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Horsley & Witten, Inc.
Environmental Services

Final Report

PAMET HARBOR MANAGEMENT PLAN
Truro, Massachusetts

June 1994

Prepared for:

Harbor Management Planning Committee
Town of Truro
Truro, MA 02666

Funding Assistance Provided By:

Massachusetts Coastal Zone Management
Harbor Planning Grants Program

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1. PURPOSE and INTRODUCTION

EXECUTIVE SUMMARY

This Pamet Harbor Management Plan represents a planning effort begun in 1987 and completed in 1994. The intent of the Plan, agreed upon by town and state officials, and citizens at public hearing, is to restore the usefulness of Pamet Harbor, while protecting its varied natural resources, water quality and visual appeal. Maintenance dredging is recommended to enhance navigation, water quality and beach nourishment. Other recommendations promote compatible public access, scenic qualities, shellfish and appropriate land use policies. A Harbor Management Planning Committee, composed of town officials, harbor users and local interest groups, guided the plan's development with consultant expertise and technical assistance and grant funding from the Massachusetts Coastal Zone Management Office (MCZM). The Plan is intended to be consistent with the 1988 Harbor Planning Guidelines of MCZM.

1. PURPOSE AND INTRODUCTION

Pamet Harbor in Truro, Massachusetts is locally unique in many respects. The Pamet is Truro's only boating harbor and has its only boat launching facility. The town's major shellfish beds and saltwater wetland system is found here. The first English settlers of Truro colonized the river mouth, attracted by its ready access to Cape Cod Bay, its natural bounty and its sturdy, surrounding hills.

Today, the Pamet is a magnet for residents and tourists alike who want to enjoy the ever-changing variety offered by the nine-foot tidal range influencing the harbor. In the morning, the low tide bares the expansive tidal flats where gulls and terns sit musing about their next meal, while shellfishermen begin work for theirs. The afternoon will gather enough seawater to lift the moored fleet high off the mud and encourage visions of maritime grandeur for the little seaport. Fishermen and daysailers will hustle back in, seizing the opportunity afforded by the window of high tide navigability. At dusk, the sun will set directly behind the channel mouth out in the broad bay, luring other citizens down to the basin to salute the remains of the day. In 1987, the Pamet was designated by the

Massachusetts Department of Environmental Management as a "local scenic river," the only one on Cape Cod recognized for its recreational assets and aesthetic qualities.

The intent of the Pamet Harbor Management Plan is to restore the usefulness of the harbor, while protecting its natural resources and scenic beauty. As a small harbor subject to extreme tidal change (nine-foot rise and fall), the Pamet nevertheless hosts many varied resources and activities. This diversity of natural and human components has sometimes produced competition and conflicts. This Harbor Plan examines these resources, identifies issues relating to their use, and recommends strategies to harmonize conflicts, thereby maximizing enjoyment of the area. Through implementation of the policies and actions recommended in this plan, Truro can help to ensure that the concentrated diversity now offered by the tiny Pamet Harbor can persist and even be enhanced.

Truro exhibits some characteristics which set it apart from other Cape Cod towns and which mandate special consideration. These characteristics include lack of industry, small tax base, and orientation to water-dependent uses. Development pressures in Truro take on a different guise than in many other Cape towns, which are fighting marina development and condominiums on the waterfront. Because of the small scale of the Pamet, even minor changes can seem significant. Through development of a pending Local Comprehensive Plan and this Harbor Management Plan, Truro residents will chart the course for future land development and water uses in Pamet Harbor. Project team members will coordinate their efforts with the ongoing Local Comprehensive Plan (LCP) to ensure that the two resulting plans provide a coherent framework for future land and water-use decision-making.

The Pamet Harbor Management Planning Committee (HMPC) was formed by Truro Selectmen in 1987 at the request of the Harbor Commission. In 1988, the Committee drafted a request for proposals to hire a consultant to advise on the Harbor Plan. In 1989, the Town was awarded a $14,000 matching grant for the Harbor Plan from the

Massachusetts Coastal Zone Management Office (MCZM). In 1990, the request for bids was issued, but owing to complications of the then-new state Uniform Procurement Act, no consulting contract was awarded. In 1991, the Committee worked with MCZM to issue a new proposal request based on the 1988 (reprinted 1990) harbor planning guidelines of MCZM. In February, 1992, the Committee issued the request, screened four applicants, and, in July, 1992, signed a contract with Horsley & Witten, Inc., an environmental consulting firm in Barnstable.

In January, 1993, the environmental consultant's contract was extended, by mutual consent, in order to accommodate results from a separate study by the Massachusetts Department of Environmental Management of the harbor's bathymetry, in anticipation of dredging the harbor channel. Horsley & Witten, Inc. submitted a draft Harbor Plan to the Town in September 1993. A revised draft was submitted in January 1994, after review of town officials' and MCZM's comments on the draft plan and a public hearing held in September 1993, which focused on the Goals and Objectives. A public hearing on the revised draft was held in March 1994, which focused on the Action Plan. The final plan was delivered to the Town in June 1994.

Under the provisions of the Harbor Planning Grants Program of MCZM, the Town of Truro established a work program consistent with MCZM Harbor Planning Guidelines and accepted MCZM's grant condition that the plan's objectives, standards and policies should be consistent with those of the Executive Office of Environmental Affairs and its agencies. The HMPC believes that this plan meets those criteria and further believes that implementation of this plan will be consistent with MCZM policies.

Upon adoption by the Truro Board of Selectmen and MCZM, this plan should be considered the Town of Truro's official position on issues related to the harbor planning area. An implementation committee, designated by the Selectmen of the Town, will be given the responsibility of ensuring that the recommended actions of this plan are implemented by the Town. It will no longer be merely the opinions of the HMPC or its consultants.

2. PUBLIC PARTICIPATION and EDUCATION

2. PUBLIC PARTICIPATION AND EDUCATION

Building a consensus for action is the key to implementing any harbor management plan. The planning process for the Pamet Harbor Management Plan includes broad-based participation by the Truro citizenry, both permanent and seasonal residents alike. The Harbor Management Planning Committee (HMPC) itself represents all interested boards and committees of town government, as well as citizen groups, such as the local yacht club and conservation trust (see Appendix A).

All working meetings of the Planning Committee were advertised and open to the public. Well-attended public hearings were held on July 7, 1992; February 23, 1993; July 15, 1993; September 30, 1993; and, March 28, 1994. The July meetings were purposely held during the height of the summer season to encourage attendance by Truro's large summer population. Comments were recorded and used to refine planning materials.

The Committee also solicited public opinions through the use of a narrative-type attitudinal survey (see Appendix B). The consultants also conducted extensive interviews with harbor users and town officials for their opinions about harbor planning issues. Commercial fishermen submitted a petition stating their interest in seeing the harbor become more usable and several of their representatives attended the February, 1993 public hearing. (See Appendix E.)

While the goals and objectives elicited general support, some of the specific actions recommended by the HPMC and its consultants have proved controversial. For instance, the proposed wooden footbridge to provide a public access walkway along the former railroad bed has been criticized by three upriver sailboat owners whose sailing access to the bay would be hampered or denied by the bridge. The HMPC still believes that the idea has enough merit to be included in the plan but has postponed any firm decision about its installation until specific hearings and cost estimates are obtained.

Another letter critical of the draft plan was received from a professional botanist who believes further study is necessary before implementing most of the action alternatives recommended in the plan. Again, the HMPC believes that the recommendations are generally sound, but is willing to modify particular proposals as more information becomes available through the implementation process. Limited funding for the plan prevents detailed examination of each recommended alternative at this level of planning.

Comments were received from a harbor landowner and a resident whose family lives nearby during and subsequent to the March 1994 public hearing, objecting to the proposed boat ramp pier, traffic safety on Depot Road, land values of landowners in the study area and swimming access in the harbor. In addition, a local petition was submitted reflecting these same concerns. A petition was also received objecting to proposed restrictions on off-road vehicle usage on the barrier beaches abutting the harbor. This final plan expands on these issues and is intended to address their concerns within the limitations imposed by the harbor plan's scope of work. The HMPC believes that some of these issues, such as traffic study, are beyond the scope of work and may be addressed through the ongoing Local Comprehensive Plan.

Media coverage of the planning process has been extensive; samples are found in Appendix C. In addition to regular meetings of the Planning Committee, the consultants presented their harbor findings to a large audience of the Truro Neighborhood Association forum on the Pamet on August 23, 1993 (see Appendix C).

In July, 1993, with assistance from the Center for Coastal Studies, Truro officials installed permanent interpretive displays at the Harbor parking lot, educating visitors about the Pamet's salt marsh and estuarine resources.

3. BOUNDARIES OF HARBOR PLANNING AREA

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Pamet Harbor is located at the mouth of the four-mile long Pamet River estuary and its tributaries: Little Pamet River to the north and Mill Creek/Eagles Neck Creek to the south. A detailed physiography of the river is given in the 1987 Pamet River Greenway Management Plan (Greenway Plan) of the Truro Conservation Trust (pp. 9 - 13.)

The primary study area (Figure 1) for this Harbor Plan was selected by the Harbor Management Planning Committee in 1991 and confirmed by the consultants and a Planning Committee report of September 8, 1992:

> "Beginning at a point ten (10') feet below mean low tide from the shores of Cape Cod Bay, a line going east and touching the southern edge of the Corn Hill parking lot (Sheet 45, Parcel 50), thence following said lot line to Corn Hill Road, and then going southerly and easterly along the southern side of Corn Hill Road to a parcel of land, owned by the Town of Truro, known as the "Railroad Right of Way" (Sheet 49, Parcels 17 and 18; Sheet 50, Parcels 38 and 175). Thence, southerly along the east edge of said "Railroad Right of Way" including the parcel known as the Pamet Harbor parking lot, to a point at the southeast corner of the Aubin property (Sheet 50, Parcel 175 on said "Railroad Right of Way". From said point, westerly along the southern boundary of said Aubin property to the "Toe of Great Hills" at the northeast corner of a parcel of land owned by Paul R. Waldman (Sheet 49, Parcel 25) and thence around the "Toe of Great Hills" to Great Hills Road; thence southerly along the eastern edge of Great Hills Road to the southeast corner of the Dalsheimer property (Sheet 49, Parcel 20) and westerly along the common east - west boundary of the said Dalsheimer property and the Town of Truro property (Sheet 59, Parcel 19) to the shores of Cape Cod Bay, and thence westerly to a point ten (10') feet below mean low tide; thence northerly following the ten (10') feet below low tide line to the beginning point. Sheet and

parcel numbers refer to the FY 1991 Truro Map and Ownership Volume and ownership is as stated in that volume.

The rationale for choosing these boundaries include: (1) easily identifiable; (2) they bound the area which has the greatest effect on the harbor and surrounding estuaries; (3) they bound the area that is consistent with the traditional uses of the harbor."

The planning area consists of approximately 150 acres. About 75 percent of that total consists of intertidal areas; the remainder is all within the 100-year coastal floodplain. Dune, beach, salt marsh and tidal flats comprise the majority of the sediment, with the exception of artificial fill creating the railroad bed, parking lot and boulder jetties.

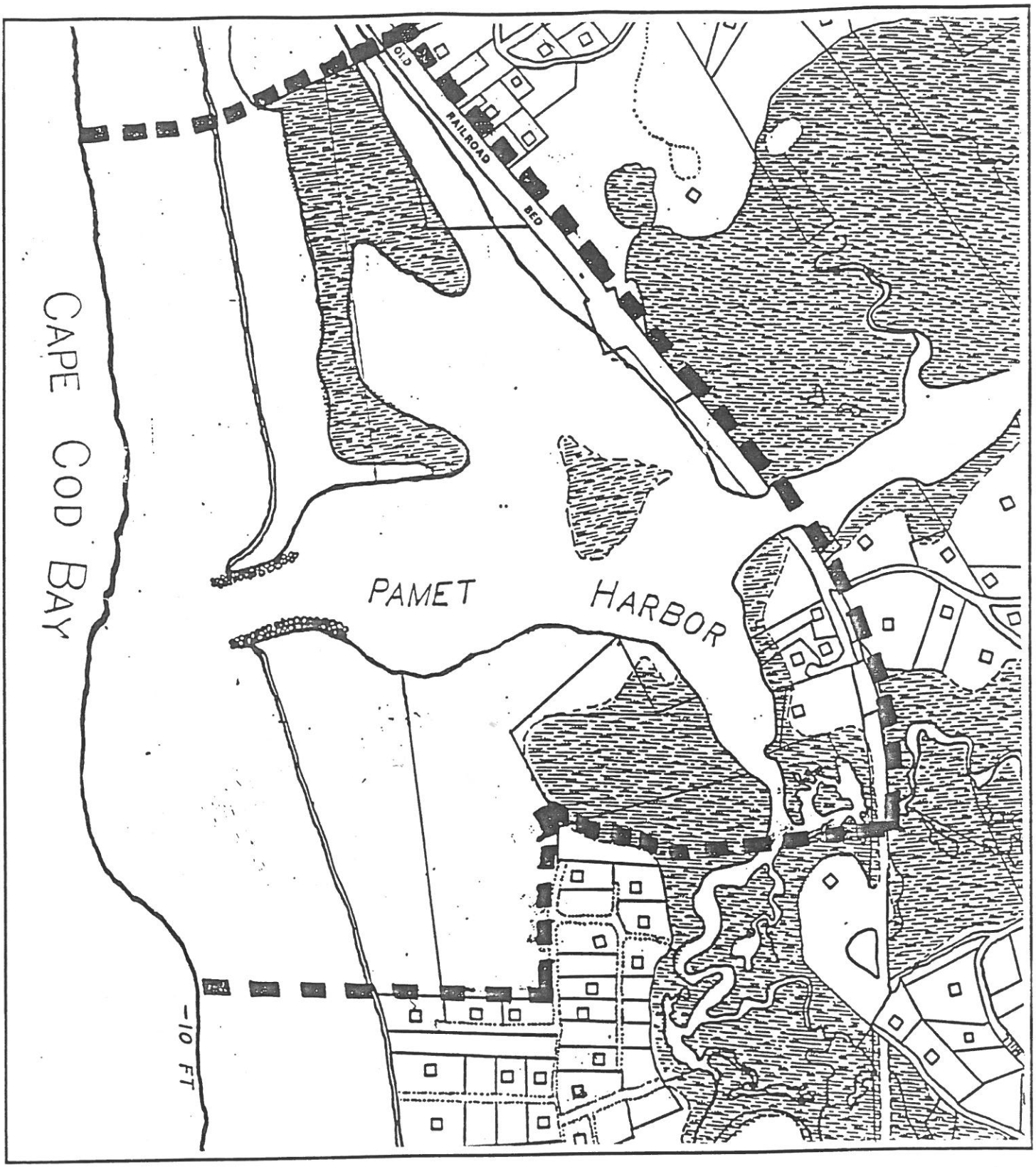


FIGURE 1.
Map Showing Boundaries of Harbor Planning Area
Pamet Harbor Management Plan

Boundary of Harbor Planning Area

North

Not to Scale

H&W, Inc.

Source: Town of Truro, MA, Pamet Harbor Planning Committee, 1992

4. FINDINGS REPORT

4. FINDINGS REPORT

The purpose of this section is to evaluate the impact of water use and land use practices, regulations and policies on the Pamet Harbor ecosystem and coastal processes. It is based upon a review of past technical reports, water quality data, aerial photographs, relevant statutes, bylaws and regulations, a series of interviews conducted by the consultant, and an assembly of computerized maps employing a geographic information system (GIS).

The majority of the analyses is focused in the immediate vicinity of Pamet Harbor, according to the study area selected by the Harbor Management Planning Committee. However, Horsley & Witten, Inc. has identified the ground water drainage basin as a project boundary for the purposes of evaluating potential contamination sources, and a more expansive public viewshed.

I. Man-Made Resources

A. Land Ownership and Use (See also, Chapters II.B.1 & II.B.2 of Greenway Plan)

As indicated on Map 1, most of the study area is owned either by the Town of Truro or the Truro Conservation Trust. The latter is a private, non-profit organization dedicated to acquiring and managing natural areas for conservation and/or passive recreation. Almost all of the Trust's landholdings within the study area are wetland, including tidal flats. The Town's parcels include the entire bayfront of the study area (Corn Hill and Fisher Beaches), the railroad bed, the Depot Road parking area and wetlands. These parcels are managed by the Selectmen, Beach Commission, Harbor Commission and Conservation Commission for conservation, beach recreation, boating and off-road vehicle recreation.

Other parcels within the study area include the Pamet Harbor Yacht Club, three small cottages near the boat ramp, one summer cottage near the Corn Hill parking lot (Bunker) and the large dune system owned by George Dalsheimer behind Fisher Beach. In 1993 this lot was proposed for subdivision into three or four lots, with the largest lot (along the channel) to

be left undeveloped, but zoning concerns regarding frontage had not been resolved by June 1994.

With the Dalsheimer exception, there is no substantial land left to be developed into residential housing or other uses within the study area. Therefore, the study area is unlikely to change much, at least visually, for many years to come. There is great potential for development, however, within the rest of the lower Pamet Valley, outside of the National Seashore. The 1987 Greenway Plan found that one new house per month was being built in the Pamet watershed during the 1980s development boom. The threat to the visual integrity of the river valley above the study area, which resulted in the 1987 Department of Environmental Management's designation of the Pamet as a "Scenic River," is still significant.

B. Harbor Resources, Uses and Facilities

1. Boating, Moorings, Docks (See also, Chapters II.B.5 of Greenway Plan)

Boating is currently limited due to shoaling within the harbor and the resulting shallow depths. Many boats currently sit on dry tidal flats during low tide, though the previous Harbormaster reports that only half a dozen boat owners have ever complained to him about this aspect. Safe navigation from the boat basin to the bay means that boats must operate only within two and one-half hours on either side of high tide, or else grounding will occur. The mooring basin accommodates approximately 130 boats (see Figure 2). This number has risen slowly since 1978, according to data in the Greenway Plan (1987, Table 8). For instance, there were 90 mooring permits in 1978, 115 in 1984 and 130 in 1993. The 1993 revenue to the town from mooring permits was $12,700.

The Harbormaster has the authority to rent moorings to transient boaters if the moorings lie vacant for 48 hours. There are almost always moorings available for transients, who usually rent by the week or month. No overnight transients presently visit the Pamet due to shoaling limitations and facilities, such as restaurants, stores or amenities. Even with navigational changes to the Pamet, the harbor is unlikely to attract overnight boaters

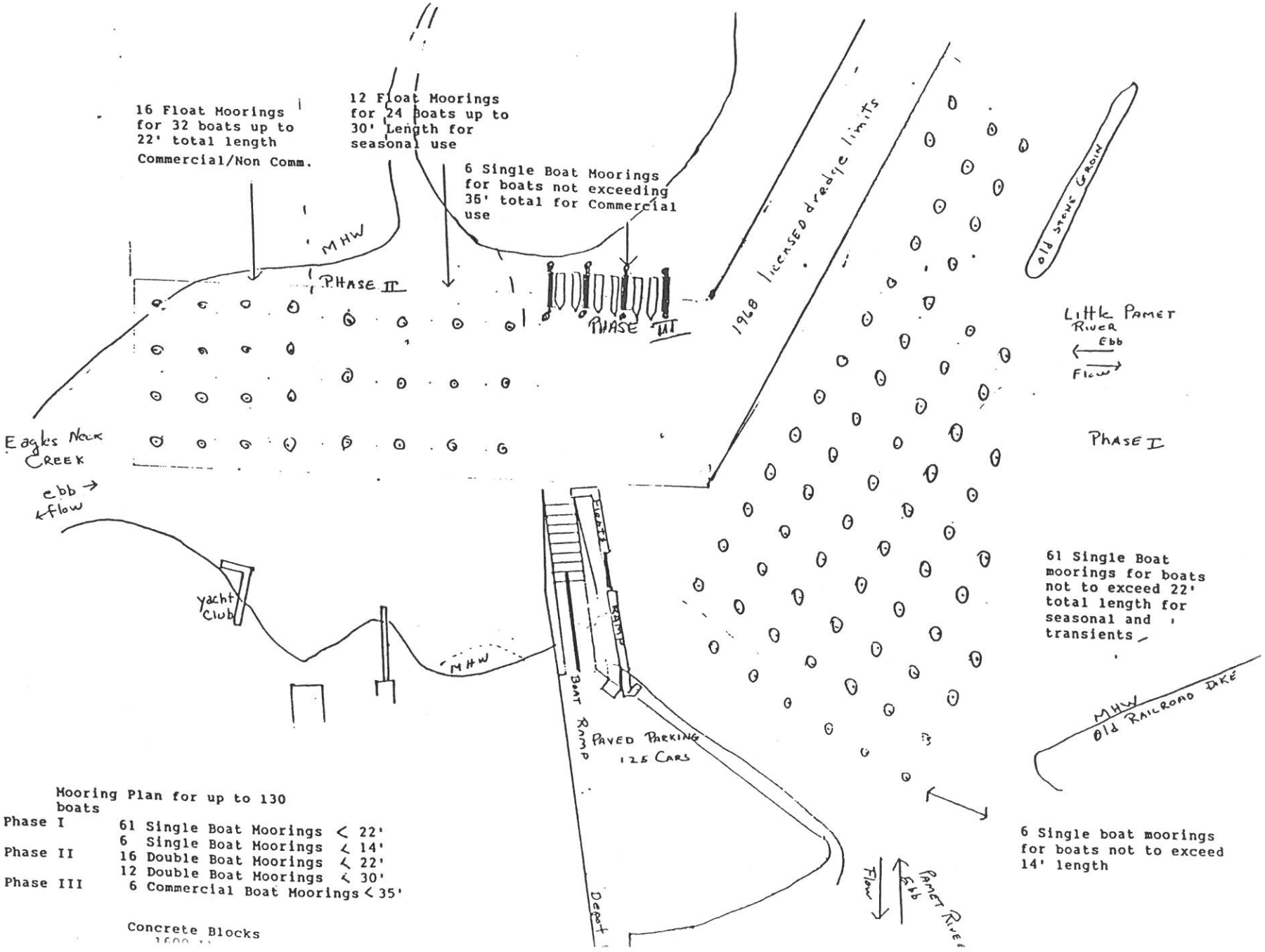
There is a waiting list (about 40 boaters) for new moorings; however, most townspeople surveyed believe the present number of moorings is appropriate; there are no calls for substantial expansion or reduction in the number of boats. There is a need to make more efficient use of the available mooring space and provide a clear channel fairway to the Bay. (See Figure 2.) Furthermore, the HMPC believes that harbor facilities are at their maximum capacity at present and does not recommend expansion of any parking area.

In 1992, there were thirteen vessels moored in the Pamet whose owners were engaged in some commercial fishing work. None of these commercial vessels exceeded 27 feet in length. The captains of two boats moored in Pamet Harbor were employed full-time as commercial fishermen. Interviews, public hearings and surveys indicate there is support for a continued limited presence of commercial fishing boats in the harbor. Fishermen express that their primary need is enhanced navigability at the harbor. Other amenities useful to commercial fishermen, for which there is apparent official and public support, are ice, telephone, rest room, trash disposal, and an off-loading dock. All but the proposed pier and ice are currently available at the harbor. HMPC does not support an on-site fueling facility, due to fears that it would commercialize the harbor and present increased potential for pollution.

When the 1993 survey was taken, about one-quarter of the moorings were occupied by centerboard-type sailboats. Two motorboats were diesel-powered, and the rest had gasoline engines, primarily outboards. The largest moored boat was 27 feet in length overall, though eight of ten boats fall within a 16 to 25 feet-long range. About one-third of the boats moored in Pamet Harbor were owned by year-round Truro residents and nearly eighty percent were owned by Truro taxpayers. The deepest draft vessel was about three and one-half feet.

Boating facilities include a two-lane, 40-foot wide, concrete boat launching ramp, originally built in 1958 (widened in 1989) with state Public Access Board (PAB) funds, and adjoining parking lot with 53 double and 25 single or 131 single spaces. In August 1993, the Truro Conservation Commission approved

FIGURE 2.
PAMET HARBOR MOORING PLAN: TOWN OF TRURO HARBOR COMMISSION



an Order of Conditions for a fixed 145-foot wooden pier and a removable, 91-foot float system plus a right angle, 18-foot removable float to replace the smaller float system now in use. (See Figure 3.) There is a need for a pier to accommodate ramp users safely and efficiently.

Since the widening of the ramp in 1989, sales of both seasonal and daily ramp permits by the town have not increased substantially (890 launchings, $6,200 revenue to town, 1993). For instance, there were 822 daily ramp permits issued for the entire 1978 season, when only a single ramp was available. Launchings may be limited by parking spaces available. Yet, on a hot summer day, it is still rare to see the parking lot filled with boats and trailers. The parking lot, which cannot be expanded owing to space constraints, will probably be the limiting factor to increased usage of the Pamet, even after any dredging, which might tend to attract additional boaters. There is no public nor official support to purchase additional land to increase parking at the harbor. Nor is the Pamet a popular transient anchorage because of space and shoaling limitations, and lack of shoreside facilities, such as stores and restaurants. Furthermore, the HMPC believes that harbor facilities are at their maximum capacity at present and specifically does not recommend expansion of any parking area.

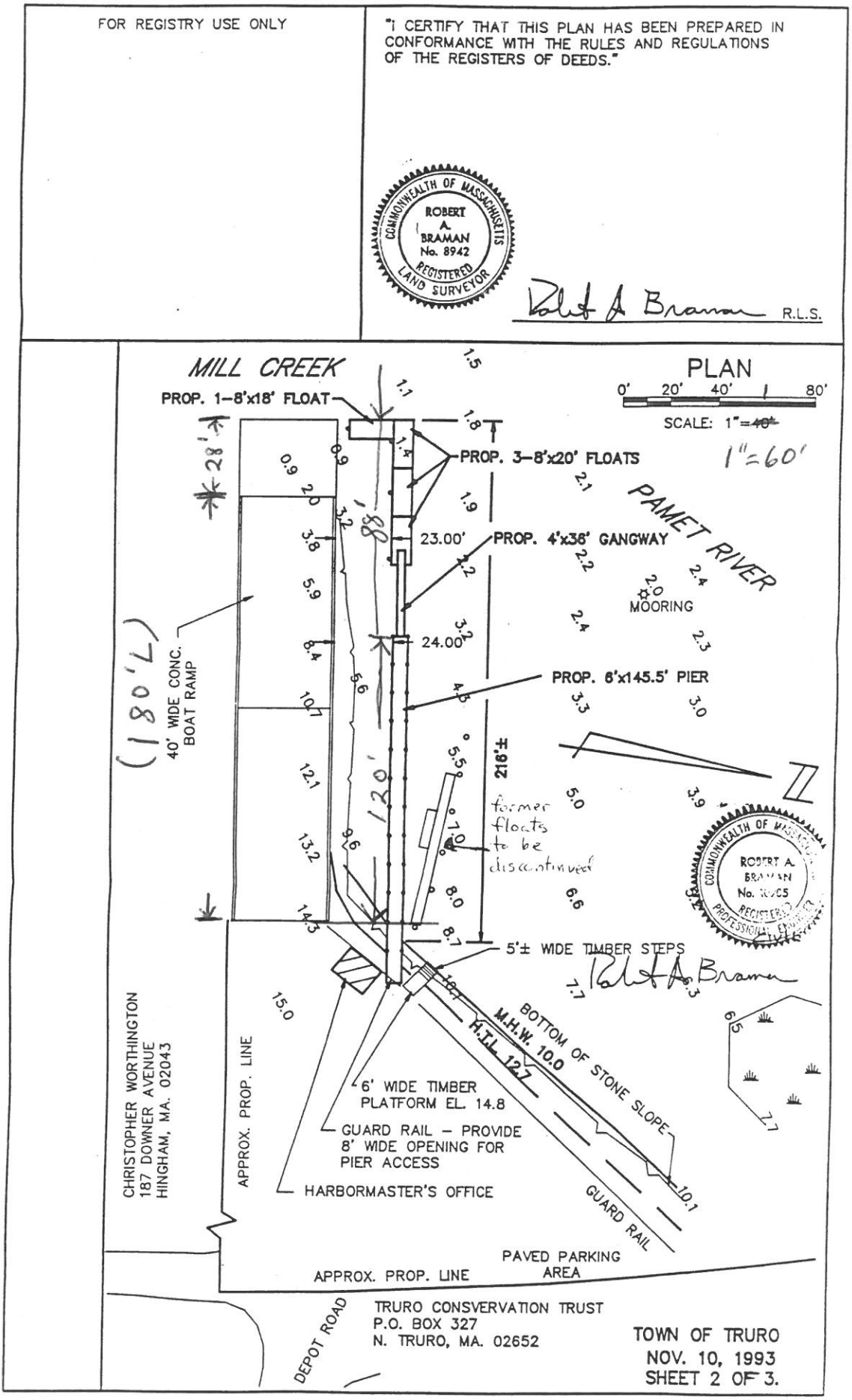
Table 1.

Pamet Harbor Boat Ramp Usage, 1987 - 1993

YEAR	DAILY PERMITS	NON-TRAILERED BOATS	TOTAL
1987	674	51	715
1988	898	47	945
1989	718	87	805
1990	616	63	699
1991	563	85	648
1992	677	119	796
1993	783	115	898

Source: Town of Truro, Annual Reports

FIGURE 3.
PUBLIC ACCESS BOARD, DOCK AND FLOAT SYSTEM, 1993



The Pamet Harbor Yacht Club maintains a small boat dock for seasonal use, as does a Great Hills homeowner on the west bank of Eagles Neck Creek. The activities of the Yacht Club previously included a vigorous dinghy sailing instruction program, though that has dwindled due to lack of sailing space in the harbor, shoaling and changing demographics of club members (fewer children, more older members). Sailing instruction in Cape Cod Bay is undesirable owing to frequent strong winds and rough conditions.

There has never been the boom of private dock-building in the Pamet, as experienced elsewhere on Cape Cod in the past ten years, because most landowners accept the navigation limitations imposed by the shallow river upstream of the harbor. There are less than three lots in the harbor study area which could have potential for private docks. The Local Comprehensive Plan presumably could concern itself with this phenomenon upstream, if dock-building becomes a problem in the future.

In the past, periodic maintenance dredging was used to keep the mooring basin and the entrance channel at sufficient depth. Last dredged in 1968, a dredging project is currently being planned by Massachusetts Department of Environmental Management for commencement in the fall of 1994. This work is aimed at making the previously-licensed channel (60 feet wide, 4 - 6 feet deep) and basin (600' x 200') navigable over more parts of the tidal cycle. The dredged basin extends from the parking lot south to the Yacht Club. The channel extends from the basin west through the jetties 1,000 feet into Cape Cod Bay. The dredged area includes intertidal and subtidal lands now owned by the Town, Dalsheimer, Truro Conservation Trust and three small lots owned privately between the Yacht Club and boat ramp.

The concentration of boats and boating facilities near the parking lot and ramp has resulted in decreased opportunities for swimming in that area. Previously, through the mid-1980s, the town bounded a "Grandmother's Beach" swimming area adjacent to the parking lot, but state regulations governing distance separations between boating and swimming have resulted in the closure of that facility. (324 Code of Massachusetts Regulations 2.03(4) states: "Camping, swimming, sleeping, and picnicking activity shall not be permitted within the boundary of the Public Access Facility.") Another

potential impact associated with boating is the discharge of human wastes. However, none of the boats currently in the harbor is of sufficient size to allow living-aboard and overnight transients, while accommodated, are non-existent in practice. Therefore, the likelihood of significant levels of human discharges are limited. A portable toilet, located next to the Harbormaster's office, also precludes this problem. The Harbor Commission applied and recently received a grant to help fund a portable type sewage disposal unit.

2. Other Infrastructure

Roads leading to the harbor are narrow and winding, such as Depot, Old County and Mill Pond Roads. Some residents have expressed concern that these roads are not capable of accommodating increased vehicular traffic associated with any expansion of boating activity at the Harbor. Despite this concern, the Truro Police Department reports that from January 1991 through April 1994 there was only one accident on Depot Road and one minor accident in the harbor parking lot that was associated with boat-trailering. Most of the large boats are trailered only twice per year (in and out) and during the off-season. Some town officials believe that, if the harbor was dredged, trailer traffic would be spread out over a greater length of time during the day, rather than being concentrated around periods of high tide, as it is now, thereby reducing the risk of accident.

The town-owned railroad bed, extending a half-mile south from the Corn Hill parking lot, is an underutilized public resource. It is high, flat and dry and is suitable as a walking or bicycle trail. It offers panoramic views of the harbor and Pamet Valley and plenty of public parking at Corn Hill. Unfortunately, few people use it as a walking path, probably because it dead-ends at the river where the former trestle (dismantled 1969) was located. Much enthusiasm among the HMPC and public hearing participants greeted the consultants' proposal that a footbridge be re-established over the river to connect the railroad bed with the harbor parking lot, which would create a continuous loop around the lower Pamet up to Wilder's Dike (Route 6A). Subsequently, three letters have been received by the HMPC from sailboat owners upriver of the former trestle, objecting to the idea in that it would block their access to the bay. This proposal clearly needs more definition

before implementation, but the popularity of walking as the number one exercise amongst Americans should not be discounted.

Town beaches exist at Corn Hill (Gull Island) and Fisher Beach (off Fisher Road). The former has a large parking area to accommodate 200+ vehicles and is the town's primary supervised swimming beach on the Bayside. Fisher Beach is disconnected from the town landing at the end of Fisher Road by intervening private properties. Nevertheless, the public traditionally traverses the beach of these private lots to reach the town-owned land stretching to the harbor jetties. Both town beaches are popular for swimming and surf casting. Both are used for off-road vehicle recreation. A small, informal swimming area is used just inside the south jetty very close to the meandering Pamet Harbor channel. There is a need to separate this swimming hole from the boating channel for safety reasons.

For a description of the harbor jetties and their history, consult the 1987 Greenway Plan.

Man-Made Resources: Summary Findings:

1. The Town or State owns most of the submerged lands proposed for dredging.

2. Increased development upriver could threaten the visual beauty of the Pamet Valley.

3. Pamet Harbor has not been dredged in over 25 years. Shoaling has resulted in a very limited period of safe navigation during each tidal cycle. Boating user-hours, both commercial and recreation, have diminished as the harbor becomes increasingly less navigable.

4. Most Truro citizens believe the harbor is approximately at equilibrium in terms of number of boats and ratio of commercial to recreational and power to sail. Most believe that making the harbor more useful for the uses that are currently enjoyed is more important than expanding uses or number of users. Ice availability is the only new

amenity enjoying public and official support. There is neither official nor popular support for providing boat fuel at the harbor.

5. The Corn Hill railroad bed offers a fine opportunity to create a walking trail. If connected to the harbor parking area by a footbridge, its effectiveness and popularity would be greatly enhanced.

6. The Town has accepted state regulations which limit swimming opportunities adjacent to the boat ramp, pier and channel. Other close-by locations can be explored by the Town. However, the HMPC has been unable to identify a safe location for swimming at the harbor.

II. Natural Resources Inventory

The extensive description of natural resources and features given in the 1987 Pamet River Greenway Management Plan (Greenway Plan) is still valid and current, with some exceptions, and should be consulted for more detailed information. For example, twelve pages of data and analysis related to the Pamet's shellfishery are given in the Greenway Plan. In addition, much of this data is depicted visually in the maps presented in Chapter 5 of this report.

A. Coastal Processes (See also, Chapter II.B.3 of Greenway Plan)

The Pamet is a deep valley, carved by glacial runoff approximately 15,000 years ago. It is a flood-dominated estuary, meaning that flood tide currents exceed those during ebb tide. This results in a net transport of sediments into the harbor and causes shoaling. The Pamet's inlet changed cyclically, with the northward migration caused by longshore drift, followed by break-throughs further south. A diverse ecosystem comprised of salt marshes, tidal flats, barrier beaches and dunes provides a unique habitat for a variety of shellfish, finfish, a variable population of terns, mammals, other birds and humans. Although humans probably are the minority (in numbers) within this ecosystem, they have had, and will likely continue to have, the greatest impact on the Pamet.

The most significant disruption to the ecosystem during its first 15,000 years was caused by residents who (beginning in 1869) built railroad bridges, a highway bridge and various other dikes to provide access (and swamp gardens) across the Pamet. This diking converted the upper Pamet to a freshwater system. Some argue that this has provided greater biological diversity within the Pamet, providing freshwater habitat east of Route 6. Others argue for a restored ecosystem in its natural state.

1. Harbor Morphology Modifications: Artificial Inlets and Dikes

The coastal processes at Pamet Harbor interact in a complex fashion to mold the harbor and beach into a constantly evolving coastal system. The dominant coastal processes include winds, tides, waves and currents. The combination of these processes result in sediment transport along the beach and within the harbor in the form of shifting shoals. Although the unpredictable nature of the coastal processes at Pamet create a dynamic, constantly changing environment, it is possible to make predictions on future shoreline and harbor change based on a study of the history of the area.

A variety of studies have been completed describing the history of the Pamet Harbor area. These include Geise and Westcott (1980, funded through an MCZM Community Assistance Grant), Fitzgerald and Levin (1981), Geise and Mello (1985), Robinson (1987), Lewis (1989), Massachusetts Shoreline Change Project (1989), and Geise et al., (1990). These reports indicate that in the early 1800s, the harbor supported a vibrant maritime economy. Today the Harbor is still an important recreational asset to the Town, but its value has been diminished by severe shoaling, poor water quality and beach erosion. These problems have resulted from the interaction between human activities and the dominant coastal processes.

Prior to human influence, the natural inlet at Pamet Harbor showed a tendency for northward migration. This migration was the result of a net northerly longshore sediment transport. The eventual result of such a northward migration would normally be for a new inlet to break through the barrier beach at a more southerly location, allowing the old inlet to shoal and eventually close off. A modern day example of this inlet formation process is

the new breach in Chatham. At Pamet Harbor, this cycle was interrupted by human attempts to stabilize the inlet near its present location. An inlet was dredged in this location in 1918-1919 and was also stabilized by stone jetties. New jetties were constructed at the inlet in 1950-1951 and the channel was dredged in 1965, and again in 1968.

The Pamet Harbor system has also been altered by the construction of dikes with tidal gates that reduce or severely restrict the tidal prism. The major barrier, Wilder Dike, was constructed in 1869 to replace a rotting bridge across the mid-section of Great Pamet, and in the mid-1950s fill for Route 6 was placed across the Pamet Valley several hundred feet east of Wilder Dike. A culvert was placed under Route 6 to provide drainage from the freshwater marsh east of the highway. Dikes were also placed across Little Pamet, Mill Creek and Bang's Creek for a railway in the 1860s.

Geise and Mello (1985) estimate that 50-60 percent of the Pamet's historical salt marsh has been converted to freshwater wetlands, including all of the Little Pamet, due to such dikes. Dikes were also built to convert wetlands to agricultural uses, such as the Mill Pond and Head O'Pamet cranberry bogs. In most cases, culverts were placed under the dikes allowing only one-way (seaward) drainage.

The intended benefits of the dikes either never materialized or are now obsolete. The railroad is gone. Commercial agriculture is no longer viable, and the cranberry bogs are abandoned. Dikes carrying roads have made townwide transportation more convenient, but bridges or larger culverts could accomplish the same purpose.

Three primary negative impacts of diking on the Pamet Harbor are:

1. Mosquito Control officials report that the effects of the dikes have made their ditch and drainage work more difficult. This has resulted in increased debate between Cape Cod Mosquito Control and the Cape Cod National Seashore about the practice of ditching to drain the marshes.

2. The dikes tend to decrease flows throughout the Pamet system, thereby increasing sedimentation. This is likely contributing to shoaling in the Harbor and exacerbates the need for maintenance dredging.

3. A smaller volume of seawater, also known as the tidal prism, exists because of the dikes, which limits the area of shellfish propagation and obstructs fish from breeding in the upper reaches of the Pamet.

Review of previous studies indicate the combination of inlet stabilization and dike construction has resulted in an increase in harbor sedimentation, a reduction in water quality, and beach erosion. Construction of jetties at the inlet entrance created a temporary block for northward moving littoral drift. Sand accumulated behind the southern jetty until the shoreline built out to the end of the jetty. This interruption in littoral drift resulted in erosion of the shoreline above the north jetty. At this point, the effectiveness of the jetty in blocking littoral drift from entering the inlet was severely reduced. (See Figure 4.)

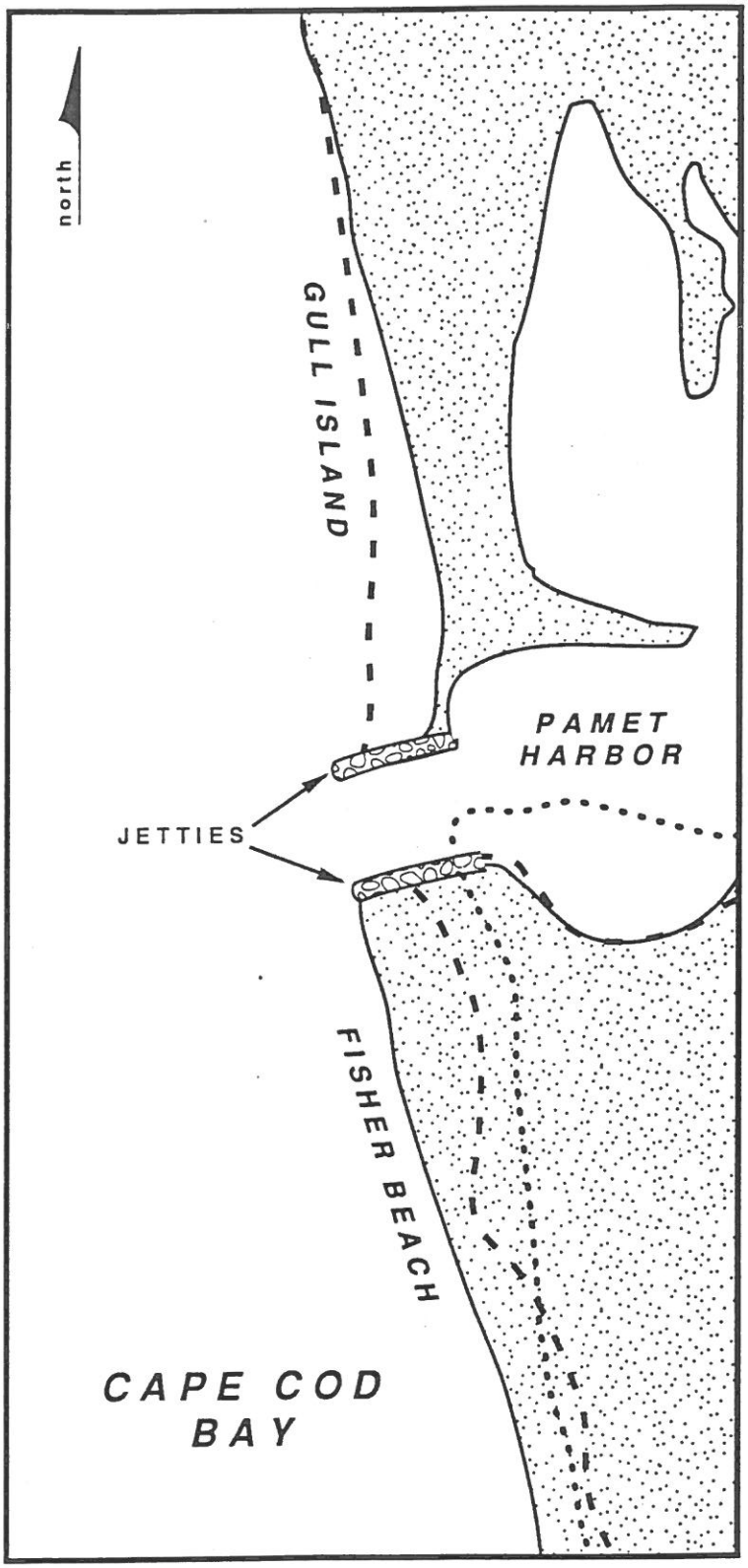
During flood tides, sand is transported around the end of the jetty into the harbor and deposited on the flood-tidal shoals. During ebb tides, small quantities of this sand are transported back to the ebb-tidal shoal, and are then available for continued northerly transport. However, because of the reduction in tidal prism created by the dikes, the current velocities within the channel have been reduced and the self-flushing capabilities of the channel are limited. This compounds the shoaling problems in the harbor, since the current velocities are not high enough to scour a natural channel. (See Map 2.)

The high sedimentation rates within Pamet Harbor are therefore due to accretion of the beach out to the west end of the south jetty, and resultant sediment transport into the inlet entrance during flood tides. Low current velocities and reduced tidal prism created by construction of the dikes has also contributed to sedimentation within the harbor. Additionally, the reduction in tidal prism has resulted in decreased water quality and tidal flushing. Erosion of the northern barrier beach has been caused by a reduction in

FIGURE 4.

Pamet Harbor Shoreline Changes

Truro, Massachusetts



Net littoral drift of beach sediment near the mouth of Pamet River is from south to north. Due to the presence of stone jetties at the mouth in this century, interrupting this flow of sand, Fisher Beach has experienced accretion (build-up) of sediment, while Gull Island has eroded. (See also, Giese, 1980 and Fitzgerald/Levin, 1981.)

Shoreline at Mean High Water

1933 .....

1951 - - - -

1978 ~~~~

SCALE: 1 inch = 425 feet

Source: Based on data from Massachusetts Coastal Zone Management Office, "Massachusetts Shoreline Change Program", 1985. (Map 0013)

available sediment supply, as northward moving littoral drift is trapped by the south jetty and then transported into the harbor.

2. Sediment Quality

A knowledge of the sediment quality within Pamet Harbor is important for several reasons. First, the disposal methods associated with a planned dredging project within the harbor could be affected by poor sediment quality. Second, the type and quality of sediments identified can be used to infer potential environmental problems related to oil spills, boating impacts and poor water quality.

On September 22, 1992, Aubrey Consulting, Inc. (ACI) collected a series of surface grab samples in the Pamet Harbor. These samples were collected in a variety of locations, including the mooring basin, tidal flats, entrance channel and adjacent barrier beaches. A qualitative analysis was performed on the samples to identify the general sediment characteristics. Samples collected from the outer shoals and barrier beach are composed of clean, well-sorted medium to coarse-grained sand. Those samples collected from the channel and shoals immediately inside the inlet entrance are composed of clean medium-grained sand with trace amounts of organics. Fine gravel sediments with organic deposits were found within the deepest portions of the mooring basin near the public launching ramp. These sediments consisted of silty material with traces of peat. Samples collected from the tidal channel leading south from the mooring basin contained medium-grained sand and traces of peat.

Subsequent to ACI's qualitative analysis, the Department of Environmental Management commissioned Coastal Engineering Co. Inc. of Orleans to conduct a quantitative analysis of sediment size and quality to define the disposal options for dredged material. The results are given in Appendix D. They essentially confirm the qualitative results from ACI, suggesting that the majority (72 percent) of the spoil can be used effectively and compatibly as beach nourishment sand, presumably along eroded portions of Gull Island, while the remainder is expected to be adequate as an intermediate cover for the Truro Town Landfill.

3. Localized Erosion and Sedimentation

Although systemic erosion and accretion patterns are discussed above, localized potential erosion problems also exist. Some evidence of small-scale scouring resulting from propeller wash is found at the toe of the twin boat ramps. Also, recent patching with unvegetated soil of the parking lot shoulder facing the water could cause minor sedimentation into the harbor. This bare soil patching is also found at the Mill Pond Road dike repair, conducted in spring 1993.

Estimated at a rate of one foot per 100 years (Geise et al, 1990), sea level rise, and subsequent flooding of tidal areas with organic sediments, is deemed responsible for the increase in elevations of salt marshes in Pamet Harbor relative to the fresh marsh in the upper Pamet. The culvert at Route 6 prevents the upper Pamet from receiving the same sediment supply. This lack of hydraulic head hampered efforts to drain the storm-inundated upper Pamet during Ballston Beach overwashes in 1991 and 1992.

Coastal Processes: Summary Findings:

1. Net transport of beach sediments is south to north along Cape Cod Bay near Pamet, and west to east into Pamet Harbor. Owing to the artificial inlet maintained by the harbor jetties, this sand movement results in chronic accretion along Fisher Beach, erosion along Gull Island, and accretion (shoaling) inside Pamet Harbor.

2. Dike construction throughout the Pamet River system has reduced tidal volume, converted saltwater habitats to fresh, reduced water quality and contributed to shoaling inside the harbor.

3. Preliminary sediment testing within the harbor suggests that contamination does not exist and that most of the proposed dredge material has compatible grain size to be used for beach nourishment. The remainder is suitable for use as landfill cover.

B. Water Quality (See also, Chapter II.B.3 of Greenway Plan)

The Massachusetts Division of Water Pollution Control has classified the waters of Pamet Harbor as SA, meaning that the highest anti-degradation standards must be met (see Table 2).

1. Shellfish/Beach Closures

In November, 1986, under the authority of Massachusetts General Laws, Chapter 130, Section 74A and 75, the Massachusetts Department of Environmental Quality Engineering (now DEP;since 1986, this authority has been transferred to the Massachusetts Division of Marine Fisheries.) closed "the waters, flats and all tributaries thereto of Pamet Harbor and Pamet River, east of a line drawn south across the east end of the jetties at the mouth of Pamet Harbor". Prior to this the Truro Board of Health in 1985-1986 temporarily closed the shellfishing area. These closures had been in effect almost continuously since then until November 7, 1993 when the state allowed the town to re-open the Pamet shellfish beds (west of the railroad bed) to recreational harvesting. Initial reports indicate that the stocks of soft-shell clams, quahogs, and blue mussels are plentiful, along with a more limited oyster population.

These closures have been based upon water quality data collected (primarily) at eight stations along the Pamet. Five of these stations are within the study area (see Map 3). Water samples were tested for total and fecal coliform bacteria, both of which are non-pathogenic bacterial indicators of other possible bacteria which may be pathogenic. The water quality standard for shellfishing areas is 14 organisms/ml (fecal coliform). Fecal coliform bacteria are derived from warm-blooded animals (including humans).

Four possible sources of coliform bacteria exist: 1) storm water runoff, 2) wildlife sources/domestic animals, 3) boat wastes, and 4) septic systems. Several surveys of the condition of septic systems within the watershed suggest that failing septics are not the primary source of coliform pollution (Davidson, 1992). Specifically, the Truro Greenway Committee conducted a septic system survey in 1985, based upon septage hauler's reports on file with

Table 2. **Coastal and Marine Water Quality Classifications**

Class SA - These waters are designated as an excellent habitat for fish, other aquatic life and wildlife and for primary and secondary contact recreation. In approved areas they shall be suitable for shellfish harvesting without depuration (Open Shellfish Areas). These waters shall have excellent aesthetic value.

- Dissolved Oxygen - (a) Shall not be less than 6.0 mg/l unless background conditions are lower; (b) natural seasonal and daily variations above this level shall be maintained, levels shall not be lowered below 75 percent of saturation due to a discharge; and (c) site-specific criteria may apply where background conditions are lower than specified levels or to the bottom stratified layer where the Director determines that designated uses are not impaired.

- Temperature - (a) Shall not exceed 85°F (29.4°C) nor a maximum daily mean of 80°F (26.7°C), and the rise in temperature due to a discharge shall not exceed 1.5°F (0.8°C); (b) natural seasonal and daily variations shall be maintained, there shall be no change from background that would impair any uses assigned to this class including site-specific limits necessary to protect normal species diversity, successful migration, reproductive functions or growth of aquatic organisms; and (c) any determinations concerning thermal discharge limitations in accordance with Section 316(a) of the Federal Act will be considered site-specific limitations in compliance with these regulations.

- pH - Shall be in the range of 6.5 - 8.5 standard units and not more than 0.2 standard unit outside of the normally occurring range. There shall be no change from background conditions that would impair any use assigned to this class.

- Fecal Coliform Criteria - (a) Waters approved for open shellfishing shall not exceed a geometric mean MPN of 14 organisms per 100 ml, nor shall more than 10 percent of the samples exceed a MPN of 43 per 100 ml (more stringent regulations may apply (see §4.06 (1)(d)(4) of the Massachusetts Surface Water Quality Standards); and (b) waters not designated for shellfishing shall not exceed a geometric mean of 200 organisms in any representative set of samples, nor shall more than 10 percent of the samples exceed 400 organisms per 100 ml. This criterion may be applied on a seasonal basis at the discretion of the Division of Water Pollution Control.

- Solids - These waters shall be free from floating, suspended and settleable solids in concentrations or combinations that would impair any use assigned to this class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.

- Color and Turbidity - These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class.

- Oil and Grease - These waters shall be free from oil and grease and petrochemicals.

- Taste and Odor - None other than of natural origin.

the Truro Board of Health. This survey identified 14 systems which received more frequent than normal pumpouts. One of these systems, the Pamet Laundry utilized a discharge pipe and was determined to be a source of coliform contamination. In 1986, the Laundry did not receive a permit to re-open and has been abandoned.

Another study of septic systems was completed by Richard Lewis II and C.S. Davidson, M.D. (1990). The authors visited approximately 75 percent of the septic systems abutting the river. This study concluded that septic systems are not a likely source of the elevated coliform concentrations. Viruses, however, were noted as a possible threat as they are significantly more mobile in ground water and have been demonstrated to travel great distances in sandy soils. For example, a study of septic systems on Long Island, New York, documented viruses at a distance of 183 meters (610 feet) from septics. Based upon ambient ground water temperatures in Truro and an average ground water flow velocity, viruses can be expected to move approximately 120 feet from septic systems towards the Pamet. Dilution within the harbor would significantly affect actual viral concentrations in the shellfishing waters.

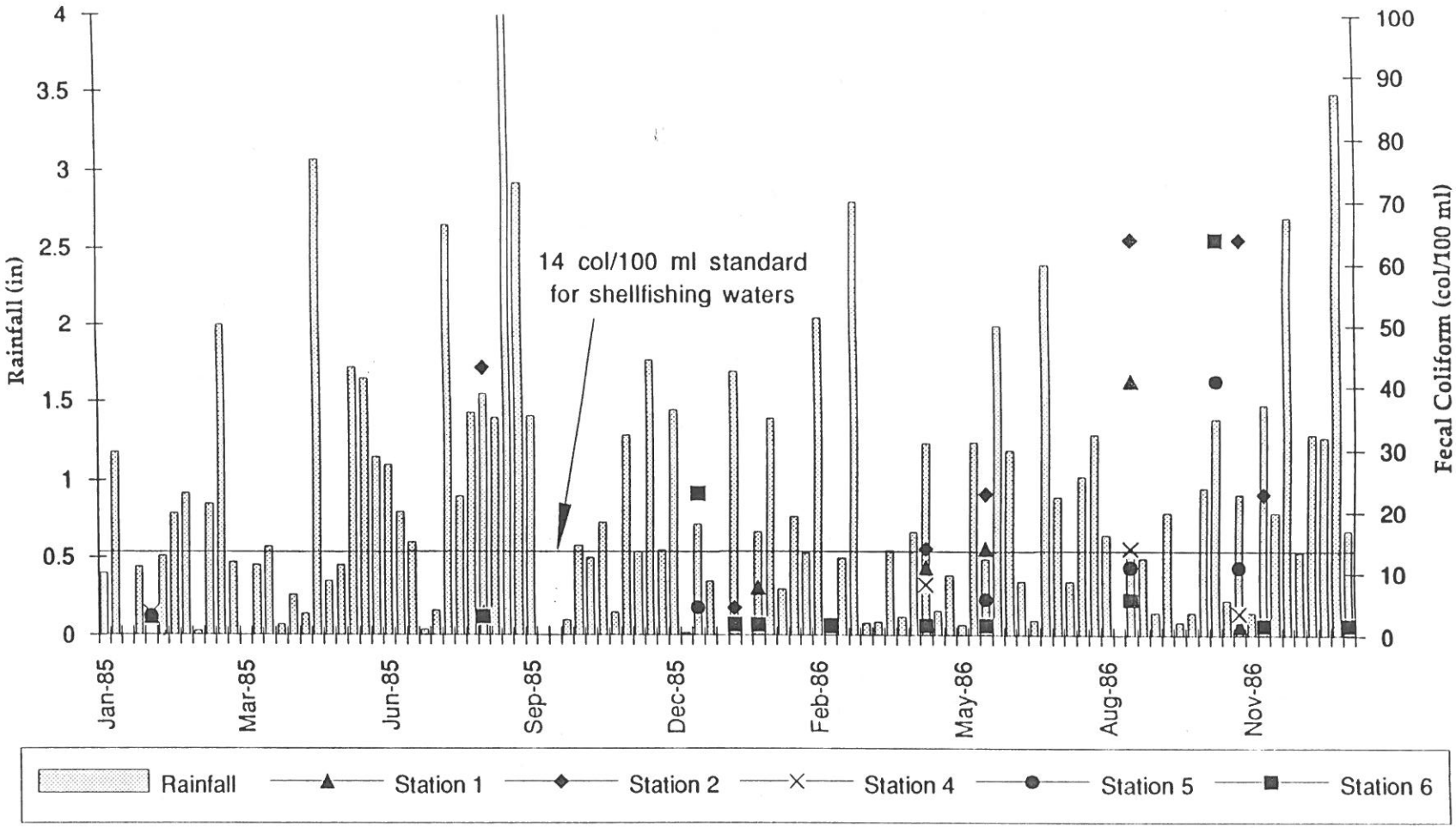
2. Stormwater Runoff

Stormwater runoff has been identified as the major contributor to coliform problems in shellfishing areas throughout the Cape Cod region. An analysis of water quality data suggests a relationship between rainfall (runoff) and high coliform levels (Figure 5). Historically, rivers have been used as receiving waters for stormwater runoff to prevent flooding of roadways. Several pipes which discharge road runoff into the Pamet system are located at Meetinghouse Road, South Pamet Road and Wilder's Dike (see Map 4). The first two of these have recently been upgraded to prevent in-water discharge.

The majority of the runoff from Route 6 (between Edgewood Farm and Unionfield Road) collected in highway catchment basins and discharged into the river at the Pamet Roads exit ramp. A study conducted by M. Kim (1990) that included sampling actual runoff water sources during and after two rain events at the Route 6 bridge demonstrated very high concentrations of fecal

FIGURE 5.

Comparison of Rain Events to Coliform Concentrations - Pamet Harbor, Truro, MA



coliforms (eleven samples averaging 45,800 organisms/ml). In 1993, the State Highway Department re-engineered this drainage system to divert most highway stormwater to leaching basins. No follow-up water quality monitoring has been conducted at this site to determine if the realignment has had a beneficial effect.

Water quality samples taken from the Depot Road parking lot at the boat ramp also indicated high coliform levels (Snow, 1992). A verbal commitment by the Public Access Board to divert parking lot runoff into infiltration systems has been made, but no formal design work has ever been presented to the town.

Bacterial analyses conducted as part of the EPA Buzzards Bay Project suggest that bacteria may be stored (and possibly concentrated) within portions of the ecosystem. Specifically, beach wrack (which is comprised of decaying plant matter and other debris) has been found to accumulate coliforms and prolongs the survival of the bacteria. Fine-grained sediments within the Harbor near the stormwater discharge points, as well as the extensive salt marsh peat, may function similarly.

A water quality study conducted by Richard Lewis II (1989) analyzed and concluded that "the limit for swimming closure was frequently exceeded at: 1) low tide in the river, 2) all the time in the creeks, and 3) everywhere in the basin after a rain event." This suggests that the primary sources of coliform pollution are rain-induced stormwater runoff. Ratios of fecal coliform to fecal streptococcus (of less than one) indicated that animal (versus human) sources were responsible for the elevated bacterial levels.

3. Nutrients

Very little information is available concerning nutrient concentrations in Pamet Harbor. No symptoms of eutrophication such as low dissolved oxygen or eelgrass declines have been documented.

However, it is clear from other estuarine studies throughout the Cape Cod area that nutrient enrichment can result in algal blooms (large populations

which are normally visible). Algal blooms can reduce the oxygen content of estuaries, endangering fish and marine invertebrates. Though no eelgrass is present in the Pamet, algal blooms can cause epiphytes to grow (plants growing on other plants) on eelgrass, reducing its habitat value. Algal blooms can be acute events (once in a while) or chronic (regularly occurring); chronic blooms indicate that a water system is undergoing eutrophication.

A water quality study of the Little Pamet River by William Doolittle (1975) found increasing concentrations of nutrients along the Little Pamet River proceeding from Route 6 toward the river's mouth. The report, however, also indicates that little flow actually enters Pamet Harbor.

A water quality assessment tool developed as part of the EPA-sponsored Buzzards Bay Project may be useful in evaluating nutrient impacts in Pamet Harbor. This tool sets nitrogen loading limits based upon the flushing rate and size of the receiving water body. For a shallow coastal embayment with a flushing rate of 4.5 days or less, SA-classified waters have a nitrogen loading limit of 200 mg/cubic meter/Vr (Vr = Vollenweider flushing term). Waters classified as "Outstanding Resource Areas" (such as Pamet) have a nitrogen loading limit of 100 mg/cubic meter/Vr.

Horsley & Witten, Inc. applied this tool to the Pamet by analyzing the land uses within the watershed (ground water drainage area) to Pamet Harbor, modeling the existing nitrogen loading. The number of septic systems within the delineated ground water drainage basin was estimated at 725 by counting houses on the USGS Topographic Quadrangle (1972), and updating this with land use/growth data contained within the Greenway Plan (1985). These data indicate that 79 new homes were built within the Pamet area during the 1980-1985 period, suggesting an annual growth rate of 13.2 new homes per year. This growth rate was used for the years 1972-1980. A growth rate of 6.5 new homes per year was used for the 1985-1993 period to reflect the economic recession.

Because no flushing rate is currently available for Pamet Harbor, Horsley & Witten, Inc. chose two conservative values of two and four days to provide a preliminary assessment of nitrogen loading. These estimates were based

upon the fact that the harbor nearly empties with each tidal cycle as evidenced by the exposure of extensive sand bars throughout the harbor. The actual flushing rate, therefore, may be closer to 0.5 - 1.0 days. However, without more definitive data, Horsley & Witten, Inc. used more conservative estimates of two to four days. The results of this modeling indicates that the respective nitrogen loading rates are seven and fourteen mg/cubic meter/Vr. These are well below the recommended standards, indicating that Pamet Harbor does not appear to be in any immediate danger of eutrophication.

4. Acidity

Although the upper Pamet River (east of Route 6) was not included in our study area, water quality analyses reported by Marine Research, Inc. (1985) suggest that this portion of the Pamet is low in alkalinity (ranging between 11 and 24 mg/liter), and therefore is poorly buffered against acidic impacts. Alkalinity is a measure of the ability of the water to withstand pH changes. This suggests that the upper portion of the river sensitive to acidic inputs such as acid precipitation, and those fish which spend part of their life cycle in the fresh portion of the river, may be affected (both lethally and sub-lethally) by increased acidity in the river. Sub-lethal effects include impacts other than death, such as shortened lifespan and reproductive ability. Increasing natural tidal flow to upper parts of the Pamet would buffer this acidic freshwater system.

5. Metals/Hydrocarbons

The introduction of metals (from bottom paint) and hydrocarbons (from engine exhaust and discharges) also represents a potential threat to the Pamet Harbor ecosystem. Although no studies of the Pamet are available, shellfish (and finfish) are capable of concentrating small amounts of metals and hydrocarbons from the water column and sediments into their tissue. Many sub-lethal effects, such as mutagenic problems, have been documented in shellfish elsewhere.

Stormwater runoff is the most likely contributor of metals, oils and other hydrocarbons to the Pamet Harbor. As mentioned previously in this report,

boat bottom paints and engine discharges may also be sources of metals and hydrocarbons. Owing to the few numbers of docks and other wooden marine structures, preservatives, such as creosote and CCA treatments, are unlikely to cause much effect on water quality. A chemical analysis of harbor sediments by Coastal Engineering Co. Inc. in 1993 indicate that neither metals (such as mercury and lead) nor oil and grease exist in elevated levels.

Water Quality Summary Findings:

1. From 1986 to 1993, portions of Pamet Harbor have been closed to shellfishing due to high coliform bacteria counts.

2. Available data indicates that the two most significant sources of coliform bacteria pollution are stormwater runoff from roads and wildlife sources within the estuary's extensive wetland system. Septic systems have not been proven to be a major source of bacterial pollution, though they may contribute viruses to the harbor.

3. The high coliform bacteria counts appear to be related to rainfall events, indicating that a "rainfall closure" might be implemented. This would allow for opening of the shellfishing areas between rain events.

4. A preliminary nitrogen loading analysis indicates that Pamet Harbor does not appear to be significantly threatened by excessive nitrogen inputs from septic systems, lawn fertilizers and road drainage.

5. Work is ongoing by the town and state highway departments to correct stormwater runoff problems to prevent direct discharge into the receiving waters of the Pamet. The re-opening of the Pamet to shellfishing may be related to this mitigation.

6. Metals and oil contamination of Pamet Harbor sediments has not been found, indicating that their presence in the water column is probably not significant.

7. Low alkalinity in the upper (freshwater) Pamet could be buffered by restoring tidal flow to its more original patterns throughout the estuary.

C. Shellfish and Finfish Resources

(See also, Greenway Chapter I.E and II.B.6)

Pamet Harbor, and the tidal portions of its tributaries, hold Truro's most important shellfish stocks. Consistent sets of soft shell clams (steamers) and hard shell clams (quahogs) accompany smaller, more erratic populations of oysters and bay scallops. Edible blue mussels have become more plentiful in recent years, even before the harvesting closures described above. Sea worms and sand eels are harvested regularly as bait for rod and reel fisheries for striped bass and bluefish, which are plentiful from the shore and by boat just off the harbor mouth in Cape Cod Bay. See Maps 2 and 3 for locations of these resources. According to the Truro Shellfish Officer, major shellfish beds are not located within the limits of the previously-licensed channel or boat basin. Likewise, no moorings are now located in shellfish beds as defined by the Division of Marine Fisheries.

Table 3.
Shellfish Harvests by Year (In Ten-Quart Pails)
Pamet River and Harbor, Truro MA

Year	Quahogs	Steamers	Oysters	Blue Mussels
1989-93		no data-beds closed		
1988	210	300	120	55
1987	375	410	206	110
1986	275	306	192	98
1985		no data		
1984	quahogs & steamers	870	320	115

(Source: Truro Shellfish Officer, 1993 and 1987 Greenway Plan)

According to a shellfish biologist of the Massachusetts Division of Marine Fisheries (DMF), the harbor shellfish beds are expected to remain open for harvesting except in summer periods when boats and bacteria growth are at

their peak. It is unlikely that upriver beds will ever re-open. Since the town has not allowed summer harvesting for many years (as a stocks conservation measure), public health bacteriological concerns about harvesting shellfish from areas near anchorages are not relevant to the Pamet. (Pamet Harbor is not technically defined as a "marina" by DMF because there are no boats secured to docks or slips. Similarly, because there are no live-aboards on Pamet boats, DMF is unlikely to use its discretionary authority to close the shellfish beds unless actual water quality data indicates high coliform counts.)

Management of the shellfisheries is conducted by a part-time town shellfish officer. No aquaculture is presently operated within Pamet Harbor, though some "backwater" areas, such as the mouth of the Little Pamet River and Mill Creek, possess sufficient nutrients and water quality and are not intrusive to vessel navigation.

As revealed by surveys, interviews and public hearings, shellfishing is one of the most popular activities in the Pamet among townspeople. Most residents believe that "restoring the usefulness" of the Pamet includes maintaining clean, healthy stocks of shellfish available for harvesting. There is no support for commercial shellfishing, though there are no apparent objections to the potential for unobtrusive aquaculture.

There is no anadromous fish run in Pamet River. Sea-run brown trout were stocked in the tidal river the early 1980s, but this practice has been discontinued by the Department of Fisheries, Wildlife and Environmental Law Enforcement.

D. Rare Species Habitat

(see also, Greenway Plan, Chapter I.E.)

Historically, both Fisher Beach and Gull Island have been used as nesting colonies for least terns and piping plovers, though the Massachusetts Audubon Society has not documented any nesting pairs there since 1984. These species are attracted to flat, unvegetated beaches and, in fact, are attracted to recent dredge spoils and beach nourishment projects as nesting habitat. A nourishment project proposed for six acres of Gull Island as part of

the disposal options for the imminent Pamet dredging project may reinvigorate the rare bird nesting sites there.

No rare plants, mammals or invertebrates are known to exist within the study area, according to the Critical Habitats Atlas of the Association for the Preservation of Cape Cod and the Massachusetts Natural Heritage Program.

Shellfish, Finfish, Rare Species: Summary Findings:

1. Pamet Harbor hosts the town's most significant shellfish beds. These beds have been more often closed than open between 1986 and 1993 due to bacteriological contamination. A recent reopening has revealed a large population of recreationally-important species, such as quahogs and steamers.

2. The ability to harvest clean shellfish is a very popular activity among townspeople in Truro. Efforts to promote water quality in the harbor would protect that resource and activity.

3. There is no anadromous fish run in Pamet.

4. No rare species are currently found within the harbor study area. Beach nourishment may enhance tern nesting habitat on Gull Island.

III. Harbor / Land Use Regulations

(See also, Greenway Plan, Chapter II.B.2)

Truro's land use regulations provide a blueprint for development and act to discourage or encourage land practices which have a direct impact on the Pamet Harbor's marine resources, water quality, coastal processes, and scenic vistas. There are several regulatory options available to guide land development including: zoning bylaws, subdivision rules and regulations, health regulations, wetlands bylaws, and waterways regulations. This section reviews current land use and water use regulations which affect Pamet Harbor. Additional review of Truro's land use regulations can be found in the Truro Local Comprehensive Plan, currently under development.

A. Zoning Bylaw

The type of land development which will occur in the Pamet Harbor study area is dictated by Truro's Zoning Bylaw. The intensity, location, and type of land development has a direct impact on the level of pollutants which will be released to the harbor ecosystem. The scale and type of permitted development also affects scenic vistas to and from the harbor. A recent study of the Pamet River ecosystem indicated that the Pamet River is experiencing increasing problems due to poor water quality (Lewis, 1989). The harbor has been closed to shellfishing intermittently since 1986 due to high bacteria levels. Potential sources of bacteria include the release of wastewater effluent from septic systems, stormwater runoff, and wildlife. Because Truro has no town sewer system (and unlikely ever to have one), the density of development provided through zoning would determine the number of septic systems used in the study area, and the volume of stormwater runoff generated owing to increased impervious surfaces, such as roofs and driveways.

A buildout analysis was conducted by Land Use, Inc. for the Local Comprehensive Plan in 1993. Land Use, Inc. reports that most of the Pamet River watershed has already been subdivided and that changing lot sizes in this area will have little impact. Still, this study also quotes the potential for approximately 2,000 additional lots townwide. It assumes that the ratio of seasonal to year-round houses will remain consistent at 2.1 and based upon this, a projected 640 additional year-round units and 1,360 additional summer units could be developed townwide. In the Truro Center area closest to the harbor, approximately 33 percent of the land is still available for housing development. (The LCP will be examining more specific buildout analysis and its expected impacts within the Pamet River watershed, but results were not yet available in June 1994.) Presumably, adding another third of the Pamet area's land into housing development will add a relative amount of increase in nutrients and potential contaminants in the river system.

Land in the drainage area to the Pamet Harbor is located in one or more of the following zoning districts:

1) Residential;
2) Truro Center Limited Business (shown as General Business on the Zoning Map);
3) Route 6 General Business;
4) Seashore District;
5) Flood Plain Overlay District.

The majority of the drainage basin is located in the Residential District. Permitted uses include single family dwellings, home occupation, civic uses, and agriculture-related uses. Uses requiring a special permit include: research facilities, raising of livestock, fur-bearing animals, or fowl, and marine installations. Uses which involve the raising or handling of animals may represent a significant source of nutrient and bacteria loading to nearby water supplies; therefore, their impact on the Pamet Harbor and River should be considered before a special permit is issued. Likewise, research facilities and marine installations can pose a threat to nearby water quality due to the handling and storage of hazardous materials.

A relatively small portion of the Pamet Harbor drainage area is zoned for business uses. The Truro Center Limited Business District and the Route 6 General Business District are located in the harbor's drainage area. These districts allow a range of retail, office, and business uses including activities such as auto service stations and repair garages which typically handle or store hazardous materials. There is presently no requirement that these uses which handle, store, or generate hazardous or toxic materials must obtain a special permit for operation. Land Use, Inc. also reports that fast-food restaurants are presently allowed in the Limited Business District and should be prohibited (draft Local Comprehensive Plan).

Land uses located in the Seashore District are restricted to conserve natural conditions, wildlife, and open space. Very little future development is expected in this district due to the lack of large remaining developable tracts of land. Permitted dwellings (built before 1959) are allowed to expand up to 50 percent in area, but this potential is not significant in terms of increased pollution load, owing to the small number of residences involved. Land Use Inc. recommends the town consider adopting a District of Critical Planning

Concern over the Seashore District to prevent æsthetic problems of new additions (draft Local Comprehensive Plan).

Truro regulates development in its Flood Plain District. Much of the low-land surrounding the Pamet Harbor is prone to flooding (see Map 11 of the Greenway Plan). Development in flood-prone areas may be restricted to prevent loss of life and property. On land designated as coastal high hazard areas, Truro requires that new construction be located landward of the reach of mean high tide. Man-made alteration of dunes is prohibited. On lands where construction is permitted, design controls have been adopted to minimize storm damage and loss of flood storage area. Lands affected by the Flood Plain District are expected to change over time due to coastal processes, such as sea-level rise. The Town of Truro may wish to amend its Zoning Bylaw to require the effects of sea-level rise be considered before any building permits for structures in the Flood Plain District are issued.

In addition to guiding the location, type, and intensity of development, zoning controls may be used to guide the character and aesthetics of an area. Pamet Harbor offers scenic vistas to residents and visitors alike. Land around the harbor consists of gently rolling bluffs and low-lying coastal dunes. The height and location of structures may be limited through zoning to protect scenic vistas from the water to the land and vice versa. The Truro Zoning Bylaw limits building height; however, vistas could be better protected through requiring structures to be placed at lower elevations whenever possible, rather than on the bluff ridges. Landscaping requirements may also be adopted to provide a natural scenic buffer between structures and the harbor. A 1990 viewshed analysis of the Pamet River Valley, conducted by the Truro Conservation Trust, provides data on scenic overlooks and public viewsheds (see Map 5).

The Truro Local Comprehensive Plan (LCP) identifies views, ridge lines and land along the river as key elements in Truro's landscape character (LCP, July 1993 draft) and adopts a goal to protect Truro's rural character. To do this, the LCP recommends consideration of a Pamet River Overlay zone to guide development along the river. Further, the LCP suggests that "all construction should seek a balance between the view of the river from the house and the

view of the house from the river." The HMPC recommends that this proposed Overlay adopt this suggestion and the Viewshed principles outlined above.

The Site Plan Review process is one tool which may be used to ensure compliance with design standards (such as building size, location, and landscaping) and water quality criteria defined in Table 1. Site Plan Review is currently required for large developments. However, the town may wish to require Site Plan Review for all new uses and structures located immediately adjacent to the harbor to provide better control of development impacts. Land Use Inc. recommends Site Plan Review for all non-residential developments (draft Local Comprehensive Plan).

B. Subdivision Regulations

Subdivision regulations "fine-tune" zoning bylaws by addressing site-specific design concerns such as street construction, utility placement, and traffic patterns in subdivisions.

It is believed that release of stormwater is one cause of high bacteria levels in Pamet Harbor. Subdivision regulations typically provide guidelines for drainage control. In order to minimize release of stormwater to the harbor, new subdivisions can be required to retain stormwater on-site through infiltration whenever possible. The use of vegetated swales and detention areas would also serve to contain stormwater-generated contaminants on-site.

C. Health Regulations

Local Boards of Health may adopt regulations to protect public health. Water quality is one important aspect of public health. The Town of Truro has adopted several regulations aimed at protecting water quality. On-site sewage disposal is often a major source of water pollution. The Truro Board of Health has adopted regulations which require that on-site disposal systems be upgraded to meet Title 5 standards of the State Sanitary Code prior to the sale of property, change of use, and land subdivision, or in cases where a system

requires frequent pumping (three or more times annually). Systems must also be upgraded to Title 5 standards before an applicant receives a building permit to increase living space, a special permit, or a new license or transfer of an existing license for operation of a motel, cottage colony, cabins, campgrounds, lodging house, or restaurant.

Regulations have also been adopted to minimize the release of toxic or hazardous materials town-wide. Landowners and petroleum or other chemical distributors are required to register fuel storage tanks with the Board of Health. Old tanks (over 15 years old) must be tested to detect leaks and all spills must be reported to the Board of Health, Fire Chief, and owner. Use of herbicides are only allowed with the approval of the Board of Health, with the exception of home application. Use of septic tank cleaners or cesspool cleaners which contain organic chemicals is also prohibited.

The Truro Board of Health has adopted regulations which are specifically aimed at protecting the town's surface waters, including Pamet Harbor. In 1987, the Board of Health adopted the Pamet River Protection District. In this district, no new septic systems may be installed within 100 feet of wetlands and all failing septic systems must be upgraded to meet Title 5 requirements. In 1988, the Board of Health adopted regulations aimed at minimizing negative development impacts on the town's surface waters. All commercial and multi-family developments must obtain a permit from the Board of Health to discharge septic system effluent. As part of the permit application, the developer must submit a nutrient loading analysis for nearby surface waters in cases where a septic system or fertilized lawn area would be located within 300 feet of a surface water or in the recharge area of a surface water, such as the Pamet River and Harbor. The developer must also explain how road runoff would be treated. In cases where the development would produce or store hazardous or toxic materials, the applicant must explain how these materials would be handled, stored, and disposed of, and their impact on public health and safety.

D. Wetlands Bylaw

Alteration of wetland areas is overseen by the Truro Conservation Commission in accordance with the Massachusetts Wetlands Protection Act (WPA). However, many Massachusetts communities have adopted wetland bylaws which offer increased resource protection beyond the minimum standards mandated by the WPA The adoption of local wetlands bylaws has been upheld by the Massachusetts Supreme Judicial Court. The Court recognizes that the state act serves as the starting point for wetlands protection. For example, local Conservation Commissions may adopt a local bylaw to protect local marine and inland resources through adopting additional development restrictions for lands directly or indirectly impacting these resources, or through protecting wetlands for specific purposes other than those included in the state act. Despite at least two attempts in the past ten years, the Town of Truro has not adopted a local wetland bylaw, the only Cape Cod town not to do so.

E. Waterways Regulations

The types and intensity of water uses, as opposed to land uses in Pamet Harbor, may in the future be controlled through adopting waterways regulations, such that the Harbor is effectively "zoned". Alternatively, an actual zoning district can be created separating incompatible waterways uses. In Pamet Harbor, uses such as swimming, SCUBA diving, and snorkeling are prohibited by the Harbor Commission in navigable waters. These regulations currently conflict with the de facto swimming done inside the south jetty. In addition, jet skis and hovercraft may only use navigable waters of the Pamet Harbor which extend from the launching ramp through the jetties as a means of egress. A speed limit of five miles per hour is imposed in the harbor to ensure safety (see Appendix G).

The Pamet Harbor Commission is "an appointed commission with responsibility for advising the Harbormaster and the Selectmen on the operation of the harbor and for authorizing expenditures from the Pamet Harbor Commission Operating Budget for salaries, utilities, buildings and equipment, and the Pamet Hydrographic Study and Engineering Services

Budget for Studies." The Harbormaster "is empowered to enforce all rules, regulations, bylaws, state and federal laws which apply to the Pamet Harbor and to any boats or other watercraft therein." In effect, the Pamet Harbor Commission recommends by-laws and regulations for adoption by the Town. The adopted by-laws and regulations are implemented and enforced by the Harbormaster. New Pamet Harbor bylaws were drafted by the Commission in 1993 to be acted upon at a Town Meeting. (See Appendix G.)

The Harbormaster also oversees the location and use of boat moorings. The town charges a fee for all moorings. Moorings are expected to be installed under the supervision of the Harbormaster and must be placed out of navigation channels and away from other boats. Moorings may not be transferred and reserved mooring locations are lost if they are not used for two consecutive years. A mooring plan was drafted in 1993 which segregated small boats to the non-dredged flats north of the basin, while enabling more efficient use of the deeper basin for larger boats and commercial vessels. The plan would also separate the mooring field from the dredged channel, enabling access to and from the boat ramps and the bay more safely, rather than having launched boats thread their way through the haphazard mooring field as in the recent past.

Water/Land Use Regulations Summary Findings:

1. Though the Pamet Valley is zoned predominantly for residential use, the Zoning Bylaw allows some commercial uses which represent potential water quality threats.

2. The Town has adopted a number of innovative health regulations, such as the Pamet River Protection District, which seeks to prevent septic system contamination of the Pamet through increased setbacks.

3. Truro is the only town on Cape Cod without a local Wetlands Protection Bylaw. Such bylaws can provide significant protection powers to protect resources such as Pamet Harbor.

4. The Town has adopted Waterways Regulations which effectively zone uses, such as swimming, SCUBA diving, and snorkeling (which are prohibited), in "navigable waters." The de facto swimming area inside the south jetty conflicts with this rule.

5. A mooring plan has been adopted by the town to increase the efficiency of the mooring field/boat basin, without requiring expansion of the basin.

6. The Pamet Valley retains many parcels which could be developed, potentially threatening the water quality and visual appeal of the watershed.

IV. Coordination With Local Comprehensive Plan

In 1991, the Town of Truro embarked on a process to produce a Local Comprehensive Plan (LCP) intended to be consistent with the Regional Policy Plan of the Cape Cod Commission, the county land-use regulatory agency. In 1992 Land Use, Inc. was hired as consultant for the plan. In July 1993 Land Use, Inc. produced an incomplete first draft of the LCP. The Harbor Management Planning Committee asked its consultant to review the LCP work to date (July 1993) to prevent incompatibility between the Harbor Plan and the LCP. It is expected that the LCP, being not as far along as the Harbor Plan, will likewise include the Harbor Plan's findings, goals and actions as it continues to refine its own work. (Please refer to the recommendations in the LCP for changes in the town's regulatory structure endorsed in this harbor plan.)

LCP sections available for review by HMPC were Land Use, Water Resources, Capital Facilities and Wetlands, Wildlife and Plant Habitat:

A. Land Use

The LCP reviewed the town zoning bylaw but had not completed work on the health regulations. The LCP analysis is consistent with HMPCs; where

HMPC's concerns are amplified by the LCP, they are noted in the Harbor Plan (4.III.)

B. Water Resources

The LCP identifies bacterial pollution of the Pamet as a major surface water quality issue. Its understanding of this issue conforms with that of HMPC. The LCP also confirms the HMPC's concern about stormwater and non-point sources of contamination.

C. Capital Facilities

The LCP does not include maintenance dredging and other harbor capital improvements in its analysis for future financial planning and perhaps should include them in both the narrative and infrastructure map for this section.

D. Wetlands, Wildlife and Plant Habitat

The LCP identifies the Pamet River as meriting a state designation as an Area of Critical Environmental Concern or county designation as a District of Critical Planning Concern. The HMPC takes no position on this issue, but believes that a strong, locally-adopted wetlands protection bylaw may accomplish the same end, while keeping primary regulatory control local. The HMPC and LCP both endorse the idea of a local wetlands bylaw.

V. Priority Issue: Enhancing Navigability

On October 12, 1993 the Harbor Management Planning Committee deliberated on the emphasis and priority of issues identified in the draft harbor plan. The list agreed upon by the Committee, in descending order of importance, is as follows:

- Navigability and Harbor Safety
- Water Quality
- Shellfishing

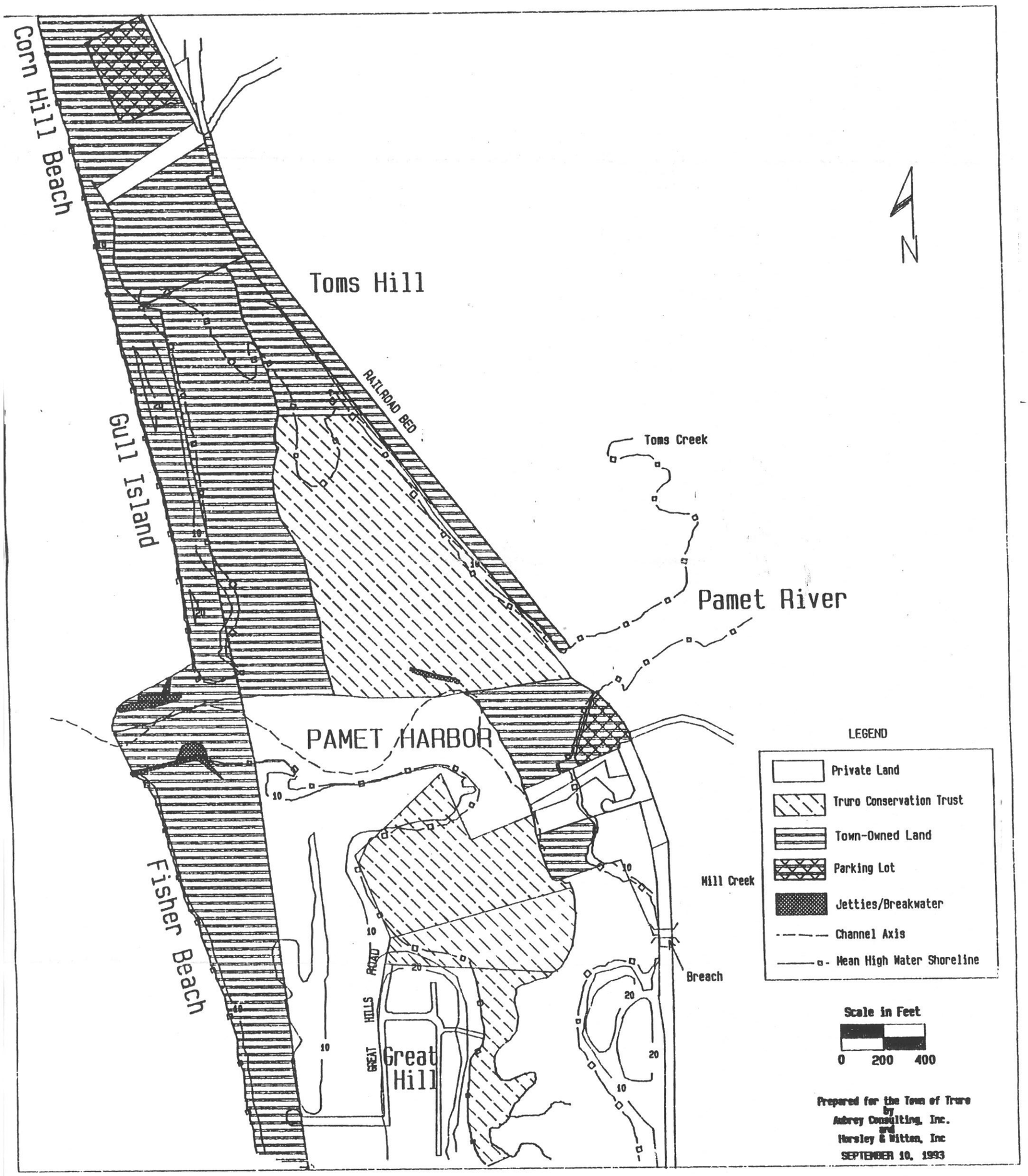
- Public Access
- Moorings
- Facilities for Some Commercial Fishing
- Fiscal Management
- Land Use - Landscape and Visual Quality*
- Natural Resource Protection*

*The last two goals were seen not so much as lower priority issues, but as themes that should be considered throughout the recommendations pertaining to the other issues.

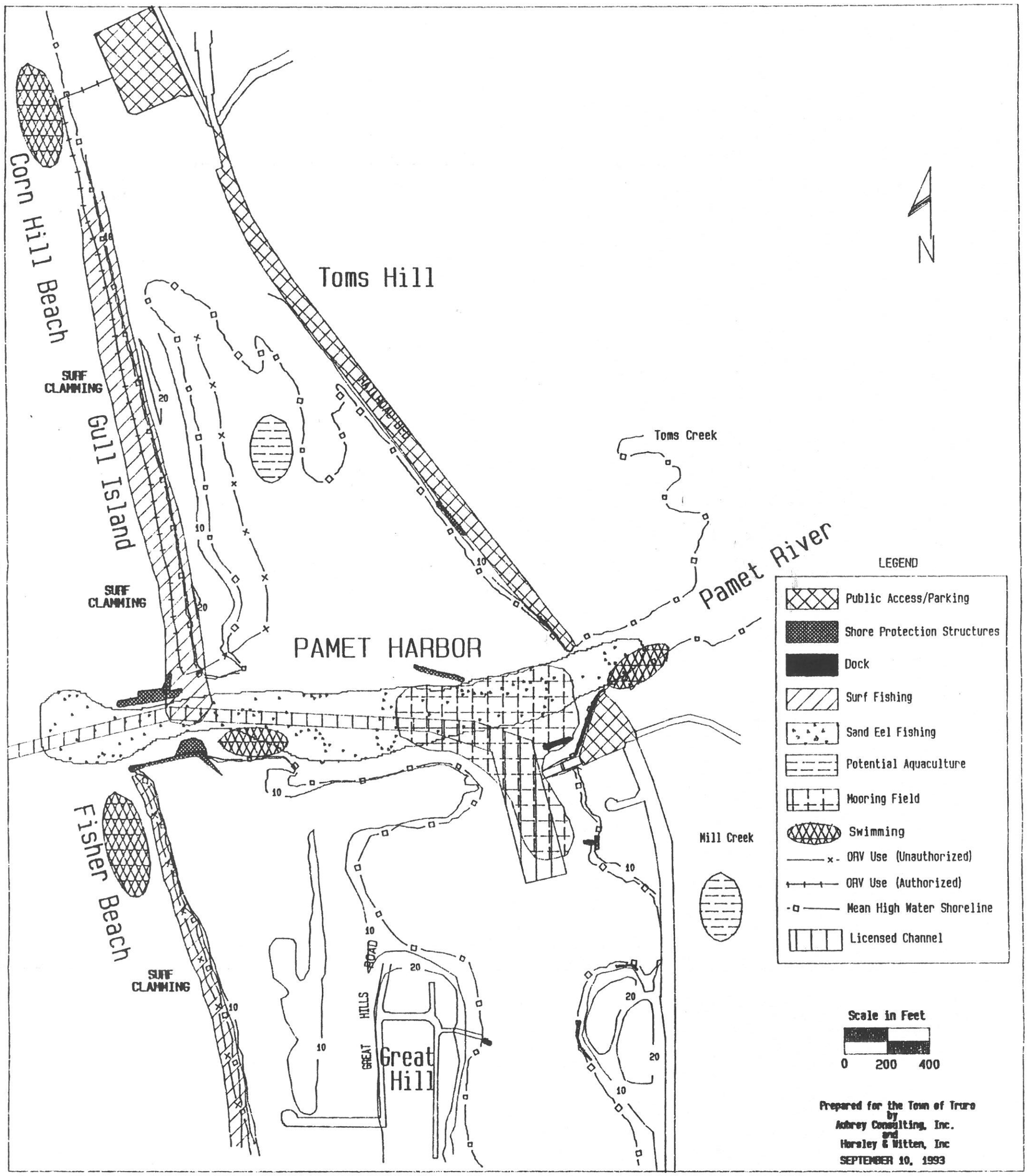
The priority of the Navigability and Harbor Safety issue is clearly related to the fact that boating is severely hampered in Truro's only harbor owing to shoaling problems in the channel and boat basin. The Harbor Plan examines this issue and the options to correct this perceived deficiency in Chapter 7 (Navigation Alternatives Analysis).

5. MAPS

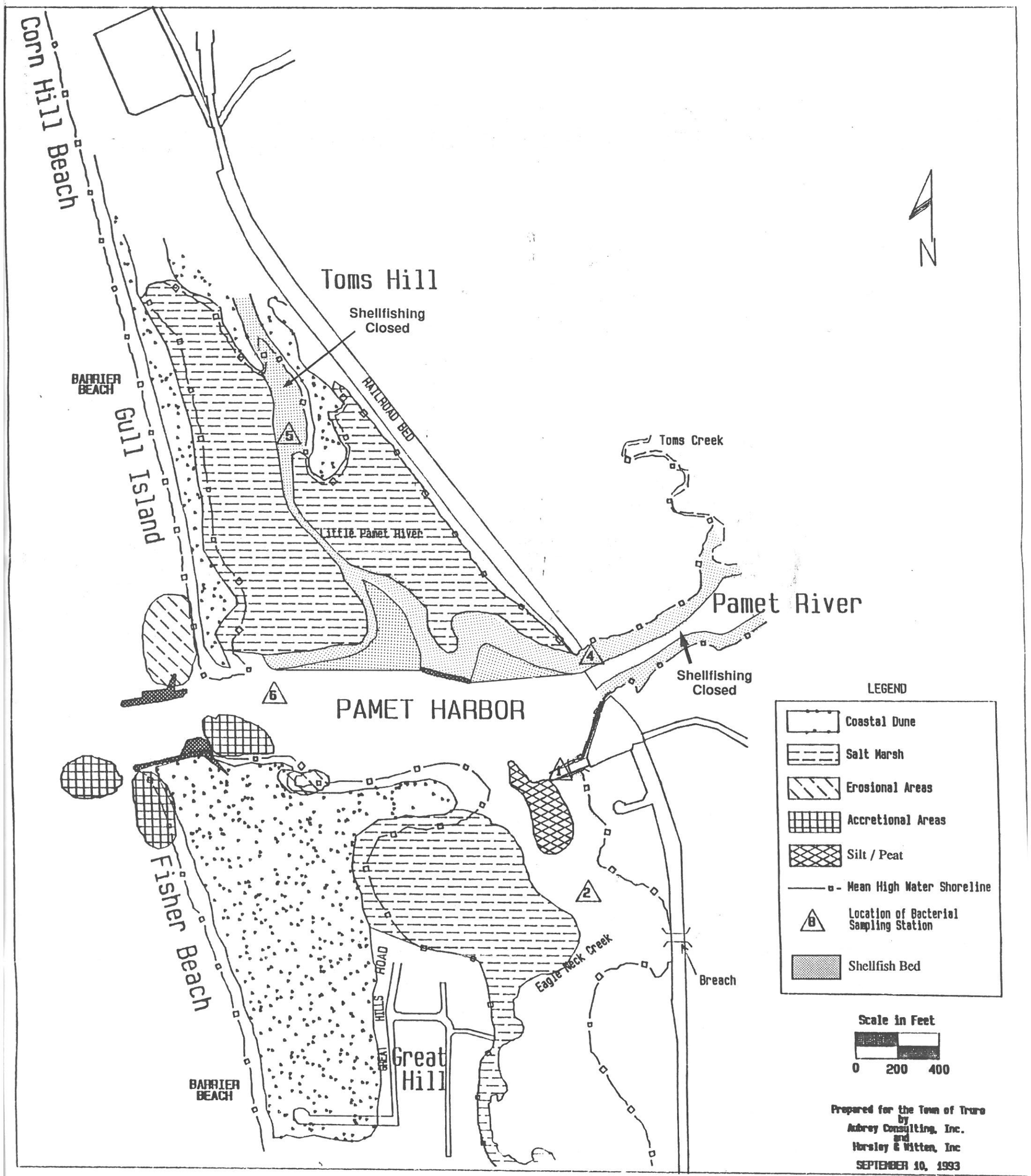
MAP 1.
PAMET HARBOR MANAGEMENT PLAN
BASE AND LAND OWNERSHIP MAP



MAP 2.
PAMET HARBOR MANAGEMENT PLAN
EXISTING USES MAP



MAP 3.
PAMET HARBOR MANAGEMENT PLAN
NATURAL RESOURCES MAP



MAP 5.
COMPOSITE VIEWSHED
LOWER PAMET

Viewshed Boundary

Ⓜ View Stations (K - X)

North

Scale: 1" = 725'

Source: Pamet River Viewshed Analysis, 1990 The Truro Conservation Trust

Harbor

Bar

Tidal Flat

Pamet

Truro

PAMET ROAD

PAMET

ROAD

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

6.0 GOALS, OBJECTIVES, AND POLICIES

Based on the findings and analysis, priorities and options discussed above, the HMPC has adopted the following goals, objectives and policies outlined below.

I. Navigation and Harbor Safety

Goal: To restore the usefulness of the Pamet Harbor system as a tidal harbor through enhancing the navigability of the harbor system while ensuring public safety.

Objectives:

1. Provide for safe and adequate access to and from Cape Cod Bay by recreational and commercial boats typically used in the Pamet Harbor system at all periods over an average tidal cycle.

2. Minimize potential conflicts between use of the water for navigation versus other recreational uses.

Policies:

1. Work with state and federal officials to ensure periodic maintenance dredging of channel and mooring basin in Pamet Harbor.

2. Ensure navigational safety through clearly marking and patrolling all navigational channels and mooring areas.

3. Restrict the location of moorings and docks/piers so as to prevent encroachment into navigational channels and open water recreational areas.

4. Establish an emergency response plan which adequately addresses typical harbor safety emergencies.

5. Establish safety regulations for harbor use through town waterway regulations.

6. Promote safe navigational practices through public education and enforcement of safety regulations.

II. Water Quality

Goal: To restore and maintain the Pamet Harbor system's water quality to meet state standards for water-related activities and recreation.

Objectives:

1. Maintain the water quality of the Pamet Harbor system in areas which could support water-contact sports (swimming) and recreation.

2. Improve water quality in Pamet Harbor in areas currently closed to shellfishing due to high bacteria counts.

3. Improve the town's ability to detect changes in water quality in the Pamet Harbor system and to identify trends.

4. Minimize release of contaminants associated with typical land and water activities.

5. Prohibit development in critical areas and minimize disruption of natural systems, such as wetlands, which aid in maintaining water quality.

6. Minimize potential degradation of water quality due to accidents or spills involving contaminants.

7. Minimize degradation of water quality due to waterfowl.

Policies:

1. The level of key chemical and bacteriological contaminants shall be monitored on at least an annual basis.

2. Deterioration of water quality shall be minimized through eliminating all direct discharges of untreated stormwater throughout the Pamet watershed, particularly Route 6, Snows Landing, and runoff from the harbor parking lot.

3. Public feeding of wildlife shall be prohibited throughout the Pamet Harbor system.

4. Release of nutrients to the Pamet Harbor system shall be minimized through use of best management practices for agricultural practices, such as proper manure storage.

5. The discharge of sanitary wastes from boats shall be prohibited unless discharged into an approved sanitary waste disposal site.

6. Educate residents about the connection between typical land use activities and degradation of water quality (for example: use of lawn fertilizers and improper disposal of household hazardous wastes).

7. Land zoned for commercial, institutional or office uses shall meet environmental performance standards aimed at protecting water quality and shall be sited in a way which minimizes impact to sensitive resources.

8. Establish an emergency contingency plan for hazardous materials spills and ensure that all local emergency spill response personnel are trained and are knowledgeable of proper response procedures. Prohibit fueling of boats from shoreside facilities.

III. Shellfishing

Goal: To restore the usefulness of the Pamet as a safe and productive shellfishery, symbolic of the health and quality of the Town's major wetland system.

Objectives:

1. To restore and maintain shellfishing waters which meet or exceed state surface water quality standards, including anti-degradation standards, particularly for bacterial contamination, for significant portions of downstream sections of the Pamet and its tidal tributaries, to enable the shellfishery to be opened and sustained.

2. Restore and maintain shellfish stocks, particularly quahogs, soft shell clams and blue mussels.

3. Investigate the feasibility of private aquaculture in areas that do not conflict with navigation, public recreation, and recreational shellfishing, as a way to promote jobs and income based on renewable natural resources and as a means to enhance natural shellfish recruitment. (Refer to Map 3.)

Policies:

1. Re-establish a shellfish propagation program.

2. Investigate standards which allow for private aquaculture through the town's shellfishing regulations.

3. Prohibit any water and land activities, such as moorings, which would interfere with shellfishing in designated areas.

4. Improve water quality such that shellfishing would be permitted in the Pamet Harbor system.

IV. Public Access

Goal: Maintain and improve public access to the harbor area for residents and visitors alike in order to provide for a quality outdoor experience offering a range of water-related activities and experiences while also ensuring the protection of the harbor's sensitive areas and marine resources.

Objectives:

1. Provide public access to the Pamet Harbor system for a range of uses both in and along the water including water-contact sports (swimming), finfishing, shellfishing, recreational boating, hiking, and environmental education.

2. Maximize public access to the waterfront from town-owned land. (Example: canoe landing on town-owned land.)

3. Provide handicapped access to the waterfront from public lands. (Example: proposed pier.)

4. Minimize negative impacts from public access to sensitive areas and marine resources.

5. Establish hiking trails on town-owned parcels located along the waterfront in order to encourage their use for exercise, appreciation of resources, and as an alternative to motorized transportation.

6. Encourage development of interpretive programs in order to educate and enlighten recreational users and visitors about the magnificent and dynamic features of the Pamet Harbor system's natural and cultural history, and the impact of land activities on this system.

7. Provide visiting boaters with transient moorings available to the general public on a short-term basis.

Policies:

1. All town lands located along the waterfront shall provide public access which together provide for a range of recreational experiences.

2. Provide handicapped access to any public hiking trails and/or swimming areas established within Pamet Harbor.

3. Preserve and protect water-dependent uses and facilities along the waterfront.

4. Encourage provision of public access to Pamet Harbor by existing private uses/establishments built along the waterfront, such as the Yacht Club. (Example: canoe livery.) This policy is not meant to encourage private development for commercial uses.

5. Site public access areas away from sensitive areas and adopt environmental design standards aimed at minimizing potential impacts to water quality and marine resources.

6. Designate areas not needed for general boating navigation for non-motorized craft and other forms of user access.

7. Designate publicly-owned areas for off-road vehicle (ORV) enjoyment that do not interfere with private property, rare and endangered species habitat, land susceptible to erosion, and sensitive resources.

8 Ensure that the Harbormaster has moorings available for short term transient use.

V. Moorings

Goal: To restore the usefulness of the harbor as a safe, efficient anchorage for a diverse mix of small craft, while also guarding against unnecessary encroachment into navigational channels, commercial fishing anchorage, shellfishing areas, and other areas used for water-related recreation.

Objectives:

1. Provide secure moorings for a specified number of boats in order to provide public access to Pamet Harbor and Cape Cod Bay.

2. Establish a mooring plan related to the carrying capacity of the harbor system and which considers the need to prevent encroachment on navigational channels, to identify sensitive resources, and to protect areas used for water-related recreation, commercial fishing and shellfishing.

3. Establish funding for harbor improvements to maintain moorings.

Policies:

1. Develop a mooring plan which defines the dimensional limits for a Pamet Harbor mooring basin, maximum number of boats of varying shape, size and type, while also minimizing the total amount of space which must be devoted to moorings. (Refer to Figure 2.)

2. Assign mooring locations based on size and type of boat, instead of owner preferences.

3. Use town-owned mooring floats to the maximum extent possible in order to provide for the most efficient use of space in the mooring basin.

4. Establish mooring fees, and other harbor fees, which would be dedicated for harbor projects.

5. Encourage a launch service as an alternative to beach storage of individual boat tenders.

6. Prohibit moorings in designated shellfish beds. (Refer to Map 3.)

VI. Commercial Fishing

Goal: To sustain a limited presence of commercial fishing boats in the Pamet Harbor so as to diversify the town's economy.

Objectives:

1. Provide modest facilities and services for commercial fishing which do not diminish the harbor's natural and aesthetic resources.

2. Improve the Town's ability to detect changes in fish landings in the Pamet Harbor system and nearby Cape Cod Bay and to identify the harbor's contribution to Truro's economy.

Policies:

1. Establish a navigational channel and reserve a safe anchorage to facilitate boat loading and offloading procedures for commercial fishing.

2. Reserve limited deep water mooring space for larger commercial fishing vessels (up to 35 feet in total length) owned and operated by persons who hold a valid commercial fishing license. (See Figure 2.)

3. An unlimited number of moorings shall be permitted for small commercial fishing vessels (under 30 feet), subject to availability on the general mooring waiting list.

VII. Fiscal Management

Goal: To maintain, and where possible enhance, the Pamet Harbor system's economic value to Truro residents, including its ability to support tourism, local recreation, commercial fishing and potentially shellfishing, thereby providing jobs and income for local residents.

Objectives:

1. Provide a consistent source of funding for water quality remediation, monitoring and research necessary for restoration of the Pamet Harbor ecosystem.

2. Provide a consistent source of funding for periodic evaluation of harbor and waterfront facilities and services, as well as construction and operation of public facilities and services, where appropriate.

3. To identify and acquire non-essential harbor facilities, operations and amenities, to the greatest extent possible, through alternative means such as harbor user fees, donations, volunteerism, or private fund raising.

4. To reduce the local financial burden associated with harbor restoration and use, where possible, through seeking available sources of public funding.

5. Promote public support for harbor-related expenditures through enhanced public education.

Policies:

1. Utilize local authority to appropriate funds and/or bonds for harbor restoration and development consistent with policies expressed in this plan.

2. Establish mooring and launching fees necessary to provide funding for harbor and waterfront maintenance and enhancement, and dedicate these monies solely for harbor and waterfront use through an enterprise fund.

3. Seek donations and volunteer services.

4. Identify and pursue appropriate subsidies, such as state and federal grants, reimbursements and low-interest loans, foundation grants and charitable donations.

5. Educate residents about the economic benefits associated with restoration and enhancement of the Pamet Harbor system.

VIII. Land Use, Landscape and Visual Character

Goal: To preserve or enhance the natural sights, sounds and smells of the Pamet harborscape which contribute to Truro's rural seaside character.

Objectives:

1. Retain the seaside character of Pamet Harbor.

2. Enhance public views of the harbor from town roads.

3. Encourage use of house designs in keeping with the harbor's rural seaside character.

4. Limit noxious odors and noises in the vicinity of the harbor.

Policies:

1. Establish a Pamet River viewshed overlay district within the zoning bylaw, which protects vistas of land areas visible from the waterways and which enhances views of the harbor from public roads located around the harbor.

2. In the proposed overlay district (see #1 above), encourage architectural designs which are compatible with the landscape and which enhance views from the water, perhaps through encouraging the orientation of facades towards the harbor rather than towards the street, or else which

either impose design controls for rear facades or require screening from public view through vegetative plantings and height restrictions.

3. Either prohibit or require adequate screening for any uses/activities causing noxious odors and/or noise, or which are visually unattractive (i.e., fish cleaning stations, trash dumpsters, loud generators or machinery, etc.).

4. Utilize selective pruning in order to provide periodic public vistas along town roads of the harbor area.

5. Limit overhead lamps, spotlights, large reflective surfaces and other intrusions into ambient lighting at the harbor.

6. Acquire as much land as possible adjacent to the river and harbor, as appropriate, to preserve natural conditions.

IX. Natural Resource Protection

Goal: To protect and where possible enhance the quality and productivity of natural resources of the Pamet Harbor system, including its waters, wetlands, flora and fauna and their habitat for their own sake, as well as for sustainable human recreational and commercial use.

Objectives:

1. Establish an undisturbed vegetated buffer zone along wetlands associated with the Pamet Harbor system.

2. Limit impacts from human-related activities to wetland systems, flora and fauna, and flora and fauna habitat.

3. Preserve the ability of the Pamet Harbor system's natural resources to support recreational activities such as swimming, fishing and shellfishing, boating, and operation of off-road vehicles.

4. Improve the town's ability to detect changes in the Pamet Harbor ecosystem and to identify trends.

5. Encourage investigation of benefits (boating, shellfish, siltation and water quality) resulting from manipulation of existing culverts or dikes to allow more natural patterns of tidal flow in harbor and improved upstream drainage.

Policies:

1. Investigate benefits of adoption of a town wetlands bylaw.

2. Monitor and enforce boat speed limits in the harbor and throughout the estuary system in order to minimize erosion of beach and marsh areas.

3. Prohibit all dredging not related to maintaining a safe navigation channel and public mooring basin, unless dredging is necessary for natural resources enhancement.

4. Establish a monitoring program aimed at evaluating impacts to natural resources in Pamet Harbor, with special attention being devoted to assessment of impacts to vegetation and shellfish.

5. Encourage public acquisition and/or dedication of wetland areas for conservation in the Pamet system, particularly along its salt marsh and dunes.

6. Develop an open space management plan for all town-owned lands located along Pamet Harbor.

7. Educate harbor users and residents about the relationship and impact of boating and other upland recreational uses on natural resources in the harbor.

8. Support natural resource agencies studying upstream drainage improvements.

7. NAVIGATION ALTERNATIVES ANALYSIS

7. NAVIGATION ALTERNATIVES ANALYSIS

I. Alternatives

Option One: Maintenance Dredging

Dredging and disposing of accumulated sediments is an effective, though usually temporary method to restore navigability to a shoaled harbor. Last dredged in 1965 and 1968 (see Map 1 for channel location), the Massachusetts Department of Environmental Management (DEM) is currently seeking permits for another maintenance dredging project of 7.4 acres in Pamet Harbor for $590,000 (DEM to pay $442,000 or 75%; town to pay $148,000 or 25%). Potential impacts during dredging include short-term physical displacement of shellfish beds and secondary impacts, such as siltation and noise, which are regulated by the town, state and federal agencies, including the Massachusetts Coastal Zone Management Office, the Massachusetts Department of Environmental Protection, the Army Corps of Engineers and the Truro Conservation Commission. For a detailed look at these concurrent jurisdictions, please refer to Appendix H.

Commonly, a positive impact of dredging is the increase in circulation and flushing rates which tend to dilute and lower pollutant concentrations. Clean sand can be used to widen barrier beach stretches that have been eroded, such as the south end of Gull Island. Another positive impact is the potential creation of tern nesting habitat on the dredge material used as beach nourishment.

Maintenance dredging involves the restoration of a previously-licensed channel and other historical dredged area limits, such as the Pamet boat basin, enlarged in 1968. This would mean a 60-foot wide channel and 200-foot wide boat basin dredged to a depth of four feet below mean low water. This depth would be sufficient to accommodate safely all of the boats currently moored in the harbor throughout the entire tidal cycle, rather than limiting navigation until times of high tide.

Other advantages of this option include state cost-sharing (75% match has been allocated), potential availability of a county dredge (reducing mobilization costs for future maintenance dredging), and public acceptance, based on interviews, public hearings and surveys. The Pamet would be useful for daily launching, generating increased town revenues through ramp fees, and would be available as a secondary harbor of refuge.

Maintenance dredging will shift the meandering channel of today away from the informal swimming area that is popular inside the south jetty, resulting in greater swimmer safety. A greater acreage of sandy beach would be created on Gull Island, slightly improving opportunities for increased public recreation at that site.

Estimated costs of dredging 80,000 cubic yards in Pamet Harbor would be four to six dollars per cubic yard or $320,000 to $480,000. Mobilization and demobilization costs of a small dredge capable of performing this work would be an additional $30,000. (The estimated cost of the state-contracted restoration dredging proposed for 1994 is $590,000.)

Option Two: Narrowing of Harbor Jetties

Moving the jetties closer together than the 280 feet that presently separates them could have the desired effect of increasing the velocities of tidal flows in and out of the harbor. This increased water speed would tend to flush contaminants and sediment out of the harbor faster, keeping the channel and shellfish beds open longer. Costs would be expensive since the jetty which is moved would have to be reset by a professional marine contractor. Dredging would be needed to reestablish a navigable harbor, in the hopes that the narrowed jetties would then keep the channel open longer. A more narrow distance between the jetties, however, may make navigation more difficult because there might be less margin for error for inexperienced boaters to keep clear of the rocks. Faster currents between the narrowed jetties might also reduce steerage for sailboats, some of which now navigate in and out under sail alone.

Costs of moving the north jetty 100 feet to the south are approximately $120,000 to $150,000 (not including engineering and permit fees).

Option Three: Maintenance Dredging and Narrowing Jetties

A combination of maintenance dredging and narrowing the jetties may increase the effectiveness of each. The initial cost would be higher than either option undertaken separately, but long-term costs might be less since future maintenance dredging might be deferred for longer durations, relying on the channel's increased ability to flush itself.

Estimated costs of dredging 80,000 cubic yards in Pamet Harbor $350,000 to $510,000, plus costs of moving the north jetty 100 feet to the south, approximately $120,000 to $150,000.

Option Four: Removal of Jetties and/or Dikes

This technique would permit the Pamet's natural inlet to restore itself, allowing the mouth to migrate south to north towards Corn Hill, then break through again at Fisher Beach and repeat the historic pattern. While this option hints at equilibrium, it is insufficient unless the Pamet's original tidal prism is restored through the removal of dikes, culverts and other obstructions to tidal flow. Even then, Giese (1990) suggests that little additional velocity in tidal currents could be expected through dike removal.

Navigation would be difficult at best through a natural inlet and most boaters would not attempt a bar-crossing without local knowledge. Harbor mouth migration would also disrupt established recreation uses at town beach at Corn Hill and Fisher Road. The visual enhancement of the harbor would be minimal since the jetties are a low-lying feature, particularly at high tide. Costs of this option would be substantial owing to the heavy equipment and barges needed to remove the boulders.

While removing dikes and restoring a more natural tidal flow would not be detrimental to the primary issue of restoring safe navigation to Pamet Harbor, its chief benefit would be habitat-related. As such, it would not be sensible to

explore it at length as a navigation option. (For a more detailed discussion of effects related to dike removal, see Greenway Plan, Appendix D.)

Option Five: Improvement Dredging

Improvement dredging would entail enlarging the dimensions of the previously-licensed dredged areas, such as deepening the channel to accommodate larger boats or lengthening the boat basin to handle more moorings. At this time, there is no popular support for improvement dredging because townspeople believe that the number and size of boats in the harbor is about at equilibrium, in keeping with the goal of maintaining Pamet as a small-scale, non-commercial harbor. Increasing the area of dredging would mean expanding into salt marsh areas or the very productive shellfish flats north of the thread of the river. The Wetlands Restriction Act (G.L. c 130 s. 105) prohibits new dredging throughout most of the Pamet and the Wetlands Protection Act (G.L. c. 131 s. 40) sets higher standards of review for improvement versus maintenance dredging.

Improvement dredging is also not recommended for further study because modeling by ACI indicates that dredging will not significantly improve water quality. Finally, any improvement dredging would not preclude the need for eventual maintenance dredging (and its costs) to sustain the expanded limits of the new dredged area.

Costs: $4.00 to $6.00 per cubic yard.

Option Six: Sand Bypassing System at Harbor Entrance

In the 1970s, Truro resident Charles Martin urged the town to consider a sand bypassing system to continuously move sand from Fisher Beach to Gull Island to the north. This machinery would duplicate the natural process of longshore transport of sand, which was interrupted by the installation of the jetties. Bypassing the sand would prevent the south jetty from filling to entrapment and enable it to function properly; that is, to stop sand from spilling into the navigation channel. A sand bypass system would obviate the need for periodic dredging, but might be aesthetically disturbing, both visually

and aurally, in such an open, public setting. No Cape Cod harbors are maintained in this manner.

Costs for installation of a small sand bypassing system are estimated at $800,000 to $1,200,000. Operating costs are approximately $4.50 per cubic yard. To bypass 20,000 to 40,000 cubic yards annually would cost $90,000 to $180,000 each year.

Option Seven: No-Action Alternative (Existing Conditions)

Under this scenario, the Town takes no action to improve navigability in the harbor, other than perhaps to re-mark the meandering natural channel with pitch pine trunks, as practiced in the past two years. This option requires the least expenditure, but provides no benefit in terms of improved navigation. This alternative has been practiced de facto since 1968 when the harbor was last dredged and is responsible for the continuing deterioration of the Pamet as a boating harbor. Navigation will be limited to only two hours on either side of high tide, the Pamet will not be visited by transient boaters, ramp revenues accruing to the town will continue to drop, water quality will not be improved and the harbor cannot be relied upon as an informal harbor of refuge for boaters caught in sudden squalls on Cape Cod Bay.

Benefits of this scenario might include the apparent creation of the Pamet as a shallow-draft only harbor, turning it into a canoe park and removing motorboats and sailboats. But the Pamet will never have a natural inlet so long as the artificial mouth (as defined by the harbor jetties) continues to persist. Costs of this option are zero in terms of monetary commitment, but huge in opportunity cost, in terms of lost chances to improve boating, shellfishing and other income-generating recreation.

II. Numerical Model of Options One, Two, Three

After examining the findings, priority issues and options to implement the priority issue of improving navigation, the HMPC asked its consultants, through a sub-contractor, Aubrey Consulting Inc. (ACI), to examine three of the seven options (Options One, Two and Three) identified by the

Committee. These options include maintenance dredging, narrowing the harbor jetties, and a combination of the two. ACI's report follows (also see Appendix F).

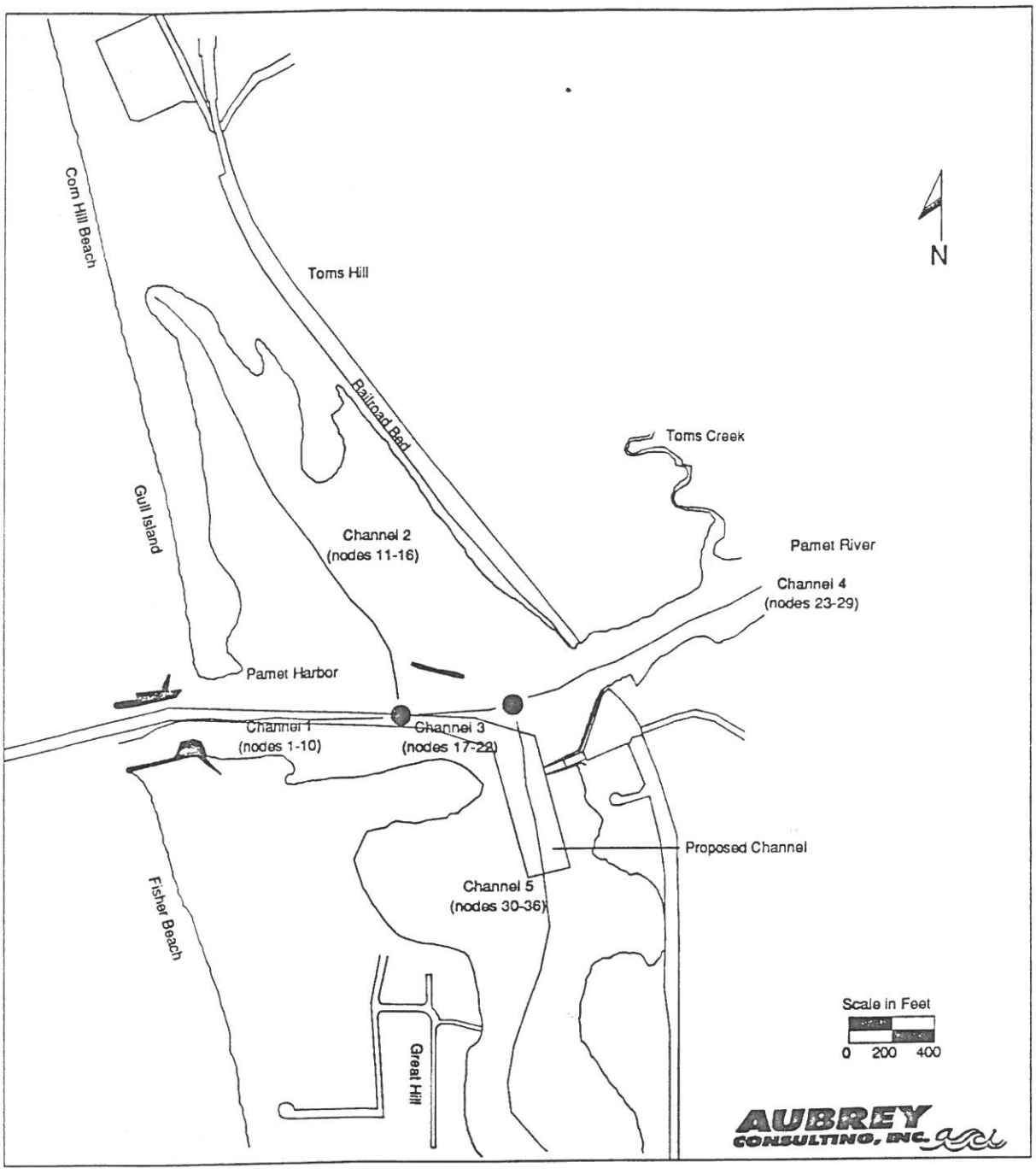
Management studies of tidally influenced estuaries must include a thorough evaluation of the hydrodynamics of the estuary system. Estuarine hydrodynamics control a variety of coastal processes including tidal flushing, pollutant dispersion, tidal currents, sedimentation, erosion, and water levels. In natural, unaltered estuaries, changes in the hydrodynamics of the system generally evolve over long periods of time, resulting in gradual fluctuations in these coastal processes. In other estuarine systems, however, where proposed management alternatives can sometimes alter the hydrodynamics of the system, changes in these coastal processes can be dramatic. In many cases, the changes can result in detrimental impacts to the environment although, if properly designed, they can result in positive impacts to the environment.

The identification and evaluation of proposed management alternatives for estuarine systems, therefore, depends on a thorough understanding of the hydrodynamics of the system, and how proposed alterations to the system can affect the coastal processes. One of the most accurate ways to determine the hydrodynamics of an estuary is to model the system numerically. For the Pamet Harbor Management Plan, a one-dimensional (1-D) numerical model was used to quantify the tidal hydrodynamics of the harbor system.

Three project alternatives for improving navigation in the Pamet Harbor system were investigated using the 1-D model. The first option involved maintenance dredging of the channel from the harbor entrance to the mooring basin near the boat ramps (Figure 6). The channel leading from Cape Cod Bay to the mooring basin was 60 feet wide and minus four feet at mean low water (MLW). The channel widened to 200 feet and minus six feet MLW in the mooring basin area. This dredging plan was developed jointly by the Department of Environmental Management (DEM) and the Town of Truro in 1993. Modifications to the cross-sections at all affected nodes in the model grid were made to reflect the proposed channel dimensions.

FIGURE 6.

PAMET HARBOR
NUMERICAL MODEL GRID



A comparison between existing conditions and the proposed channel configuration at node 3 (near the jetties) is shown in Figure 7.

Option Two for Pamet Harbor reflects modifications to the entrance jetties. This alternative was developed jointly by the HMPC and the H&W consulting team. The alternative consisted of narrowing the jetties by 100 feet to a total width of 180 feet.* This modification was developed to determine if changes in the jetty configuration would alleviate shoaling problems in the harbor entrance. Modifications to the cross-sections at the grid nodes between the jetties were made to reflect the proposed jetty reconfiguration. A comparison between existing conditions and the proposed jetty configuration at node 7 is shown in Figure 8.

The third option consisted of narrowing the jetties and dredging the channel. The combination of these alternative was made to determine if the proposed changes would improve both tidal flushing and shoaling problems in the harbor entrance. Modifications to the cross-sections at the grid nodes affected by the dredging and between the jetties were made to reflect the proposed changes.

The 1-D model was used to examine the tidal exchange between Cape Cod Bay and the Pamet Harbor system. Water quality within the estuary is highly dependent upon this exchange, which can be quantified using the tidal prism, or volume of water exchanged during an average flood or ebb cycle. Once the tidal prism is known, then residence times can be calculated. The definition of residence time is the average time that a particular water parcel spends in the estuarine system. Very long residence times generally are indicative of sluggish circulation and poor water quality. Short residence times usually indicate a rapid exchange of water between the open ocean and estuary, and can be associated with increased water quality.

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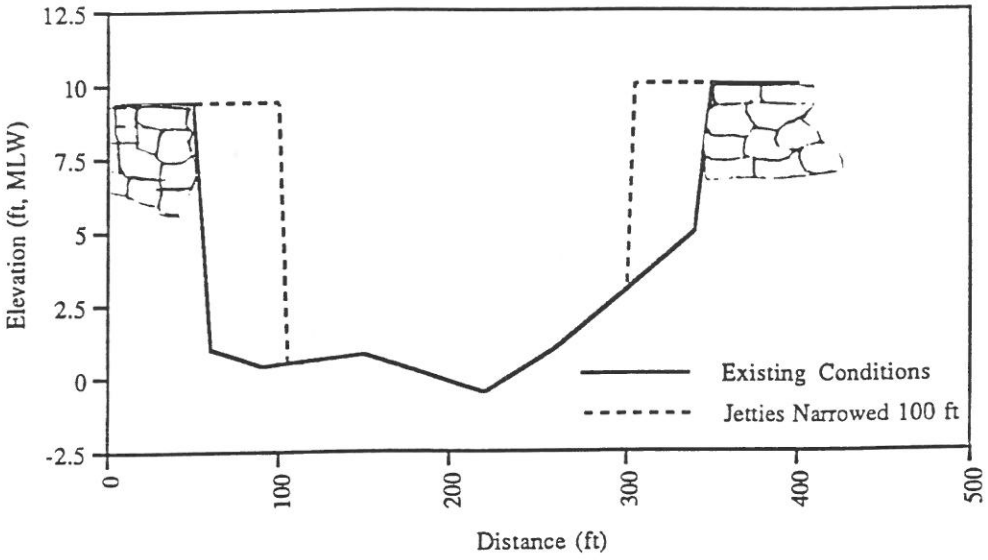
* This change in dimension of 100 feet reflects a committee choice and is not to be considered optimal by engineering standards. Optimization of channel/jetty width would require a separate engineering design study where a number of different channel widths, depths and configurations would need to be evaluated using the calibrated numerical model. This engineering study should include an examination of channel shoaling rates and how these rates vary as a function of channel width, depth and orientation, as well as jetty spacing.

Figure 7.
Channel Cross-Section at Node 3
Existing and Proposed Narrowed Jettties



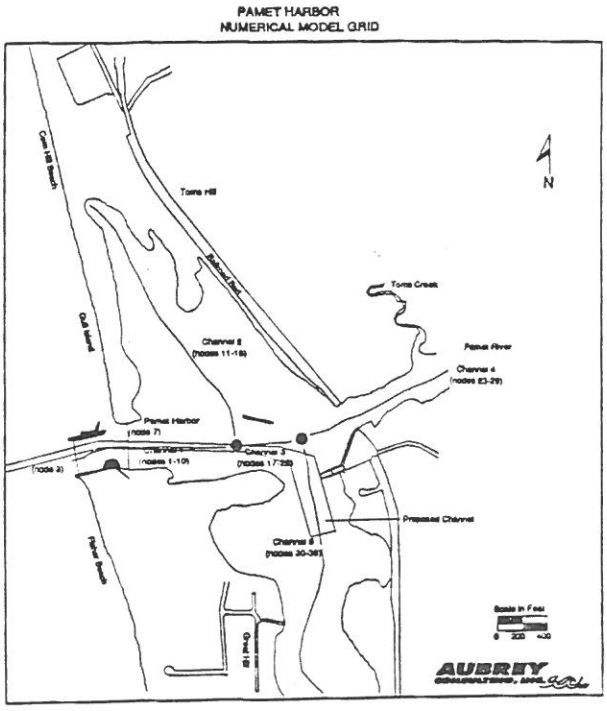
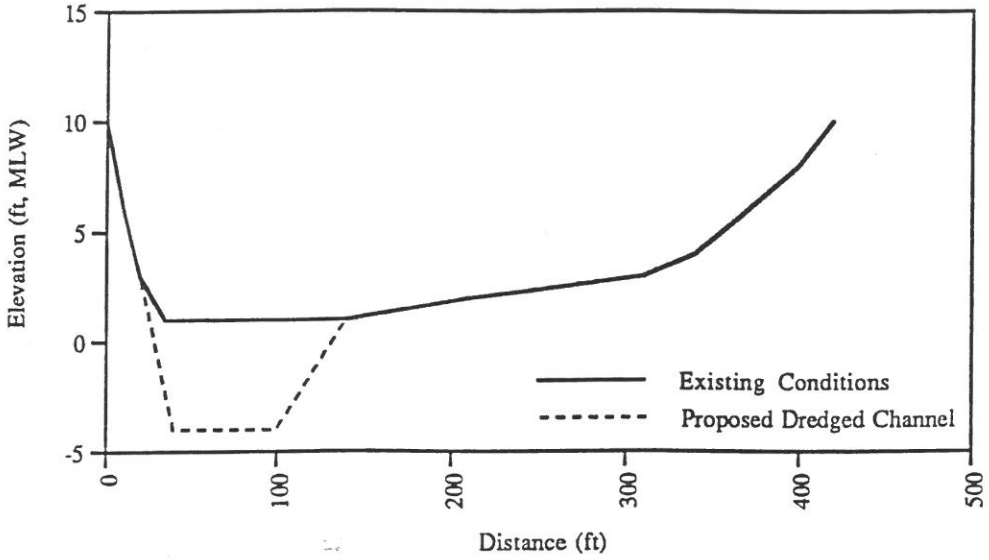
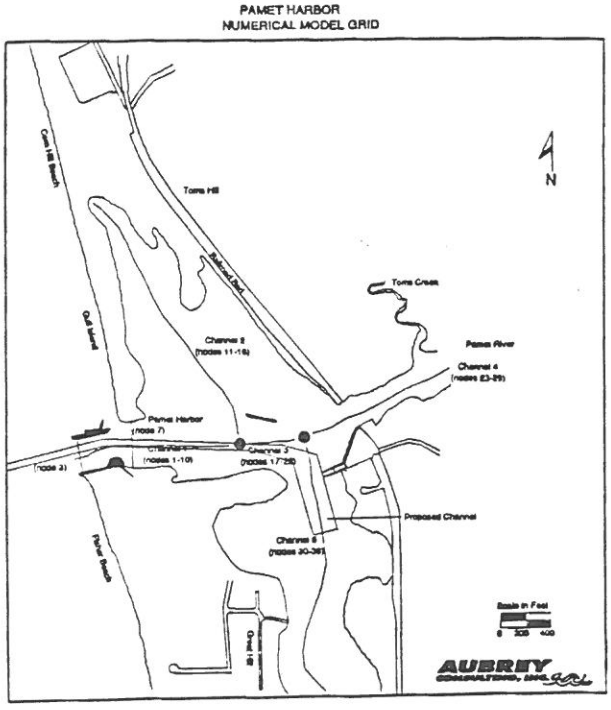


Figure 8.
Channel Cross-Section at Node 7
Existing and Proposed Channel Dredging





For the Pamet Harbor system, residence times were determined for the following four sub-sections of the estuary (Figure D-2 in Appendix F): north channel (includes extensive tidal flats on Channel 2), south channel (includes mooring basin and tidal flats on Channel 5), upper Pamet River (Channel 4), and entire harbor area (Channels 1-5). The system was divided into sections so that potential problem areas (areas with long residence times) could be identified. One calculation for the entire Pamet Harbor system would simply result in an average residence time, blending together those areas with longer and shorter residence times. From a management standpoint this would not be as desirable as residence times calculated for specific areas within the estuary.

The results from model calculations of tidal prism and residence time for the existing Pamet Harbor system are summarized in Table 4. The tidal prism values indicate that the upper Pamet River exchanges a greater volume of water than the north or south channels. Residence times are relatively short throughout the harbor, ranging from 0.18 days in the Upper Pamet River to 0.38 days in the south channel. The residence time of 0.30 days for the entire Pamet Harbor reflects an average of conditions across the whole harbor. The short residence times predicted by the 1-D model are the result of complete drainage of many parts of the harbor at low tide.

Table 4.
Tidal Prism and Residence Times for Pamet Harbor

Section	Tidal Prism (cubic feet)	Residence Time (days)
North channel	3,710,000	0.34
South channel	3,130,000	0.38
Upper Pamet River	10,300,000	0.18
Entire Pamet Harbor	23,500,000	0.30

Changes in the tidal hydrodynamics for the three project alternatives were modeled and compared with the existing conditions. The changes in residence times for each of the alternatives, in terms of percent of existing conditions, are shown in Table 5. Changes in maximum tidal current

velocities within the harbor entrance for each of the project alternatives are shown in Table 6.

Table 5.
Percent Change in Residence Times Between Existing Conditions and Project Alternatives

Option	Harbor Entrance	Mooring Basin
1) Harbor dredging	- 1.9%	- 3.5%
2) Narrow jetties	+ 1.1%	+ 0.08%
3) Harbor dredging and narrow jetties	- 1.9%	- 3.2%

Table 6.
Maximum Tidal Current Velocities for Existing Conditions and Project Alternatives

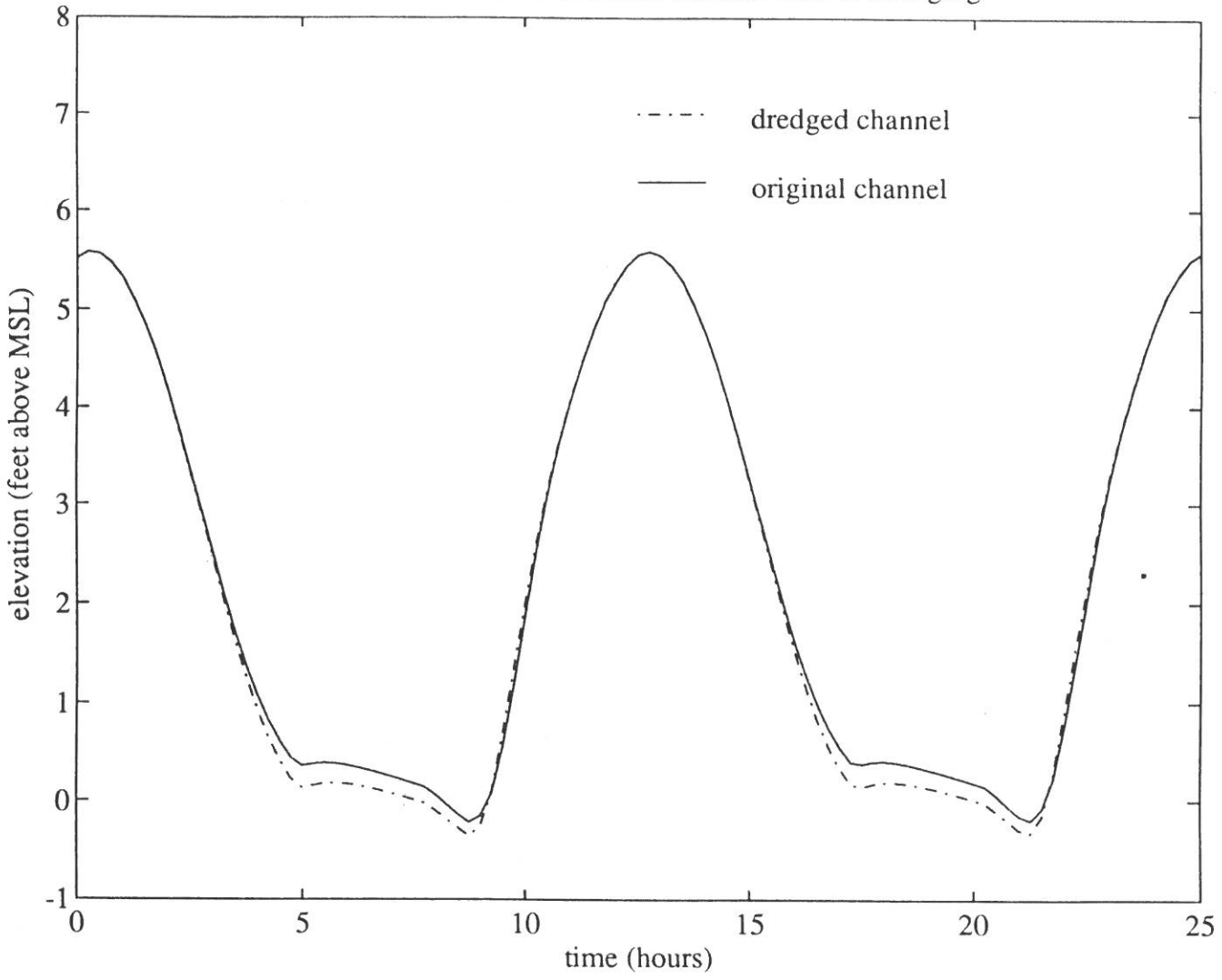
Option	Flood Velocities (feet/sec)	Ebb Velocities (feet/sec)
Existing conditions	1.83	1.69
1) Harbor dredging	1.57	1.51
2) Narrow jetties	2.78	2.49
3) Harbor dredging and narrow jetties	2.24	2.13

Results from the 1-D model show that the primary impacts of maintenance dredging only are slightly shorter residence times (implying improved water quality) and lower current velocities at the harbor entrance. Additionally, the dredging resulted in slightly lower, low tides in those areas affected by the dredging, as can be seen by Figure 9. The 1-D model predicted few changes elsewhere within the harbor for Option One.

Option Two (narrowing the jetties) resulted in slightly longer residence times (decreased water quality) throughout the harbor and significantly higher current velocities at the harbor entrance. Since the area through which the water enters the harbor is decreased by narrowing the jetties, the volume of water entering and exiting the harbor is also decreased, thereby increasing the residence times. The increased current velocities at the entrance would likely alleviate some of the shoaling problems, since critical threshold velocities needed for sediment transport would be exceeded more often.

FIGURE 9.

Elevation Difference in South Channel Due to Dredging



The third alternative of dredging the harbor and narrowing the jetties results in slightly shorter residence times (improved water quality) as well as increased tidal current velocities at the harbor entrance. The improvement in residence times for the third alternative is nearly equal to the improvements estimated for Option One. The primary difference in the two alternatives is the increase in current velocities at the harbor entrance. Increased current velocities in this area will likely alleviate some of the shoaling problems seen in the past, and may reduce the frequency of maintenance dredging.

III. Conclusion

The results of this modeling tend to confirm popular conceptions that dredging will improve navigation, while perhaps enhancing water quality slightly, at least in the harbor (see Table 7). Changes in current velocities, and therefore sedimentation/erosion patterns, will likely occur as a result of the modeled alternatives. These changes, however, will only be significant at the harbor entrance, since major changes in tidal current velocities were not seen in other portions of the study area (see Table 7). Alterations in the sedimentation/erosion patterns will be most significant between the jetties where a large shoal tends to form on the south side of the channel. Owing to the increased flood and ebb tidal current velocities resulting from narrowing the jetties, with or without dredging, the potential for shoaling between the jetties is reduced. The shoaling rates beyond the jetty confines are not likely to be affected.

Dredging alone, without moving the jetties, will still result in shoaling between the jetties because the deepened channel causes lower current velocities and more sedimentation. But maintenance dredging is an established means of restoring the usefulness of small harbors and should be considered the best alternative in terms of immediate cost-effectiveness. As time goes on, however, studies to redesign the harbor by narrowing the jetties in conjunction with continued dredging should be conducted to determine if long-term costs savings could result by increasing the interval between dredging cycles. The drawback of narrowing jetties is that it may complicate

small craft navigation by reducing space to maneuver and increasing current velocities.

Table 7.
Project Alternatives and Relative Effects on
Water Quality and Channel Shoaling

Option	Effect on Water Quality	Effect on Channel Shoaling	Effect on Navigation	Costs
0) No action	continued negative	continued negative	continued negative	none; income lost
1) Harbor dredging	negligible; minor positive	temporary minor negative	major positive	$110,000/5 yrs. * after initial restoratio
2) Narrow jetties	negligible; minor negative	major positive	negative	$120,000 - $150,000'
3) Harbor dredging and narrow jetties	negligible; minor positive	major positive	minor negative	$110,000/ 5 yrs. + 120,000 - $150,000*

*(Costs are after initial dredging.)

Based upon an analysis of the costs and benefits (environmental, economic, recreational) associated with the three most appropriate options, it is recommended that the Town pursue an initial dredging project to restore the previously-licensed channel and boat basin and support that decision with a commitment to maintain the dredge limits over time. This commitment would entail dredging every two to five years, or as conditions warrant, a small amount of sand rather than having to conduct larger dredging projects at longer intervals. The decision on whether to narrow the jetties must be deferred, pending further engineering study, but should still be pursued, albeit as a lower priority.

8. ACTION PLAN

8. ACTION PLAN

Based upon input received from the Town of Truro, an Action Plan has been prepared for the management of Pamet Harbor. It includes both water-based and land-based recommendations to achieve the Town's goals and objectives for the protection and use of the harbor.

Throughout our analysis of Pamet Harbor, several alternative management strategies were identified. This section of the report presents these alternatives and recommended actions. The Pamet Greenway Plan (1986) contains 75 management recommendations for the Pamet. These have been reviewed in the context of this study and, where appropriate, they have been incorporated into the Actions.

In order to assist the Town in determining implementation strategies, the Harbor Plan categorizes each recommendation in terms of priority for timely action. Actions within each category are considered equivalent and not relative to the order in which they appear (see Table 8).

I. High Priority

A. Restoration and Maintenance Dredging

The Pamet Harbor is clearly in need of a dredging project to restore its usefulness as a small boating harbor. Periodic dredging likely will be required as on-going maintenance of the harbor, despite other structural modifications (such as reconfigured jetties and/or removal of dikes), primarily because Pamet is a "flood-dominant" estuary. This means that water floods the harbor faster than it ebbs, and therefore flood currents are higher in velocity than ebb currents. Flood-dominant estuaries characteristically experience a net influx of sediment due to the high velocity of the flooding currents. To support analysis of the dredging alternative, a 1-D numerical model was run to simulate changes in harbor hydrodynamics based on the dredged channel design proposed by the DEM and Town of Truro. Use of this model allowed evaluation of the impacts of the proposed dredging on tidal flushing, tidal elevations and current velocities. It is likely that maintenance dredging will

Table 8. Action Plan - Summary

Key	Activity	Priority	Time Frame	Capital Cost	Annualized Cost	Funding Sources	Responsible Agency
A.1	Restoration Dredging (80,000 cubic yds.)	High	Fall 94 - Spring 95	$590,000 ($442,000 state)	$150,000 to town for 10 yrs. + $43,313 intrst.	DEM- Waterways; Truro Harbor Fund/ Bonding	DEM - Waterways; Harbor Commission
A.2	Maintenance Dredging (20,000+ cubic yds.)	High	between 2000 and 2002	$110,000	$110,000 to town over 10 years + intrst.	Truro Harbor Fund	Harbor Commission
B	ORV Management Plan	High	Fall '94 - Spring '95		$5,000/yr. patrols	Police Budget; Town Meeting	Selectmen
C	Harbor Swimming Mgmt.	High	Summer 1995	$300	$300 replacement every 5 - 10 yrs.	Harbor Fees	Beach Commission; Harbor Commision
D	Rainfall Closure for Shellfish	High	Fall 1995	0	0	n/a	Board of Health; Shellfish Officer; DMF
E	Harbor/Waterways Regulations	High	Fall-Spring 1994/95	0	0	n/a	Harbor Comm. & Master; Town Meeting
F	Stormwater Management	High	1995 - 1997	$5,000+/site	0	Highway Depts.; Public Access Board	MASS DPW; PAB; DPW Depts.
G	Public Access Pier	High	1994 - 1995	$67,200 (state)	$500 - $5,000 town maintenance/hauling	Truro Harbor Fund; Public Access Board	Harbor Commission; DPW Department; PAB
H	Implementation Committee	High	Fall 1994	0	$500	Town Budget; Town Meeting	Selectmen; Town Meeting
I	Funding: Harbor Budget and Capital Plan	High	1994	n/a	n/a	Harbor Fees; Town Budget; Town Meeting	Harbor Commission; Finance Committee

Table 8. Action Plan - Summary

Key	Activity	Priority	Time Frame	Capital Cost	Annualized Cost	Funding Sources	Responsible Agency
J	Toms Hill Railroad Trail	High	1995	$2,000	$200	Donations;	Recreation Commission
						DPW Budget	DPW Department
K	Traffic Mgt. and Parking	Moderate	1995 - 1996	0	0	n/a	Local Comp. Plan. Comm.
L	Viewshed Overlay	Moderate	1995 - 1996	0	0	n/a	Planning Board;
	District Study						Town Meeting
M	Wetlands Bylaw Study	Moderate	1995 - 1996	0	0	n/a	Conservation Comm.;
N	Public Education	Moderate	1995 - ongoing	$1,000	$200 reprints	Harbor Fees;	Harbor & Cons. Comm.;
						Donations	Conservation Trust
O	Sewage Pump-out	Moderate	1995 - 1996	$3,000 - $5,000	n/a	Harbor Fees; User	Harbor Commission;
	Facility					Fees; State Grant	Board of Health
P	Dike Removal Study	Low	1996 - 1998	$20,000	n/a	Town Meeting;	Conservation Comm.;
						Donations; State	Conservation Trust
Q	Jetties Modification	Low	2004	n/a	n/a	Harbor Fees;	Harbor Commission;
	Redesign Study					State DEM	DEM - Waterways
R	Pedestrian Bridge	Low	1999	$30,000	n/a	State Grants;	Recreation Comm.;
	Design Study					Town Meeting	MA Public Access Bd.
S	Shellfish Tissue	Low	1995 - 2000	$3,000	n/a	Shellfish Fees;	Board of Health;
	Testing						Shellfish Officer

be required every two to five years, depending on storms, to keep the channel and basin at a four feet depth at MLW. This maintenance dredging would presumably be much less than the 80,000 cubic yards expected to be removed this year after 25 years of accumulation. Consequently, the costs will be less for future maintenance after the 1994 channel restoration. For example, a 20,000 cubic yard maintenance dredging project five years from now might cost $110,000. Gull Island can be expected to experience continued erosion, freeing up space for future beach nourishment as a disposal area for clean, compatible sand.

The various advantages and disadvantages of dredging the harbor have been analyzed and are discussed below.

Advantages:

- Traffic on Depot Road spread out over longer periods of time than current four- or five-hour window - decreasing congestion.
- Enhanced harbor revenues from increased use.
- Restoration/maintenance of boating uses and safe navigation in the harbor.
- Potential improved water quality due to better flushing.
- Beach nourishment of eroded Gull Island.
- Slight increase in tidal flushing.
- Less costly and less aesthetically intrusive than sand bypassing equipment.
- Will enable town to adjust harbor fees to pay for harbor maintenance.
- Smaller costs for regular dredging ($110,000 for 20,000 cubic yards) after initial channel restoration paid for primarily by state ($590,000 for 80,000 cubic yards; state to pay $442,000, town $148,000.)

Disadvantages:

- Potential increased traffic on Depot Road and may lead to a crowded parking lot.
- Costs: town and state funding needed.

- Short-term potential environmental impacts, such as physical disruption of shellfish habitat and siltation.
- Short-term potential aesthetic impacts, such as noise, odor, eyesore of dredge and spoils.
- Decrease in tidal currents at harbor entrance; continued shoaling.

Recommended Action:

Support the currently proposed DEM dredging restoration project; monitor post-dredging shoaling rates; and develop a dredging master plan to include periodic future maintenance dredging, with expected intervals at no more than five years;; support county efforts to purchase a dredge (Harbor Commission and Selectmen).

B. Management of Recreational Vehicles

Off-road vehicles (ORVs) are currently used along both the north and south barrier beaches. (See Map 2.) Like many other "active" uses of resource areas, ORV usage can conflict with other more "passive" uses, such as hiking and birding. The challenge of a management plan is to accommodate as many desired uses as possible, while not excluding others or allowing any significant environmental impacts to the valued resource area.

The management plan for appropriate ORV usage in the Pamet Harbor area should be developed by the Selectmen with input from appropriate town boards and enforced by the Town.

Advantages:

- Allows both active (ORV) and passive use of the barrier beaches.
- Limits the environmental impacts of chronic ORV use.

Disadvantages:

- Enforcement requirements by the Town. ($5,000 annually for patrols).

Recommended Action:

Owing to the complexities of this issue, the Selectmen, with proper guidance from the Beach Committee and Police and extensive public comment not available in the scope of the harbor plan, should make recommendations for any changes in use. (Selectmen).

C. Management of Swimming Areas

At present, there are three main swimming areas utilized in the Pamet Harbor area (see Map 2 in Chapter 5). The swimming area just inside the southern jetty is in close proximity to the navigation channel. This represents a potential navigation and safety problem.

This swimming area could be more clearly marked with warning buoys to alert both swimmers and boaters of this potential hazard. Shifting the proposed dredged channel closer to the north jetty, as proposed in the 1993 engineering design, should also mitigate this problem.

The so-called Grandmother's Beach adjacent to the boat ramp had to be abandoned in the 1980s when it was learned that state regulations prohibit swimming at Public Access boating facilities. Further, no swimming is allowed within 150 feet of designated mooring areas and navigable channel.

Advantages:

- Increased safety to swimmers.
- Allows continued usage of this swimming area.
- Minimal costs: $300 for bouys and lines, anchors

Disadvantages:

- Does not provide conservative safety buffer between two conflicting uses.
- Potential liability issues for the town in managing the harbor.
- Costs associated with the establishment and maintenance of swimming area buoys and navigational aids.
- Swimming access is partially on privately-owned land.

Recommended Action:

Designate swimming hazard areas with buoys; move channel north through proposed dredging; (Harbor/Beach Commissions).

D. Rainfall Closure for Shellfishing in the Pamet

The analysis of fecal coliform data suggest that the high concentrations of bacteria are most closely related to rainfall (See Figure 5). Stormwater discharges and drainage from wetland areas during and immediately following a rain storm are believed to be the principal contributors of these bacteria, which have been detected above acceptable water quality standards since 1986. Recent stormwater discharge mitigation may be responsible for the limited reopening of the Pamet (harbor only) to shellfishing.

The Massachusetts Division of Marine Fisheries has the authority to change the current status of the shellfish closure to a "rainfall closure". This has been done recently for the Herring River in Wellfleet. A rainfall closure prohibits shellfishing only during a 48-hour period following rain storms. Otherwise, the area is open to shellfishing.

To obtain a rainfall closure, an analysis of water quality and rainfall data must be completed. An interview with DMF staff indicated that it may be a year or more before their staff are able to complete the required analysis. It is possible that the Town could assist in this analysis to complete it in a more timely manner. The analysis conducted as part of this project represents the first step in this process and should be submitted to DMF for its review.

Advantages:

- Possible opening of more of the Pamet to shellfishing.
- Potential for aquaculture projects.

Disadvantages:

- Possible increased water quality monitoring costs ($1,000 annually).

Recommended Action:

Submit rainfall vs. bacteria graph (Figure 5) with formal request to Massachusetts Division of Marine Fisheries for a "rainfall closure" (Board of Health; Shellfish Officer).

E. Harbor/Waterways Regulations

Because Pamet Harbor is a mixed use harbor, there are potential conflicts between uses. Some of the potential conflicts include uses such as boating, swimming, and shellfishing. To ensure optimal use of the harbor, these activities need to be managed spatially and/or temporarily. The best known option to implement such management is through clear harbor/waterways regulations. These regulations would be administered by the Truro Harbor Commission through its Harbormaster. (Local harbor regulations must be approved by the Division of Environmental Law Enforcement of the Department of Fisheries, Wildlife and Environmental Law Enforcement under M.G.L 90B and mooring assignment procedures must be sent to the Department of Environmental Protection/Waterways Division under 310 CMR 9.07.2.) A mooring plan has been designed by the Pamet Harbor Commission, to be implemented in three phases that will cap the number of moorings at 130. The phases are described in the Table below (see also Figure 2):

Table 9.
Pamet Harbor Mooring Plan
Source: Pamet Harbor Commission, 1993

	Description	Location	Total boats
Phase I: (1994)	61 single boat moorings for boats under 22 feet in length	North of boat ramp	61
	6 single boat moorings for boats under 14 feet in length	North of boat ramp, along shore	6
Phase II: (by 1995)	16 double boat moorings for boats under 22 feet in length	South of boat ramp	32
	12 double boat moorings for boats under 30 feet in length	South of boat ramp	24
Phase III: (by 1996)	6 commercial boat moorings for boats under 35 feet in length	Opposite boat ramp, across basin	6
			129 TOTAL

Advantages:

- Implementation of management program for harbor uses.
- More clearly defined role for Harbor Commission.

Disadvantages:

- Administrative costs associated with enforcement of regulations or by-laws.

Recommended Action:

Town Meeting adoption of comprehensive set of harbor use regulations or by-laws (drafted November 1993) (Harbor Commission). See Appendix G. Submission to state for final approval.

F. Stormwater Management

Stormwater discharges from roadways surrounding the Pamet are believed to be a major contributor to the water quality problems which are responsible for

the current shellfish closure. Recent projects, such as the drainage improvements at the Route 6 dike and Meetinghouse Road, have improved this situation somewhat. However, several other stormwater discharges remain, such as the Castle Road and Old County Road (Route 6A) intersection and the Pamet Harbor parking lot.

All direct stormwater discharges into the Pamet should be mitigated. Possible options include leaching catch basins, infiltration galleries, detention ponds, oil/grease separators, sedimentation basins and constructed wetlands.

Advantages:

- Improved water quality.
- Possible permanent opening of shellfishing area.
- Higher quality of shellfish meats (reduced metals/hydrocarbons).

Disadvantages:

- Costs ($5,000-$50,000 per site).

Recommended Action:

Construct sedimentation/detention basins and/or construct wetlands to interrupt stormwater runoff discharges (Public Access Board; Highway Department); coordination and cooperation between local and state highway departments should be sought in carrying out these improvements.

G. Public Access Pier

To address the need for safe and adequate access to and from boats in the harbor, both those launched daily at the ramp and those moored in the basin, a permanent pier and float system is needed. The state Public Access Board has designed and secured Conservation Commission approval for a wooden pier to spring off the parking lot adjacent to the Harbormaster's office and run parallel to the boat ramp. The outer third of the pier will be comprised of floats which will be removed during the off-season, reducing the visual

intrusion of the pier. This pier will replace the small floats-only system that was useful only as a dinghy dock and not large or stable enough to accommodate vessel tie-ups. The new pier will cost $67,200 of state funds and will serve temporary or overnight tie-ups only. Transient boaters will be allowed to tie up overnight if moorings are not otherwise available.

Advantages:

- Safe and stable access and egress from boats to shore.
- Enhances access particularly for infirm or disabled boaters.
- Reduces year-round visual intrusion by having removable sections (floats).
- Facilitates emergency access for rescue personnel.
- Does not displace existing mooring areas.

Disadvantages:

- Maintenance costs associated with removing/reinstalling floats seasonally and reinserting ice-lifted pilings ($500 - $2,000 annually).
- Replacement of pilings and superstructure after life-span (10 -20 years); (Cost: $67,200).

Recommended Action:

Install pier and float system for use in 1994 (1995 at the latest). (State Public Access Board; maintenance by Truro Highway Department).

H. Implementation

A committee smaller, and more efficient than the present HMPC should be established by the Selectmen or Town Meeting as a standing committee of the town and given the responsibility of ensuring that actions recommended by this Harbor Plan are implemented. This implementation committee should work with the boards identified with authority to implement this plan to see that such work is coordinated and cost-effective. The committee should also

be charged with updating this plan every five years or as necessary, given changing conditions.

Alternatively, the composition of the existing Harbor Commission could be modified to include a more diverse range of interests, as are presently found in the HMPC. This would preclude the need for a separate implementing committee and save on costs of funding a new committee. If or when Truro hires a professional staff planner, that staffer could alternatively be given the charge of implementing this plan.

Advantages:

- An implementing committee, whether created anew or its responsibilities given to a modified Harbor Commission, would coordinate and ensure that recommended actions are effected.

Disadvantages:

- Costs of staffing a new committee ($500 per year).
- Dilution of Harbor Commission focus.

Recommended Action:

Seek Town Meeting approval to create a new standing committee charged with implementation of this harbor plan, with representation from diverse constituencies (Selectmen); incorporate this harbor plan, at least by reference, into other town plans, including the Local Comprehensive Plan;

I. Funding

A variety of funding sources can be used to implement this harbor plan, using state, town, and federal sources. Harbor receipts should be used to pay for a portion of operating costs of the harbor and some of the capital costs. The Town presently maintains a Dedicated Account for Pamet Harbor, which is designated for capital costs of improvements, rather than operating costs.

Where appropriate, volunteer help should be sought in implementing the plan to keep costs low.

Recommended Action:

Incorporate priority capital costs of harbor restoration (such as town's share of dredging costs) into town's capital outlay budget and bond (Harbor Commission, Finance Committee and Selectmen); prepare operating budget for harbor and adjust harbor fees to help support operating budget (Harbor Commission).

J. Toms Hill Railroad Trail

A cost-effective means of increasing on-foot public access to the harbor area would be to utilize an existing town-owned but officially-ignored facility: the town-owned railroad bed stretching from the Corn Hill parking lot south to the old railroad trestle crossing of the Pamet River. Though it would not be a through-route without establishing a footbridge over the Pamet (see Action Q), the railroad bed trail would offer panoramic views of the harbor and upriver marsh. For a nominal amount of money (perhaps $2,000), the trail could be graded and brushed out to remove poison ivy and thorny vegetation from the path. An attractive self-guided tour of the history and ecology of the river system could be designed and printed, using donations from private environmental education sources.

Advantages:

- Already publicly-owned property
- Would not intrude into private areas
- Very little cost involved ($2,000)
- Likely to be quite popular
- Affords opportunities for public education

Disadvantages:

- Path would dead-end without footbridge across river
- Slight potential for increased erosion of rail bed from pedestrian use

Recommended Action:

Authorize Truro Highway Department, perhaps with volunteer help, to conduct simple grading and weeding of existing pathway on rail bed. Use signs to designate the trail for public use. Install self-guided brochures, explaining natural and cultural history (Highway Department, Conservation Commission).

II. Moderate Priority

K. Traffic Management and Parking

Serious concerns were voiced at and subsequent to a recent public hearing on the draft plan regarding issues of safety on roads leading to the harbor (such as Depot Road) and parking at the ramp. The Harbormaster has pointed out that due to a change in the regulations and fees applicable to large boats at Provincetown, an increased number of wide-load trailered boats are being brought to Pamet Harbor for launching, creating unusual and potentially dangerous traffic conditions. Even so, the HMPC does not believe that the modest level of improvements proposed for the harbor will substantially alter existing levels of use and so no widening of Depot Road or expansion of the existing parking lot is contemplated or recommended.

In the event that ramp demand does substantially increase in the future, off-site parking and shuttle service would be explored as a first alternative, rather than condemning land adjacent to the ramp for expanded parking space. Traffic safety issues townwide are important and should be addressed in a broader context, such as in the design of the Local Comprehensive Plan (LCP), now underway.

Advantages:

- LCP offers broad framework to study traffic patterns, levels of service and safety

Disadvantages:

- Some residents of Depot Road want traffic study before adoption of harbor plan

Recommended Action:

Encourage LCP Committee to address issues of traffic on small country roads throughout the town, but particularly near the harbor and on route to the beaches. The HMPC recommends that the Selectmen consider reasonable steps to control or restrict the movement of wide-bodied trailered boats on any road leading to the harbor.

L. Viewshed Overlay District

In 1987, the Massachusetts Department of Environmental Management designated the Pamet as a Scenic River. This designation has had an honorary, but no regulatory effect. Construction and landscape alterations continue to undergo no review for aesthetic impact anywhere in Truro, even in Pamet Valley.

In 1990, the Truro Conservation Trust conducted a Pamet River Viewshed Analysis, which identified scenic vistas and public overlooks of the Harbor and river system. Ten of the 24 vantage points provided long-distance views of the Pamet Harbor study area from public roads, landings, or public land (Stations K, L, Q-X; see Map 5). Town adoption of this scenic viewshed would provide a zoning framework in which development guidelines could be designed to protect the public's views. For example, houses could be sited away from vista points or fences designed to allow sightlines of the Harbor.

Advantages:

- Protection of scenic views and aesthetic qualities of the Harbor.
- Conformance with state Scenic River policy, while maintaining primary regulatory role at local level.
- No additional town costs.

Disadvantages:

- Perceived additional restrictiveness of Town regulations.

Recommended Action:

Study impact of adopting Viewshed Overlay District zoning (Planning Board).

M. Local Wetlands Bylaw

The Town of Truro is the only town on Cape Cod not to have enacted its own wetlands protection bylaw. This is inconsistent with the fact that the Town clearly has unique wetlands (including the Pamet system) which are not adequately protected by the Massachusetts Wetland Protection Regulations (310 CMR 10.00). Several key components need to be amplified within Truro's own wetland protection bylaw:

1) Aesthetic wetland values could be added to the list of wetland values contained in the state regulations. The Pamet wetland system provide unique aesthetic values which were not contemplated in the drafting of the state regulations.

2) Sea level rise should be accommodated in Truro's own wetland bylaw. As sea level rises naturally or with the proposed opening of the dike system, existing wetlands will need to migrate inland. The state regulations do not provide for this.

3) An increased jurisdictional zone (beyond the state-prescribed 100 feet) is very important in the Pamet due to the surrounding steep slopes and the sensitivity of the system to changes within its watershed but beyond the arbitrary 100-foot buffer (see Map 5).

4) Private docks and piers should be addressed throughout the Pamet system, not merely at the harbor.

Advantages:

- Protection of the aesthetic wetland values intrinsic to the Pamet.
- Protection of wetlands with respect to natural sea level rise and potential opening of the dike system.
- Jurisdiction over uses within the watershed but beyond the arbitrary 100-foot buffer.

Disadvantages:

- Cost of drafting and adopting the bylaw ($1,000 or less).
- Perceived additional restrictiveness of town regulations.

Recommended Action:

Draft wetlands bylaw (at least for Pamet River) for consideration by Town Meeting (Conservation Commission, Town Counsel).

N. Public Education

Informed residents, visitors and users are more likely to be supportive of continued restoration of the harbor's usefulness. The Town can conduct a number of related activities and publications aimed at conveying that information, through continuing efforts at the school or periodic efforts, such as a summer lecture series. This educational program should convey all aspects of the Pamet's importance to the community, including natural features and economic benefits related to tourism and fishing. Outside agencies that can provide technical assistance in this regard include the Massachusetts Coastal Zone Management Office, Sea Grant Office at Woods Hole and MIT, the Barnstable County Cooperative Extension Service and the Massachusetts Marine Educators, as well as local non-profit groups, such as the Massachusetts Audubon Society and the Truro Conservation Trust.

Recommended Action:

Encourage the Chamber of Commerce to include trail and harbor information in its visitor guide (Harbor Commission); produce a summer lecture series about the Pamet ecosystem (Conservation Commission/ Conservation Trust); publish a map and guide or erect an interpretive kiosk display at the harbor parking lot and distribute guide townwide (Harbor Commission/ Conservation Commission); produce an economic analysis of the harbor's impact on increased tourism in Truro (Finance Committee).

III. Low Priority

O. Removal of Dikes

Based upon the impacts associated with the dikes discussed in the "Findings Report", one management option involves the removal/replacement of these structures to restore more natural flow conditions in the Pamet. There appears to be widespread support for this idea among Truro citizens, as indicated by a 1985 poll which showed that only 13 percent (63 of 523) opposed the idea of opening dikes.

Several studies have been conducted on the impacts of removal of the man-made dikes. In 1983, Graham S. Giese (unpublished) investigated the various effects of the man-made alterations on the natural tidal system. Additionally, he investigated whether removal of some or all of the dikes or changes in their configuration would, in conjunction with well-conceived dredging, restore recreational and commercial uses of the harbor. Initial projections, using available mathematical techniques predicted that the approximate increase in the size of the tidal prism was not sufficient to substantially alter shoaling problems, though it may increase water quality in conjunction with a harbor dredging program.

A second study conducted by Giese et al. (1990) utilized a shallow-water numerical tidal model to estimate the effect on the tidal prism of eliminating the most prominent dikes in the system, Wilder's Dike and the landfill for Route 6, located just east of Wilder's Dike. Wilder's Dike contains a clapper valve that permits discharge of fresh water into the Pamet River, but prevents tidal flow into the fresh water wetlands east of the Dike. The results of this study indicate that removal of Wilder's Dike and the Route 6 landfill would likely not increase the size of the tidal prism by more than five percent. Additionally, there would be little change in tidal flushing and sediment transport pathways.

Based on review of these previous studies, it was determined that, while ecosystem benefits might accrue, removal of some or all of the man-made dikes would have little effect on increasing the recreational and commercial

uses of the harbor. Therefore, further consideration of this alternative, through more detailed numerical modeling, was not conducted.

Advantages:

- Improved boating (canoeing/kayaking) access, but not harbor navigation.
- Restoration of the natural hydrologic environment.
- Increase in salt marsh ecosystem east of Route 6.

Disadvantages:

- Financial costs of improvements.
- Alteration to the existing ecosystem.
- Short term water quality impacts associated with the conversion of freshwater marsh to salt marsh in the Upper Pamet.
- Loss of freshwater wetlands east of Route 6.

Recommended Action:

Conduct a feasibility and environmental assessment study of the proposed removal of dikes to effect habitat changes (Conservation Commission). Cost: $20,000 to $30,000.

P. Modification to Pamet Harbor Jetties

One alternative considered as part of this study was the narrowing of the Pamet Harbor entrance jetties. Through modeling, the jetties were moved closer together by 100 feet, for a total width of 180 feet. Use of this model allowed evaluation of the impacts of the proposed dredging on tidal flushing, tidal elevations and current velocities. The impacts of narrowing the jetties have been analyzed based purely on changes in the hydrodynamics of the system, rather than economics and or navigation considerations. The various advantages and disadvantages of narrowing the jetties have been analyzed and are presented below.

Advantages:

- Increase in tidal current velocities at the Harbor entrance.
- Potential decrease in shoaling at the Harbor entrance.

Disadvantages:

- Slight decrease in tidal flushing.
- Significant costs.
- Short-term potential environmental impacts, such as physical disruption of shellfish habitat and siltation.
- Narrowing of navigational channel, creating a potential boating hazard.
- Costs: $120,000 to $150,000 for relocation, $20,000 to $30,000 for optimal design.

Recommended Action:

Defer design study until periodic maintenance dredging of harbor is fully evaluated; if dredging seems cost-ineffective after ten years, then initiate jetty re-design study, using harbor receipts (Harbor Commission).

Q. Sewage Pump-Out Facilities

Current state and regional policies encourage the establishment of marine sewage pump-out facilities. Such facilities provide a safe and environmentally-sound alternative for the disposal of boat-derived sewage wastes. A facility could be established in proximity to the current boat ramp and could be easily accessed by boaters. The collected septage would be ultimately transported to the Town's septage disposal facility. New state grant funding for pumpout facilities could be accessed to subsidize the costs. The Town of Truro has submitted and received such a grant.

Advantages:

- Provide a safe and environmentally-sound marine sewage disposal option.
- Minimize the risks associated with through-hull discharges.

Disadvantages:

- Costs would be high on a per-user basis because of the small number of boats which have marine heads.
- Enforcement.

Recommended Action:

Indefinitely postpone construction of pump-out station until or unless the boating capacity/type of use is significantly increased; monitor use of portable sani-john at Harbormaster's office as disposal option for boat porta-potties; enforce no-discharge rules within the harbor. (Harbormaster and Harbor Commission).

R. Pedestrian Bridge

The abandoned rail bed provides a unique public access opportunity. Hikers currently access the rail bed from the Corn Hill parking lot and hike southerly towards the harbor. Wonderful sunsets are enjoyed from this vantage point.

This public access could be enhanced with a foot bridge spanning the harbor and connecting the rail bed on the north side of the harbor to the parking lot/boat ramp area. Figure 10 shows two photographs taken of Uncle Tim's Bridge in Wellfleet as an example of this type of structure.

Advantages:

- Enhanced public access.
- Linkage of the northern and southern portions of the Harbor.
- Increased aesthetic opportunities to sunset and nature watchers.

Disadvantages:

- Decreased navigation for sailboats into the upper parts of the Harbor/River.
- Costs of construction ($30,000) and maintenance ($500 annually).
- Attractive nuisance and safety hazard associated with bridge diving at high tide.

Recommended Action:

Obtain cost estimates for design and construction of bridge (Recreation Commission).

S. Shellfish Tissue Testing

The findings report indicated that stormwater runoff and boats are sources of metals and hydrocarbons to the harbor and that shellfish have the ability to bioaccumulate these compounds within their tissue. A representative sample of shellfish meats could be analyzed for metals and hydrocarbons to determine the degree to which this may be occurring within Pamet Harbor.

Advantages:

- A better understanding of the quality of shellfish.
- Possible economic advantage of marketing clean shellfish.
- Evaluation of the impacts associated with long-term chronic discharges.

Disadvantages:

- Costs of analyses (approximately $2,500).

Recommended Action:

Collect and test shellfish tissue for metals and hydrocarbons at Barnstable County Health and Environmental Department laboratory (Board of Health).

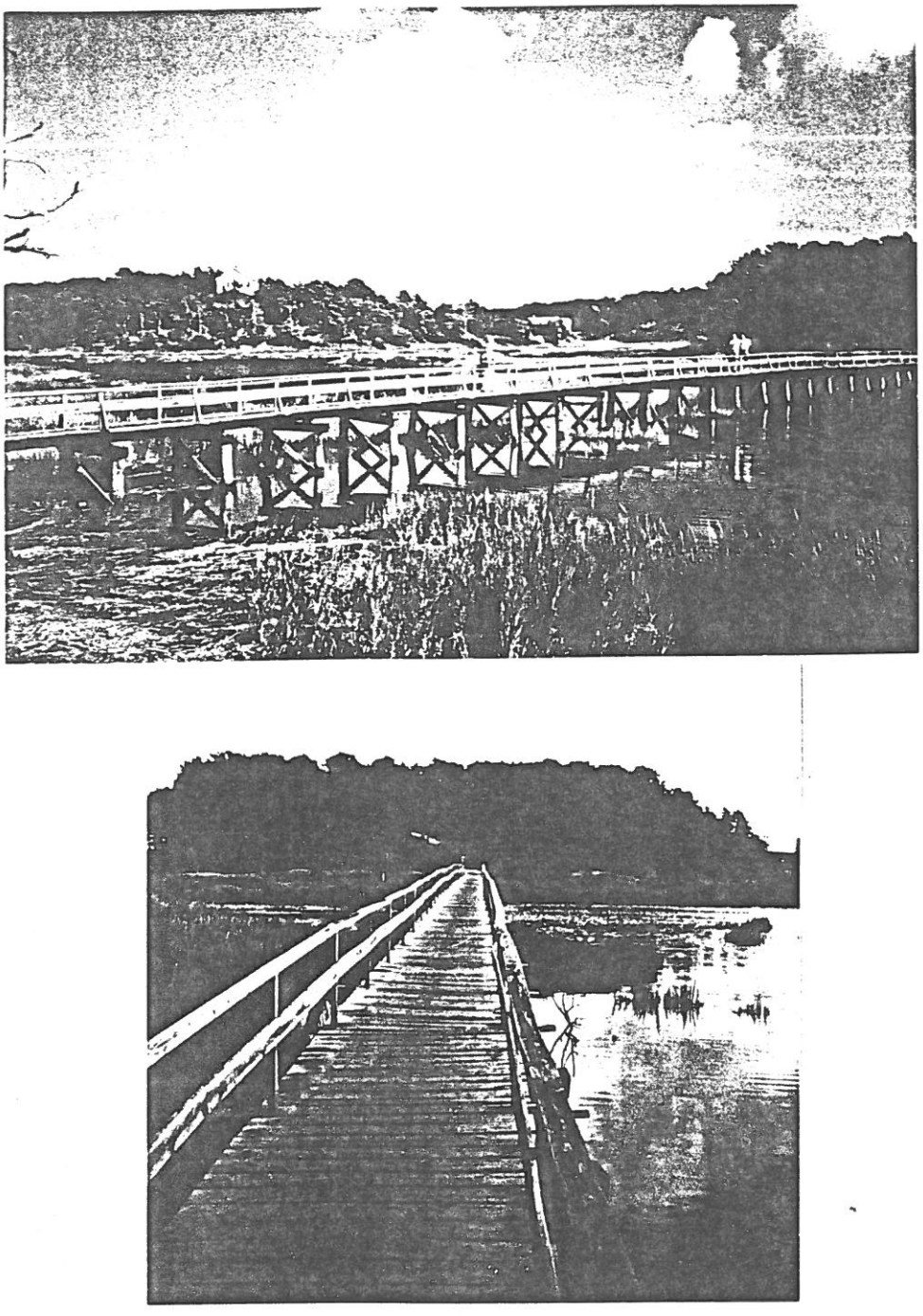


Figure 10. Uncle Tim's Bridge, Wellfleet, Massachusetts

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APPENDIX A

APPENDIX A

Town of Truro
Pamet Harbor Management Planning Committee
1992 -1993 Membership

Eleanor Fortini, Chair*
Harbor Commission

Reuben Wisotzky, Vice-Chair*
Truro Neighborhood Association

Tamson Garran (ex-Chair)*
Harbor Commission

Marguerite Holway*
Shellfish Constable

Betsey Brown*
Pamet Harbor Yacht Club

Dr. Charles Davidson*
Citizen at Large

Brenda Boleyn*
Truro Representative to Coastal
Zone Management Adv. Committee

Marina Matricardi*
Appeals Board

Albert Kaufman*
Planning Board

David Perry, Publicity
Police Department

Irving Wheeler
Harbormaster

David Kelly
Harbor Commission

Walter Bingham, Jr.
Truro Conservation Trust

Thomas Kane
Harbor Commission

Mark Dundus
Harbor Commission

Harry Towle
Conservation Commission

Albert Silva
Truro Chamber of Commerce

Paul Morris
Highway Department

William Painter, Advisor
Beach Commission

Susan Wilmot, Advisor

Norman Edinberg
Finance Committee

Pam Rubinoff, Advisor
Coastal Zone Management Office

Mark Robinson, Project Manager
Horsley & Witten, Inc. (Consultant)

Scott Horsley, Project Director
Horsley & Witten, Inc. (Consultant)

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* (Steering Committee)

APPENDIX B

APPENDIX B

JULY 1992 OPINION SURVEY

Pamet Harbor Commission

Truro Town Hall • P.O. Box U
Truro, Massachusetts 02666

Return to Eleanor Fortini, Harbor Management Planning Committee, Town Hall, Truro 02666

The Town of Truro, through its Harbor Management Planning Committee, has retained HWH, Inc. to prepare a management plan for Pamet Harbor. As part of the public participation process, we seek your opinions on issues related to the harbor, its use and future. The results of this survey will help to suggest goals, objectives and actions related to the plan.

1. How do you use or enjoy the harbor? Why is it important to you?

2. The Committee has stated an operating goal of the plan is to "restore the usefulness of the harbor, while protecting the productivity and natural resources of the estuary and harbor basin." Is this the proper goal?

3. If the harbor can be dredged with little long-term environmental impact, do you think it should be the major part of "restoring the usefulness" of the harbor? What do you think should be dredged--the entrance channel, the existing boat basin, a larger boat basin?

4. Last year about 130 boats had mooring permits in the boat basin. Should the harbor be made to accommodate more boats or simply allow the present number to enjoy better conditions? Should there be fewer boats in the Pamet?

5. Is there adequate public access to the harbor? If not, what more is needed?

6. What are the greatest threats to the harbor, its beauty and its natural resources?

7. What level of commercial fishing support should the harbor provide?

8. How important an objective is it to ensure that shellfish could be harvested year-round in the harbor? Where do you think pollution is coming from?

9. To what degree should the town permit swimming inside the harbor?

10. Is the harbor safe for boaters? What makes it unsafe? How could it be made more safe?

11. Is traffic safety on Depot Road leading to and from the harbor a problem?

12. Should the town as a whole subsidize improvements to the harbor or should the users pay?

APPENDIX C

APPENDIX C

SELECTED NEWSPAPER ARTICLES

The Cape Codder Tuesday, February 11, 1992 Page 13

Hoping to Reverse Tide, Truro Pushes For Pamet Harbor Plan

By Joyce Johnson

For just about as long as anyone can remember, there have been navigational problems at the Pamet Harbor.

Rather than improving, records — and a quick viewing of the harbor entrance at low tide — indicate access is worsening.

But the Pamet Harbor Commission, working with a management group representing about every aspect of Truro life, hopes to turn that tide.

Last night, Committee Chairman Tamson Garran outlined the immediate and long term plans of the group for the Truro Finance Committee.

The plans include installing 100 town-owned moorings by next summer and applying for grants for dredging and other improvements.

But before any of that can happen, the town must have a harbor management plan. Bid specifications for a consultant to develop the plan should be published by this week, Mr. Garran said. About $28,000 will be paid to the consultant through a Coastal Zone Management matching grant. Other grants, if received, would help in replacing the float system and dredging the harbor.

Mr. Garran said the county is considering purchasing dredging equipment that Truro could rent for a nominal fee that would greatly reduce cost of dredging the harbor. Eleanor Fortini, a member of the committee, is also a member of the dredging group that has been analyzing the county's harbor and river needs.

Mr. Garran said, in an effort to improve boating conditions, many of the private moorings in the harbor have been removed and owners have been told to pick them up. They will be replaced with town moorings that will be installed in a "grid" on the Corn Hill side of the harbor, bringing "order and quality" to the mooring system.

Mr. Garran reported that in bad weather, many makeshift moorings, such as two cement blocks tied together, have resulted in boats straying and damaging other boats. Mushroom-style moorings also have caused problems because they have not been dug in deep enough, so vessels scrape against them.

Fees from private moorings and those sold by the town last summer amounted to about $8,000. Mr. Garran expects that sum to reach $9,300 next summer from renting the town moorings.

Last year there were about 650 "day" launchings during the season, he said, a drop from about 1,000 launchings a few years ago, an indication of the deterioration of harbor access from sand building up in the channel.

Mr. Garran said there is now an "official" waiting list for people who want moorings. The study will also determine how many boats can use the harbor comfortably.

Mr. Garran praised Harbormaster Irving Wheeler for his efforts in controlling activity at the harbor and for his diplomacy.

"He is one of the best public relations people on the face of the Earth," Mr. Garran said. "He speaks kindly and gently to all."

Mr. Garran presented the Fiscal 1993 budget of $15,000, which will leave about $13,000 in the harbor account to be held for future expenses. He indicated that the salary account will be increased next year to allow for more coverage at the harbor.

Ms. Fortini noted that charges at the harbor are very low compared to other similar facilities and could be increased.

While the committee does not want to "drive people out," Ms. Fortini said, it does wants funds from the harbor to help pay for dredging. Mr. Garran said he hopes no money will have to be raised and appropriated. If there is a bond issue to pay for dredging, it would be paid for from the harbor's revolving account, he said.

Ms. Fortini said she is encouraged by the progress made by the two committees.

"It's all coming together finally," she said.

The Cape Codder
10/23/92

Comprehensive Pamet Harbor Plan Continues to Make Slow Progress

By Joyce Johnson

Progress is slow but steady for developing plans to upgrade Pamet Harbor in Truro, members of the Pamet Harbor Commission and Harbor Planning Committee reported last week.

The harbor and channel are navigable for only a few hours of each tide because of extensive silting.

A 23-member committee was appointed to develop the plans, but major decisions such as dredging will go before the voters prior to implementation.

"A harbor management plan must consider all aspects of the uses of the harbor, including how these uses will interact with one another, and the committee must have representatives from all areas of government and the private sector which have anything to do with the harbor," the committees said in explaining the unusual size of the planning group.

In addition to the committees, a consultant has been hired, with the state Coastal Zone Management office and town sharing costs.

The consultant's preliminary report, expected to favor a plan to dredge the harbor and the channel to it from Cape Cod Bay, is expected within the month.

Last Wednesday, Special Town Meeting voters approved a $15,000 transfer from the Pamet Harbor fund — derived from mooring and ramp receipts — to be combined with $45,000 from the state to pay for engineering plans for dredging the harbor.

The area to be dredged will follow the dredge plan that was implemented in the 1960s.

The engineering study, which will provide a detailed bathymetric survey to determine the quality of the material to be dredged, will also indicate future dredging needs for the area.

The dredging project has been endorsed by the harbor management planning committee and harbor commission, but no work will be done until voters have an opportunity to evaluate the information and vote on it.

Should the county purchase a dredge, the use of it would cut costs of the project and future maintenance.

In the meantime, projects are already in the works to increase the safety of mooring for all boaters, make better use of available space, and increase income for the harbor facility.

A newly installed shallow water mooring system has been stalled in the area directly in front of the parking lot. It can accommodate up to 80 boats at one time.

The moorings may have to be relocated when the dredging is done, but would remain similar in use and construction.

New town-owned moorings and floats will be installed in the deep water anchorage, south of the boat ramp and towards the Pamet Yacht Club. Construction of those facilities will start next year.

A new, double boat ramp was installed in 1989, paid for by the state Public Access Board of the Department of Fisheries, Wildlife and Environmental and Law Enforcement agency. The town is obligated to conform to state rules and regulations, however controversial, once it accepts such state projects.

The public access board plans to install a new access wharf and float system next year that will replace the present "courtesy" float system. It will parallel the existing ramp and extend into deep water at all tides.

In other plans, the access board intends to rebuild the parking lot and its drainage system to control more effectively road runoff into the Pamet River, considered a major cause in high coliform counts that have closed the area to shellfishing.

(The state Department of Highways recently changed the drainage system on Route 6, which contributed to runoff and pollution of the upper Pamet, as well.)

Increased mooring and ramp fees will probably be one of the negative results of the improvements to the harbor facility, although no increases are planned for the 1993 season.

Although access for large boats will be limited, use of the harbor by commercial vessels is included in the projected plans.

Other potential concerns under review by the committees relate to the expected increase in traffic and parking needs.

Cape Cod Times
SUNDAY, NOVEMBER 22, 1992

Truro's Pamet Valley

Where man and nature are intrinsically linked

BY HAMILTON KAHN
STAFF WRITER

TRURO – In the Pamet River Valley peace prevails, but powerful forces are at work.

Nestled in the heart of the Cape Cod National Seashore, the valley possesses an unspoiled beauty that stretches 2½ miles from Cape Cod Bay to the Atlantic Ocean.

There are not many places that have been tamed by humanity and remain beautiful, but the Pamet Valley is one of them. It is not as nature created it; its free-flowing waters were long ago interrupted at many intervals and locations by dikes and embankments, giving shape to the valley's presently accepted form: a tidal salt marsh to the west of Route 6, a fresh water marsh to the east.

And this is the way the Pamet has been for more than a century.

The Pamet Valley is also a place where nature can make its presence known in startling ways, such as when an angry Atlantic last year cut a 100-foot swath through the barrier dunes at the Head of the Pamet during the Halloween northeaster. With all the power and majesty of a large-scale natural birth, the ocean waters flooded the valley and created a large sand flat on what had been a fresh-water swamp.

(Although there were immediate concerns that the overwash might lead to creation of a cross-Cape channel, the accepted scientific view at this point is that only a significant rise in sea level could manifest that change, which would make an "island" out of half of Truro and all of Provincetown.)

A month after the Ballston breach, nature asserted itself at the other end of the Pamet when another high tide removed the Mill Pond railroad dike, allowing the water from Pamet Harbor to flood a man-made fresh-water marsh.

The harbor, which was explored by the Pilgrims in 1620, has repeatedly shoaled over the years, and currently is navigable only at extreme high tide.

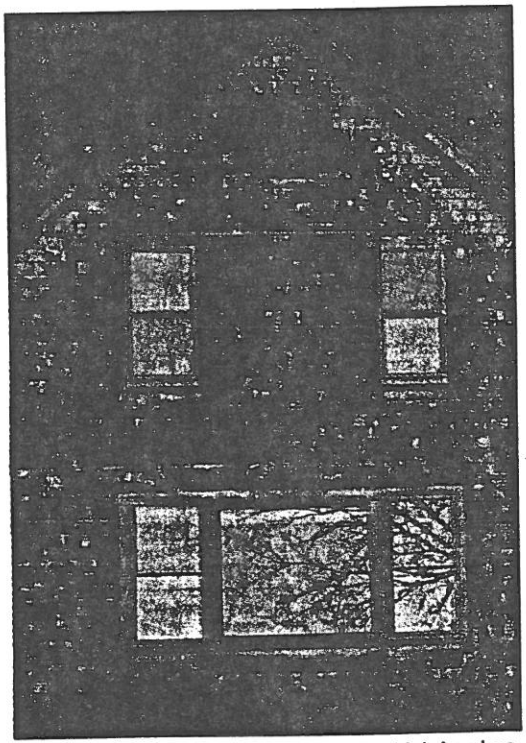
The residents of the valley once looked to the river as a source of revenue from fishing and trade. As the fishing industry waned, they allowed it to be altered by construction of various dikes, including ones to carry the railroad that led to the town's new identity as a summer resort. Then came the view of the river as a recreational resource for boating, shellfishing and scenic beauty.

Through all this, little thought was ever given to appreciating the river for its own sake. It was there to be used.

A year-long study of the harbor, and the potential effects of dredging and development of the harbor on the rest of the river and its tributaries, is currently being conducted by Horsley Witten Hegemann Inc., a Barnstable consulting firm that has been hired by the town's harbor management planning committee.

"It was always a tricky harbor, but it was a useful harbor," says project manager Mark Robinson, who also prepared a Pamet River Greenway Management Plan in 1986 for the Truro Conservation Trust. "What has changed are people's perceptions of it."

The manipulation of the harbor to have it conform to people's needs began in the early 1900s, Robinson says. That, along with construction of some 16 dikes inland, severely reduced the "tidal prism" that runs out of the harbor twice a day, borne by 10-foot tides.



■ **A summer cottage off Depot Road, which borders the river, catches the sun's last light.**

The most significant interruption in the river is Wilder's Dike, the piece of land upon which Route 6 is located. Built in 1869, it gives the valley its schizophrenic quality: freshwater marsh to the east, salt-water tidal marsh to the west.

Replacing Wilder's Dike with a bridge, which is not likely to happen anytime soon, if ever, would restore the river to its natural state, but the transition could be unpleasant. Most of the fresh water vegetation would die, and the valley could be enveloped by the smell of decay for years, Robinson says.

At a meeting last July, Truro residents made it clear that they still view the river and harbor as a resource for their uses, meaning that dredging of the harbor is likely to come soon. Voters approved a $15,000 dredging study at a special town meeting last month, and although the study does not commit the town to dredging, without it the the town will soon no longer have a harbor.

Robinson says he thinks the Pamet River is unique in that it is the only river that begins at the ocean and flows to the bay. The valley was formed by glaciers, and the headwaters flow from the glacier's groundwater remnants, rather than from underground

Please see **PAMET** /B-12

APPENDIX D

APPENDIX D.
Sediment Analysis

BRP WP WQC-1 SUPPLEMENTAL DATA

SECTION 4 DESCRIPTION OF MATERIAL TO BE DREDGED

A. GRAIN SIZE ANALYSIS

DESCRIPTION	SIZE FRACTION % OF TOTAL BY WEIGHT	
	BEACH NOURISHMENT	LANDFILL COVER
Course Gravel	1.2%	0.3%
Fine Gravel	3.4%	2.6%
Sand (.075-2)	90.5%	66.9%
Silt Clay {0-.075}	4.9%	30.2%

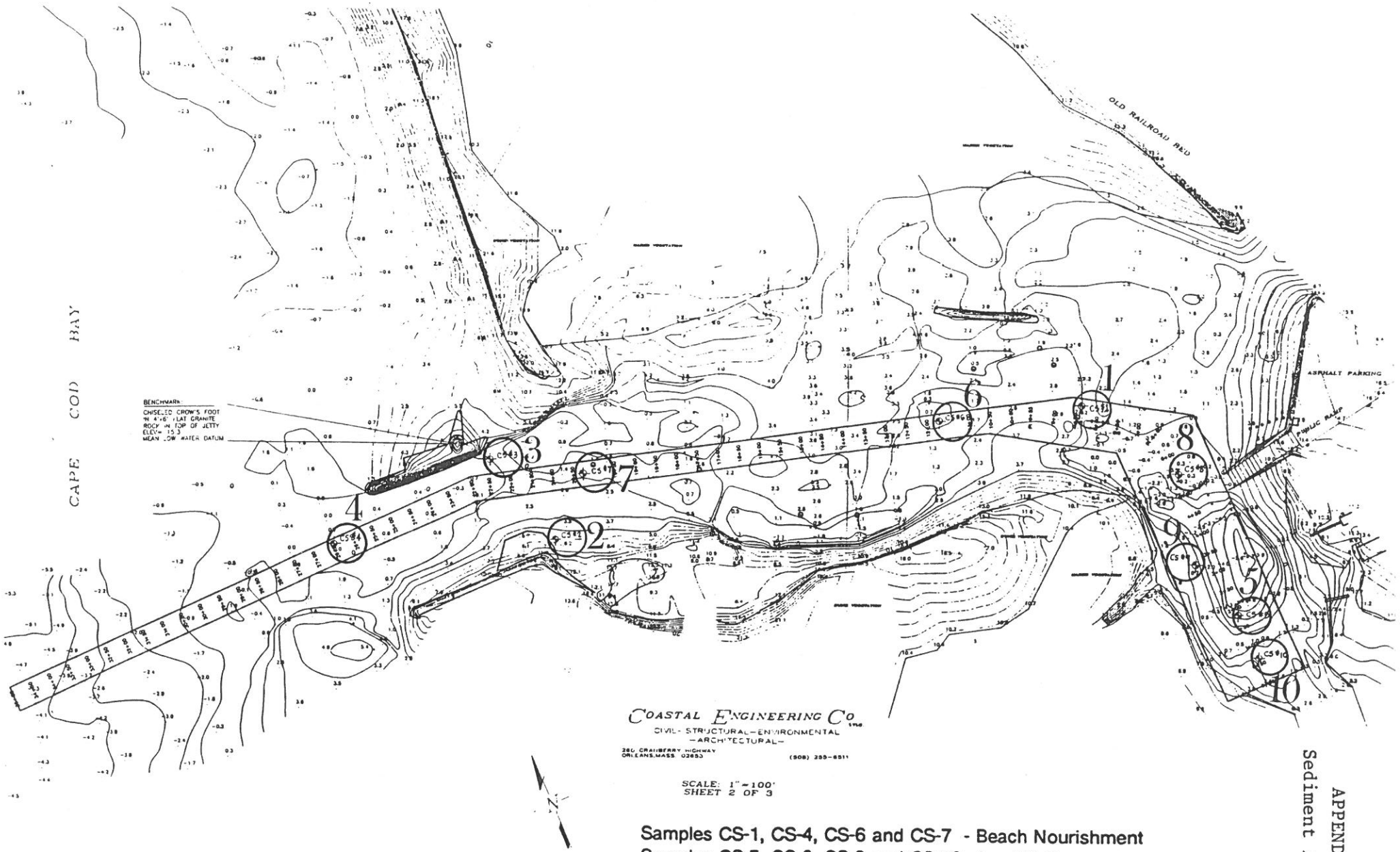
Samples CS-1, CS-4, CS-6 and CS-7 - Beach Nourishment
Samples CS-5, CS-8, CS-9 and CS-10 - Landfill Cover

B. CHEMICAL ANALYSIS OF SEDIMENT

	BEACH NOURISHMENT	LANDFILL COVER
% Volatile Solids	.17 to .35	.20 to .62
Total Oil & Grease (ppm)	34	150
Mercury (ppm)	< .10	.49
Cadmium (ppm)	< .50	< 1.3
Lead (ppm)	1.3	24
Chromium (ppm)	1.7	14
Copper (ppm)	< 2.5	< 6.6

Samples CS-1, CS-4, CS-6 and CS-7 - Beach Nourishment
Samples CS-5, CS-8, CS-9 and CS-10 - Landfill Cover

SOURCE: "Pamet River Entrance Channel and Mooring Basin, Town of Truro," Mass. Bureau of Resource Protection - Water Pollution Control, Application dated 16 September 1993 by Coastal Engineering Co., Inc.



Samples CS-1, CS-4, CS-6 and CS-7 - Beach Nourishment
Samples CS-5, CS-8, CS-9 and CS-10 - Landfill Cover

SOURCE: "Pamet River Entrance Channel and Mooring Basin, Town of Truro," Mass. Bureau of Resource Protection - Water Pollution Control, Application dated 16 September 1993 by Coastal Engineering Co., Inc.

APPENDIX D.
Sediment Analysis

BRP WP WQC-2

SUPPLEMENTAL DATA

SECTION D. CONSTRUCTION IN WATER

8. GRAIN SIZE OF SEDIMENTS IN WATER:

	BEACH NOURISHMENT	LANDFILL COVER
Course Gravel	1.2%	0.3%
Fine Gravel	3.4%	2.6%
Sand (.075-2)	90.5%	66.9%
Silt Clay {0-.075}	4.9%	30.2%

See attached grain size analysis.

Samples CS-1, CS-4, CS-6 and CS-7 - Beach Nourishment
Samples CS-5, CS-8, CS-9 and CS-10 - Landfill Cover

9. GRAIN SIZE BY WEIGHT PERCENT PASSING STANDARD SIEVES:

	BEACH NOURISHMENT	LANDFILL COVER
#10 Sieve	< 4% Fine Gravel	< 3% Fine Gravel
#200 Sieve	< 91% Sand < 5% Silt/Clay	< 67% Sand < 31% Silt/Clay

Appendix D.

Sediment Analysis

9.03: continued

(3)

Table I
Classification of Dredge or Fill Material
By Chemical Constituents
All units are in parts per million

	Category One	Category Two	Category Three
Arsenic (As)	< 10	10 - 20	> 20
Cadmium (Cd)	< 5	5 - 10	> 10
Chromium (Cr)	<100	100 - 300	>300
Copper (Cu)	<200	200 - 400	>400
Lead (Pb)	<100	100 - 200	>200
Mercury (Hg)	< 0.5	0.5 - 1.5	> 1.5
Nickel (Ni)	< 50	50 - 100	>100
Polychlorinated Biphenyls (PCB)	< 0.5	0.5 - 1.0	> 1.0
Vanadium (V)	< 75	75 - 125	>125
Zinc (Zn)	<200	200 - 400	>400

Category One materials are those which contain no chemicals listed in Table I in concentrations exceeding those listed in the first column.

milligrams/liter = parts/million = micrograms/gram

Category Two materials are those which contain any one or more of the chemicals listed in Table I in the concentration range shown in the second column.

Catergory Three materials are those materials which contain any chemical listed in Table I in a concentration greater than shown in the third column.

Other important man-induced chemicals or compounds not included in Table I which are known or suspected to be in the sediments at the dredge site will of course be given weight in the classification of the material and the choice of dredging and disposal methods. When the Division has reason to suspect the presence of any other toxins due to a nearby discharge, additional testing for that element may be required.

(4)

Table II
Classification of Dredge or Fill Material
By Physical Characteristics

	Type A	Type B	Type C
Percent silt-clay	<60	60 - 90	>90
Percent water	<40	40 - 60	>60
Percent volatile solids (NED methods)	< 5	5 - 10	>10
Percent oil and greases (hexane extract)	< 0.5	0.5 - 1.0	> 1.0

Type A materials are those materials which contain no substances listed in Table II exceeding the amounts indicated in the first column.

Type B materials are those materials which contain any one or more of the substances listed in Table II in the concentration range shown in the second column.

Type C materials are those materials which contain any substance listed in Table II in a concentration greater than shown in the third column.

Source: MA Div. of Water Pollution Control 314 CMR 9.03

9.03: continued

(5) Dredging, Filling and Disposal Techniques - Table III identifies the normally approvable techniques for dredging or filling, the normally approvable methods of placing or disposal of the material and the normally approvable

Table III
Normally Approvable Dredging, Handling and Disposal Options

CHEMICAL TYPE (TABLE I)	Category One			Category Two			Category Three		
PHYSICAL TYPE (TABLE II)	A	B	C	A	B	C	A	B	C
Dredging Methods									
Hydraulic	X	X	X	X	X	X	X	X	X
Mechanical	X	X	X	X	X	X	X	X	X
Disposal Methods									
Hydraulic: Sidecast	X	X	0	0	0	0	0	0	0
Hydraulic: Pipeline	X	X	X	X	X	X	X	X	X
Mechanical: Sidecast	X	X	0	0	0	0	0	0	0
Mechanical: Barge	X	X	X	X	X	X	X	X	X
Placement									
Land or in-harbor disposal with bulkheading:	X	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Open ocean disposal at high energy, sandy sites	X	0	0	0	0	0	0	0	0
Open ocean disposal at low energy, silty sites	0	X	(b)	0	(b)	(b)	(b)	(b)	(b)
Unconfined in-harbor	X	0	0	0	0	0	0	0	0
Beach Replenishment	X	0	0	0	0	0	0	0	0
Other Conditions									
Timing and Placement to Avoid Fisheries Impacts (spawning and running periods and areas)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)

Legend: X = Normally approvable
0 = Not normally approvable
(a) = Normally approvable but control of effluent will be required
(b) = Approvable only after bioassay, performed in accordance with established EPA procedures, indicates no significant biological impact. A statistically comparable project which has successfully passed the bioassay test may be substituted. If a significant biological impact is found, this material is unsuitable for open water disposal.
(c) = Required in all cases.

RESULTS OF SEDIMENT SAMPLING FOR PAMET HARBOR BY AUBREY CONSULTING, INC. 9/22/92

CORE #: 1
DEPTH OF WATER: 6"
TIME: 13:15
LENGTH OF CORE: 14"
TYPE OF CORE: barrel
BOTTOM DESCRIPTION: sand
BIOLOGICAL DESCRIPTION: no plants, sand eels
CORE DESCRIPTION: med. sand, tan, no clay, appears good quality

CORE #: 2
LOCATION: centerline of channel between the 2 jetties
DEPTH OF WATER: 2'
TIME: 13:05
LENGTH OF CORE: 16"
TYPE OF CORE: barrel
BOTTOM DESCRIPTION: sand
BIOLOGICAL DESCRIPTION: sand eels - no plants
CORE DESCRIPTION: med. sand, tan, no clay, appears good quality

CORE #: 3
LOCATION: back beach below dune on N jetty
DEPTH OF WATER: n/a
TIME: 13:25
LENGTH OF CORE: 6"
TYPE OF CORE: barrel
BOTTOM DESCRIPTION: sand
BIOLOGICAL DESCRIPTION: n/a
CORE DESCRIPTION: fine to med. sand, tan, no clay, appears good quality

CORE #: 4
LOCATION: at the centerline of the channel
DEPTH OF WATER: 6"
TIME: 13:55
LENGTH OF CORE: 8"
TYPE OF CORE: barrel
BOTTOM DESCRIPTION: sand
BIOLOGICAL DESCRIPTION: sand eels, clams, crabs, fish
CORE DESCRIPTION: clean brown/grey sand, fine to med. grained

CORE #: 5
LOCATION: northwest meander in channel in main boat basin
DEPTH OF WATER: 16"
TIME: 14:05
LENGTH OF CORE: 10"
TYPE OF CORE: barrel
BOTTOM DESCRIPTION: sand & shell
BIOLOGICAL DESCRIPTION: sand eels
CORE DESCRIPTION: brown to gray sand, fine to med. grained

CORE #: 6
LOCATION: north channel in main boat basin
DEPTH OF WATER: 1"
TIME: 14:15
LENGTH OF CORE: 10"
TYPE OF CORE: barrel
BOTTOM DESCRIPTION: sand / shell
BIOLOGICAL DESCRIPTION: polychaetes
CORE DESCRIPTION: brown to gray sand, fine to med. grained

CORE #: 7
LOCATION: 250' west of steps on parking lot in main boat basin
DEPTH OF WATER: waters edge
TIME: 14:40
LENGTH OF CORE: 10"
TYPE OF CORE: barrel
BOTTOM DESCRIPTION: sand / shell
BIOLOGICAL DESCRIPTION: polychaetes, lots of clam shells
CORE DESCRIPTION: brown to gray sand, shell, fine to med. grained

CORE #: 8
LOCATION: Mouth of creek entering harbor from the north (flood tide delta)
DEPTH OF WATER: 6"
TIME: 14:30
LENGTH OF CORE: 10"
TYPE OF CORE: barrel
BOTTOM DESCRIPTION: sand / shell
BIOLOGICAL DESCRIPTION: polychaetes & sand eels
CORE DESCRIPTION: brown, dark to light gray sand, med. grained

CORE #: 9
LOCATION: North side of Pamet River mouth, east side of main boat basin
DEPTH OF WATER: waters edge
TIME: 14:50
LENGTH OF CORE: 10"
TYPE OF CORE: barrel
BOTTOM DESCRIPTION: sand / shell
BIOLOGICAL DESCRIPTION: sea lettuce (ulva), razor clam shells, hermit crabs, brown kelp (choradaria???)
CORE DESCRIPTION: brown sand, fine to med. grained

CORE #:10
LOCATION: South Boat Basin
DEPTH OF WATER: 3'
TIME: 15:10
LENGTH OF CORE: 10"
TYPE OF CORE: barrel
BOTTOM DESCRIPTION: sand / shell
BIOLOGICAL DESCRIPTION: polychaetes / fucas attached to small cobbles
CORE DESCRIPTION: black sand and shell, fine to med. grained

CORE #: 11
LOCATION: center of S portion of boat basin
DEPTH OF WATER: 8'
TIME: 15:45
LENGTH OF CORE: N/A
TYPE OF CORE: Van Veen grab
BOTTOM DESCRIPTION: muck
BIOLOGICAL DESCRIPTION: could not determine
CORE DESCRIPTION: mostly organics intermixed with silts and clays

CORE #: 12
LOCATION: South Boat Basin
DEPTH OF WATER: 2'
TIME: 15:15
LENGTH OF CORE: 3' penetration; 16" recovery
TYPE OF CORE: barrel
BOTTOM DESCRIPTION: sand
BIOLOGICAL DESCRIPTION: none seen
CORE DESCRIPTION: fine to med. grained sand

CORE #: 13
LOCATION: South Boat Basin
DEPTH OF WATER: 2'
TIME: 15:30
LENGTH OF CORE: 16"
TYPE OF CORE: barrel
BOTTOM DESCRIPTION: muddy
BIOLOGICAL DESCRIPTION: none seen
CORE DESCRIPTION: 0-12" muck, 12-16" sand

CORE #: 14 South Boat Basin
LOCATION:
DEPTH OF WATER: 3'
TIME: 16:05
LENGTH OF CORE: 10"
TYPE OF CORE: barrel
BOTTOM DESCRIPTION: muddy with dead seaweed
BIOLOGICAL DESCRIPTION: none observed
CORE DESCRIPTION: 0-2" muck, 2-8" sand

CORE #: 15
LOCATION: South portion of main boat basin
DEPTH OF WATER: 2'
TIME: 15:15
LENGTH OF CORE: 11"
TYPE OF CORE: barrel
BOTTOM DESCRIPTION: muddy
BIOLOGICAL DESCRIPTION: none observed
CORE DESCRIPTION: gray, clayey sand and muck

Cape Cod Times
SUNDAY, NOVEMBER 22, 1992

PAMET

Continued from B-1

springs, as many residents believe.

The word "pamet," lower case, is, in fact, a geological term, which Woods Hole geologist and former Truro resident Graham Giese says is defined as a dry valley formed by glacial deposits on Outer Cape Cod. (The word is originally derived from the Payomet Indians who orignally settled the valley.) But because the Pamet is not a dry valley, the Pamet itself is not actually a pamet, in the strict sense of the word, Giese says.

In response to a recent survey, Truro residents said their favorite "use" of the harbor is for watching sunsets. And although that may seem superficial, Robinson says appreciation of aesthetics may lead to a wider concern about the Pamet River and valley.

"We have to encourage them to expand on that interest," Robinson says.

Ultimately, the valley will continue to be shaped by the same forces that have brought it to where it is today: mankind and nature, each with its own "agenda," conscious or otherwise.

Charles Davidson, chairman of the Truro Conservation Commission, says he is comfortable that the needs of people can be met without damaging the river. Specifically, he believes that the harbor can be dredged and made into a useful recreational resource without ruining shellfish beds or otherwise harming the environment.

"If I thought for one moment that dredging the harbor would be a major detriment to its future, I would react more strongly to the idea of it," Davidson says.

From the Head of the Pamet to Pamet Harbor, the Pamet Valley has long been its own little world, enclosed by the glacier-formed hills to the north and south. Families whose roots go back several generations live along the river's banks in houses dating back a century or more.

Perry Anthony, who lives in the house on North Pamet Road her parents bought in 1923, remembers a feeling of isolation during the summers she spent in Truro as a child during the '30s and '40s. Few people had cars then, and virutally all the necessities of life were delivered to your door – groceries, fish, ice.

"We didn't see people much," Mrs. Anthony recalls. "I learned to climb trees, my sister learned to read books."

Truro's tranquility appealed enough to her father, illustrator Edward Wilson, so much that he and her mother, Dorothy, left New Jersey and moved to Truro year round, where they lived for 30 years. Mrs. Anthony followed the same pattern in 1976, when she and her husband, stage and film director Joseph Anthony, also moved to Truro.

Today, the open views of the valley from her home have been filled by the trees that have grown up over the years, but the same atmosphere of peace exists, Mrs. Anthony says, which is why she feels so much at home.

"The seasons change so gorgeously in this valley," she says.

TNA looks closely at Pamet watershed

Studies indentify problems, Truro must find solutions

Only town on Cape without wetlands law

By Peter Steele

Truro Neighborhood Association members heard Monday from environmental consultants that they must decide how they want to manage the environmentally sensitive Pamet River watershed area, which has the potential to hold another 500 homes and host expanded recreational and economic activities.

John K. Whiteman, consultant to the Truro local comprehensive plan, told over 150 people at the association's annual meeting that the Pamet watershed area encompasses about one quarter of the land in Truro.

"There is the potential of another 500 homes in this area," he said. "And that is a conservative estimate."

In drafting the wetlands section of the local comprehensive plan, Whiteman said three themes have evolved: the potential for development of the watershed area, the complex mix of social, economic and environmental issues there, and the partnerships that will be needed to address the issues. He said partnerships between the town, the Cape Cod National Seashore and private landowners in the watershed will be needed to manage the area.

The watershed is comprised of 36,000 acres, Whiteman said, of which 50% is protected by the Seashore, the Town of Truro, a conservation trust or private landowners. Thirty percent of that area has been developed, which means there is at least one building on a lot, he said. There are now 700 homes in the Pamet watershed, Whiteman said.

Fifteen percent of the area is still buildable, and five percent of the privately owned land is unbuildable, he said. Whiteman said there are 450 buildable acres left in the watershed, most of which are already divided into small parcels.

Only about 50 parcels actually abut the Pamet River, and only four of those are buildable, he said. The rest of the parcels are mostly wetlands to the north and south of the river, he said. Whiteman suggested the town purchase the parcels that are buildable to protect the river.

Related story page 9

He said the Pamet is an exceptional resource, not only for its environmental value, but for the second-home market and tourist industry. Two-thirds of all the structures in Truro are seasonal residences, he said, each of which brings in $1,000 net revenue to the town without overstressing services, such as schools. If managed properly, the remaining buildable lots in the Pamet watershed area could earn a fiscal net return for the town, Whiteman said.

He told the audience that the town will need a viable long-term water supply and suggested Provincetown, Truro and Wellfleet work together to find one. The local comprehensive plan will urge the town to work with the National Park Service to find a water supply within Seashore boundaries, Whiteman said. The Higgins Hollow area would most likely produce the highest yield for a water supply, he said.

Scott Horsley, consultant to the Pamet Harbor management plan, said the plan studies just the harbor area, not the entire Pamet River valley. Midway through the year-and-a-half long plan, Horsley said, "We see the most significant impact is the placement of the dikes and bridges." He said these structures have had a dramatic effect on the Upper Pamet by stemming the natural tidal flow of the area.

The high counts of coliform, which come from animal feces and cause illness, that have been found in the Pamet are related to storm water run-off that washes into the river, not from septic systems, Horsely said. With data to support that conclusion, he said the state Department of Environmental Protection agency could be persuaded to issue a "rainfall closure" that would allow the opening of shellfish beds 48 hours after a rainfall, he said. There are low-cost options to mitigate storm water run-off, he added.

Horsely urged the crowd to review Truro's bylaws and regulations on wetlands. "Truro is the only town on the Cape that does not have a wetlands bylaw," he said.

The harbor plan will make recommendations, including the rainfall closure, removal of dikes to allow natural flushing of the harbor area, and construction of a pedestrian bridge stretching from the harbor parking lot to the railroad bed to allow access to the recreation area beyond it, Horsley said.

Another recommendation is to close the section of the barrier beach south of the harbor to off-road vehicles, since there is no public access there anyway. The vehicles would still be allowed to the north, where there is public access, he said.

Mark Tabor, on-site planner for the Seashore general management plan, said the Pamet River valley is a microcosm of what is happening in the Seashore. He said the area includes natural resources, such as estuarian systems, ponds and barrier beaches, and cultural resources, such as historical architecture and landscaping, harbor and marine activity, historic trails such as Old King's Highway and possibly prehistoric remains.

The Seashore's job is to balance the uses and decide which gets priority, Tabor said. "The environment must take the priority," he said. "We must defer to the environmental resources."

Tabor said human systems should be adapted to the environmental resources. Faced with the loss of parking at the ocean beaches, residents may decide parking is not the best use of the shoreline and opt for shuttle buses and pedestrian trails to the beaches, he said. "Towns can make a great profit by using alternative transportation," Tabor said.

The Seashore seeks to protect the historical integrity of historical structures and landscaping while respecting he rights of property owners, he said. "But we must plan limits on residential growth and bring the human impact in line with the impact on resources," he said.

He said the question is not how does the Pamet affect the Seashore? The question to ask the Pamet River Valley, Town of Truro and the Seashore, Tabor said, is, "Are you ready for a change?"

Experts explain what's wrong with Pamet

River rising, salt marsh becoming fresh, coliforms from animal waste

By Peter Steele

Sea level at the Pamet River is rising, the saltwater marsh at the Upper Pamet has been transformed into a freshwater marsh and high coliform counts that have forced the closure of shellfish beds come from animal, not human, waste.

The Truro Neighborhood Association heard this account Monday from environmental experts who explained the Pamet River Valley from geological, biological and botanical points of view. The panel discussion of the Pamet watershed was moderated by Brenda Bolelyn, professor of biological sciences at Cape Cod Community College and vice-chairman of the Cape Cod National Seashore Advisory Commission. She is a Truro resident.

Dr. Graham Giese, a founder of the Center for Coastal Studies in Provincetown and professor at Woods Hole Oceanographic Institute, spoke of the formation of the Pamet River valley and its condition today. The Pamet River valley is a flooded glacial outwash left by the last Ice Age, Giese said.

The valley was flooded by sea levels that have been rising over the past 14,000 to 15,000 years since the ice melted, he said. The sea level is still rising at the rate of about one foot every 100 years, he said, and so is the groundwater, but at a much slower rate.

Two saltwater marshes exist on the west side of Wilder Dike near Pamet Harbor. One freshwater marsh exists on the east side of the dike, Giese said. The marshes on the west side are rising with the sea level as sediment is washed in, but the freshwater marsh is not rising because the dike prevents the sediment from reaching it.

The oceanside barrier dune at Ballston Beach is migrating inland to the west about 250 feet every 100 years, Giese said. The dune migrates landward by storm/wave overwash, which carries sediment into the marsh behind the dune and forms the foundation for the dune as it moves inland, he said.

The sand had not been allowed to deposit behind the dune since road crews would remove sand from the road that runs behind it, interrupting the migrating process, Giese said.

On the bay side, the barrier beach from Fisher Beach to Corn Hill has been separated by the tidal inlet that forms Pamet Harbor. The inlet is protected by two jettys jutting into the bay, perpendicular to the barrier beach.

Since sand is washed from south to north along the beach, the beach behind the south jetty has stabilized so much that sand is actually being carried around it and into the harbor, Giese said. The beach behind the north jetty is starved for sand and has eroded, he said.

Removing the jettys is not a good idea if the town wants to keep a navigable harbor, Giese said. But moving sediment from the south side to the north side of the jettys could be part of a dredge project, he said.

Dr. Charles Seymour, a medical microbiologist who studied the Pamet from 1989 to 1991 for MIT and Boston University, spoke of the fecal coliform count in the river and wetlands. He illustrated his comments with slides showing 1930s depictions of typhoid and polio as monsters that needed to be slain. Typhoid and polio originated from human feces in water sources that reentered humans as they consumed the water, he said.

The monster is now the U.S. government with overly stringent regulations because they don't distinguish if the e coli bacteria is from humans or animals, Seymour said. He said MIT/Boston University researchers studied nine sites along the Pamet to determine if the fecal coliform is coming from animal or human waste. The coliform counts necessitate regular closing of the Pamet's shellfish beds.

The coliform bacteria is "not coming from septic tanks," Seymour said. He said the researchers found some "hot spots" of the coliform, but "people are not doing it."

After rainfalls, the fecal coliform counts shot up, he said, as the rain and road runoff washed animal wastes into the water. "It is looking like people are not responsible on circumstantial evidence," Seymour said.

The researchers caught animals and birds to see if they contained carcinogens that would make people sick. "Basically, we found carcinogens everywhere," Seymour said. "We found a large number of birds are carrying all kinds of bacteria."

He said if that is why the shellfish beds are being closed, "we have to not invite birds to come here."

Howard S. Irwin is a botanist, professor, chairman of the Truro Conservation Commission and was a member of the 1961 Department of Interior team that did surveys for the Cape Cod National Seahore. He said botanists interpret flora based on ecosystems, which are dynamic and always in a state of flux.

All over the world, mankind has exerted its influence on ecosystems so that they are now under stress that makes it difficult for species to adapt to genetically, Irwin said. He called for cultural instruments, such as the National Park Service, endangered species legislation, local codes and regulations to increase environmental awareness.

The construction of Wilder Dike in the 1880s isolated the Upper Pamet from the tidal flow and rainfall, Irwin said. That resulted in the transition of a saltwater marsh to a freshwater marsh and "made the Upper Pamet an artifact," he said. The Upper Pamet was then dominated by such flora as cattails, highbush blueberries and poison ivy, all found in fresh water.

Mosquito control ditches drained off more water, he said. Then black cherry, bayberry and golden rod, to name a few, moved in as the area became drier, Irwin said. "The trend was away from a salt marsh to upland woods," he said. Salt marshes are preferable because they feed fish stocks and provide breeding grounds, Irwin said.

Whereas the flora of the Lower Pamet, which is west of Route 6 near the harbor, continues as a salt marsh, the diked off parts east of Route 6 have been artificially maintained, Irwin said. The Upper Pamet is "now characterized by upland woodland," he said.

Giese said the Pamet could become unstable as the salt marsh rises with sea level, but the freshwater marsh sinks relatively lower and lower to sea level. Irwin said it is time to consider removal of dikes and clapper valves to allow the tidal flow along the whole river.

"It is high time that we consider the return," he said. "It requires the will of all of us to see through the long-term problems of the town, not just talk about it."

APPENDIX E

Pamet Harbor Commission

Truro Town Hall • P.O. Box U
Truro, Massachusetts 02666

APPENDIX E.

Public Hearing Comments Sampling

QUESTIONS - ANSWERS - COMMENTS

July 7, 1992 Public Hearing

The following questions, answers and comments from Pamet Harbor Planning Management PUblic Hearing held July 7, 1992.

Frank Caulfield - Read a statement from J.E. Bruinooge re: Economic impact on commercial fishermen due to limited time harbor channel is open. Boat size - limit boats to 31'. Maintenance dredging a must Shellfish resource wasted - Control coliform levels - animal access to beaches- Leaching chambers to catch at least first hour of runoff of runoff from parking lot.

Kevin Davis - Are commercial fishermen being considered as part of harbor plan?

Yes, the harbor planning group as well as the consultant would interview some fishermen. The plan expressly mentions concern for this aspect of harbor use.

Peter Sullivan - Would there be a linkage between Wellfleet and Truro and their respective harbor plans?

There are no plans currently, but if a common interest presents itself, then, yes.

Judy Barro - What does dredging mean? How much noise would a dredge make? Where will the sand and other spoils go?

Permits are needed in order to dredge. Dredging is heavily regulated. The dredged material is disposed of in various ways, depending on the quality of the spoils. If the material is free from contamination, the sand would be used for beach nourishment. In the past, most of the material has been used for this purpose.

Pamet Harbor Commission

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David Dutra - Commercial fisherman - Stated he had obtained a list of 30 commercial fishermen who had expressed interest is using Pamet Harbor if the harbor were open full time.

The Harbor Planning Management Comm. had not seen the list, however, it would like a copy of the list of fishermen.

Frank Caulfield - Expressed concern for lobster fishermen, lack of time to pull pots due to the shortened period of time the channel was navigable. What is the time frame needed to complete plan?

Harbor Plan will address channel dredging including the issue of emergency dredging. The plan is scheduled to be completed within one year. A one year time frame is needed to evaluate seasonal impacts on the harbor.

Joe Manning - Questioned the proposed boundaries - Not easterly enough.

One of the tasks outlined in the harbor plan expressly addresses the need to redefine the boundaries, if necessary.

Bill Worthington - Stated that the Pamet River was dredged in 1919 and that the sand and spoils were used to fill in land where the present day Pamet Yacht Club sits.

Margaret Thompson - Stated that the embankments of the Pamet River be considered as part of the Harbor Plan.

Penny Hart - Requested that the Harbor Plan look into the recreation issue, particularly the use of the socalled "grandmothers beach".

Diane Sullivan - Has the town secured any funds for the implementation of the plan?

Not at the present time, however, the committee will look at all options at the proper time, including any State or Federal funds that may be available. Harbor fees will also be used to support this project.

Pamet Harbor Commission

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APPENDIX E.

Kevin Davis - What happens if the harbor closes up completely?

There are vehicles for emergency dredging, however, emergency permits would have to be approved and the town would have to bear the associated costs.

Joe Manning - Are clapper valves currently owned by the railroad or are some of them privately owned?

This is another question the committee will answer as part of the long range plan.

Sten Stenson - Stated sympathies with the commercial fishermen, but also expressed concern about the encroachment upon the wetlands that dredging might have upon them.

All uses will be examined, and limited when deemed necessary, ie: capped - This is to ensure a multi-use harbor. Mark Robinson, consultant stated that this was why a harbor plan was needed - to be responsive to the various uses of the harbor - Balance is the key to a successful plan.

Jonathan Colman - Are there specific times to dredge?

Pam Rubinoff stated, "yes, depending on circumstances, low tide would limit dredge use. Example, Chatham uses a bulldozer at low tide." Mass. and Federal regulations along with nature control the dredging proces

Dick Fortini - Reported that the harbor in Orleans is being dredged at the current time. Anyone interested in observing a dredge in action could go to Orleans and see for themselves.

Sten Stenson - Reported that he remembered the last two dredgings at Pamet Harbor and that the spoils were dumped north of the jetty.

David Dutra - Questioned what effect the cut on the east side, Ballston Beach, would have on the river, and on the harbor?

Mark Robinson stated there was a chance that the dune would rebuild itself.

APPENDIX E.

Public Hearing Comment Sampling

Minutes
Pamet Harbor Management Planning Committee Public Meeting
February 23, 1993
7:30 PM
Truro Town Hall

Material submitted to the public:

DRAFT Pamet Harbor Goals, Policies, and Objectives

Open letter from Pamet Harbor Commission and Harbor Planning Committee updating progress of Truro Harbor Plan.

Eleanor Fortini, Harbor Planning Committee Chr., welcomed the public and outlined the Pamet Harbor Goals and Objectives, DRAFT. She explained how these goals were derived and introduced Mark Robinson, Consultant, who then gave a brief overview of the DRAFT. Mark presented slides and noted the Committee's thrust of essentially improving and restoring the usefulness of the Pamet Harbor. Maintaining or hopefully improving the water quality, improving the boating environment, preserving the natural beauty, and balancing sometimes competing interests within the harbor are all important components of this proposed future plan.

The Goals and Policies were reviewed and questions from the public were received and addressed as follows:

Water Quality:

1 .Must boats with heads go out of the harbor to discharge? It was mentioned that a harbor that has been designated a "no discharge zone" must provide pump out facilities. Selectman

2. More accurate testing of water was needed.

3. Is the water quality monitored in the same way as Wellfleet Harbor? Please find out. Truro Fisherman

4. Rt. 6 solution to water quality/road run-off problem by re-routing flow did not solve problem. Run-off still flowing into the Pamet River. Wish Highway Dept. would consider eliminating "salting"with chemicals. Small flounders were seen for the first time in many years in the Pamet Harbor this year. Truro Fisherman

Navigation and Water Safety:

1. Commercial fisherman stated that commercial boats are heavily regulated and are probably the safest boats in the harbor.

2. It was suggested that size and type of boat should not be a restricting factor for commercial boats in the Harbor Plan during off season. This would allow fishermen to cut down off time during Fall, Winter, and Spring Fisheries.

Public Access and Recreation:

1. Walking trails should not be constructed of anything made of oil products, ie. blacktop. Use rocks, shells instead.

2. Audience liked idea of footbridge over the river...should pursue strongly. Question of how to fund was raised. Need to consider boats up stream when determining height. Committee should look at Perkins Cove, Ogunquit, Maine. Footbridge would allow possible swimming provision in harbor far enough away from the boat ramp to satisfy State legal requirements.

3. Should trails accommodate bikes? Mixed reaction from the public.

4. "No Wake" signs should be posted in the harbor.

5. Harbormaster should have a boat.

Shellfishing:

1. Public supported idea of private aquaculture- grants. New Mill Creek area a suggested possibility.

2. Shellfish Warden stated that harbor has high bacteria count. State checks seven places in harbor on a monthly basis. Public in support of finding out reason for closure, of cleaning up the problem, and opening up shellfish beds.

Commercial Fishing:

1. At present there is no fin-fish landing at Pamet Harbor. Only fishermen off loading are lobstermen.

2. Commercial fishermen (two present) did not think there should be a boat size limit and did not like "limited presence" wording. Do not feel the town can fairly deny them the opportunity to earn a living by fishing and unloading their catch in their hometown harbor.

3. They felt there should be a % of mooring space set aside for commercial fishing boats. Type of commercial fishing boats everchanging, as is industry, making it hard to predict economically feasible boat size.

Moorings: No public comment.

Land Use, Landscape, and Visual Character: No public comment.

Natural Resource Protection:

1. It was suggested that a site for a canoe livery be located in the harbor or surrounds.

2. It was suggested that the town investigate the possibility of future land aquisition for recreational purposes. That the parcel next to the boat ramp, if available and could be acquired, would provide excellent handicap water access and recreation space.

Fiscal Management: No public comment.

Eleanor opened up the meeting for general questions from the public. They were as follows:

1. What part of the harbor will be dredged? Ans. Map of 1967 illustrates area of maintenance dredging proposed.

2. Is the removal of the railroad dike and the possible improvment of the Pamet River flushing rate included in the engineering considerations of the proposed plan?

3. Could the basin be dug out and space for large boats/yachts be provided?

4.What is the status of a county wide dredge? Ans. Nothing has been heard for two to three months although monies are available to july 1, 1993.

5. Would it be feasible for Truro to purchase and operate their own dredge?

The meeting adjourned at 9:30 PM reminding the public to attend future meetings on findings and the Draft Completed Plan.

Attached is the list of people present.

Sue Wilmot, Secretary

APPENDIX F

APPENDIX F

NUMERICAL MODELING
Conducted by Aubrey Consulting, Inc.

The 1-D model, DYNLET1, written by the U.S. Army Corps of Engineers, Coastal Engineering Research Center (Amein and Kraus, 1991), was chosen to model Pamet Harbor. This model has the advantage of being more stable than the standard 1-D linked-node tidal models since the numerical scheme uses an implicit solution technique. The numerical model was used to simulate the present conditions within the Harbor, including flushing rates, tidal elevations, and current velocities. Three additional simulations of the model were used to evaluate the potential impacts of the proposed dredging and reconfiguration of the entrance jetties. Changes in tidal flushing, tidal currents, tidal elevations and erosion and scour trends were estimated for each of these model simulations. A brief description of the numerical model theory is given below, followed by a discussion of the model setup.

Numerical Model Theory

A detailed description of the governing equations used in the numerical model can be found in Amein and Kraus (1991). Generally, the two equations necessary to describe the tidal hydrodynamics of a particular system are the following depth-averaged conservation of mass (1) and momentum (2) equations:

$$\frac{\partial Q}{\partial y} + \frac{\partial A}{\partial t} - q = 0 \tag{1}$$

$$\frac{1}{A}\frac{\partial Q}{\partial t} + \frac{1}{A}\frac{\partial}{\partial y}\left(\frac{Q^2}{A}\right) = -\tau_b \frac{P}{\rho A} + \tau_s \frac{B}{\rho A} - gS_e - g\frac{\partial z}{\partial y} \tag{2}$$

where:

$A(x,t)$ = cross-sectional area
$Q(x,t)$ = the volume flow rate
q = the lateral inflow or outflow per unit channel length per unit time
τ_b = the bottom shear stress
P = the wetted perimeter of the channel cross-section
ρ = the density of water
τ_s = the surface shear stress
B = top width of the channel cross-section
S_e = rate of head loss with longitudinal distance
g = acceleration due to gravity
z = water surface elevation.

The head loss term in the momentum equation addresses the turbulent losses due to a rapid transition of cross-sectional area of successive nodes. This term is assumed to be negligible in the present analysis. The bottom shear stress consists of frictional stress and eddy viscosity effects. Since the flow velocities within the system are relatively small, the eddy viscosity term may be incorporated within the term describing the bottom friction stress: the empirical friction coefficient. Both equations (1) and (2) are known as the one-dimensional long-wave equations. In general, they area applicable where the assumption of hydrostatic pressure distribution is valid, i.e. flow situations where the wavelength is significantly greater than the water depth.

The 1-D model uses a channel cross-section described by any number of points. For each point in the cross-section the empirical friction coefficient must be specified. A sample cross-section is shown in Figure D-1. Equations (1) and (2) constitute a system of first-order nonlinear hyperbolic partial differential equations. The solution technique used in this model is an implicit scheme which uses centered finite difference equations in both space and time. The two nonlinear algebraic equations are solved by a general form of the Newton iteration method. Since implicit techniques require the simultaneous solution of the governing equations at every node, the procedure needs rapidly convergent matrix solvers. By taking advantage of the coefficient matrix sparseness and bandedness, an accurate solution technique was developed.

The program allows for flexible grid spacing and is unconditionally stable allowing for the use of large time steps. The model can provide detailed one-dimensional velocity information both along-channel and cross-channel in a system of interconnecting channels. Locations of stations along a particular cross-section can be arbitrarily set, allowing the velocity and stage at locations of interest to be obtained readily. The only difference between DYNLET1 and a fully two-dimensional solution technique is that the flow direction is constrained along the axis of the channel in DYNLET1.

Boundary conditions in the numerical model are specified at all free channel ends. These external boundaries are defined by current velocity, tidal amplitude or discharge conditions. The tidal amplitude may be described by a time series of water surface elevations at each time step or by specifying the height and period of sinusoidal forcing.

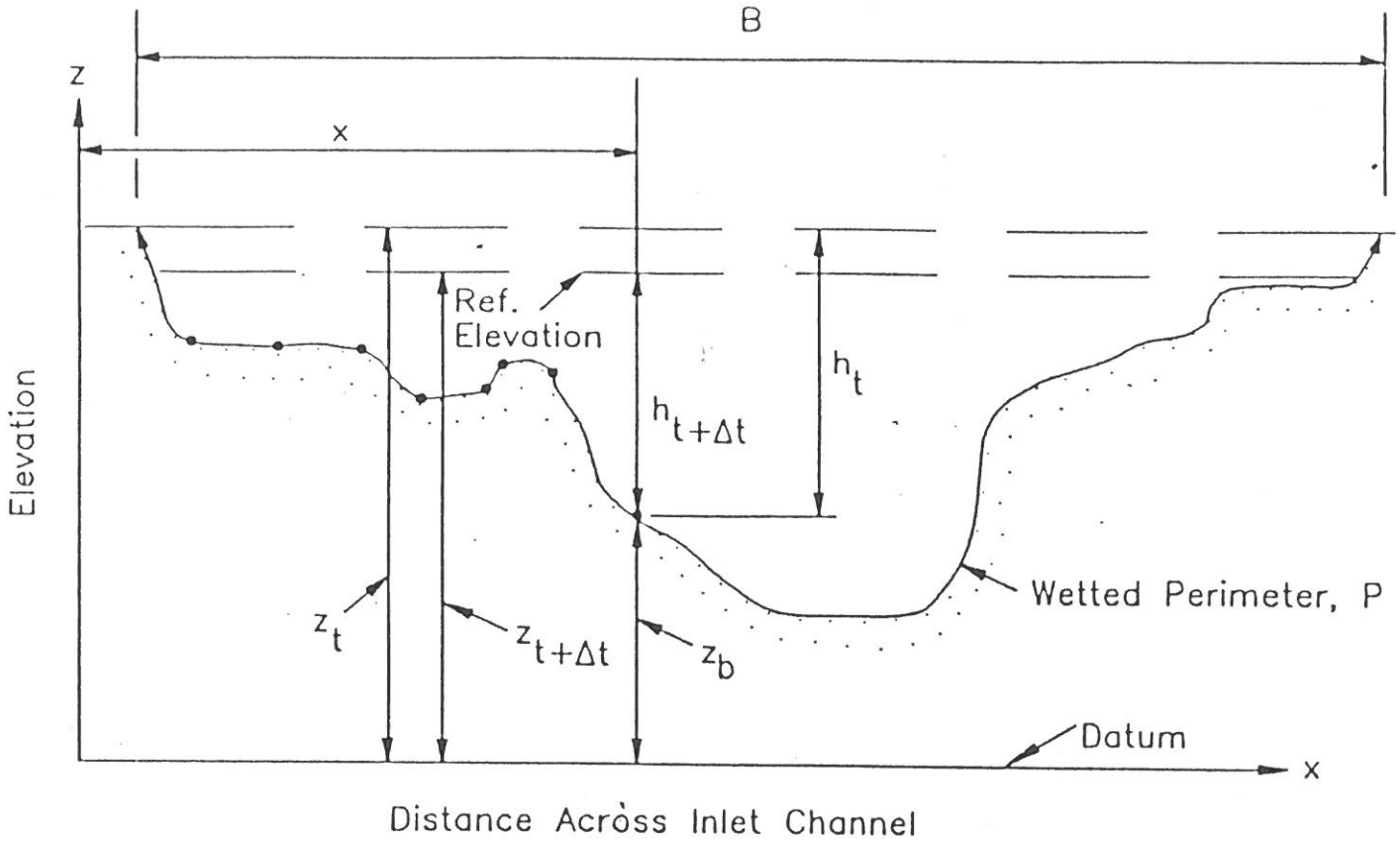


Figure D-1: Definition sketch for inlet channel cross-section (from Amein and Kraus (1991)).

Numerical Model Setup

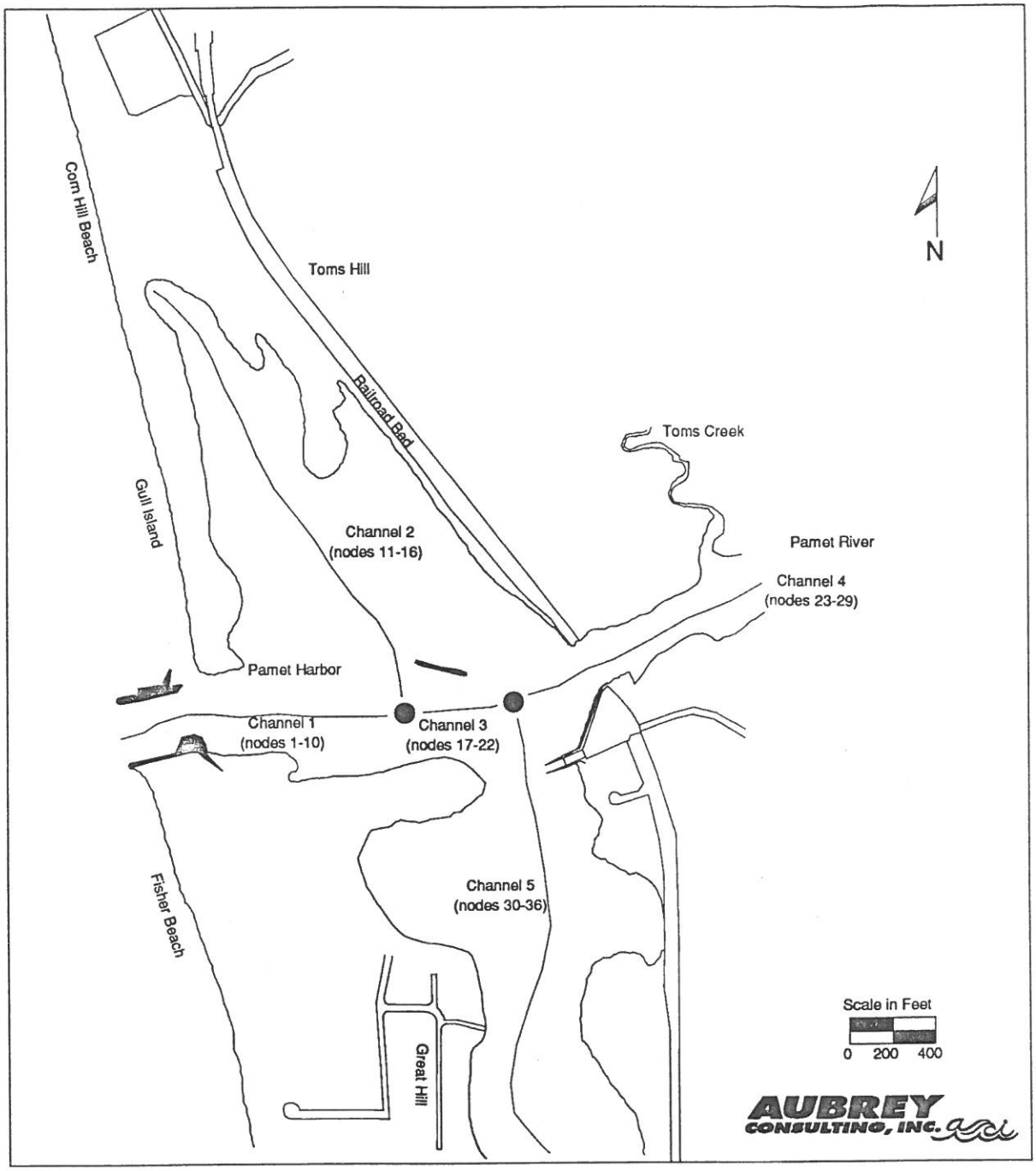
Implementation of the 1-D numerical model requires that a grid be developed encompassing all areas of the Pamet Harbor system. The grid may be composed of any number of channels (sections of the main estuary or sections that branch off of the main estuary) and nodes (cross-sections along the channels). The location where a channel splits is called a junction. In the model, a junction is defined as the end of one channel and the beginning of another. Multiple nodes exist at each junction, depending on the number of intersecting channels. All nodes at each junction must be defined by identical cross-sections.

The model grid established for the Pamet Harbor system is shown in Figure D-2. Five channels were required to model the Pamet Harbor system: the entrance channel, Little Pamet mouth (includes extensive tidal flats), the central Harbor area, the upper Pamet River, and Mill Creek (includes mooring basin area and tidal flats). The nodes describing the system are variably spaced; the smallest spacing indicates areas of special interest or rapid flow changes. A total of thirty-six (36) nodes were used to model the entire Pamet Harbor system.

Boundary conditions within the model were defined at all free channel ends. The tidal forcing was simulated using the M2, M4, and M6 tidal constituents at the entrance of the Harbor (beginning of channel 1). These constituents were derived through harmonic analyses of previous measurements of tidal fluctuations made by Giese et. al., (1990). The boundaries at the other free channel ends (2, 4, and 5) were defined by a velocity of zero.

The channel cross-section geometry must be supplied to the numerical model at each of the grid nodes. To accomplish this, the model grid was overlain on the most recent bathymetric map surveyed by Coastal Engineering, Inc. (1992). Channel cross-sections were digitized at each of the 36 node locations. Cross-section data for the Pamet River was taken from Giese et. al., (1990) since the Coastal Engineering, Inc. bathymetry map does not extend beyond the railroad dike. By using these data describing the Harbor bathymetry, the numerical model was setup to simulate existing conditions within Pamet Harbor.

FIGURE D-2.
PAMET HARBOR
NUMERICAL MODEL GRID



Numerical Model Calibration

Calibration involves fine-tuning the numerical model so that it accurately reproduces the hydrodynamics of the system being modeled. Various hydrodynamic properties of an estuary can be used to calibrate the model, including tidal elevation, current velocity, tidal prism, and salinity. However, since fluctuations in tidal elevation are the primary force controlling circulation within the Pamet Harbor system, calibration for this study was performed using tidal elevation measurements taken previously within the Harbor (Giese et al., 1990). During calibration the model results at a specific node in the grid are compared against actual field measurements at the same location. If the field measurements are not reproduced by the model simulations, the model is calibrated, or fine-tuned, by adjustment of the friction factor or the model geometry. This process continues until the field measurements are satisfactorily reproduced by the model.

Calibration of the 1-D model for the Pamet Harbor system was conducted using tidal measurements collected by Giese et al., (1990). For his study, Giese et. al., (1990) established one long-term tide station at the Pamet Harbor mooring basin and two short-term tide stations, one in Cape Cod Bay approximately 1,000 ft south of the entrance channel and the other at Wilder Dike. Model results at the grid nodes closest to the tide station at Wilder Dike were compared with field measurements of tidal elevation collected at this location. Channel 4, node 29 was the grid node closest to the Wilder Dike station. A calibration curve comparing the model results with the field measurements at Wilder Dike is shown in Figure D-3. Additionally, Figure D-4 shows a comparison of tidal elevations predicted by the model at the South Channel (mooring basin), Wilder Dike and the inlet entrance. The data show that the water elevations within the Harbor are truncated near the time of low tide. This is the primary result of limited water depths within the Harbor, which result in the Harbor going dry during times of low tide.

Once calibrated, the 1-D model was used to determine the flushing rates within the Pamet Harbor system. Additionally, the model was used to examine the changes in Harbor hydrodynamics as a result of the three project alternatives discussed above. Changes in tidal flushing rates, current velocities and water elevations were determined as a result of these project alternatives. Results from these numerical model applications are discussed in Section 7.

Figure D-3.
Comparison of Model to Field Data at Wilder Dike

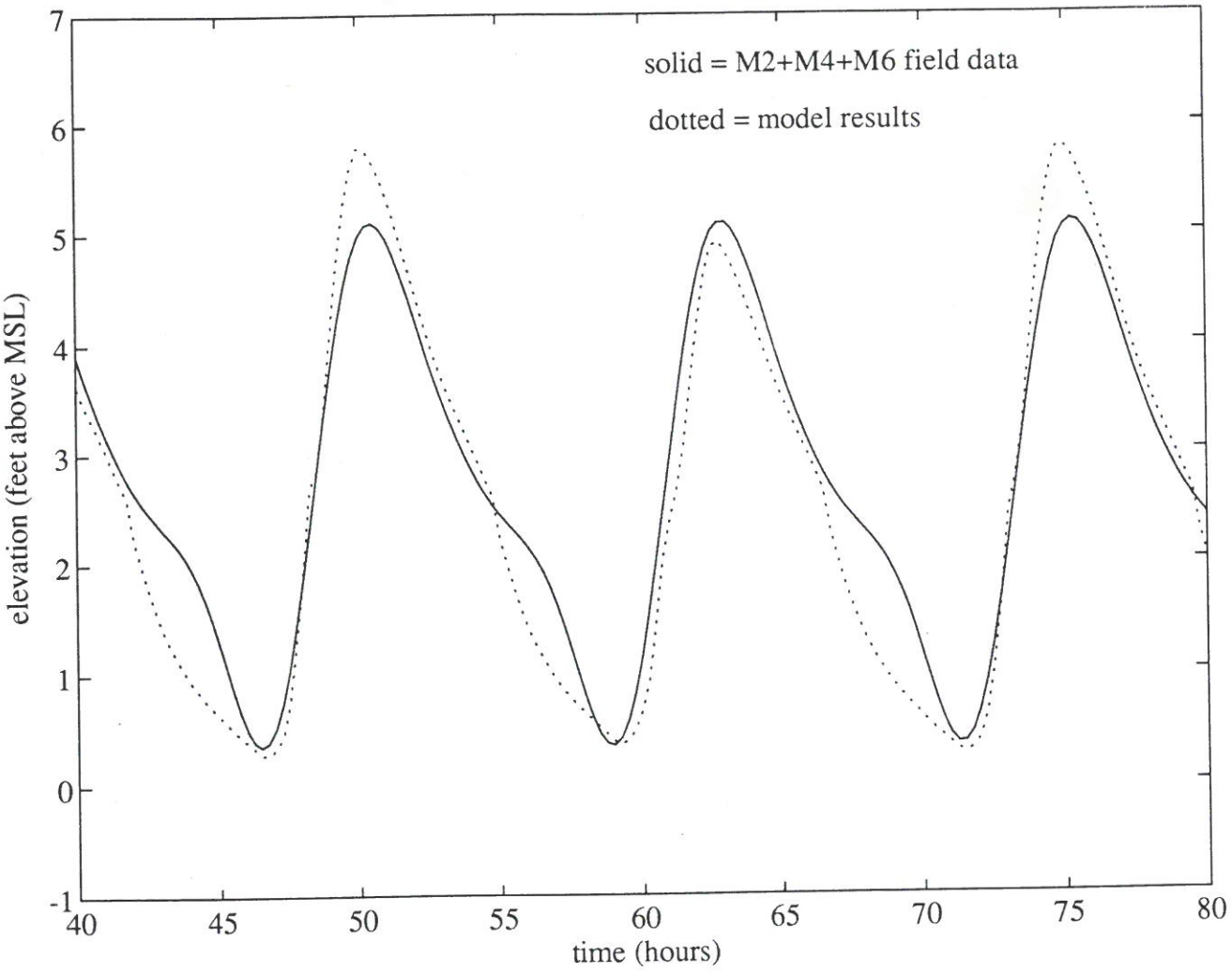
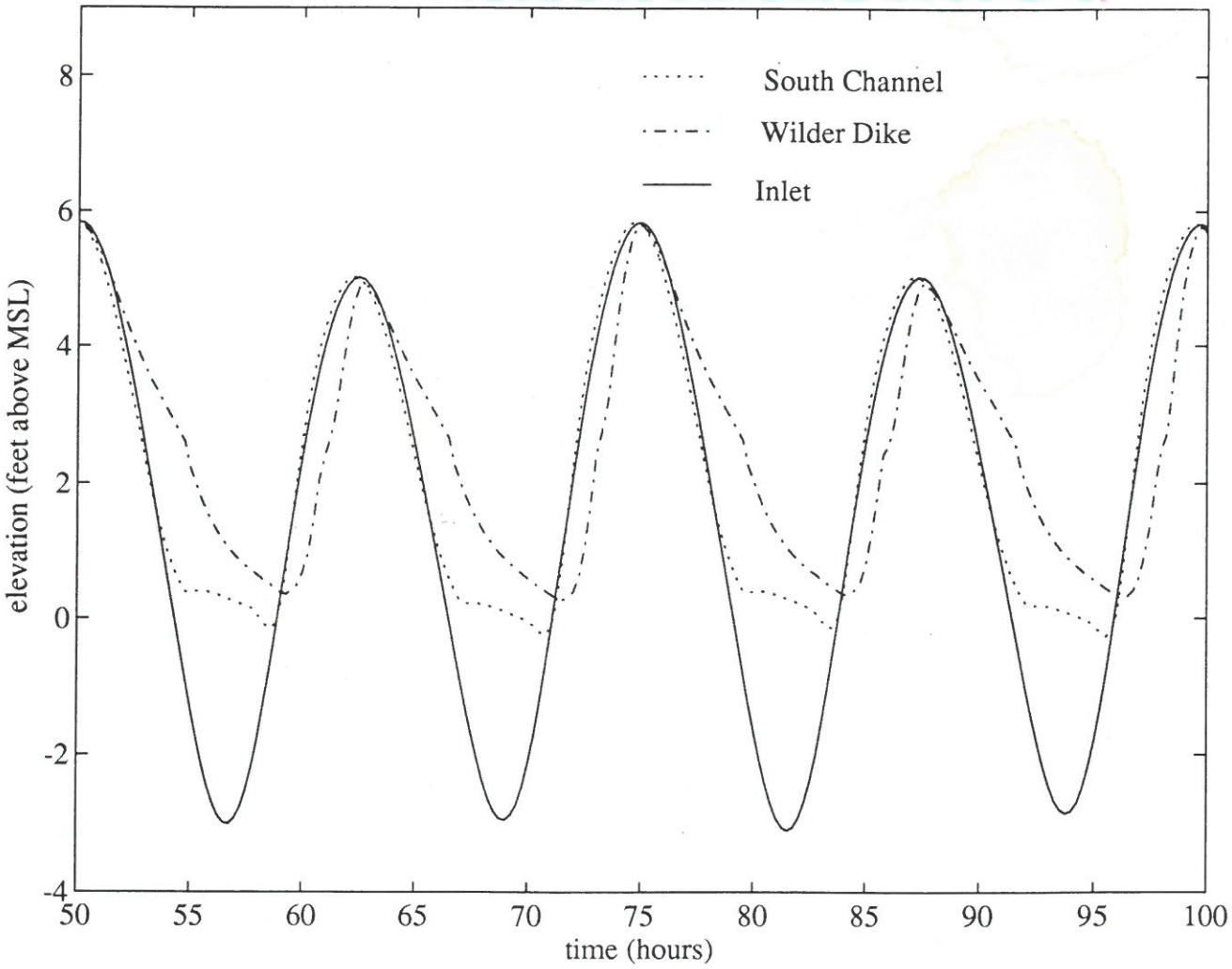


Figure D-4.
Model Results for Locations in Pamet Harbor



APPENDIX G

DRAFT

APPENDIX G.

Pamet Harbor Waterways Regulations, 1993
(Source: Pamet Harbor Commission, Town of Truro MA

The following proposed bylaw is to replace the current Pamet Harbor speed limit bylaw in it's entirety, AND TO USE THE CIVIL TICKET SYSTEM FOR VIOLATIONS.

1.0 GENERAL INFORMATION

1.1 **APPLICABILITY:** These bylaws apply to all persons and vessels using the waters of the Pamet Harbor and adjacent waterways.

1.2 **SEVERABILITY:** Should any section of this bylaw be found unlawful by any competent authority, that section shall be severed and only that section shall be found unlawful

1.3 **OPENING AND CLOSING:** The opening and closing dates for the Pamet Harbor operation shall be announced by May 1st of each year.

2.0 Definitions

2.1 All words in this bylaw shall have there normal meaning unless specifically mentioned herein.

2.2 The **Harbormaster** is the legally appointed Harbormaster of the Town of Truro and the Harbormaster shall be empowered to enforce all rules, regulations, bylaws, and state and federal laws which apply to the Pamet Harbor and any to any boats or other watercraft therein

2.3 The **Assistant Harbormaster** is any legally appointed Harbormaster of the Town of Truro who shall act on behalf of the Harbormaster at the Harbormaster's discretion and shall be empowered to enforce all rules, regulations, bylaws, and state and federal laws which apply to the Pamet Harbor and to any boats or other watercraft therein.

2.4 The **Pamet Harbor**, for the purposes of this bylaw, is any water body know as the Pamet River, the Little Pamet River, Mill Pond, Mill Pond Creek, Mill Creek and any other water body which is connected to any of the above mentioned water bodies which are south of Corn Hill Road from Corn Hill parking lot to Castle Road, south and west of Castle Road from Corn Hill Road to Truro Center Road, west of Truro Center Road (aka Route 6A) from Castle Road to Depot Road, north of Depot Road from Truro Center Road to Old County Road, north and west of Old County Road from Depot Road to Fisher Road, and north of Fisher Road from Old County Road to Cape Cod Bay.

2.5 A **Permit** as used in this bylaw shall mean any permit for launching or mooring issued by the Town for the use of the Pamet Harbor and may be further defined by the words daily, weekly, monthly, annual, etc.

3.0 Rules

3.1 A speed limit of 5 miles per hour or the minimum speed require for steerage, whichever is less, shall be in effect from the from the outer jetties (mouth) of the Pamet River throughout the entire area of the Pamet Harbor. Under no conditions shall any boat travel at a speed which creates a wake in the either an anchorage or a mooring area.

4.7 Any boater that has rented a space in the Pamet Harbor in the past, and wishes to continue renting that space for his/her boat, but has not used that space in the prior season, will no longer have access to that space. The space will be assigned by the Harbormaster to individual at the top of the appropriate waiting list. (Special consideration for an exception will be given following review by the Harbormaster and Harbor Commission)

4.8 For any Town owned mooring or float vacancy exceeding forty-eight (48) hours, the annual holder shall be required to advise the Harbormaster in order to permit temporary use of the space for transients. Any transient fees collected will accrue to the Town of Truro

4.9 No mooring line shall exceed twenty-four (24) feet of line including chain, from the mooring to the boat or float. A pennant line from the buoy or float to the boat shall not exceed three (3) feet except with the specific permission of the Harbormaster.

4.10 Following acceptance of the Town Mooring plan, all moorings will be Town owned and no private moorings will be allowed.

4.11 All boats using the Pamet Harbor or launching ramp shall be properly registered, when required, by an appropriate state or the United States and shall display required identification numbers and validation stickers and shall, upon demand, show proper documentation to the Harbormaster or any Assistant Harbormaster. All boats, which are required, shall have paid the boat excise to date. Any boat not register when required or not having paid said excise when required, shall not be allowed to us the Pamet Harbor, launching ramp or moorings. An excise tax shall be considered to be unpaid when the Harbormaster has been so notified by the Truro Collector of Taxes. Issues of abatement, etc. shall not be considered a reason for non-payment unless the Tax Collector notifies the Harbormaster that the delinquent tax has been removed from the delinquent rolls. A paid bill or notification in writing from the Tax Collector that the tax has been paid in full must be presented to the Harbormaster or any Assistant Harbormaster in order that the use of the harbor, launch ramp and moorings be restored.

5.0 WAITING LIST REGULATION

5.1 Upon receiving a completed "Application for Mooring Waiting List" fro an area where there is no available appropriate mooring location, the Harbormaster shall enter the name of the applicant and a description of the vessel on to the waiting list for the appropriate area. Entry shall be chronological on the date the application is received and an appropriate fee will be paid the Town of Truro.

5.2 When a mooring position becomes available, the Harbormaster shall assign the mooring to the first individual on the waiting list with a vessel appropriate for the available location.

5.3 The Harbormaster shall post and maintain the current waiting list for each area at the harbor.

6.0 ABANDONMENT AND REMOVAL OF VESSELS

6.1 No vessel, mooring or other object shall be abandoned, sunk, or placed where it may constitute a hazard to navigation or other boats in the harbor.

6.2 Any vessel, mooring or object constituting a hazard or navigation, and any vessel or object improperly secured, swamped, sunk, washed ashore or found in a restricted area, may be removed or relocated by or at the direction of the Harbormaster or any Assistant Harbormaster, if corrective action is not taken after seventy-two hours notice to the owner, or if the owner is not known, after notice has been posted for the same period of time at the Town Office, Harbormaster's Office or on or near such vessel, mooring, or object.

6.3 The expense of such removal or relocation and any liability incurred thereof, shall be the responsibility of the owner.

STORM PRECAUTIONS "Draft Pamet Harbor Policies"

In the event of a severe storm, the following precautions should be taken by all boat owners that use Pamet Harbor.

1. If at all possible, take your boat out of the harbor.

If you can't haul your boat out of the harbor,take the following precautions:

Remove all sails, roller furling, and lower the mast if at all possible.

Remove all dodgers, biminis and enclosures

Remove all non-permanent equipment - (deck chairs, rafts, etc.

Pump excess water from bilges and drain water tank.

Make sure batteries are charges, pump switches and intakes are not jammed and are working freely.

Check lines and chafing gear

If your vessel is a sail boat and has been hauled and is in the harbor parking lot in the emergency, the mast must be taken down. This is to propect other boats stored near-by.

Remember, in time of an emergency, the ramp and haul-out areas will be extremely busy, use patience and be extra careful.

USE OF THE HARBOR FACILITIES WILL BE AT THE USER'S RISK

Any violations of these rules and regulations, disorder, depredations, discourteous conduct, profane language or public intoxication be a patron or his/her crew or guest that might cause an injury to a person or persons, causing damage to Town or private property or otherwise harm or discredit the reputation of the harbor shall be just cause for the immediate removal from the harbor,of the boat in question, making offenders subject to the penalties provided in Chapters 88, 91m and 102 of the Massachusetts Genersl Laws.

The following by-laws of the Town of Truro and State Laws are included for your information.

ALCOHOLIC BEVERAGES

It shall be unlawful for any person to consume alcoholic beverages on public highways including vehicles thereon or public places not duly licensed for such purposes within the Town of Truro. Whoever violates the provisions of this by-law shall be fined in an amount not exceeding twenty dollars for each offense.

DOGS

All dogs shall be restrained by a leash unless confined to property of their owners except when used for hunting during the hunting season and while under control of its owner.

APPENDIX H

APPENDIX H.

State and Federal Regulatory Agency Jurisdiction

State

MEPA

Reviews projects which exceed specified thresholds for potential environmental impacts and feasible alternatives. Jurisdiction (thresholds) specified in 310 CMR 11.25 & 26.

DEP Division of Wetlands and Waterways/Southeast Region

Wetlands

Reviews Orders of Conditions issued by ConCom; acts on appealed Orders and issues Superseding Orders. Jurisdiction is areas subject to protection under the Wetlands Protection Act.

Reviews dredge (less than 100 cubic yards) and fill activities under section 401 of the Clean Water Act and issues Water Quality Certificate. Jurisdiction is over any activity affecting waters of the United States (specific definition attached).

Waterways

Reviews projects under Chapter 91 for proper public purpose, public interest in tidelands, public safety, navigation. Jurisdiction is over structures and uses on filled or flowed tidelands.

Division of Water Pollution Control

Reviews dredging projects greater than 100 cubic yards, issues Water Quality Certificate. Jurisdiction is waters of the United States.

Bureau of Solid Waste

Review of upland disposal of dredged materal.

Federal

Corps of Engineers

Reviews activities in navigable waters of the United States (definition attached) under Sections 9 & 10 of the Rivers and Harbors Act of 1899; Reviews dredge and fill activites in waters of the United States under section 404 of the lean Water Act.

navigation.

Note: Navigable waters are defined as all tidal waters and specific sections of major rivers that are now, have been, or may be used for interstate or foreign commerce. Contact the Corps for a list of specific riverways subject to Section 10 authority.

The Corps, through **Section 404** permits, regulates the discharge of dredged or fill materials into the waters of the United States. This is the primary tool the Corps has to regulate activity in wetlands.

Note: Please note the distinction between navigable waters of the United States and waters of the United States. Waters of the United States are defined as including those waters listed above, and in addition, their tributaries, adjacent wetlands, and any waters or wetlands where degredation or destruction could affect interstate of foreign commerce.

In addition to the technical aspects of the review, the Corps uses the following general criteria for evaluating permit applications:

- The practicability of using reasonable alternative locations and methods to accomplish the project's objective;
- The extent and permanence of the project's beneficial or detrimental impacts.

Projects subject to 404 jurisdiction include any projects that propose work below the high tide line that may cause a discharge of dredged or fill material. Examples of these projects include construction or repair of a seawall or bulkhead, or activity in a wetland system.

Note: Please keep in mind that the regulatory definition of dredged material includes any material excavated from the waters of the U.S.; it therefore also encompasses activities not usually associated with dredging, including excavation, landclearing and ditching.

The Corps, through **Section 103**, regulates the transportation of dredged material for ocean dumping. The only current local site is the Massachusetts Bay Disposal Site.

Projects are reviewed by the Corps on the basis of their potential for impact on the waters of the United States; generally, the larger the project or the greater the potential for adverse impact, the higher the level of review.

The Corps issues permits under a program called the **Programmatic General Permit (PGP)**. Under the PGP there are three levels of project review.

Note: The PGP program supercedes the Nationwide program as of August 26, 1993. Any projects already authorized or under review for authorization under the Nationwide program as of that date have been grandfathered by the Corps.

Category I, **non-reporting** projects, are projects with minor impacts to resources under Corps jurisdiction. Category I projects do not require individual Corps authorization provided that:

- An Order of Conditions (or Superseding Order) has been issued if required under the Wetlands Protection Act;
- A Water Quality Certification has been issued by DEP; and
- Federal consistency has been issued by Coastal Zone Management.

Note: MCZM will generally not require federal consistency review for Category I projects.

Note: If you are required to provide

Massachusetts Environmental Policy Act 727-5830

Authorities: Massachusetts General Laws Chapter 30, Sections 61-62H; 301 CMR 11.00

Summary: MEPA regulations require project proponents to disclose the environmental impacts expected to result from a proposed project through an Environmental Notification Form (ENF), an Environmental Impact Report (EIR), or both.

Agency: MEPA Unit

Jurisdiction: Generally required for major projects that require state approval or funding and are defined by thresholds in the regulations.

Standards: Proposed activities with impacts above the thresholds listed in the MEPA regulations must file either an ENF, an EIR, or both. Examples of thresholds that require an ENF include:

- Pier and dock construction in an Area of Critical Environmental Concern (ACEC);
- Armoring a coastal bank;
- Projects involving the dredging of 10,000 or more cubic yards of sediment.

Thresholds for projects requiring an EIR are higher; however, MEPA can (and often does) request an EIR based on comments from the regulatory agencies submitted in response to an ENF.

Timing: Concurrent with or prior to submission of other state permit applications.

Review Period: 45-80 days if an EIR is not required and 3-12+ months if an EIR is required.

Agency Action: The Secretary of Environmental Affairs issues a Certificate stating whether or not an EIR is required. If an EIR is not required, the Secretary issues a Certificate to that effect, and state review may proceed. If an EIR is required, no state permits may be issued before the Secretary certifies that the EIR properly complies with MEPA.

Contact: Massachusetts Environmental Policy Act Unit, Executive Office of Environmental Affairs, 100 Cambridge Street, Boston, Massachusetts 02202. (617)

Wetlands Protection Act
Coastal Resources

Authorities: Massachusetts General Laws Chapter 131, Section 40; 310 CMR 10.00

Summary: The Wetlands Protection Act, administered by municipal Conservation Commissions, regulates activities affecting the Commonwealth's wetland resources.

Agency: Municipal Conservation Commission

Jurisdiction: Any activities which involve dredging, filling, removing or otherwise altering wetlands resource areas.

Standards: The Coastal Wetland Regulations include performance standards for projects proposed on, in, or adjacent to protected resource areas. These performance standards are designed to protect the following specified interests:

- Protection of public and private water supply
- Protection of fisheries
- Protection of ground water supply
- Flood control
- Protection of land containing shellfish
- Storm damage prevention
- Protection of wildlife habitat
- Prevention of pollution

When an area subject to WPA jurisdiction is found to be significant to one or more of the interests listed above, the proponent must demonstrate that the proposed activity will not impair the function of the resource.

Timing: A Notice of Intent must be filed prior to construction. If other state and/or federal permits are required, the Notice of Intent should be submitted first.

Review Period: Approximately 42 days from the date the Notice is received by the conservation commission.

Permit: Order of Conditions; valid for 3 years, extendable to 5 years. For maintenance dredging valid up to 10 years.

Contact: Municipal Conservation Commission,

usually located at town or city hall.

401 Water Quality Certificate

Authorities: Massachusetts General Laws, Chapter 21, Section 27 (12); 314 CMR 9.00; 33 United States Codes 1341 (Federal Water Pollution Control Act), Section 401

Summary: A 401 Water Quality Certification is required under the federal Clean Water Act for certain activities in wetlands and waters of the commonwealth. The purpose of state 401 review is to ensure that a project will comply with state water quality standards and other appropriate requirements of state law.

Agency: Department of Environmental Protection. Projects which involve dredging more than 100 cubic yards, or the disposal of dredged material in state waters, or projects requiring a Federal Energy Regulatory Commission (FERC) license will be processed at the Division of Water Pollution Control in Boston; all other projects will be processed by the appropriate regional office.

Jurisdiction: Any activity which could result in a discharge of pollutants into the waters and wetlands subject to federal and state jurisdiction. **Only projects that require a federal permit require 401 certification.**

Standards: Activities are reviewed for:

- Compliance with the Wetlands Protection Act
- Minimization of individual and cumulative impacts
- Alternatives analysis
- Compliance with Surface Water Quality Standards

Water quality standards and statewide water quality classifications can be found in 314 CMR 4.00.

Timing: Concurrent with other DEP permit and license applications. Generally, projects daltering up to 5,000 square feet of wetlands and dredging up to 100 cubic yards are not required to file a WQC application. For these projects, the DEP will review the Order of Conditions issued by the conservation commission to determine the project's compliance with state water quality standards.

Review Period: 120-150 days, depending on whether the project is classified as Major or Minor.

Permit: Water Quality Certificate; valid for term of the federal permit which required it.

Contact: Dredging and FERC projects: Division of Water Pollution Control, Department of Environmental Protection, One Winter Street, Boston, MA 02108, (617) 292-5673. All other projects contact the appropriate regional office.

DEP Waterways Regulations (Chapter 91)

Authorities: Massachusetts General Law Chapter 91; 310 CMR 9.00

Summary: The Waterways Regulations promulgated under MGL Chapter 91 regulate activities below the current or historic high tide line, great ponds, and navigable rivers and streams on which public funds have been expended. The regulations are designed to protect the public's rights to fish, fowl and navigate, and to promote tidelands for water-dependent uses such as commercial fishing, shipping, boat building, marinas and other activities for which direct access to the water is a functional necessity. Additionally, the regulations seek to provide greater control over the private development of waterways and filled tidelands to ensure that appropriate areas are available for public use and enjoyment.

Agency: Department of Environmental Protection, Division of Wetlands and Waterways

Coastal Jurisdiction: On flowed tidelands: any project in, on, over or under tidal waters seaward of mean high water (MHW) out to the limit of state territorial waters. On filled tidelands outside Designated Port Areas (DPA): the first public way or 250 feet from MHW, whichever is farther landward. On filled tidelands inside DPAs: between the present and historic MHW (i.e., all filled areas).

The types of activities subject to review under the regulations include but are not limited to:

- Dredging • Placement of structures • Change in use
- Placement of fill • Structural alteration

Standards: DEP reviews the projects to ensure that they:

- Do not interfere unreasonably with navigation
- Are structurally sound
- Provide a proper public purpose

- Do not interfere with public rights or rights of adjacent property owners
- Will not adversely affect natural resources
- Preserve DPAs for maritime industrial use

Timing: Application should be concurrent with filing with other state regulatory agencies; final copies of all other required state permits must be filed with DEP before the application will be considered complete and a permit or lisence can be issued.

Review Period: Within 90 days of the completion of an application; however, applications require several steps to be complete.

Permit: DEP Waterways License, Permit, or License or Permit Amendment; Amnesty License or Interim Approval.

Permits valid for 5 years; for maintenance dredging term is 10 years. Non-amnesty licenses generally valid for 30 years, longer term possible. Amnesty license valid for 99 years. Interim Approvals valid for 30 years.

Contact: Division of Wetlands and Waterways, Waterways Regulation Program, DEP, One Winter Street, 8th Floor, Boston, MA 02108. (617) 292-5695.

Massachusetts Coastal Zone Management

Authorities: Massachusetts General Laws, Chapter 6A, Sections 2-7; Chapter 21A, Section 4A; 301 CMR 20.00 (MCZM Programs); 301 CMR 21.00 (Federal Consistency Procedures).

Agency: Massachusetts Office of Coastal Zone Management (MCZM)

Summary: MCZM reviews activities in the coastal zone for consistency with its enforceable program policies. (Please call MCZM for a copy of these policies.) Under federal consistency review, MCZM reviews, and approves or denies, proposals in the coastal zone for activities requiring federal funds or permits.

Jurisdiction: Projects located within, or affecting, the Massachusetts Coastal Zone or its resources. The coastal zone is defined as "land and waters within the area bounded by the seaward limit of the state's territorial sea....and landward to 100 feet inland of specified major roads, rail lines, or other visible rights-of-ways..." and includes all of Barnstable, Dukes and Nantucket counties. The coastal zone is mapped in the *Coastal Atlas*, copies of which are available at public libraries in coastal cities and towns, and at the MCZM Boston office.

Standards: In general, to be subject to federal consistency review, a project must meet three main criteria. The proposed activity must:

1. be located within, or affect the resources of, the Massachusetts Coastal Zone;
2. involve a federal action such as funding, permitting or licensing; **and**
3. generally, but not always, exceed certain "thresholds" which trigger formal review by the Massachusetts Environmental Policy Act (MEPA) Unit.

Timing: MCZM cannot initiate consistency review until the following documents are on file:

- a Federal Consistency Certification from the project proponent identifying the related MCZM enforceable program policies and the means by which the project will be consistent with those policies;
- a copy of the federal permit or license application and all supporting data;
- the Certificate of the Secretary of Environmental Affairs regarding the completion of the MEPA process, if applicable;
- a detailed description (and all supporting data) of the proposed activity which is adequate to assess of its probable impacts on coastal zone resources; and
- a draft NPDES permit, if applicable.

MCZM's consistency decision is the last step of the state regulatory review process for projects in the coastal zone.

Review Period: For federally licensed projects, MCZM will issue its consistency decision within 3 months of receiving all necessary information. This period can be extended by MCZM to a maximum of 6 months. Direct federal activities and federally funded projects have review periods of 45 and 30 days, respectively.

Please note that MCZM cannot issue a consistency decision until copies of all applicable state licenses and permits are received at MCZM, and that federal agencies cannot issue any licenses or permits until MCZM issues a consistency decision.

Agency Action: Federal Consistency Decision; valid for term of federal permit of license which required it.

U.S. Army Corps of Engineers

Authorities: Section 10, Rivers and Harbors Act; Section 404, Clean Water Act; Section 103, Marine Protection, Research and Sanctuary Act of 1972.

Summary: The Corps issues permits for activities for dredging in navigable waters of the United States under Section 10; for "discharges" of dredged or fill material into all waters of the United States under Section 404; and for the transportation of dredged material for ocean dumping under Section 103.

Agency: United States Army Corps of Engineers, New England Division

Jurisdiction: Any construction or dredge/fill activity seaward of high water.

Standards: Under the State Programmatic General Permit process, project will be reviewed under the standards of one of three categories:

- **Non-reporting**--low impact projects not expected to substantially affect the environment;
- **Screening**--projects that are reviewed by the Corps to determine whether a higher level of review (individual) is appropriate;
- **Individual permit**--project submits plans, any supplementary information required, and goes through both the inter-agency review and public notice processes.

Projects requiring an individual permit are reviewed jointly be the Corps, USEPA, NMFS and USF&W. The Corps considers the comments of the other agencies and usually incorporates them into the permit decision.

Timing: Apply prior to construction.

Review Period: Typically 2-4 months after receipt of a complete application for non-controversial projects.

Permit: Section 10, Section 404, Section 103. Maintenance dredging clause of Section 10 permit valid for life of project; Section 404 and 103 valid for immediate activity only.

Contact: US Army Corps of Engineers, New England Division, 424 Trapelo road, Waltham, 02254. (617) 647-8330

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