

1. Resource Assessment of Dock/Pier Impacts in Pleasant Bay

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Abstract:

The preparation of a four-town resource management plan for Pleasant Bay, Cape Cod, Ma required a comprehensive assessment of the present number of private piers on the bay, the probability of numerous additional piers in the future, and the potential impacts from piers on the resources of the bay. The planning group developed a methodology to account for various components relative to piers and their use. The study area was segmented into twenty-six geographic subsections. Each subsection was evaluated for nine factors representing biological, physical, and human use characteristics critical to the impacts of docks and piers. The nine factors were: enclosed/open water bodies, water depth, shellfish habitat, eelgrass, fringe salt marsh, density of existing structures, moorings, navigational channels and recreational activity. After assessment of the areas, each of the nine factors was assigned a value of "0", "0.5" or "1" where 0 indicated the least significance and 1 represented the greatest significance. Results were tabulated and mapped according to resource sensitivity. The results indicated that a significant portion of the more secluded portions of the bay's shoreline is extremely resource sensitive. The environmental impacts from construction and use of docks and piers in these areas pose a direct

threat to the extensive and fragile resources and have been deemed inappropriate for new docks and piers. Less sensitive areas may be more appropriate for construction of new docks and piers based on bay-wide criteria to be formulated once the plan is implemented.

Introduction

To a shorefront property owner, one of the primary reasons for paying higher taxes for waterfront property is the immediate access to the water. A dock in front of the house represents easy access to the water, status, a higher property value for re-sale, and a property right. The structure is generally located in public waters in Massachusetts if it extends below the high water mark. To a resource manager then, a dock represents a potential conflict with resource protection, actual negative effects on the marine environment and private intrusion in public waters that is not a private property right. These conflicting representations often result in frustration to both homeowner and manager because there is generally a lack of cohesive policy toward siting of new docks. While the structures and their use are cause for concern, those concerns have not been adequately researched with respect to the cumulative impacts. As a result, in developing the Pleasant Bay Resource Management Plan (known as the Bayplan), we have taken a conservative approach toward the siting of new docks based on our own observations as well as information by other researchers.

Although generally thought of as benign structures in the intertidal and subtidal zones, docks and piers (hereinafter referred to as docks) have been shown to be potentially problematic. Concern centers on the effects of docks in shallow embayments and includes vegetation loss from shading, shellfish habitat loss, impacts to eelgrass, chemical leachates from treated wood, construction

impacts, fragmentation of beach habitats, sediment resuspension from boat propellers, boat paints, chemicals used in marine sanitation devices, and petrochemicals.

Arguments used by homeowners or their agents to gain a permit for a new dock suggest that docks can have a beneficial environmental effect. Carriker (1961) stated that a piling could cause a microhabitat, changing the overall circulation patterns such that a small gyre is created allowing for better settlement of shellfish larvae. How multiple docks in an area affect currents is not well understood. Untreated pilings are known to attract settlement of certain marine organisms. Other arguments we have heard are that a dock is better than a boat on a mooring because less total habitat may be affected. A boat at a dock is located at a fixed location while on a mooring; the mooring chain may scour the bottom as the boat swings (Walker et al. 1989; Short et al., 1993). Also, a dock crossing over a marsh is better than a path through a marsh because there is less total impact on the marsh vegetative growth.

Negative effects of the structures can include physical displacement of habitat from pilings, pipes, or other upright structural members. While not usually perceived as a great threat, by multiplying the number of pilings per dock by the number of docks, the cumulative effect can be substantial. Docks can shade submerged aquatic vegetation (SAV's) (Wetzel and Penhale, 1983, Short et al., 1993; Burdick and Short, 1995). Seasonal docks that are removed yearly can cause dead zones of anoxic sediment in some areas that is up to twice the diameter of the pilings (Macfarlane, personal observations). However, permanent docks that remain in the water during the winter can be lifted by ice requiring reinstallation of the pilings and reducing the amount of accessible shellfish habitat for harvest. Use of pressure treated wood can be toxic to marine organisms (Weis et al., 1991; Weis and Weis, 1992a; Weis and Weis, 1992b; Weis et al., 1993). Lastly,

there is an aesthetics issue regarding natural shorelines with those containing man-made structures.

Additionally, operation of the boats tied to docks can cause problems (Crawford et al., 1994). Prop dredging can mechanically remove habitat while also causing resuspension of sediment. Although turbidity is a natural phenomenon in wind-driven episodes, the turbidity caused by boats has not been well studied and is poorly understood (Hilton and Phillips, 1982, Yousef, 1974; Yousef et al. 1980). Petrochemical spills and chronic addition of petrochemicals to the water from boat operation at a fixed location is also poorly understood as is potential damage from boat paints, especially formulations of bottom paint.

Current Permitting System

As the permitting system currently works in Massachusetts, a property owner desiring a new dock must apply to three agencies for three separate permits because although a homeowner may own to the low water mark, most docks jut out into deeper water that is public waters. First, the homeowner needs an Order of Conditions as a permit from the local Conservation Commission, the Selectmen-appointed body of volunteers responsible for administering the state Wetlands Protection Act and local wetlands bylaw (if applicable). Second, the person must obtain a Chapter 91 (Waterways) license from the Massachusetts Department of Environmental Protection Waterways Program. In Massachusetts, the public has additional rights of fishing, fowling and navigation in the intertidal zone. These latter rights are part of the public trust doctrine and were established in the Colonial Ordinance of 1640. Third, the person must obtain a permit from the Army Corps of Engineers in accordance with Section 404 of the Clean Water Act.

In accordance with Massachusetts' amended waterways regulations (Chapter 91), in any area designated by the State as an Area of Critical Environmental Concern (ACEC), no new dock could be permitted until and unless the town completed a state-approved resource management plan. Pleasant Bay was designated as an ACEC in 1987. As a result, there has been a moratorium on the issuance of new dock permits since 1991. At the time the moratorium went into effect, there were 165 docks in the Pleasant Bay estuary, the majority of which were located in the more protected areas of the bay.

The performance standard in the existing regulations for allowing docks in an ACEC is "no adverse effect". Prior to the moratorium, property owners applying for a dock would provide mitigating measures to counteract the potential problems outlined above. Shading can be overcome by raising the structure a sufficient height to allow for sunlight to the grass, adding "holes" in the walkway for sunlight penetration through greater plank spacing, or use of plastic or metal grates. Permanent structures can be maintained by use of bubbler systems during the winter months of ice. Shellfish can be seeded around the dock. Pressure treated wood can be replaced by plastic "wood" or cedar or locust or other non-leaching materials. For many conservation commissions, these measures, presented as mitigation by homeowner representatives (engineers, consultants and lawyers), were enough to maintain the standard of no adverse impact. In addition, once one person received a permit, it was difficult to identify an adjacent property as too fragile to permit a dock and the neighbor generally received a permit as well. Moreover, each application was judged on its own merits and although cumulative effects were an interest protected by the state Wetlands Protection Act, cumulative effects were difficult to prove in potential court appeals.

Some states (Massachusetts and New Jersey) approached the problem of docks through development of a generic Environmental Impact Statement (Crawford, et al., 1998). Since an EIS

was not a reality in Massachusetts, the Pleasant Bay Technical Advisory Committee (TAC) developed a methodology to look at the proliferation of private docks in a different manner. The Bay Plan was based not on individual lot by lot decisions or a generic basis but rather by a method for estimating cumulative impacts and to determine where docks could be built that would not have an adverse impact on the system as a whole.

Study Area:

Pleasant Bay is located at the outer part of the elbow of Cape Cod within the towns of Chatham, Harwich, Brewster and Orleans (fig. 1). It was designated as an ACEC in 1987. The area has over 9000 acres within the boundary. Chatham Harbor, though not within the actual boundary of the ACEC is a major part of the estuary since the inlet for the bay is in the harbor. The primary reason for the harbor's exclusion from designation as an ACEC was that Chatham is home to the region's offshore fishing fleet and in order to maintain that industry, dredging is sometimes required, an activity prohibited by the designation. The harbor was included for the purposes of developing the management plan, however. Brewster owns a mere 40 feet of shoreline but it contains the largest portion of the watershed of the bay.

It is a shallow embayment where over 50% of the bay is less than 2 m deep at Mean Low Water (MLW). It has a migrating barrier beach on its eastern flank that protects the bay from the Atlantic Ocean. The shallow portions of the Little Bay have healthy eelgrass (Zostera marina) meadows and sometimes produce bay scallops (Argopecten irradians irradians). Habitat can support clams (Mya arenaria) and quahaugs (Mercenaria mercenaria). Mussels (Mytilus edulis) are frequently found near Chatham Harbor. Oysters (Crassostrea virginica) have not been a native species for at least the last 50 years although they have been found sporadically as a direct result of a leased area in the bay. The bay is ringed with fringe salt marsh, primarily salt marsh

cordgrass (Spartina alterniflora). There are numerous pockets of larger salt marshes indenting the shoreline. Coastal banks are the dominant land interface features.

Pleasant Bay Resource Management Plan:

Although the state imposed a moratorium on the construction of any new docks in Pleasant Bay, the towns were slow to get together to develop a plan. They had made several attempts but finally, in 1995, the four towns entered into an intermunicipal Memorandum of Agreement to develop a joint resource management plan to protect the extensive resources of Pleasant Bay. The plan was approved in Harwich in May, 1998, by Orleans and Chatham in November, 1998 and rejected by Brewster in May, 1998. However, even with Brewster's action, it can still be implemented since much of the recommendation sections centered on use of the water itself and the directly adjacent waterfront. One of the primary reasons for the towns to get together was the dock issue. Each town had received numerous requests for docks since the moratorium had been put into effect. Orleans alone received at least twenty requests per year (Macfarlane, personal observation), most emanating from new property owners. As the economy improved during the 1990's, it became widespread knowledge from realtors that a dock added anywhere from \$50-100,000 to the value of a home on Pleasant Bay.

From 1995-1998, the towns worked together to develop the plan. It was the first such instance of cooperation for this large of an endeavor in the history of the towns. The Selectmen appointed a steering committee in each town where one representative was appointed. A technical advisory committee, comprising of shellfish constables, conservation administrators, harbormasters, water quality specialists and town planners from each town. A consultant was hired as a coordinator. State, county and National Park Service (from the Cape Cod National Seashore) personnel served on the Technical Advisory Committee as well.

The planning process revolved around five issues: structures (docks and coastal engineered erosion control structures), shellfish/aquaculture, boating, biodiversity and public access. The Steering Committee sponsored workshops on each issue at which several hundred people participated during the winter of 1997 to define problems and make recommendations for the plan.

The Structures Workgroup reviewed the current statutes, bylaws and regulations of dock applications and permitting. Given the history of permits approved prior to the moratorium, the sub-group of the TAC working on the structures issue was frustrated by the lot by lot approach and the lack of a generic EIS and felt there had to be another way to approach the subject.

The Methodology

The TAC compiled data to create maps on a GIS system through assistance of the Cape Cod Commission, a county planning and regulatory agency. Base maps were created for land use, location of shellfish resources by species, marshes and eelgrass, existing docks and mooring fields, town landings, navigational channels, scenic view points, access points, etc all of which were added to the database. From the base maps, overlays were made to determine conflicts. In Pleasant Bay, shellfish is often located in a thin ribbon of land between the edge of the fringe marsh and about 250 feet offshore, in both intertidal and subtidal lands. It is also the location of most of the docks.

When the map of the docks was overlain onto the map of shellfish, the upper part of the River complex in Orleans (Meetinghouse Pond to Namequoit Point) and the protected areas of Crow's Pond and Ryder's Cove in Chatham were highly impacted. When moorings were added, it was

obvious that boating activity heavily impacted these upper areas. The question was, would they remain productive for shellfish if there was a dock every 150-ft, the average lot frontage?

Our approach was to look at the bay as a system. We knew through our collective experience that constructing a dock in a salt pond at the far end of the estuary was far different in terms of impacts than constructing a dock on the open shoreline along either Little Bay or Big Bay. From that one statement, we realized the need for a method to distinguish the differences between these two areas and developed a sensitivity index. The process was divided into ten steps, discussed below.

Step 1: We divided the bay into 26 segments or subsections that were different from one another in one or more ways. These sub sections included pond, river, and open bay shorelines (fig. 2).

Step 2: We described the attributes of each subsection with respect to biological, physical and human use factors (fig. 3). Did the area support shellfish? Was there eelgrass and/or fringe marsh? What was the depth of water at 200' from the edge of the marsh or MLW, whichever applied? Was the area open water, a river or semi-enclosed? What was the ratio of docks to parcels without docks? Was there a navigational channel within 500' of shore?

We chose these questions because in total, they would give us a sense of the area and what the potential impacts of a dock would probably be. Because aesthetics is a difficult subjective concept to quantify, we asked ourselves what was it about a dock that produces a reaction when looking at them? The answer to us was that docks make a natural shoreline look man-made. The greater the number of docks within a visual path, and the higher the docks were, the less aesthetically pleasing the scene was. We judged natural shorelines to be highly aesthetic and man-made structures to be less aesthetic. Therefore, we were able to get at the aesthetics by quantifying the ratio of parcels with docks against those parcels without them.

Step 3: We established nine criteria as follows where each criteria could have descriptions such as high, med. or low; shallow, med., deep; lots, some, none; yes, some, no. We developed a matrix using our criteria for each of the 26 areas (fig. 4). The criteria were: open/semi-enclosed water bodies; ratio of parcels with docks to those without; shellfish habitat; fringe marsh; eelgrass; water depth within 150' of shore; moorings within 500' of shore; navigational channel within 500' feet of shore; recreational use

Step 4: We defined our terms (fig. 5).

1. Enclosed/open: An enclosed area such as a salt pond at the head of the estuary would be the first area to show signs of problems resulting from nutrient loading, drainage or toxics because of lowered flushing capacity. An open area had a greater exchange with the incoming oceanic water.
2. Number of lots with docks and number without.
3. Shellfish habitat: We looked at the shoreline with respect to the historical, present and town propagation projects to determine an area's ability to support shellfish. We also looked at it with respect to clams, quahaugs or scallops; mussels and oysters were not present in the waters in the 200-ft. wide ribbon adjacent to the shore.
4. Fringe marsh: although present in many areas, it varies considerably in width. It protects coastal banks from erosion and while not as productive as extensive marshes, it has the capacity to filter nutrient loaded groundwater, contains invertebrates such as ribbed mussels (Modiolus demises) that can aid in water clarity, and provides habitat for fish and invertebrates. It has widths varying to minimal to about 20' with 10 to 20 feet being average. We felt that a marsh 5-10 feet wide provided some functions but one that was less than 5' wide was probably only providing minimal positive effects.

5. Eelgrass: We looked for presence or absence and relative abundance. The healthy meadows in the middle of Little Bay gave an indication of heavy abundance while a few sporadic plants indicated a low abundance.
6. Depth of water: A depth of 4' or more would have relatively little resuspension of particles from most outboard engines on most shallow-draft boats (proceedings boating workshop, Crawford, et al. 1998). A boat put in gear and also docking again on the return trip can have an enormous impact and can even create a channel or hole known as "prop dredging". A depth of 3-4' would cause medium disturbance and a depth of less than 3' at MLW can cause resuspension.
7. Moorings: All harbor masters automatically give waterfront property owners up to three moorings to be used in front of their property. We defined a mooring field, as a public mooring area where moorings exceeded that density within 500 feet of the shore. Areas near town landings had such mooring fields while other areas generally did not.
8. Navigational channel within 500': Many areas are highly used for both recreational and commercial activity. In accordance with state statute, a private structure should not be an impediment to navigation. We looked at where the channels were currently located and determined that structures less than 500' from the channel would cause an impediment from wakes, and cross-channel operation.
9. Recreational activity: Although difficult to actually define, we looked at the area with respect to the general public use of the area. A long narrow river connecting to a pond with a lot of boats would have a lot of recreational activity near shore as would most of the ponds because of the heavy number of moorings while the open water did not have much activity where docks would be located.

Step 5: We added a number to the descriptions as follows:

- a. high, yes, lots, shallow = 1
- b. medium, some, few = 0.5
- c. low, no, deep = 0

Step 6: We replaced the words in our matrix with the numbers for each criterion at each location (fig. 6).

Step 7: We analyzed the numbers with respect to the total impact of docks and their use in the particular segments of the bay. Areas with the highest sensitivity were deemed to be inappropriate for new docks; areas with medium sensitivity may be able to support new docks with additional criteria; areas of low sensitivity could potentially be opened up for new dock applications.

Step 8: We mapped and analyzed the data and made the cut-off points (fig. 7).

Step 9: Developed additional criteria for the medium and low sensitivity areas for conservation commissions throughout the region to adopt in their local regulations which is to be done after implementation.

Step 10: Finally, we presented the method to the public.

Conclusions

The Bay Plan included the methodology described with its appendix. The public became aware that the moratorium will continue in the River Complex, Crow's Pond, Ryder's Cove, Quanset Pond, Round Cove, Pau Wah Pond, the Narrows and Pochet. Since the plan was adopted in November, many seasonal residents may not have received the news as of this writing and thus, we have not heard comments from them. The Conservation Commissions still need to adopt the method as a tool and formalize it in their regulations. Additional criteria must be developed for other areas where docks may be permitted in the future. The Bay plan still requires a vote of approval from state agencies. Indications thus far suggest that the state will approve the plan as written and that the dock and pier methodology will stand.

As far as we have been able to ascertain, the methodology described herein is the first such attempt to address the environmental problems associated with private docks that was based on a bay-wide approach. As resource managers, we often have to make policy decisions based on incomplete information. We eagerly anticipate results from research that further amplifies our knowledge regarding the impacts of docks and their use on marine environments.

We feel that by eliminating the lot by lot procedures, we have also eliminated a more subjective approach to the permitting procedure. We believe we have made a stronger case using biological, physical and human use parameters over wider areas that will be more difficult to refute on appeal. However, we are willing to adjust the bottom line results should research prove that we have been overly conservative in our designations. Our charge in developing a resource management plan was to protect the bay. The following statement in the introduction to the plan sums up our approach.

“An estuary left alone will nurture and care for itself with no help of human hands. It is only when human activities interfere with natural processes that the Bay responds by showing signs of stress, damage and disease. This stewardship plan for Pleasant Bay is based on the premise that human intervention in the natural processes of the Bay must be minimized. With this premise, the plan seeks to encourage a level of human use which does not upset the balance of the Bay’s eco-system, endanger the productivity of its wildlife, or invade the tranquility of those who seek its shores. Accomplishing this will require residents, visitors and commercial interests alike to place the long-term health of the Bay above individual interests. It will require change and sacrifice, and on-going commitment to preserving the health, beauty, and tranquility of Pleasant Bay for future generations.”

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RATIONALE FOR DOCK CRITERIA

1. Enclosed:

Bodies of water that are semi-enclosed are more susceptible to poor flushing which leads to softer sediment that can be re-suspended, and nutrient loading from nutrients tied up in the sediments that are resuspended. Nutrient loading can lead to water quality degradation. Shellfish often set in quiescent waters of semi-enclosed areas. Kettle ponds can be shallow at the fringe marsh margin but often drop off in depth rather quickly. The protected nature of these areas are usually a haven for boats to be moored and there is usually heavy recreational activity.

2. Docks to available parcels ratio:

This criteria addresses the number of docks currently in an area in relation to the number of lots without docks. It looks at the cumulative effects of docks in an intuitive manner and from an aesthetic perspective. Respondents to the marine resources survey indicated a strong desire to keep the bay visually pleasing and as natural as possible.

3. Shellfish habitat:

This criteria refers to shellfish habitat as determined by the current shellfish constable, commercial and recreational fishermen, and historical records. It refers to the five most common and most highly regulated species of clams, quahaugs, scallops, mussels and oysters. Habitat is defined as areas that have the characteristics including but not limited to sediment type, and grain size, circulation patterns, hydrologic regime, water chemistry, plant communities and food supply necessary to support the above species. Habitat for this purpose is designated for the ribbon of land approximately 150' from the edge of fringe marsh (if any) or measured from the MHW if no fringe marsh is present. Shellfish habitat is one of the principal biological criterias as installation, physical presence of pilings or other structures, operation of boats to and from the docks, and chemical leaching in the water can all negatively affect shellfish abundance.

4. Fringe Marsh:

This criteria refers to the presence or absence of fringes salt marsh and the estimated width of the marsh perpendicular to the shoreline. The width of marsh determines the amount of man-made structure that would have to be constructed in order to traverse over the marsh.

5. Eelgrass:

This criteria refers to the presence or absence of eelgrass and its relative abundance as shown on state maps and personal knowledge by shellfish constables, harbormasters, fishermen and biologists. Eelgrass is important to the ecosystem by providing forage, protection and

6. Water Depth:

This refers to the average depth of water at 150 feet from the edge of the fringe marsh (if any) or from the MHW if no marsh is present. Water depth is important because of sediment resuspension issues below the propeller. "Prop scour" can not only damage the water pump of the motor but can also dislodge/kill juvenile shellfish during the setting season if there is not enough water above the sediment when the engine is operating. Generally, 4' water depth at low tide is judged sufficient depth to avoid the majority of prop scour. Motor boat operation in shallow water can be detrimental to shellfish and often boats tied to docks are in shallow areas at low tide.

7. Moorings:

Public waters are used for shellfishing but are also used for boating activities. The number of moorings indicate the amount of boating congestion in an area. This criteria determines the number of moorings within a 500' radius from existing docks.

8. Navigational Channel:

This criteria refers to the presence or absence of a recognized navigational channel within 500' from the MLW mark. This designates the amount of distance that could be utilized for docks if they were 125' from the marsh. If the area is a river and docks extended from each side, how much area would remain for boating activity? This criteria looks at that problem and defines areas where channels are and are not within that distance.

9. Recreational Activity:

This criteria refers to observations regarding the use of an area. Ponds with numerous moorings leading to rivers that lead to open water are generally very busy with recreational activity. Activity is not further defined but generally refers to boating activity rather than swimming, or diving, but fishing is also included as recreational activity. Open water is generally less busy because of its open nature.

Legends for figures:

Figure 1: Map of the Pleasant Bay Resource Management Plan study area.

Figure 2: Map of the Pleasant Bay Resource Management Plan sub-sections.

Figure 3: Descriptive attributes of each Bay Plan sub-section.

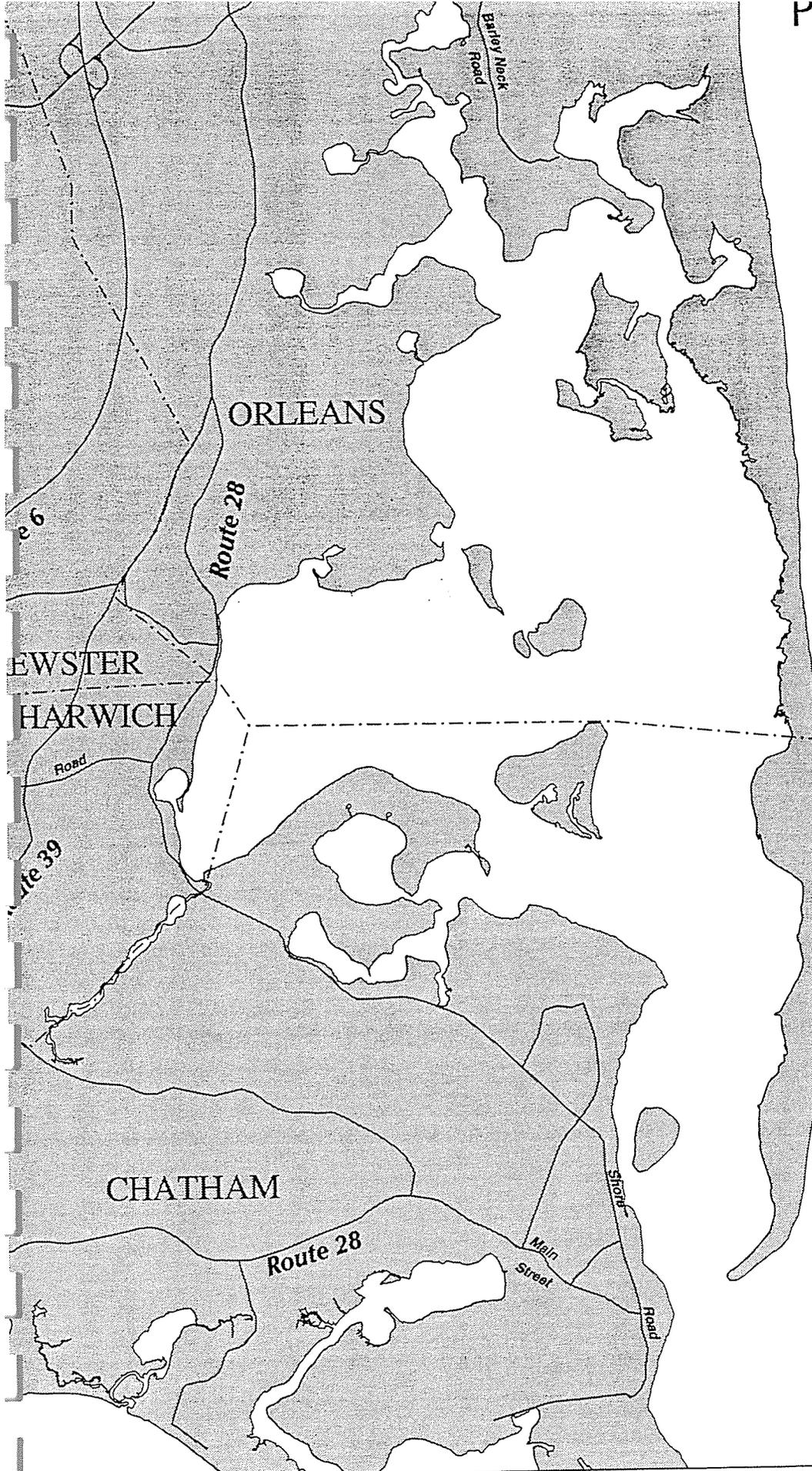
Figure 4: Matrix of criteria with one-word quantifiers for each sub-section.

Figure 5: Definition of terms used for the nine criteria.

Figure 6: Quantified matrix of each criterion at each sub-section.

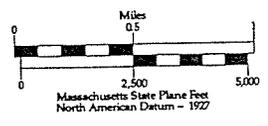
Figure 7: Map of the Pleasant Bay Resource Management Plan sub-sections based on the numerical sensitivity index.

Pleasant Bay



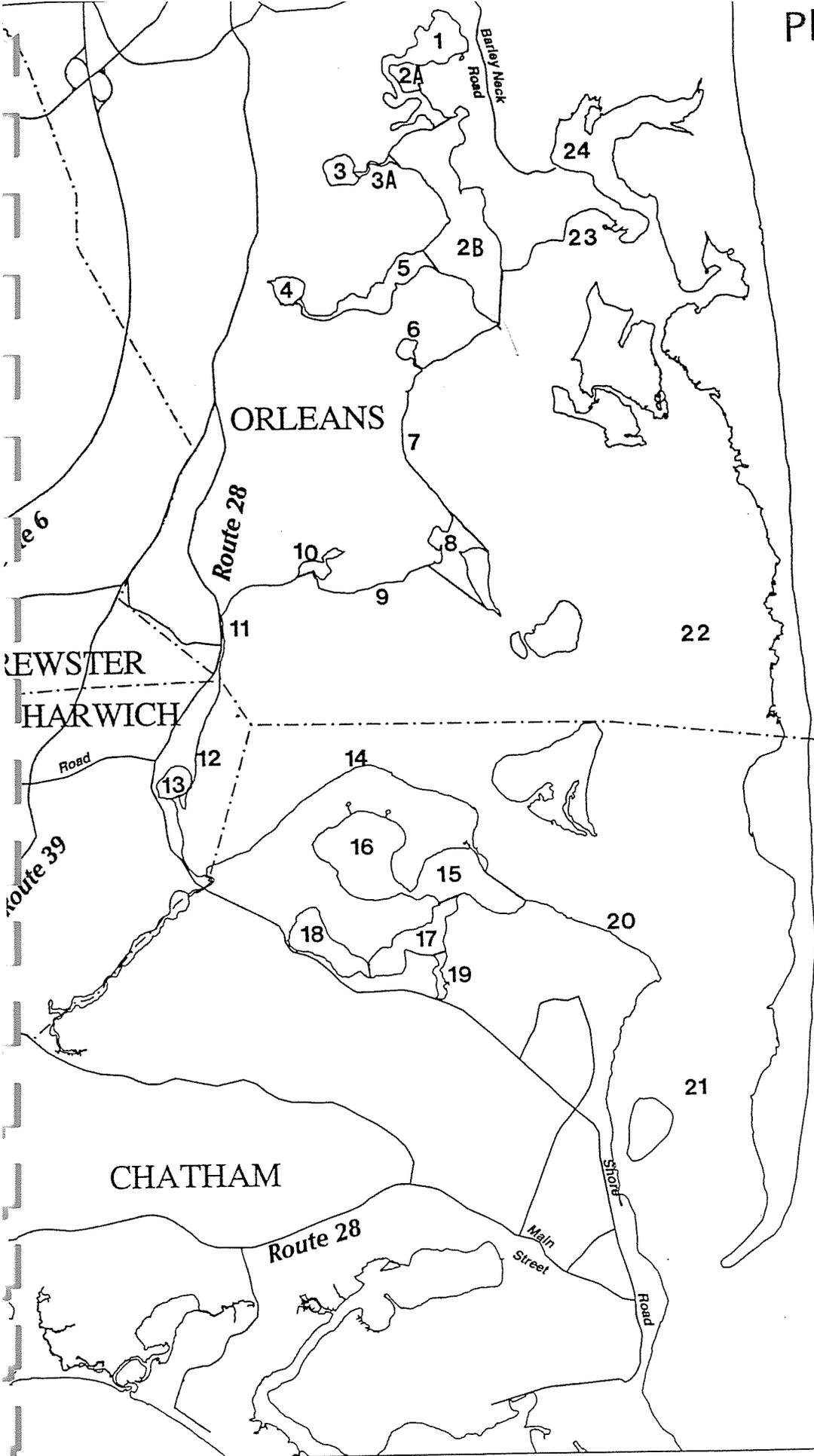
These maps were produced by the Cape Cod Commission for the Pleasant Bay Resource Management Plan. This project is partially funded through Massachusetts Coastal Zone Management by a grant from the Office of Ocean and Coastal Resources Management, National Oceanic and Atmospheric Administration, and the U.S. Department of Commerce. The views expressed are those of the author(s) and do not necessarily reflect the views of NOAA or any of its sub-agencies. This information is available in alternative formats upon request.

--- Town Boundary
~ Major Road



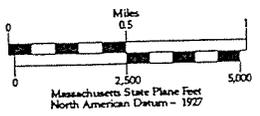
Map Created on December 22, 1998

Pleasant Bay



These maps were produced by the Cape Cod Commission for the Pleasant Bay Resource Management Plan. This project is partially funded through Massachusetts Coastal Zone Management by a grant from the Office of Ocean and Coastal Resources Management, National Oceanic and Atmospheric Administration, and the U.S. Department of Commerce. The views expressed are those of the author(s) and do not necessarily reflect the views of NOAA or any of its sub-agencies. This information is available in alternative formats upon request.

--- Town Boundary
--- Major Road



Map Created on December 22, 1998

PLEASANT BAY: SENSITIVE AREA DESIGNATIONS AND DESCRIPTIONS

1. *Meetinghouse Pond* is an enclosed pond on the upper end of an estuary. If there is a problem with flushing in the bay, it would be most noticeable here. There is a low dock to parcel ratio currently, with less than 25% of the parcels with docks, which means approximately 75% of the parcels could potentially each request a dock. It is a known shellfishing area close to shore (approximately 200 feet from fringe marsh) and beyond, which would coincide with the locations of potential dock placements. There is some deep water shellfishing here, but not in the fringe area. Fringe marsh may be found along the entire shoreline, while eelgrass is spotty, and the water depth is shallow (shown in bathymetry results). The pond is heavily used for moorings, it has no navigational channel, but is highly used by people coming and going for recreation. It is a busy place possibly due to its having both filling and pump-out stations.

2. *Kent's Point - Upper River*, which as a river makes the designation of enclosed versus open is a difficult one. It is a narrow body of water, where over 50% of the parcels have docks. This is a known shellfish area with a productive fringe marsh. There is spotty eelgrass, the area is shallow, moorings are medium density, there is definitely a navigational channel and is a busy area for its size.

3. *Kent's Point - Namequoit* is less narrow than the Upper River although it is very narrow around Mayflower Point. This area has a medium density of docks to parcels, and is a known spot for shellfishing, although some parts are not highly productive. There is fringe marsh in the majority of this area, although spotty in some locations, and it has a medium density of moorings, definite navigational channel and heavy recreational use.

4. *Lonnie's Pond* is definitely enclosed with a narrow channel leading to it. (This is a potential site for eutrophication in the future.) There is a medium density of docks to parcels, known shellfish habitat in the fringe and deep waters along the fringe, spotty eelgrass, deep water close to shore, heavy use of moorings, no navigational channel and heavy navigational use.

5. *Lonnie's Channel* is enclosed, narrow and shallow. There is one dock, some shellfishing in the river itself, fringe marsh throughout the channel, no eelgrass, and heavy recreational use from people coming and going.

6. *Arey's Pond* is similar to Lonnie's Channel and very active.

7. *Namequoit River* may be described similarly to Lonnie's Channel except that the channel is wider which provides more space for moorings.

8. *Pah Wah Pond* which is similar to Arey's, with recreational use associated with a town landing. It is an important area with a river and navigational channel.

9. *Little Bay* is an area with open water, few docks relative to the shoreline and number of parcels, little shellfishing, medium fringe marsh which is not contiguous. Eelgrass is heavy, but just offshore. It is shallow, with one mooring field, but medium density within 200 feet of the shore. There is no navigational channel and not as much recreational useage.

10. *Narrows/Sipsons* is not really enclosed, has some docks, is a shellfishing area, has light fringe marsh, spotty eelgrass, is shallow, has some moorings, a navigational channel and is used recreationally.

11. *Bay /North Shore* has open water, very few docks relative to the amount of shoreline, shellfish within a 200-foot ribbon along the shore, spotty eelgrass, no fringe marsh, water depth is shallow, and moorings are few in number. There is no navigational channel close to shore, but has some recreational use.

12. *Quanset Pond and Channel* is enclosed, shallow, and has some shellfish in deep areas within 200 feet of shore. The eelgrass is spotty, mooring is very heavy within 200 feet of the shore, and there is a channel and heavy recreational use.

13. *Bay/Northwest* is open, has few docks, some shellfishing areas, no fringe marsh, spotty eelgrass, is shallow, has many moorings, and is heavily used for recreation.

14. *Bay West* is open, about half the parcels have docks, is a fair location for shellfishing, has light fringe marsh, but no eelgrass, and has shallow water close to shore, heavy moorings, no channel and is a heavily used area for recreation.

15. *Round Cove* is enclosed, has good shellfishing, and heavy fringe marsh and eelgrass. There are many moorings, there is a navigational channel and heavy recreational use.

16. *Nickersons Neck* is open, has few docks, shellfish within 200 feet "ribbon," no eelgrass, is shallow, has some moorings, has a navigational channel, and some heavy recreational use.

mediate fringe

17. *Bassing Harbor* is ^{open} enclosed, has a low number of docks to parcels, has shellfishing habitat, heavy fringe marsh, heavy eelgrass, shallow water, some moorings, a navigational channel and is heavily used.

18. *Crows Pond* is semi-enclosed, has some docks, has shellfish habitat close to shore, some fringe marsh heavy eelgrass, deep water, heavy moorings, no navigational channel and is heavily used.
19. *Upper Ryders Cove* is semi-enclosed, has between 1/4 and 1/2 parcels with docks, and is a shellfishing area, with heavy fringe marsh, spotty eelgrass, shallow water, heavy moorings, a navigational channel, and is heavily used.
20. *Ryders Cove* is semi-enclosed has a low number of docks to parcels, is a shellfishing area, has heavy fringe marsh, some fringe marsh, shallow water, heavy moorings, a navigational channel, and has medium recreational use.
21. *Frost Fish Creek* is semi-enclosed has between 1/4 and 1/2 parcels with docks, is a shellfishing area, with fringe marsh, some eelgrass, is shallow, has moderate number of moorings close to shore, no navigational channel and is not heavily used.
22. *Ministers Point* is open, does not have many docks, has moderate shellfishing, ~~moderate~~^{heavy} fringe marsh, heavy eelgrass, shallow water, moderate number of moorings, a navigational channel, and is heavily used.
23. *Chatham Harbor* is open, has no docks, some shellfishing, no fringe marsh, no eelgrass, shallow water close to shore, some moorings, a navigational channel and is heavily used.
24. *North Beach* is open, has no docks, is a good shellfishing area, has heavy fringe marsh, heavy eelgrass, shallow water, no moorings, no navigational channel, and heavy recreational use.
25. *Old Field Point* is open, has no docks, some shellfishing habitat, heavy fringe marsh, spotty eelgrass, few moorings, no navigational channel, and light recreational use.
26. *Pochet Inlet* is semi-enclosed, has few docks, shellfishing habitat, heavy fringe marsh, spotty eelgrass, shallow water, some moorings, a navigational channel, and light recreational use.

Inventory of Resource and Use Issues Relevant to Docks and Piers

Area	Number of Docks	Parcels w/ No Dock	Shellfish Habitat	Fringe Marsh	Belgrass	Water Depth w/in 150'	Moorings w/in 150'	Navigational Channel w/in 150'	Recreational Use
(1) Meetinghouse Pond	11	32	Yes	Heavy	Light	Shallow	Heavy	No	Light
(2A) Kents Point - Upper River	18	10	Yes	Heavy	Light	Shallow	Light	Yes	Heavy
(2B) Kents Point - Namequoit	19	39	Yes	Heavy	Heavy	Shallow	Light	Yes	Heavy
(3) Lonnie's Pond	8	8	Yes	Heavy	Light	Deep	Heavy	No	Light
(3A) Lonnie's Channel	1	6	No	Heavy	None	Shallow	None	Yes	Heavy
(4) Arey's Pond	8	12	Yes	Heavy	Light	Shallow	Heavy	No	Light
(5) Namequoit Riv	16	32	Yes	Heavy	Light	Shallow	Heavy	Yes	Heavy
(6) Pah Wah Pond	6	7	Yes	Heavy	Light	Deep	Heavy	Yes	Light

Inventory of Resource and Use Issues Relevant to Docks and Piers

Area	Number of Docks	Parcels w/ No Dock	Shellfish Habitat	Fringe Marsh	Eelgrass	Water Depth w/in 150'	Moorings w/in 150'	Navigational Channel w/in 150'	Recreational Use
(7) Namequoit Riv - Narrows	4	31	Yes (slight)	Light	Heavy	Shallow	Medium	No	Heavy
(8) Narrows, Sipsons Is.	4	11	Yes	Light	Light	Shallow	Light	Yes	Heavy
(9) Bay/North	1	5	Yes (slight)	Light	Light	Shallow	Light	No	Heavy
(10) Quanset Pond	4	11	Yes	Heavy	Light	Deep	Heavy	Yes	Light
(11) Bay/Northwest	11	15	Yes (slight)	Light	Light	Shallow	Heavy	No	Heavy
(12) Bay/West	5	21	Yes	Light	Light	Shallow	Heavy	No	Heavy
(13) Round Cove	0	8	Yes	Heavy	Light	Shallow	Heavy	Yes	Light
(14) Nickersons Neck	2	16	Yes (slight)	Light	Heavy	Shallow	Light	Yes	Heavy
(15) Bassing Harbor	3	24	Yes	Heavy	Heavy	Shallow	Medium	Yes	Heavy

Inventory of Resource and Use Issues Relevant to Docks and Piers

Area	Number of Docks	Parcels w/ No Dock	Shellfish Habitat	Fringe Marsh	Eelgrass	Water Depth w/in 150'	Moorings w/in 150'	Navigational Channel w/in 150'	Recreational Use
(16) Crows Pond	14	37	Yes	Light	Light	Deep	Heavy (south side)	No	Heavy
(17) Upper Ryders Cove	12	34	Yes	Heavy	Heavy	Shallow	Heavy	Yes	Heavy
(18) Ryders Cove	6	34	Yes	Heavy	Heavy	Shallow	Heavy	Yes	Light
(19) Frost Fish Creek	5	12	Yes	Heavy	Light	Shallow	Light	No	None
(20) Ministers Pt	5	19	Yes (slight)	Light	Heavy	Shallow	Light	Yes	Heavy
(21) Chatham Harbor			Yes (slight)	Light	None	Shallow	Light	Yes	Heavy
(22) North Beach - Pochet Bridge; Strong, Li'l Sipsons, Hog Sampsons, Hog Islands	1	N/A	Yes	Heavy	Heavy	Shallow	None	No	Heavy

DEFINITIONS OF TERMS

SHELLFISH HABITAT:

1. ALL TRADITIONALLY STATE-REGULATED SPECIES (SOFTSHELL CLAMS, QUAHAUGS, MUSSELS,,SCALLOPS, OYSTERS) THAT HAVE HISTORICALLY, CURRENTLY, OR IN THE FUTURE COULD POTENTIALLY SUPPORT SHELLFISH.
2. ALL SPECIES ARE OF EQUAL VALUE.
3. A. YES = EVIDENCE OF BEING ABLE TO SUPPORT SHELLFISH
B. SLIGHT = SUPPORTS SHELLFISH BUT NOT IN ABUNDANCE,
C. NO = NO EVIDENCE OF SUPPORTING OR BEING ABLE TO SUPPORT SHELLFISH.

FRINGE MARSH:

1. BANDS OF SPARTINA ALTERNIFLORA WITH SOME S. PATENS AREAS IN TRANSITION AREA FROM WATER TO UPLAND.
2. A. HEAVY = 10 FEET OR GREATER WIDTH
B. MEDIUM = 5 - 10 FEET WIDTH
C. LIGHT = < 5 FEET WIDTH

RATING SCALE TO EVALUATE FACTORS

- A. 1 = HIGH CONCERN
- B. 0.5 = SOMEWHAT OF A CONCERN
- C. 0 = LOW CONCERN

RATINGS FOR SPECIFIC WORDS:

- A. YES/HEAVY; SEMI ENCLOSED/SHALLOW ; $> 0.5 = 1$
- B. SLIGHT/LIGHT; SEMI-OPEN, MODERATELY SHALLOW; $0.25-0.5 = 0.5$
- C. NO/NONE; OPEN/DEEP; $< 0.5 = 0$

RATIO OF DOCKS:

1. NUMBER OF DOCKS TO TOTAL PARCELS
2. A. $> 0.5 = 1$
B. $0.25 - 0.5 = 0.5$
C. $< 0.25 = 0$

WATER DEPTH:

1. DEPTH OF WATER AT 150' FROM SEAWARD EDGE OF FRINGE MARSH AT MEAN LOW WATER
2. A. $> 4' \text{ DEPTH} = 0$
B. $3' - 4' = 0.5$
C. $< 3' = 1$

MOORINGS AND NAVIGATIONAL CHANNEL

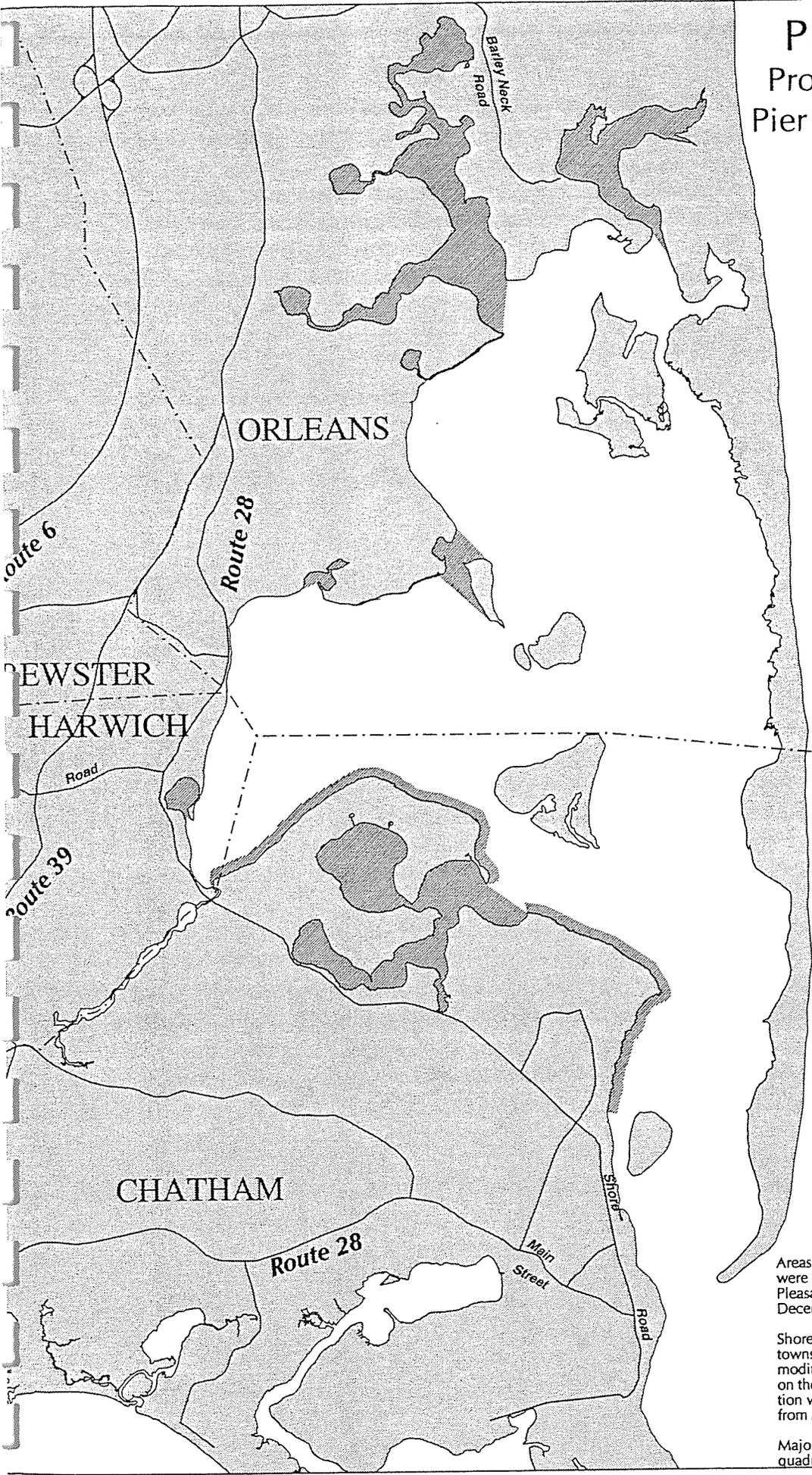
1. EITHER FACTOR WITHIN A 500 FT. RADIUS FROM MLW

AN ASSESSMENT OF BIOLOGICAL, PHYSICAL AND HUMAN USE IMPACTS ON THE SHORELINE OF PLEASANT BAY (7/97)

#	Section	Area	Enclosed	Docks	Shellfish Fringe	Elgrass	Water Depth	Moorings	Navigat	Ch	Recreat.	TOTAL	Ranking
1	9	Bay/North Shore	0	0	0.5	0	0.5	1	0	0	0.5	2.5	Less Sensitive
2	7	Little Bay	0	0	0.5	0.5	0.5	1	0.5	0	0.5	3.5	Less Sensitive
3	23	Old Field Pt	0	0	0.5	1	0.5	1	0	0	0.5	3.5	Less Sensitive
4	21	Chatham Harbor	0	0	0.5	0	0	1	0.5	1	1	4	Less Sensitive
5	11	Bay/Northwest	0	0.5	0.5	0	0.5	1	1	0	1	4.5	Less Sensitive
6	12	Bay/West	0	0.5	0.5	0.5	0	1	1	0	1	4.5	Less Sensitive
7	22	North Beach	0	0	1	1	1	1	0	0	1	5	Less Sensitive
8	3A	Lonnie's Channel	1	0	0.5	1	0	1	0	1	1	5.5	Less Sensitive
9	14	Nickersons Neck	0	0	0.5	0.5	1	1	0.5	1	1	5.5	Less Sensitive
10	19	Frost Fish Creek	1	0.5	1	1	0.5	1	0.5	0	0	5.5	Less Sensitive
11	20	Ministers Pt	0	0	0.5	0.5	1	1	0.5	1	1	5.5	Less Sensitive
12	1	Meetinghouse	1	0	1	1	0.5	1	0.5	0	1	6	Less Sensitive
13	3	Lonnie's Pond	1	0.5	1	1	0.5	0	1	0	1	6	Less Sensitive
14	16	Crows Pond	1	0.5	1	0.5	1	0	1	0	1	6	Less Sensitive
15	8	Narrows, Sipsons	0.5	0.5	1	0.5	0.5	1	0.5	1	1	6.5	Less Sensitive
16	24	Pochet Inlet	1	0	1	1	0.5	1	0.5	1	0.5	6.5	Less Sensitive
17	4	Arey's Pond	1	0.5	1	1	0.5	1	1	0	1	7	Less Sensitive
18	6	Pah Wah Pond	1	0.5	1	1	0.5	0	1	1	1	7	Less Sensitive
19	10	Quanset Pond	1	0.5	1	1	0.5	0	1	1	1	7	Less Sensitive
20	13	Round Cove	1	0	1	1	0.5	0.5	1	1	1	7	Less Sensitive
21	18	Ryders Cove	1	0	1	1	0.5	1	1	1	0.5	7	Less Sensitive
22	15	Bassing Harbor	1	0	1	1	1	1	0.5	1	1	7.5	Less Sensitive
23	2A	Kent's Pt-Upper	1	1	1	1	0.5	1	0.5	1	1	8	Less Sensitive
24	2B	Kent's Pt-Nam	1	0.5	1	1	1	1	0.5	1	1	8	Less Sensitive
25	5	Namequoit Riv	1	0.5	1	1	0.5	1	1	1	1	8	Less Sensitive
26	17	Upper Ryders	1	0.5	1	1	0.5	1	1	1	1	8	Less Sensitive

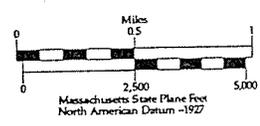
Blol., Phys., Human Use Values = 0, .5, 1 TOTAL (Sum) = 0 to 9

Pleasant Bay Proposed Dock and Pier Moratorium Areas



These maps were produced by the Cape Cod Commission for the Pleasant Bay Resource Management Plan. This project is partially funded through Massachusetts Coastal Zone Management by a grant from the Office of Ocean and Coastal Resources Management, National Oceanic and Atmospheric Administration, and the U.S. Department of Commerce. The views expressed are those of the author(s) and do not necessarily reflect the views of NOAA or any of its sub-agencies. This information is available in alternative formats upon request.

- Area of Proposed Permanent Moratorium
- Moratorium to continue for remaining shoreline until formulation and adoption of dock and pier performance standards and design criteria.
- Town Boundary
- Major Road



Map Created on April 14, 1998

Areas of Proposed Dock and Pier Moratorium were delineated on GIS work maps by the Pleasant Bay Resource Management Plan, December 1997, then digitized by CCC.

Shoreline, town boundaries, and ponds from towns' assessor maps of various dates with modifications made by CCC GIS in 1997 based on the Department of Environmental Protection wetland mapping aerial photos (photos from March 1993).

Major Roads - MassGIS; digitized from USGS quadrangles, 1:25000 scale, various dates.