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THE POTENTIAL EFFECTS OF INCREASING OIL TANKER SIZE ON NARRAGANSETT BAY

An Advisory Report to the
Coastal Resources Management Council

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THE RHODE ISLAND
STATEWIDE PLANNING PROGRAM

265 Melrose Street
Providence, Rhode Island 02907

The Rhode Island Statewide Planning Program, a division of the Department of Administration, is the central planning agency for state government. The work of the Program is guided by the State Planning Council, comprised of state, local and federal representatives. The objectives of the Program are to plan for the physical, economic, and social development of the state; to coordinate the activities of governmental agencies and private individuals and groups within this framework of plans and programs; and to provide planning assistance to the Governor, the General Assembly, and the agencies of state government.

This technical paper is one of a series prepared by the staff of the Statewide Planning Program. These papers present information developed through selected phases of work of the Statewide Planning Program to the program committees and staff, the participating state, local, and federal agencies, and to others interested.

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PREFACE

This brief report outlines the possible ramifications of the growth of the world tanker fleet, both in size and in numbers, and this growth's subsequent effect on Narragansett Bay. An advisory report prepared at the request of the Coastal Resources Management Council, its purpose is to provide information to the Council in a problem area of current concern. Due to time limitations, the data is not as complete as might be desired, but it is felt that the data that has been compiled will be sufficient to give a good indication of possible trends as a result of this growth.

A detailed bibliography is included in this report and is recommended as a source of further development of this topic if deemed necessary.

This paper was prepared by Mr. Thomas A. Conboy, Junior Planner. The graphics were prepared by Mr. Mansuet Giusti and Mr. Peter Ouimette, and the text was typed by Mrs. Vikki Lecuivre.

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INTRODUCTION

The Suez Crisis in June, 1967, forced the major oil companies to look into the feasibility of an alternate route for the shipment of both crude and refined oil products. As a result of this incident and also due to the resultant savings, major oil companies now appear committed to an era of so-called "supertankers". Even if the Suez Canal were to be re-opened and the political climate somehow stabilized, it is doubtful that the oil companies would revert to smaller ships which could pass through Suez fully loaded. The main reason for this lies in the fact that the cost per barrel of oil shipped is greatly reduced by the use of these larger tankers. It now appears that these ships will grow not only in size but also in number and in their percentage of the world's tanker fleet.

As these ships continue to grow, especially in terms of their draft, a re-evaluation of the petroleum traffic on Narragansett Bay is needed to determine what effects this growth will have in the areas of port adequacy, congestion, and possible pollution problems.

PART ONE: TANKER FLEET GROWTH

Although present data is incomplete, there is enough information available to make the following statement: the world tanker fleet is growing in total tonnage at a rapid pace, and the bulk of this growth is being caused more by an increase in tonnage per ship than by an increase in the number of ships themselves. In other words, tankers are growing larger, and are doing so at an increasing rate. There are four reasons for this growth in size:

1) The capital cost for higher payload - it is, up to a point, cheaper per ton to build a very large tanker than a smaller, conventional one.
2) Propulsion costs do not go up proportionately with size.
3) Automation has reduced crew sizes, enabling fewer men to move more oil.
4) The cost per barrel of shipping petroleum products is reduced with the use of larger ships. This point is a reflection of points 1-3 above.

This growth has been a continuous one since the end or World War II. In 1959, more than 37 percent of the world fleet consisted of ships over 25,000 dead-weight tons (dead-weight tons is a measure of everything a ship carries, including cargo, stores, etc., expressed in long tons), and 16 percent were rated at more than 35,000 DWT. By 1964, one-fifth of the world's tankers had capacities of 30,000 DWT and up.

In terms of number of ships, the world tanker fleet in 1971 numbered nearly 4,000 vessels, compared with about 3,200 in 1960. In terms of deadweight tonnage the world fleet grew by 14.8 percent during 1970, compared with 13.2 percent in 1969. The average tonnage of tankers over 10,000 DWT at the end of 1970 was 46,897.

Some 340 new tankers were scheduled for delivery in 1971, with more than 100 of them in the supertanker class of more than 200,000 DWT. This growth in size can be seen in the fact that in 1950, 30,000 tonners were the pride of the fleet. In 1971, a 370,000 DWT tanker was launched and two 447,000 DWT vessels are scheduled to go into service in 1973. It is important to remember that when speaking of these larger ships in the 250,000 to 400,000 DWT class, we are also including Very Large Crude Carriers (VLCC) which, although they play a major part in the oil industry, may be of little significance in future planning for Narragansett Bay in that there are no refineries in the area and the small amounts of crude oil that are brought into the Bay would probably not necessitate the use of a VLCC.

In terms of size, there has been a rapid growth in the average size of the world tanker fleet. The average tonnage of tankers in the 10,000 DWT and over class as of June, 1971, was 50,195 DWT. This compares with only 46,897 DWT six months earlier. New ships delivered in the first half of 1971 averaged 141,693 DWT and vessels on order as of June 30, 1971 averaged 161,534 DWT.

The main reason for this steady growth in size is one of cheaper construction cost and cheaper transportation cost. The following table shows that as ship size increases the cost of construction per ton decreases:

Table 1[1]

SCALE FOR ESTIMATING TANKER CONSTRUCTION COSTS IN THE U.S. (1971)

Deadweight Tonnage	Cost per DWT	Estimated Total Cost
50,000	$409	$20,450,000
100,000	310	31,000,000
200,000	231	46,200,000
300,000	199	59,700,000
400,000	178	71,200,000

The most recent census of the world's tanker fleet available gives figures as of December 31, 1970. The following tables give the age, DWT and draft of the 4,232 tankers in use at that time. It can be seen that the use of larger, deeper ships started in the mid nineteen sixties and has increased, especially in the 200,000 to 249,999 DWT and 250,000 to 299,999 DWT classes.

The John I. Jacobs and Company Ltd. has listed the following tankers being on order as of June, 1971. Again, this breakdown shows that the move towards large ships has not abated and that these ships seem to be firmly entrenched as the heart of the world's future tanker fleet.

This present and future growth of "supertankers" has been spurred not only by the economics of larger ships but also by the fact that both the United States and Europe are finding themselves in the position of having to import more and more oil as their needs increase. It is forecasted that by 1980 the United States will have to import at least 13 million barrels per day, or 55 percent of its

Table 2[2]

TANKERS BUILT 1941-1970
(Weight in Deadweight Tons)

Year Built	Total	Under 20,000	20,000 39,999	40,000 59,999	60,000 79,999	80,000 99,999	100,000 124,999	125,000 149,999	150,000 199,999	200,000 249,999	250,000 299,999	300,000 349,999	350,000 and Over
Prior to 1941	81	78	3										
1941	6	5	1										
1942	20	17	3										
1943	63	42	21										
1944	82	55	27										
1945	98	60	38										
1946	8	7	1										
1947	12	11	1										
1948	20	19	1										
1949	54	30	23	1									
1950	74	45	27	2									
1951	85	62	23	-									
1952	102	77	22	3									
1953	167	112	50	5									
1954	216	141	68	7									
1955	164	103	53	6	2								
1956	145	67	67	9	1	1							
1957	195	74	92	24	2	3							
1958	247	88	111	43	2	3							
1959	247	78	105	55	7	-	2						
1960	202	71	81	44	5	-	1						
1961	167	63	41	54	6	3	-						
1962	169	65	39	51	4	8	1	1					
1963	146	45	13	59	19	8	2	-					
1964	199	47	25	55	48	21	3	-					
1965	209	66	21	28	71	14	9	-					
1966	182	51	14	16	54	25	16	4	1	1			
1967	171	83	11	2	18	30	20	2	4	1			
1968	214	111	25	2	8	18	17	5	12	14	-	2	
1969	265	138	35	3	4	15	10	1	14	37	4	4	
1970	222	86	35	1	6	7	6	8	5	57	11	-	
TOTAL	4,232	1,997	1,077	470	257	156	87	21	36	110	15	6	

Table 3[3]

DRAFTS OF TANKERS BUILT 1941-1970
(Weight in Deadweight Tons)

Draft in Feet	Total	Under 20,000	20,000 39,999	40,000 59,999	60,000 79,999	80,000 99,999	100,000 124,999	125,000 149,999	150,000 199,999	200,000 249,999	250,000 299,999	300,000 349,999	350,000 and Over
10	1	1											
11	3	3											
12	20	20											
13	39	39											
14	90	90											
15	106	106											
16	94	94											
17	108	108											
18	135	135											
19	105	105											
20	139	139											
21	63	63											
22	46	46											
23	16	16											
24	31	31											
25	35	35											
26	34	34											
27	43	43											
28	130	129	1										
29	74	72	2										
30	414	360	54										
31	421	275	146										
32	177	38	138	1									
33	160	7	153	-									
34	155	3	151	1									
35	155	2	150	3									
36	171	-	154	17									
37	114	1	79	33	1								
38	172	-	24	147	1								
39	144	1	20	113	9	1							
40	122	1	4	80	36	1							
41	104	-	1	50	53	-							
42	90	-	--	10	72	8							
43	49	-	-	14	28	7							
44	68	-	-	1	27	37	2	1					
45	21	-	-	-	13	8	-	-					
46	42	-	-	-	11	27	4	-					
47	33	-	-	-	4	21	8	-					
48	24	-	-	-	-	16	8	-					
49	43	-	-	-	2	22	18	1					
50	15	-	-	-	-	4	11	-					
51	15	-	-	-	-	3	12	-					
52	12	-	-	-	-	-	12	-					
53	10	-	-	-	-	-	5	3	2				
54	19	-	-	-	-	1	3	5	3	7			
55	8	-	-	-	-	-	4	3	1	-			
56	9	-	-	-	-	-	-	5	4	-			
57	3	-	-	-	-	-	-	-	3	-			
58	5	-	-	-	-	-	-	-	4	1			
59	9	-	-	-	-	-	-	3	6	-			
60	7	-	-	-	-	-	-	-	5	2			
61	4	-	-	-	-	-	-	-	2	2			
62	49	-	-	-	-	-	-	-	4	45			
63	20	-	-	-	-	-	-	-	-	20			
64	11	-	-	-	-	-	-	-	-	11			
65	15	-	-	-	-	-	-	-	2	6	7		
66	6	-	-	-	-	-	-	-	-	1	5		
67	9	-	-	-	-	-	-	-	-	9	-		
68	8	-	-	-	-	-	-	-	-	6	2		
71	1	-	-	-	-	-	-	-	-	-	1		
81	6	-	-	-	-	-	-	-	-	-	-	6	
TOTAL	4,232	1,997	1,077	470	257	156	87	21	36	110	15	6	0

Table 4[4]

TANKERS ON ORDER AS OF JUNE, 1971

Size Group, DWT	Number	Total DWT
10,000-12,999	4	46,500
13,000-16,999	11	167,900
17,000-19,999	3	55,800
20,000-24,999	39	906,800
25,000-29,999	61	1,679,500
30,000-34,999	31	961,500
35,000-39,999	7	247,800
40,000-44,999	-	-
45,000-49,999	-	-
50,000-59,999	-	-
60,000-69,999	9	616,800
70,000-79,999	-	-
80,000-89,999	5	400,000
90,000-99,999	6	585,300
100,000-124,999	15	1,746,900
125,000-149,999	22	2,931,700
150,000-174,999	3	465,000
175,000-199,999	2	383,400
200,000-249,999	108	24,460,400
250,000-299,999	137	36,311,200
300,000 + Over	16	5,408,400
TOTAL	479	77,374,900

total demand, mainly from the Eastern Hemisphere. By 1985, it is estimated that as much tanker tonnage as now exists in the entire world trade (153 million DWT) will be required to supply U.S. energy import needs alone. A study done for the U.S. Department of Transportation predicts that by 1983 the major routes for transporting oil will be served solely by 300,000-ton to 500,000-ton tankers. Most of today's under 100,000-ton fleet will merely distribute oil to refineries from the central unloading points, or from refineries to markets. The effects of this trend will not be felt immediately in Rhode Island due to such factors as time of construction, expected life of present fleet ships, and the time required to construct new major off-loading points for these larger ships. In terms of planning, this means that Rhode Island should have ample time to investigate this trend and plan for the future.

While this rush to larger, deeper, and wider tankers appears to be unchanged, there are some factors which experts feel will slowly level off this growth. Foremost among these are inflation and construction terms. Shipbuilders are asking for down payments of 10 to 40 percent of the price of a new vessel as tanker construction moves into a seller's market. Some yards want substantial progress payments as well. Inflation has caused cost per DWT to double in the last five years, and some yards are demanding escalation clauses in their contracts.

Another negative factor is the lack of adequate mooring and storage facilities. Most major ports in the U.S. can handle ships having up to 40 foot drafts. None, however, can handle the new breed of tankers requiring more than 70 feet of water.

In response to this problem, Congress has directed the U.S. Army Corps of Engineers to study the construction of Atlantic coast ports which can handle tankers such as the six new ships for which construction contracts were awarded by the federal government in June, 1972. These ships, scheduled for completion in 1975 or 1976, will have drafts of 67 to 70 feet. At the present time only one port in the contiguous 48 states, Seattle, can accommodate these ships.

The Corps of Engineers study will not be completed until June, 1973. However, six sites have been identified as having the best potential: Machias Bay and Casco Bay (Portland), Maine; Raritan Bay (the Port of New York); Delaware Bay and Cape Henlopen, Delaware; and Norfolk, Virginia.

Local regulations, too, are beginning to affect tanker movements into port areas. For example, the State of Delaware has passed a coastal zone law which would prohibit, among other things, the construction of an off-shore terminal facility.

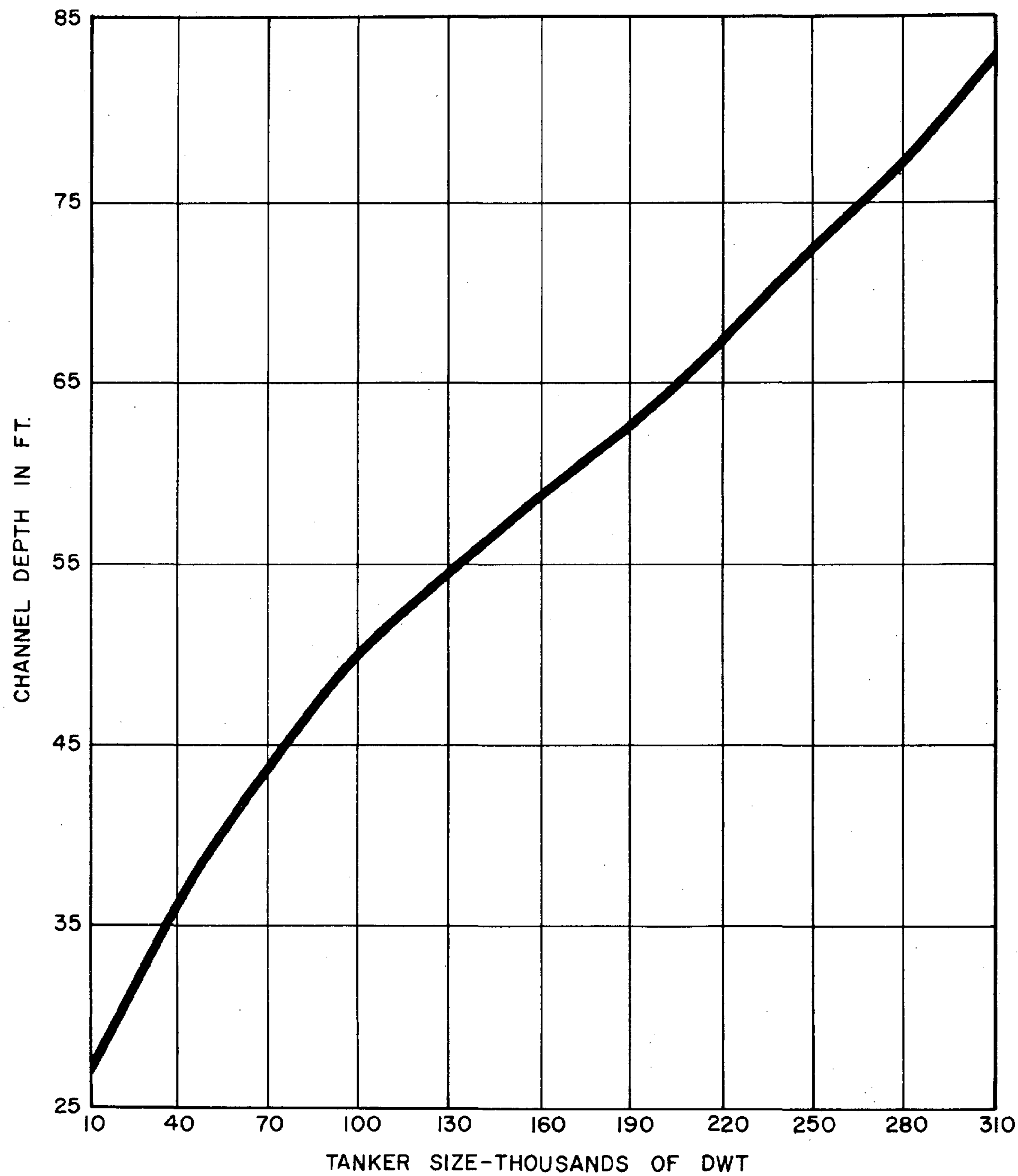
PART TWO: EFFECTS OF FLEET GROWTH ON BAY TRAFFIC

As oil tankers grow larger in total deadweight tons they also increase in another aspect that is critical to traffic on the bay. This critical aspect is one of draft. As can be seen from Tables 2 and 3, oil tankers are being built with greater capacities and resultant deeper drafts. Figure 1 shows the approximate channel depths required as the size of ships increase. While these depth/size comparisons are not exact, they are close enough to serve as a useful guide. It should also be pointed out that for safety purposes channels must generally be 5 to 10 feet deeper than the maximum draft of the vessels using them.

The present traffic on Narragansett Bay consists of both ship-to-shore oil transfers and ship-to-ship, or "lightering", transfers prior to a ship-to-shore operation. The two main channels on the Bay are the Providence River Channel and the Mount Hope Bay-Fall River Harbor Channel, highlighted in Figure 2 in black. The Providence River Channel varies in width from 600 feet to 1,700 feet, with depths ranging from 32.1 feet to 40.0 feet, measured at mean low water. It is 9.4 nautical miles long. The Mount Hope Bay-Fall River Harbor Channel varies in width from 400 feet to 1,100 feet, with depths ranging from 32.0 feet to 37.2 feet, measured at mean low water. It is six nautical miles long. This means that for practical purposes tankers, whether they be ocean-going or "lighters" are restricted to a draft of approximately 35 feet at low tide. Larger ships can use this channel with the size increasing as the

FIGURE 1[5]

CHANNEL DEPTH REQUIRED
FOR VARIOUS TANKER SIZES (DWT)



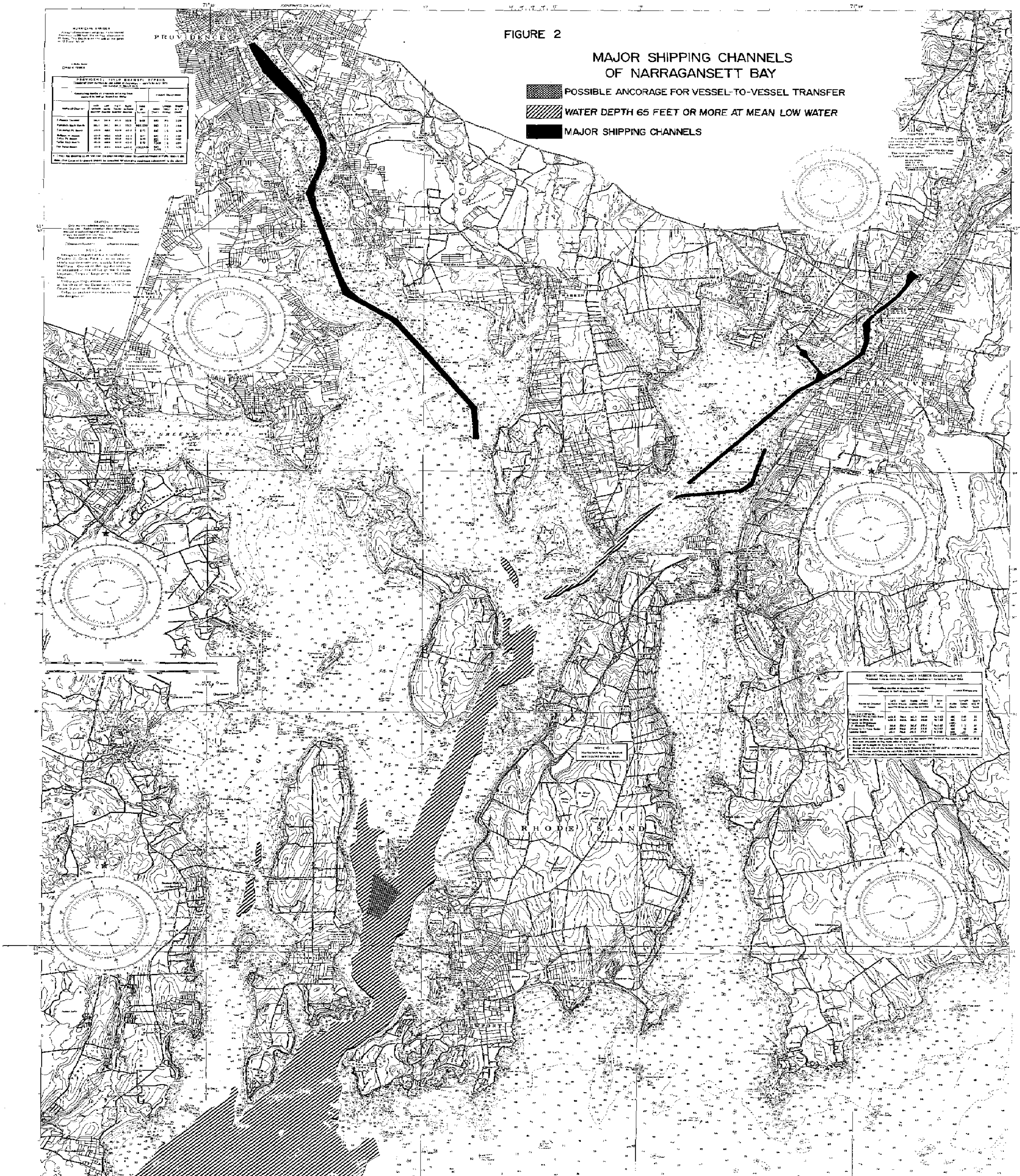


FIGURE 2
MAJOR SHIPPING CHANNELS
OF NARRAGANSETT BAY
POSSIBLE ANCORAGE FOR VESSEL-TO-VESSEL TRANSFER
WATER DEPTH 65 FEET OR MORE AT MEAN LOW WATER
MAJOR SHIPPING CHANNELS
PROVIDENCE
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tide rises. However, as a general rule, no matter how large a super tanker that can be accommodated, the necessary "lightering" that follows will be limited to ship of 35 feet draft.

If one were to assume that this lightering is to continue within existing draft limitations, the next question would concern the size of ocean-going tankers that the Bay can receive. Figure 2 shows an area highlighted by diagonal lines which represents those waters which have a depth of 65 feet or greater, measured at mean low water. This area is, in effect, the East Passage of the Bay. Using Figure 1 as a guide, it could be concluded that a tanker of some 200,000 DWT could safely use this route. As with the channels, a rise in the tide increases the draft, and therefore the capacity, of a ship using this passage. It would appear that 65 feet is a good, but not maximum, working figure when talking of ship sizes for the lower Bay.

With the increased demands for petroleum products and the growth of ship sizes, it would appear that "lightering" will not only continue to play a major role in the Bay's shipping traffic, but will probably increase. Although dredging is an alternative to this, it does not appear to be a very attractive one, from the points of view of either financing or ecology. The cost of deepening either the passage or the channels would be prohibitive and even if it were financially possible, it would present serious ecological problems. It is extremely doubtful that material dredged from the bottom of the present channel would meet Environmental Protection Agency standards for disposal.

PART THREE: POSSIBLE POLLUTION PROBLEMS

Pollution of our waterways with oil products is caused by three main factors: bilge pumping, transfer leakage, and collisions. The expected increase in traffic on the Bay could affect all three of these areas. Increased traffic by lighters or visits by larger ships could increase pollution caused by bilge pumping. This is now the greatest cause of oil pollution on our waters. It is caused by the fact that ships must take in sea water as ballast and must store some of it in empty oil tanks. When preparing to reload with oil, these tanks must be cleaned and the oil-water mixture which results must be disposed of. In many cases it is simply pumped overboard, although efforts are being made to reduce this problem.

The probability of transfer leakage, whether ship-to-ship or ship-to-shore, will be increased with the advent of more traffic on the Bay. With ships growing larger, more "lightering" will be needed and more lighters per main tanker will be required, thus increasing the risk of transfer spillage. However, tighter controls and new techniques could be a positive factor.

It seems reasonable to assume that transfer leakage is more likely to occur on a ship-to-ship transfer than a ship-to-shore transfer, since the latter involves a stable platform at one end of the operation. It would also seem reasonable that leaks from a ship-to-ship transfer would be more difficult to clean up, since they would tend to occur in more open waters, rather than in sheltered harbors.

In the area of collisions, some authorities feel the larger ships will reduce the total number of ships carrying oil and thus reduce the chances of a collision and resultant spill, while others feel that these larger vessels will cause more "lightering", and therefore, will acutally generate more traffic in the already crowded harbors. It would appear that Narragansett Bay would fall into the latter category but it is difficult to determine just how much more traffic these supertankers will generate.

In an area related to collisions, there are those who feel that the newer supertankers are actually underpowered in that some ships have increased capacity twelvefold while increasing horsepower only threefold. On the other hand, there are those who feel that the smaller tankers in the world fleet, which are usually older ships, are not as maneuverable as they once were and pose a hazard to safe navigation.

PART FOUR: SUMMARY AND CONCLUSIONS

The world's oil tanker fleet is presently growing both in number and in ship size and indications are that it will continue to do so. The effect of this growth on Narragansett Bay will probably be one of more oil tanker traffic, for while ship sizes are growing, the demand for petroleum products is growing at an even faster rate. The Bay's East Passage has the ability to handle shipping of 65 feet at mean low tide, with deeper drafts possible depending on the tides. The two major channels in the northern part of the Bay are limited to ships of approximately 35 feet in draft. It appears that ship-to-ship transfer will become a major portion of the Bay's oil-related traffic and will probably grow as the size of ships increases, unless such transfers are prohibited. There is a trend to build the newer tankers longer and wider, so that the drafts may become stabilized while the volume increases. This would mean more traffic in the form of lighters.

The possibility of increased pollution is, of course, evident as traffic increases but this does not mean that it has to occur. Tighter control measures and new anti-pollution techniques are a definite factor in these considerations but it is difficult to gauge their effect in a report of this length.

Assessment of Rhode Island's position is also complicated by recent and possible future developments outside the state. Construction of a refinery in the Bahamas by a consortium of nine oil producers, the existence of deep-water ports in Canada, the possible construction of deep water terminals on the Atlantic coast of the United States, the export policies of mid-eastern and South American crude oil producing countries, and the oil import policies of the United States can all affect the volume of petroleum products handled in Narragansett Bay, and the type and number of ships carrying these products.

Evaluation of the future courses of action available to Rhode Island must also consider possible changes in the local situation. At present, there are no oil refineries on Narragansett Bay, Mount Hope Bay, or their tributaries. Consequently, little or no crude oil is now shipped into the area by tanker. If an oil refinery were located on any of these water bodies, much larger tankers (and probably the VLCC type ships) would have to be accommodated than those expected to be used in the transportation of "finished" petroleum products for the next few years. Since the Coastal Resources Management Council has jurisdiction over the location of oil refineries within that part of Narragansett Bay and adjoining waters within Rhode Island, the factor of tanker size must be considered in making any decisions on location of refineries. However, the location of a refinery in the Fall River area, over which Rhode Island has no direct control, would have essentially the same impact on the size and number of tankers operating in Narragansett Bay.

Under existing conditions, with no oil refineries located in this area, there are five basic alternative courses of action open to Rhode Island in dealing with the problems posed by the use of increasingly larger tankers. These are:

1) Permit ship-to-ship transfer of oil. This would maintain or improve the position of Narragansett Bay as an oil handling port (now the fourth largest in New England), but would run the maximum risk of an oil spill polluting waters in the lower Bay.

2) Prohibit ship-to-ship transfer of oil in Narragansett Bay. This would substantially reduce the pollution hazard, but, as discussed previously, increasing ship drafts will eventually cause traffic to shift to other ports, thus increasing the cost of oil in Rhode Island and reducing an important economic activity.

3) Prohibit ship-to-ship transfer until the use of larger tankers makes it absolutely necessary. This would defer the pollution potential, but careful timing would be essential, and the situation could change too rapidly to respond under this policy. This alternative must be considered an interim approach. It would gain time to formulate other solutions or to benefit from improved technology for vessel-to-vessel transfers, until the use of larger tankers is so widespread as to demand selection of one of the other alternatives.

4) Limit the ship-to-ship transfer of oil to cargo destined for a Rhode Island port; prohibit use of the Bay as a sheltered anchorage for trans-shipment to ports out of state. This would reduce the exposure to pollution hazards to some extent and yet maintain the state's economic position.

5) Dredge channels to permit ship-to-shore transfer. This alternative would probably not be technically feasible due to cost and pollution factors involved.

If either the first or fourth alternatives is selected, this activity should be confined to a designated transfer area in which all ship-to-ship operations would be required to take place. Such an area has been designated for the Coastal Resources Management Council and is shown on the map, highlighted by cross-hatched lines, south of Gould Island. Continuous policing of the area, including standby spillage control equipment, should be considered.

More detailed study of such factors as the total oil storage capacity of facilities located on the Bay, detailed maps of such storage areas and their water approaches, the engineering feasibility and environmental problems of dredging parts of the passage to make traffic management easier and safer, and a thorough study of the feasibility of establishing a central ship-to-ship and ship-to-shore facility for the Bay should be incorporated into the Council's resources management plans and programs as these are formulated, regardless of the alternative selected.

FOOTNOTES

1 "The New Breed of Tankers", Petroleum Today, Fall, 1971, p. 16.

2 Department of Commerce, "A Statistical Analysis of the World's Merchant Fleets, 1972."

3 Ibid.

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