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Arthur D. Little, Inc.

RECREATIONAL BOATING NEEDS ASSESSMENT AND EXPANSION FEASIBILITY STUDY FOR THE TIDAL WATERS OF NEW HAMSPHIRE

A Recreational Boating Inventory and Assessment
Facilities, Needs, Opportunities and Constraints

Part I - New Hampshire Coastline Summary

Part II - Harbor-by-Harbor Inventory

Submitted to the New Hampshire Port Authority

by

Arthur D. Little, Inc.

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INTRODUCTION

The purpose of this report is to present the findings and conclusions of an analysis of recreational boating needs and improvements along the New Hampshire coastline. The study covers all the tidal waters of New Hampshire but focuses on the harbor areas with the greatest need and potential for recreational boating improvements. The project was directed by the New Hampshire Port Authority with Federal funding and additional assistance provided through the New Hampshire Office of State Planning. The objective of the study was to "provide the basis for a comprehensive program for better utilization of the New Hampshire coast with special emphasis on the needs of the recreational boating interests." Based on an analysis of priority needs and sites, the study was to develop a set of action programs and implementation priorities for recreational boating improvements.

The overall effort was organized into three phases:

- Preliminary Evaluation of Study Area and Demand for Recreational Boating;
- Selection and Evaluation of Alternative Sites and Methods to Meet Recreational Boating Needs; and
- Project Development and Implementation Recommendations.

This report summarizes the findings of all three phases and is organized in two parts:

- Part I - reports the findings and conclusions for the entire New Hampshire coast.

- Part II - reports the findings and conclusions individually for each of the five recreational boating areas--Hampton/Seabrook, Rye Harbor, Little Harbor, Piscataqua River/Back Channel, and Great and Little Bays.

Additional working papers and technical appendices have also been prepared and are available through the New Hampshire Port Authority and the Office of State Planning.

PART I

NEW HAMPSHIRE COASTLINE SUMMARY

I. THE NEW HAMPSHIRE COASTLINE AND ITS BOATING FACILITIES

New Hampshire has roughly 15 miles of coastline on the Atlantic Ocean between Massachusetts to the south and Maine to the north. Although much of this coast consists of unprotected beaches or rocky shoreline exposed to the ocean, there are five groups of harbor and channel areas in which vessels can find refuge, as shown in Figure 1.

Hampton and Seabrook Harbors are the southernmost harbor areas and share a common entrance under a bascule bridge although each has distinctive physical characteristics and boating populations. The next harbor up the coastline about eight miles north of Hampton and Seabrook is Rye Harbor which affords quick and unimpeded access to the ocean and relatively straightforward navigation within the Harbor. About five miles north of Rye are Portsmouth, Newcastle and Little Harbors which provide a wide variety of boating conditions and use. About six miles further upstream on the Piscataqua River inside of the Sullivan Bridge lie Great and Little Bays.

Each of the harbor areas has different physical characteristics (e.g., bridges, currents, bottom conditions, and access) which influence the types of boaters using the harbors and the types of boating facilities

which have been developed. Commercial fishing boats are most heavily represented in Hampton/Seabrook, Rye, and the Portsmouth/Back Channel areas, while sailboats are most heavily represented in Rye and Newcastle/Little Harbor. Recreational powerboats are most in evidence in Hampton, Rye, the Back Channel and Great and Little Bays. A brief discussion of each area follows in order to provide some insight into the relative levels and type of usage experienced by each harbor compared to the others. A tabulation of existing recreational boating facilities in these harbor areas is shown in Table 1.

A. Hampton-Seabrook

Hampton and Seabrook Harbors are connected on to the ocean by a narrow entrance channel which is frequently shoaled, has occasionally strong currents, and is poorly marked by navigational aids. The Route 1A Bridge is only manned for limited periods during high tides, making it less attractive to sailors than some of the northern harbors. As a result of these physical characteristics, Hampton and Seabrook Harbors are infrequently visited by transient vessels and are utilized more by part- and full-time commercial fisherman and recreational boaters familiar with and experienced in these harbors. Small to mid-sized powerboats (both inboard and outboard) make up the majority of the boating population.

Table 1

Existing Recreational Boating Facilities
On New Hampshire Coast - 1980

	Total	Hampton	Seabrook	Rye	Little Harbor	Sagamore Creek/ Back Channel	Piscataqua River Portsmouth/ New Castle	Great & Little Bays
Moorings	883	180	65	140	50	25	248	159
Mooring Waiting List**	257	47	38	146	142*	142*	142*	26
Marina Slips	370	130	0	6	1	85	23	125
Boat Ramps	16	3	3	1	1	0	2	5
Boat Ramp Usage/Year	10,400	3,000	800	2,300	300	-	3,500	500

*Portsmouth/NewCastle waiting list includes Piscataqua Rive, Little Harbor and Back Channel

**Some people have put themselves on more than one waiting list. For this reason, the total of the breakdown by harbor exceeds the total of 257.

Source: New Hampshire Port Authority, on-site interview, ADL estimates.

B. Seabrook Harbor

Seabrook Harbor has one central mooring area which accommodates some 65 boats. The Town of Seabrook maintains a paved launch ramp adjacent to the town pier and dinghy float. The available parking and at this site is small and limited to town residents. There is a new pier on the east side of the harbor currently maintained and utilized by the Public Service Company which will retain that status through the duration of the power plant construction project. Upon completion of the project, the state will assume responsibility for the site and may further develop it for commercial fishing or recreational boating. There are currently no marina, marine service or fuel facilities in Seabrook Harbor. There are two unimproved launch sites and several moorings farther up the Blackwater River.

C. Hampton Harbor

Hampton Harbor has six mooring areas in which about 165 moored vessels are accommodated. Most are situated in the central mooring area to the east and north of the entrance channel. Also located in the central harbor area, the Hampton Beach Marina has slips for roughly 100 boats, has a boat ramp and provides the only marine service and fuel in the combined Hampton-Seabrook areas. Farther up the Hampton River the Hampton Landing Boat Club has about 25 slips, moorings for roughly two dozen boats and a boat ramp. There is a concrete boat ramp adjacent to the State fish peir and float and two unimproved ramps upstream of the central harbor areas.

D. Rye Harbor

Rye Harbor currently accommodates almost 150 boats and has a waiting list for moorings of about the same number. The harbor provides the quickest and simplest access to the ocean of all the New Hampshire harbor areas, an attraction which is reflected in user or would-be-user demand. All of theose presently using the harbor are on moorings with the exception of six boats which are tied at a private pier in the southeast corner of the harbor. In recent years shoals have developed in several portions of the anchorage area and in one part of the entrance channel; they can be remedied by maintenance dredging. The harbor has one boat ramp which is maintained by the State. This concrete slab ramp is in fair condition and ins one of the most heavily utilized on the seacoats. There is currently no marina or marine service/repair facility in Rye Harbor.

E. Little Harbor

Five miles farther up the coast from Rye Harbor lies Little Harbor. This well-protected area also provides users with close and easy access to the ocean. The harbor has a designated Corps of Engineers project area theoretically sufficient to accommodate 250-350 boats on free swing moorings. Because of limited public access and a somewhat smaller dredged area only about 50 boats use the dredged area. Harbor depths allow utilization by sailboats and deeper draft vessels, and as with Rye Harbor, no bridge crossing constrains the entrance to the harbor from the ocean.

Except for one boat tied at the Wentworth Pier, all boats in the harbor are on moorings and are accessed by dinghies tied at the private Wentworth Pier. Users of this facility are required to pay an annual fee. Public access to moorings from the shore is currently non-existent. Little Harbor does not have any marinas or other support service facility. One infreqnently used boat ramp in the harbor area is located at Witch Creek. This facility cannot be use at low tide

F. Piscataqua River/Back Channel

Farther up the Back Channels and Sagamore Creek, there are several private piers with slips and Mike's Marina. The area is bounded by a fixed bridge at the Piscataqua River between Shapleigh's and Goat Islands and the bascule bridge at Little Harbor. There are several outhaul moorings near Goat Island and seven adjacent to Mike's Marina. In addition, this marina has 85 power boats at slips. There is one unimproved, privately-owned boat launch ramp on Goat Island. Bridge constraints and shallow depths limit significant use of the area by sailboats.

On the Lower Piscataqua River, there are a variety of locations at which boats can be moored, berthed or launched. At the two yacht clubs, the several private piers and public parks, there are about 50 slips and roughly 125 to 140 boats moored. A boat ramp at Pierce's Island is one of the most heavily used on the coast. Although some portions of this area have shallow depths, bridge constraints, currents and exposure to commercial shipping traffic, the relatively close proximity to the ocean make it a more desirable area than upstream at Great and Little Bays.

G. Great and Little Bays

Great and Little Bays currently have 275 boats on moorings. Much of the shoreline of the bays is privately-owned land and, as a consequence, many of those holding moorings are individuals who wish to keep their boats near their property. Public access is extremely limited, and most access to the water is through private commercial facilities. Shallow water discourages the use by larger powerboats and sailboats. The distance between these areas and the ocean also makes it less attractive to many users.

The Great Bay Yacht Club, several of the marinas and smaller piers have most of the moorings not accessed directly by individuals from their private waterfront property. The majority of the marina slips are located at Great Bay Marina and at Benn's Marina; there are several small piers and marinas which accommodate up to 20 boats at slips. There are four boat ramps in Great and Little Bays in poor to fair condition which experience only modest use.

II. BOATING DEMAND AND TRENDS ON THE NEW HAMPSHIRE COASTLINE

There are a number of indications that demand for coastline boating facilities exceeds the available supply. The primary indicator of this is the 257 people currently on the mooring waiting list and the additional waiting lists at all local marinas. Other indicators are the increasing number of mooring permits and salt water boating registrations in the State and the increasing population and boat ownership trends.

A. Increasing Boat Registrations

In New Hampshire, boats are registered for coastal waters by the United States Coast Guard. In 1979, 15,334 boats with motors were registered in New Hampshire for salt water and interstate waters. Not all of these boats registered actively use the New Hampshire coastline; the total includes some registered for use on interstate waters as well as some used in the waters of other states. Many out of state users register in New Hampshire because of a favorable tax situation. Some of the registrations are for recreational boats and some for commercial, although the exact breakdown is not known. However, it is not likely that commercial boating accounts for more than 3-4% of the total registrations.[1] While registrations for coastal recreational

[1] Residents of New Hampshire do not need a general fishing license and thus cannot be counted. There were less than 10 non-resident general fishing permits issued in 1979 and only 235 commercial lobstering permits and 33 finfishing permits issued.

boats actually or potentially using New Hampshire coastal harbors cannot be estimated precisely, they probably made up no more than one third of the total or around 5000 in 1979. The rest are recreational boaters on intrastate waters, out-of-state boaters registering in New Hamsphire, or commercial boaters.

Saltwater and interstate water boat registrations in New Hampshire have steadily increased over the last fifteen years, as shown in Table 2. Although this data series includes recreational boats used in areas other than the coastline, it is worth noting that the overall increase 1977-1979 averaged 9.6% per year, and growth in the last five years averaged nearly 8% per year. The decreases shown in the years 1966, 1972, and 1979 most likely reflect adjustments in the data rather than a significant change in the underlying upward trend (see explanatory notes on Table 2).

In contrast to the substantial increases in saltwater and interstate registrations, the New Hampshire state freshwater boat registrations showed an average increas of less than 2% per year from 1961 to the peak in 1973 (see Table 3). The combination of the energy crunch and recession also resulted in some declines in the latter 1970's (1978 and 1979 totals were affected by procedural changes).

Table 2

NEW HAMPSHIRE
MOTOR BOAT REGISTRATION
SALTWATER AND INTERSTATE WATERS

Year	Number	Annual Change		Year	Number	Annual Change	
		Number	%			Number	%
1965	5,733			1972	7,621	- 307	- 3.9
1966	4,639	-1094	-19.1	1973	8,594	+ 973	12.8
1967	5,295	+ 656	14.1	1974	10,466	+1872	21.8
1968	5,725	+ 430	8.1	1975	12,080	+1614	15.4
1969	6,438	+ 713	12.5	1976	13,780	+1700	14.1
1970	7,162	+ 724	11.2	1977	14,736	+ 956	6.9
1971	7,928	+ 766	10.7	1978	16,124	+1388	9.4
				1979	15,334	- 790	- 4.9

Source: U.S. Coast Guard

The United States Coast Guard currently maintains records on salt water registrations. Technically the registrations are for boats with motors primarily used on navigable waters, generally including all coastal waters and their tributaries and all interstate waters. With respect to New Hampshire, these navigable waters include:

a. The Atlantic Ocean within Territorial Seas
b. The Connecticut River
c. The Piscataqua River
d. The Merrimac River from its Mouth to the Border Between Massachusetts and New Hampshire (Pending Judicial Review).
e. Black Pond
f. Salmon Falls River
g. Horn Pond
h. Milton Three Ponds
i. Great East Pond
j. Province Lake
k. Lower Kimball Pond
l. Lake Umbagog

There are at least two points in time when the data series published by the Coast Guard was affected by data collection procedures. In 1966, the data was purged of inactive registrations. (a similar purging probably also explains the declines in 1972 and 1979). In 1974, the registrations were changed to include "all boats propelled by some machinery," from just "boats with more than 10 horsepower". There is no available data on registrations for salt water alone. It should also be noted that the registrations may include not only New Hampshire registrations but also boats from neighboring states such as Massachusetts where the tax environment is less desirable.

Table 3

NEW HAMPSHIRE
MOTOR BOAT REGISTRATION
FRESHWATER

Year	Number	Annual Change	
		Number	%
1961	37,750		
1962	39,273	+1523	4.0
1963	40,207	+ 934	2.4
1964	39,074	-1133	-2.8
1965	40,790	+1716	4.4
1966	41,929	+1139	2.8
1967	43,338	+1409	3.4
1968	45,973	+2635	6.1
1969	45,674	- 299	-0.7
1970	47,322	+1648	3.6
1971	47,271	- 51	-0.1
1972	46,045	-1226	-2.5
1973	46,079	+ 34	0.7
1974	45,157	- 922	-2.0
1975	45,092	- 65	-0.1
1976	45,278	+ 186	0.4
1977	45,626	+ 348	0.4
1978	42,909	-2717	-5.9
1979	38,939	-3970	-9.2

Source: State of New Hampshire, Department of Safety

The state maintains records on boats with motors utilized primarily on New Hampshire lakes. Some of the variations from year to year can be explained by varying levels of enforcement of proper registrations; the level of enforcement may differ from year to year depending on state budgetary constraints. The drop in 1978 fresh water registrations can be explained by three factors: the impact of the energy crisis, a new tax law and a change in the procedure of boat registration. The tax law, instituted in late 1978, requires direct payment to the state rather than to the town in which it is registered, and is based on a computerized system with tax rates tied to the length, age and type of boat. This new system taxes larger, newer boats more heavily than small old ones and is more easily monitored than the previous system. The procedural change in registration has been a switch from registering motors to registering boats. All of these three factors, contributed to the drop in registrations by 2,717 in 1978 and 3,970 in 1979.

B. Increasing Mooring Permits

Another indicator of demand for coastline boating facilities is the growth in mooring permits issued. The number of mooring permits are a subset of the number of registrations for coastal waters. Trends in the number of mooring permits issued between 1977 and 1980 (Table 4) have indicated dramatic growth. In the mid-sixties, there were 200-300 permit holders per year; now there are between 850 and 1000. This represents about 10% annual growth in the number of moorings. Despite this dramatic growth, there is still a waiting list for moorings of 257. As shown on Table 1, this waiting list is longest for Portsmouth/Newcastle and Rye Harbor.

C. Increasing Population

The growth in recreational boating in New Hampshire has been supported by strong growth in population and households particularly in the southeast part of the State. Population in New Hampshire, currently about 900,000 is growing much faster than the nation and faster than its neighboring coastal states of Maine and Massachusetts. Past growth rates are summarized in Table 5. Throughout the past decade the growth in households has been more rapid than the growth in population in New Hamsphire has been no exception to this phenomenon. In general households have been growing almost twice as fast as population, increasing at the rate of 3.6% per year in New Hampshire, and 2.4% per year in the U.S. Examination of selected characteristics of the population highlights some additional

TABLE 4

New Hampshire Port Authority
Mooring Permit Receipts & Estimated Number of Mooring Permits
1966-1980

Fiscal Year July 1-June30	Fiscal Year Fees Collected	Rate[1]	Average Number of Permitholders per Year (April 1-May30)
1966	$ 217	@ $1/3 yrs.	200 - 300
1967	94	@ $1/3 yrs.	
1968	81	@ $1/3 yrs.	350 - 400
1969	149	@ $1/3 yrs.	
1970	191	@ $1/3 yrs.	
1971	305	@ $1/3 yrs.	600 - 700
1972	137	@ $1/3 yrs.	
1973	229	@ $1/3 yrs.	
1974	321	@ $1/3 yrs.	
1975	306	@ $1/3 yrs.	850 - 1000
1976	13,155	877@ $15/3 yrs.	
	2,750	55@ $50/yr.	
1977	2,295	153@ $15/3 yrs.	
	2,255	51@ $50/yr.	
1978	600	40@ $15/3 yrs.	
1979	10,830	722@ $15/yr.	
	1,900	19@ $100/yr.	
1980	14,430	962@ $15/yr.	
	2,700	27@ $100/yr.	

[1]Mooring Permit Rate Structures as Follows:

- Up through 1975 - $1.00 for 3 years.
- Beginning March 1976 - $15.00 for 3 years - In State Residents
  $50.00 per year - Out of State Residents
- For one year (1978) - DRED Collected for Mooring Permits - $10 for Fishermen
  - $ 1/ft. for Pleasure Boats.
- Beginning April 1, 1979 - $15.00 Per Year for Residents and Non Residents Real Estate Tax Payers
  $100 Per Year for All Other Nonresidents.

[2]The available data is not complete enough to allow accurate estimates of the number of permit holders per year, but the ranges given do provide an accurate indication of the trends since 1966. Currently there are about 950 permitholders.

Source: New Hampshire State Port Authority and ADL estimates.

Table 5

Population Growth 1970-1979

	Population (000)			Population Aged 18-44 (000)			Households (000)		
	1970[a]	1979[a]	Annual Rate of Change	1970[a]	1979[a]	Annual Growth Rate	1970[a]	1979[b]	Annual Rate of Change
New Hampshire	742	887	2.1%	257	364	3.9%	225	298	3.6%
Rockingham County	139[b]	180[c]	3.3%	n.a.	n.a.	n.a.	42[d]	62[d]	4.4%[d]
Neighboring Coastal States									
Maine	997	1,097	1.1%	331	419	2.7%	303	371	2.6%
Massachusetts	5,697	5,769	0.1%	1,967	2,353	2.0%	1,760	2,020	1.7%
USA	203,810	220,099	0.9%	71,735	88,968	2.4%	63,449	76,473	2.4%

[a] Estimates are for July 1

[b] Estimates are for April 1

[c] 1978 Provisional

[d] Arthur D. Little, Inc., Estimate

Note: The State Office of State Planning estimates that population growth in New Hampshire has been even faster, growing at a rate of about 2.5% per year, 1970-1979, and that growth in Rockingham County has been about 3.6% per year in that period.

Sources: U.S. Census, CPR 25, #873, February, 1980
#876, February, 1980
#807, July, 1979
#879, January, 1980

factors which have supported the increase in boating activity. Typical boat users are likely to be young families (ages 18-44) in middle to upper middle income brackets. At the national level, population ages 18-44 increased 2.4% per year between 1970-1979; population in that same age group grew 3.9% per year in New Hampshire. This growth rate not only exceeds that of the nation, but also exceeds that for Maine (2.7% per year) and Massachusetts (2.0% per year).

D. Increasing Boat Ownership

While population growth in New Hamsphire has been faster than national population growth, indications are that boating has grown even more rapidly. This is readily seen from the change in the number of boats per thousand population (as measured by salt/interstate water registrations per thousand population in Rockingham County). In 1970, there were 52 registrations per thousand population; they rose to 90/1000 in 1979. This change represents represents an increase of 7% per year. At the national level, this ratio increased from 43/1000 to 52/1000 population in the same period, an increase of only 2.4% per year (see Table 6).

E. Future Boating Demands

Based on a review of population and household forecasts available from the United States Bureau of Census and the New Hampshire Office of State Planning, future growth in population and households is expected to be strong in New Hampshire

TABLE 6

BOAT OWNERSHIP TRENDS

BOATS PER THOUSAND PEOPLE

Year	United States U.S. Population (000,000)	United States Recreational Boats (000)	United States Boats Per 000 Population	Rockingham County Rockingham County Population (000)	Rockingham County Salt Water Registrations	Rockingham County Boats Per 000 Population
1979	220.1	11,625	53	NA	15,334	NA
1978	218.2	11,270	52	180.0	16,124	90
1977	216.4	10,515	49	173.5	14,736	85
1976	214.7	10,105	47	166.6	13,780	83
1975	213.1	9,740	46	161.7	12,080	75
1974	211.4	9,616	46	160.7	10,466	65
1973	209.9	9,435	45	154.9	8,594	55
1972	208.2	9,210	44	149.2	7,621	51
1971	206.2	8,981	44	144.0*	7,928	55
1970	203.8	8,814	43	138.9	7,162	52

*Estimated

Source: United States Department of Commerce, Bureau of Census, National Marine Manufacturers Association, and United States Coast Guard.

and even stronger in Rockingham County, especially with the influx of Massachusetts residents. While the rate of growth is projected to slow down over the next two decades, it is likely to continue to increase at a rate exceeding 1% per year.

Part of the reason that boating demand is increasing more rapidly than population is that the baby boom of the 1950's is now swelling the ranks of the age group most likely to buy boats. Those born in the tail end of the baby boom--i.e., in the end of fifties--will become 40 in the year 2000. Many younger families with dual incomes are also moving to New Hampshire or purchasing or renting second homes. Thus strong growth in boating (4-6% per year) can be expected for the coming decade. Further growth is likely to trail off in the decade of nineties, but demand is still estimated to be a high level throughout this period. Table 7 summarizes the estimated demands for permanent slips or moorings in the tidal waters of New Hamphsire over the next ten years.

Table 7

Recreational Boating In the Tidal Waters of New Hampshire
Existing and Anticipated Demands for Permanent Slips or Moorings

Demand Components	All Tidal Waters of N.H.
1. 1980 Moorings/Slips	1253
2. 1980 Mooring Waiting List	257
3. Additional Estimated 1980 Needs	200
4. Increased Needs 1981-1985	400-700
5. Increased Needs 1981-1985	300-600
Total Additional Needs to 1990 (2 + 3 + 4 + 5)	1200-1700
TOTAL NEEDS	2500-3000

III. LOCAL NEEDS, CONSTRAINTS AND OPPORTUNITIES (PHYSICAL, ENVIRONMENTAL, LAND USE)

As discussed in detail above, there are indications that recreational boating activities are on the rise throughout the nation in general and in New Hampshire in particular. Within the broader frameworks of national saltwater and freshwater boating trends and regional social and economic growth, there are local forces which shape and constrain existing and potential future boating activities along the New Hampshire coast. The focus of this section is on the needs and demands of boaters along the New Hampshire coastline; however, at the local harbor level, needs and demand cannot be divorced from permanent physical constraints. For this reason, needs must be assessed harbor-by-harbor together with the consideration of each area's physical charactristics. Some of these characteristics impose a permanent constraint on future change and use of the harbor area, but other characteristics represent constraints that could result in expanded boating opportunities. Present capabilities, needs, opportunities, and constraints in the different harbor areas are summarized in Table 8 and Figure 2.

During the course of this study, site visits were performed and interviews were conducted with individuals involved in New Hampshire and regional boating. These included harbor masters, marina operators, commercial party boat operators, recreational sailors and boaters, commercial fishermen, town managers and boards of selectmen. In addition, questionaires were mailed to all of those currently retaining mooring permits in each of the harbor

Table 8

Harbor Area	# Moored Boats	Type of Boats Accomodated in 1980 (% of total) Power	Sail	Waiting List - 1980 #	Boat Ramps	# Slips	Constraints to Expanded Opportunities: Water Depths	Public Access/ Parking	Bridge Clearances	Currents Rocks, and Other Hazards	Sensitive Areas
Seabrook	65	98	2	38	3	0	major	minor	major	major (rocks)	minor
Hampton	180	90	10[a]	47	3	130	major	minor	major	major (rocks)	minor
Rye	142	65	35	146	1	6	major	minor	none	none	minor
Little Harbor	60	2	98	142[b]	1	1	minor	major	none	none	moderate
Back Channel	80	90	10	142[b]	0	85	minor	major	major	none	moderate
Piscataqua	183	35	65	142[b]	2	23	minor	moderate	minor	major (currents)	minor
Great & Little Bays	159	40	60	26	5	128	minor	major	moderate	minor	moderate

[a] Includes sailboats offshore at Plaice Cove.

[b] Little Harbor, Back Channel and Piscataqua River have a combined waiting list of 142.

areas, to all of those currently retaining slips in New Hampshire marinas, and to those individuals on the waiting list for mooring permits. A sample of the questionnaire is attached to this report. Approximately 35% of those questioned responded. The questionnaires that were returned were analyzed and results are summarized in Tables 9 and 10.

Demand for addictional moorings throughout the coastline as well as maintenance of existing anchorage areas (dredging, improvement of navigational aids, etc.) was consistently expressed. Mooring demand was particularly high in Rye Harbor and in New Castle and Little Harbors. These areas provide users with the easiest access to ocean waters and can accommodate large as well as small vessles.

With respect to other facilities, demands, boat ramps received the most attention after moorings. Ramp condition and parking (condidtion of lot and organization to fit trailers) were common concerns expressed at Rye. The primary complaint of the Seabrook ramp is the unavailability of parking to out-of-town users and only limited availability to town residents. Individuals in New Castle and Little Harbor expressed the need for a low tide ramp facility with public access and parking. Demand for marina slips was modestly expressed in all areas except Seabrook.

TABLE 9

HARBOR AREA NEEDS/PROBLEMS
BASED UPON
QUESTIONNAIRE RESPONSES FROM
MOORING AND MARINA USERS BY HARBOR AREA
(Expressed as a percent of respondents from each area)

		Boating Facilities			Physical Support Facilities				Managerial Support Facilities					Harbor Conditions		Land Conditions	
Harbor Area	Response/[1] Total	Moorings	Slips	Ramps	Docks	Fuel	Other Sources	Dinghy Storage	Mooring Management	Speed Control	Security	Navigation Aids	Safety	Dredging	Ocean Access	Parking	Public Access
Hampton	(60/	17%	7%	5%	8%	22%	10%	2%	–	5%	7%	12%	5%	37%	–	8%	–
Seabrook	(10/	20%	–	20%	30%	20%	30%	–	–	–	–	–	–	30%	–	30%	–
Rye	(39/	23%	–	8%	21%	13%	13%	8%	–	–	57%	37%	3%	26%	–	15%	–
Portsmouth	(58/	18%	7%	5%	10%	18%	24%	–	–	2%	7%	3%	4%	9%	2%	9%	10%
NewCastle, Little Harbor	(44/	27%	5%	14%	11%	5%	9%	2%	2%	2%	5%	–	–	11%	–	11%	7%
Great & Little Bays	(58/	16%	3%	5%	19%	18%	28%	2%	–	7%	3%	4%	4%	14%	2%	9%	–

Note: This is based on a tabulation of questionnaires received from mooring permit holders and marina users (see Appendix for copy of questionnaire); it assumes that the sample is representative of the total population of users.

[1] This is a ratio of the questionnaire respondents to the total number of mooring permit holders and individuals in marinas who received questionnaire.

TABLE 10

HARBOR AREA NEEDS/PROBLEMS
BASED UPON
QUESTIONNAIRE RESPONSES FROM
WAIT LISTEES BY HARBOR AREA
(Expressed as a percent of respondents from each area)

		Boating Facilities			Physical Support Facilities				Managerial Support Facilities					Harbor Conditions		Land Conditions	
Harbor Area	Response/[1] Total	Moorings	Slips	Ramps	Docks	Fuel	Other Sources	Dinghy Storage	Mooring Management	Speed Control	Security	Navigation Aids	Safety	Dredging	Ocean Access	Parking	Public Access
Hampton	(1/)[2]	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Seabrook	(0/)[3]	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Rye	(76/)	42%	5%	3%	13%	13%	17%	5%	3%	-	-	-	1%	18%	-	14%	3%
Portsmouth	(1/)[2]	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
NewCastle, Little Harbor	(4/)	25%	-	-	-	-	75%	-	-	-	-	-	-	25%	-	-	-
Great & Little Bays	(5/)	80%	-	-	20%	-	60%	-	-	-	-	-	-	-	-	20%	20%

Note: This is based on a tabulation of questionnaires received from those on mooring waiting lists (see Appendix for copy of questionnaire); it assumes that the sample is representative of the total population of users.

[1]This is a ratio of the questionnaire respondents to the total number of mooring permit holders and individuals in marinas who received questionnaire.

[2]Insufficient Sample return.

[3]No Respondents.

Facilities which service and support boating activities, such as a dock space (for temporary tie-ups), fuel supply, marine supply, repair and maintenance service, and dinghy storage were needs common to all harbor areas.

Dredging is a recognized need throughout most of the New Hamsphire recreational boating areas. Maintenance dredging is required to facilitate access by current users particularly at Hampton-Seabrook where rapid deposition causes frequent problems for both commercial fishermen and recreational boaters. Major dredging projects would be required to enlarge most of the existing boating areas or to add new ones.

In general, the largest demand for current and future use of Seabrook and Hampton Harbors is by commercial fishermen and small to medium sized recreational powerboats. Rye Harbor, because of its quick access to ocean waters and deep harbor area, has the single most concentrated demand for improved and additional facilities overall. Little Harbor and portions of the Back Channels have similar intense demand because of easy water access. This latter area is greatly in need of additional land access through public property.

IV. EVALUATION OF ALTERNATIVES

In order to meet the current and projected recreational boating needs identified in Sections II and III, and in order to do this in the context of numerous physical and economic constraints, a number of alternative strategies and improvement possibilities have been identified. These have been discussed at the public workshops and with interested parties in New Hampshire. Our evaluations of these alternatives are discussed in this section of the report. We have first described general types of alternative strategies and our evaluation of their relative feasibility and effectiveness in different harbor areas. We have then described specific improvement possibilities and sites in each of the five harbor areas. This section of the report concludes with an evaluation of selected improvement possibilities in terms of physical considerations (environmental, land/water access, marine engineering), economic considerations (construction costs, costs per boat, and economic impact), and project financing considerations (both public and private). Section V presents our recommendations based on these evaluations. Further detail on individual harbors is included in Part II of this report.

A. Evaluation of Alternative Strategies

Five general types of alternatives were identified for meeting additional recreational boating needs on the New Hampshire coastline:

- Better utilization and management of existing deepwater mooring areas not requiring dredging (mooring realignments, improved parking/access);

- Improvement/expansion of existing marinas and yacht club facilities (more slips, better parking, some dredging);

- Improvement/expansion of existing launch ramp facilities (parking, ramps);

- Development of new or expanded deepwater mooring areas (dredging, parking expansion and improvement of land and water access); and

- Development of new marina facilities (dredging, parking, land facilities, slips).

These five alternatives all represent viable approaches to meeting recreational boating needs on the coastline. No single alternative can adequately meet these boating needs, nor can any one alternative be put forth as the best or most cost-effective way of meeting these needs in all harbor areas. Instead, a different mix and phasing of these alternatives is likely to be appropriate in different areas.

A summary of our evaluation of these five general approaches in relation to boating needs, potentials, constraints, and costs in each of the five harbor areas is presented in Figure 3. As a result of this evaluation, specific improvement possibilities and sites were identified in each harbor and some were selected for more detailed evaluations as discussed below.

Figure 3

EVALUATION OF FIVE ALTERNATIVE APPROACHES TO MEETING RECREATIONAL BOATING NEEDS IN NEW HAMPSHIRE HARBOR AREAS

ALTERNATIVES	HARBOR AREAS				
	Hampton/Seabrook	Rye	Little Harbor	Piscataqua/Back Channel	Great & Little Bays
(1) Improved Use of Existing Mooring Areas					
• Need	minor (short waiting list, slow growth)	major (long and growing waiting list)	major (long and growing waiting list)	major (long and growing waiting list)	moderate (some waiti list, slow growth)
• Potential	major (widespacing, unused areas)	minor (already close spacing in all areas)	major (widespacing unused areas)	moderate (some unused areas, some widespacing)	major (widespacing unused areas)
• Constraints	major (silting, low bridge, hazards)	minor (some silting, congestion, wave surge)	minor (multiuse area)	major (limited public access/parking, low bridges, strong currents)	moderate (water and public land
• Costs	moderate (parking, moorings, maintenance dredging)	minor (parking, moorings and realignment)	moderate (new access and parking, moorings)	major (new access and parking, moorings)	minor (access agreem moorings)
(2) Improvements/Expansion of Existing Marinas & Yacht Clubs					
• Need	moderate (poor conditions but low demand)	-	major (expanding resort and membership)	major (expanding membership, strong demand)	moderate (uncertain demand)
• Potential	moderate (restricted to power boats)	-	major (highly desirable location and access)	major (already being actively considered)	major (most marinas have multiple expansion possibili
• Constraints	major (silting, low bridge, hazards)	-	moderate (public access, parking limitations and possible dredging problems)	moderate (strong currents, parking difficulties)	moderate (limited access to ocean)
• Costs	moderate (dredging, repairs, facilities)	-	moderate (significant dredging but project could piggyback on others)	moderate (minimal dredging, new floats, slips)	moderate (minimal dredging)
(3) Improvement/Expansion of Existing Launch Ramps					
• Need	minor (six ramps, limited use)	moderate (one congested ramp)	major (one almost useless ramp)	moderate (two ramps poorly developed)	minor (many ramps limited use)
• Potential	moderate (potential sites include Public Service Pier)	major (double ramp possible at existing site)	moderate (some dredging and new site)	major (physical improvements and parking)	moderate (improvement possibilities)
• Constraints	moderate (silting, hazards, parking)	minor (congestion)	minor (public access through multiuse area at Ordiorne Park)	minor (congestion)	moderate (limited water depths & access to ocean)
• Costs	minor (possible improvements)	minor (improved parking & new ramp)	moderate (some dredging for full tide use)	minor (parking & ramp improvements)	minor (parking and ramp improvements)
(4) Development of New or Expanded Mooring Areas					
• Need	minor (short waiting list, slow growth)	major (long and growing waiting list)	major (long and growing waiting list)	major (long and growing waiting list)	minor (little demand many deep water ar
• Potential	moderate (many areas with access and some water)	minor (few areas of significant size)	major (one area with public access potential)	moderate (minor in river, power boats only in Back Channel)	moderate (many areas with potential acc
• Constraints	major (silting, low bridge, hazards)	minor (some silting and wave surge)	minor (multiuse area)	major (parking and access difficulties)	minor (water access
• Costs	moderate (could be coordinated with dredging projects)	major (dredging plus parking and moorings)	major dredging plus parking and moorings)	major (parking, access, dredging and moorings)	moderate (minor dre parking and mooring
(5) Development of New Marina Facilities					
• Need	none (moorings and existing marinas will be adequate.	major (moorings will not provide sufficient density)	moderate (moorings and yacht club may not provide sufficient density)	moderate (moorings and marinas/yacht clubs may not provide sufficient density)	none (moorings and existing marinas or expansions will b adequate)
• Potential	-	major (projects have been considered, backup space adequate)	moderate (backup space adequate, demand strong)	moderate (backup space marginal, demand strong)	-
• Constraints	-	minor (some silting and wave surge)	moderate (multiuse area)	major (primarily power boats on river and in back channel)	-
• Costs	-	major (dredging, plus parking and new facilities)	major (dredging plus parking and new facilities)	major (dredging or bulkheads plus parking and new facilities)	-

(1) In Hampton-Seabrook, it is estimated that existing recreational boating facilities (6 ramps, 2 large moorng areas, 2 marinas and parking) have adequate capacity to meet most of the foreseeable demands in the near term. If demands do increase more than anticipated in the near term, improve utilization of existing mooring areas (primarily in Hampton) will provide adequate space for an estimated 40-50 additional moorings. Little or no additional public investment would be required to provide access and parking for these moorings. In the longer term, the expansion possibilities at the Hampton Beach Marina (both slips and moorings) and the reuse potential of the Public Service Pier (for either recreational boating or commercial fishing facilities relocate from the existing state fish pier) appear to provide adequate opportunities and boating capacities with a minimum public investment. Over both the short- and long-term the most critical need is for regular maintenance dredging by the Corps (at the harbor entrance) and by the State (inside of the bridge); in the inner harbor, the existing 22-acre authorized dredging area could be expanded to include more of Seabrook Harbor. Because of limited current demands and uncertain future demands, no specific projects were selected for more detailed study in Hampton-Seabrook. However, the more detailed evaluation of improvement possibilities in other harbor provide adequate information to develop both policies and recommended strategies for Hampton-Seabrook as discussed in Section V.

(2) In Rye Harbor, it is estimated that current and projected boating demand considerably exceeds the capacity of existing facilities and mooring areas. (There was a 1980 mooring waiting list of 146.) Better utilization of existing moorings will not significantly affect overall harbor capacity due to currently high mooring density (9 boats/acre), and specific improvements selected for further study included expanded mooring areas and new marina facilities in the northwest and southwest corners of the harbor. In order to alleviate current congestion, the expansion of boat ramp capacity and the provision of better accommodations for the commercial party boats were also selected for additional evaluation.

(3) In Little Harbor, it is also estimated that current and projected boating demands greatly exceed the capacity of existing facilities and mooring areas (there was a 1980 mooring waiting list of 142 for the Little Harbor-Portsmouth area). Better utilization and access for existing mooring areas will substantially increase overall harbor capacity due to the existing low mooring density (2 boats/acre). Because of the high and possibly rapidly growing demands in the harbor (e.g., Wentworth development), additional improvements identified and selected for further evaluation included new marina/mooring facilities off either Fort Stark or Fort Dearborn and expansion of Wentworth Yacht Club slips on both sides of the harbor. (Wentworth developers are also considering marina facilities on the Back Channel side of their property but this area would be restricted primarily to powerboats.) The single existing launch ramp at Witch Creek is largely due to mud flats. The underutilization of this facility necessitates relocation of the Witch Creek launch ramp to another Fort Dearborn site.

(4) In the Piscataqua River and Back Channel areas, needs and demands vary greatly. This is because of the large number of different areas (2 marina/yacht clubs, 2 launch ramps, many mooring areas) and the variety of constraints (e.g., strong currents, low bridges, shallow water). Because of the cost and difficulty of providing adequate public access to existing or expanded mooring areas scattered throughout this area, specific improvement possibilities selected for further study included parking/access improvements and concentration of moorings at selected access points or marinas. The substantial waiting list for the overall area (142 in 1980) and the potentially rapid growth of Portsmouth also necessitated additional consideration of much denser recreational boating facilities at new or expanded marina/yacht clubs.

(5) In the Great and Little Bay areas, it is estimated that existing recreational boating facilities (4 marinas, 5 launch ramps, 4 major mooring areas) have adequate capacity to meet foreseeable demands in the near term. In order to satisfy currently unmet demands from the 1980 waiting list (26 names) and other near-term demands, existing mooring area capacities could be more fully utilized. Over the longer term, marina expansions offer additional opportunities. Because of the currently low demands and the ability to provide adequate capacities with minimal public investments, no specific alternatives were selected for further detailed study in this area.

B. Selection of Specific Improvement Possibilities and Sites

On the basis of our evaluation of the five strategies in each harbor area, specific improvement possibilities were selected for further consideration and evaluation. These improvement possibilities are tabulated in Figure 4. General location of the selected high priority sites in Rye, Little Harbor, and Portsmouth/Back Channel are illustrated in Figure 5. Some of these improvement possibilities have been identified in previous studies (e.g., Pierce Island and Rye Harbor Marinas) and others are now being actively considered by others (e.g., Portsmouth and Wentworth Yacht Club expansions). In order to provide a better basis for comparative evaluations in this study, development and cost standards were applied as uniformly as possible to all options. The figures in this study may, therefore, vary from previously reported results of individual studies. The standards and possible variations are discussed in a separate Appendix.

C. Evaluation of Site-Specific Improvement Possibilities

In addition to a general evaluation of the need, potentials, constraints, and costs associated with selected improvement possibilities, more specific evaluations of physical, economic, and financial/institutional factors were conducted as discussed below:

FIGURE 4
IDENTIFIED BOATING IMPROVEMENT POSSIBILITIES
AND SITES NEW HAMPSHIRE COASTLINE

Harbor Area Site	Type of Improvement	Area Covered	Capacity
Rye 0 West End	improved parking, improved in and out launch ramps	1.0 acres of improved parking 13.5 acres of existing moorings	73 cars, 40 boat trailers, 2 ramps, 146 existing moorings
Rye I (including 0) Entire Harbor	expanded parking, realigned moorings	0.1 additional acres of parking	146 existing moorings, 18 moorings added for total of 164 moorings, 9 additional cars
Rye II (including 0, I) Southwest Corner	permanent party boat facilities	0.1 additional acres of parking	3 new slips, 9 moorings added to 164 moorings from Phases 0 and I for total of 173 moorings, 5 additional cars
Rye III (including 0, I, II) Northwest Corner	improved revetment, dredging, new marina development and parking	2.0 additional acres of parking 7.9 additional acres of slips	283 new slips, 173 moorings (from Phases 0, I, and II) 283 additional cars
Rye IVA (including 0, I, II, III) Southwest Corner	dredging, parking and expanded mooring area	0.2 acres of parking 5.1 additional acres of moorings	123 existing moorings, 44 additional moorings, 22 additional cars
Rye IVB (including 0, I, II, III) Southwest Corner	dredging, parking new revetment, and marina	2.0 additional acres of parking 7.1 additional acres of slips	287 additional slips, 147 remaining moorings 274 additional cars

FIGURE 4
IDENTIFIED BOATING IMPROVEMENT POSSIBILITIES
AND SITES NEW HAMPSHIRE COASTLINE (CONTINUED)

Harbor Area Site	Type of Improvement	Area Covered	Capacity
Little Harbor 0 Fort Dearborn	relocate launch ramp and parking new pier/float access	0.5 acres of parking 27 acres of existing moorings	25 cars and 10 car/trailers 1 ramp, 50 existing moorings
Little Harbor I (including 0) Central Harbor and Fort Dearborn	expanded parking, realigned moorings	1.0 additional acres of parking 27 acres of existing and additional moorings	50 existing moorings, 100 to 139 moorings added for total of 150 to 189 moorings 70 additional cars
Little Harbor II (including 0, I) Wentworth Pier	dredging, expansion piers and floats, expanded parking	1.5 additional acres of parking 5.9 acres of slips	183 new slips, 189 moorings (Phase 0, I high end of range) 185 additional cars
Little Harbor III (including 0, I, II) Wentworth Golf Course	dredge and fill new piers and floats expanded parking	2.5 additional acres of parking 10.9 additional acres of slips	337 additional slips, 189 remaining moorings (Phase 0, I, and II) 337 additional cars
Little Harbor IV (including 0, I, II, III) South Side and Fort Dearborn	dredging, expanded parking new piers and floats	2.6 additional acres of parking 8.4 additional acres of slips 14.7 additional acres of moorings	224 additional slips, 102 additional moorings plus 189 moorings (Phases 0, I, and II) for total of 291 moorings 275 additional cars
Piscataqua I Newcastle/ Goat Island	improved parking, realigned moorings	0.1 acres of parking 264 existing moorings 18.0 acres of existing and expanded moorings	15 additional cars, 30 additional moorings for total of 294 moorings

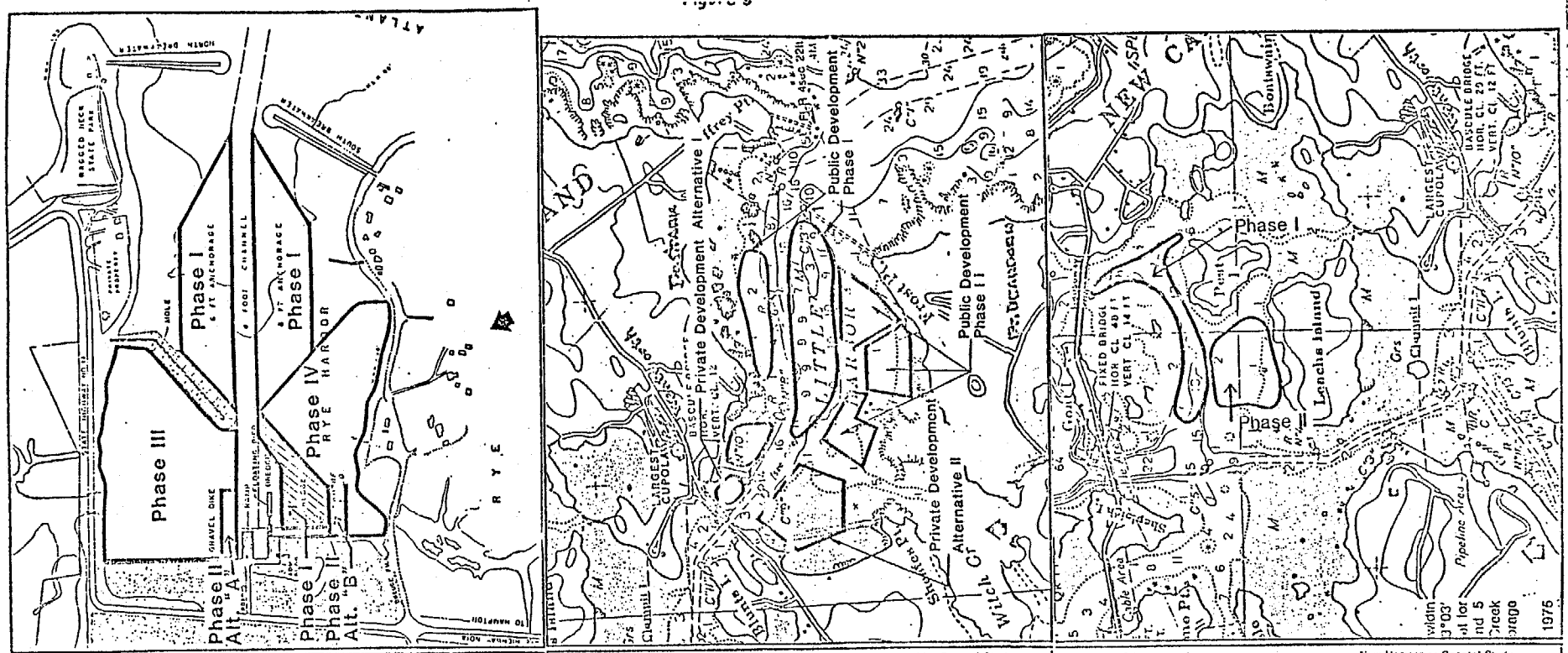
FIGURE 4
IDENTIFIED BOATING IMPROVEMENT POSSIBILITIES
AND SITES NEW HAMPSHIRE COASTLINE (CONTINUED)

Harbor Area Site	Type of Improvement	Area Covered	Capacity
Piscataqua II Newcaslte-Portsmouth	expanded piers, floats, expanded parking	1.0 additional acres of slips 0.3 additional acres of parking	30 additional cars, 23 existing plus 30 additional slips for total of 53 slips
Piscataqua III Pierce Island	new revetments, floats piers, parking	5.2 additional acres of slips 1.8 additional acres of parking	243 new cars, 243 new slips plus 53 existing slips (Phase II) for total of 296 slips
Piscataqua IV Gypsum Cove	new parking, access, and floats	3.0 additional acres of moorings 0.3 additional acres of parking	52 additional moorings, 26 additional cars
Hampton-Seabrook I Entire Harbor	realigned moorings, expanded parking	41.0 acres of existing moorings	245 existing moorings, 45 additional moorings, for total of 290 moorings 23 additional cars
Hampton-Seabrook II (including I) Hampton Marina	improved marina and parking	3.0 acres of slips 3.2 existing acres of parking	130 existing slips
Hampton-Seabrook III (including I, II) Hampton and Seabrook Piers	relocate fishing facilities and floats, expand mooring areas and marina with dredging	20 additional acres of parking 3.0 additional acres of moorings 1.5 additional acres of slips	290 existing moorings (Phase I) plus 20 additional moorings, for total of 310 moorings, 60 additional cars, 130 existing slips plus 50 new slips for total of 180 slips

FIGURE 4
IDENTIFIED BOATING IMPROVEMENT POSSIBILITIES
AND SITES NEW HAMPSHIRE COASTLINE (CONTINUED)

Harbor Area Site	Type of Improvement	Area Covered	Capacity
Back Channel I Goat/Pest Island	dredge and fill for new parking, floats/outhauls	0.7 acres of additional parking 16.6 acres of additional moorings	5 existing moorings, plus 134 to 186 additional moorings, for total of 139-191 moorings, 93 additional cars
Back Channel IIA Leaches Island	new causeway, parking, pier and dredging	0.8 acres of additional parking 14.5 acres of additional moorings	191 moorings (Phase I, high range) plus 201 additional moorings, for total of 293 moorings 100 additional cars
Back Channel IIB Leaches Island	new causeway, parking, pier, floats and dredging	3.5 acres of additional parking 7.3 acres of slips	482 new slips 482 additional cars
Great Bay I Great Bay	access and parking for additional moorings and realignment	0.4 acres of improved parking 18.0 acres of existing moorings	159 existing moorings, plus 100 additional moorings, for total of 259 moorings 50 cars
Great Bay II Great and Little Bays	marina expansion		125 existing slips, plus 100 additional slips for total of 225 slips

Figure 5



Rye Harbor
Development Phases

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Mass. 02172

Planning • Architecture • Landscape Architecture
Civil Engineering • Environmental Services

New Hampshire Coastal Study
Project No. 0183
Drawn By J.L.
Checked By C.G.S.
Approved By R.T.W.
Drawing Date 3/23/81
Sheet Number A-1
Scale 1"=331'

Little Harbor
Development Phases

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Mass. 02172

Planning • Architecture • Landscape Architecture
Civil Engineering • Environmental Services

New Hampshire Coastal Study
Project No. 0183
Drawn By J.L.
Checked By CGS
Approved By MF
Drawing Date 3/23/81
Sheet Number A-7
Scale 1"=300'

Back Channel
Leachs Island Development Phases

Sasaki Associates, Inc.
64 Pleasant Street, Watertown, Mass. 02172

Planning • Architecture • Landscape Architecture
Civil Engineering • Environmental Services

New Hampshire Coastal Study
Project No. 0183
Drawn By J.L.
Checked By C.G.S.
Approved By M.F.
Drawing Date 3/23/81
Sheet Number A-13
Scale 1" 600'

1. Evaluation of Physical Factors

The physical factors investigated further included marine engineering, environmental and access factors as summarized in Figure 6.

a. Marine Engineering Factors

The most critical marine features which will influence the suitability of different sites, other than gross features such as area, exposure, and water depth, are the type of bottom materials and currents. The feasibility and costs of using various types of piles, mooring anchors and foundations depends heavily on both the amount of sand/silt overlay, and on the currents. This is particularly true where vertical and horizontal ice loads are likely and where there are high hydrodynamic loads. Detailed data on currents and bottom conditions were reviewed for Piscataqua River sites and new subbottom profile data was collected for Pierce Island, Little Harbor and Rye Harbor sites. Detailed results of these investigations have been submitted as a separate Appendix.

The significance of marine engineering factors for the various improvement possibilities is presented in the last narrative column of Figure 6.

Figure 6

Evaluation of Potential Recreational Boating Improvements
In Relation To Physical Feasibility Considerations

Description of Alternatives		Physical Feasibility Considerations		
Type of Improvements	Existing or Additional Boats Accommodated	Environmental Impacts and Dredging	Access (Land, Water and Parking)	Marine Engineering (Currents Safety and Bottom Conditions)
Rye 0 parking and boat ramp	146 existing moorings	no significant impact	no constraint	some exposure to wind and wave surge
Rye I realign moorings and additional parking	18 additional moorings	no significant impact	no constraint	some exposure to wind and wave surge
Rye II party boat piers/parking	3 + 9 additional mooring	minimal dredging and impact	no constraint	well protected
Rye III marina, parking, and dredging north side	283 additional slips	significant dredging, minimal impact anticipated	requires substantial utilization of currently unused public land	well protected with improvements to mole
Rye IVA dredging, parking, and moorings south side	44 additional moorings	significant dredging, minimal impact anticipated	no constraint with modest improvements	some exposure to wind and wave surge
Rye IVB dredging, revetment, marina, and parking south side	287 additional slips	significant dredging, moderate land-side development; minimal anticipated	requires substantial utilization and improvement of currently unused public land	well protected with construction of new mole
Hampton-Seabrook 0 maintenance dreding	245 existing moorings	regular maintenance dredging required; minimal impact impact anticipated	no foreseeable land-side constraints but limited by bridge to power boats	shifting bottom conditions and difficult harbor entrance
Hampton-Seabrook I realign moorings	45 additional moorings	regular maintenance dredging required; minimal impact anticipated	no forseeable land-side constraints but limited by bridge to power boats	shifting bottom conditions and difficult harbor entrance
Hampton-Seabrook II improvement of marina and dredging/parking for moorings	100 existing slips 40 existing moorings	regular maintenance dredging required; minimal impact anticipated	no forseeable constraints but limited by bridge to power boats	shifting bottom conditions and difficult harbor conditions
Hampton-Seabrook III state pier shift and marina expansion with dredging	50 additional slips 20 additional mooring	regular maintenance dredging required; minimal impact anticipated	no foreseeable constraints with addition of public service pier	shifting bottom conditions and difficult harbor conditions

Figure 6

Evaluation of Potential Recreational Boating Improvements
In Relation to Physical Feasibility Considerations
(Continued)

Description of Alternatives		Physical Feasibility Considerations		
Type of Improvements	Existing or Additional Boats Accommodated	Envrionmental Impacts and Dredging	Access (Land, Water and Parking)	Marine Engineering (Currents Safety and Bottom Conditions)
Little Harbor 0 parking and launch ramp/pier	50 existing moorings	minimal land-side development with minimal environmental impacts	requires improvements and expanded utilization of unused public land	well protected
Little Harbor I realign moorings, additional parking	139 additional moorings	minimal land-side development with minimal environmental impacts	requires improvements and expanded utilization of currently unused public land	well protected
Little Harbor II Wentworth Marina and dredging	183 additional slips	significant dredging of small area; possible bedrock; minimal impacts anticipated	possible parking problems associated with resort expansion	well protected
Little Harbor III Wentworth Marina expansion and dredging	337 additional slips	significant dredging of larger area; minimal impacts anticipated	parking needs require dredge and fill adjacent to golf course	well protected
Little Harbor IV Fort Dearborn Marina and dredging	102 additional moorings 224 additional slips	significant dredging of larger area; and significant use of Fort Dearborn; same impacts because of lack of current development, multiple use impacts require careful planning	parking needs require use of two acres of Fort Dearborn	well protected
Back Channel I dredge and fill for parking to access unused mooring area	186 additional moorings	moderate dredge and fill for parking minimal anticipated impacts because of existing causeway	dredge and fill required for parking off causeway; limited by bridges to power boats	well protected
Back Channel IIA	201 additional moorings	significant dredging and moderate land-side development; unknown impacts associated with Leaches Island	access required to and from Leaches Island	well protected
Back Channel IIB dredging, causeway, parking parking, and access to new Leaches Island Marina	482 additional slips	significant dredging and development of Leaches Island, impacts on Leaches Island unknown	new causeway, parking, and access required to and from Leaches Island	well protected

Figure 6

Evaluation of Potential Recreational Boating Improvements
In Relation to Physical Feasibility Considerations
(Continued)

Description of Alternatives		Physical Feasibility Considerations		
Type of Improvements	Existing or Additional Boats Accommodated	Environmental Impacts and Dredging	Access (Land, Water and Parking)	Safety and Bottom Conditions
Piscataqua I realign moorings	30 additional moorings	no significant impact	continuing land access and parking problems	moderate currents near Newcastle
Piscataqua II expanded Portsmouth Marina	30 additional slips	no significant impact because of existing facilities	expansion of satellite parking required	moderate currents near Newcastle
Piscataqua III new Pierce Island Marina, dredging and parking	243 additional slips	minimal dredging and moderate development; multiple use impacts require careful planning	requires increased utilization of Pierce Island; potential long-term parking/traffic limitations	strong currents off Pierce Island limit development principally to power boats
Piscataqua IV access road, parking, and platform mooring at Gypsum Cove	52 additional moorings	moderate dredge and fill; minimal impact because of existing development	land and water access both extremely difficult due to bridges, currents, and land availability	protected cove; but strong river currents restrict use to power boats
Great Bay I access agreements or new access and parking for existing mooring areas	100 additional moorings	no significant impact	best access is through private marinas, new development/acquisition needed if agreements cannot be worked out	well protected, but strong river currents restricts to principally local use
Great Bay II marine expansion and dredging	100 additional slips	minimal dredging; minimal impact because of existing development	no constraints in most cases	well protected but strong river currents restrict to principally local use

In general, strong currents represent a problem primarily on the Piscataqua River--particularly at the Pierce Island site but also at the Gypsum Cove and Portsmouth Yacht Club sites. At these sites currents restrict the use of floats and marinas primarily to powerboats and add to the cost of permanent boating facilities.

Subbottom conditions represent a problem on both the Piscataqua River and in Little Harbor. On the Piscataqua River, the bottom is generally scoured bedrock making the use of pilings extremely difficult and limited. In Little Harbor, bedrock and ledges are shallow enough in some areas to restrict water depths, to constrain possible expansion of deepwater areas, and to limit the size and location of potential marina facilities or mooring areas.

In summary, the results of our marine engineering investigations have not precluded the feasibility of any of the alternative recreational boating improvements. They have, however, indicated that some improvements would have to be limited in size (e.g., Little Harbor), some would be more costly (e.g., Piscataqua River Marinas) and some would be limited in the types of boats served (e.g., Piscataqua River facilities primarily for power boats).

b. Environmental Factors

The most critical environmental factors which will influence the suitability of different sites relate to dredging and dredge spoils disposal, potential disruption of marine environments (including wetlands), and potential land use conflicts. The feasibility and costs of dredging will depend on the nature of the bottom material and its appropriateness for construction fill

or beach nourishment, and on the availability and suitability of disposal sites if the material cannot be used for fill or beach nourishment. Critical marine environments and wildlife habitats require special protection and can strongly affect specific siting and construction procedures. The assessment of environmental factors in this study was at a reconnaissance level only. Previous dredging records were reviewed for Rye, Hampton/Seabrook, the Piscataqua and the Back Channel and additional chemical analysis of bottom material was conducted in the Back Channel and Little Harbor.

The significance of environmental factors for the various improvement possibilities is presented in the first narrative column of Figure 6.

In general, dredging feasibility is not expected to be precluded in any of the selected sites due to either bottom conditions or environmental disruption. Bottom material is generally considered to be appropriate for beach nourishment in Hampton-Seabrook and possibly Rye and Little Harbors. It is likely to be suitable for fill in most areas of Rye and Little Harbors as well as parts of the Back Channel (e.g., off Goat Island). Where bottom material is not suitable for fill or beach nourishment, previous and recent testing indicates that it would probably be suitable for disposal at sea.

Potential disruption of marine environments and critical habitat areas represent a particular concern in Little Harbor (primarily Fort Dearborn and Witch Creek) and in the Back Channel (primarily Leaches Island). A preliminary review indicates that careful siting and planning could either avoid or mitigate most disruption (Leaches Island may be the exception).

c. Access Parking and Land Use Factors

Access, parking, and land use factors played a major role in the selection of potential sites for recreational boating improvements. Therefore, no sites were selected where these factors would preclude feasible boating improvements. However, these factors still present serious constraints at almost all sites. Detailed programming of improvements will have to pay careful attention to optimizing these conditions.

The significance of these access, parking, and land use factors for various improvement possibilities is presented in the second narrative column of Figure 6.

Public access constraints are particularly severe at the Little Harbor, Piscataqua and Great Bay sites. Our evaluation has found that these constraints could be removed in almost all cases with a modest amount of public investment (Fort Dearborn, Goat Island Causeway, Pierce Island) or with a reasonable level of private-public cooperation (e.g., Great Bay Marina and Wentworth/Porstmouth Yacht Clubs). Public access constraints are very difficult and costly to alleviate for the Leaches Island site and for many other sites not investigated.

Parking limitations represent a critical factor at almost all sites for improved moorings, marinas and launch ramps. In almost all cases these limitations could be removed with moderate public investments recouped in part by user fees. This is particularly true for the Hampton-Seabrook, Rye Harbor, Fort Dearborn, and Pierce Island sites. More substantial investments would be required at the Back Channel sites, and private-public agreements would be required to remove limitations at the Piscataqua and Wentworth Yacht Clubs and Great Bay Marina.

Potential land use conflicts exist in most of the areas due to either increased parking (e.g., Wentworth and Piscataqua), or multiple use (e.g., Fort Dearborn, Pierce Island, and Rye Harbor). Since the sites have been selected in part to minimize these conflicts, our review of these potential land use conflicts indicates that multiple use conflicts can be adequately mitigated or avoided in virtually all cases. Careful planning would be required to minimize multi use conflicts at sites such as Fort Dearborn and the Goat Island Causeway, and private-public agreements would be necessary to minimize private use conflicts at the yacht clubs and marinas.

2. Evaluation of Economic Factors

The economic factors investigated further included estimated construction costs, cost effectiveness, and economic impact as summarized in Figure 7.

a. Estimated Construction Costs

The estimated construction costs for the alternatives are summarized in column 3 of Figure 7. These costs were estimated on the basis of the general design and construction standards detailed in a separate appendix. The major elements of these costs in the various alternatives include parking, moorings, dredging, floats, piers and revetments or breakwaters. General design and construction standards used were as follows:

- Parking. Parking improvements were required in almost all cases Gravel parking areas @350 square feet per car and 500 square feet per boat trailer were estimated to cost $0.71 to $2.00 per square foot (plus 30% construction and engineering contingency) exclusive of land costs. These costs are equivalent to $325 per car and $487 per boat trailer. Parking standards of one car per slip and one car for every two moorings and one car and trailer per Sunday launch were generally employed based on previous experience and the different mix of boat use at marinas and moorings. The costs shown in Figure 7 reflect these standards; however, substantially higher costs estimated at $600-$700 per car would result if the parking areas were to be paved and landscaped.

Figure 7

Evaluation of Potential Boating Improvements
in Relation to Economic Considerations

Description of Alternatives		Estimated Capital Costs		Economic Impact Implications	
Type of Improvements	Existing or Additional Boats Accommodated	Total Capital Cost	Additional Capital Cost Per Boat	Based on COE Standards	Alternative Method
Rye 0 parking and boat ramp	146 exist. mrgs.	$ 48,000 (pkg.) 72,000 (ramp & pkg.) $120,000	$325/exist. mrg. $60/exist annual launch	$29,200 ? na	$58,400 ? na
Rye I realign moorings and additonal parking	18 add'l. mrgs.	$14,600 (mrg. upgrade) 5,850 (pkg.) 7,200 (mrgs.) $27,650	$100/exist. mrg. 325/new mrg. 400/new mrg. $725/new mrg.	$14,400	$36,000
Rye II party boat piers/parking	3 + 9 add'l.	$71,100 (pty. boat/floats/pkg.) 2,925 (pkg.) 3,600 (mrgs.) $77,625	$23,700/exist. pty. boat $325/new mrg. 400/new mrg. $725/new mrg.	? $7,200 na	? $18,000 na
Rye III dredging, parking, and marina north side	283 add'l. slips	$ 815,000 (dredging) 325,000 (revetment) 462,000 (floats etc.) 183,000 (pkg.) $1,785,000	$2,880/slip 1,148/slip 1,632/slip 646/slip $6,306/slip	$210,000	$629,000
Rye IVA dredging, parking, and moorings south side	44 add'l. mrgs.	$670,000 (dredging) 17,600 (mrgs.) 14,300 (pkg.) $701,900	$15,227/new mrg. 500/new mrg. 325/new mrg. $15,952/new mrg.	$35,200	$88,000
Rye IVB dredging, revetment, marina, and parking south side	287 add'l. slips 26 less mrgs.	$ 670,000 (dredging) 526,500 (revetment) 1,352,000 (mole) 186,600 (pkg.) 426,000 (floats etc.) $3,161,500	$ 2,334/slip 1,834/slip 4,711/slip 650/slip 1,484/slip $11,013/slip	$164,800	$493,200

Figure 7
Evaluation of Potential Boating Improvements
in Relation to Economic Considerations
(Continued)

Description of Alternatives		Estimated Capital Costs		Economic Impact Implications	
Type of Improvements	Existing or Additional Boast Accommodated	Total Capital Cost	Additonal Capital Cost Per Boat	Based on COE Standards	Alternative Method
Hampton-Seabrook 0 maintenance dredging	245 exist. mrgs.	$360,000 (dredging) $360,000	$1,469/mrg. $1,469/mrg.		
Hampton-Seabrook I realign moorings	45 add'1. mrgs.	$18,000 (add'1. mrgs.) 6,500 (exist. mrgs.) $24,500	$400/add'1. mrg. $100/exist. mrg.	$36,000	$90,000
Hampton-Seabrook II improvement of marina and dredging/parking for moorings	100 exist. slips	$ 60,000 (dredging) 78,000 (pkg.) $138,000	$429/boat 557/boat $986/boat	$28,000	$56,000
Hampton-Seabrook III state pier shift and marina expansion with dredging	50 add'1. slips 20 add'1. mrgs.	$120,000 (dredging) 24,320 (floats, etc.) 39,000 (pkg.) 8,000 (mrgs. $191,320	$1,714/boat 486/slip 557/boat 400/mrg. $2,757 slip $2,671/mrgs.	$56,000	
Little Harbor 0 parking and launch ramp/pier	50 exist.	$29,250 (pkg.) 65,300 (ramp & pkg.) $94,550	$585/exist. mrg. $60/add'1. annual launch	$10,000 ? na	$20,000 ? na
Little Harbor I realign moorings, additional parking	139 add'1. mrgs.	$ 5,000 (mrg. upgrade) 33,150 (pkg.) 40,800 (mrgs.) $78,950	$100/exist. mrg. 325/new mrg. 400/new mrg. $725/new mrg.	$81,600	$160,000

Figure 7
Evaluation of Potential Boating Improvements
in Relation to Economic Considerations
(Continued)

Description of Alternatives		Estimated Capital Costs		Economic Impact Implications	
Type of Improvements	Existing or Additional Boats Accommodated	Total Capital Cost	Additional Capital Cost Per Boat	Based on COE Standards	Alternative Method
Little Harbor II Wentworth Marina and dredging	183 add'l. slips	$ 587,600 (dredging) 273,000 (revetment) 326,040 (floats etc.) 118,950 (pkg.) $1,305,590	$3,211/slip 1,491/slip 1,782/slip 650/slip $7,134/slip	$146,400	$439,200
Little Harbor III Wentworth Marina expansion and dredging	337 add'l. slips	$1,184,725 (dredging) 331,500 (edge) 552,200 (floats etc.) 219,050 (pkg.) $2,287,475	$3,515/slip 983/slip 1,639/slip 650/slip $6,788/slip	$242,200	$726,600
Little Harbor IV Fort Dearborn Marina and dredging	102 add'l. mrgs. 224 add'l. slips	$1,439,600 (dredging) 370,500 (revetment) 383,760 (floats etc.) 40,800 (mrgs.) 172,900 (pkg.) $2,407,560	$4,416/boat 1,137/boat 1,713/slip 400/mrg. 530/boat $6,483/mrg. $7,796/slip	$241,600	$727,200
Back Channel I dredge and fill for parking to access unused mooring area	186 add'l. mrgs.	$110,000 (dredge & fill) 60,350 (pkg.) 74,400 (mrgs.) $244,850	$ 591/mrg. 325/mrg. 400/mrg. $1,316/mrg.	$148,800	$372,000
Back Channel IIA dredging, causeway parking, and access to new mooring area	201 add'l. mrgs.	$1,019,000 (dredge & fill) 80,400 (mrgs.) 65,650 (pkg.) 780,000 (off site access road) $1,945,050	$5,070/mrg. 400/mrg. 325/mrg. 3,881/mrg. $9,676/mrg.	$160,800	$402,000

Figure 7

Evaluation of Potential Boating Improvements
in Relation to Economic Considerations
(Continued)

Description of Alternatives		Estimated Capital Costs		Economic Impact Implications	
Type of Improvements	Existing or Additional Boat Accommodated	Total Capital Cost	Additional Capital Cost Per Boat	Based on COE Standards	Alternative Method
Back Channel IIB dredging, causeway, parking, and access to new Leaches Island Marina	482 add'l. slips	$ 773,000 (dredge & fill) 234,000 (revetment) 668,000 (floats etc.) 313,300 (pkg.) 780,000 (off site access road) $2,768,300	$1,603/slip 490/slip 1,386/slip 650/slip 1,618/slip $5,743/slip	$169,200	$987,600
Piscataqua I realign moorings	30 add'l. mrgs.	$12,000 (mrgs.) 9,750 (pkg.) $21,750	$400/mrg. 325/mrg. $725/mrg.	$24,000	$60,000
Piscataqua II expanded Portsmouth Marina	30 add'l. slips	$45,000 (floats etc.) 19,500 (pkg.) $64,500	$1,500/slip 650/slip $2,150/slip	$24,000	$72,000
Piscataqua III new Pierce Island Marina, dredging and parking	243 slips	$ 157,950 (pkg.) 486,000 (floats etc.) 243,000 (dredging) 234,000 (revetment) 911,050 (barrier walls) $2,032,000	$ 650/slip 2,000/slip 1,000/slip 963/slip 3,749/slip $8,362/slip	$185,800	$557,400
Piscataqua IV access road, parking, and platform mooring at Gypsum Cove	52 mrgs.	$ 10,000 (pier) 16,900 (pkg.) 48,000 (road) 78,000 (mrgs.) $152,900	$ 192/mrg. 325/mrg. 923/mrg. 1,500/mrg. $2,940/mrg.	$41,600	$105,000

Figure 7

Evaluation of Potential Boating Improvements
in Relation to Economic Considerations
(Continued)

Description of Alternatives		Estimated Capital Costs		Economic Impact Implications	
Type of Improvements	Existing or Additional Boats Accommodated	Total Capital Cost	Additonal Capital Cost Per Boat	Based on COE Standards	Alternative Method
Great Bay I access agreements or new access and parking for existing mooring areas	100 add'l. mrgs.	$40,000 (mrgs.) 35,500 (pkg.) $75,500	$400/mrg. 325/mrg. $725/mrg.	$80,000	$200,000
Great Bay II marina expansion and dredging	100 add'l. slips	$220,000 (floats/pkg.) 50,000 (dredging) $270,000	$2,200/slip 500/slip $2,700/slip	$80,000	$240,000

- Moorings. Mooring realignments were considered in all harbor areas and where needed were estimated to cost $50-$200 per mooring for resetting and repairing or upgrading. New moorings where they became possible were estimated to cost $200-$800 per mooring depending on the size of boat and type of mooring needed. In general, an average of $100 per realigned mooring and $400 per new mooring was used in developing the cost estimates of Figure 7.

- Dredging. Dredging costs are likely to vary substantially from site to site depending on the amount of material to be removed, the types of material (and its suitability for beach nourishment, construction fill, or ocean dumping) and the nature of the disposal sites. Where material was assessed as being suitable for fill or beach nourishment, and where suitable nearby disposal sites existed, a dredging cost of $6 per cubic yard was used (plus $35,000 dredge mobilization). Costs of $8.50 per cubic yard were used where ocean dumping might be necessary. These costs were based on recent Corps of Engineers experience--particularly in Hampton-Seabrook and Portsmouth. Dredging to 8 feet below mean low water was assumed where sailboats were to be accommodated; dredging to 6 feet below mean low water was assumed otherwise. The costs shown in Figure 7 reflect these standards, however, lower mobilization costs could be achieved through judicious scheduling, and lower dredging costs could possibly be achieved where limited dredging could be conducted from the land.

- Floats and Piers. Floats and piers were considered in almost locations and, where needed, they were estimated to cost $12 per square foot (plus 30% construction and engineering contingency) based on recent experience involving private construction. Public construction, depending on standards and contracting procedures, could cost an estimated $22 per square foot plus contingencies. The costs shown in Figure 7 reflect the $12 per square foot costs.

- Revetments and Breakwaters. In most cases (revetments and/or breakwaters or moles) were needed for new or repaired marinas; such projects usually required dredging. Revetments were estimated to cost $300 per lineal foot ($200 per lineal foot for upgrading) while the breakwaters for Pierce Island and Rye Harbor were estimated to cost $1300 per lineal foot (the Pierce Island breakwater could cost considerably more because of currents and exposure). Including 30% construction and engineering contingencies, the costs assumed for Figure 7 were $390 per lineal foot for revetments and $1,690 per lineal foot for breakwaters.

The construction costs tabulated in column 3 of Figure 7 range from less than $30,000 for minor mooring realignments to over $2,000,000 for several of the new marina options (all figures in 1980 $). In order to compare these costs we have estimated the construction costs per boat as tabulated in column 4.

b. Construction Costs Per Boat

The construction cost per boat tabulated in column 4 of Figure 7 give one indication of the relative cost-effectiveness of the alternatives evaluated. However, the level of service provided to the recreational boater also varies considerably as does the capability of a given alternative to accommodate the varying boating needs in different harbors.

In Hampton-Seabrook, the most cost-effective way to meet near-term recreational boating needs is to continue to provide adequate maintenance dredging and possibly realigned moorings to meet local community boating demands. Because of the relatively rapid rates of deposition and the comparatively high costs of maintenance dredging (estimated at $1,469 per mooring every 10-15 years), it does not appear cost-effective to meet foreseeable nonlocal boating demands with expanded mooring areas in the Hampton-Seabrook Harbor. On the other hand, existing water depths and protection in the harbor make marina expansion more cost-effective than elsewhere on the coast (e.g., 1/2 to 1/4 the cost per additional marina slip at Rye Harbor). Therefore, if non-local demands for powerboat slips on the New Hampshire coast were to increase, expanded marina facilities at Hampton-Seabrook should be considered a high priority in terms of their relative cost-effectiveness.

In Rye Harbor, the most cost-effective way to meet near- to mid-term recreational boating needs is to improve the launch ramp and develop new marina facilities behind the mole in the northwest corner of the harbor. Compared to other Rye Harbor improvements that could accommodate the apparent Rye Harbor waiting list demand of 146, the northwest harbor marina is about twice as cost-effective as a southwest corner marina and almost three times as cost-effective as additional dredged mooring areas. Compared to other marina facilities that could accommodate both sail and power boats elsewhere on the New Hampshire coast this marina option is also relatively cost-effective at approximately $6,300/slip for up to 283 slips.

Compared to improved public access and mooring alignment options at all harbors, however, this marina does not appear to be cost-effective solution to the apparent immediate mooring waiting list demand of 230 in all the coastal harbors.

This is because the mooring realignment and access improvements in other harbors are estimated to be about five to six times as cost-effective as the Rye Harbor marina in meeting needs for up to 400 additional boats in coastal harbors. Assuming that at least one half of the immediate need would be for powerboats, up to 400 additional moorings could be developed at a cost of $700 to $1,300 per boat. To meet the anticipated near- to mid-term needs for an additional 500-700 boats in coastal harbors, the northwest Rye Harbor marine would provide a relatively cost-effective method to meet combined sail/power needs--however, not dramatically so in relation to the Little Harbor marina options.

In Little Harbor, the most cost-effective way to meet immediate recreational boating needs of 100-125 spaces in the harbor is clearly to provide better access and parking for realigned moorings in the existing mooring areas. This option will be at least 10 times as cost-effective in meeting needs for up to 139 boating spaces as will the marina or expanded mooring area options. This alternative (Little Harbor 0 and I) is also more cost-effective than all other alternatives yielding net additions of over 50 boats in the coastal harbors. Beyond an additional 139 boating spaces, the most cost-effective improvement in Little Harbor is the Wentworth marina--whether it is located on the golf course, motel, or back channel side of the proposed development. For accommodating up to 500-600 additional boats over the mid-term, this new marina option would have a cost-effectiveness of about $6,000/boat comparable to the northwest Rye Harbor marina and considerably better than those of a Pierce Island or southwest Rye Harbor marina.

In the Lower Piscataqua and Back Channel areas, the most cost-effective ways to need immediately apparent boating needs of 100-125 spaces is to realign existing moorings and provide improved access/parking to a currently almost unused deep water powerboat mooring area of about 16 acres. At an estimated cost of $1,300 per mooring, this option represents the most cost-effective way of meeting needs in excess of 30 spaces and less than 215 spaces in this area so long as the additional needs were at least 75% for powerboats. If the needs were for more sailboat spaces, the expansion of the Portsmouth Yacht Club and new marinas at either Rye or Little Harbors would be more cost-effective than the previously studied Pierce Island Marina and Gypsum Cove moorings.

In the Great and Little Bay areas, the most cost-effective way to meet immediately apparent boating needs of 20 to 30 spaces as well as mid-term forecast needs of 50 to 100 spaces is to improve public access and parking for existing deep water mooring areas. Particularly cost-effective would be agreements with the Great Bay Marina to assure adequate access and parking from its facility to nearby underused deep-water areas. With an abundance of potential parking facilities due to its large winter storage operation, the Great Bay Marina is a unique position to expand the availabiltiy of moorings at minimal cost.

In summary, the most cost-effective options for meeting immdediately apparent boating needs are the options involving realigned moorings and improved public access and parking--particularly at Little Harbor (up to 139 sailboats), but also at Goat Island (up to 183 powerboats) and in smaller areas of the Lower Piscataqua (30 sailboats), Rye Harbor (18 sailboats), Great and Little Bays (up to 100 boats) and Hampton-Seabrook (up to 45 powerboats). In order to meet near- to mid-term forecast needs for up to 700 boats in New Hamshire's coastal waters several marina options appear feasible and relatively cost-effective as well. The marina expansions at Hampton-Seabrook (powerboats only) and Portsmouth Yacht Club would be particularly cost effective; but for significantly increased sailboat capacities, the most cost-effective options would be new marinas in Little Harbor or the northwest corner of Rye Harbor.

c. Economic Impact Implications

The economic impacts of recreational boating improvements are not likely to be a major criterion for prioritizing and selecting from the alternative improvements evaluated. While impacts are likely to be slightly greater per boat at a marina than at a mooring the difference in impacts at different sites is likely to be insignificant. Column 5 of Figure 7 tabulate the range of generalized economic impacts in accordance with two different methodologies--one is used by the Corps of Engineers in calculating benefits of increased recreational boating associated with dredging projects and is generally considered to be very conservative; the other method has been employed in several recent New England harbor studies using typical boater expenditures and is considered to reflect area wide effects.

The Corps of Engineers method is based on the equivalent leased value of additional boats or additional boat utilization depending on their size and type. For the mix of boats likely to be found in New Hampshire harbors, the economic impacts calculated in accordance with the conservative Corps of Engineers standards would average about $800 per additional boat immediately accommodated ($600 per boat for future boats) plus about $200 per boat whose utilization rate was increased from 70% to 95% of maximum. Sample calculations have been presented in a separate appendix and economic impacts estimated in this "officially" sanctioned manner would range from less than $50,000 for smaller projects aimed at improving existing conditions or accommodating less than 50 additional boats, to more than $200,000 for major new marinas such as evaluated in Rye and Little Harbors.

The alternate method used is one that reflects the actual boater expenditures (exclusive of boat purchase) as surveyed in several recent studies. For the same mix of boats as cited in the first example, economic impacts calculated in this manner are likely to average slightly over $2,000 for every new mooring, and about $2,500 for every new marina slip. Economic impacts calculated in this way would range from less than $100,000 for the smaller projects directed at moorings and improved conditions for existing bosts to over $700,000 for some of the new marine options.

3. Evaluation of Financial/Institutional Factors

The financial/insitutional factors investigated further included public financing options (general fund vs. revenue bonds repaid by user fees) and additional private boater fees and investment requirements as illustrated in Figure 8.

a. Potential Public Financing

In order to assess potential financial feasiblity, we first had to develop a reasonable potential public financing assistance. In the past, dredging, parking, access, and marine protection (bulkheads, revetments) have often been financed by a combination of state and federal funds supported by the general tax base. Recognizing the substantially altered fiscal environments at both the state and federal levels we have in this report evaluated financial feasibility starting from the following assumptions:

Figure 8
Evaluation of Potential Recreational Boating Improvements
in Relation to Project Financing Considerations

Description of Alternatives		Potential Project Financing			
		Private Boater		Public	
Type of Improvements	Existing or Additional Boats Accommodated	Additional Fees	Additional Investment	Revenue Bonds Repaid by User Fees	General Fund
Rye 0 parking and boat ramp	146 exist. mrgs.	$16/yr. per mrg./yr. $3/launch	- -	$24,000 pkg. 36,000 ramp/pkg. $60,000	$24,000 pkg. 36,000 ramp/pkg. $60,000
Rye I realign mooring and additional parking	18 add'l. mrgs.	$16/yr. per mrg./yr. -	$100/exist. mrg. - $400/add'l. mrg.	$2,925 pkg. - $2,925	$2,925 pkg. - $2,925
Rye II party boat piers/parking	3 + 9 add'l. mrgs.	$2/car pkg. $16/yr. per mrg./yr. -	$11,850/pty. boat - $400/add'l. mrg.	$35,550 floats 1,462 pkg. - $37,012	- $1,463 pkg. - $1,463
Rye III marina, parking, and dredging north side	283 add'l. slips	$280/slip/yr. - $245/slip/yr. $32/yr. pkg. fee	-	$ 815,000 dredge - 462,000 floats 91,500 pkg. $1,368,500	- $325,000 revet. - 91,500 pkg. $416,500
Rye IVA dredging, parking, and moorings south side	44 add'l. mrgs.	$307/mrg./yr. (all harbor mrgs.) $16/yr. per new mrg.	$400/add'l. mrg.	$670,000 dredge - 7,150 pkg. $677,150	0 - $7,150 pkg. $7,150
Rye IVB dredging, revetment, marina, and parking south side	287 add'l. slips 26 less mrgs.	$245/slip/yr. - $247/slip/yr. $34/yr. pkg. fee $233/slip/yr.		$ 670,000 dredge - 676,000 mole 93,300 pkg. 426,000 floats $1,865,300	- $ 526,500 revet. 676,000 mole 93,300 pkg. - $1,295,800

Figure 8

Evaluation of Potential Recreational Boating Improvements
in Relation to Project Financing Considerations
(Continued)

Description of Alternatives		Potential Project Financing			
		Private Boater		Public	
Type of Improvements	Existing or Additional Boats Accommodated	Additional Fees	Additional Investment	Revenue Bonds Repaid by User Fees	General Fund
Hampton-Seabrook 0 maintenance dredging	285 exist. mrgs.	$147/mrg.	-	$360,000 dredge	
Hampton-Seabrook I realign moorings	45 add'l. mrgs.	-	$400/add'l. mrg.	-	-
		-	$100/exist. mrg.	-	-
Hampton-Seabrook II improvement of marina and dredging/parking for moorings	100 exist. slips	$43/boat/yr.	-	$ 60,000 dredge	-
	40 exist mrgs.	$56/boat/yr.	-	71,500 pkg.	$6,500 pkg.
				$131,500	$6,500
Hampton-Seabrook III state pier shift and marina expansion with dredging	50 add'l. slips	$171/boat/yr.	-	$120,000 dredge	-
	20 add'l. mrgs.	$74/slip/yr.	-	24,320 floats	-
		$56/boat/yr.	-	35,750 pkg.	$3,250 pkg.
		-	$400/mrg.	-	-
				$180,070	$3,250
Little Harbor 0 parking and launch ramp/pier	50 exist. mrgs.	$16/yr. per mrgs.	-	$ 8,125 pkg.	$21,125 pkg.
		$3/launch	-	33,150 ramp/pkg.	33,150 ramp/pkg.
				$41,275	$54,275
Little Harbor I realign moorings, additional parking	139 add'l. mrgs.	-	$100/exist. mrg.	-	-
		$16/yr. per mrg.	-	$16,575 pkg.	$16,575 pkg.
		-	$400/add'l. mrg.	-	-
		-	-	-	-
				$16,575	$16,575
Little Harbor II Wentworth Marina and dredging	183 add'l. slips	$321/slip yr.	-	$ 587,600 dredge	-
		$149/slip/yr.	-	325,000 revet.	-
		$267/slip/yr.	-	326,040 floats	-
		$65/yr. pkg. fee	-	118,950 pkg.	-
				$1,305,590	

Figure 8

Evaluation of Potential Recreational Boating Improvements
in Relation to Project Financing Considerations
(Continued)

Description of Alternatives		Potential Project Financing			
		Private Boater		Public	
Type of Improvements	Existing or Additional Boats Accommodated	Additional Fees	Additional Investment	Revenue Bonds Repaid by User Fees	General Fund
Little Harbor III Wentworth Marina expansion and dredging	337 add'l. slips	$352/slip/yr. $98/slip/yr. $246/slip/yr. $65/slip/yr.	- - - -	$1,184,725 dredge 331,500 revet. 552,200 floats 219,050 pkg. $2,287,475	- - - -
Little Harbor IV Fort Dearborn Marina and dredging	102 add'l. mrgs. 224 add'l. slips	$442/boat/yr. - $257/slip/yr. $277/boat/yr.	- - $400/add'l. mrgs. -	$1,439,600 dredge 383,760 floats - 86,450 pkg. $1,909,810	- $370,500 revet. - 86,450 pkg. $456,950
Back Channel I dredge and fill for parking to access unused mooring area	186 add'l. mrgs.	$30/yr. per mrg. $16/yr. per mrg.	- - $400/mrg.	$55,000 dredge/pkg. 30,225 pkg. - $85,225	$55,000 dredge/pkg. 30,225 pkg. - $85,225
Back Channel IIA	201 add'l. mrgs.	$263/mrg./yr. (all back channel mrgs.) $16/mrg/yr. -	- $400/mrg. - -	$1,019,000 dredge/fill - 32,825 pkg. - $1,051,825	- - $ 32,825 pkg. 780,000 $812,825
Back Channel IIB	482 add'l. slips.	$160/slip - $139/slip $32/yr. pkg. -	- - - - -	$ 773,000 dredge/fill - 668,000 floats 156,850 pkg. - $1,597,850	- $ 234,000 revet. - 156,850 pkg. 780,000 road $1,170,850

Figure 8

Evaluation of Potential Recreational Boating Improvements
in Relation to Project Financing Considerations
(Continued)

Description of Alternatives		Potential Project Financing			
		Private Boater		Public	
Type of Improvements	Existing or Additional Boats Accommodated	Additional Fees	Additional Investment	Revenue Bonds Repaid by User Fees	General Fund
Piscataqua I realign moorings	30 add'l. mrgs.	- $16/yr./mrg.	$400/mrg. -	- $4,875 pkg. $4,875	- $4,875 pkg. $4,875
Piscataqua II expanded Portsmouth Marina	30 add'l slips	$225/slip $65/slip	- -	$45,000 floats 19,500 pkg. $64,500	- -
Piscataqua III new Pierce Island Marina, dredging and parking	243 slips	$32/slip $300/slip $100/slip - $455/slip	- - - - -	$ 78,975 pkg. 486,000 floats 243,000 dredge - 455,525 blkhd. $1,263,500	$ 78,975 pkg. - - 234,000 revet. 455,525 blkhd. $768,500
Piscataqua IV access road, parking, and platform mooring at Gypsum Cove	52 add'l. mrgs.	- $16/mrg./yr. - -	- - - $1,500/mrg.	- $8,450 pkg. - - $8,450	$10,000 pier 8,450 pkg. 48,000 road - $66,450
Great Bay I access agreements or new access and parking for existing mooring areas	100 add'l. mrgs.	- $16/mrg./yr.	$400/mrg. -	- $17,750 pkg. $17,750	- $17,750 pkg. $17,750
Great Bay II marina expansion and dredging	100 add'l. slips	$297/slip $50/slip	- -	$220,000 floats/pkg. 50,000 dredge $270,000	- -

- Dredging costs for channels and harbor entrances would continue to be shared by the state and federal governments and supported by the general tax base.

- Dredging costs for mooring areas and marinas would be eligible for state revenue bond financing through the Port Authority or other state agency with an assumed tax-exempt interest rate of 8% over the projects life (20 years). Bonding would have to be supported by additional mooring fees or marina changes.

- Public parking costs would be 50% financed out of the state's general fund (or federal grants) and the remaining 50% would be eligible for state revenue bond financing through the Port Authority or other state agency with an assumed tax-exempt interest rate of 8% over the projects useful life (20 years). Bonding would have to be supported by additional parking fees, mooring fees, marina charges, or lease revenues.

- Private marina parking costs would be eligible for 100% revenue bond financing as outlined above.

- The costs of floats, piers, gangways, etc. would be eligible for 100% revenue bond financing through the Port Authority or other state agency with an assumed tax exempt interest rate of 8% over the project's useful life (10 years).

- The costs of public access roads and public launch ramps would be paid paid for out of the state's general fund (or federal grant).

- The costs of marine protection improvements (moles, bulkheads) would be 50% financed out of the state's general fund (or federal grants) and the remaining 50% would be eligible for state revenue bond financing through the Port Authority or other state agency with an assumed interest rate of 8% over the projects useful life (20 years). Bonds would have to be supported by user fees, charges or lease revenues paid by those benefitting from the improvements.

- The costs of revetments would be paid for out of the state's general fund where they improved state owned lands, and would be eligible for 100% tax-exempt revenue bond financing through the Port Authority or other state agency where they were on private property associated associated with a major recreational boating improvement. Assumed interest rates would again be 8% over the project's useful life.

These figures tabulated in Figure 8 reflect these public financing assumptions. While many alternative financing procedures are possible, these assumptions were judged to present a good basis for evaluating financial feasiblity and more detailed financial feasibility and more detailed financial arrangements that might in the future be adopted by the Port Authority and the state.

b. Potential Private Boater Financing

In order to further assess financial feasibility and the implications of the public financing assumptions outlined above, the additional private user fees and investments needed to support the alternative projects are also tabulated in Figure 8. Required fees would range from an additional $16 to $50 per year for moorings (primarily to offset 50% of the cost of parking improvements) to $400 to $950 per year for slips (to offset marina construction and dredging costs).

These fees and charges would represent substantial increases over current rates in New Hampshire but appear comparable to those at nearby Maine and Massachusetts harbors. While far smaller fee increases have been quite controversial in the past, it is our view that fees of this magnitude do not preclude financial feasibility--particularly if the revenues generated were dedicated to needed recreational boating improvements.

V. IMPLEMENTATION RECOMMENDATIONS

A. Recommended Improvement Program

In this section of our report we have presented our recommendations for the prioritizing and phasing of recreational boating improvements in the tidal waters of New Hampshire. These improvements, designed to meet the current and projected recreational boating needs as identified in Sections II and III, were evaluated in relation to several criteria in Section IV. Based on these evaluations and an assessment of both overall and individual harbor needs, we have developed a list of prioritized recreational boating improvements and phasing as illustrated in Figures 9 and 10.

1. For the first three years (Phase I) we have recommended full implementation of approximately $600,000 worth of recreational boating improvements consisting largely of improved access and parking for realigned moorings in existing deepwater areas of Rye Harbor, Little Harbor and behind Goat Island in Portsmouth/New Castle. These three major projects combined with minor realignments and improvements in Great Bay and Hampton/Seabrook would provide a total of an estimated 518 additional permanent moorings on the New Hampshire coastline--accommodating approximately 45-60% of the estimated additional 1985 need for these facilities. It is recommended that the total cost of these improvements be financed by private investment of $233,000 (for mooring tackle, etc.) by $179,000 of state issued, tax exempt revenue bonds finance primarily by mooring fee increases of $10 to $25 per year, and by $186,000 of state funded public improvements

FIGURE 9 PHASE I RECOMMENDATIONS

PHASE I-1981-1984	DESCRIPTION			POTENTIAL FINANCING		
	Existing Boats	Additional Boats	Cost	Private Investment	State Revenue Bond Financing by User Fees	State/Federal Funded
1. Little Harbor 0,I	50	139	177,500	60,000	57,000	70,050
2. Rye Harbor 0,I	146	18	147,650	21,800	62,925	61,925
3. Back Channel I	3	186	244,850	74,400	85,225	85,225
4. Hampton Seabrook I	310	45	24,500	42,500	-	-
5. Piscataqua I	271	30	21,750	12,100	4,875	4,875
6. Great Bay I	284	100	75,500	40,000	17,750	17,750
TOTAL PHASE I.....		518	$687,750	251,300	228,625	241,625

FIGURE 10 PHASE II RECOMMENDATIONS

PHASE II (1984-1987)	DESCRIPTION: Existing Boats (Incl. Phase I)	DESCRIPTION: Additional Boats	DESCRIPTION: Additional Costs	POTENTIAL FINANCING: Private Investment	POTENTIAL FINANCING: State Revenue Bonds Fin by Lease Rev.	POTENTIAL FINANCING: State/Federal Funded
1. Little Harbor II, or III or IV	189	183 to 337	$1,306,000 to $2,408,000	-	1,305,590 to 2,287,875	0 to 956,950
2. Rye II, III	164	292	1,863,000	-	1,405,600	418,000
3. Piscataqua II	301	30	64,500	-	69,500	-
4. Hampton-Seabrook 0, II, or III	355	70	687,320	20,000	671,500	9,750
PHASE II Total		575 to 729	$3,921,000 to $5,023,000	$20,000	$ 3,447,000 to 4,429,000	$427,750to $884,700

(for access improvements and parts of the parking). We have also recommended initation of design and engineering work on at least two new privately operated marinas in the northwest corner of Rye Harbor and at the Wentworth Hotel and of possible marina expansion at Portsmouth Yacht Club or Hampton Marina.

2. For the second three years (Phase II, 1984-1987) we have recommended implementation of the marina developments and expansions initiated in Phase I--assuming the needs continue to grow sufficiently to justify the needs for these facilities at that time. These facilities and associated dredging and marine safety improvements would cost an estimated $3.7 to $4.8 million (in 1980 $) with an estimated $376,000 to $790,000 to be funded by the state and an additional $3,279,000 to $3,940,000 to be financed by state issued tax exempt revenue bonds backed by lease revenues equivalent to an estimated $350,000 to $450,000 per year or about $600 per additional slip per year. These improvements would accommodate an estimated 575-729 slips and together with existing facilities and the Phase I improvements could, therefore, accommodate 80-90% of the estimated 1990 need.

B. Recommended Action Plan

In order to implement the recommended strategies and two-phased improvement program for recreational boating on the New Hampshire coastline, we recommend that the Port Authority and the State of New Hampshire pursue the following six point action program.

Recommended Action Plan

1. Establish a special improvement fund for recreational boating with revenues accruing from specially dedicated mooring fees, launch ramp fees, parking fees, etc. associated with recreational boating.

   - Obtain authorizing legislation to use this fund for funding or or financing all or part of the following types of recreational boating improvements--parking areas, launch ramps, dinghy docks and storage, revetments, breakwaters, and dredging for recreational boats.

   - Obtain authorizing legislation to pledge revenues from this fund to back tax exempt revenue bonds to be issued by the Port Authority or State of New Hampshire. Such authorizing legislation should also provide for revenue bond financing of marina improvements.

- Adopt a new annual fee schedule of $2 per foot for mooring permits. All fees in excess of $15 per year would be dedicated to the special capital improvement fund for recreational boating. Annual non-resident fees should also be established at $5 per foot.

- Adopt a parking fee or permit schedule for special parking/access facilities at Fort Dearborn, Rye Harbor, Goat Island, Hampton and other facilities which may be develped. This permit/fee schedule should be equivalent to $10 per year or $1 per use ($4 per use for cars with trailers). The permit and special sticker program could be administered by either the Port Authority or DRED with enforcement and collection of use fees administered by DRED. All permit and use fees should be dedicated to the special capital improvement fund for recreational boating.

2. Adopt a six year capital improvement program providing for recreational boating improvements and additional mooring/marina capacity for 1000 to 1200 boats.

- After public review and Port Authority consideration of the evaluation and prioritization of improvements in this report, a capital improvement program should be adopted by the Port Authority reflecting a realistic assessment of needs, opportunities, constraints and financial resources.

- After adoption by the Port Authority, the capital improvement program for recreational boating should be acted upon by the Office of State Planning and incorporated into other agency programs (e.g., DRED and Public Works).

- Annually revise the capital improvement program to reflect changing needs, opportunities, constraints, and financial resources.

- Annually update the needs assessments based on waiting list information and updated data on population and boat registrations.

3. Adopt a set of mooring equipment, alignment and management standards to be followed by the harbor masters and recreational boaters.

- Alignment standards should be established in officially designated mooring areas with public access and should reflect the specific depths and tidal range of the area with spacing being additionally determined by the length of boat.

- Equipment standards should be adopted which reflect the need in higher density mooring areas to assure stable moorings and secure tackle. Anchor weights varying by material (because of varying displaced weights) and type (e.g., granite blocks vs. mushroom anchors) should be adopted and mooring tackle should be inspected regularly to assure adequate size and condition.

- Mooring management standards should be adopted which establish clear rules for waiting list administration. People abandoning moorings should be given priorities on future waiting lists but long-term mooring rentals or vacancies should not be permitted. A mooring plan for each harbor area should be maintained showing the location of each mooring, the size of boat, and the swing radius (based on tidal range, boat length, and tackle).

4. Proceed immediately with priority improvement projects in an intensive effort to adequately accommodate all boaters who have been on mooring waiting lists.

- Proceed with realignment of moorings in Rye Harbor, Little Harbor, and on the Piscataqua River, increasing the densities and assuring that the deepest waters are reserved for deep-draft boats with powerboats being assigned to shallower waters.

- Harbor masters should submit an alignment plan to the Port Authority for administrative authorization consistent with standards adopted in Recommendation #3.

- Relocate the Witch Creek Launch Ramp to the other Fort Dearborn location that would provide suitable access to the existing Little Harbor mooring area. Provide for limited immediate parking (possibly unimproved) with back-up facilities to include the current Witch Creek parking lot and other underutilized Ordiorne State Park parking facilities.

- Initiate specific programs at Fort Dearborn (with DRED), at Goat Island (with Department of Public Works and Highways) and at Rye Harbor (with DRED) to assure adequate access and parking improvements as soon as possible in these areas.

5. Enter into agreements with appropriate agencies and commercial facilities in order to accommodate and facilitate plan implementation, including the following:

- DRED to provide access through Ordiorne State Park and allow capital and management improvements at Rye Harbor (parking lot and land use), Hampton Harbor (State Pier parking lot) and Ordiorne State Park (ramp, parking lot and other improvements).

- State Department of Public Works and Highways for access and development of of parking facilities adjacent to Goat Island Causeway.

- Private marina operators (e.g., Great Bay Marina) for improvements and expansion of facilities and increased mooring access.

6. Adopt a long-range strategy for improving recreational boating on the New Hampshire coastline.

- The Port Authority should adopt a long-range strategy for improving recreational boating, incorporating the material developed in this study and reflecting policy and program recommendations developed as a result of public review of this study.

- This strategy should be coordinated with DRED Master Plans for coastal areas, reflecting the need to accommodate mixed use with minimal conflicts. The Office of State Planning should act to assure its incorporation in other State Master Plans.

PART II

HARBOR BY HARBOR INVENTORY AND ANALYSIS

The basis for much of the analysis in Part I is a detailed harbor by harbor inventory of all boating facilities in each of the New Hampshire coastal harbors. While the focus of this study was on needs and demand of the New Hampshire coastline as a whole, this inventory was initiated in the early stages of the study to evaluate the existing facilities and physical conditions in each of the harbor areas. The findings of this inventory are presented in this section of the report and the facilities inventory is summarized in Table 1. The harbor areas covered are:

- Hampton/Seabrook Harbors
- Rye Harbor
- Little Harbor
- Lower Piscataqua River/Back Channel
- Great and Little Bays

I. HAMPTON AND SEABROOK HARBORS

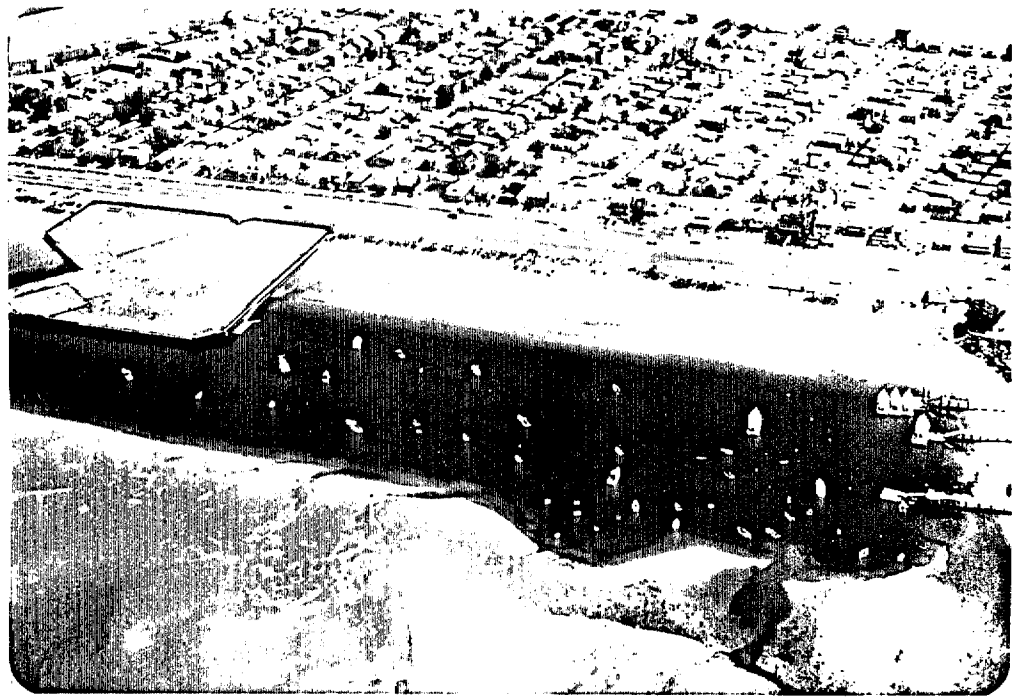
A. Physical Description

Hampton and Seabrook Harbors, shown in Figures 1 and 2, are the first protected harbor areas on the southern end of New Hampshire's seacoast. The entrance channel is a fairly narrow passage (50 feet wide) with occasionally dangerous currents which occur during extreme tides and are compounded as a result of the confluence of the Hampton and Blackwater Rivers in the Harbors. Rocks in the entrance channel area and in other parts of the two harbors also represent hazards.

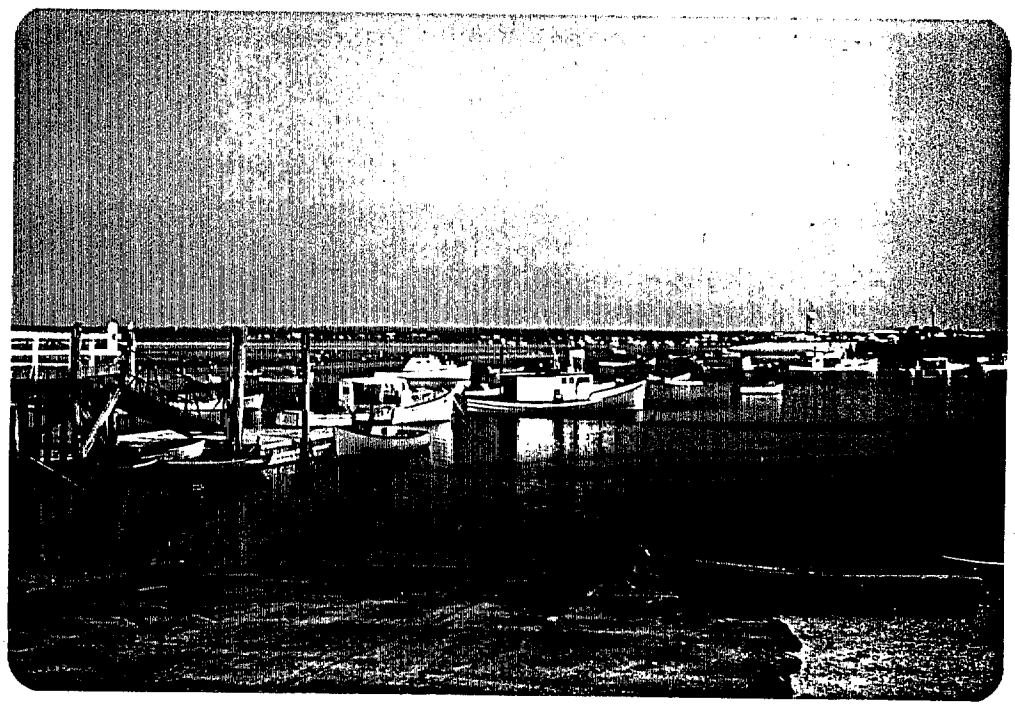
A major constraining physical characteristic throughout these harbors is the shallow water depth. Additional factors which compound the problem include the hazardous nature of the harbor entrance, land access limitations, and deficiences in navigational aids.

The Corps of Engineers is responsible for dredging the channel entrance up to the Route 1A bridge. The most recent project was completed in 1977 and the channel is scheduled to be dredged again in the summer of 1981. The Route 1A highway bridge with its 40-foot bascule span has a clearance of 18 feet at mean high water. The combination of relatively high currents, shallow (and shifting) bottom depths, and the effects of heavy seasonal highway traffic on drawbridge operations virtually precludes the development of sail boating in the harbor.

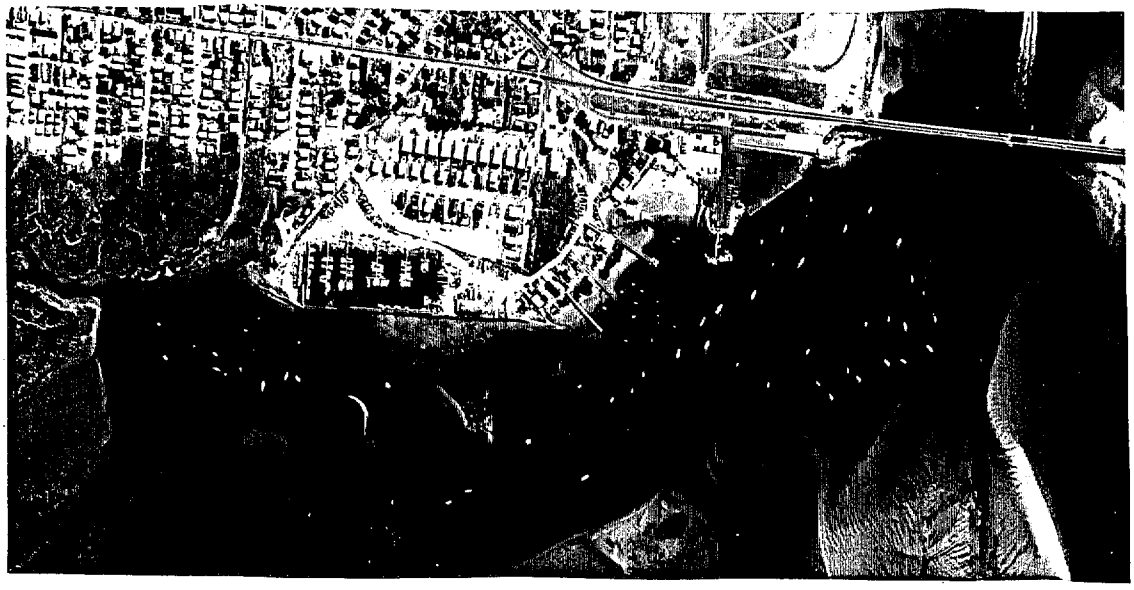
Seabrook Harbor,
September 1978



Seabrook Harbor, July 1980

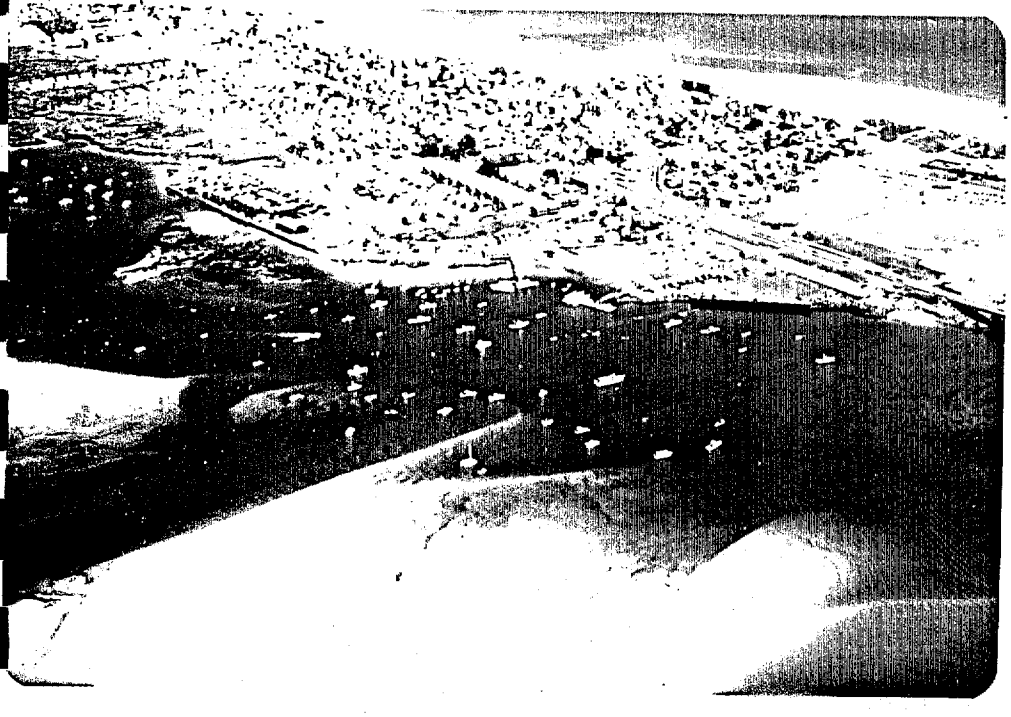


Seabrook Boat Ramp, July 1980



Hampton Harbor, September 1978

Hampton Harbor,
July 1980



Hampton Beach Marina,
July 1980

Except for isolated occurrences of rock ledges (including some in the entrance channel), most of the harbor bottom is comprised of clean sand or sand mixed with mud. Though there may be small, isolated areas where contaminants typical of harbors used for boating purposes are found; in general, the sediments are not heavily polluted, and are suitable for use as fill or for beach nourishment.

The inner harbor areas of both Seabrook and Hampton rapidly shoal after dredging. At mean low water, the north-south channel just above the mooring area is narrow (20 feet to 30 feet) and shallow (3 feet). Similarly shoaling occurs in Hampton Harbor on the edge of the central mooring area, in the area adjacent to the Hampton Bay Marina and in the channel leading to the Hampton Landing Boat Club.

B. Land Access

Seabrook and Hampton Harbors provide ample public access to moored boats and for boat launchings. The Hampton Beach Marina and the Hampton Landing Boat Club are the primary private facilities in the area. Dinghies tied to the float at the State Fish Pier in Hampton Harbor and beached on the shores of both harbors are the main transport for owners to their moored boats. Of the two improved boat ramps in Hampton and Seabrook Harbors, only the latter is constrained by lack of parking for out of town ramp users.

C. Boating Facilities

Because of unique, somewhat limiting physical characteristics, Hampton and Seabrook Harbors cater primarily to a commercial and semi-commercial fishing boat population. Seabrook Harbor is used almost exclusively by commercial fishermen and commercial party boat owners, while Hampton has a large proportion of commercial fishing boats as well as a number of strictly recreational boats scattered through the several harbor mooring and tie-up areas. The commercial boats in both Harbors range in size from 15-foot outboard motor skiffs to 35- to 40-foot inboard motor vessels; associated drafts are between 0.5 and 4 feet. The party boats in both harbors (five in Seabrook and seven in Hampton) range in size from 30 to 70 feet, drawing 3.5 to 5 feet. While most of the recreational boats are 15 to 20 foot outboards, there are several larger inboard cruisers. There is one sailboat, roughly 28 feet in length, in Seabrook moored close to the mouth of the Blackwater River.

Seabrook Harbor accommodates up to approximately 70 moored boats. In July of 1980, 55 were moored in the main harbor and three were moored at the mouth of the Blackwater River. There are no marina facilities in in Seabrook Harbor. There is one improved boat ramp with limited parking (10-15 cars with trailors; Seabrook residents only) in the harbor proper; the ramp is adjacent to the dinghy float (see Figure 1). There are two unimproved ramps upstream on the Blackwater River which are infrequently used.

The Public Service Company of New Hampshire constructed a pier as a support facility for construction of the Seabrook Power Plant. After project completion, the pier will become the property of the State of New Hampshire.

Hampton Harbor accommodates 200 to 300 moored boats at any one time depending upon the location and demand. Approximately 100 boats are moored in the area adjacent to the State Fish Pier; all except one are commercial or semi-commercial fishing vessels. About 40 are over 25 feet in length, including Gauron's four party boats (30 to 35 feet long). The mooring area provides 3 feet to 4 feet of water at mean low water. Except for the party vessels (which are on private piers), the State pier provides access to these boats. Although the public parking lot at the State Pier is full during most weekends, those familiar with the area feel that it has sufficient capacity. The party boat operators provide their own parking.

There are approximately 30 moorings in front of Hampton Marina, 10 of which are monitored by the operator. These latter are accessed by owners' dinghies which are kept inside the marina. The remainder are accessed through the State Pier. There are currently three small boats at the Willows. All are reached by dinghy from the adjacent shore. There are no parking facilities at the Willows and use of moorings are restricted to residents of the Willows. Roughly 20 small boats are moored off of Eastman Point. Parking is unavailable so moorings are also restricted to residents.

The Hampton Landing Boat Club and adjacent mooring area is located upstream on Nudds Canal from the central Harbor. The area accommodates 40 to 50 boats on moorings in addition to the 30 slips and a boat ramp. The moorings are accessible by dinghy which are tied to the Club's float or stored near the club house. Weekend parking at the facility is deemed adequate by club members.

Located roughly two miles north of Great Boar's Head on the unprotected coast, Plaice Cove accommodates roughly 40 smaller boats. The vessels are predominantly sailboats (Hobie cats, daysailers, etc.) and small outboards which are easily brought up on shore in the event of a major storm. Access to the boats is from the beach and moorings are restricted to residents.

The Hampton Beach Marina is the only private marina facility in the Hampton-Seabrook area. It has slips for approximately 100 boats ranging in size from 10 feet (outboards) to 35 feet or 40 feet (power cruisers). The entrance channel to the west of the marina and portions of the interior of the marina have shoaled in to one or two feet depths at mean low water. The facility has a boat ramp. The marina has the only gas and diesel pumps, and marine maintenance service in the area and sells marine supplies.

D. Area Boating Needs

In the summer of 1980 there were 38 boats on the Seabrook Harbor waiting list and 47 on the Hampton Harbor waiting list. Over the course of the boating season the Hampton harbormaster has usually been able to accommodate those remaining on this list who have not found accommodation elsewhere or simply dropped off the list.[1]

The principal need in both Hampton and Seabrook Harbors appears to be improved harbor maintenance by dredging of shoaled areas. The shared entrance channel under the Route 1A bridge, the narrow neck leading to the interior of Seabrook Harbor, the outer edges of Hampton Harbor mooring areas and channels, and the channel leading to the Hampton Landing Boat Club commonly experience shoaling. Their physical constraint inhibits marine activity for commercial fishing boats and recreational boats alike.

E. Opportunities for Improvement

Dredging east of the Route 1A Bridge in the entrance channel to Seabrook and Hampton Harbor is the responsibility of the U.S. Army Corps of Engineers. In the summer of 1981 the Corps will dredge 60,000 cubic yards of material from this location depositing it on the coastal beach south of the harbor entrance.

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[1] Many boat owners are on Hampton Harbor waiting list as a second alternative.

Maintenance of the interior of Hampton and Seabrook Harbors is the responsibility of the State of New Hampshire. Because dredging is a costly operation ($5. to $15. per cubic yard of material), it is to the advantage of those requiring dredging minimizing the costs of projects by combining a dredging project with other dredging or land improvement projects. The mobilization costs for a dredging operation are ∿ $15,000; if inner harbor dredging were scheduled immediately following the Corps entrance channel project, for example, the mobilization costs could be saved or shared. If the dredged material is of sufficient quality to be used to supplant beach erosion or construction fill, the dredging project can serve dual purposes, with additional benefits realized aesthetically or through the sale of dredged material.

The Hampton Beach marina is the only full service marina facility in the Hampton-Seabrook area providing fuel, maintenance, marine supplies, slips, winter storage and a boat ramp. The primary need associated with this facility is its poor physical condition. Because the marina offers the full complement of services it is the natural alternative to meet growing recreational marina needs and could do so if it were upgraded. The slip area and parking could be enlarged to accommodate additional vessels; the slip area could be dredged to accommodate a more varied boat population; and the exterior sea walls could be rebuilt to afford more protection. The marina is privately operated; bank loans or state assistance in the form of loans or tax incentives would be required to stimulate this improvement.

The Public Service Company's pier in Seabrook Harbor will become the property of the State following completion of the Seabrook construction project. Because that will occur 3 years to 10 years from the present time, it is appropriate to begin considering the opportunities offered by the facilities for the future. The Hampton Beach Marina is an existing maintenance and marina facility serving the community; an additional marina facility would not be required at the Public Service site unless an increased demand could be demonstrated. A viable alternative for the site would be as a fish pier serving commercial fishermen as a loading/unloading facility. This would provide a location for commercial fishing activity separate from recreational boating traffic in Hampton Harbor.

II. RYE HARBOR

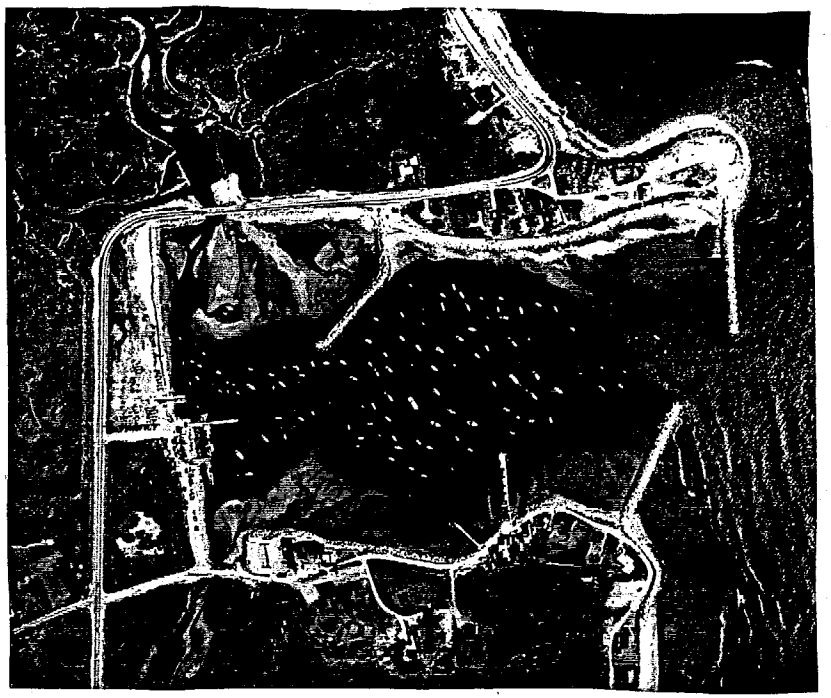
A. Harbor Description and Inventory

Rye Harbor is a natural cove located approximately 13 miles north of the mouth of the Merrimack River and 5 miles south of Portsmouth Harbor. Although two breakwaters were built on the north and south sides of the mouth of the harbor in the 1950's, the entrance is exposed and has an outcrop of rocks just south of the channel as illustrated in Figure 3 . The inner harbor is well protected, 39 acres in size , and surrounded primarily by state-owned land. The entrance channel is 200 feet wide and has a Corps of Engineers authorized depth of 8 feet. This was most recently dredged in 1963 and 1964. The project area included a 5 acre mooring area at a 6 foot depth and a 5 acre mooring area at an 8 foot depth.

Because of the low land surrounding Rye Harbor and the close proximity of the mooring area to the ocean, it is a fairly exposed harbor which at times experiences adverse weather conditions. These physical characteristics are a principal constraint to existing and potential additional boating activity in Rye Harbor. Adverse weather and physical conditions affecting Rye Harbor such as tides, waves, winds, and storms make it less protected shelter for boats than Little Harbor or the inner portions of Hampton and Seabrook Harbors. The mean range of the tides is 8.5 feet and the spring range is 9.8 feet.

Waves are commonly generated by easterly winds which approach the New Hampshire coast from the Atlantic Ocean and the Gulf of Maine. The Isles of Shoals, located about 7 miles offshore, afford a minor amount of protection from

Rye Harbor, July 1980



Rye Harbor, September 1978

Rye Harbor Boat Ramp, July 1980

large ocean waves. Short period waves and long period swells from the east and southeast are modified and deflected by numerous shoals on the Continental Shelf. Cape Ann is approximately 20 miles south of Rye Harbor; it affords protection against waves generated by southerly winds. Although there are no wave measurements available for the immediate area, users have observed waves 3 feet to 6 feet in height in the harbor during storms or periods of high winds from the easterly, northeasterly and southeasterly directions.

The U.S. Weather Bureau at Boston and at Portland, Maine reported that for the years 1949 through 1958, inclusive, the prevailing winds blow offshore from the westerly direction. There is little difference of duration of the prevailing winds between the northwest and southwest quadrants. The majority of prevailing winds blow at speeds between 8 and 24 miles/hour for the longest duration. Winds from the easterly direction occurring approximatley 1/3 of the time generate waves that affect the New Hampshire coast. The duration of easterly winds is greatest from the northeast quadrant. The most severe gales blow from the northeast.

The United States Weather Bureau records indicate that 50% of the 160 storms that occurred during a 75 year period (1870-1945) blow from the northeast. These were significant disturbances of long duration with high winds. These storms caused shore inundation, the battering of seawalls by wave attack, and washing and blowing of debris and sand onto coastal roads resulting in flood damages to low lying shore developments.

Some areas of the Corps authorized project area have been overlain with sands and silts since the dredging in 1964. Depths range from 6 feet to 8 feet in the entrance and southern mooring area to as low as 3 feet to 5 feet in other areas. Most of the bottom materials are silts and mud on the south side with more granular materials, snads, and silts on the north side and in the northwest corner.

B. Land Access

Much of the land bordering Rye Harbor is owned by the State of New Hampshire. This includes the entire western side and much of the northern side. The south side is both commercial land (Saunder's Restaurant) and residential land. The northern side of the harbor also has some residential land.

Most of the access to boats moored and utilizing Rye Harbor is through the State fish pier and adjacent boat ramp. Dinghies are tied to floats, are on nearby outhauls or are beached on the northeast shore. The only private pier is operated by Steven Foss on the southeastern side of the harbor.

C. Boating Facilities

The Harbor currently accommodates approximately 142 boats on moorings and outhauls. These range in size from 15-foot skiffs to 65-foot commercial party boats. The drafts of the commercial party boats are 5 to 5.5 feet, and the drafts of the sailboats are up to 6 feet. Over the last 30 to 40

years the population of commercial fishing and lobster boats has been stable with the population of recreational boaters gradually increasing.

There is currently no marina facility in Rye Harbor although Steven Foss maintains a private dock in the southeast corner of the Harbor which permanently accommodates six boats (sail and power).

No moorings are designated for transient vessels although the Harbormaster can usually accommodate three to five visiting boats on temporarily vacant moorings; other transients raft up with moored boats. A total of 30 to 40 boats per week visit the Harbor in peak season (15 to 20 midweek and 15 to 20 on weekends). Vessels can tie up for a limited stay at the State Pier. Both gas and diesel fuel are available at this site, as is fresh water. No maintenance or service facilities are available in Rye Harbor.

There is one boat ramp in Rye Harbor and it is one of the most frequently used on the New Hampshire coast. Between 25 and 30 boats use the ramp daily on the weekends with 5 to 15 boats launching daily during the week. The ramp is constructed of long concrete slabs with a grout and gravel filler between slabs.

Parking is reportedly adequate for most Rye Harbor users. On peak, mid-summer weekends, the unpaved portion of the lot becomes overcrowded at times due to the lack of formally designated parking spaces.

D. Area Boating Needs

Rye Harbor currently has one of the largest waiting lists on the New Hampshire coast with 146 boat owners. Although the size of the list is somewhat misleading because some of the waiting listees are also on the other harbor area waiting lists, the list indicates that there is a significant demand for boating accommodations in Rye Harbor.

Rye Harbor's principal attraction is its close proximity to ocean waters, lack of bridge constraints and relatively deep waters for sail boats. While these qualities are more suitable for sailors and many commerical fisherman than Hampton and Seabrook Harbors to the south, Rye Harbor does not afford the protection from high winds, waves and storms that is found in Little Harbor or within Seabrook and Hampton Harbors. These physical constraints are discussed in section A above. These physical conditions require careful attention when considering alternatives to meet the demand for additional accommodations.

Rye Harbor is likely to continue to be a popular harbor on the New Hampshire coastline. Because recreational boating is a growing activity and because the commercial fishing population has stablized, the demand for accommodation will probably be by recreational sailors and power boaters. The opportunities to satisfy these demands must be evaluated within the context of Rye Harbor's physical characteristics.

The opportunities for satisfying Rye Harbor's needs are presented in Figure 4 and include:

- Realigning existing moorings, strategically placing different categories of boats, upgrading mooring management and adding up to 20 additional moorings.

- Building shoreline facilities (slips) for the commercial party boats on the southeast side in order to ease traffic at the State Fish Pier and provide additional mooring capacity; and build a second ramp next to the existing one to facilitate maneuvering (one ramp in, one out).

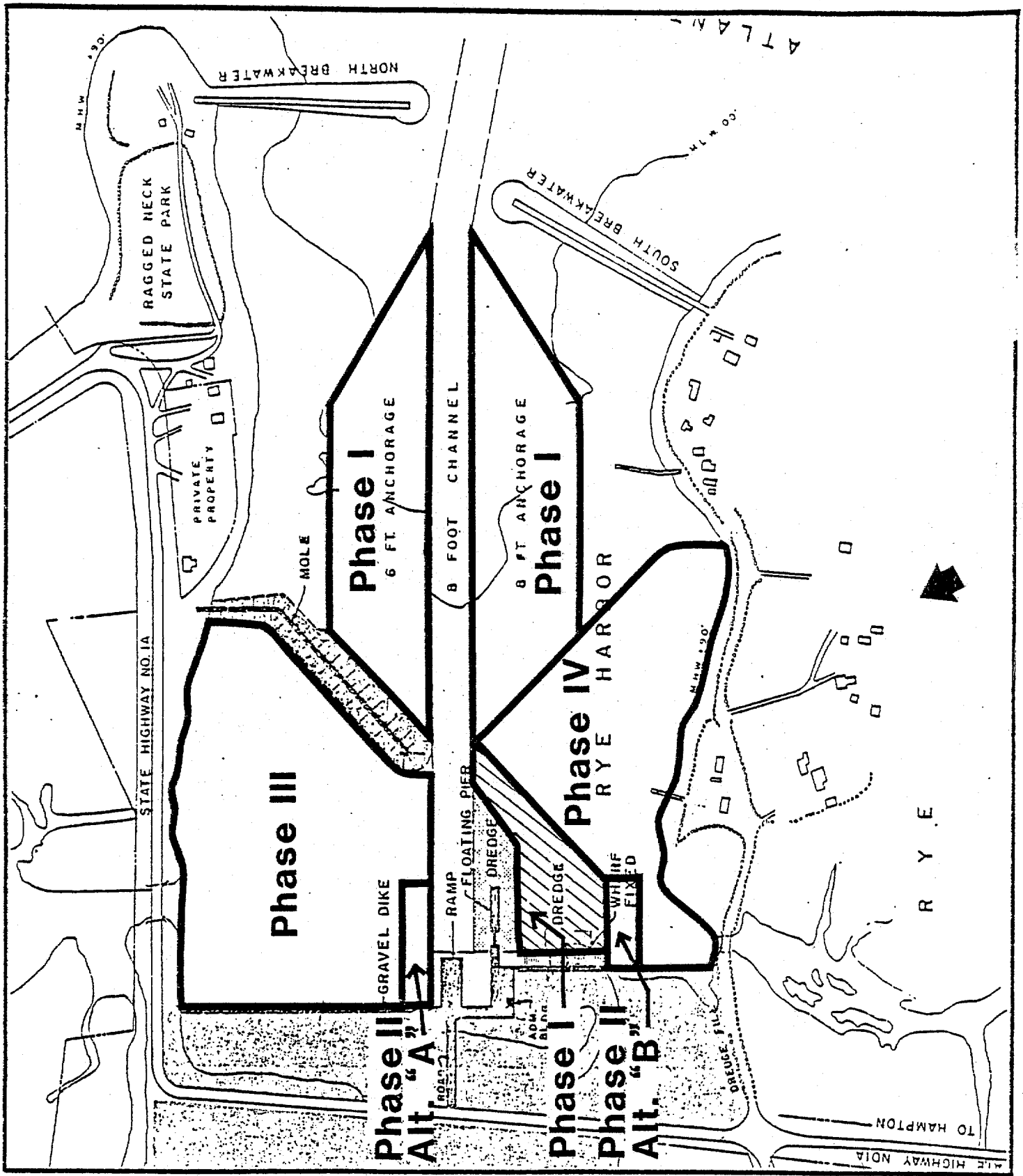
- Building a public marina (possibly leased to private operator) on the northeast corner of the harbor and dredging the south side of the harbor to enlarge the mooring area.

- Building a private marina on the south side (this alternative would require construction of a breakwater to protect the facility and additional dredging).

These are discussed more fully in the engineering evaluation prepared by Sasaki associates.

E. Evaluation of Improvement Opportunity

The opportunities listed above are presented in approximate order of increasing cost. Because the bottom materials are sands and silts of a quality which is likely to pass Corps of Engineers standards, dredging would be a feasible alternative particularly if a Rye Harbor dredging project were to be combined with another dredging project.



Rye Harbor
Development Phases

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Planning · Architecture · Landscape Architecture
Civil Engineering · Environmental Services

New Hampshire Coastal Study
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F. Implementation Recommendation

Rye Harbor is one of the more heavily utilized harbor areas along the New Hampshire coastline. Although significant demand for additional facilities has been identified, the harbor is currently filled close to its capacity without major alteration to the existing shoreline.

Two initial adjustments which would slightly ease the current demand are: realignment and upgrading management of existing moorings; and relocation of the three commercial party boats to shoreside slips. Both alternatives would provide space for an additional 10 to 30 boats (depending on boat size and mooring configuration). Relocation of the party boats would allow them permanent dock space for loading and unloading of passengers and supplies and would make the state fish pier more available to fishing and recreational boats. The cost of these alternatives are high. If an additional 5 to 10 boats took the place of the relocated party boats, the costs of the new moorings would be borne by the additional boats served ($400 to $800 per mooring). Additional mooring fees could contribute to the relocation costs (new slips at $169,000 to $179,000): 10 moorings at $100/year to possibly $300/year mooring permit fee would provide an income to the Port Authority of $1000 to $3000. If the slip construction of $169,000 to $179,000 were paid over a 20 year life (annual payments of $17,220 to $18,240), the mooring revenue would only provide a small contribution to those costs. Realignment of moorings at $340 each represent an annual cost of $85 over 5 years at an interest rate of 8%.

These alternatives would only satisfy a fraction of the demand, however. Additional moorings on the south side would require dredging. The total annual cost per boat would be $3370[1]. This alternative would only yield 44 additional spaces.

In conclusion, the low density additional mooring alternatives will be difficult to justify economically. High density marinas such as Rye development phase III incur more reasonable per-boat-costs at $8,460 each. Slip rentals of $30 to 40 per foot would be sufficient to pay off these costs over 20 years. The main drawback for this alternative would be the introduction of an additional 283 boats into an already densely populated harbor. Future harbor traffic under such conditions would be chaotic and potentially dangerous, particularly in rough sea conditions which occur not infrequently within the harbor. For these reasons, these alternatives should be considered carefully in comparison to development alternatives in less densely populated, more protected areas such as Little Harbor.

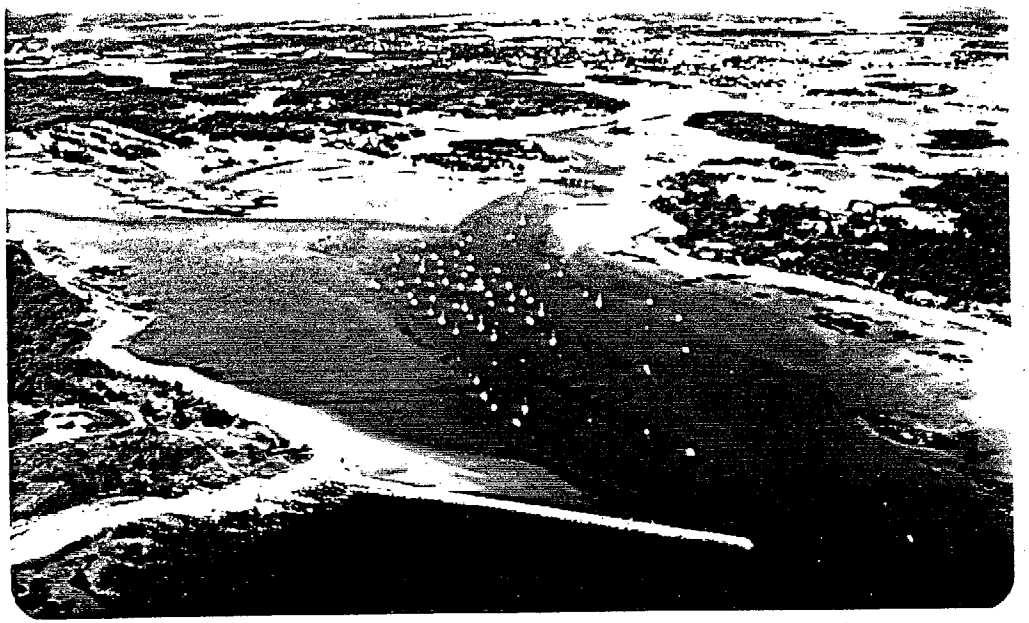
[1] $33,100 over 20 years at 8%.

IV. LITTLE HARBOR

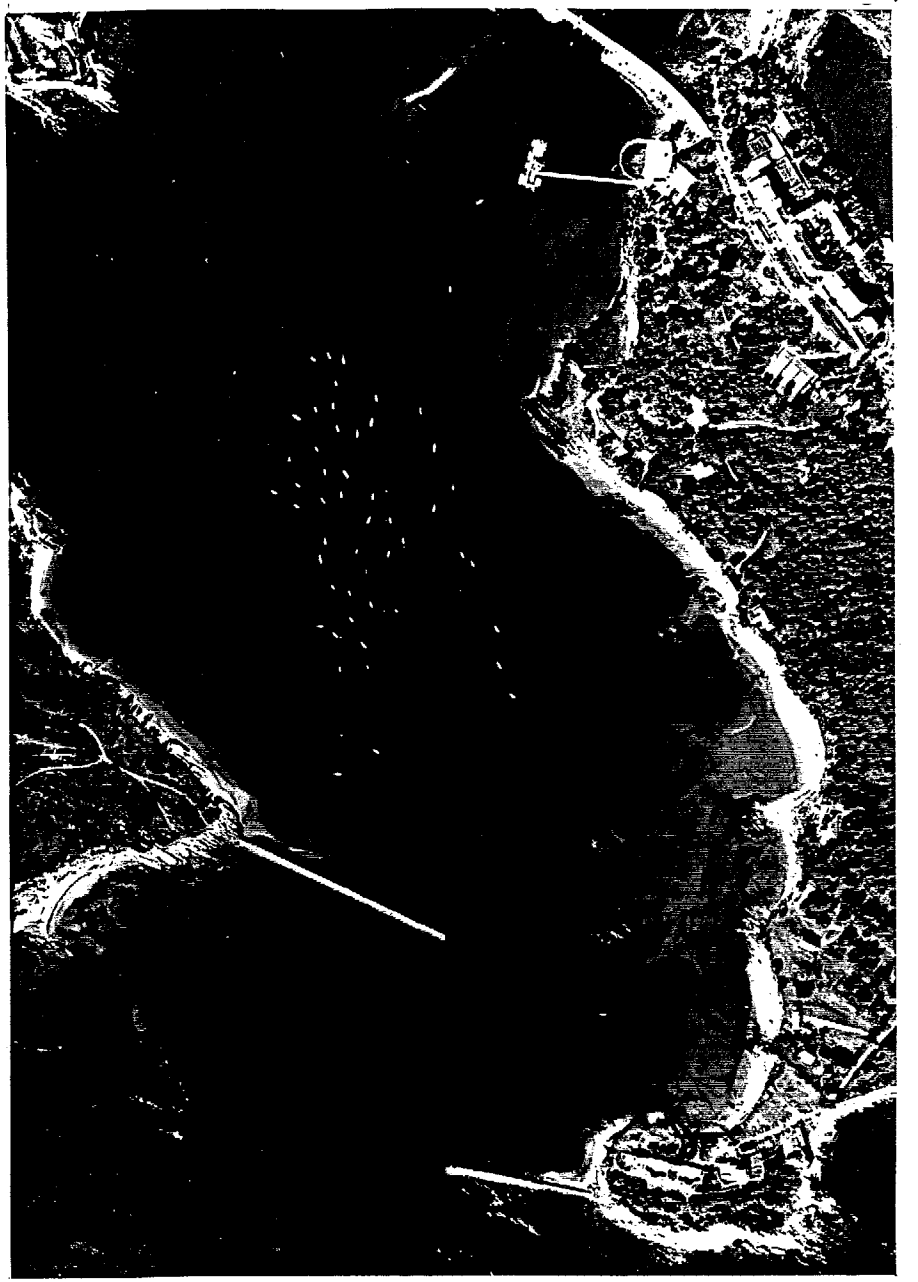
a. Physical Description

Little Harbor is the first harbor of refuge for deep draft boats from Newburyport towards Maine. The harbor forms the southern boundary of the Island of Newcastle and is bisected by the Rye-Newcastle town line. The main entrance to little Harbor is guarded by two small jetties and faces east in the approach to Portsmouth Harbor. The entrance is relatively free of hazards and the projecting jetties were upgraded in the 1960's. The harbor entrance is significantly safer than those at Rye and Hampton-Seabrook Harbors. From the harbor entrance a marked channel of about 9' in depth extends through the unmanned bascule bridge. This connects the harbor with recently improved Sagamore Creek Channel to Mike's Marina, upstream, and through the Back Channel area to the Piscataqua River.

As shown in Figure 5 the harbor is approximately 70 acres at mean low tide of which 40 acres is an improved Corps of Engineers project area with an authorized depth of 12'. This area was last dredged in 1903 when the 26 acre mooring area was established. The Corps of Engineers has conducted surveys in the harbor as recently as 1979-1980. Water depths in the harbor were measured in March 1981 and range from 16' near the harbor entrance to 6-12' in most of the mooring area. Substantial tidal flats exist to the west on both sides of Witch Creek. This is an extremely shallow creek which drains to large wetland areas inland of Odiorne State Park. As part of this study, subbottom profiling was



Little Harbor, July 1980



Little Harbor, September 1978

Little Harbor Mooring Area, July 1980

conducted indicating significant ledge and relatively shallow bedrock (i.e., 6' and less below mean low water) in the area west of the Wentworth Pier and in the area of Sheafe's Point and Fort Dearborn as well as on the northern side of the harbor where rock out crops are most visible. Bottom samples tested in April 1981 indicate

Probings indicate that fine sands, mud and clays are the prevailing bottom conditions throughout the harbor.

b. Land Access

The property surrounding Little Harbor is largely owned by the State of New Hampshire (Fort Stark on the north side and Fort Dearborn/Odiorne Point on the south side) and by the Wentworth Hotel (golf course and hotel site). Public land access to the harbor for boating is currently severely limited. Some boaters obtain access through the Wentworth Hotel Pier. Parking is limited and the required membership cost for the Wentworth Yacht Club is relatively expensive by comparison to mooring permit fees. Other boaters can get land access to the harbor at the unimproved Witch Creek launch ramp but this facility is rarely used due to the extremely shallow water conditions. Future plans for both the Wentworth Hotel (recently purchased by Swiss Air) and the state owned properties at Fort Stark and Fort Dearborn are uncertain at this time, but there appears to be the potential for significantly expanded boater access to Little Harbor from both the public and the private shorelines.

c. Boating Facilities

Current boating facilities of Little Harbor include the unimproved Witch Creek launch ramp, the Wentworth Hotel Pier (including lockers and dinghy storage) and the Corps dredged mooring area and channel. As noted above the public Witch Creek launch ramp and 40 to 50 car parking lot is infrequently utilized (estimated at less than 10 launchings per month). This is largely due to the poor location and the extensive mud flats and shallow waters at Witch Creek (1-3' at mean low water). Because of the Witch Creek inadequacies access to the existing mooring area is currently limited almost exclusively to the Wentworth Pier. While this private pier provides excellent access its use is restricted by high annual membership fees and limited parking. A program to improve the pier and private boating land and shoreline facilities may be pursued by the new owners to complement potential hotel expansion. Public access to the mooring area by Wentworth Pier is therefore likely to remain extremely difficult. The mooring area itself is currently underutilized despite the large number of boats on the waiting list for mooring in the Portsmouth area. In 1980, the estimated 50-60 boats in the Little Harbor mooring area were scattered at a density of approximatley 2 boats per acre. This density is 25% to 50% less than might be optimally achieved considering the existing conditions at Little Harbor. The underutilization of this area is reportedly due to two factors: land access is limited; and the Corps authorized area is underutilized because of considerable silting along the edges of the

area making it too shallow for moored boats. The Corps of Engineers rejected dredging requests for Little Harbor in 1968 because of an inadequate ratio of benefits to project cost.

d. Area Boating Needs and Opportunities

The Portsmouth, Newcastle and Little Harbor areas currently accommodate approximately 450 recreational boats at moorings and marinas. In 1980 there were an additional 142 wait listed in this area. Many have been on the list for several years; others had reportedly taken their name off the list because of the long delays; and some have not even applied. As noted in Part I, considering the probable continuing growth in Southern New Hampshire and current unmet demands there is likely to be a demand for roughtly 300 additional marina or mooring spaces (primarily for sailboats) over the next five years in the Portsmouth, Newcastle and Little Harbor area. Over the following ten years there could be a demand for an additional 200 spaces if the population and boating demand continue to grow as they have been growing and are projected to grow. Facilities to the north (for example, Pepperell Cove) and to the south (for example Rye Harbor) also have long waiting lists and Newburyport, Massachusetts is expected to have one for the first time in 1981. Because the Portsmouth, Newcastle and Little Harbor area is generally considered to have some of the greatest potential for accommodating additional boats--especially sailboats--the area offers an attractive location to meet at least some portion of the demand. Little Harbor, in particular, because of its safety, lack of bridge constraint, public access and location close

to the ocean is often cited as having the greatest potential for additional cost-effective recreational boating facilities for sailboats.

With these potential demands and opportunities in mind several alternatives were explored for accommodating different portions of the demand in Little Harbor. The alternative improvements identified are illustrated in Figure 6 and include:

1) upgraded mooring management and increased moorings for the existing mooring areas;

2) improved public access and parking to serve the existing mooring area and a relocated Witch Creek launch ramp;

3) dredging and expanding mooring areas;

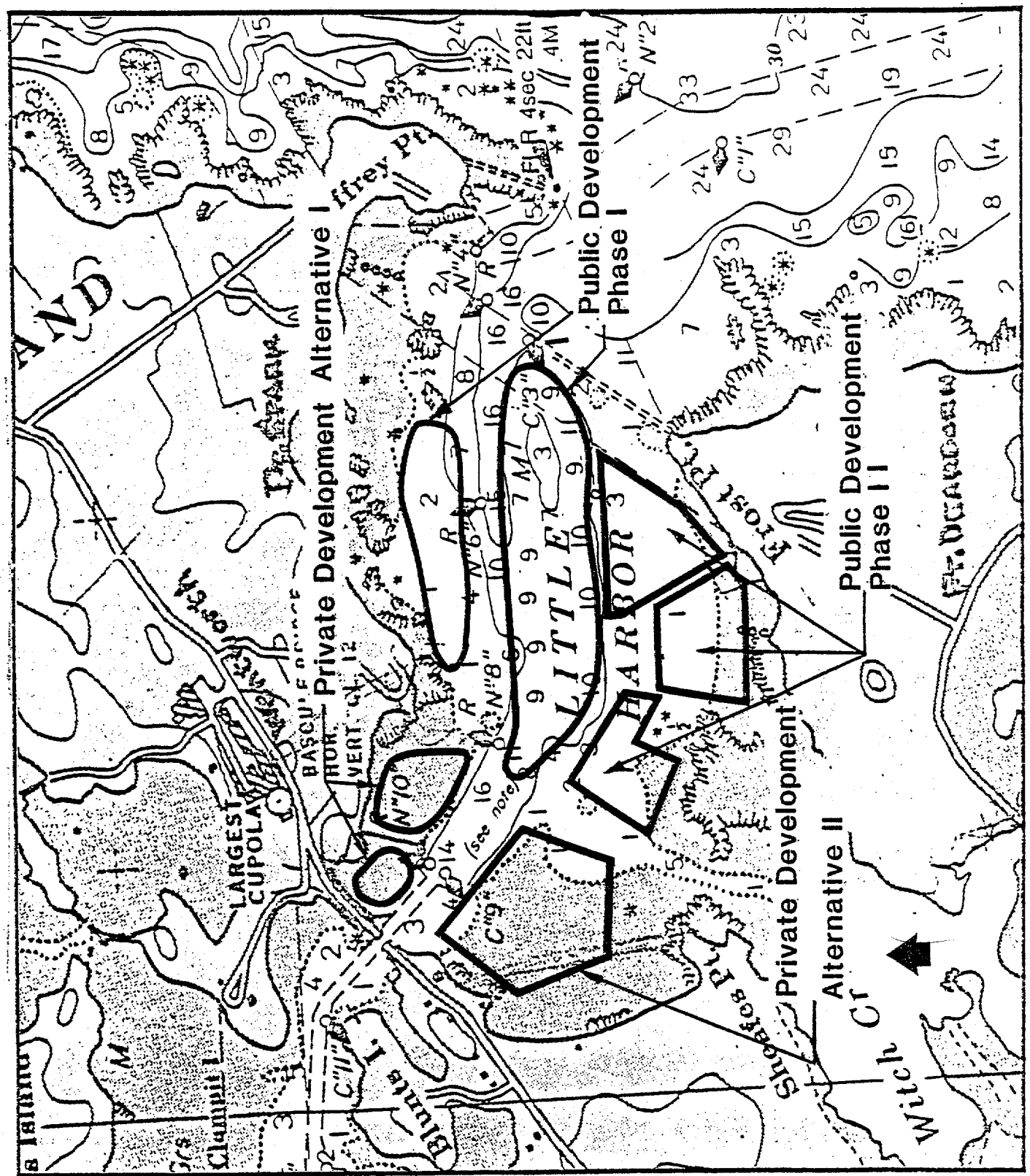
4) dredging and Wentworth Hotel Marina facilities and

5) dredging and Fort Dearborn Marina facilites.

e. Evaluation of Improvement Opportunity

The potential for various improvements to accommodate additional recreational boating in the Little Harbor has been evaluated in relation to physical, economic and institutional factors summarized in Part I, Figures 7 through 9.

Figure 5



Little Harbor

Development Phases

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Planning · Architecture · Landscape Architecture
Civil Engineering · Environmental Services

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f. Implementation Recommendation

The first alternative outline in Part I, Figure 7--upgraded mooring management--accommodates a substantial number of additional boats (40 to 80 depending upon their size) without requiring substantial public expenditures. However, this alternative is not workable without the provision of public access, parking and dinghy storage on the Fort Dearborn side of Little Harbor. A combination of the first two alternatives is what is recommended as the first step to improve recreational boating opportunities for Little Harbor. With an estimated cost of $585 per boat in Little Harbor this step represents a modest investment that could be financed directly by the private boat owners (for upgraded mooring equipment and relocation) and by the state (for the parking facilities, pier and dinghy storage at Fort Dearborn). Park/parking fees of approximately $2.00 per day and dinghy storage fees of approximately $100.00 per season would be sufficient to pay off the full cost of the publicly financed improvement over their estimated 20 year life. Moderately higher mooring permit fees could generage sufficient revenues to finance the share of potentially needed mooring and expansion in the future.

There are limited opportunities for additional moorings along the New Hampshire coast line and it is likely to be extremely difficult to justify substantial dredging for mooring areas alone. It is, therefore, likely that high density marina facilities will present the only way to adequately accommodate long-term boating demand along the New Hampshire coast. Private marina development in the context of the Wentworth Hotel expansion would provide an excellent

opportunity to accommodate a substantial number of additional boats (150 to 200 depending upon their size) with minimal environmental impact and minimal public investment. This is because of the potential economic benefit for the Wentworth Hotel development from both permanent and transient berths and because of the potential fiscal and economic benefits of such a marina to the Portsmouth, Newcastle and Rye area. The type of development characterized as Phase I private development in Figures 7-9 is therefore also strongly recommended for implementation within the next 3-5 years. It is particularly necessary that this option be pursued soon given the substantial additional boating demand likely to arise from the types of resort accommodations being considered for the Wentworth Hotel. Otherwise the additional capacity provided by upgrading mooring management in Little Harbor could be completely offset by the additional demands from development contemplated at the Wentworth. Wentworth Hotel development should therefore be encouraged to provide adequate boating as well as parking accommodations.

Although this private marina development alternative would require substantial dredging of a small area near the Wentworth Pier environmental effects are anticipated to be minimal and the dredge spoil material is expected to be relatively clean. While the cost of this alternative is relatively high (an estimated 1.5 million dollars of investment) and would be equivalent to approximately $8,100 per boat, Wentworth Yacht Club membership fees of approximately $500 per year and slip rentals of $25 per foot would be sufficient to pay off these investments over their estimated 20 year life. Additional charges would be required to support O&M costs but the existence of other Wentworth

Hotel resort facilities should permit a substantial reduction in these charges from what would be required in an independent marina. In summary it is anticipated that a marina facility at this site would be highly cost competitive and would return significant benefits to the Wentworth Hotel, the town and the overall economy. Such a marina would help reduce the pressure on other mooring facilities along the shoreline and would offset the increased recreational boating demand from Wentworth residents and visitors.

Upgraded mooring management and Wentworth Marina development are anticipated to adequately meet short-term requirements for recreational boating in the Little Harbor area but should boating demand continue to increase other improvements will be needed. The additional improvements investigated included substantial dredging for either public or private marina development or additional moorings. These alternative involve substantial higher construction cost ranging from $9,500 to $24,000 per boat. Because of these higher costs, financing would be extremely difficult through private boat owner fees charged to additional boaters alone. While some of these dredging costs could be spread across all boaters and financed by general increases mooring fees or slip rentals, financial feasibility would likely depend upon substantial public assistance to finance at least a portion of the dredging cost.

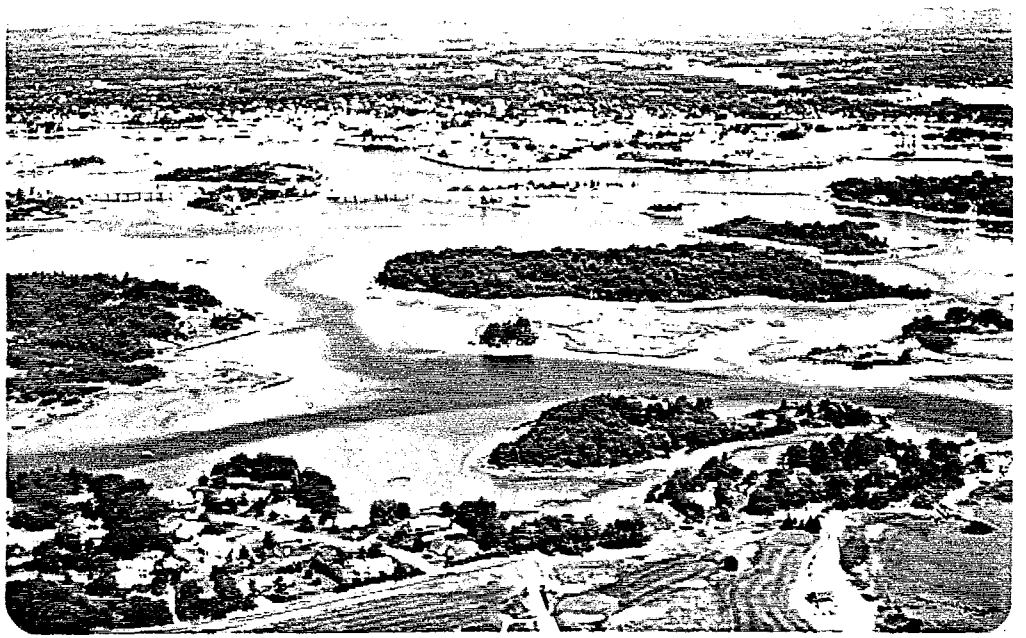
IV. LOWER PISCATAQUA RIVER/BACK CHANNEL

a. Physical Description

The Lower Piscataqua River and Back Channel areas illustrated in Figure 7 include several distinct recreational boating areas, some of which were investigated in the July, 1979 mooring and docking facilities study for Portsmouth.[1] For discussion purposes we have divided the area into four subareas:

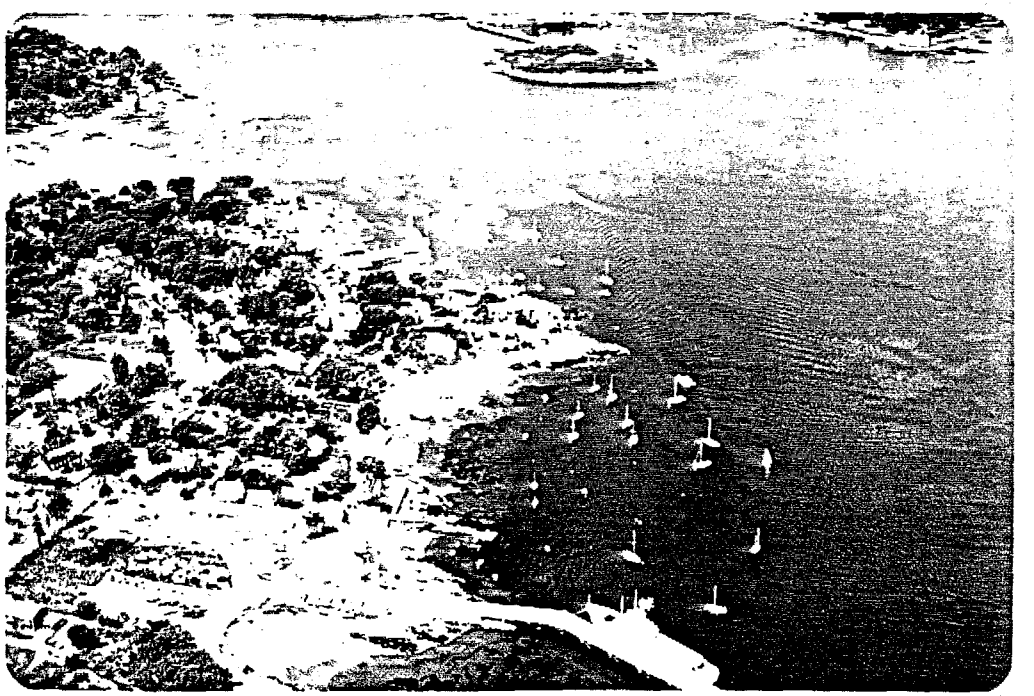
- the Sagamore Creek/Back Channel area;
- the Piscatqua River shoreline off Newcastle and Goat Islands;
- the Pierce Island/Prescott Park area and
- the Piscataqua River shoreline north of the Memorial Bridge

The Sagamore Creek/Bay Channel area is connected to Little Harbor by unmanned by operable bascule bridge with a 12'clearance. It is connected to the Piscataqua River by a fixed bridge with a 14' clearance between Shapleigh and Goat Islands. It is also possible to go through two fixed bridges behind Pierces Island to reach the Piscataqua River. In addition to the 75 to 100' wide and 6' deep channels dredged in 1969, there are two 75' wide anchorage areas (approximately 2 acres) on the Sagamore Creek which were also dredged to 6' at that time. Other than Mike's Marina at the head ot the Sagamore Creek, the only other deepwater in this large area lies between Pest Island and Goat and Shapleigh Islands. There are approximately 20 acres of water with between 7 and 15' of depth at mean low water in this area; some areas are reportedly experiencing minor to moderate silting as a result of



Back Channel and Leach's Island,
July 1980

Portsmouth Yacht Club, July 1980



Newcastle and Coast Guard Pier, July 1980

construction of the Goat Island causeway. Extensive probing taken during a Corps of Engineers survey indicate that the bottom material is largely sand and mud with penetrations by a 3/4" pipe averaging 4 to 8'.

The Piscataqua River areas off Newcastle and Goat Islands vary considerably in their depth, currents, and bottom conditions. In most of these areas the currents are strong and the bottom is scoured, but in some areas such as Hart's Cove, the water is shallow, the currents are weak, and the bottom is not scoured. In addition to the deepwater areas found on the New Hampshire side of the Piscataqua, there are also large areas of deepwater on the Maine side of the river with some such as Pepprell Cove being relatively well protected and free of strong current problems.

The Pierce Island/Prescott Park area also includes areas with widely varying depths, currents and botton conditions ranging from the area between Pierce Island and Portsmouth (where most of the area is exposed at low tide, where currents are minimal, and where bottom conditons are reportedly bedrock with a relatively thin covering of mud and sand) to the area north of Pierce Island (where water depths fall off rapidly, where currents between the island and channel exceed 3 knots, and where bottom conditions are largely exposed bedrock). The area between Pierces Island and Portsmouth is locked by two fixed bridges, but the area to the north of Pierces Island is open to the ocean.

The Piscataqua River areas in Portsmouth River north of the Memorial Bridge have generally strong currents, deepwater, and scoured bedrock. One exception to these conditions is the curve area west of the By-Pass Bridge between the Port Authority and the Gypsum Plant. This cove area was investigated in detail in the 1979 report and was found to have negligible currents, adequate depths for moorings, and botton conditions suitable for pile driving.

b. Land Access

Land Access for recreational boaters represent a serious problem in all of the subareas except Pierce Island/Prescott Park above. In the Sagamore Creek/ Back Channel areas, almost all land near the deepwater areas is privately owned. Land acquisition of landfill would therefore be required to provide adequate parking and access to these areas if they were to be used for additional moorings. The two major publicly owned sites--Leaches Island and the Wentworth Mansion--are not located adjacent to deepwater. Leaches Island represents limited opportunity for improved access to boating areas but would require substantial improvements and easements through the Wentworth property.

Access to the Piscataqua River areas off Newcastle and Goat Islands is also limited with principal private access possibilities existing at the Kittery Point and Portsmouth Yacht Clubs. These two principal private access points both have limited parking although the Portsmouth Yacht Club does have a secondary parking lot in town. Publicly owned shoreline exists at Goat Island

Common and the Coast Guard station but safe deepwater areas suitable for moorings are not generally found near the potential public access points. Public access is also possible at several points where the road runs along the shoreline but parking represents a problem in these areas.

Access to the Piscataqua River in Portsmouth north of the Memorial Bridge is limited by extensive shoreline development and inadequate parking. A launch ramp with public access exists at North Mill Pond but boating opportunities are relatively limited. In the 1979 Mooring and Docking Facilities Study, of the cove area west of the By-Pass Bridge also found major access limitations requiring expensive dredge and fill operations adjacent to the Gypsum Plant or construction of an access road parallel to Market Street which would then require dinghy access through the North Mill Pond and under the Boston and Maine Bridge.

Public access to the Pierce Island/Prescott Park area is generally quite good since both Pierce Island and Prescott Park are publicly owned. The Pierce Island launch ramp is the most heavily used launch ramp on the coast, and parking (while unimproved) appears to be adequate to accommodate current demand. The state fish pier on Pierce Island has also been a major source and may be expanded in the future. Pierce Island provides public access for a number of moorings, and Prescott Park also provides access for a limited number of both slips and moorings.

c. Boating Facilities

These areas include two marinas, two yacht clubs, two public boat launch ramps, extensive moorings along the lower Piscataqua River, and scattered moorings throughout.

In the Sagamore Creek/Back Channel area the major boating facility is Mike's Marina which accommodates approximately 85 boats (primarily powerboats) near the Route 1B Bridge. There are also approximately 35 moorings along Sagamore Creek used primarily by commercial fishermen, and several moorings in the large but relatively inaccessible mooring area between Pest and Goat Islands.

In the Piscataqua River areas off Goat and New Castle Islands there are two private yacht clubs--the Portsmouth Yacht Club with approximately 25 ships and the Kittery Point Yacht Club which has a private pier but no slips. There are several other private piers and docks including one used by commercial fishermen on Shapliegh Island. There are 75 to 100 moorings along this shoreline most of which are sailboats some of which are used by Yacht Club members, others by shoreline property owners and others by the public at large, but access and parking are limited.

In the Pierce Island/Prescott Park area, recreational boating facilities include the Pierce Island launch ramp and an unimproved parking area which is used by approximately 350 to 450 boats per month according to a 1978 survey. There are also about 20 to 25 moorings behind Pierce Island (many of which

are dry at low water) and a small boat marina with about 20 slips. On the river side of Pierce Island there are about 10 moorings as well as the state fish pier with 15-20 commercial fishing boats and the Prescott Park slips for transient boats.

The Upper Piscataqua, Physical Description

The Memorial Bridge (Route 1 vertical lift bridge) crosses the Piscataqua from central Portsmouth to Badgers Island and Kittery. Directly upstream lies the old waterfront of the city which now is partially commercial/residential but also provides facilities for the local tugs and the Granite State Minerals Corp, which imports road salt. Continuing upstream, the Viking of Falmouth Corporation leases the next slip and operates the two passenger vessels providing service to the Isle of Shoals. The Port Authority on Noble's Island lies just below the State Bridge (Route 1 bypass vertical lift bridge).

North Mill Pond is shallow and largely blocked by road and rail crossings. During the urban and commercial development, it has been surrounded by highways and bridge accesses without access of its own. Its shoreline lies in an industrial area. Its entrance into the river lies upstream of the bridge.

North of the bridge lies the berth of the National Gypsum Company plant which manufactures wallboard and handles large specialized bulk gypsum carriers. Above the Route 95 bridge (a full 137-1/2 foot clearance bridge), a cove contains the tanker berth for the Schiller Plant of the Public Service Company of New Hampshire. From there, the west bank of the Piscataqua is devoted to industrial properties and their private berths, including Atlantic Terminals, Sprague, Simplex Wire, C3 (an LPC terminal). This stretch of industrial activity extends along the entire upper reach of the channel up to its upper turning basin off Newington, just below the entrance to Little and Great Bays.

On the Maine side of the river, Spinney's Creek above the bridges is blocked off from the river by the Route 103 roadway to Eliot. On the river side of this roadway across the Creek entrance, Jerry's Marina is a large facility catering mainly to power boats. Otherwise, the Maine shore of Kittery and Eliot above Badgers Island principally is residential.

Upper Piscataqua, Facilities

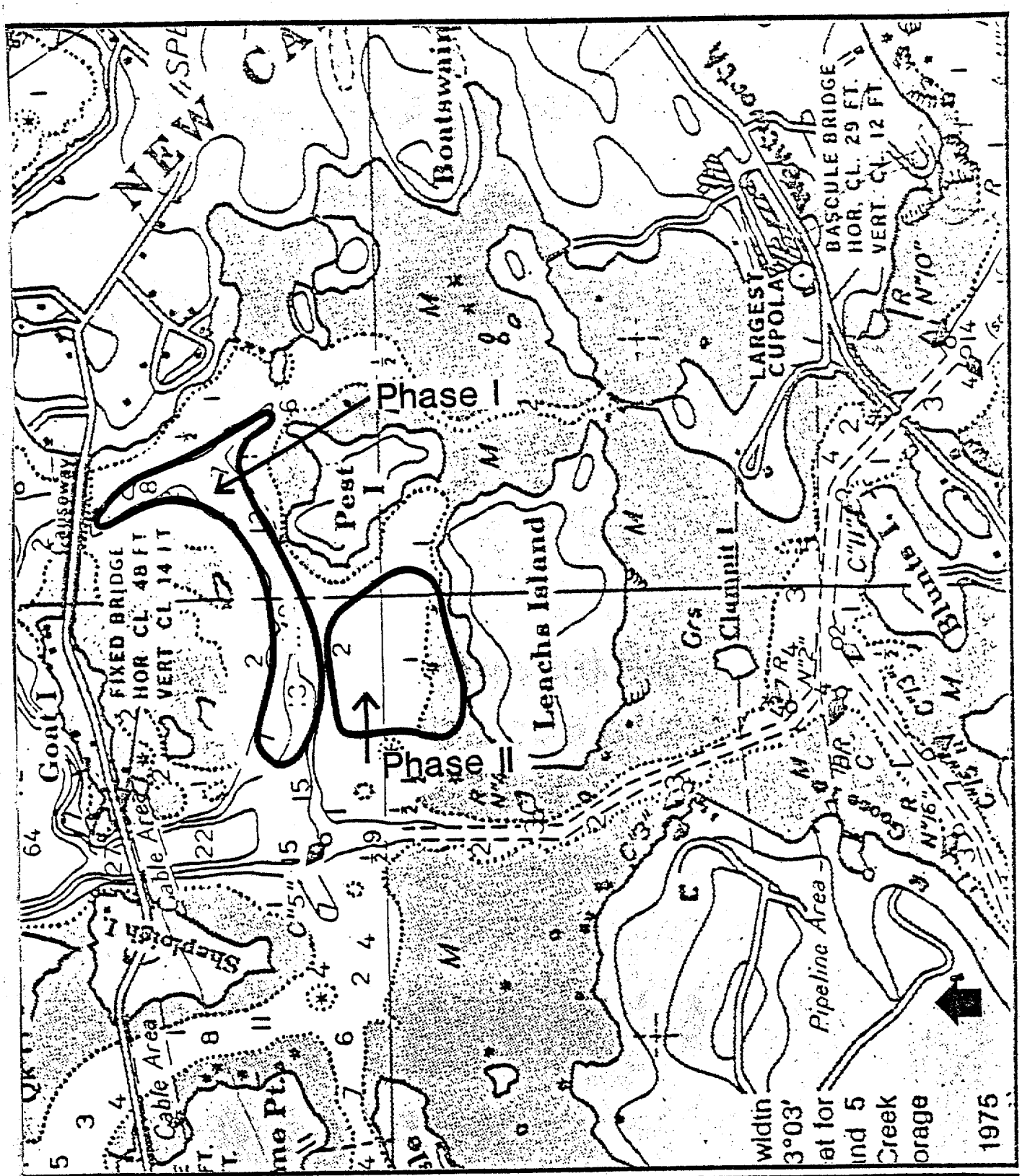
There are no organized public boating facilities in this entire area. On occasion, transient cruising boats may anchor or berth near the old waterfront, or upstream. A few local skiffs and small boats may utilize the sheltered water areas, but there are no launching ramps, marinas or anchorages on the west bank of the river. North Mill Pond contains a ramp and five to ten moorings.

D. Area Boating Needs and Opportunities

As noted in Part I and in the previous discussion of Little Harbor, there is a short-term additional demand for roughly 300 additional marina or mooring spaces over the next five years in the Portsmouth/Newcastle/Little Harbor area plus an additional 200 spaces over the following ten years if population and boating demand continue to grow as they have been. Since boating demand has been shifting increasingly to sailboats, however, the opportunities in these four subareas are severely limited not only by parking and access but also by bridge constraints and strong currents. Potential improvement opportunities which have been identified and investigated in either the 1979 Portsmouth study or this study are illustrated in Figure 8 and include:

1) upgraded mooring management and increased moorings in the existing mooring areas;

2) improved access and parking for existing deepwater areas with expanded moorings;



Back Channel

Leachs Island Development Phases

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Planning · Architecture · Landscape Architecture
Civil Engineering · Environmental Services

New Hampshire Coastal Study
Project No. 0183
Drawn By J.L.
Checked By C.G.S.
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Scale 1":800'

Sheet Number
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3) private marina/yacht club expansion at Kittery Point or Portsmouth Yacht Clubs and

4) private/public marina development at Goat Island or Leaches Island.

E. Evaluation of Improvement Opportunities

The potential for various improvements to accommodate additional recreational boating in the lower Piscataqua River or Back Channel areas has been evaluated in relation to physical, economic, and institutional factors as summarized in Part I, Figures 7 through 9.

F. Implementation Recommendations

The first alternative--upgraded mooring management--could accommodate a limited number of additional boats (25-35) major investments in parking and access improvements without significant public investments but would be needed to further increase mooring capacity in this area. Access to these additional moorings would still depend primarily on membership in Portsmouth and Kittery Point Yacht Clubs although a small number of moorings could be added off Pierce Island.

The second alternative--improved access for existing deepwater areas--could provide for a substantial number of additional moorings (250-300 depending on their size) but these moorings would have to be restricted primarily to power

boats and the construction costs for the parking and access would be relatively high due to the dredge and fill required. The area between Goat Island and Pest Island represents a more desirable and cost-effective solution of this type than the area previously studied at the Gypsum Plant. While restricted primarily to power boat moorings due to the bridges this solution could free up space for sailboats if power boats on Piscataqua River moorings were relocated to this site. The parking/access construction costs and this site are estimated to equal approximately $2,000 additional per boat and would require mooring permit fees of approximatley $100/year for all 350 boats moored off Newcastle, Goat and Pierce Isalnd if costs were to be fully shouldered by boat owners and amortized over a 20 year period at 8%.

The third alternative--expansion of existing yacht club facilites--is more costly than the previous two alternatives. However, the demand at this time is apparently sufficient to justify the additional investment and Portsmouth Yacht Club is currently considering expanded facilities. Investments in expanded capacity at both Kittery Point and Portsmouth Yacht Clubs should be encouraged as a way of reducing the pressure on other public facilities and mooring areas.

The fourth alternative--development of a new private/public marina at Pierce Island or Leache's Island--could accommodate a large number of boats at either Pierce Island (approximately 250 slips) or Leaches Island (up to 900 slips) at an initial construction cost ranging from about $10,000 to $15,000 per boat depending on the size of the marina. In addition to the very high cost

of these options, the problems of currents off Pierce Island and bridge restrictions at Leaches Island make these development potential primarily appropriate for power boats. Because of the high costs of these options and because of the greater demand for sailboat facilities these alternatives are not recommended for further consideration until other alternatives are developed and excess demand becomes strong enough to justify the high constrctuion cost of these options.

Great and Little Bays

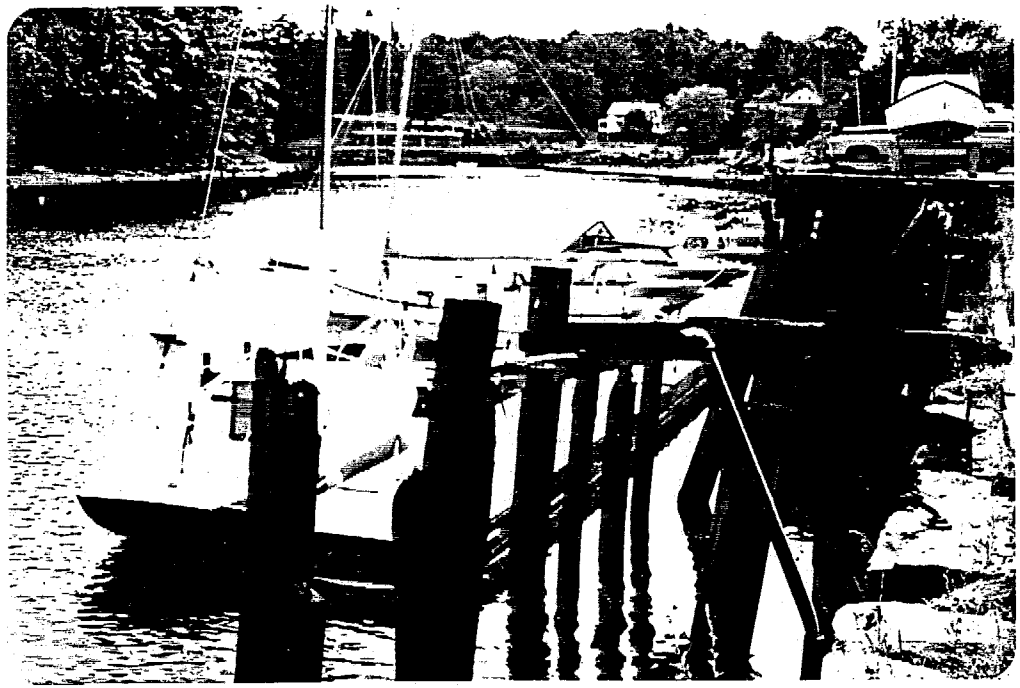
a. Physical Description

Great Bay and Little Bay act as collection points for four of the tributaries of the Piscataqua River (the Lamprey, Squamscott, Oyster and Bellamy Rivers), while the Salmon Falls and Cocheco Rivers join the Piscataqua some four miles above the Bay entrance (see Figure 8). The water flow in these four tributaries is not large and the flushing rate of the Great Bay system due to the rivers is low. However, Great Bay is tidal and has a large area; the resulting cyclic currents at the entrance narrows at Dover Point, reach high velocities and present problems for small craft.

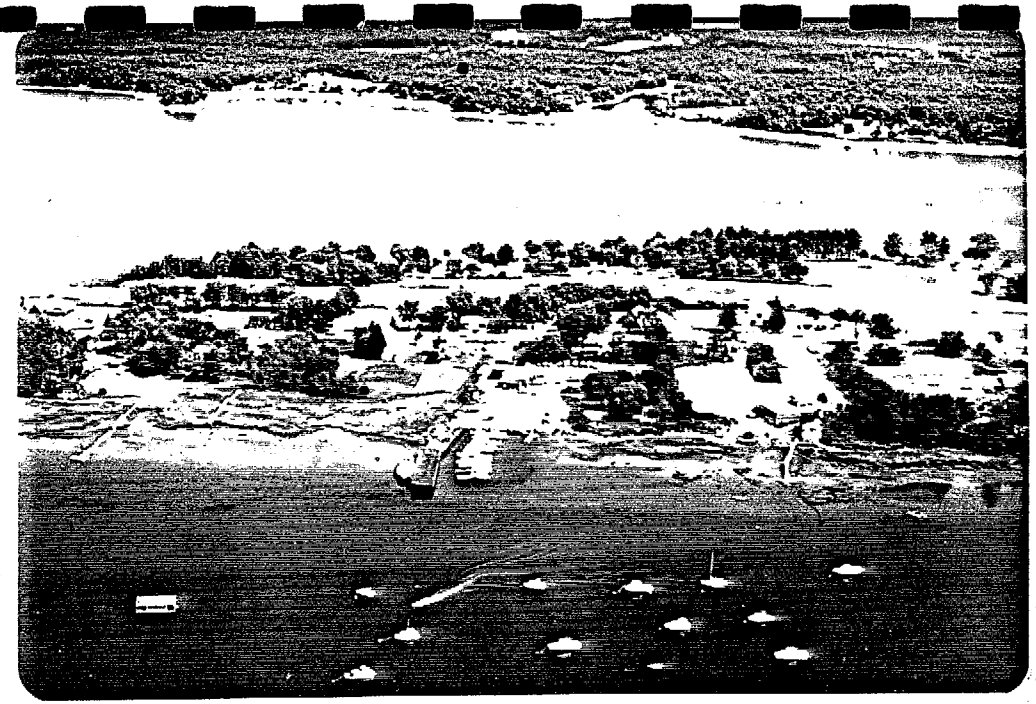
The dredged Piscataqua deepwater channel stops short of Great Bay but the river continues northward past the Bay entrance. The Bay reacts to the tidal level changes in the river as a resonator at its own frequencies. This gives rise to some unusual phase relationships in the flows at the Bay entrance and in the river down to Portsmouth Harbor.

Deep water consists of a channel through Little Bay and about one mile past Adams Point into Great Bay, whereupon it begins to shallow out. It has been described officially as a 200-foot by 12-foot by 5-mile area. Actually, the deeper water is 1000- to 1200-feet wide with a 12-foot depth at the edges and 30-foot depth at midchannel. Deep spots up to 55 feet are reported. Tidal currents keep this channel clear but some gradual silting occurs. There are no deepwater channels leading off this main area.

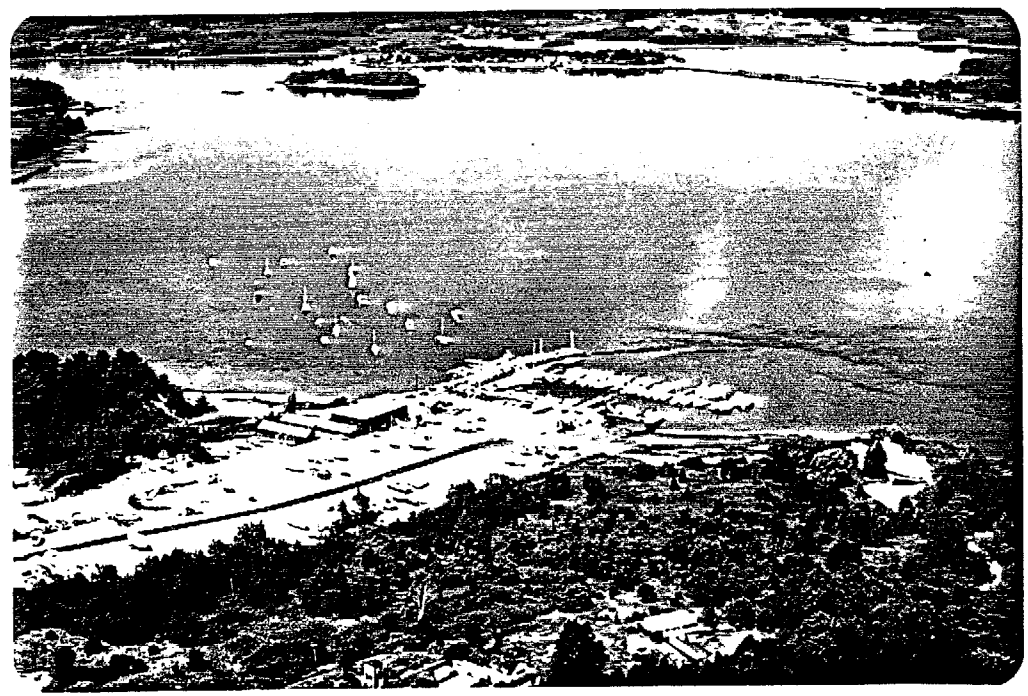
Historically, the Bay was a thoroughfare for the cargoes from the towns of Exeter, Newmarket, Newfield, Durham, and so on, to the port of Portsmouth and vice versa. These cargoes were carried in shallow-draft, wind-propelled gundalows or in other small craft of various types. When this water traffic ceased, the Corps of Engineers dredging projects lapsed and the rivers gradually silted up. Bridges for road and rail began further to block the untravelled waterways.



Newmarket Marina, July 1980



Ben's Marina and Great Bay Yacht Club,
July 1980



Great Bay Marina, July 1980

b. Land Access

Access to the deepwater areas of Great and Little Bays is limited by the extensive shallow waters and tidal mudflats along most of the shoreline, and by the limited public land ownership. The best access to the major mooring areas is from the two major marinas--Great Bay and Benn's--and from a pier at Mike's Bait Shop. State properties providing potential access to deepwater moorings are located at Dover Point and at the end of the Scammel Bridge. Pease Air Force Base also has some shoreline properties with potential access to deepwater mooring areas. Several frequently used town launch ramps exist in the area but only the one at Hilton State Park provides potential access to mooring areas.

C. Recreational Boating Facilities

1. Moorings

The Great Bay Yacht Club owns property on the east or Piscataqua shore of Dover Point and has about 40 moorings. These are utilized primarily by sailboats.

Bellamy Shores is the area on Dover Point near the east end of the Scammel Bridge (Route 4 to Durham). A number of private moorings are located in this area in front of private residences and Mike's Bait Shop has 15 moorings there. Piers go out to usable water depths.

Cedar Point lies on the western end of Scammel Bridge and private moorings are situated close inshore along the properties between highway and Bay. The bottom drops off quickly.

The total number of mooring permits issued by the harbor master now stands close to 275. The waiting list is handled via the Port Authority inasmuch as many applicants prefer moorings in Portsmouth or other shore locations. Except for the blocks of moorings assigned to the marinas, most permits are issued to individuals desiring to keep their boats near their property. With few exceptions, the shoreline of the Great Bay area is privately owned and there is no public access to the shorelines except through the few commercial facilities. About 23 part- and full-time lobstermen operate in the Bay.

There are several other moorings that are located in conjunction with the facilities discussed below.

2. Marinas

Great Bay Marina in Newington has about 60 slips and 40 moorings. The Marina is reportedly the largest winter storage in New England with 400 to 500 boats, but a relatively small proportion operate from the facility in season. A noticeable reduction in powerboat trips downstream has been noted due to fuel costs. The site on Broad Cove is convenient both to the Piscataqua and the Bay.

Benn's Marina lies on the opposite shore of Little Bay on Dover Point and has about 12 moorings and a launching ramp. This is a complete installation with parking space, pier and some 37 slips.

On the Lamprey River: The principal town on the Lamprey is Newmarket. Just below the dam that once provided water power for the granite buildings of the mills, there is a small marina with about 20 small slips and several moorings in the stream. The marina building is constructed on pilings beyond the quaywall since the shoreline is pre-empted by a marginal road in back of industrial buildings. Parking is severely limited. About a quarter of a mile downstream, the Town Ramp is available at high tide. It is a paved ramp and has parking space for only two or three vehicles.

The Squamscott River: There are no facilities above the Route 108 bridge at Newfields which has a 9.5-foot vertical clearance. A small marina called Chapman's Landing is located on the east bank of the river at the bridge and provides a launching ramp. Two or four moorings are situated in the river off the landing. One mile downstream the B&M Railroad bridge across the river has a clearance of 5 feet and prevents boats of any size reaching Chapman's Marina. Chapman's Marina has parking for a dozen cars and lies on the highway. A small town landing is situated in Newfield. The river flow seems to keep sufficient channel open for small boats to reach Great Bay.

On the Cocheco River: At Dover just below the dam, Maglara's Marina has 24 slips and a ramp. The boats are all small inboard or outboard power boats. The marina is located on a steep bank between road and river and has limited parking area. The slips extend out into the channel, but since the marina is at the end of the navigable river, there is no through traffic.

3. Boat Launch Ramps

A small launching ramp is available in Newington for town residents on the Piscataqua. There is parking for about two cars.

Hilton State Park lies just north of the Sullivan Bridge on Dover Point. This is a multi-purpose park which contains a double launching ramp and considerable parking area. The ramps dry out at low tide.

The ramp on the north side of Adams Point is usable only from three hours before to three hours after high tide. Furthermore, the area is open only between 10:00 a.m. and 4:00 p.m., and recreational activities in the Wild Life Area are restricted. There is parking for two or three cars and no support facilities.

Jackson's Landing on the Oyster River at Durham is operated by the University of New Hampshire and has a ramp and a float. The river is badly silted. The UNH boathouse is located at the landing and there is a good sized parking area. Two moorings were in use above the landing but their utility is questionable--one being used by a lobsterboat which probably was grounded out at low tide. The Durham Town Landing has very shallow water with some dozen small moored craft and no hauling facilities. Gilman Park has no usable waterfront.

4. Other Areas

South of Adams Point where the main channel ends, the Bay consists principally of tidal flats and shallows. There are no facilities located in this part of Great Bay.

The Bellamy River lies on the west and south of Dover and contains no boating facilities. The Scammel Bridge, although shown on charts as a bascule bridge, has been unmanned and inoperative for many years, has a 9-foot vertical clearance, and effectively blocks the river. It has been reported that the town has acquired 16 acres of shorefront property on Royalls Cove on the west bank of the river just above the bridge. Provided this cove could be dredged and provided the bridge could be made operative, this area would be a suitable base for beach and boating recreational activities.

The Salmon Falls River forms the boundary between New Hampshire and Maine, and joins with the Cocheco to become the Piscataqua. It is extremely shallow and about one mile above its juncture with the Coheco it is crossed by a fixed highway bridge with a 5-foot vertical clearance.

D. Area Boating Needs and Opportunities

The 46-foot vertical clearance of the General Sullivan Bridge at the entrance to Little Bay and the exceedingly high currents under the bridge restrict sailboat movements in and out of the Bay. These same currents make operation of small boats in the vicinity of the bridge potentially dangerous.

Shallow water discourages the use of large power boats or large sailboats. Fuel costs further prevent extensive operation of power boats from this area to the open ocean. Trailerable small craft desiring ocean trips can utilize Portsmouth, Hampton or Rye. The notoriously severe currents under the Sullivan Bridge coupled with high currents in the Piscataqua discourage regular passages between the Bay and Portsmouth Harbor and make passage for small boats hazardous.

Besides the limits imposed by bridges and dams on the rivers entering Great and Little Bays, the gradual shallowing of these rivers has limited the size of boats that can use them. Furthermore, knowledge of the channels and currents is required for their use; that is, they have become limited to local use and cannot be considered general public boating areas. Boats homeported at Dover or Newmarket may travel down to Portsmouth and back, but few boats out of Portsmouth will venture up to Dover or Newmarket without a local guide on board.

There are adequate deepwater areas in Great Bay to accommodate anticipated demands for moorings in the forseeable future, and the existing marinas have expansion potential should additional demands evolve. The major need in the area is for better access to the existing deepwater areas for additional moorings.

E. Evaluation of Improvement Opportunities

Because of the availability of existing deepwater mooring areas, because of the short waiting lists, and because of expansion potential of existing marinas, the only short-term improvements reviewed related to upgraded mooring managment and improved access to the deepwater mooring areas. Access could be achieved either through existing marinas or through alternative public facilities. Since it would be more cost-effective to provide access through existing facilities such as Great Bay Marina dredging does not appear necessary at the present time although it would be required in the future to support marina expansion.