Stratton Consulting Engineers

Overview

In 1980 a study was conducted by Tippetts-Abbett-McCarthy-Stratton Consulting Engineers for the Town of Marshfield Planning Board. The study, "Coastal Zone Management Feasibility Studies Related to Channel Shoaling, Town Pier Facilities and Town Pier Access", addresses the shoaling problem in Green Harbor as well as other marine access issues for commercial and recreational users. This summary will focus only on the report's discussion of the shoaling problem.

To study the navigation and access problems at Green Harbor, the Town of Marshfield applied for funding under the state Coastal Zone Management (CZM) program in 1978 and was approved in 1979. This report and the associated studies were made possible by this CZM grant. The purpose of the grant centered on a series of feasibility studies regarding: (1) Correction of the shoaling problem; (2) Improved facilities for commercial fishermen at the Town Pier; and (3) Improved access to the pier. The scope of work included the following: review of previous studies and reports; identification of prevalent existing conditions, problems, and issues; development and evaluation of potential alternative solutions; recommendations for improvements; preparation of conceptual design plans; and implementation plan for each component of the study.

The report notes that Green Harbor has a long history of sedimentation problems which are well-documented through data and descriptions. The Green Harbor River has been acting as a sediment trap over the past centuries and has been significantly affected by human activity in the area. The orientation of the jetties, as originally built in 1899, was not sufficient to keep the harbor and entrance channel free of sediment through tidal action. At the time of the report, the inlet received approximately 25,000 cy/yr of sediment from offshore sources. The report notes that these shoaling problems are particularly significant given that the area is characterized by extensive fishing and boating activities at both a commercial and recreational level.

The historical data indicates two sedimentation problems for Green Harbor River: (1) shallow anchorage, caused by storms washing sand across beach bars and ocean-carried suspended sediment. This sedimentation has been reduced as the anchorage basin side slopes have stabilized after years of maintenance dredging; and (2) shallow ocean and bay shoals in the entrance channel, caused by the combination of wave/tidal action transporting sand onto the ocean and bay shoals. This is the major sedimentation problem for the Green Harbor River.

Alternatives

The study evaluates the use of a training structure or sluice gates as two alternatives to the shoaling problem.

Alternative #1: Build a training structure that is parallel to the west jetty and equal to it in length

Description and Purpose

A typical tidal inlet will be flanked by two parallel jetties of equal length. The existing Green Harbor jetties are not parallel and are different lengths. The study considered three combinations of structures and materials and ultimately selected a stone jetty due to significantly lower cost than other options.

The proposed training structure would be located on the east side of the entrance channel inside the existing east jetty. The structure would be parallel to the west jetty and would extend from the Narrows to the end of the west jetty. The height of the structure would vary, such that the inner section closest to the harbor would be submerged at high tide. The outer portion of the structure would taper up from mean low water to equal the height of the existing east jetty and extend past the end of the east jetty until the training structure and the west jetty were the same length. The structure would be exposed at mean low water, but would be largely submerged at mean high water.

The purpose of the training structure would be to force the ebb tidal flow into a channel, and thereby increase the velocity of the ebb flow to create more effective flushing of sediment out of the inlet. With part of the structure submerged at mean high water, the ebb tidal currents would have a higher velocity than the flood currents, which would result in greater flushing of sediment out of the inlet and into Massachusetts Bay. The outer 100 feet of the training structure would be equal in height to the existing west jetty, which would provide necessary wave protection to the entrance channel.

With this proposed structure, the maximum ebb velocity would be increased by channeling the ebb tidal flow between the structures. In addition, the maximum flood flow would be decreased due to the flooding of the inter-jetty region once the training structure was submerged. Additional studies are needed to evaluate the feasibility of widening the inlet from 100 feet to 150 feet. A wider inlet might have the necessary tidal currents to scour sand; however, it also will create additional exposure to wave activity.

Evaluation

The study concludes that the structure is feasible and estimates a total cost of $790,000 in 1980. It is anticipated that the structure should produce current velocities capable of maintaining the inlet without maintenance dredging. At the time of the report maintenance dredging cost approximately $100,000/year. If the training structure effectively eliminated dredging, it would pay for itself in 7-8 years at that time. The study describes additional field studies, including hydraulic measurements at spring and neap tides, as well as office studies, including interpretation of field data and modeling, that are required to define adequately the tidal hydraulics of Green Harbor.

Alternative #2: Build sluice gates in the dyke

Description & Purpose

These gates would be used to store an additional volume of water north of the dyke. The gates then would be opened selectively in conjunction with an ebb tidal flow to provide extra flushing action to scour the inlet and carry sediment out into the ocean.

The study notes that more investigation is needed on several issues. First, storage of water in the marsh would cause flooding of buildings below mean sea level on the marsh. Any increase of water for storage would cause flooding above the dyke and above the basin north of the dyke, from approximately Seminole Avenue to the north end of Surf Avenue. Second, the marshland would provide additional volume of suspended sediments that would cause additional silting of the anchorage to an unknown extent. Use of the marshland would increase the volume of water flowing and velocities which in turn would cause scour of sediment. Third, construction of the sluice gates would be expensive, and also would require a gate operator and operating rules. Fourth, there could be unknown environmental effects from releasing a large volume of fresh water into the anchorage or adding a large volume of salt water to the marsh. Finally, the additional volume of water available for scour will not be channelized after it passes the Narrows and as a result, the channel would meander.

Evaluation

The study concludes that the feasibility of the sluice gates could not be determined at that time. It was anticipated that the project would require the removal of several hundred buildings or the construction of a dyke around the river and marsh storage area. The dyke would require a gravity storm drainage system for all low-lying residential areas to a central sump to be pumped up to a storage basin. In addition, it would be necessary to make provisions for storm overwash from the ocean.

Implementation Plan

Future action regarding improvements and construction on the Green Harbor jetties would proceed either through local implementation or through implementation by the federal government via the Army Corps of Engineers.

Under local implementation, the Town itself would supervise the improvement work. Green Harbor, however, is already an authorized federal project. As a result of this designation, any local improvement proposals must be approved by the Army Corps. The Corps would have to issue a permit for the work and the plan would be scrutinized closely. If at any time after the implementation the Corps decided that the project was in any way detrimental to navigation, they could require complete removal of the improvement at the Town's expense.

Under implementation by the federal government via Army Corps of Engineers, the Town could either (1) continue the current program of operation and maintenance, or (2) request that a study of navigation improvements be conducted by the Corps. At the time of the 1980 study, the Corps was evaluated Green Harbor to optimize operational efficiency. In August 1979 the Corps completed a Reconnaissance Report, done under authority of legislation (PL 91-611 §216) that review various federal projects to establish the following: the level of continued operation and maintenance funding justified for budget purposes; how well a project is serving its authorized purpose; what other purposes are being or could be served; the need (if any) for an in-depth study to establish recommendations to Congress for project modification.

For Green Harbor, the report recommended continuation of operation and maintenance (O&M) at least at the current level. The report also recommended that an in-depth study be performed to determine if project modification is justified for the reduction of O&M costs and the loss of benefits during periods between scheduled maintenance. As of the 1980 date of this study, no formal response had been received from the Office of the Chief of Engineers, but it was expected the report would be approved.

If the Town requested a study of navigation improvements be conducted by the Corps, that study could be financed either by operation and maintenance (O&M) funds, or as a navigation study under Section 107 of the

Rivers and Harbors Act. Under O&M funding, the government bears the full cost of the study. The difficulty with this approach is that Green Harbor would be competing with all other authorized projects for a portion of the overall O&M budget for a given year. This approach could not guarantee that improvement would happen at a specific time.

In the alternative, the improvements may qualify for study under the continuing authority of Section 107 of the Rivers and Harbors Act. Construction costs are estimated to be under $2 million (in 1980 dollars). This approach allows a fairly rapid study process and evaluation. Local interests would have to contribute 50 percent of all costs attributed to recreational boating benefits. The exact percentage of these benefits is estimated by the Corps after they finish their report. The higher the percentage attributed to the commercial sector, the less the Town would have to pay. The Corps last estimate said benefits to Green Harbor were 80 percent recreational. To begin this process, the Town must write a letter to the Corps. The study recommended that the Town pursue the Section 107 study.

1988 Study

In 1988 a study was completed by Coastal Hydraulics Research Center for the Army Corps of Engineers. The study, "Inlet Hydraulics at Green Harbor, Marshfield, Massachusetts", focuses solely on the shoaling problems in Green Harbor.

Title: Inlet Hydraulics at Green Harbor, Marshfield, Massachusetts

Author: Coastal Hydraulics Research Center – Lee L. Weishar, David G. Aubrey

Prepared for the Army Corps of Engineers

Date: July 1988

Overview

The primary objectives of this study were to (1) accurately describe how the existing project at Green Harbor behaves in a physical sense; and (2) develop economically viable and environmentally sensitive alternatives that would produce a more stable entrance channel for the harbor. The study was comprised of the following three areas of investigation: review of historic data; year-long collection of directional wave data to determine the predominant wave climate of the harbor and quantify sand movement offshore and within the project; and development of a computer-based tidal inlet hydraulic model to simulate existing flow patterns and to predict how those patterns would be altered by potential structural changes.

Findings: Wave Studies

Virtually all the waves generated enter the harbor inlet from an angle of about 260 degrees from true north (due in part to refraction of waves approached from different directions). The highest, most powerful waves are concentrated in the later winter and early spring.

Limited quantities of sand are available to be moved into the harbor. There is very little sand-sized material offshore from the harbor mouth to the north. A band of shallow sand deposits underlain by glacial till extends south from the mouth of the harbor along Green Harbor Beach, the width averages 2100 feet although it is narrowest near the harbor entrance. A narrow strip of glacial till interspersed with streamers of sand lies seaward of the shallow sand band; beyond this area the bottom is glacial till not worked by the ocean. There are highly irregular contours with apparent rock outcrops north of the harbor and regular contours to the south.

The following longshore sediment transport occurs: (1) To the north: 8,500 cu yd/year; (2) To the south: 26,150 cu yd/year; and (3) Net transport: 17, 650 cu yd/year (to the south).

Green Harbor has a very small tidal prism, i.e., the volume of water available in the harbor to flush out accumulated sediment is limited, and entrance channel currents are slow. As a result, currents in the entrance channel are able to move sediment in or out of the entrance channel only during a short period of time each tidal cycle. These conditions result in minimal tidal flushing of material either into or out of the harbor entrance. Any sand, silt, or cobbles which get into the project are unlikely to be moved out by the flushing action of tidal currents.

Findings: Wave-Refraction-Diffraction Analysis

Most waves approach the channel entrance from various angles and are refracted in such a way that sediment transport is directed toward the inlet from both the northwest and the southwest sides. Waves either directly enter the entrance channel or are reflected off the inside of the west jetty. In addition, northeast storms generate large waves that spill over the northeast jetty.

Conclusions of the Wave Studies

There is an extremely limited source of sand-sized material directly offshore and to the north of Green Harbor. Of the average 8,500 cu yd of sediment transported annually from the south toward the inlet, 90% is being transported around the west jetty. The amount will increase as the shoal expands (due to wave refraction at Green Harbor beach).

Approximately 8,000 cu yd of material are transported directly into the inlet from offshore. The mechanism is the refraction of waves at the entrance mouth. Long-period waves approaching the harbor entrance from the north are refracted by the offshore bathymetry until they can either directly enter the entrance channel or are reflected off the west jetty.

Sources of material resulting from wave reflection off the west jetty is a combination of sand being transported toward the Narrows by reflected mach stem waves and erosion of the inner beach region landward of the east jetty.

Windblown and wave overtopping sources of sand are difficult to quantify. Windblown sand definitely occurs, but is believed to be relatively small. Wave overtopping occurs on the east jetty during large northeast storms and waves break directly on the inner beach region. This wave overtopping both transports new sediment from the seaward side of the jetty and erodes material from the inner beach directly into the channel. While this only happens during the largest storms, it has the potential to transport significant quantities of material in a relatively short period of time.

Summary

- Sediment transport within Green Harbor is a wave-dominated process.
- Wave energy is transmitted into the inner jetty region by direct propagation, wave reflection, and wave refraction. This combination of wave forces is the primary process responsible for shoaling at GH
- Wave energy is also transmitted into the inter-jetty region during storm conditions by overtopping of the east jetty
- Wave reflection and refraction lead to sediment transport around the west jetty and redistribution of sediment within the inner jetty region
- Tidal currents combine with wave processes to redistribute sediment within the inter-jetty region.
- No evidence of sediment being transported through the Narrows and forming a flood-tidal shoal

- Peak tidal flows are of sufficient strength to initiate sediment motion and to transport sediment; however, these velocities are maintained only during a small portion of the tidal cycle. Reduced tidal flows are due primarily to the limited storage area in the back-bay region.
- Lengthening of the west jetty increased wave reflection and wave diffraction in this region
- At the same time, regional refraction has been increasing the fillet on the west side of the jetty
- Sand has been continually transported into the lee of the west jetty by refracted waves and been trapped there
- Offshore sediment transport at Green Harbor is geomorphically controlled
- North of the harbor entrance there is little if any sand available for transport
- South of the harbor entrance there is and in the offshore and nearshore regions, but the majority of this sediment is not transported due to the fetch-limited conditions which occur within Massachusetts Bay

Recommendations

The report indicates that it is clear the basic shoaling problem remains and will continue. With a limited tidal prism, the natural tendency will be toward an entrance channel with a small cross-sectional area. As long as sources of shoal material are available, nature will work in that direction and bring sediment into the harbor and channel. The objective of efforts described in this report is to extend the period of time between dredging operations by reducing the rate of shoaling.

The conclusion makes the following recommendations for decreasing the dredge return frequency at Green Harbor.

- Reduce the west jetty lee side fillet which is partially responsible for building the entrance shoal
- Raise and sand tighten the east jetty to minimize wave overtopping during storms
- Eliminate or reduce the length differential between the east and west jetties. This will accomplish the following:
    - Eliminate or minimize mach stem reflected waves which build the entrance shoal
    - Reduce erosion on the east side of the Narrows, thus reducing the quantities of sediment available to the shoal at the Narrows
    - Reduce overall reflected wave energy during storms, thus providing safer boating conditions
- Riprap the east Narrows in the inter-jetty region to reduce erosion and sediment transport in the inter-jetty region
- Implement a beach grass planting program for the dune region adjacent to Green harbor Beach to minimize sand transport into the inter-jetty region by aeolian processes

Numerical Hydraulic Simulation

The hydraulics of Green Harbor were simulated using a numerical model to provide a cost-effective method to evaluate suggested design alternatives. The model uses tidal current data and is first calibrated to accurately simulate existing conditions, then boundary conditions are modified to reflect different alternatives

Training Structure Evaluation

The 1980 study proposed a training structure located on the east side of the entrance channel inside the existing east jetty, parallel to the west jetty, and extending from the Narrow to the end of the west jetty.

The structure would be exposed at mean low water, but would be largely submerged at mean high water. The outer portion of the structure would taper up from mean low water to equal the height of the existing east jetty and extend past the end of the east jetty until the training structure and the west jetty were the same length.

The 1980 study concluded that the maximum ebb velocity would be increased by the training of the ebb tidal flower between the structures. At the same time, the maximum flood flow would be decreased by permitting the total inter-jetty region to become flooded once the training structure was submerged

Numerical hydraulic simulation results:

- Max depth-averaged flood velocity was increased from 1.03 to 1.27 ft/sec
- Max depth-averaged ebb velocity was increased from -0.99 to 1.24 ft/sec
- This represents an increase in velocity of approximately 17%

The 1988 study concludes that the increase in channel flushing is not sufficient to justify the construction of a structure that would be submerged at high tide and exposed at low tide. A half-tide training structure between the Narrows and the seaward end of the east jetty would not increase channel current velocity enough to materially improve the flushing capacity of the inlet.

Cut River Jetty Evaluation

One proposed solution was the rebuilding of an inlet pile jetty at the Cut River mouth as a means of reducing shoaling in the entrance channel. At the time of the report, only the piles of the old jetty remain. Simulated results show the following:

- increased velocity for northeaster conditions
- no increased flushing because of the half training wall
- This structure had little effect on the overall system during the maximum conditions

The 1988 study concludes that the jetty does not provide increased flushing during northeasters and does not have any positive effect during storm conditions. Rebuilding a pile jetty at the mouth of the Cut River would have a negligible effect on entrance channel shoaling because it would have little impact on current velocity.

Average Yearly Dredged Quantities:

- Outer shoals – 9,300 cu yd/year
- The Narrows – 10,800 cu yd/year
- The magnitude of this shoaling is large enough to cause an annual problem for boating traffic

Channel Shoaling

Chronology of major events, as found in the 1980 and 1988 studies:

1633-1872: Harbor entrance channel was shallow, and had a meandering and unstable form that migrated up and down the coast.

1633: A channel, now called the Cut River, was constructed to connect the Green Harbor River to Duxbury Bay. This is the first recorded man-made modification to the inlet back-bay system.

1806: Inlet was sealed by a storm.

1807: State House of Representatives grants a petition to construct a canal where the inlet had been located in order to drain stagnant water from the marsh.

1811: Storm breached the beach that had formed since 1806.

1872: Dyke was constructed at the present location (Route 139/Dyke Road) to reclaim wetlands for farming. After this construction, the entrance to Green Harbor became more shallow and winding, creating an increased hindrance to navigation. In particular, the width of the inlet at the Narrows was reduced by approximately one-half. The area behind the dyke settled approximately 3.5 feet because it was no longer subject to the tides. The harbor entrance channel continued to be shallow with a meandering form.

1879: Increased farming productivity of the wetlands is noted. The dyke was widened to create a road connecting Green Harbor and Brant Rock.

1897: A Joint Board of Harbor and Land Commissioners was established. The Board was charged with evaluating the condition of the harbor and deciding what action, if any, should be taken regarding possible removal of the dyke. The Board found that construction of the dyke had worsened navigation conditions in Green Harbor. Despite these bad conditions, however, the Board found that the beneficial value of the farmland gained because of the dyke construction outweighed the detriment to navigation. The Board recommended the dyke not be removed, and instead advised that the State should build two jetties at the entrance to Green Harbor to increase tidal flow through the channel and to periodically dredge the channel.

1899: The State constructed east and west stone jetties out to the 6-foot contour at mean low water to straighten and deepen the entrance channel. The channel and anchorage basin were dredged; however, the old channel form eventually reappeared. Around this time a timber pile structure was constructed near the mouth of the Cut River to prevent sand flow from Duxbury Beach.

1899-1968: Massachusetts maintained the jetties and performed periodic maintenance dredging of the entrance channel and anchorage basin. The harbor entrance channel remained shallow with a meandering form.

Mid-to-late 1950s: Town meetings gave approval to rebuild the Town Pier, to construct and extend the bulkheads, and to prepare a Master Plan for the Green Harbor Tidal Basin.

1958: A five member Green Harbor Basin Committee was formed to work with the Planning Board to investigate potential development of the basin.

1959: Engineering report, prepared by Fay, Spofford & Thorndike, Inc., addressed the long-standing shoaling problem in the harbor and inlet channel.

1962: Engineering report, prepared by Fay, Spofford & Thorndike, Inc., addressed development opportunities in Green Harbor.

1968: Green Harbor is designated as a Federal navigation project. The Army Corps of Engineers modified the jetties originally built by the State. The Army Corps sealed and lengthened the west jetty by 200 feet on the seaward end, and raised the east jetty to 14 feet above mean low water. The Army Corps also dredged the entrance channel, anchorages, and turning basin.

Mid-1970s: Planning Board hired Metcalf & Eddy, Inc. to conduct a feasibility study and to prepare a conceptual master plan and implementation program for Green Harbor basin and adjacent areas

1976: Metcalf & Eddy complete the report. Recommendations include improved access and pier facilities and a study of the shoaling problem.

1980: Sewage treatment plant began operation on a portion of the soil site. An access road to the plant was constructed across the marsh from Route 139 (Dyke Road)

As noted in the dredging studies conducted in the 1980s, since navigation project was implemented in the 1960s, the Army Corps has made several alterations to the project in an attempt to control the shoaling problem. Nevertheless, the Corps has needed to dredge the harbor and entrance channel every few years. Dredge spoil material is deposited on an area of salt marsh north of the Town Pier.

Appendix B: Financial Tools

The following financial tools have been compiled to provide the implementation team with information about the various financial tools available to fund waterways activities.

Enterprise Funds

History

The enterprise fund statute (Mass. Gen. Laws ch. 44,§ 53F½) was enacted in 1986. Communities previously had utilized special revenue funds, which were authorized by general laws or special acts, to separately account for different municipal services. Use of these special revenue funds was limited to select services and costs. The funds were most often used in connection with water, gas and electric utility services. The funds were used mainly to account for annual operating costs of the service, but not indirect costs, capital improvements, or fixed assets.

Definition

Through the creation of a separate accounting and financial reporting mechanism, an enterprise fund allows a municipality to account for all financial activities associated with a particular municipal service. Revenues and expenses of a municipal service are set aside into a separate fund with financial statements independent from all other governmental activities, rather than comingled with the revenues and expenses of other governmental activities. A variety of municipal services and departments, which charge a fee in exchange for goods or services, are eligible for the creation of an enterprise fund.

Advantages and Disadvantages

A detailed financial evaluation of the municipal service is a necessary first step to determine whether an enterprise fund is a beneficial financial investment, worthwhile pursuit. Action measure

Advantages of an enterprise fund include the following:

- Identifies a total service cost - by consolidating direct operating, direct capital, and indirect costs, a municipality is able to clearly identify the total cost of a service and to determine funding sources. The total service cost may include enterprise-related costs appropriated in the General Fund operating budget, subsidies from the General Fund or other funds, or a reimbursement from the enterprise fund to other funds for subsidized costs in the two previous complete fiscal years.
- Provides useful management information- Through consolidation of revenues, expenses and operating performance of the fund, the municipality gains useful information for decisions regarding user charges and fees, as well as a any potential subsidy. As a further accounting measure, the municipality can choose to include the enterprise fixed assets and infrastructure as assets. Then the annual depreciation of these assets can be documented in audited financial statements.
- Retains investment income and surplus - All investment earnings and any operating surplus are retained in the enterprise fund rather than returned to the General Fund at end of the fiscal year. Operating surplus is defined as actual revenues in excess of estimates and appropriations in excess of expenses. Any surplus that is certified by the Director of Accounts as available is labeled “retained earnings”. These retained earnings then must be appropriated by the municipality’s legislative body and can only be used for expenditures relating to the enterprise fund, as well as other restrictions.

Disadvantages of an enterprise fund include the following:

- Financial transparency - The knowledge of total service cost for use in management decisions can be either beneficial or detrimental, depending on the perspective of a specific party. This financial transparency may raise questions of equity as well as opposition from other municipal services and citizens. The revenue and costs of a particular service may not have been explicitly known or noticed before, but with the potential creation of an enterprise fund this total cost cannot be ignored.
- Removes investment income and surplus from the General Fund - It is beneficial to the enterprise fun to retain investment income and surplus; however, the town legislative body may have significant concerns over the loss of this money from the General Fund, especially if the service generated more profit than it cost. The legislative body may not want to lose this influx of income and surplus because once in the General Fund, this money can be appropriated to any applicable town need, and is not limited to the service that generated it.
- May be more difficult to obtain appropriation or subsidy from the General Fund - Once an enterprise fund is adopted, the legislative body is able to see clearly the total service cost, including how much additional revenue the service generates as well as how much it costs the town in general appropriations or additional subsidies. If the service is notably profitable, the legislative body may choose to decrease general appropriation to the service or reduce or eliminate additional subsidies.

Governmental Entities Eligible to Adopt Enterprise Fund Accounting

Under the enterprise fund statute (Mass. Gen. Laws ch. 44,§ 53F½), only Massachusetts cities and towns are authorized to adopt an enterprise fund. Regional school, vocational-technical school and/or special purpose districts are not authorized to adopt an enterprise fund, unless permitted by special legislation.

Services Eligible for an Enterprise Fund

Enterprise funds may be established, "for a utility, health care, recreational or transportation facility." Examples of eligible services include:

- Public utilities – water, sewer, trash disposal;
- Health care – ambulance service, nursing homes;
- Recreation – skating rinks, pools, golf courses; and
- Transportation – airports, dock and wharf facilities.

A municipality may not establish an enterprise fund for normal government operations or services, e.g., public safety, inspection services, or cemeteries.

Process of Adopting an Enterprise Fund

A city or town may adopt an enterprise fund by vote of the legislative body, subject to the local charter, i.e., by vote of the city council with the approval of the mayor or by town meeting. The legislative body must vote separately on each proposed enterprise fund in order for it to be adopted. By voting separately on each fund, the legislative body is able to evaluate clearly and independently the merits of each fund.

The language of the vote for the enterprise fund should clearly define the eligible municipal service and the date when the fund will be enacted. After the fund is adopted, the municipality creates a separate fund in its accounting records and identifies the assets, i.e., capital items and infrastructure, as well as liabilities, and equity in other funds if applicable, to be transferred to the enterprise fund. The municipality is required to operate the enterprise fund for at least three years before the fund may be rescinded.

User Fees

User fees are established by the board or officer designated under the general enabling legislation or local charter. An enterprise fund is not required to fully recover its costs through user fees. An enterprise fund may be financially self-sufficient or it may budget a surplus or subsidy. If the fund must be subsidized, usually by the General Fund, the details of this financial information should be presented during the discussion and vote by the legislative body to adopt the enterprise fund.

Massachusetts Boat Registration

Boat excise tax must be paid for boats moored or located in Massachusetts on July 1. The excise is assessed for the fiscal year that begins on that date. Bills are issued by the city or town where the boat is moored or docked for the summer season, or where the boat is registered or principally located during the calendar year if it is not moored or docked for the summer.

Boats are taxed at a rate of ten dollars per one thousand dollars of value (see valuation chart below). The value of a vessel is the fair cash value as determined by the assessor of each city and town, but the value of a vessel is not to exceed the value based on the length and age of the vessel under a schedule established by the General Laws Chapter 60B §2(c). Based on this valuation method, the maximum excise tax for any vessel is $500.

VALUATION CHART

	Under 4	4 thru 6	7 or More
Length	Years of Age	Years of Age	Years of Age
Under 16'	$1,000	$700	$400
16' but less than 17.5'	$1,500	$1,000	$800
17.5' but less than 20'	$3,000	$2,000	$1,500
20' but less than 22.5'	$5,000	$3,300	$2,500
22.5' but less than 25'	$7,500	$5,000	$3,800
25' but less than 27.5'	$10,500	$7,000	$5,300
27.5' but less than 30'	$14,000	$9,300	$7,000
30' but less than 35'	$18,500	$12,300	$9,300
35' but less than 40'	$24,000	$16,000	$12,000
40' but less than 50'	$31,500	$21,000	$15,800
50' but less than 60'	$41,000	$27,300	$20,500
60' or over	$50,000	$33,000	$24,800

The tax levy in Marshfield for Boat Excise Tax in 2011 was $9,283.16 (Annual Town Report, p. 163).

The table below, populated with data from the 2012 Massachusetts Boating Registration list, provides an example of how the revenues from boat excise taxes are generated. The vessels in the table below include those listing Marshfield as the “storage town”, or principal location. This is only an illustration, as it is the assessor who determines (1) which vessels are taxable in Marshfield, and (2) the actual valuations of vessels (which may be less than the value listed in the schedule). Further, the table does not include documented vessels.

Under 4 years of age			4 to 6 years of age			7 or more years of age			Totals
Excise Valuation*	# of vessels	Excise tax $10/$1000	Excise Valuation	# of vessels	Excise tax $10/$1000	Excise Valuation	# of vessels	Excise tax $10/$1000	
$1,000	33	$330	$700	50	$350	$400	363	$1,452	**$2,132**
$1,500	4	$60	$1,000	6	$6,000	$800	169	$1,352	**$7,412**
$3,000	8	$240	$2,000	20	$400	$1,500	149	$2,235	**$2,875**
$5,000	6	$300	$3,300	18	$594	$2,500	236	$5,900	**$6,794**
$7,500	5	$375	$5,000	13	$650	$3,800	126	$4,788	**$5,813**
$10,500	0	$0	$7,000	8	$560	$5,300	100	$5,300	**$5,860**
$14,000	1	$140	$9,300	2	$186	$7,000	20	$1,400	**$1,726**
$18,500	1	$185	$12,300	1	$123	$9,300	28	$2,604	**$2,912**
$24,000	0	$0	$16,000	0	$0	$12,000	8	$960	**$960**
$31,500	0	$0	$21,000	0	$0	$15,800	9	$1,422	**$1,422**
$41,000	0	$0	$27,300	0	$0	$20,500	0	$0	**$0**
$50,000	0	$0	$33,000	0	$0	$24,800	0	$0	**$0**
		$1,630			**$8,863**			**$27,413**	**$37,906**
	58			**118**			**1,208**		**1,384**

Table 18: Estimation of excise tax on vessels in 2012 State Boat Registration List with Marshfield as storage town. Valuation of vessels used to calculate excise tax (Taken from MGL CH 60B §2).