Potentials For A Delaware Deepwater Port

October, 1970

Gladstone associates

ECONOMIC CONSULTANTS

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Prepared for

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by

Gladstone Associates
Washington, D.C.

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PURPOSE

The purpose of this report is to analyze the market potentials for a deepwater port facility in the lower Delaware Bay.

While those items listed below are excluded from this analysis and to some extent are being covered by other studies, nonetheless we recognize their relevance. These items are appropriate for discussion in following stages based, in part, on the market potentials analyzed in this report.

Items excluded from analysis at this stage are:

A Public costs and benefits.
B Economic impact on Southern Delaware.
C Economic impact on Port of Wilmington.
D Specific design or location considerations.
E Environmental and ecological impact.
F Specific regulatory or fiscal policies of state government.

CONCLUSIONS

A At least one deepwater port facility will be built on the East Coast of North America in the 1970's.

B Once a deepwater port facility is in operation on the East Coast, the economic feasibility of a second deepwater port will be seriously diminished. It is unlikely that a second East Coast facility will be built during the 1970's.

C Taking all factors into account, the Delaware Bay region is at least as advantageous as any of the other four locations given recent consideration, and probably more so. These other locations include Long Island Sound, Boston, Maine, and Nova Scotia.

D Such a port will principally serve as a trans-shipment point for petroleum (POL) and iron ore imports. Trans-shipment of petroleum may be to smaller ships or eventually to a pipeline.

E From a purely economic and technical point of view, on-shore development of industrial facilities is not necessary for a deepwater port to be feasible. However, certain industries could probably derive substantial economies from locating close to such a port facility. This is particularly true of the petroleum industry. Therefore substantial pressures for on-shore industrial development should be expected.

F Non-port related development might be affected indirectly, either positively or negatively. The magnitude and character of this impact has not been evaluated.

G The private sector savings from a deepwater port, as compared to present transportation systems, are likely to be on the order of $72 million to $105 million annually by 1980, increasing to $205 million to $293 million by the late 1990's. These savings would be substantially decreased if at-sea POL transfers are not prohibited.

H Under existing tax structures, little if any of these private sector savings would accrue as revenue to the State of Delaware. Since most commodities passing through the deepwater port facility would be imports, not taxable by states, Delaware must carefully structure the way in which it gains revenue from this facility.

I This analysis has taken into account private market factors alone. We believe that the potential public costs and public benefits, including ecological and environmental considerations, could be of substantial significance in establishing the desirability of this project. These public sector factors could have a determining effect on whether such a facility should be built and the specific location and composition of the facility.

DETERMINANTS OF POTENTIALS

The potentials of a new deepwater port in lower Delaware Bay are analyzed in this section of the report. General transportation factors are outlined first and serve as an introduction to the second part of this section covering specific transportation parameters as they relate to a deepwater port. Finally, long term supply and demand factors that relate to transporting specific commodities are covered.

General Transportation Factors

Before actual and potential product movements can be analyzed in terms of volumes, distance, routes and growth rates, it is necessary to establish principles of transportation systems. The following list outlines these principles:

General Considerations

A The value of a product may be changed simply by changing its location.

B No mode of transportation is inherently more efficient than any other mode of transportation.

C The economics of transportation is not measured in distance but rather in the cost of overcoming distance. A journey of 100 miles may be more expensive than a journey of 1,000 miles depending upon: (1) the mode of transportation, (2) the type of commodity transported, (3) the configuration of the terrain or sea, and (4) the terminal facilities at origin and destination.

Intermodal Transportation

D A unified transportation system assures efficient movement in a worldwide integrated network of transportation modes.

E The employment of several different modes of transportation in a unified system can offer substantial cost savings. A deepwater port functions as a point at which two modes of transportation can interchange, creating a more efficient transportation system.

Volume and Distance

F As both the volume and distance a commodity is transported increases, the cost per ton/mile decreases.

G Economies are achieved in transportation systems by moving large cargos over long distances.

H Oil tankers, as single purpose modes of transport, have greater capacities than multi-purpose modes of transport such as bulk carriers.

Freight Rates

I In the past, special low freight rates were established for high volume, frequent movement of bulk commodities over the same route. A new pattern of commodity movement may not qualify for these low rates even though the distance travelled is the same or less than established routes.

J Freight rates between frequently employed origins and destinations are lower for all modes of transportation.

K Freight rates are generally lower on bulk raw materials than on semi-manufactured or finished products.

Technology

L Rapid technological change in the past 20 years has revolutionized transportation. The payload capacity of all forms of transportation has increased greatly. The most obvious example of this is the unprecedented growth in the capacity of petroleum tank ships.

M LASH, Seabee, and containerization are technological innovations for the handling of high value/low density products such as general cargo.

N Delivery capacity has increased beyond the ability of receiving systems (ports) to operate efficiently.

O As the deadweight tonnage of a ship increases, its draft increases.

Linkages

P Historically established transportation routes and circulation patterns tend to remain intact due to inertia to the point of inefficiency.

Q Established transportation routes and circulation patterns between origins and destinations tend to become stronger with time and usage.

R The location of manufacturers, transportation facilities, and associated industries are often fixed by transportation linkages. Once fixed, these facilities may make it difficult to reorient a transportation network.

S Freight rates generally are lowest on commodities moving between strongly linked points.

T The Jones Act requires that ocean freight domestic movement travel in ships built in the United States and operated under American flags of registry.

Transfer Terminals

U The most significant cost in intermodal shipments is terminal handling charges at points of trans-shipment. Whether a commodity moves an additional 50 or 300 miles after trans-shipment on a 10,000 miles journey has little affect on total transportation costs.

V Given the location of East Coast markets and the significance of trans-shipment costs, no port site from Maine to Virginia has a strong locational advantage as a transfer terminal.

Specific Parameters

TANKERS

Advancing shipbuilding technology, increasingly large demand for petroleum imports, and greater distance of petroleum sources have been the impetus for the construction of supertankers. During the past ten years there has been an increase in the size of petroleum tankers from the standard T-2 tanker of approximately 16,700 deadweight tons to supertankers in excess of 200,000 deadweight tons with drafts of more than 50 feet. Existing harbors in the United States cannot handle these new supertankers because of draft restrictions. One solution to this problem could be construction of an off-shore deepwater trans-shipment terminal.

Since 1960, the average size of new tankers has increased 150 percent, from 42,000 deadweight tons (DWT) to 105,000 DWT. Table 1 shows that ships in excess of 75,000 DWT have such deep drafts as to prohibit their use of the Delaware River and Bay which has a channel depth of 40 feet.

Table 1

SUPERTANKER CHARACTERISTICS

DWT	Length	Breadth	Depth	Draft
77,000	752'	80'	59'	44'
100,000	861'	128'	61'	44.5'
101,550	808'	132'	72'	--
130,000	858'	147'	75'	53'
151,000	951'	156'	79'	53'
173,000	1,013'	159'	81'	54'
175,000	1,032'	159'	84'	49.5'
213,000	1,043'	161'	82'	--
214,000	1,013'	159'	--	--
224,000	1,023'	160'	85'	65'
240,000	1,100'	170'	--	63'
250,000	1,056'	171'	88'	68'
312,000	1,142'	176'	--	80'
370,000	-	-	-	89'

Source: Gladstone Associates

The increase in vessel sizes experienced in the 1960's is anticipated to continue at an even more rapid pace in the future. As seen in table 2, by 1983 it is projected that there will be more than 400 ships with capacities in excess of one quarter million DWT.

Table 2 PROJECTED SIZE AND NUMBER OF TANK SHIPS IN 1983

Vessel Deadweight Tons (in thousands)	Number of Vessels Actual 1966	Projected 1983
10 - 50	2540	2110
50 - 100	288	1189
100 - 125	29	397
125 - 150	5	48
150 - 200	2	224
200 - 300	-	371
400 - 600	-	45
700 - 800	-	(1)
1,000	-	(1)

(1) The number of ships in this class is at present underterminable However, there should be a considerable number of ships in the 700-800,000 DWT class and it is possible that there will be ships in the 1,000,000 DWT class by 1983.

Source: Litton Systems Inc, U. S. Army Corps of Engineers and Gladstone Associates.

Table 3, which shows ships under construction in 1968, lends support to these projections. Although the number of ships with capacity of more than 125,000 DWT will be small, they will have a great impact on petroleum movements. In 1966, only 7 tank ships had capacities in excess of 125,000 DWT. By 1983, almost 700 tankers will have capacities in excess of 125,000 DWT. These 700 ships will account for over 60 percent of the total tanker capacity by 1983. By the year 2000, ships in this size class will account for 75 percent of total tanker capacity.

Table 3

DEADWEIGHT TONNAGE ANALYSIS OF TANK SHIPS OF MORE THAN 175,000 DWT UNDER CONSTRUCTION OR ON ORDER AS OF DECEMBER 31, 1968

Deadweight Tonnage In Thousands	Number of Ships	Total DWT
175 to 180	3	526,000
180 to 185	3	540,000
185 to 190	1	188,000
190 to 195	2	380,000
195 to 200	2	395,000
200 to 205	1	200,000
205 to 210	8	1,663,000
210 to 215	63	13,304,000
215 to 220	18	3,874,000
220 to 225	10	2,218,000
225 to 230	13	2,959,000
230 to 235	4	922,000
240 to 245	7	1,683,000
250 to 270	43	10,953,000
Above 310	5	1,618,000

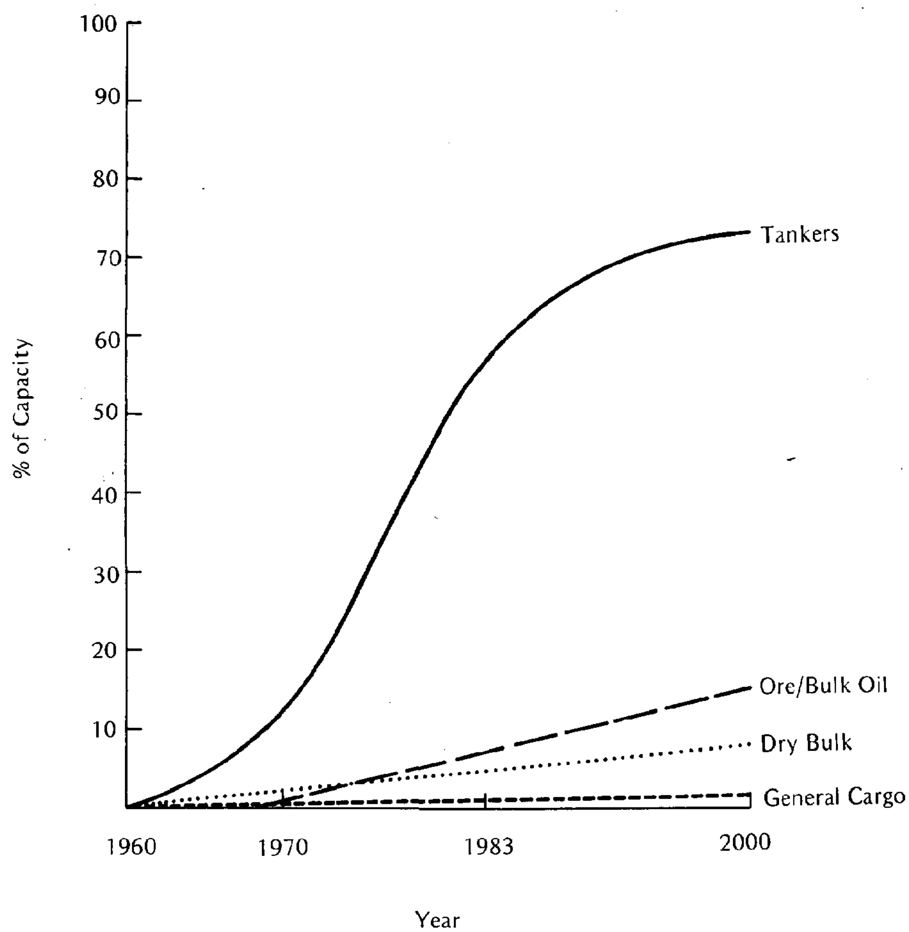
Source: Sun Oil Company, "World Tank Ship Analysis."

Ships in excess of 125,000 DWT have drafts of 50 feet or more. Presently, ships with drafts of 50 feet cannot serve any East Coast port. Furthermore, only 21 percent of the world's ports have a depth of 50 feet or more. Only 6 of these are located in the United States, all of which are on the West Coast.

The graph following indicates the percentage of tanker capacity which will be found in tankers with drafts in excess of 50 feet. Clearly, 75 percent of all petroleum movements by the year 2000 will be unable to utilize any existing port along the East Coast of the United States.

Graph 1

PERCENT OF CAPACITY OF FLEET IN SHIPS WITH MORE THAN 50 FOOT DRAFT



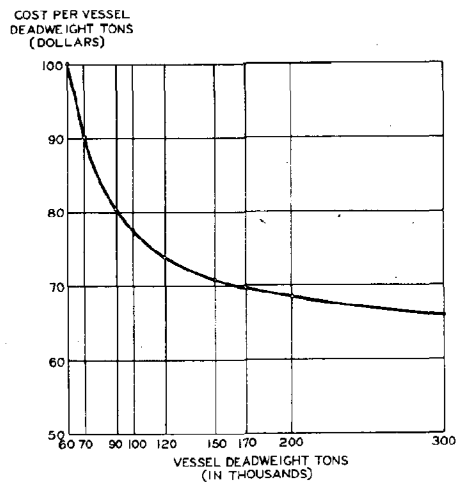
Source: Gladstone Associates

Because of the cost savings involved in the operation of superships, the Gulf Oil Corporation has set up an off-shore, deepwater terminal in Bantry Bay, Ireland. This facility allows Gulf Oil Corporation to minimize the cost of construction per deadweight ton of tanker and the cost of transporting petroleum products on the Persian Gulf – Northern Europe route.

The main impetus for increases in tanker size and capacity has been cost savings. These savings are in the form of both construction cost and transportation cost. As the size of the tanker increases construction cost per deadweight ton decreases. On trips of more than 6,000 nautical miles, tankers with more than 200,000 DWT capacity experience increased cost savings. These pheonomena are displayed on the opposite page.

Graph 2

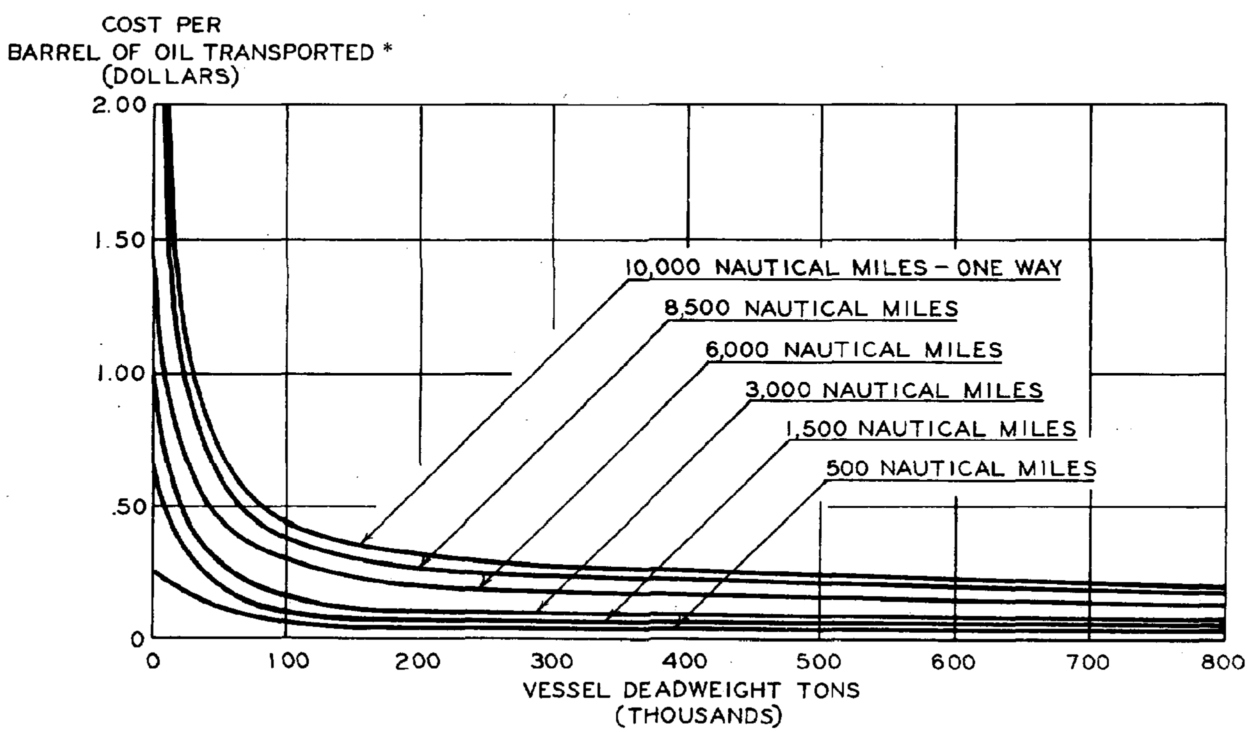
THE RELATIONSHIP BETWEEN VESSEL SIZE AND CONSTRUCTION COST



Source: The American Association of Port Authorities

Graph 3

THE RELATIONSHIP BETWEEN VESSEL SIZE, TRANSPORTATION COST AND ROUTE LENGTH



* 7.111 Barrels Per Long Ton

Source: The American Association of Port Authorities

Technology has made superships feasible and their cost savings necessarily will lead to the construction of deepwater ports at major petroleum markets.

DRY BULK CARRIERS

A dry bulk carrier is a ship which carries coal, iron ore, grain, and other dry commodities shipped in bulk.

Although substantial increases in the size of dry bulk carriers have been experienced in the past few years, only a small number of these ships will require a deepwater or an off-shore terminal by the year 2000. Dry bulk ships will necessarily be limited in size by the nature of their cargo and the industries they serve.

Since 1965, the increase in the size of all dry bulk carriers has been substantial. The average size of ore and ore-bulk-oil carriers (OBO) has nearly doubled in the two year period, 1965 – 1967. These phenomena are demonstrated in table 4.

Table 4 AVERAGE SIZE OF BULK CARRIERS CONSTRUCTED, 1940-1967

	In Thousands of DWT		
Year	Bulk (all)	Ore	OBO[1/]
1940	12	14.7	--
1945	19	17.7	13.5
1950	19	23.0	21.7
1965	25	37.0	36.7
1966	33	46.0	47.0
1967	39	63.0	80.0

[1/] Ore, Bulk Oil

Source: American Association of Port Authorities.

Even though 45 percent of the bulk fleet capacity will be in vessels of more than 50,000 DWT by the year 1983, it is projected that only 5 percent of the capacity will be in ships having 50 foot drafts. It is anticipated that this will increase to 8 percent by the year 2000.

While the main impetus for switching to larger dry bulk carriers has been similar to that of petroleum tankers, projected increases will not be as significant. Bulk carriers must respond to a series of fixed conditions in the form of industry location and product mixes. Consequently, they are restricted in size due to a need for greater flexibility.

GENERAL CARGO CARRIERS

General cargo carriers move a diverse group of products which are higher in value and lower in density than products moved by bulk carriers.

Because general cargo carriers must be highly adaptable to varying localized factors, a variety of products, and a great number of ports, there have been no trends to significantly larger general cargo carriers as is the case with tankers and bulk carriers, nor is it anticipated that ther will be.

Conventional general cargo carriers are below 20,000 deadweight tons and therefore incur no difficulty in servicing any East Coast port due to draft problems. Containerizing cargo will have little effect on general cargo carriers. The largest container ship in service is the 21,900 DWT 'Encounter Bay' which draws only 35 feet of water when fully loaded. While container ships of the future will carry 2,500 containers they will not increase appreciably in their draft requirements. It is projected that the largest container ship in the year 2000 will carry 4,000 containers. A ship of this size draws only 35 to 40 feet of water.

RAILROADS

Railroad freight rates, historically established, permit the movement of bulk commodities at lower rates than those applied to general cargo. Freight rates are generally established on commodities moving in large volume on a continuous basis. These rates tend to favor ports which have historically handled the greatest volume of a given commodity.

Coal moving from the Applalachian coal fields to East Coast ports moves for the most part at lower rates to Hampton Roads.

Any area or port that presently is not serviced by a first-class railroad line has little chance of obtaining one. New track construction is very expensive and seldom undertaken. Considering the strong linkage established between the Appalachian coal fields and Hampton Roads, it is unlikely that a new deepwater port would generate enough coal export traffic to warrant construction of a feeder line.

PIPELINES

Generally, pipelines are the most expensive form of transportation to construct and the least expensive to operate. The major commodity that moves via pipeline is petroleum. However, natural gas, coal slurry, and other forms of slurry can also use pipelines as a means of transport. A new pipeline of coal slurry was recently activated in southern Utah.

Efficient use of a pipeline requires the use of large diameter pipes 24 hours per day at full capacity. For the most part, United States petroleum movements could only justify a pipeline for short distance transport.

By the year 2000 it is anticipated that pipeline technology will have advanced to the point that many products will move via this form of transport.

Long Term Supply and Demand

Potential demand for an East Coast deepwater port is analyzed in this section with regard to commodity volumes, commodity types, and route lengths as they relate to the geographic location of product sources and demands. The following contains a commodity analysis of long term supply and demand.

COAL

Domestic coal production has remained relatively constant since 1935. This is reflected in coal production statistics which indicate an average annual increase of only one percent in the past three decades. Demand for domestic coal has also stabilized.

One half billion tons of coal was produced in 1966, 93 percent of which was domestically consumed. Of the remaining 7 percent, one third was exported to Japan with anticipation that this will increase to two thirds by the year 2000.

The East Coast accounts for 75 percent of total United States coal production even though only one half of United States coal reserves are located there.

East Coast ports handle virtually all United States coal exports, 90 percent of which are exported through Hampton Roads. Hampton Roads is particularly well located for coal exports because of its proximity to 52 percent of coal production areas and favorable freight rates from these sources.

Neither the present level nor the anticipated increase of coal exports is sufficient to warrant the use of superships. While the use of superships could be justified because of distance between Japan and the United States, there would be insufficient volume to warrant their use.

IRON ORE

Major world sources of iron ore are located in Africa, South America, and Canada. Presently 75 percent of United States iron ore imports come from either Canada or Venezuela, areas too close for the feasible use of superships. With changing technology, it is projected that by the year 2000, iron ore reserves in Africa and the West Coast of South America will be more accessible; hence the development of these reserves will be facilitated by the use of superships.

The demand for iron ore in the United States will increase at an average annual rate of 2 percent to a level of 35 million tons in the year 2000. Over 80 percent of these imports will enter the East Coast through either Baltimore or the Delaware River and Bay.

Thus, by 2000, with continuing steady growth, a high volume, and increased distance superships in the 100,000 to 200,000 DWT class will be used increasingly to import iron ore.

GRAINS

Demand for United States grain in Africa and Asia is expected to increase at an average annual rate of 10 percent while European demand will remain constant.

Wheat, sorghum, and corn are predominantly located in the mid-west and far western states whereas soybeans are located throughout the country. Consequently, 75 percent of United States grains are exported through the gulf ports.

An average annual increase of 4 percent and levels of 50 to 100 million tons moving increasingly greater distances are a sufficient impetus for superships. However, due to the location of domestic sources the Delaware River and Bay is not suitably located for deepwater grain traffic.

FOREST PRODUCTS

While total East Coast import and export of forest products has increased at an average annual rate of 9 percent through the 1960's, it has achieved a present level of only 5 million tons. This volume is insufficient to support even the marginal use of superships.

PETROLEUM

Presently 82 percent of total United States demand for petroleum is met by domestic production. The remaining 18 percent, or 100 million tons, is met through imports. There will be an increasing reliance on oil imports to meet projected domestic demands.

Domestic sources of oil are located in the central and western states and supply about 95 percent of local demand. Consequently 70 percent of United States petroleum imports flow into East Coast ports.

New York, with its demand for natural oil to be burned as industrial and residential fuel, and Delaware, with 67 percent of the East Coast refinery capacity, account for 70 percent of total East Coast oil imports. It is projected that these two ports will account for 75 percent of total East Coast oil imports by the year 2000.

Presently 75 percent of United States oil imports come from the Caribbean. This distance is insufficient to warrant the use of superships. However, projections indicate oil coming from Africa and the Middle East (hauls in excess of 6,000 miles) will account for approximately 55 percent of total United States oil imports by the year 2000. African and Middle East oil imports will reach a level of 200 million tons by the year 2000, 140 million tons of which will enter the United States through East Coast ports.

In the 1960's there was a sufficient volume of petroleum moving increasingly greater distances to stimulate the trend towards the use of supertankers. It is anticipated that there will be even greater increases in both volume and distance of petroleum movement and a consequent demand for an increasing number of supertankers. Given the demand for petroleum imports on the East Coast and given the fact that 70 percent of all petroleum will move in supertankers by the year 2000, the demand for a deepwater transfer terminal will be overwhelming.

SUMMARY

This section has set forth a commodity by commodity analysis that considers the interrelationships among transportation factors as they effect long term supply and demand. These factors are related to the need for a deepwater port along the East Coast of the United States.

A deepwater terminal appears to be most significant for the handling of petroleum products. Because of increased use of supertankers and increased demand, a deepwater port, in all probability, will be constructed along the East Coast of North America by 1980. The lower Delaware Bay would be a good choice from a market view point.

While the movement of POL justifies the construction of a deepwater port, such a port could not be justified for movement of the other commodities discussed above with the possible exception of iron ore.

DETAILED ANALYSIS

This section analyzes the movements of commodities to and from the East Coast with special emphasis on potential need for a deepwater trans-shipment terminal. The analyses encompass bulk commodities and general cargoes with projections to the year 2000. The opening section covers commodities with strong deepwater trans-shipment potentials, followed by a section on commodities with weak potentials.

Strong Potentials

PETROLEUM IMPORTS

Introduction

Petroleum and oil are words used interchangeably to mean crude and residual oils. These are natural or semi-refined oils which must either be further refined or, if of high enough quality, burned as home heating oil or industrial fuel.

World demand for petroleum (POL) has increased dramatically since the Second World War. Most indications are that this trend will continue in the future at an unprecedented rate.

At present, 82 percent of total United States demand for petroleum is met by domestic production. The remaining 18 percent, 100 million tons, is met by imports. There will be an increasing reliance on oil imports to meet projected increases in domestic demands.

Table 5

FLOW OF CRUDE AND RESIDUAL OILS:
EAST COAST PORTS, 1961 AND 1968
(Thousands of Long Tons)

	Imports		Domestic Receipts		Domestic Shipments		Net Flow Inbound[1/]	
	1961	1968	1961	1968	1961	1968	1961	1968
Delaware River	22,491.5	29,534.2	15,853.5	16,126.8	614.7	174.4	37,730.3	45.486.6
New York	20,004.7	32,936.8	11,847.3	8,581.8	1,842.6	1,633.0	30,009.4	39,885.6
New England	7,061.4	13,869.0	2,426.1	4,158.4	396.3	2,259.4	9,121.9	15,768.0
Hampton Roads and South	5,114.7	8,066.6	1,845.5	1,100.0	1,079.4	2,305.8	5,880.8	6,860.7
Baltimore	2,758.4	3,839.0	1,497.4	1,424.3	119.5	277.5	4,136.3	4,985.8
Total Coast	62,545.4 (72,600)[2/]	88,245.6 (107,426)[2/]	33,469.8	31,391.3	4,052.5	6,650.1	91,962.7	112,986.7

1/ Imports and Receipts less Shipments.

2/ Numbers in parentheses include oil imported thru Maine to Canada.

SOURCE: Army Corps of Engineers and Gladstone Associates.

The movement of petroleum in waterborne commerce is a result of the distance between the producing wells and the refining facilities for petroleum products. The movement of large quantities of POL over great distances can be accomplished at significant cost savings in huge ships.

Since 70 percent of American petroleum imports pass through East Coast ports, a deepwater port in the lower Delaware could handle huge quantities of oil due to the enormous transportation cost savings which accrue from the movement of petroleum in supertankers.

Petroleum Imports in the Past Decade

The figures in Table 5 indicate total East Coast oil imports have increased 6 percent annually since 1961 to a level of 88 million long tons in 1968. However, domestic oil receipts during the same period declined 1 percent annually to 31 million long tons.

The figures in Table 6 show the extent to which oil imports are becoming increasingly important as a source for meeting domestic consumption of petroleum products. In 1961, domestic oil accounted for 32 percent of total East Coast petroleum movements. This figure shrank to 22 percent in 1968.

Since 1961, Delaware River and Bay imports have risen 4.5 percent annually to a level of 29.5 million long tons. In addition to imports, Delaware River and Bay ports received 16 million long tons of petroleum in domestic shipments.

Table 6 IMPORTS[1/] AS A PERCENT OF TOTAL PORT OIL[2/] HANDLING BY MAJOR PORTS, 1961 - 1968

Port Area	Imports as Percent of Net Inbound 1961	Imports as Percent of Net Inbound 1968	Annual % Change
Delaware River	59.6%	64.9%	+ 0.76%
New York	63.9%	82.4%	+ 2.64%
Rest of East Coast	82.8%	93.4%	+ 1.51%
Total Coast	68.0%	78.1%	+ 1.44%

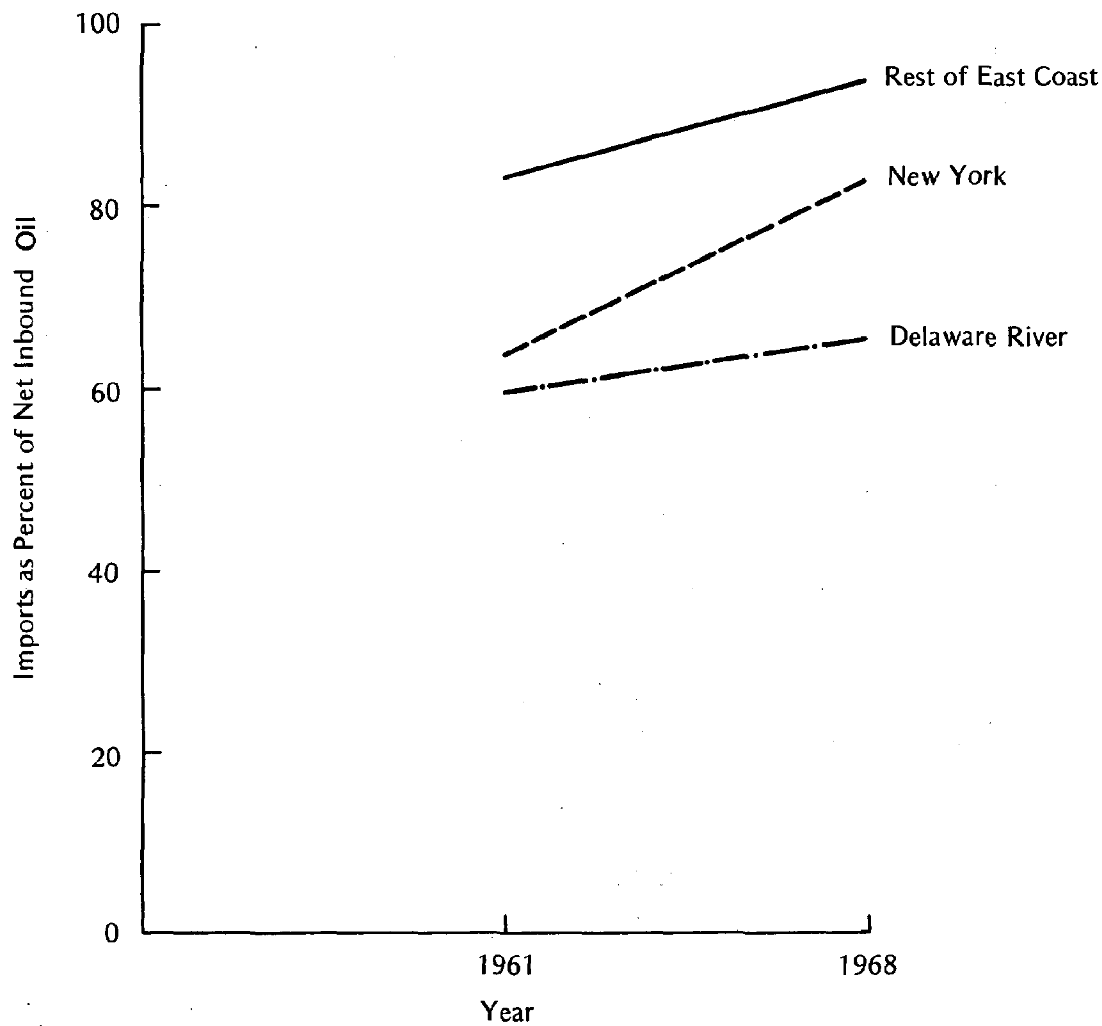
1/ Excludes oil imports into Portland for pipeline shipment to Canada.

2/ Crude and residual only.

SOURCE: Army Corps of Engineers and Gladstone Associates.

The Delaware River and Bay ports handled one-third of all East Coast oil imports in 1968, second only to New York which handled 37 percent. On the other hand, the Delaware River and Bay ports handled 51 percent of all East Coast domestic receipts in 1968. While 65 percent of all Delaware River and Bay inbound oil was imported, it has shown among all East Coast ports the slowest growth in, and least reliance upon, imported oil to meet its consumption requirements.

Graph 4



THE GROWING IMPORTANCE OF IMPORTED OIL, 1961 - 1968

Projected Petroleum Imports

Among those groups which have attempted to forecast future oil imports, there is a wide range of results due to varying assumptions necessary in multiple contingency analysis.

First, some projections include oil imported into Portland, Maine for pipeline shipment to Canada whereas other projections do not include these imports.

Second, import projections are based on assumptions regarding domestic supply and demand for petroleum. Domestic production projections vary due to the need to estimate existing production sources as well as possible future domestic production (such as Alaskan oil deposits and western shale reserves). Furthermore, the government can have a large impact on projected oil imports through policies dealing with oil import quotas, off-shore drilling, and indirectly port development which might otherwise permit the use of supertankers.

Perhaps the most important and difficult determinant of oil imports to project is domestic demand for POL. The difficulty of projecting domestic demand results from multiple contingency analyses of technological, environment, economic, and social changes and their possible affects on petroleum use in the major consuming sectors. Factors strongly influencing increased petroleum use include:

A Economic and environmental factors affecting a relative decline in the demand for coal, nuclear fuel for power generation, and gas.

B Accelerated substitution of plastics for other materials in a wide variety of uses.

C New uses for petroleum.

Factors which might decrease the use of petroleum products include:

A Greatly increased use of electricity generated by non-petroleum fuels.

B Rapid growth in transportation systems utilizing non-petroleum sources of power.

C Environment restrictions on the use of petroleum fuel.

D Revolutionary advancements in technology of substitutable raw materials and energy sources such as coal and oil shale.

E Slower population and economic growth rates than those projected for the forecast base.

All of these considerations require assumptions which invariably differ for each group making projections. Consequently, we have listed three or four projections of oil imports made by both private and public agencies and have taken their mean. All projection information referred to below is based upon the mean of these projections, thereby normalizing any grossly incorrect assumptions which might have been made in order to arrive at any single projection.

Table 7 and graph 5 show United States oil imports reaching a projected level of 360 million long tons by the year 2000. This will represent a 5.5 percent average annual increase compared with a historic growth rate of 10.6 percent annually in the 1950's.

Table 7 PROJECTED U.S. OIL* IMPORTS

Year	Actual	Litton 1/	AAPA 2/	Newport 3/	U.S. Government 4/	Mean Projection
	(Millions of Long Tons)					
1953	55.0					
1963	113.4					
1973		196.5	140.0	150.4	150.0	159.2
1983		307.4	170.0	202.2	180.0	214.9
2003		499.5	285.0	343.7	318.0	361.6
	(Average Annual Percent Increase)					
1953-1963	10.6%					
1963-1973		6.2%	2.4%	3.3%	3.2%	4.0%
1973-1983		5.6%	2.1%	3.4%	2.0%	3.5%
1983-2003		3.1%	3.4%	3.5%	3.8%	3.4%
1963-2003		8.5%	3.8%	5.1%	4.5%	5.5%

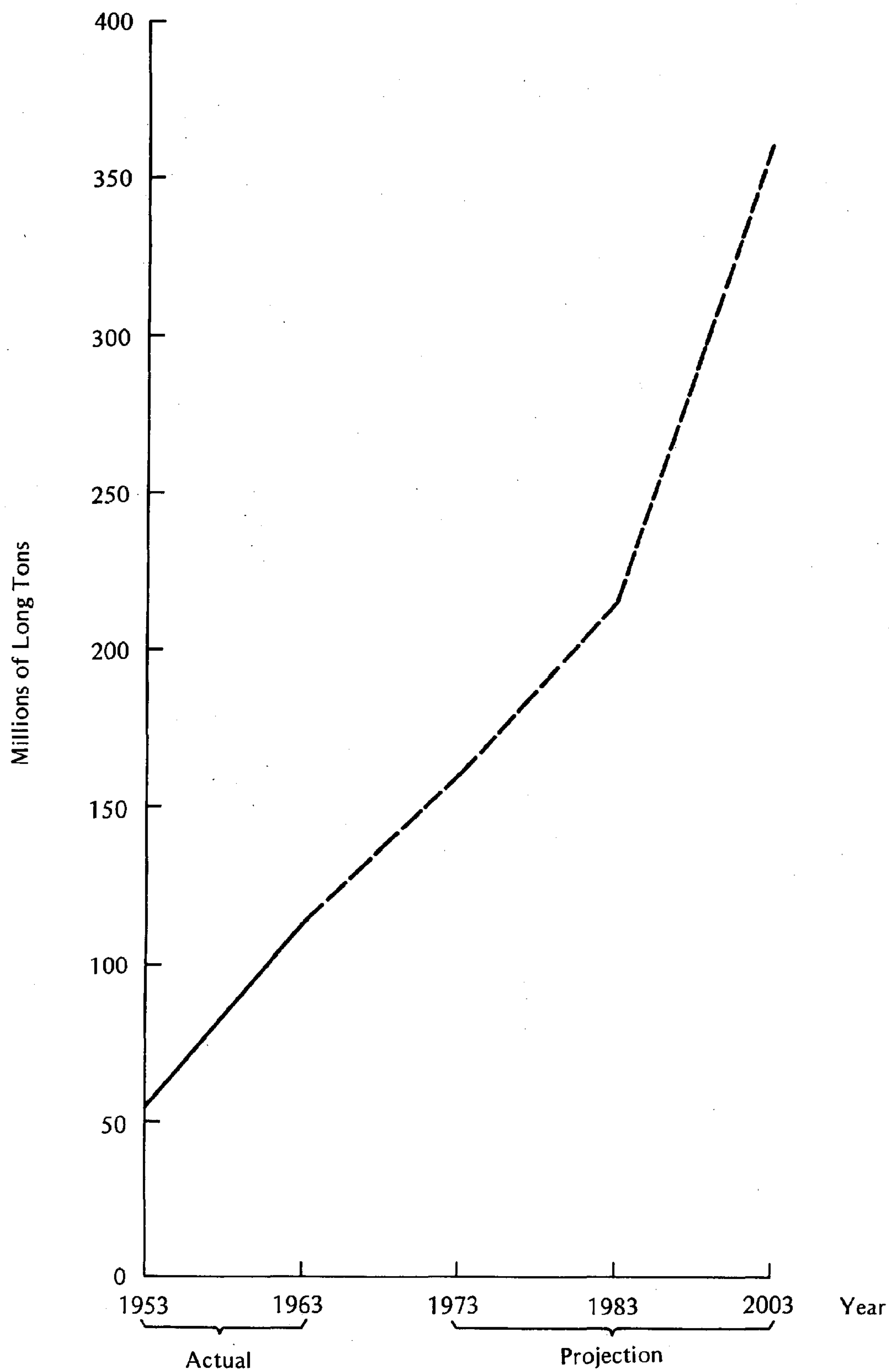
* These are projections for crude and residual oil only.

1/ Littons Systems, Inc., 1968.

2/ American Association of Port Authorities, 1968.

3/ Newport News Shipbuilding and Dry Dock Company, 1970.

4/ Unpublished Department of Interior working paper.



Graph 5

PROJECTED U.S. OIL IMPORTS

Oil imports entering the United States through East Coast ports increased 7.4 percent annually in the 1950's and 5.7 percent in the 1960's. While this is slightly less than the increase experienced for the United States as a whole, it is projected that the East Coast will maintain the same growth rate for imports as the entire United States until the year 2000. Consequently, East Coast oil imports will continue to represent 70 percent of all United States oil imports.

Table 8 PROJECTED EAST COAST OIL* IMPORTS

Year	Actual[1/]	Litton[2/]	AAPA[3/]	Newport[4/]	Mean Projection
	(Millions of Long Tons)				
1953	48.0				
1963	83.6				
1968	107.4	110.7	88.8	106.8	102.1
1973		137.7	94.0	130.0	120.6
1983		207.3	111.0	175.0	164.4
2003		327.8	155.0	276.0	252.9
	(Average Annual Percent Increase)				
1953-1963	7.4%				
1963-1968	5.7%	6.5%	1.2%	5.6%	4.4%
1968-1973		4.9%	1.2%	4.3%	3.6%
1973-1983		5.1%	1.8%	3.5%	3.6%
1983-2003		2.9%	2.0%	2.9%	2.7%
1963-2003		7.3%	2.1%	5.8%	5.1%

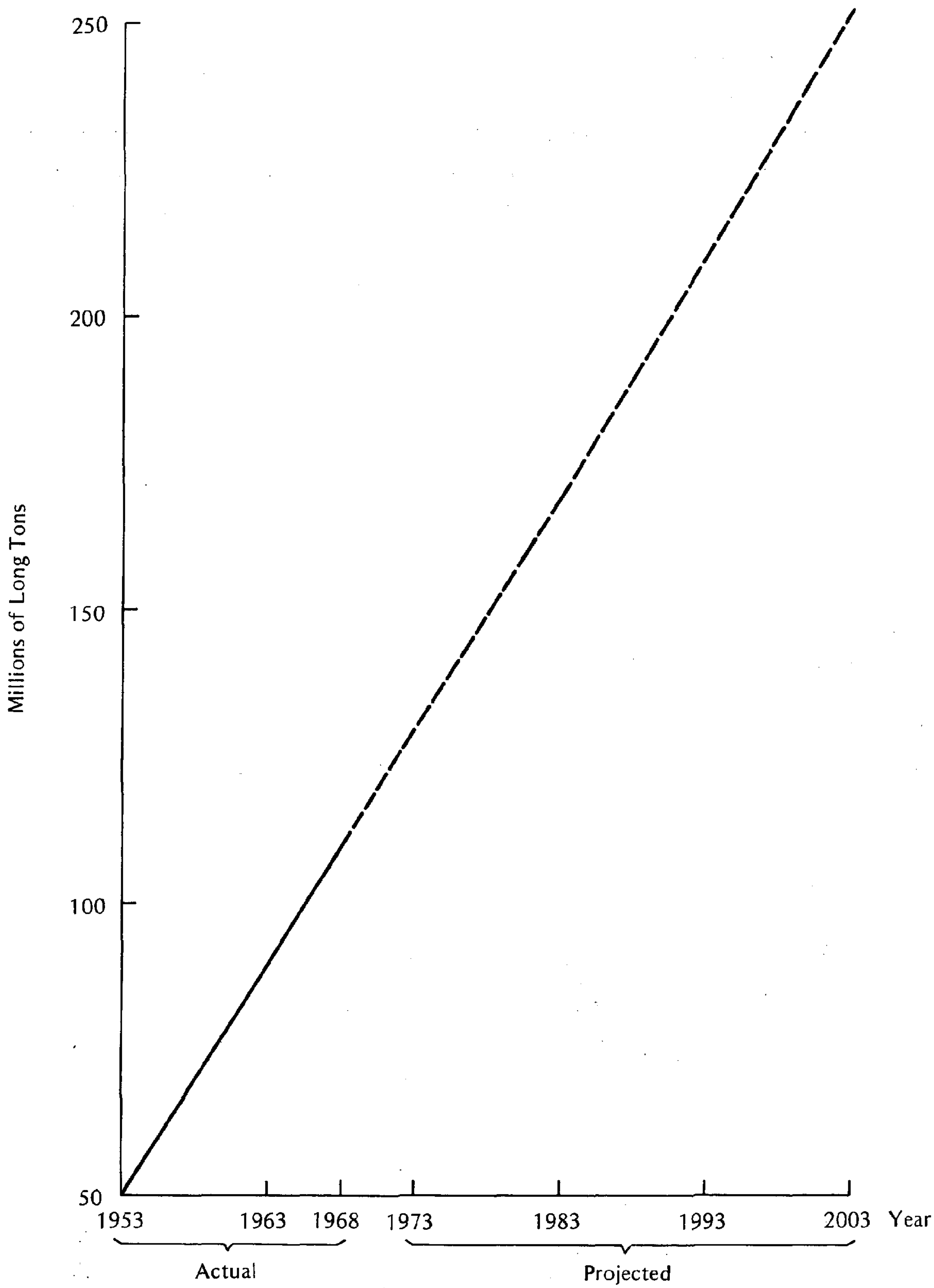
* These are projections of crude and residual oils only.

1/ Army Corps of Engineers, Waterborne Commerce of the U.S., 1968.

2/ Litton Systems, Inc., 1968.

3/ American Association of Port Authorities, 1969.

4/ Newport News Shipbuilding and Dry Dock Company, 1970.



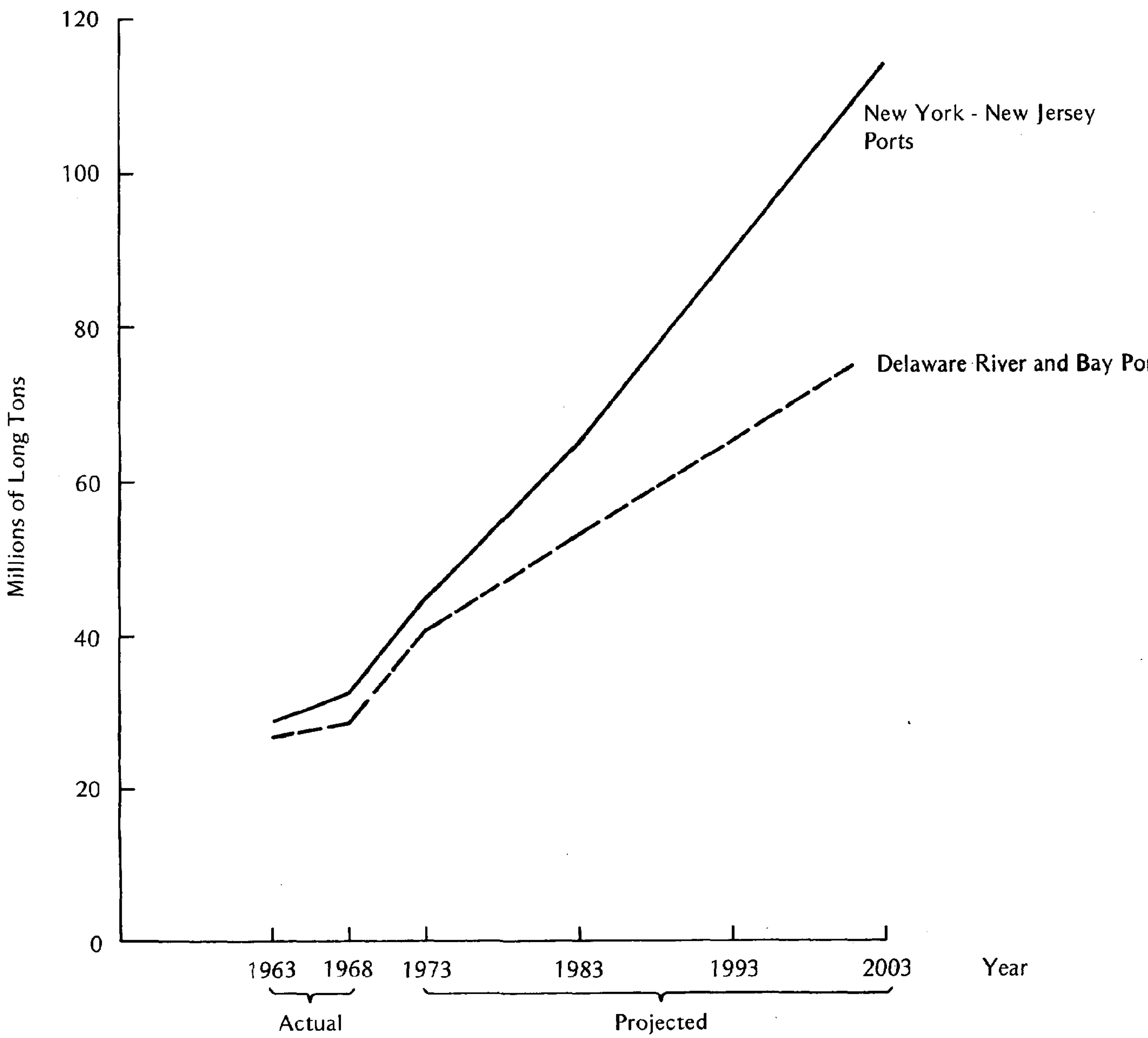
Graph 6

PROJECTED EAST COAST OIL IMPORTS

Source: Gladstone Associates

By the year 2000 East Coast oil imports will reach a projected level of 250 million long tons. Delaware River and Bay petroleum imports in the past two decades have been increasing at a decreasing rate. Assuming this trend will continue in the future, Graph 7 portrays projected oil imports for the Delaware River and Bay ports. While Delaware River and Bay POL imports will increase to 75 million long tons by the year 2000, New York imports will reach a projected level of 114 million long tons.

Graph 7



PROJECTED OIL IMPORTS BY PORT, 1973 to 2003

Source: Gladstone Associates

The Location of Refineries

Petroleum throughput capacity is a measure of the crude oil tonnage which a refinery or group of refineries can process in a year allowing for downtime for maintenance.

As seen in Table 9 , total United States petroleum throughput capacity is presently 602 million long tons per year. Of this total, 398 million long tons of capacity, or 66 percent, are located along ocean coasts. The largest capacity is located along the Gulf Coast of the United States accounting for 59 percent of total coastal capacity. Refineries along the East Coast of the United States account for 18 percent of total coastal capacity and 12 percent of total United States capacity. In 1969, refineries along the East Coast had a combined petroleum throughput capacity of 71 million long tons per year.

Table 9 PETROL THROUGHPUT CAPACITY PER YEAR*, 1969

(Millions of Long Tons)

	Total	Shut Down and Operable	New Construction	Number of Refineries	Annual Tons per Refinery (millions)
Total U.S.	602.21	59.86	18.62	284	2.114
Total East Coast	71.18	1.46	0.37	20	3.559
Gulf Coast	232.51	0.37	11.32	42	5.536
West Coast	93.81	0.73	4.38	44	2.132

* Allows for "down-time" for maintenance, etc.

SOURCE: U.S. Department of Interior and Gladstone Associates.

The capacity of East Coast refineries has decreased approximately 1 percent annually since 1960. However, refinery capacity shows a trend toward greater concentration in fewer areas along the East Coast, specifically at New York and Philadelphia, in fewer but larger refineries. Table 10 shows the extent to which East Coast Refinery capacity is concentrated along the Delaware River and Bay. Refineries along the Delaware River and Bay comprise 67 percent of total East Coast refinery capacity. Present Delaware River and Bay refinery capacity is 47 million long tons of oil per year, the second largest concentration of capacity for any single port area in the nation.

Table 10

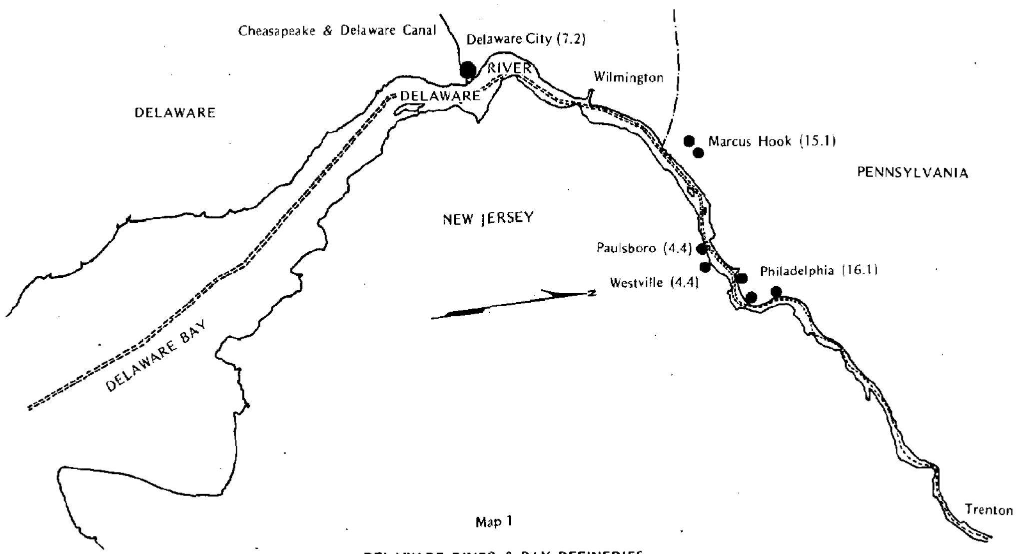
1969 CRUDE OIL CAPACITY
BY PORT AREA OF THE U.S. EAST COAST

Port Area	City	Number of Refineries	Operating or operable in millions of long tons per year	Additional capacity under Construction	% of Total East Coast Capacity
Total East Coast		20	70.21	0.26	100.0%
Providence	Providence	1	00.38	-	0.5%
N.Y.-N.J.	Perth Amboy	6	18.88	-	26.8%
Baltimore	Baltimore	2	1.03	-	1.5%
Hampton Roads	Yorktown	1	2.21	-	3.1%
Savannah, Ga.	Savannah	2	0.44	-	0.6%
Delaware River	Total	8	47.10	0.26	67.1%
	Philadelphia	3	16.08	0.26	22.9%
	Marcus Hook	2	15.09	-	21.5%
	Paulsboro	1	4.38	-	6.2%
	Westville	1	4.38	-	6.2%
	Delaware City	1	7.19	-	10.2%

Note: Delaware River represents the second largest port concentration of capacity in the U.S.

Source: U.S. Bureau of Mines and Gladstone Associates

Map 1 and Table 10 indicate the refinery capacity of various port areas along the East Coast. Well over 80 percent of the Delaware River and Bay refinery capacity is located in the metropolitan area of Philadelphia.



Map 1

DELAWARE RIVER & BAY REFINERIES

Numbers in parenthases indicate refinery capacity in millions of long tons per year.

Petroleum Sources

The projected origin of United States oil imports by the year 2000 may be seen in Table 11 below. Projections by the Newport News Shipbuilding and Dry Dock Company and the American Association of Port Authorities indicate a growing reliance upon oil imports from Africa and the Middle East to meet growing domestic demands. Graph 8 portrays the mean of these projections in tons.

Presently 75 percent of total United States oil imports originate in the Caribbean whereas 14 percent or 16 million long tons originate from Africa and the Middle East. By the year 2000, from 45 percent to 65 percent of all United States oil imports will originate in Africa and the Middle East. These imports will amount to between 160 and 235 million long tons by the year 2000.

Table 11 PERCENT DISTRIBUTION OF PROJECTED U.S. OIL[1/] IMPORTS BY PLACE OF ORIGIN, 1963 TO 2003

Origin	Actual[2/] Origin 1963	1973 Projections AAPA[3/]	1973 Projections Newport[4/]	1983 Projections AAPA[3/]	1983 Projections Newport[4/]	2003 Projections AAPA[3/]	2003 Projections Newport[4/]
Caribbean	75%	68%	60%	61%	45%	50%	30%
Africa	0%	2%	12%	5%	25%	10%	38%
Middle East	14%	19%	20%	25%	25%	35%	30%
Other	11%	11%	8%	9%	5%	5%	2%
All Oil Imports	100%	100%	100%	100%	100%	100%	100%

1/ Includes crude and residual oils only.

2/ U.S. Waterborne Foreign Trade, FT 985, Bureau of the Census

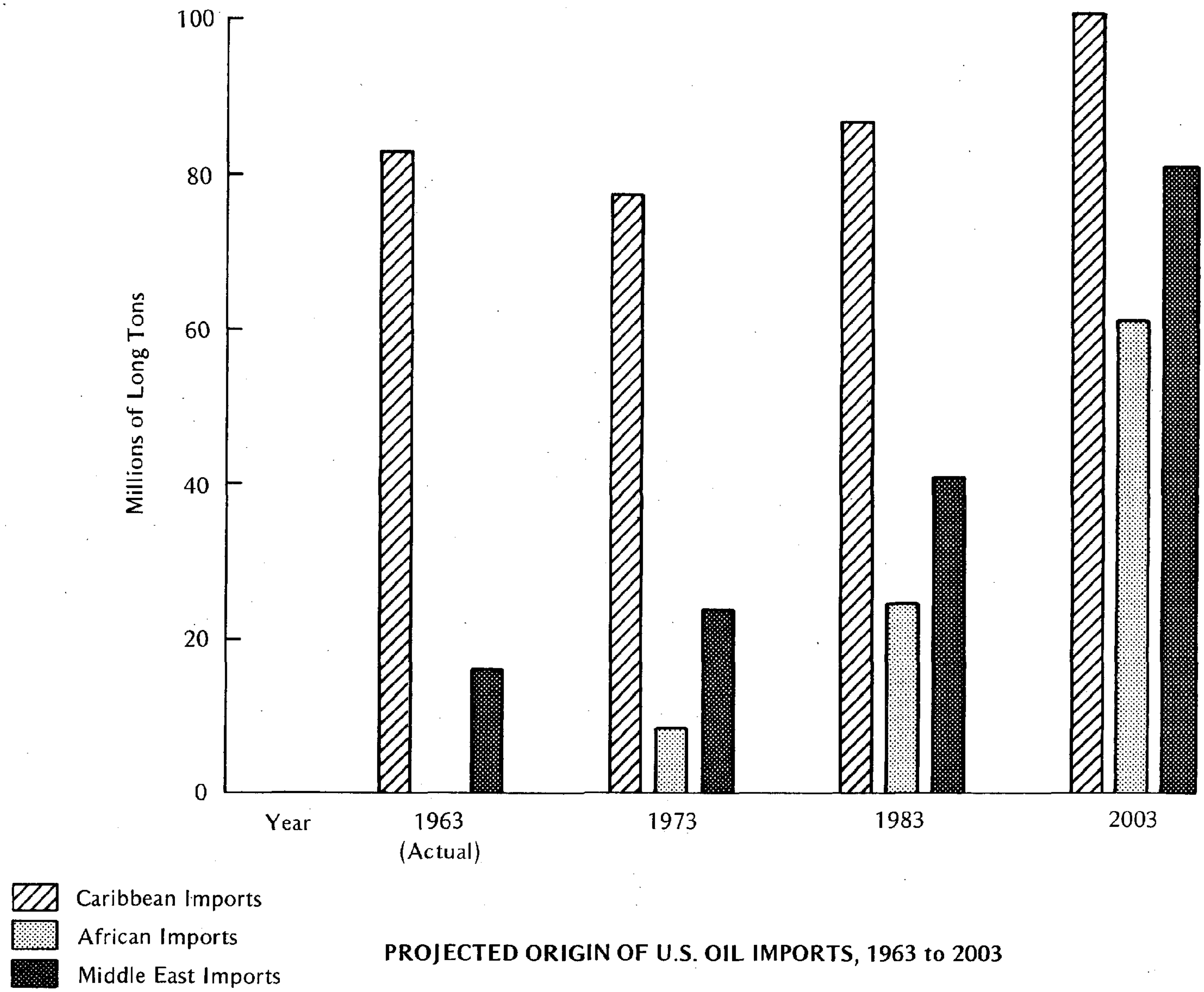
3/ American Association of Port Authorities, 1969.

4/ Newport News Shipbuilding and Dry Dock Company, 1970.

SOURCE: Gladstone Associates.

Since supertankers are most effective in reducing transportation costs for long journeys, the growing importance of Africa and the Middle East as a sources of United States oil imports, will add to the demand for a deepwater port which can properly service supertankers.

Graph 8



PROJECTED ORIGIN OF U.S. OIL IMPORTS, 1963 to 2003

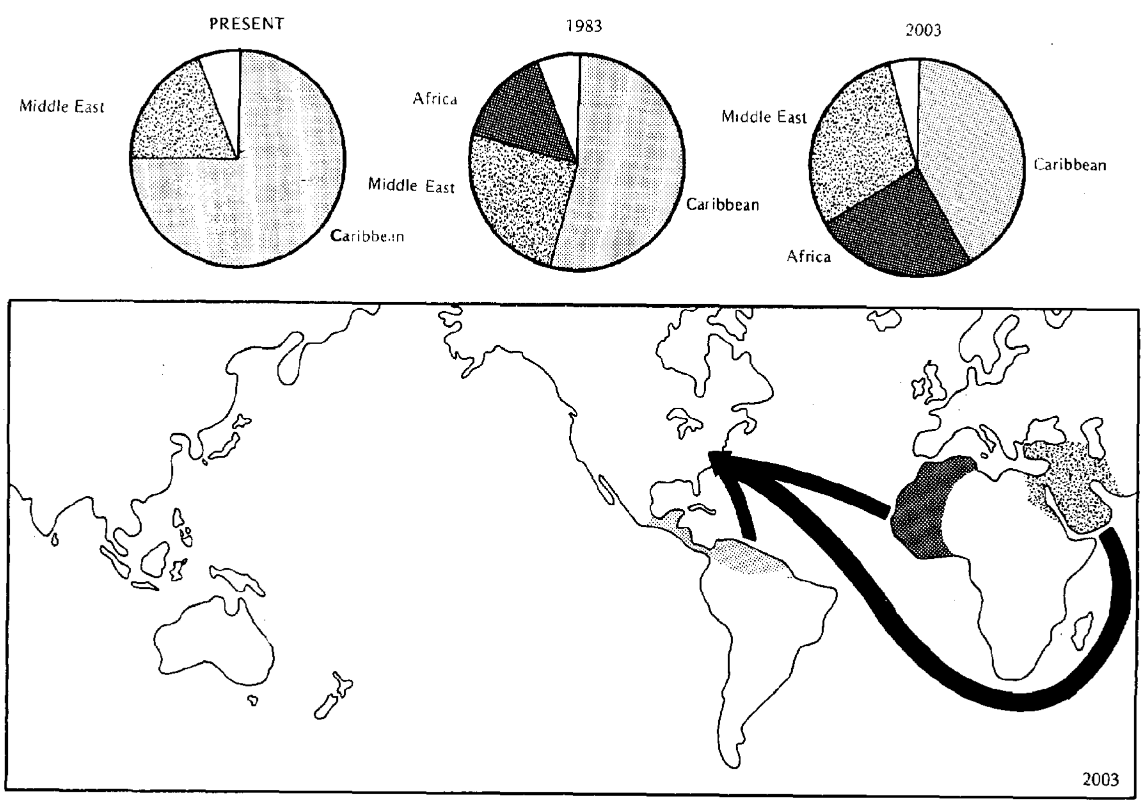
Deepwater Port Potentials

Earlier discussions indicated that 70 percent of tanker ship capacity would be found in ships with drafts in excess of 50 feet by the year 2000. Consequently, it could be conservatively assumed that 70 percent of non-Caribbean imports will be transported in supertankers. If the Delaware River and Bay ports continue to import 33 percent of total East Coast oil imports, then a deepwater transfer terminal in the lower Delaware would handle a projected 84 million long tons of oil by the year 2000.

This appears to be a conservative estimate for a deepwater transfer terminal along the East Coast. The only deepwater transfer terminal in existence, at Bantry Bay in Ireland, handles well over this amount.

The oceanborne movement of East Coast oil imports is portrayed in Map 2 . These lines dramatically indicate the inefficiencies petroleum companies are facing and their desire for a deepwater transfer terminal to reduce transport costs.

Map 2
PROJECTED ORIGINS OF UNITED STATES OIL IMPORTS



IRON ORE

Introduction

United States and world demand for high grade iron ore has increased at a moderately high rate since the Second World War. It is projected that United States iron ore imports will increase at a rate of two percent annually through the year 2000. These imports will be bound mainly for East Coast ports which will handle a projected 35 million tons by the year 2000.

Presently, 75 percent of United States iron ore imports come from either Canada or Venezuela, areas too close for the feasible use of superships. With changing technology, it is projected that iron ore production in Africa and the West Coast of South America will be economically feasible by the year 2000; the development of these reserves will facilitate the use of superships.

It appears probable that a deepwater transfer terminal located in the Delaware could handle a significant amount of projected iron ore imports.

Table 12

IRON ORE IMPORTS, 1961-68

(thousands of long tons)

	Delaware River & Bay	New York	Baltimore	Hampton Roads	East Coast Total	Total United States
1961	9,427	0	8,564	510	18,501	26,500
1968	10,582	2	10,374	342	21,300	26,200
	(Average Annual Percent Increase)					
1961-68	1.75%		3.02%	-7.02%	2.16%	-0.16%
	(Percent Distribution of United State Iron Ore Imports)					
1961	35.6%	0.0%	32.3%	1.9%	69.8%	100.0%
1968	40.4%	0.0%	39.6%	1.3%	81.3%	100.0%

Source: **Army Corps of Engineers and Gladstone Associates.**

Iron Ore Imports in the Past Decade

While total United States iron ore imports in the 1960's remained constant at a level of 26 million long tons, East Coast iron ore imports increased 2.2 percent annually to 21.3 million long tons in 1968.

East Coast iron ore imports in 1961 amounted to 18.5 million long tons, representing 70 percent of total United States iron ore imports. By 1968, East Coast tonnage accounted for slightly more than 81 percent of total United States iron ore imports, amounting to 21.3 million long tons.

East Coast ports showed varying trends through the 1960's, as seen in Table 12. Iron ore imports into the Delaware River ports increased one and three-quarter percent annually to 10.6 million long tons in 1968. At the beginning of the decade, Delaware River and Bay ports handled 36 percent of total United States iron ore imports increasing to 40 percent in 1968. Iron ore imports moving into Baltimore increased 3 percent annually to a level almost identical to that of the Delaware River and Bay ports. These two ports handled 80 percent of United States, and virtually all East Coast, iron ore imports.

Projected Iron Ore Imports

Since 1960, the level of total United States iron ore imports has remained constant at approximately 26 million long tons. However, several projections indicate that iron ore imports will increase through the year 2000. Projections by Newport News Shipbuilding and Dry Dock Company, Bath Iron Works, and Booz-Allen are set forth in Table 13.

Table 13 PROJECTED UNITED STATES OCEANBORNE IRON ORE IMPORTS

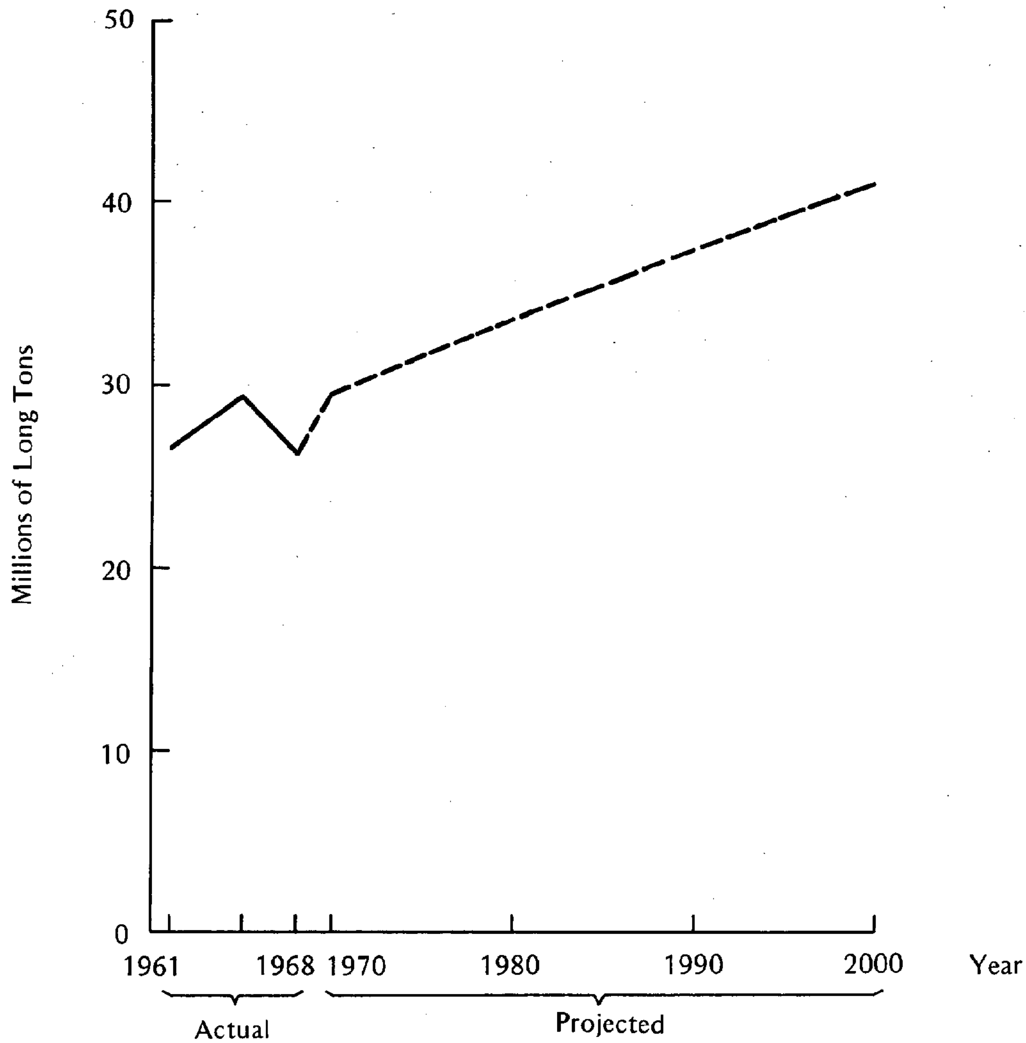
Year	Actual	Newport[1/]	Bath[2/]	Booz Allen[3/]	Mean Projection
	(millions of long tons)				
1961	26.5				
1965	29.4				
1968	26.2				
1970		29.0	28.5	32.0	29.8
1980		29.7	35.2	35.0	33.3
1990		32.2	40.1	40.0	37.4
2000		34.9	44.1	44.1	41.0
	(Average Annual percent increase)				
1961-68	-0.16%				
1968-80		1.11%	2.86%	2.80%	2.26%
1980-2000		0.75%	1.26%	1.30%	1.01%
1968-2000		1.04%	2.14%	2.14%	1.77%

1/ Newport News Shipbuilding and Dry Dock Co., 1970

2/ Bath Iron Works Corp., 1970

3/ Booz-Allen Applied Research, Inc. 1969

The mean of these projections can be seen in graph 9. In the next three decades total United States iron ore imports will increase at an anticipated rate of 1.8 percent annually. While present imports amount to 26 million long tons, by the year 2000 the United States will be importing a projected 41 million long tons.



Graph 9

PROJECTED U.S. IRON ORE IMPORTS

Source: Gladstone Associates

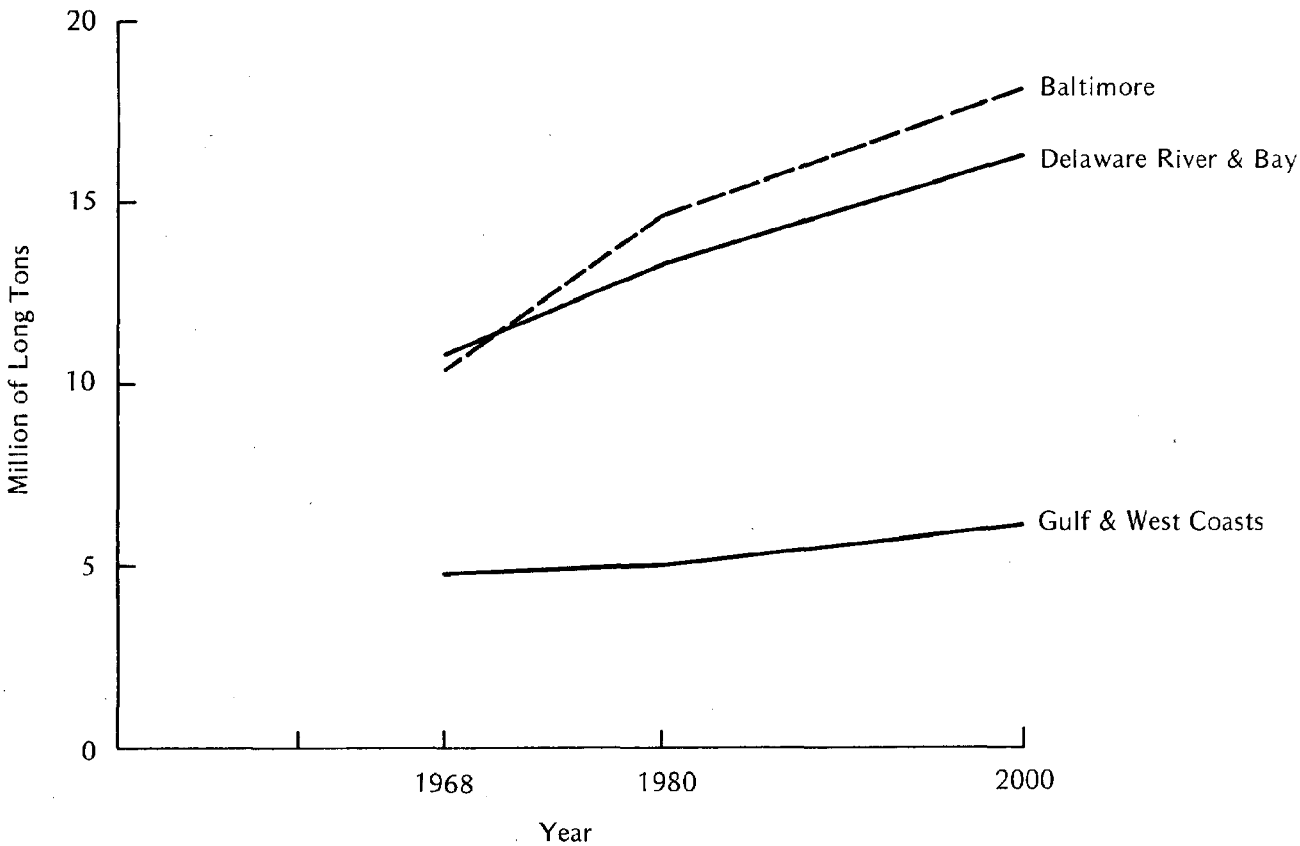
East Coast iron ore imports are projected to increase slightly faster than other coastal areas. Since the East Coast is more remotely located with regard to domestic iron ore sources, the Eastern seaboard will become more reliant upon imports to meet increased demand for steel production. Iron ore imports into Baltimore are projected to increase slightly faster than those into the Delaware River and Bay because of recent investment in steel producing capacity in Maryland. Baltimore will surpass the Delaware River and Bay as the largest single destination of United States iron ore imports, handling 44 percent of the total or 18 million long tons by the year 2000. The Delaware River and Bay ports will continue to handle 40 percent of total United States iron ore imports amounting to 16.3 million long tons by the year 2000.

East Coast iron ore imports are projected to increase 2 percent annually, rising from a 1968 level of 21 million long tons to 35 million long tons by the year 2000. However, technological advances which could reduce the costs of benefication processing of low grade domestic ores could alter the import projections

Table 14 PROJECTED IRON ORE IMPORTS, BY PORTS, 1968-2000

	Delaware River & Bay	New York	Balti-more	Hampton Roads	East Coast Total	Total U. S.
	(thousands of long tons imported)					
1968	10,582	2	10,374	342	21,300	26,200
1980	13,250	0	14,550	500	28,300	33,300
2000	16,315	0	17,915	620	34,850	41,000
	(average annual percent increase in imports)					
1961-68	1.75%	-	3.02%	-7.02%	2.16%	-0.16%
1968-1980	2.10%	-	3.35%	3.85%	2.74%	2.26%
1980-2000	1.16%	-	1.16%	1.20%	1.16%	1.01%
1968-2000	1.69%	-	2.27%	2.54%	1.99%	1.77%

Source: Gladstone Associates



Graph 10

PROJECTED IRON ORE IMPORTS, BY PORTS, 1968 - 2000

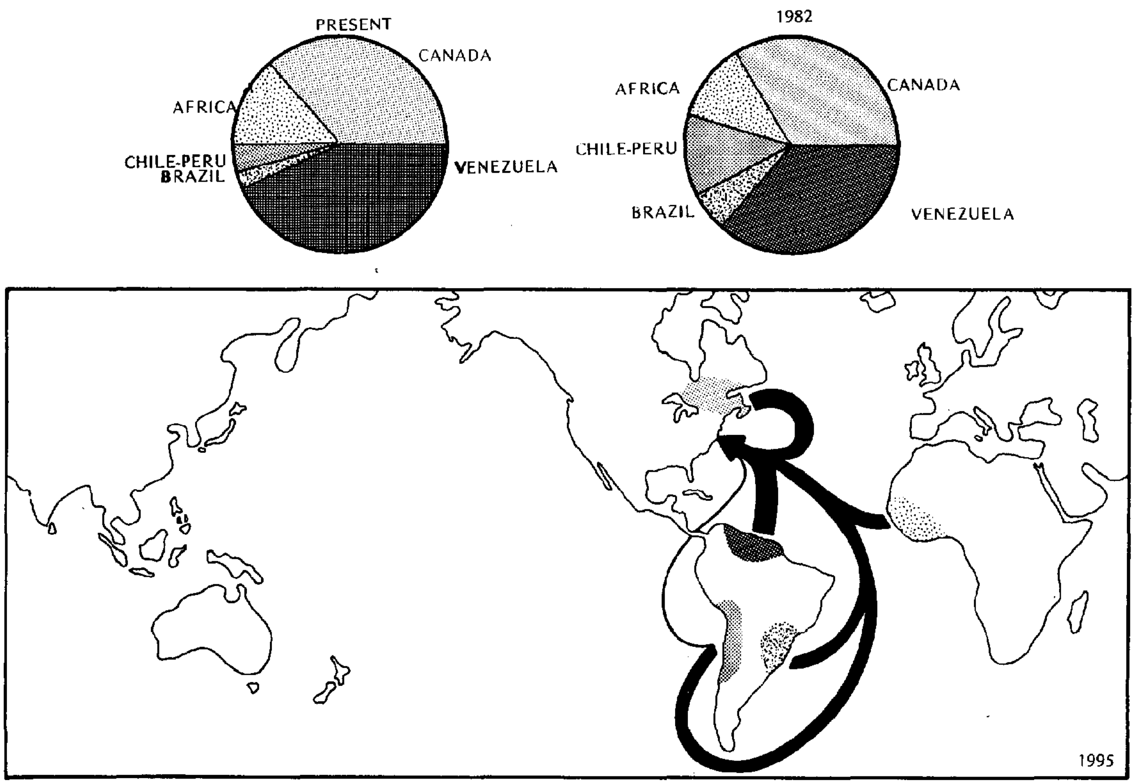
Source: Gladstone Associates

The Source of Iron Ore Imports

The impetus for the use of superships in transporting bulk commodities has been the need to transport large volumes a great distance. Iron ore imports from Canada and Venezuela, accounting for 72 percent of the United States total, do not move a sufficient distance to realize large cost savings when transported in superships. However, 7 million long tons of iron ore in 1968 moved to the United States in vessels traveling in excess of 6,000 miles. As indicated earlier in this report, sufficient cost savings are realized on journeys of this length to warrant the use of superships.

Map 3

THE ORIGIN OF UNITED STATES IRON ORE IMPORTS



Source : Bath Iron Works and Gladstone Associates

Projections by the Bath Iron Works Company, seen in Table 15, anticipate iron ore imports from nations more than 6,000 miles away to increase to 10 million long tons by 1982.

Table 15

PROJECTED ORIGIN OF IRON ORE IMPORTS, BY POTENTIAL USE OF SUPERSHIPS,1968-82

	1968		1982		Average Annual Percent Increase 1968-82
	Millions of Long Tons	Percent of U.S. Total Imports	Millions of Long Tons	Percent of U.S. Total Imports	
Total Imports	26.18	100.0%	36.34	100.0%	2.77%
Country of Origin and Use of Superships					
Convential Ships					
Canada	8.56	32.7%	12.71	35.0%	3.46%
Venezuela	10.33	39.5%	13.74	37.8%	2.36%
Subtotal	18.89	72.2%	26.45	72.8%	2.86%
Either Type of Ship					
Brazil	1.25	4.8%	2.38	6.6%	6.46%
Subtotal	1.25	4.8%	2.38	6.6%	6.46%
Supership Candidates					
Chile	1.45	5.5%	2.86	7.9%	6.95%
Peru	0.92	3.5%	0.94	2.6%	0.16%
Africa	3.67	14.0%	3.71	10.2%	0.08%
Subtotal	6.04	23.0 %	7.51	20.7%	1.74%

Source: Bath Iron Works and Gladstone Associates

Deepwater Port Potential

A deepwater port in the lower Delaware Bay could significantly reduce the transportation costs of importing iron ore.

United States demand for iron ore imports is predominantly concentrated in Baltimore and along the Delaware River. Moving iron ore in superships from distant sources to such a concentrated market would result in significant transportation cost savings. Without the added stimulant of a deepwater port in lower Delaware Bay iron ore shipments from nations in excess of 6,000 miles from the United States are projected to increase to 13 million long tons by the year 2000. The stimulus of cost savings resulting from the employment of superships might double these figures. Ten and one-half million long tons of iron ore appears to be a conservative estimate of trans-shipments through a deepwater port in the lower Delaware by the year 2000.

Weak Potentials

COAL

Introduction

The relative importance of coal as a world energy source has decreased since the turn of the century. Even so, waterborne United States coal exports have remained at a constant level since the 1950's. Due solely to increasing Japanese demand, slight increases in total waterborne coal exports are anticipated for the remainder of this century.

Japan is rapidly becoming the largest single consumer of United States coal exports. It is anticipated that because of the great distance involved in shipping coal to Japan, quantities of coal will be moving in superships in the future between the two countries.

Domestic Coal Reserves and Production

Table 16 shows that one half of all United States coal reserves are located along the East Coast of the United States. However, nearly three quarters of all United States bituminous coal production is located in the same Eastern area.

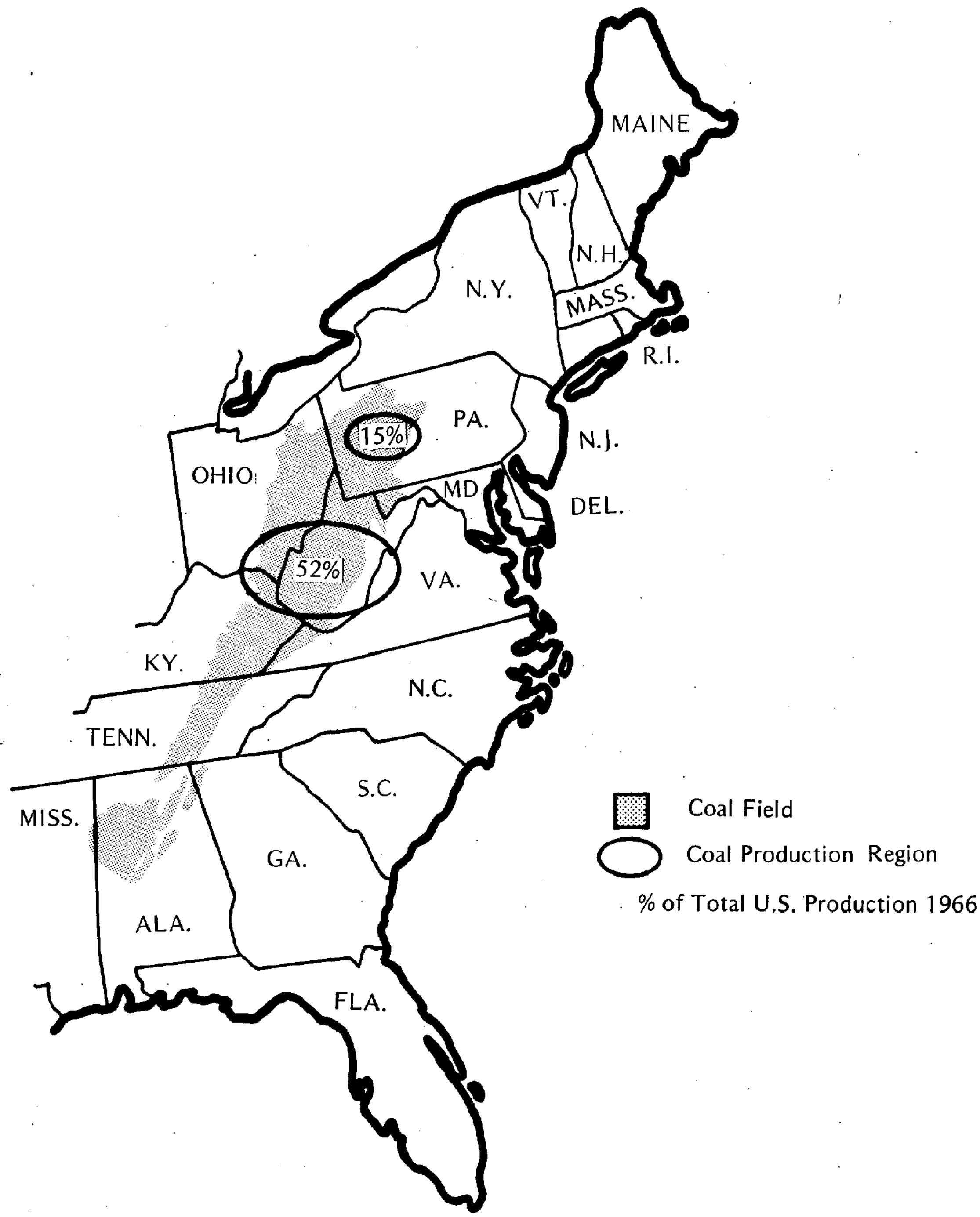
Table 16 UNITED STATES COAL RESERVES AND 1966 BITUMINOUS COAL PRODUCTION

	United States Bituminous Coal Reserves Billions of Long Tons	Bituminous Coal Production		
		1935-39 Average (Millions of Long Tons)	1966	(1936-1966) Average Annual Percent Change
United States Total	599.3	357.3	476.8	1.12%
Maryland	1.1	1.4	1.1	-0.67%
Pennsylvania, West	51.3	86.2	72.7	-0.52%
Virginia	8.7	10.9	31.8	6.39%
Kentucky	58.9	30.7	83.2	3.84%
West Virginia	91.1	96.0	133.7	1.31%

Source: U.S. Bureau of Mines, U.S. Geological Survey and Gladstone Associates

Map 4

U.S. COAL RESERVES AND PRODUCTION



Coal production is concentrated in West Virginia, Kentucky and Virginia. Reserves close to Hampton Roads yield 52 percent of total United States coal production. This is the only coal producing area in the United States which has increased its production since the 1930's. Productive coal regions close to Philadelphia and Baltimore accounted for only 15 percent of total United States coal production in 1966 and have been steadily and slowly decreasing since 1935.

Changing technology in coal production in the late 1960's has accessed coal reserves located in southern Utah. The importance of Utah coal for meeting future United States and foreign consumption demands cannot be determined with any great precision. However, it appears as exports increase to Japan, Utah coal production might very well serve as a more economical source for that market.

In the past decade virtually all United States coal exports have moved through ports located along the East Coast. However, in recent years, the increasing importance of the Japanese market for United States coal exports has given impetus to some coal movement through ports located along the West Coast. The total amount of export coal passing through these West Coast ports has been small.

Coal Exports in the Past Decade

In 1966, the United States mined nearly ½ billion long tons of coal; 93 percent of this total coal production was domestically consumed.

Since 1960, total coal exports have increased at an average annual rate of one percent while waterborne exports decreased at an average annual rate of one half percent. Total United States waterborne coal exports have remained at approximately 31 million long tons through the 1960's. However, coal exports to Asia (mainly to Japan) increased at an average annual rate of 35 percent, achieving a level of 14 million long tons in 1968. These figures are displayed in Table 17.

Table 17

U.S. EXPORT OF COAL
(Millions of Long Tons)

	1964	1968	Average Annual Percent Increase 1964-1968
Bituminous Coal			
Total Exports	42.9	45.2	1.3%
Overseas Exports 1/	30.2	30.3	0.1%
Exports to Asia	5.8	14.1	35.8%
Anthracite Coal			
Total Exports	1.4	0.5	-16.1%
Overseas Exports 1/	0.9	0.1	-22.2%
Exports to Asia	0.05	0.02	-15.0%
Total All Coals			
Total Exports	44.3	45.7	0.8%
Overseas Exports 1/	31.1	30.4	- 0.6%
Exports to Asia	5.85	14.12	35.3%

1/ Includes all exports of coal except those destined for Canada.

SOURCE: U.S. Bureau of Mines and Gladstone Associates.

United States coal reserves are concentrated along the East Coast, with the greatest mining activity located in West Virginia, Kentucky and Virginia. During the past decade Hampton Roads was the only East Coast port which increased its coal exports because of its

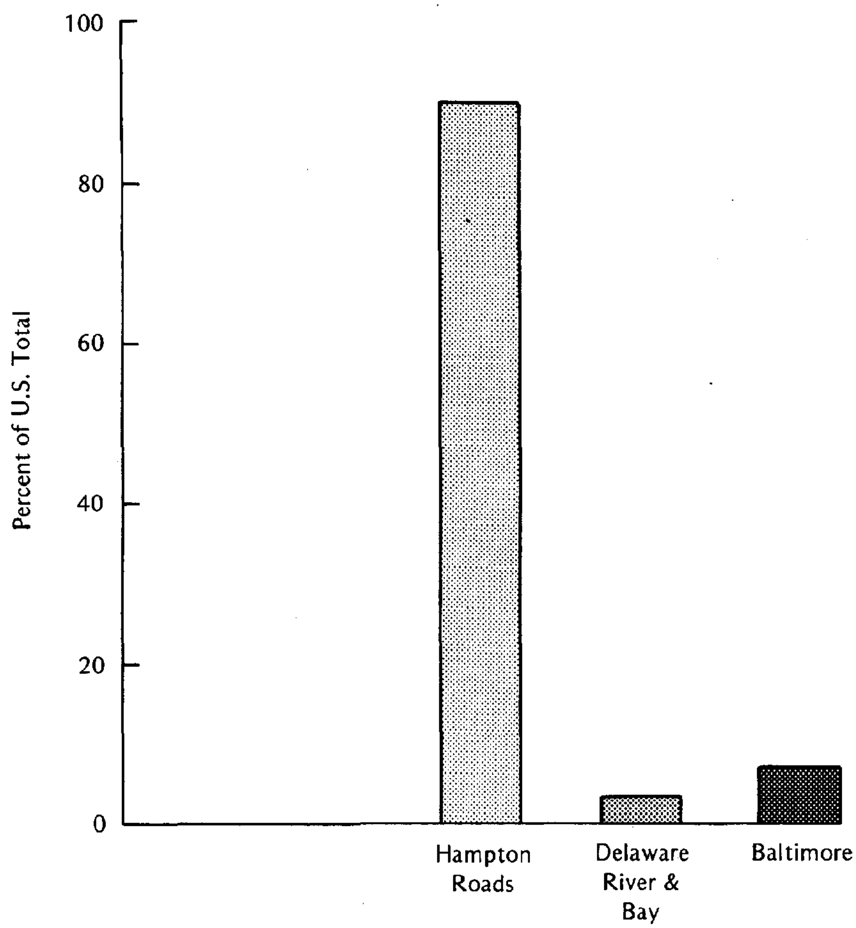
Table 18

U.S. COAL EXPORTS
BY PORTS
1964 AND 1968 1/

	1964		1968		1964-1968
	Thousands of Long Tons	Percent of U.S. Total	Thousands of Long Tons	Percent of U.S. Total	Average Annual percent Increase
Hampton Roads	27,329	84.5%	28,363	90.3%	0.94%
Los Angeles	-	0.0%	7	0.0%	-
Philadelphia	1,905	5.9%	845	2.7%	-13.88%
New Orleans	-	0.0%	30	0.1%	-
Baltimore	3,099	9.6%	2,160	6.9%	-7.58%
Total Overseas	32,334	100.0%	31,404	100.0%	-0.30%

1/ Bituminous and anthracite coals.

Source: Association of American Railroads and Gladstone Associates



Graph 11

PORTS EXPORTING COAL OVERSEAS, 1968

more favorable location relative to coal producing regions. Hampton Roads presently handles 90 percent of total United States coal exports.

Coal exports from Delaware River and Bay ports declined through the past decade from 2 million tons to less than 1 million tons. These ports handled slightly less than 3 percent of total United States coal exports. The Delaware River and Bay ports are not as favorably located as Hampton Roads to coal producing regions.

Special freight rates have been established by the railroad industry enabling a shipper to move large volumes on a continuous basis to the same point at a relatively lower rate. These special rates, once established, are rarely changed and favor a port which moves the greatest volume of a bulk commodity. Hampton Roads is presently favored in freight rate schedules. Consequently, coal moving from an equal distance to either the Delaware River ports or Hampton Roads will incur higher transportation charges if shipped to the Delaware River area.

Projected Coal Exports

Several projections of total United States coal exports have been made. These include projections by: (1) Litton, (2) Bath Iron Works, (3) Booz-Allen, and (4) National Coal Association. These projections are substantially congruent.

Coal exports will increase at a relatively slow rate of 2 percent annually through the year 2000, increasing from 31 million to 56 million long tons. These projections are presented in Table 19 and in graphic form on the following page.

Table 19 PROJECTED UNITED STATES COAL EXPORTS

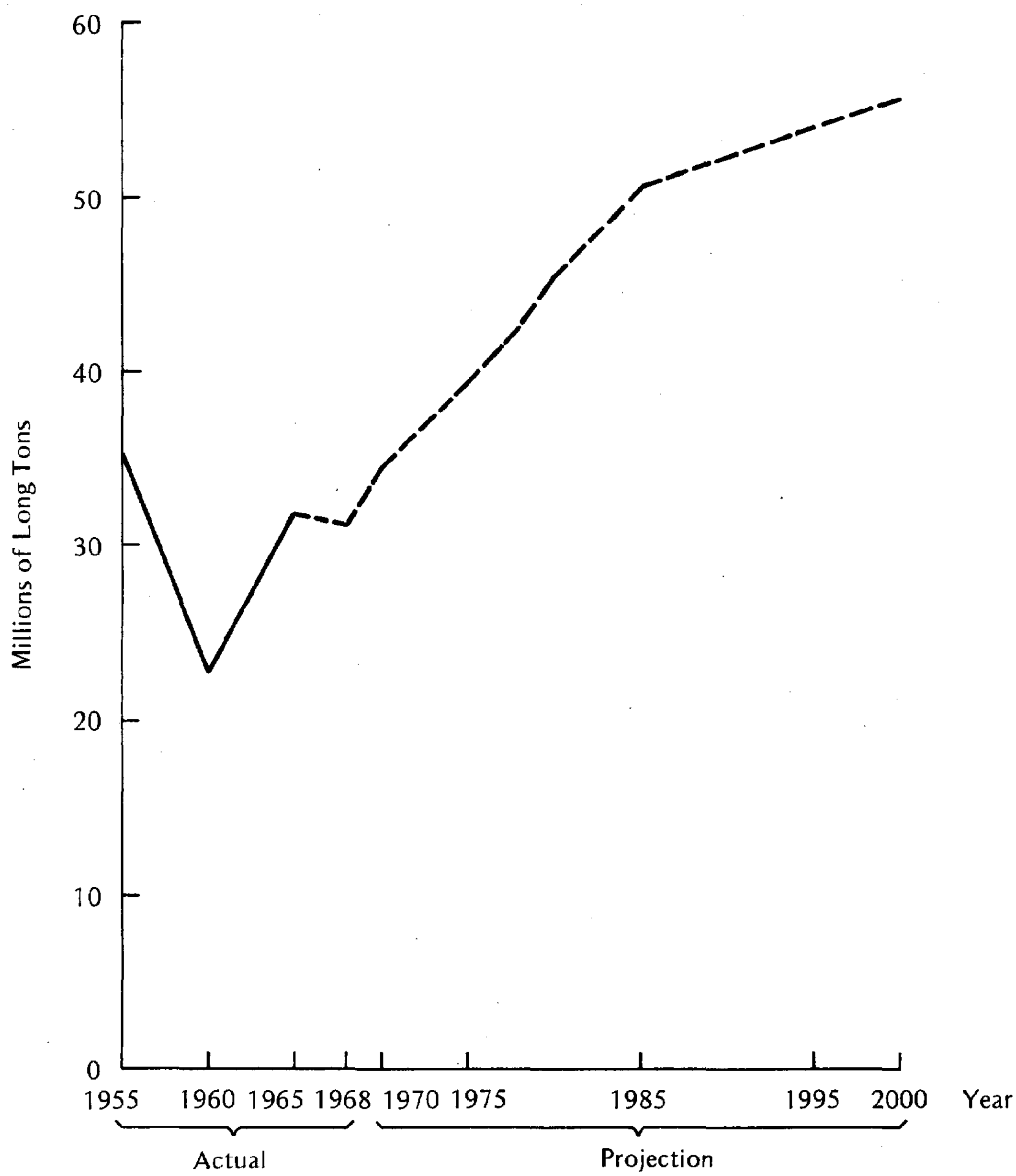
Year	Actual	Bath[1/] Iron Works	Litton[2/] Systems Inc.	Booz[3/] Allen Research	National[4/] Coal Association	Mean Projection
		(Millions of Long Tons)				
1955	35.5					
1960	22.8					
1968	31.1					
1970		33.9	34.8	32.0	35.7	34.1
1975		40.5	38.7	41.0	36.6	39.2
1980		45.4	43.0	48.0	-	45.4
1985		52.8	47.9	51.0	-	50.6
2000		-	54.3	57.1	-	55.7
		(Average Annual Percent Increase)				
1968-1970		4.5%	6.0%	1.5%	7.4%	4.8%
1970-1975		3.9%	2.2%	5.6%	0.5%	3.0%
1975-1985		3.0%	2.4%	2.4%	-	2.9%
1985-2000		-	0.89%	0.80%	-	0.67%
1970-2000		-	1.87%	2.61%	-	2.11%

1/ CMX Project, Bath Iron Works Corp., 1970.

2/ Oceanborne Shipping, Litton Systems, Inc. 1968.

3/ Forecast of U.S. Oceanborne Foreign Trade, Booz-Allen Applied Research, 1969.

4/ National Coal Association, 1970



Graph 12

PROJECTED U.S. EXPORTS OF COAL

Source: Gladstone Associates

Through the remainder of this century total United States coal exports will increase only 2 percent annually whereas exports to Japan will increase at an average annual rate of 6 percent. The increasing importance of Japan as a consumer of United States coal exports is displayed in Table 20.

Presently, 13 million long tons or 45 percent of all United States coal exports are bound for Japan. By 1995, exports to Japan will increase to 35 million tons, or 65 percent of all United States coal exports.

Table 20

PRESENT AND PROJECTED
DESTINATION OF COAL[1/] EXPORTS
(Million of Long Tons)

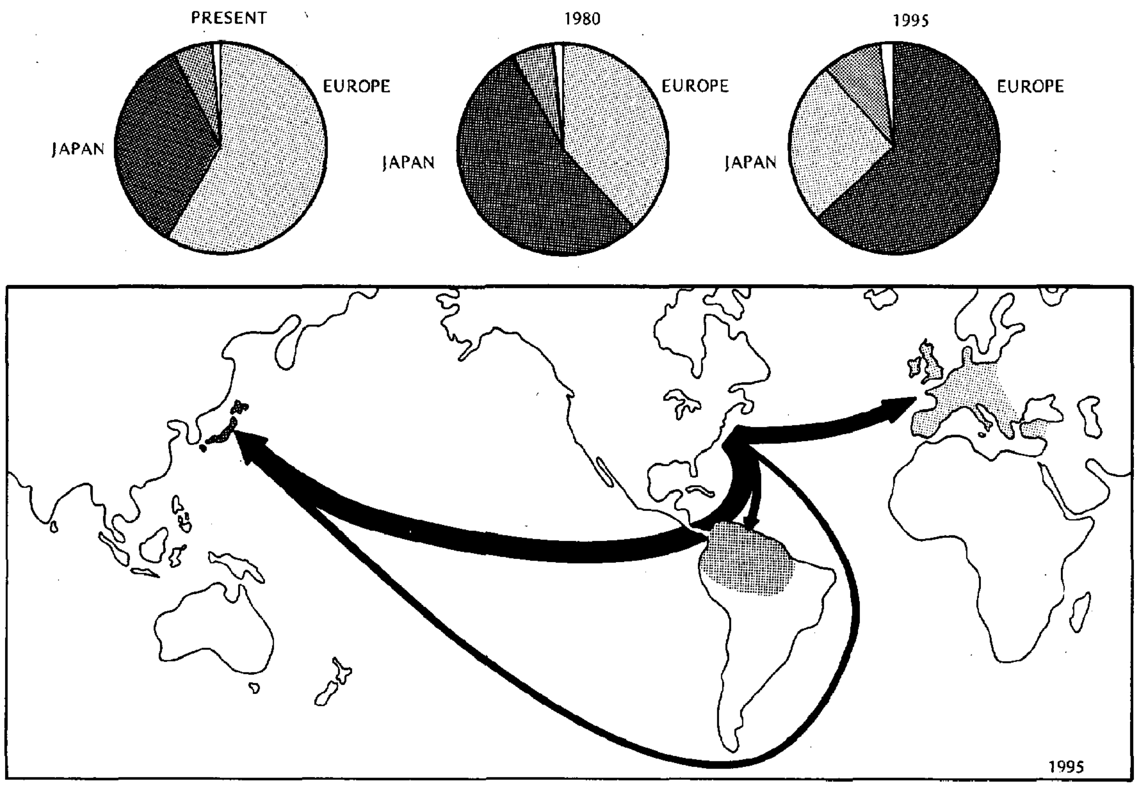
Year	Total Exports	Europe	Japan	South America	All Other
1955	35.5	25.6	2.5	1.3	6.1
1960	22.8	15.1	5.1	1.9	0.7
1965	31.7	22.5	6.8	1.8	0.6
1970	31.8	15.1	13.4	1.9	1.4
1980	47.8	14.8	27.8	3.1	2.1
1995	55.1	13.5	35.3	3.9	2.4

1/ Bituminous coal only.

Source: Booz-Allen Applied Research, 1969.

Map 5

THE DESTINATION OF UNITED STATES COAL EXPORTS



Source : Booz-Allen Applied Research and Gladstone Associates

As the route length and volume of bulk commodities increase, the greater are the economies of supership employment. While the use of superships could be justified because of the distance between Japan and the United States, the nature of coal and its domestic location make it virtually infeasible with present technology to ship directly in, or transfer to, deep draft vessels. The added restriction of a 34 foot channel through the Panama Canal would further inhibit their use.

Projections shown in Table 21 indicate coal exports through Philadelphia will remain at their 1968 level of 1 million long tons through the remainder of the century. Hampton Roads will continue to dominate coal exports.

With technological change and increased demand a deepwater port located in the lower Delaware would probably trans-ship 4 million long tons of coal by the year 2000. The terminal would act mainly as a trans-shipment point for Hampton Roads coal bound for Asia. There would be insufficient demand to justify construction of rail lines linking a Delaware Bay deepwater port and existing main lines. Hampton Roads domination of coal exports will continue because of its proximity to coal fields and its favorable freight rates.

Table 21 PRESENT AND PROJECTED DELAWARE RIVER COAL EXPORTS 1965-1995

Year	Philadelphia Exports	Deepwater Port Transshipping 1/	Total Delaware River & Bay
1965	1.9	N.A.	1.9
1975	1.0	N.A.	1.0
1985	1.0	3.0	4.0
1995	1.0	4.0	5.0
	(Average annual percent increase)		
1965-85	-2.37%	-	5.56%
1985-95	0.00%	3.33%	2.50%
1965-95	-1.58%	-	5.44%

1/ These figures assume completion of the port in 1976 and are for trans-shipping from a ship exporting coal from Baltimore, Philadelphia or Hampton Roads to Japan and Asia. Assumes 30% capture of all Japan and Asia bound coal increases.

Source: Gladstone Associates

GRAIN

Introduction

United States grain production for the past 20 years has been in excess of domestic demand.

World demand for grains,including wheat, corn, soybean and sorghum, has increased rapidly in the past decade. A significant portion of this increased demand has been met by United States grain exports.

In the past, American grain exports to Europe have equalled the combined total of grain exports to all other nations of the world. Projected grain exports to Europe will remain constant through the year 2000 while exports to Africa and Asia are expected to increase at an average annual rate of 10 percent. During this period United States grain exports will increase from 40 million to 95 million long tons.

Table 22 U.S. GRAIN EXPORTS BY COASTAL AREA 1965

	(Millions of Long Tons)			
Coast	Wheat	Sorghum and Corn	Soybean	Total Grains
Atlantic	1.62	-	0.70	2.32
Gulf	11.16	16.34	5.53	33.03
Pacific	3.96	2.60	-	6.56
Other	1.26	-	0.77	2.03
Total	18.00	19.00	7.00	44.00
	(Percent Distribution)			
Atlantic	9%	0%	10%	5.27%
Gulf	62%	86%	79%	75.07%
Pacific	22%	14%	0%	14.91%
Other	7%	0%	11%	4.61%
Total	100%	100%	100%	100.00%

SOURCE. Newport News Shipbuilding and Dry Dock Company and Gladstone Associates

While it is anticipated there will be sufficient volume moving increasingly farther distances to warrant the use of superships, this potential is precluded to a large extent by other factors.

Domestic Location

The location of domestically produced grain for the most part has determined which United States ports handle grain exports.

Wheat, sorghum, and corn are predominantly located in the midwest and far western states whereas soybeans are located throughout the United States. Consequently, 90 percent of grain exports flow through Pacific and Gulf ports as seen in Table 22.

Grain Exports Since 1960

Total United States grain exports in the 1960's increased at an average annual rate of 9 percent, rising from 24 million long tons to 40 million long tons in 1968.

Because of its distance from the main grain producing regions of the United States, East Coast grain exports have been decreasing in the past decade at an average annual rate of 3 percent. In 1968, East Coast ports handled slightly less than 3 million tons of grain, only 5 percent of the United States total.

Table 23

EAST COAST GRAIN EXPORTS,*
BY PORT, 1961-1968

Port	1961 Thousands of Long Tons	1961 Percent of Coast Total	1968 Thousands of Long Tons	1968 Percent of Coast Total	Average Annual Percent Increase 1961-1968
Delaware River & Bay	291.2	8.1%	354.1	12.4%	3.09%
New York	105.2	2.9%	24.7	0.9%	-10.93%
Baltimore	1,407.9	39.3%	700.5	24.6%	-7.18%
Hampton Roads	1,781.1	49.7%	1,773.8	62.2%	-0.06%
Major Port Total	3,585.4	100.0%	2,853.1	100.0%	-2.92%

*Includes corn, sorghum, wheat and soybeans.

Source: **Army Corps of Engineers and Gladstone Associates.**

East Coast ports showed varying trends through the 1960's as seen in Table 23. The Delaware River and Bay was the only port area to increase its grain exports, doing so at an average annual rate of 3 percent to its 1968 level of 355,000 tons. The Delaware River and Bay increased its share of total East Coast grain exports from 8 percent in 1960 to 12½ percent in 1968.

Hampton Roads is the largest exporter of grain along the East Coast, handling 1.8 million long tons of grain exports annually. In 1968, this was 62 percent of total East Coast grain exports but only 3 percent of all United States grain exports.

Projected Grain Exports

By the year 2000, it is anticipated that total United States grain exports will increase at an average annual rate of 3¼ percent from 40 million long tons to 96 million long tons. This compares with a 9 percent average annual increase experienced during the past decade. These projections may be seen in Table 24 and in the graph on the opposite page.

Table 24 PROJECTED U.S. GRAIN* EXPORTS

Year	Newport Projection	Booz-Allen Projection	Bath Projection	Actual	Mean Projection
	(Millions of Long Tons)				
1960				23.9	
1968				40.3	
1970	49.0	49.7	47.5		48.7
1975	53.6	59.7	60.0		57.8
1980	58.4	68.4	68.9		65.2
1985	63.4	77.3	74.2		71.6
2000	80.0	114.0	95.0		96.3
	(Average Annual Percent Increase)				
1960-1968				8.69%	
1970-1975	1.88%	4.02%	5.26%		3.74%
1975-1985	1.83%	2.95%	2.37%		2.39%
1985-2000	1.75%	3.17%	1.87%		2.30%
1970-2000	2.11%	4.31%	3.33%		3.26%

* Includes sorghum, corn, wheat and soybeans.

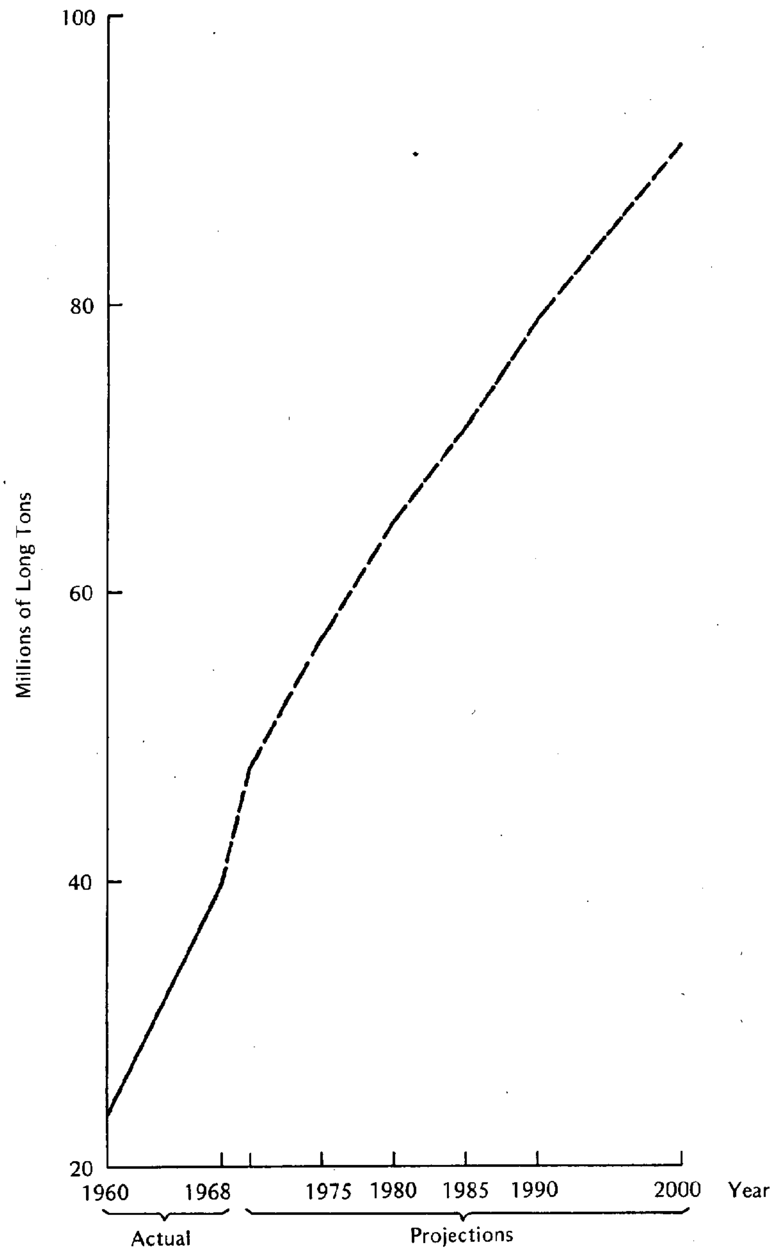
SOURCES:

Newport News Shipbuilding and Dry Dock Company, 1970.

Booz-Allen Applied Research, Inc. 1969

Bath Iron Works Corporation, 1970.

Given the East Coast proximity to the European market and distance from inland grain areas, projected East Coast grain exports will remain constant from 1968 to 1995 at a level of 2.7 million long tons.



Graph 13

PROJECTED U.S. GRAIN EXPORTS

If ports located along Delaware River and Bay continue to increase their share of total East Coast grain exports at the rate experienced during the 1960's, by 1995 these ports will export slightly over one-half million long tons. The projected average annual increase of 2 1/3 percent will be the largest gain of any East Coast port. These projections are presented in the table below.

Table 25

PROJECTED EAST COAST GRAIN EXPORTS BY PORTS, 1968 - 1995
(Assuming No Deepwater Port is Constructed)

(Thousands of Long Tons)

Year	Delaware River	New York	Baltimore	Hampton Roads	Total Coast
1968	354	25	700	1,774	2,853
Alternative I[1/]					
1970	276	10	488	1,346	2,120
1980	370	1	229	1,700	2,300
1995	570	1	1	2,148	2,720
Average Annual Percent Increase 1970 - 1995	4.26%	-3.33%	-3.69%	2.38%	1.13%
Alternative II[2/]					
1970	212	42	678	1,187	2,120
1980	230	46	736	1,288	2,300
1995	272	54	870	1,523	2,720
Average Annual Percent Increase 1970 - 1995	1.13%	1.13%	1.13%	1.13%	1.13%

1/ Alternative I assumes each port will increase or decrease its percentage capture of East Coast Exports as the 1960's trend indicated.

2/ Alternative II assumes each port will maintain its 1965 capture of total East Coast exports and increase its exports at the same rate as the coast total.

SOURCE: Booz-Allen Applied Research, Inc., and Gladstone Associates

Projected United States grain exports to Europe will increase at an average annual rate of only one-half percent, rising from 18 million long tons to 21 million tons in 1995. However, significant increases in grain exports to Asia and Africa are anticipated during this same period. Exports to Asia and Africa will increase from 24 million long tons to 75 million long tons in the late 1990's, increasing 8 percent annually.

Table 26

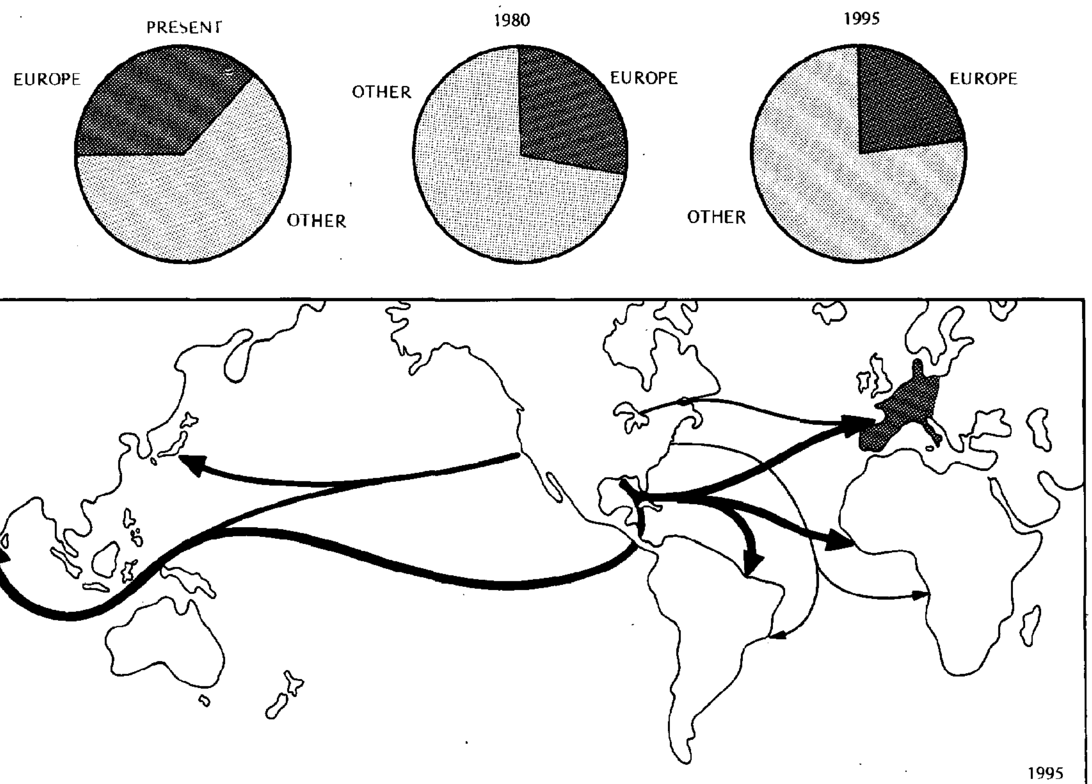
DESTINATION OF U.S. GRAIN EXPORTS
1965 - 1995

	(Millions of Long Tons)					
	Europe		All Other		Total Export	
Year	Sorghum and Corn	Wheat and Soybeans	Sorghum and Corn	Wheat and Soybeans	Sorghum and Corn	Wheat and Soybeans
1965	12.18	5.59	6.27	17.65	18.45	23.24
1970	10.77	5.10	9.13	22.28	19.90	27.38
1980	12.48	5.54	14.22	32.20	26.70	37.74
1995	14.39	6.56	21.81	50.84	36.20	57.40
	(Average Annual Percent Increase)					
1965-1970	- 2.32%	- 1.75%	9.12%	5.25%	1.56%	3.56%
1970-1980	1.59%	0.86%	5.58%	4.45%	3.42%	3.78%
1980-1995	1.01%	1.23%	3.56%	3.86%	2.37%	3.47%
1965-1995	0.60%	0.58%	8.26%	6.27%	3.21%	4.90%

SOURCE: Booz-Allen Applied Research, Inc. and Gladstone Associates.

Asia and Africa, at a significantly greater distance from the United States, will become increasingly important as recipients of United States grain exports. Reflecting this trend, plans are under way for dry bulk carriers in excess of 100,000 DWT. By the year 2000, ten percent of the dry bulk carrier capacity will be in ships of this size class or larger.

Map 6
THE DESTINATION OF UNITED STATES GRAIN EXPORTS



Source : Booz Allen Applied Research and Gladstone Associates

Deepwater Port Potential

A deepwater port located along the Eastern coast of North America would suffer from a severe locational disadvantage with regard to the export of grains. While route distance and volumes are steadily increasing, only ten percent of the dry bulk carriers of the future will be ships with drafts in excess of 50 feet. This is largely explained by the relative low density of grains compared with other bulk commodities. An East Coast deepwater terminal, with its relative isolation from grain producing regions, could be expected to handle very small quantities of grain.

Table 27 PROJECTED EAST COAST GRAIN EXPORTS, ASSUMING COMPLETION OF A DEEPWATER PORT IN DELAWARE BAY BY 1975

	(Millions of Long Tons)			
	To Europe[1/]	To Other Nations[2/]	Total	% of All U.S. Grain Exports
1965	2.32	0.00	2.32	5.27%
1970	2.12	0.00	2.12	4.48%
1980	2.30	0.39	2.69	4.17%
1995	2.72	2.47	5.19	5.54%
	(Average Annual Percent Increase)			
1965-1970	-1.72%	0.0 %	-1.72%	
1970-1980	0.85%	-	2.69%	
1980-1995	1.22%	35.56%	8.67%	
1965-1995	0.57%	-	4.12%	

SOURCE: Gladstone Associates
NOTE: If another deepwater port is built on the west coast of the U.S. then the East Coast projections should be reduced by 50% of exports to "Other Nations."

1/ Assumes all East Coast exports presently go to Europe and supplies Europe with 41.5% of its U.S. grain imports.

2/ Assumes the following capture rate for East Coast of total U.S. grain exports to non-European nations.

Wheat:	Corn and Sorghum:
1970 - 0.0%	1970 - 0.0%
1980 - 1.0%	1980 - 0.5%
1995 - 4.0%	1995 - 2.9%

Based on the following assumptions:
- By 1995 eight percent of the world dry bulk ship fleet capacity will be in ships of 100,000 DWT's or more.
- 20% of total U.S. grain exports not going to Europe will go to non-Pacific Asia and Africa
- Corn and sorghum capture rate is 1/2 of wheat and soybeans because of origin of these exports closer to other coasts
- No deepwater port will be built on the West Coast before 1995.

Without a deepwater port it is projected that the East Coast will have no increase in its grain shipments to the late 1990's. Assuming a deepwater terminal is built along the East Coast by 1975, grain exports might be expected to increase at an average annual rate of four percent through the year 2000. Table 27 indicates this increase will be largely explained by increasing volumes of United States grain exports to non-Pacific Asia and Africa.

While total East Coast and total American grain exports would increase at the same rate, total grain handling in the Delaware Bay region is projected to increase more substantially due to the volume of trans-shipments through a deepwater terminal.

As seen in the table below, assuming a deepwater terminal is constructed by 1975, total East Coast grain handling would increase from three million to five million long tons by the year 2000. Virtually all of this increase would be caused by ship to ship transfer of grains at the new deepwater terminal.

If a deepwater transfer terminal were constructed in the lower Delaware Bay, it would most probably handle trans-shipment of grain exports. However, the volume of grain exports anticipated is relatively insignificant and would in no way, without additional commodities, make such a port economically feasible.

Table 28

PROJECTED EAST COAST GRAIN EXPORTS, BY PORTS, 1968 - 1995, ASSUMING A DEEPWATER PORT IN DELAWARE BAY BY 1975

Year	Delaware River	New York	Baltimore	Hampton Roads	Total
	(Thousands of Long Tons)				
1968	354	25	700	1,774	2,853
1970	276	10	488	1,346	2,120
1980	850	1	230	1,610	2,690
1995	3,150	1	1	2,040	5,190
	(Average Annual Percent Increase)				
1970-1995	38.57%	-3.33%	-3.69%	1.94%	5.36%

SOURCE: Gladstone Associates

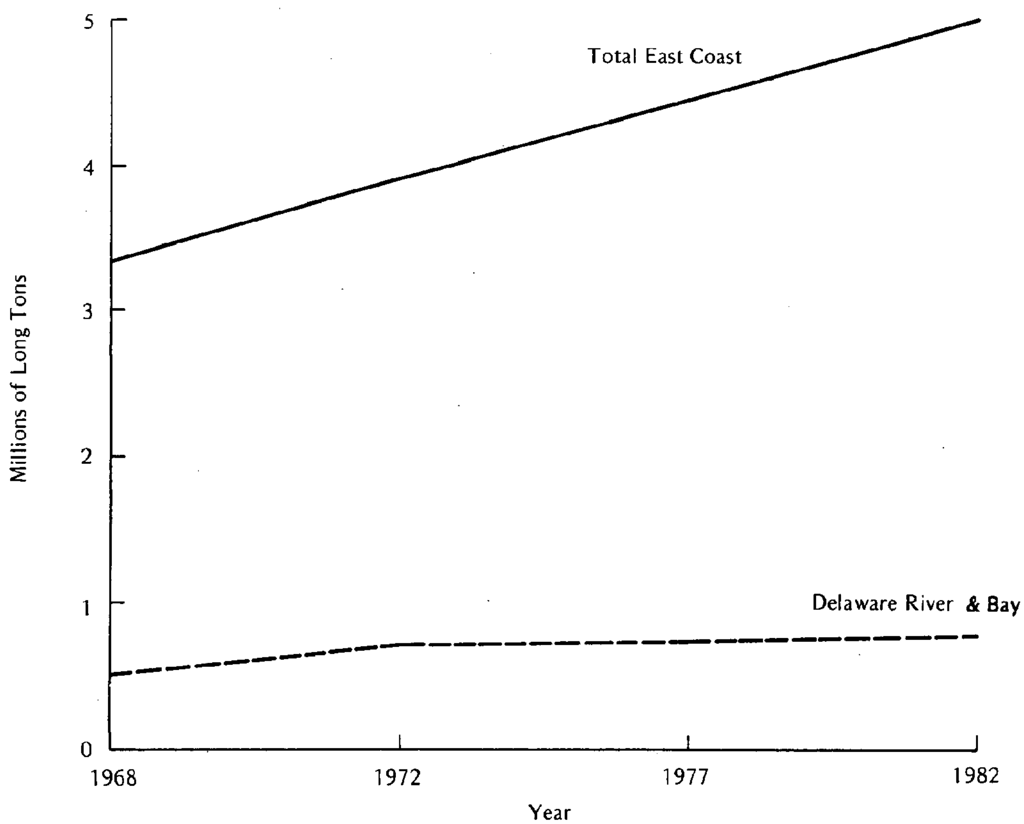
FOREST PRODUCTS

Introduction

Forest products, which include paper, lumber, wood, and pulp, are both imported and exported. The nature of the commodity, the location of its sources, and its relatively small tonnage make deepwater transport infeasible.

The Past Decade

The Delaware River and Bay port, as well as the entire East Coast, experienced an 8 percent average annual increase for forest product imports in the past 10 years. In 1968, total East Coast forest product imports amounted to 3.3 million long tons. Delaware River and Bay port captured 15 percent of this total, or ½ million long tons.



Graph 14

PROJECTED IMPORT OF FOREST PRODUCTS, DELAWARE RIVER, 1968 - 1982

East Coast exports increased 10½ percent annually during the 1960's. However, Delaware River and Bay exports increased 3 percent annually to only 12,000 long tons in 1968.

Productive forests are extremely limited in the Delaware River and Bay hinterland. Therefore, these ports necessarily suffer from a locational disadvantage with regard to forest product exports. Eighty-two percent of all East Coast forest product exports left this country through ports located south of Virginia.

Projections

No attempt has been made at projecting forest product exports because of their insignificance to the Delaware River and Bay due to the location of productive forests.

Forest product imports, however, are of sufficient tonnage to warrant projection to determine how much, if any, of these commodities would require a deepwater transfer terminal.

Table 29 PROJECTED IMPORT OF FOREST PRODUCTS, DELAWARE RIVER AND BAY, 1968 - 1982

	(Thousands of Long Tons)	
	Delaware River and Bay	Total East Coast
1968		
Paper	118.8	895.9
Lumber	376.9	1,811.6
Wood	0.0	19.6
Pulp	8.6	613.4
Total	504.3	3,340.6
1982		
Paper	192.0	1,538.0
Lumber	542.0	2,490.0
Wood	0.0	6.0
Pulp	39.0	1,008.0
Total	773.0	5,042.0
	(Average Annual Percent Increase)	
1968-1982		
Paper	4.40%	5.12%
Lumber	3.13%	2.67%
Wood	-	4.96%
Pulp	25.25%	4.60%
Total	3.81%	3.64%

Source: Newport News Shipbuilding and Dry Dock Company, the Army Corps of Engineers and Gladstone Associates.

Analysis by the Newport News Ship Building and Dry Dock Company projected East Coast forest product imports to increase by slightly less than 4 percent annually by 1982. Of the 5 million long tons imported in 1982, Delaware River and Bay ports will be handling a projected 773,000 long tons. This will represent an average annual increase comparable to that projected for the total East Coast.

Deepwater Port Traffic

In general, forest products are not moving in sufficient tonnage to require the use of superships. Even if a deepwater port were established in the lower Delaware Bay, it is doubtful that it would have a significant impact on the projected tonnage outlined above. The impact would be minimal because: (a) forest products are treated as a general cargo commodity and therefore are not moved in huge ships, (b) the small hinterland of the Delaware River and Bay ports restricts forest product imports to local consumption, and (c) forest product exports, representing a miniscular portion of total Delaware River exports, will not increase significantly because of their distance from productive forests.

GENERAL CARGO

Introduction

General cargo includes a diverse group of products requiring separate analysis from bulk cargos. It is treated separately from bulk cargos because of its higher value per ton, related special handling problems, the relatively smaller quantities in which it moves, and the great mixture of products involved. These diverse products are treated as a group since they have similarities as cited above and include many diverse products of relatively small tonnage.

It is anticipated that virtually no general cargo will move through a deepwater port located in the lower Delaware Bay.

A deepwater port offers no advantage over conventional ports since general cargo will not be moving in ships with drafts in excess of 40 feet. The primary factors affecting the location of ports that handle general cargo are port services, including rail and truck access, and large population concentrations. Physical facilities and port costs are neutral competitive factors. A deepwater port located in lower Delaware Bay would be at a competitive disadvantage with regard to location and port services.

Projections and Port Competition

Through 1980, it is projected that general cargo handled by existing Delaware River and Bay ports will increase at an average annual rate of slightly less than one percent, achieving a level of 4.9 million tons. These projections also indicate that utilization of general cargo handling capacity will not exceed 57 percent during the same projection period. These are shown in tabular form on the following page.

These figures project what will happen under present conditions . Altered conditions, in the form of a deepwater port in the lower Delaware Bay, raise the following questions:

A What specific competitive factors determine a cargo's port of export or import?

Table 30 GENERAL CARGO HANDLING CAPACITY COMPARED WITH PROJECTED CARGO: DELAWARE RIVER PORTS 1963 AND 1970-80

(thousands of short tons)

Year	Total general cargo handled	Cargo Capacity	Capacity Utilization
1963	4,183	7,080	59.1%
1970	4,485	8,605	52.1%
1975	4,675	8,585	54.5%
1980	4,875	8,520	57.2%

SOURCE: Hammer, Greene, Siler Associates, The Delaware River Port, 1965.

B Do these factors influence those individuals who ultimately decide which port their cargo will flow through?

C What impact will containerization have upon shipping in general and the above mentioned competitive factors?

D To what extent will general cargo be transported in deep draft vessels?

These questions are addressed in the material that follows.

Transportation analysis, discussed earlier in this report, indicates general cargo will not be transported in deep vessels because it generally moves shorter distances, requires a more sophisticated ship, and is less dense than bulk cargo. Therefore, a deepwater port in lower Delaware Bay may be assumed to have no advantage due to depth. Consequently, a deepwater port may be considered to be in competition with other East Coast ports in regard to general cargo handling. Competitive factors other than depth must be considered.

Competitive Factors

The four general factors which determine the competitive status of ports are:

- **A location**
- **B physical facilities**
- **C port costs**
- **D port services**

These factors are analyzed in the following discussion as they relate to the relative competitive position of a new deepwater port

location

Relative access of the major East Coast ports to the open sea is inversely related to distance from the in land industrial heart of the United States. Proximity to the open sea has virtually no affect on the decision of a shipper to select a port. With few exceptions, intercontinental ocean rates are equalized among East Coast ports to any common foreign destination. Thus, the added cost of steaming 11 hours up the Delaware River and Bay to Philadelphia represents an additional cost to the vessel operator which is not passed on to the shipper who is usually responsible for the selection of the port.

Inland transportation costs to North Atlantic ports become more equalized as goods come from farther west. However, inland transportation cost for midwest shippers do not correlate with the mileage to different ports. This is due for the most part to rail rate equalization schedules. While truck rates are generally based on mileage, there is a trend towards the use of commodity rates which are applied to commodities moving in large volumes on a continuous basis. Commodity rates from inland industrial areas tend to favor Baltimore, Philadelphia and New York in that order.

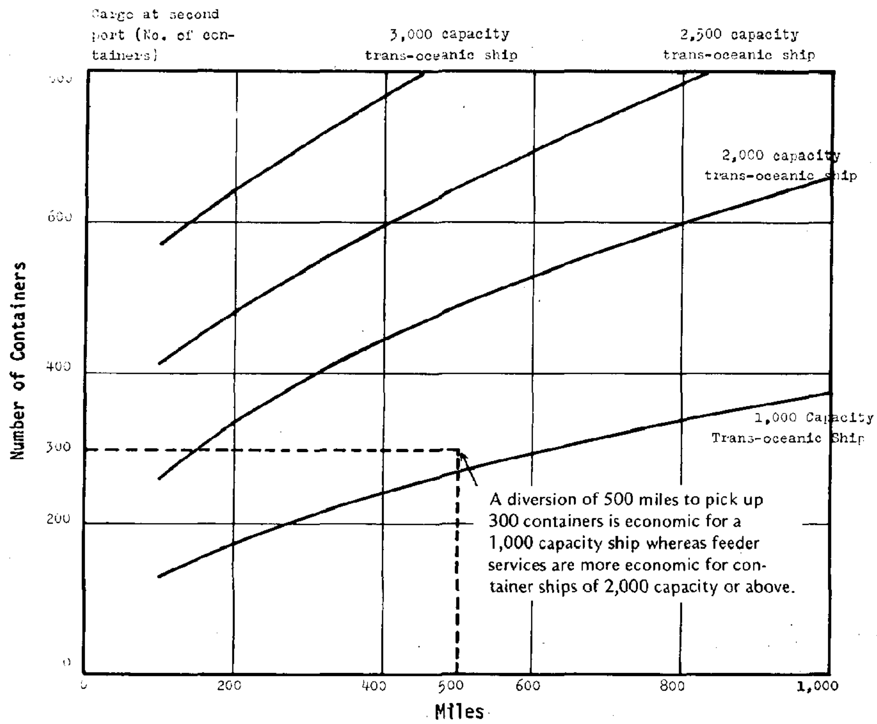
physical facilities

Quality and quantity of physical facilities appear to be of negligible importance as a competitive factor because the shipper chooses the port through which his cargo will move, not the carrier who finds varying physical conditions among ports. Physical facilities can become important as a competitive factor when specialized cargo handling is required, as in the case for most bulk commodities.

Although general cargo has not been greatly affected by physical facilities, a growing trend toward containerization warrants special consideration. The competitive status of a port with regard to containerized cargo will in large part be determined by its ability to provide adequate storage space for cargo containers. Perhaps most important with regard to port competition for containerized cargo will be the trend of shipping lines to concentrate container operations in fewer and larger terminals. This is necessarily a function of cost savings involved in container operations. The present system of 'port hopping' up the coast with final clearance from New York will be replaced by a direct shuttle service from American terminals to a single foreign destination. The graph following indicates the point at which it becomes economically feasible for a container ship to be diverted from New York to lower Delaware Bay.

Graph 15

BREAK-EVEN BETWEEN FEEDER AND PORT-OF-CALL SERVICES
(ABOVE EACH CURVE A PORT-OF-CALL SERVICE HAS THE LOWER COST;
BELOW EACH CURVE A FEEDER SERVICE HAS THE LOWER COST)



FEEDER VOYAGE DISTANCE, AND INCREMENTAL
TRANS-OCEANIC DISTANCE (MILES)

For the 2,500 capacity cargo ships of the future, a diversion of 200 miles from New York to the lower Delaware Bay appears economically feasible to pick up 500 containers. Fewer containers would require a feeder service. Assuming one sailing every three days, a 50 percent containerization rate, and the use of 20 ton containers -- to import and export 500 containers every three days would require general cargo shipments into and out of the Delaware Bay in excess of 4.8 million tons annually. Presently the Delaware River and Bay port handles approximately this tonnage in general cargo. However, this would require 100 percent use of a deepwater port for general cargo handling by the Delaware River ports. It does not appear economically feasible nor desirable to use a deepwater port for such trans-shipment activity. Many shippers will prefer to ship general cargo direct to New York where presumably it could depart for its European destination as much as three days earlier than if it were shipped through a Delaware Bay deepwater port. As explained in transportation factors, trans-shipment of commodities is a major cost factor. Therefore, the need to trans-ship all general cargo through the deepwater port would add costs far greater to the shipper than direct land shipment to New York.

port costs

The third competitive factor, port costs, includes costs borne by inland carriers and vessel operators. Inland carriers experience greater costs when servicing New York because of excessive delays due to congestion and circuitous switching. Similarly, the vessel operators experience extremely high costs when servicing the New York port. The table following indicates stevedoring as the largest single cost item borne by a vessel operator.

Table 31 Cost Per Ton of Handling 500 Tons

	Boston	New York	Phila-delphia	Balti-more	Hampton Roads
Cost per ton:					
Pilotage	$.39	$.36	$.39	$.49	$.36
Tug hire	.14	.15	.22	.36	.97
Line handling	.13	.10	.04	.08	.08
Dockage	.20	.60	.78	.35	-
Wharfage against ship	-	-	.50	.15	-
Stevedoring, basic	7.50	6.40	6.00	5.10	4.06
CC&W, basic	3.98	3.00	2.38	.78	.37
Overtime					
"Normal"	2.60	2.17	1.94	1.36	1.02
From sailing schedule	.76	-	.25	.47	.34
Total	$15.70	$12.78	$12.50	$9.14	$7.20

Source: Rowland and MacNeil, "Port of Boston Water-Borne Commerce Market," 1964.

While all ports from Maine to Hampton Roads along the East Coast are covered by a contract with the International Longshoremen's Association and hourly straight time wages vary little among East Coast ports, total stevedoring costs vary based on port congestion, local work rules, and general physical port conditions.

Port costs as a competitive factor are of very minor importance because inland transportation costs as well as vessel operator costs are rarely borne by those who decide the port through which the export or import traffic will move.

port services

Port services, the fourth competitive factor, appears to be of greatest significance because of its direct influence upon shippers. In the case of shipping services, quantity is to a great extent synonymous with quality. Frequency of sailings and ancillary services are the two most important considerations in this regard.

An exporter seeking to ship to a number of overseas destinations or seeking to deliver his product in the shortest possible time will benefit by using a port with the greatest number of sailings to his market. In 1968, New York cleared 1,000 more cargo vessels than Philadelphia. Philadelphia and Baltimore had almost an equal number of clearances. Hampton Roads and Boston together cleared approximately the same number of cargo vessels as Baltimore. Clearly, New York with the greatest number of vessel calls offers a shipper a greater choice in reaching various foreign markets and a greater frequency with which he can reach a given destination.

New York's competitive advantage is not limited to the number of vessel clearances. The overwhelming percentage of vessels called last at the port of New York. The significance of the figures presented in the table below is that cargo loaded at Philadelphia could be sent to New York three or four days later and still arrive at its foreign destination at the same time. If shipped direct from New York, it might arrive sooner.

Table 32 FINAL CLEARANCE FOR FOREIGN DESTINATION, EAST COAST PORTS, 1968

Port of Call	Average Number of Days Elapsed Before Cleared For Foreign Destination
New York	0.4
Hampton Roads	4.6
Baltimore	5.0
Philadelphia	5.0
Other East Coast Ports	8.9

SOURCE: Gladstone Associates, based on Bureau of Customs records from May 31 thru September 5, 1968.

In addition to frequency and directness of shipping from competing North Atlantic ports, other service factors may also influence a shipper's decision to select one port over another. Aside from international banking, consular representatives, and foreign Chambers of Commerce, the two most important services influencing a shipper's decision appear to be freight forwarding and steamship agents. This becomes an increasingly important factor over time because of what was referred to earlier as inertia in transportation linkages.

The ocean freight forwarder, as an agent for the exporter or importer, performs services essential in promoting foreign commerce, particularly when a manufacturer or consignee is located at an inland point and does not have the advantages of a branch office or a regular agent at the port. These services include:

A The inland movement of shipments to seaboard within the United States and, if requested, from there to destinations within a foreign country.

B The preparation and processing of necessary papers as well as the clearance of shipments in accordance with the regulations of the United States government.

C Booking and arranging cargo space on ocean carriers and the consolidation of ocean shipments.

Given no direction from the shipper as to port preference and all other costs being equal to the shipper (as in many cases they are), the freight forwarder will usually book shipments through the port at which he is located. New York has 500 freight forwarders as compared to only 30 for all the ports along the Delaware River and Bay.

Competitive factors have been appraised above and demonstrate that existing ports will continue to attract general cargo. Deepwater port competition is considered in the following portion of this report.

Deepwater Port Competition

Location, physical facilities, and port costs affect the cost of operating through a given port. The significant factor is who bears the burden of these costs. This is of vital importance because costs have a competitive influence only if they fall on those who are responsible for the selection of a port.

Location is a negligible factor for a deepwater port in the lower Delaware Bay.

For the handling of general cargo, physical facilities appear to have a minor influence as a competing factor among ports. Given the specialized function of a deepwater port and the increasing trend towards the use of containers, it appears that a deepwater port would suffer a competitive disadvantage.

Port services, the non-cost competitive factor, appears to be of the greatest significance in influencing the decision to use one port versus another. Shippers use ports which offer frequent sailings and the lowest inland freight rates. Preferences among shippers for various ports result either from repetitive use or as a result of the use of shipping agents.

Shippers, making their decision to select a port on inland freight rates and service, prefer either Baltimore, with its more favorable location relative to major industrial centers of the midwest, or New York, with its greater quantity of services in traffic volume. This largely explains the relatively small size of the hinterland serviced by the ports along the Delaware River and Bay, ranking them third behind New York and Baltimore.

A deepwater port offers several distinct disadvantages with regard to competition for general cargo. Its newness would necessarily place it in poor competition with regard to port services. The problem of trans-shipping through a specialized port would result in diseconomies to shippers.

Since bulk commodities will increasingly flow in very large superships, a Delaware deepwater port would have several competitive advantages with regard to the handling of bulk commodities. It would offer the only physical facility for such enormous ships. In addition, the handling of large volumes of various bulk commodities would enable the establishment of lower inland freight rates with regard to motor carriers. Finally, in the handling of bulk commodities, lower port costs as well as lower transportation costs are more frequently passed on to the shipper.

SUMMARY ANALYSIS AND COST SAVINGS

Transportation factors, long term supply and demand, and detailed analyses of commodities are summarized and interrelated in this section. Finally, the potential annual transportation cost savings resulting from a deepwater port are quantified.

SUMMARY ANALYSIS AND COST SAVINGS

The previous sections analyzed both transportation factors and actual and potential commodity movements. The interaction of these two phenomena allow us to project the demand for, and potential cost savings of, a deepwater port located in the lower Delaware.

A deepwater port facility could handle substantial amounts of petroleum products and iron ore at substantial cost savings. Furthermore, no change in final destination for product movements will occur in the short-run.

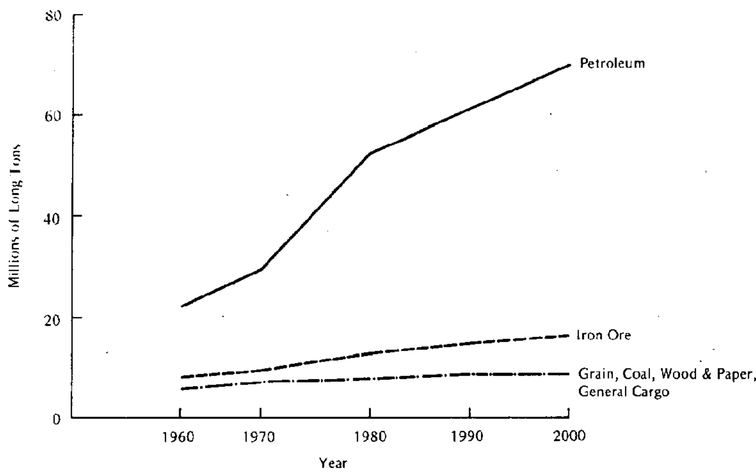
Innovations in transportation technology have permitted the construction of ships with greater capacities and hence deeper draft requirements. While this has been particularly true for oil tankers it has been less the case for dry bulk carriers and ore bulk oil carriers. By the year 2000, over 70 percent of the world tanker capacity will be in ships with drafts of 50 feet or more. These ships are unable to service any existing East Coast port.

With anticipated larger volumes of bulk products moving increasingly greater distances, the huge carrying capacity of superships will afford tremendous transportation cost savings.

As shown in Table 33, the Delaware River and Bay ports account for a substantial portion of East Coast waterborne foreign trade in petroleum and iron ore. It is projected that the Delaware River and Bay area will continue to capture significant amounts of total waterborne foreign trade in petroleum and iron ore products in the future. The amount of waterborne foreign trade captured by the Delaware River and Bay for all commodities are also shown in Table 33 with projections for the years 1980 and 2000.

The add-on effect of a deepwater port on Delaware River and Bay foreign trade would be substantial for petroleum products by 1980. The add-on tonnage of petroleum products would be on the order of six million tons by the year 1980, increasing to 23 million long tons by the year 2000. This would result in Delaware River and Bay handling 97.3 million long tons of petroleum products by the year 2000.

Graph 16



PROJECTED TOTAL WATERBORNE FOREIGN TRADE, DELAWARE RIVER
1961 - 2000
(Assuming no Deepwater Port)

Source: Gladstone Associates

Table 33. PROJECTED TOTAL WATERBORNE FOREIGN TRADE, DELAWARE RIVER AND TOTAL EAST COAST, 1961-2000
(millions of long tons)

	Delaware River & Bay	New York	East Coast
1961			
Petroleum	22.5	20.0	62.5
Iron ore	8.4	0.0	16.5
Grain	0.3	0.1	3.6
Coal	1.9	0.0	30.2
Wood & paper	0.3	0.9	3.1
General cargo	3.7	16.1	23.5
Total	36.9	37.1	139.4
1968			
Petroleum	29.5	32.9	88.2
Iron ore	9.5	0.0	19.0
Grain	0.4	0.0	2.8
Coal	0.8	0.0	30.3
Wood & paper	0.5	1.2	4.9
General cargo	5.0	19.8	29.8
Total	45.8	53.9	175.0
1980			
Petroleum	53.0	65.8	164.4
Iron ore	13.2	0.0	28.3
Grain	0.4	0.0	2.3
Coal	1.6	0.0	45.4
Wood & paper	0.8	1.6	5.0
General cargo	5.2	35.0	44.0
Total	74.2	102.4	289.4
2000			
Petroleum	75.3	114.5	252.9
Iron ore	16.3	0.0	34.8
Grain	0.7	0.0	2.7
Coal	1.9	0.0	55.7
Wood & paper	1.1	2.2	10.4
General cargo	5.5	52.0	70.0
Total	100.8	168.7	426.5

Source: Gladstone Associates

The redistribution of products moving through Delaware River and Bay with a deepwater port facility would be enormous. As shown in Table 35 a substantial number of products would be trans-shipped through a deepwater port in Delaware Bay from superships to smaller ships with final destination along the Delaware River and Bay complex. It is projected that 25 million long tons of petroleum products, almost 4 million long tons of iron ore and lesser amounts of coal and grain products would be trans-shipped through a deepwater port for final destination in Delaware River and Bay ports.

Table 34. PROJECTED IMPACT OF DEEPWATER PORT ON DELAWARE RIVER AND BAY FOREIGN TRADE, 1980-2000

(millions of long tons)

	Delaware River & Bay Foreign Trade	Added Delaware River & Bay Foreign Trade as a result of Deepwater Port[1/]	Total
1980			
Petroleum	53.0	6.0	59.0
Iron Ore	13.2	0.0	13.2
Grain	0.4	0.0	0.4
Coal	1.6	0.0	1.6
Wood	0.8	0.0	0.8
General Cargo	5.2	0.0	5.2
TOTAL	74.2	6.0	80.2
2000			
Petroleum	75.3	22.0	97.3
Iron Ore	16.3	0.0	16.3
Grain	0.7	0.0	0.7
Coal	1.9	0.0	1.9
Wood	1.1	0.0	1.1
General Cargo	5.5	0.0	5.5
TOTAL	100.8	22.0	122.8

1/ This column excludes trans-shipments from other East Coast ports to foreign nations and from foreign nations to other East Coast ports. In other words, it is the net added to ultimate destination within the Delaware Bay and avoids double counting.

Source: Gladstone Associates.

Table 35

DELAWARE RIVER & BAY FOREIGN COMMODITY MOVEMENTS IN THE YEAR 2000

(millions of long tons)

WITHOUT CONSTRUCTION OF A DEEPWATER PORT

Delaware River & Bay ← → Foreign Port

Petroleum	75.3
Iron Ore	16.3
Grain	0.7
Coal	1.9
Forest Products	1.1
General Cargo	5.5
Total	100.8

ASSUMING COMPLETION OF A DEEPWATER PORT IN 1975

Delaware River & Bay ← → Foreign Port

Trans-shipped Through Deepwater Port

Petroleum	25.0
Iron Ore	3.7
Grain	0.5
Coal	1.0
Forest Products	0.0
General Cargo	0.0
Total	30.2

Direct

Petroleum	72.3
Iron Ore	12.6
Grain	0.2
Coal	0.9
Forest Products	1.1
General Cargo	5.5
Total	92.6

Source: Gladstone Associates

Table 36.

PROJECTED DEEPWATER PORT TRAFFIC IMPORTS

(millions of long tons)

Year And Import	Total Import Traffic	Trans-shipment 1/ To Delaware River And Bay	Trans-shipment 1/ To Other East Coast Ports
1980			
Petroleum 2/	26.0	8.0	18.0
Iron Ore 3/	7.5	3.7	3.8
Total	33.5	11.7	21.8
2000			
Petroleum 4/	84.0	25.0	69.0
Iron Ore 3/	10.1	5.0	5.1
Total	94.1	30.0	74.1

1/ Ship to ship transfers.
2/ Assumes 50% of non-Caribbean imports in supertankers and 33% of this bound for Delaware River and Bay.
3/ Assumes 80% of iron ore moving more than 6,000 miles will be in superships and 49% of this bound for Delaware River and Bay.
4/ Assumes 70% of non-Caribbean imports move in supertankers and 33% of this bound for Delaware River and Bay.

Source: Gladstone Associates

Table 37.

PROJECTED
DEEPWATER PORT TRAFFIC
EXPORTS

Year And Export	Total Export Traffic	Trans-shipments 1/ From Delaware River And Bay	Trans-shipments 1/ From Other East Coast Ports
1980			
Coal	3.5	0.5	3.0
Grain	0.7	0.3	0.4
Total	4.2	0.8	3.4
2000			
Coal	5.0	1.0	4.0
Grain	3.0	0.5	2.5
Total	8.0	1.5	6.5

1/ From ship to ship. Assumes 33% of East Coast increase in Grain and Coal exports to Asia will move in superships.

Source: Gladstone Associates

Tables 36 and 37 show the projected impact of a deepwater port on imports and exports trans-shipped to Delaware River and Bay and to other East Coast ports. By the year 2000 over 94 million long tons of petroleum and iron ore products will be trans-shipped at a deepwater port for final destination at the Delaware River and Bay complex or other East Coast ports. By the year 2000, 8 million long tons of coal and grain products will be exported after being trans-shipped at a deepwater port from ports along the Delaware River and Bay and other East Coast ports.

Table 38. POTENTIAL ANNUAL TRANSPORTATION COST SAVINGS FOR DRY BULK IMPORTS AND EXPORTS RESULTING FROM A DEEPWATER TRANSFER TERMINAL IN THE LOWER DELAWARE BAY, 1980-2000

		Millions of Dollars in Transport Cost		Millions of 1970 Dollars
Year	Millions of Long Tons in Deepwater Trade	Using 50,000 DWT Ships	Using 150,000 DWT Ships and Trans-Shipping At Delaware	Potential Transportation Cost Savings Of A Deepwater Port In Lower Delaware Bay 1/
1980				
Iron Ore	7.5	$ 40.0	$ 24.8	$ 15.2
Coal	3.5	$ 18.7	$ 11.6	$ 7.1
Grain	0.7	$ 3.7	$ 2.3	$ 1.4
Total	12.3	$ 62.4	$ 38.7	$ 23.7
2000				
Iron Ore	10.1	$ 53.8	$ 33.3	$ 20.5
Coal	5.0	$ 26.7	$ 16.5	$ 10.2
Grain	3.0	$ 16.0	$ 9.3	$ 6.7
Total	18.1	$ 96.5	$ 59.1	$ 37.4

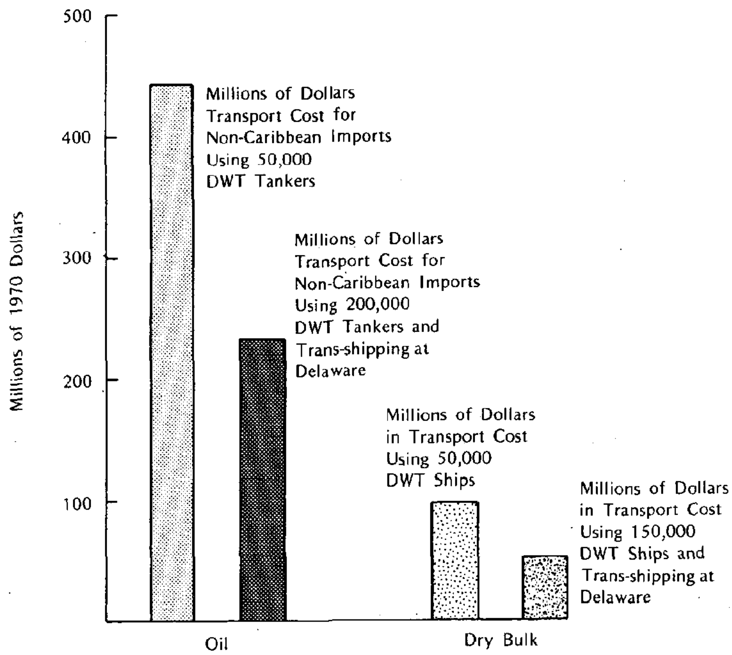
1/ These savings do not reflect added handling cost at transfer terminal which would reduce these figures from 20% to 30%.

Source: Gladstone Associates

The potential annual transportation cost savings for dry bulk imports and exports, resulting from a deepwater transfer terminal, are portrayed in Table 38. Savings of more than $23 million could be anticipated by the year 1980 as a result of a deepwater transfer terminal. By the year 2000, savings will increase to over $37 million annually.

The potential transportation cost savings for oil imports resulting from a deepwater transfer terminal are displayed in Table 39. For the year 1980, it is estimated that annual transportation cost savings will range from a low of $48 million to a high of $81 million. This is expected to increase to from $167 million to $255 million by the year 2000.

With construction of a deepwater transfer terminal in lower Delaware Bay, potential transportation cost savings for bulk commodities by the year 2000 could reach as high as $292 million annually. These figures are seen in graph 17.



Source: Gladstone Associates

Graph 17

POTENTIAL ANNUAL TRANSPORTATION COST SAVINGS RESULTING FROM A DEEPWATER TRANSFER TERMINAL IN THE YEAR 2000

Table 39. POTENTIAL ANNUAL TRANSPORTATION COST SAVINGS FOR OIL IMPORTS RESULTING FROM A DEEPWATER TRANSFER TERMINAL IN THE LOWER DELAWARE BAY, 1980-2000

Year	Millions of Long Tons: Total East Coast Non-Caribbean Oil Imports Low	High	Oil Likely To Move In Supertankers Thru The Delaware Deepwater Port 1/ Low	High	Millions of Dollars Transport Cost For Non-Caribbean Imports: Using 50,000 DWT Tankers Low	High	Using 200,000 DWT Tankers and Trans-Shipping at Delaware Low	High	Transportation Cost Savings of Deepwater Port In Lower Delaware 2/ (million of 1970 dollars) Low	High
1980	48.0	80.0	19.0	32.0	$101.0	$171.0	$ 53.0	$ 90.0	$ 48.0	$ 81.0
2000	112.0	170.0	66.0	101.0	$352.0	$538.0	$185.0	$283.0	$167.0	$255.0

1/ Assumes 50% of Non-Caribbean imports move in supertankers in 1980 and 80% in 2000, and assuming Delaware deepwater port will capture 80% of these movements in 1980 and 85% by the year 2000.

2/ These savings do not reflect added handling cost at transfer terminal which would reduce these figures from 20% to 30%.

Source: Gladstone Associates

ADDENDUM

This section summarizes information in a manner corresponding to the outline of our contract. As the study proceeded and analysis ensued,certain components warranted more in-depth development as they related to the feasibility of a deepwater port. While all contract components were explored, some were found of greater importance; this weighting is reflected in the content and structure of the preceeding text.

ADDENDUM

Demand for deepwater facilities in the Middle Atlantic Region.

A The projected United States demand for iron ore imports in the next ten years will increase by 3 million long tons, from 30 million in 1970 to 33 million in 1980. Baltimore and Delaware River ports will continue to handle practically all of these imports.

B The projected 10-year demand for coal exports to Japan and elsewhere will increase 10 million long tons by 1980 to a level of 45 million long tons. Ninety percent will be shipped from Hampton Roads.

C The projected 10-year demand for petroleum imports in the United States is 205 million long tons for 1980, an increase of 65 million long tons. For the East Coast specifically, imports will increase from 102 million long tons to 160 million long tons in 1980.

D Since the deepwater port will serve primarily as a transfer point, the advantage of locating complementary processing facilities nearby is diminished. The primary cost of trans-shipping commodities is incurred at the transfer point; therefore, there would be no transportation cost advantage in shipping cargo 2 miles to shore as opposed to shipping it 200 miles to New York.

Consequently, a deepwater port would further entrench the existing network and locations of processing facilities.

Inventory and analysis of existing ocean going-handling facilities in the Middle Atlantic Region.

A Given the specialized function of a deepwater transfer terminal, it will not compete with existing East Coast and Delaware River and Bay ports. As such, a deepwater port will complement projected commodity movements to and from established shipping terminals. As indicated earlier in this report, the existing port facilities along the Delaware are adequate to handle projected cargo movements. Fifty-seven percent of general cargo capacity will be utilized by 1980. Presently, the coal and grain export capacity of Delaware River ports is underutilized; projected export tonnage will not alter this condition. While iron ore and petroleum imports will increase substantially, present capacities appear adequate. These can not be quantified because capacity is, to a large extent, both a function of private storage space and the time element involved in commodity processing.

B Since a deepwater port will complement projected commodity movements to and from established ports, the average time requirements for loading and unloading cargo at existing ports is not a competitive factor in our analysis.

C The existing ports along the East Coast range in depth from approximately 35 feet to 50 feet. These ports cannot handle supertankers and will not compete with the proposed deepwater port.

D Since the East Coast ports, from Maine to Hampton Roads, operate with similar water temperatures and weather conditions, as well as an identical longshoremen's contract, no single port has a competitive advantage due to number of operational days.

E The predominant imports and exports of major East Coast ports are as follows:

1. Delaware River and Bay – iron ore and petroleum imports.
2. New York – fuel oil and general cargo.
3. Baltimore – iron ore imports.
4. Hampton Roads – coal exports.

F Since the same longshoremen's contract applies to all the ports along the East Coast, the labor costs are comparable as seen in Table 31 of the preceeding text.

G The existing ports have developed a set of supporting facilities. In general these facilities are utilized under capacity as follows:

1. Sixty percent of East Coast port capacity for general cargo is utilized.
2. Iron processing facilities are currently operating at 75 percent of capacity.
3. At the present time 70 percent of the refinery capacity is being utilized.
4. Since the capacity for coal exports is related to the existing transportation network, which favors Hampton Roads, all other ports are operating substantially under theoretical capacity. The Hampton Roads ports are currently operating at 75 percent of their coal export capacity.

Replacement and Incremental Demand Requirements

A There are few changes anticipated in channel depths and widths for existing ports. Baltimore is planning to increase the depth of its port to 52 feet –– not large enough to handle supertankers. The required depth for the deepwater port will be 80 feet for the next 10 years.

B Since the deepwater port will primarily serve as a trans-shipment facility, limited loading and unloading facilities will be required.

C Our analysis indicates that railroad and truck facilities will not be needed for the deepwater port due to its trans-shipment function.

D Based on the experience of Bantry Bay and other deepwater ports, the deepwater facility will have only minor requirements for utilities such as water, gas, and electricity for the next 10 years.

E Even though the primary use of the deepwater port will be petroleum shipments, the present refinery capacity and storage along the Delaware River and Bay will be adequate to meet the demand through 1980. However, approximately a 1 million ton storage facility will be necessary when the deepwater port is opened and at least a doubling of this storage capacity will be necessary within 10 years.

F Two docking berths will be adequate to meet the demands of the deepwater port facility over the next 10 years.

G Over the next 10 years, there will be practically no need nor demand for complementary bulk processing facilities in the immediate vicinity of the deepwater port because there would be virtually no transportation cost advantage to facilities so located.

H Experience indicates immediate and long-run employment will be less than 100 full time employees for the operation and maintenance of a deepwater port, exlusive of ship personnel. At least 75 percent of the employees would be highly trained technicians. In the long-run regardless of increases in commodity volumes, there will not be a corresponding increase in employment. In fact, employment may decrease due to automation.

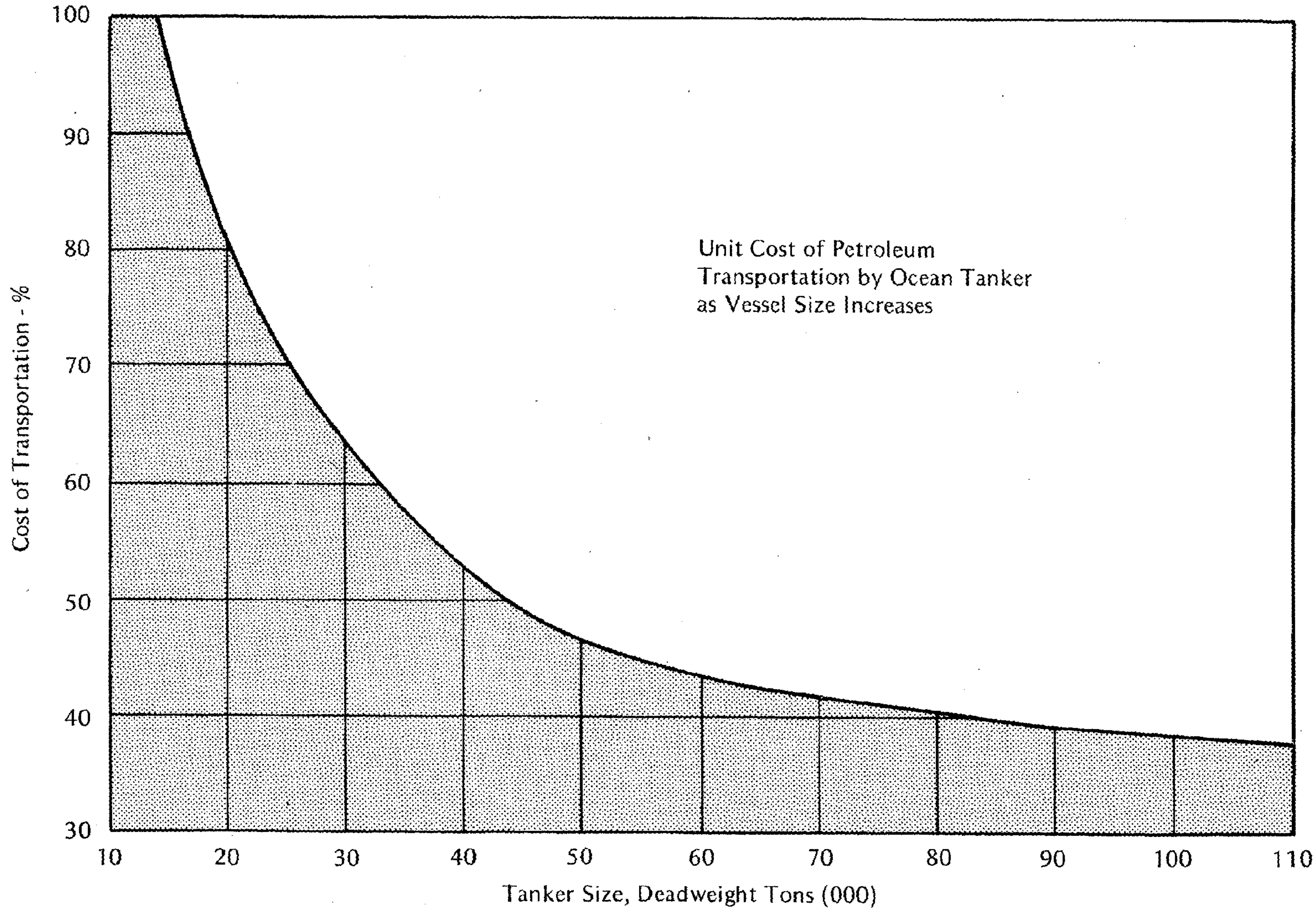
APPENDICES

Statistical information in these appendices are grouped to correspond with and support various subsections of this report. The first deals with transportation factors covered in the Determinants of Potentials. Appendices B and C cover liquid and dry bulk commodities found in text in Detailed Analysis. The final appendix is supportive tables to Summary Analysis and Cost Savings.

Appendix A: Transportation Factors

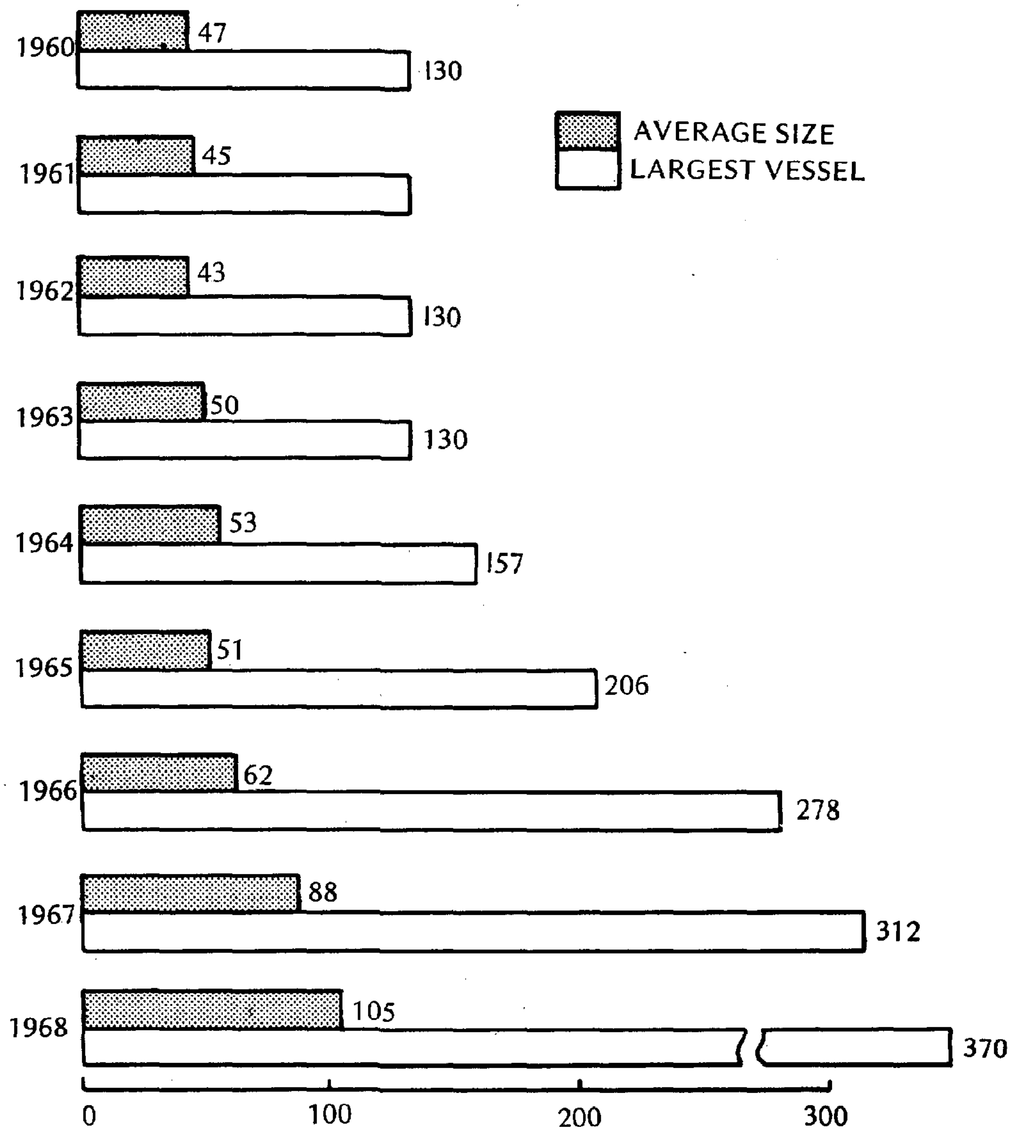

MAINE
VT.
N.H.
N.Y.
MASS.
R.I.
CONN.
New York
PA.
Philadelphia
DEL.
OHIO
Delaware River & Bay
Appalachian Mountains
MD.
W.VA.
VA.
Baltimore
KY.
Hampton Roads
N.C.
TENN.
S.C.
ALA.
GA.
FLA.

RELATIONSHIP OF TRANSPORT OPERATING COST TO TANKER SIZE



Source: Department of Army, Corps of Engineers. Total unit operating costs of a T-2 tanker, including capital costs, were taken as equivalent to 100 percent. Costs for larger vessels are related to this as a percent of the T-2 costs.

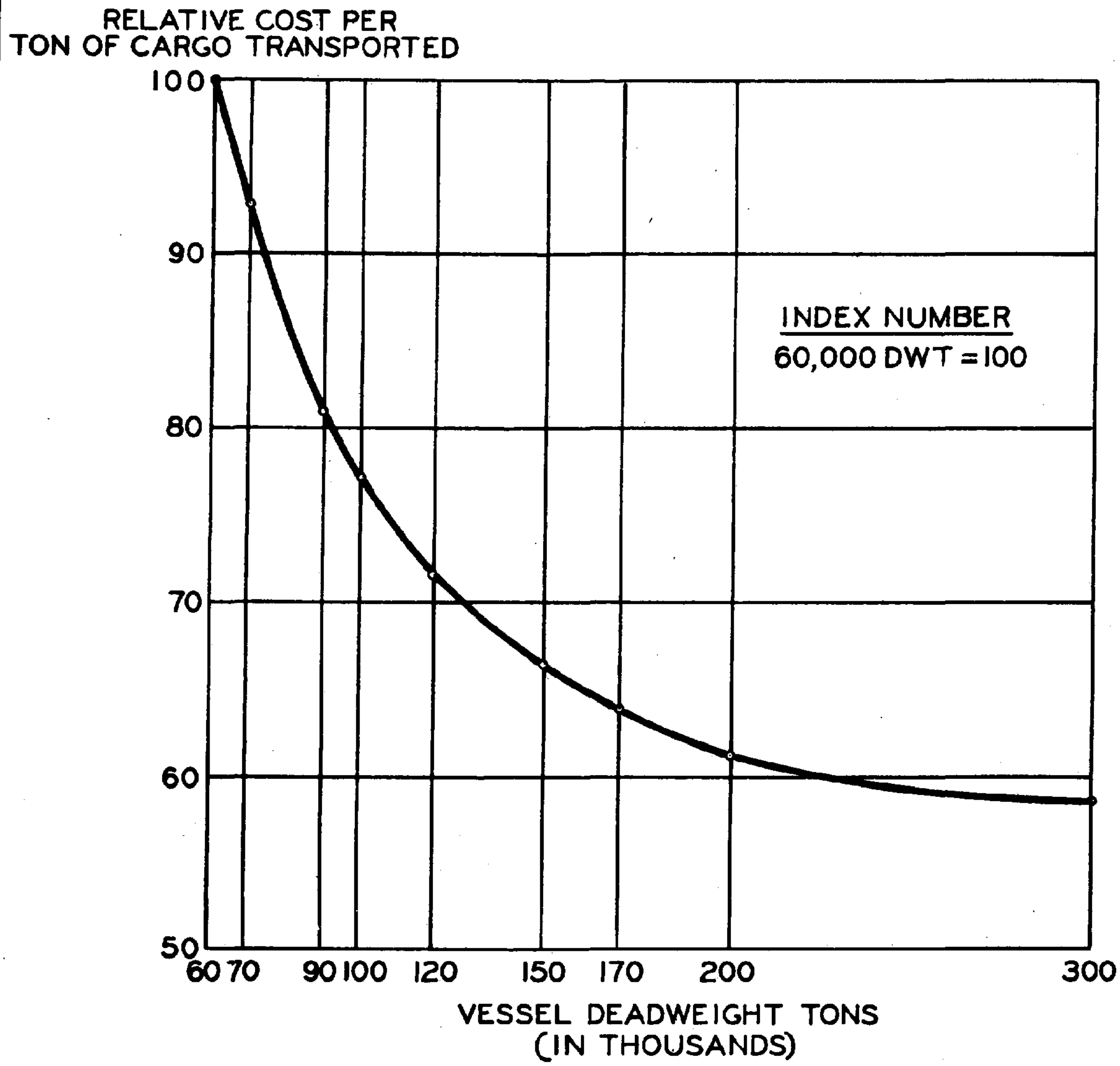
DEADWEIGHT TONNAGE OF SHIPS NEWLY CONSTRUCTED BY YEAR SINCE 1960.
(thousands of DWT)



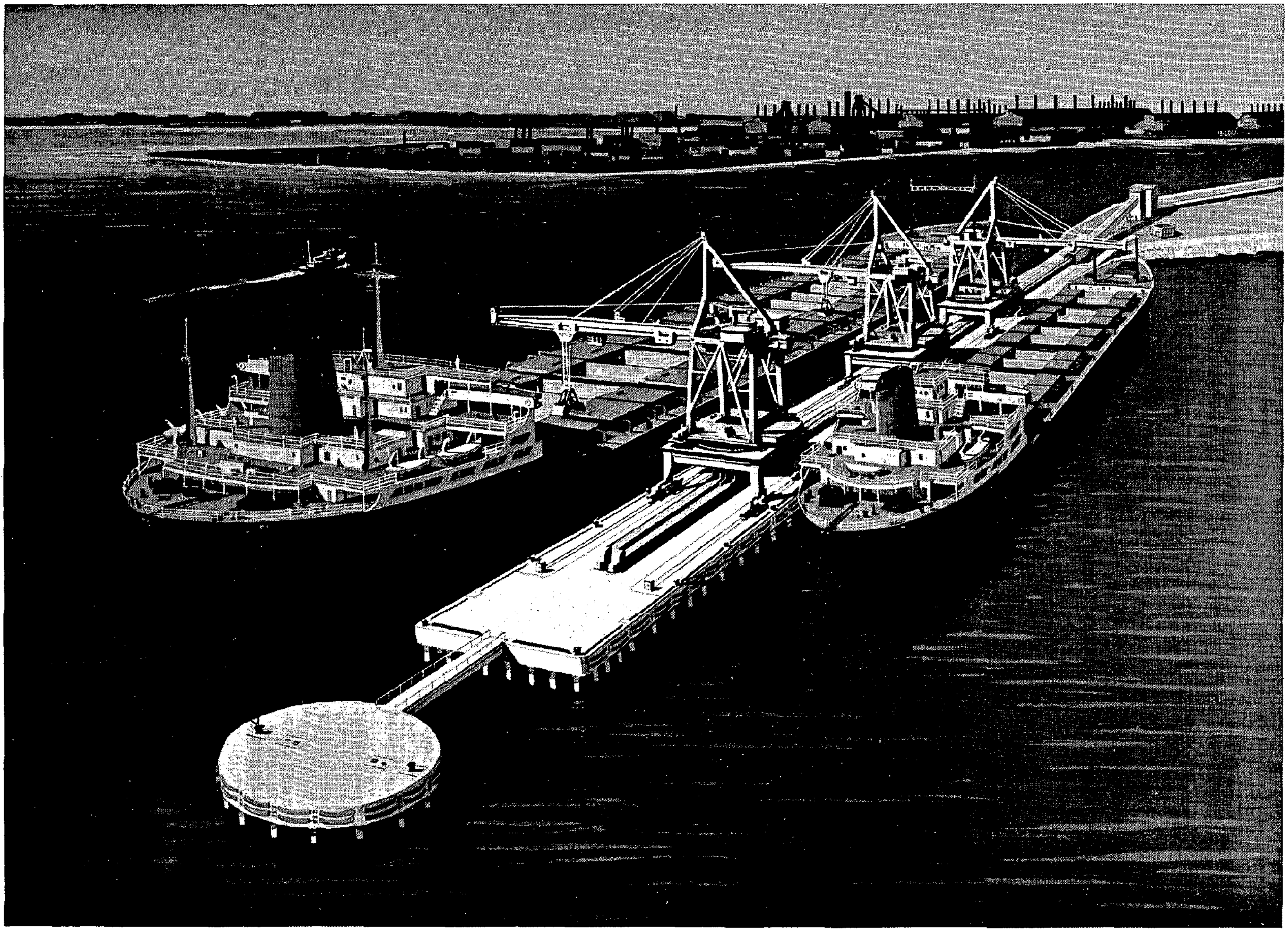
SOURCE:

SUN OIL COMPANY
ANALYSIS OF WORLD
TANK SHIP FLEET
DECEMBER 31, 1968

THE RELATIONSHIP BETWEEN VESSEL SIZE AND TRANSPORTATION COST PERSIAN GULF-JAPAN



Source: American Association of Port Authorities



Super bulk carrier compared with conventional type

Source: American Association of Port Authorities.

FORECAST OF WORLD OCEANBORNE TANKER TRADE
(Millions of Long Tons)

Year	Tanker Trade
1966	935
1973	1,554
1983	3,354
2003	6,061
2043	13,382

Source: Litton Systems Inc.

CHARACTERISTICS OF NEW CONTAINERSHIPS, 1969

Line	Vessel Characteristics			
	Length (in feet)	Width (in feet)	Draft (in feet)	Speed (in knots)
Atlantic Container Lines	646/695	86/92	29/28	22/25
American Export Isbrandsen Lines	610	78	27	20
Farrell Lines	668	90	33	22
Matson Navigation	719	95	31	23
Moore-McCormack Lines	620	90	31	25
United States Lines	700	90	28	25
Transamerican Trailer Transport	700	92	28	26

Source: The American Association of Port Authorities, 1969.

SUPERTANKER DEADWEIGHT TONNAGE COMPOSITION OF WORLD TANK SHIP FLEET AS OF DECEMBER 31, 1968

DWT In Thousands	Number of Ships	Total DWT	T-2 Equivalent
100 to 105	33	3,362,900	224.3
105 to 110	10	1,079,800	69.7
110 to 120	18	2,082,000	131.4
120 to 130	16	1,969,000	130.0
130 to 140	5	678,600	43.1
140 to 150	4	592,300	39.1
150 to 160	6	922,700	60.7
160 to 170	2	334,100	23.4
170 to 180	1	177,800	12.1
180 to 190	4	745,900	51.1
190 to 200	4	762,100	51.3
200 to 210	11	2,268,700	147.9
210 to 220	6	1,262,800	83.1
Over 310	2	652,000	39.2

Source: Sun Oil Company, "World Tank Ship Analysis".

DRAFT ANALYSIS OF SUPERTANKERS
OF WORLD TANK FLEET AS OF
DECEMBER 31, 1968

Draft In Feet	Number of Ships	DWT	T-2 Equivalent 1/
50	16	1,568,700	106.3
51	9	1,030,500	63.6
52	10	1,305,400	85.4
53	6	802,800	52.3
54	8	1,023,000	67.5
55	5	672,200	45.6
56	3	465,200	31.3
57	3	581,000	39.6
58	2	264,300	15.9
59	6	960,600	65.0
60	2	380,800	25.8
61	2	405,500	25.9
62	13	2,653,900	173.1
63	3	531,300	35.0
79.5	2	652,000	39.2

1/ A T-2 Tanker is defined asapproximately 16,600 D.W.T.

Source: Sun Oil Company, "World Tank Ship Analysis."

COST OF JAPANESE TANKERS IN TERMS OF DWT

Year	DWT	Total Cost (000,000)	Cost Per DWT
1968	23,600	$4.3	$182.0
1968	23,800	4.8	201.7
1967	35,200	4.1	116.5
1967	74,000	6.8	91.9
1968	150,000	13.0	84.0
1967	173,000	14.5	82.9
1968	175,000	13.2	75.4
1967	175,000	14.0	80.0
1968	209,000	15.1	72.2
1968	213,000	14.5	60.8
1968	230,000	15.5	67.0
1972-73	400,000	22.1	55.3

Source: Japan Daily Shipping & Shipbuilding Gazette, and Gladstone Associates.

DISTRIBUTION OF TANKER SIZE, BY YEAR OF CONSTRUCTION

DEADWEIGHT TONS – (000's)

Year	· 20K	20-40	40-60	60-80	80-100	100-125	125-150	150-200	200
1946	85.7	14.3							
1947	87.5	12.5							
1948	93.4	6.6							
1949	61.3	38.7							
1950	67.0	33.0							
1951	78.0	22.0							
1952	80.3	17.5	2.2						
1953	68.4	30.0	1.6						
1954	67.4	30.1	2.5						
1955	65.2	32.0	2.8						
1956	48.0	46.5	4.8		0.7				
1957	38.8	47.6	11.0	1.0	1.6				
1958	40.0	42.2	16.2	0.4	1.2				
1959	33.8	40.7	21.6	2.6		1.3			
1960	39.1	37.2	21.2	1.9		0.5			
1961	41.5	22.9	30.1	4.2	1.2				
1962	41.8	20.6	30.6	2.4	3.5	0.6	0.6		
1963	29.0	9.7	44.8	10.3	6.2				
1964	26.2	10.9	32.2	19.8	10.4	0.5			
1965	34.4	7.1	17.9	29.7	7.6	3.3			
1966	26.8	7.2	9.5	30.7	14.5	8.9	1.1	0.6	0.6
1967*	36.5	16.4	2.7	10.7	13.6	5.0	1.1	6.8	7.2

* Ships under construction or on order as of December 31, 1966.

Source: 1946-66 Data: U.S. Dept. of Commerce, Maritime Administration, "A Statistical Analysis of the World's Merchant Fleets", December 1967; 1967 Data: Sun Oil Company, "Analysis of World Tank Fleet", December 1967.

ANALYSIS OF WORLD TANK FLEET

BY SIZE CLASS AS OF DECEMBER 31, 1968

Size Group by Deadweight Tons	World Fleet (1000 Deadweight Tons)	Percent
Under - 20,000	22,927.1	18.1
20 - 40,000	29,024.8	22.9
40 - 60,000	24,638.4	19.5
60 - 80,000	19,022.3	15.0
80 - 100,000	13,979.1	11.1
100 - 120,000	6,524.7	5.2
120 - 140,000	2,647.6	2.1
140 - 160,000	1,515.0	1.2
160 - 180,000	511.9	0.4
180 - 200,000	1,508.0	1.2
200 - 220,000	3,531.5	2.8
300 - 320,000	624.0	0.5
Total	126,454.4	100.0

Source: Sun Oil Company, "World Tank Ship Analysis."

TANKER PORTS (CRUDE OIL)

Percent of World Ports	Have Depths Over:
87	25'
76	30'
71	35'
53	40'
35	45'
21 *	50'

* Of 108 U. S. and foreign tanker ports engaged in U. S. trade, 17 foreign ports and 7 U. S. ports have depths of 50 feet or over. The 6 U. S. ports are on the West Coast and one is Baltimore Harbor as authorized to be constructed by 1972.

Source: Litton Systems, Inc.

PORT DEPTHS AND POSSIBLE OBSTACLES TO HARBOR DEEPENING

Harbor	Authorized Depth (in feet)	Major Relocation and Dislocation [1/]	Rock
		(Beginning depth of Problem in feet)	
Atlantic Coast			
Boston	40	40-50	60
Portland, Me.	45	45	60
New York	45	60	-
Baltimore	55	60	-
Norfolk	45	55	-
Delaware River	40	-	41
Gulf Coast			
Galveston	42	-	52
West Coast			
Columbia	40	45	40
San Francisco	55	100	300
Los Angeles	40	42	-
Great Lakes	30 Maximum Due to Seaway Constriants		

Source: U. S. Army Corps of Engineers, Harbor and Port Development, 1968.

1/ The depth at which major investment must be placed in relocation of bridges, tunnels, piers and buildings.

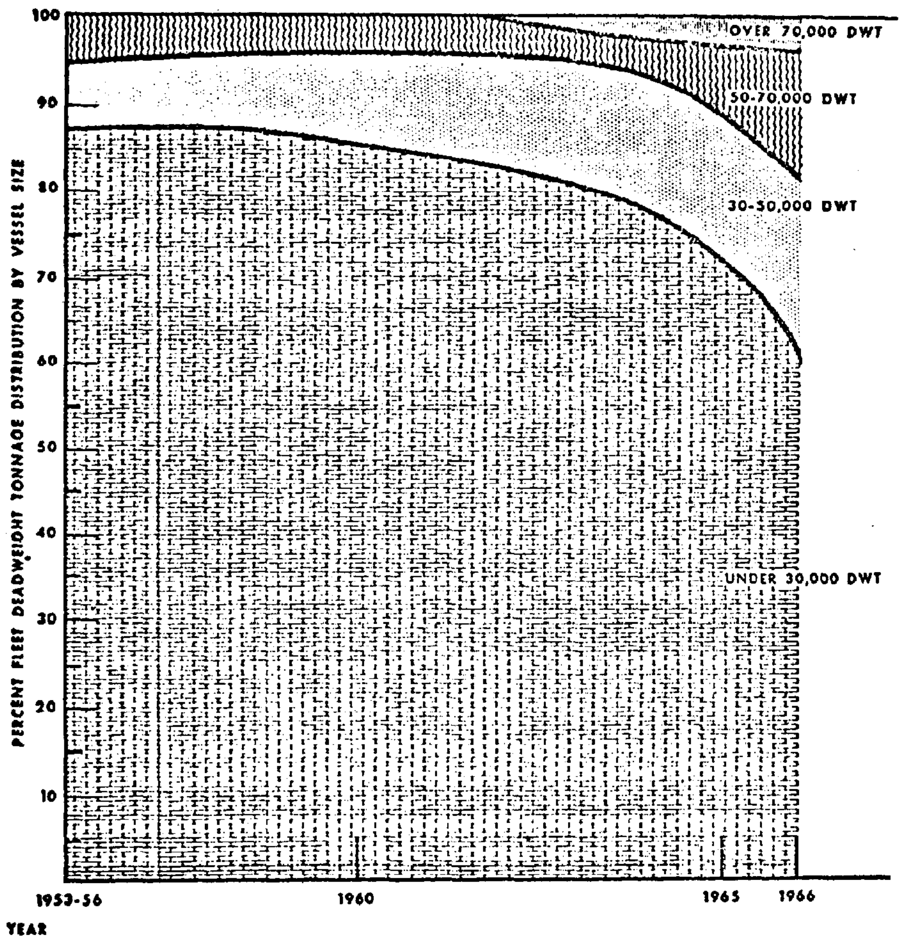
FOREIGN PORT DEPTHS HANDLING
BULK COMMODITIES 1968

Harbor	Depth in Feet Existing	Depth in Feet Planned	DWT of Largest Vessel Existing	DWT of Largest Vessel Planned	Type of Cargo 1/
Africa					
Algiers, Algeria	52	-	-	-	POL
Las Palmas, Canary I.	60	-	100,000	-	POL
Ras Es Sider, Libya	-	-	200,000	-	POL
Marsa, Libya	72	-	100,000	300,000	POL
Australia					
Port Hedland	54	-	100,000	150,000	ORE
Middle East					
Bahrain	70	-	200,000	-	POL
Kharg, Iran	68	-	300,000+	500,000	POL
Tripoli, Lebenon	60+	-	100,000		POL
Mena Ahmadi, Kuwait	100	-	300,000	-	POL
Oman	66+	-	100,000	-	POL
Saudi Arabia	85	-	100,000	-	POL
Syria	51+	-	100,000	-	POL
Asia					
Indonesia	50+	-	-	-	POL
Americas					
Tubar Ao, Brazil	53	-	120,000	250,000	ORE
Halifax, Canada	70	-	-	-	POL
Peru	38	-	50,000	-	POL,ORE
Palva, Venezuela	40+	-	70,000	-	ORE

Source: Richard Waugh, ASCE, Water Depths Required for Ship Navigation, no date.

1/ POL is petroleum products; ORE is iron ore.

Figure
WORLD DRY BULK FLEET



SOURCE: FIGURE 4 DRAWN USING DATA FROM DEPARTMENT OF COMMERCE, MARITIME ADMINISTRATION, MERCHANT FLEETS OF THE WORLD, AND LLOYDS REGISTER OF SHIPS, 1966-1967.

PROJECTED 1983 WORLD DRY BULK CARRIER FLEET

BY SHIP SIZE

Deadweight Tons	No. of Ships in Baseline Fleet	No. of Ships to be Added	Total
10,000	106	30	136
10-20,000	195	173	368
20-30,000	326	310	636
30-40,000	217	138	355
40-50,000	111	143	254
50-60,000	107	89	196
60-80,000	102	116	218
80-100,000	31	45	76
100,000	8	14	22
	1,203	1,058	2,261

Source: "A Statistical Analysis of the World's Merchant Fleets", U.S. Department of Commerce, Maritime Administration, December 1967.

SIZE CHARACTERISTICS OF DRY BULK CARRIERS

Type	DWT	Length	Width	Draft
Dry Bulk	50-75,000	715-825 ft.	95-125 ft.	35-45 ft.
Dry Bulk	100,000	820-875'	125-130'	45-50'
OBO[1/]	106,000	830'	131'	49'9"
Dry Bulk	130,000	--	--	53'
Dry Bulk	146,218	996'	142'	55'
OBO[1/]	157,000	--	--	56-58'
Dry Bulk	185,000	1,040'	152'	57'
OBO[1/]	215,000	--	--	60-62'
Dry Bulk	317,000	1,230'	183'	66'
Dry Bulk	400,000	1,325'	198'	71'

1/ Ore, Bulk Oil Carrier

Source: American Association of Port Authorities, Department of Transportation, Gladstone Associates

CONSTRUCTION COSTS OF DRY BULK AND COMBINATION CARRIERS IN TERMS OF DWT

(United States Yards)

Type of Ship	DWT	Cost ($ millions)	Cost Per DWT
Dry Bulk	20,000	11.0	$550
Dry Bulk	60,000	18.2	$303
Dry Bulk	100,000	23.8	$238
Combination, ore/grain	60,000	18.7	$312
Combination, ore/oil	60,000	19.5	$325

Source: Bath Iron Works Report, May 1970 and Gladstone Associates.

AVERAGE ANNUAL INCREASE IN SIZE OF BULK CARRIERS CONSTRUCTED 1940 - 1967

Period	Bulk (all)	Ore	OBO[1]
1940 - 1950	10.8%	5.6%	--
1950 - 1965	2.1%	4.0%	4.6%
1965 - 1967	28.0%	35.1%	59.1%

[1] Ore, Bulk Oil

Source: Gladstone Associates

PERCENT OF ALL BULK[1] FLEET IN VESSELS OF MORE THAN 50,000 DWT

Year	Percent
1965	13%
1967	28%
1983	45%

[1] This includes OBO vessels.

Source: American Association of Port Authorities and Gladstone Associates.

PERCENT OF DRY BULK[1/] FLEET

IN SHIPS OF MORE THAN 50,000 DWT

Year	Percent
1960	5%
1965	12%
1967	18%
1983	23%

[1/] This does not include OBO vessels.

Source: U.S. Department of Commerce, Maritime Administration, and Lloyd's Register of Ships.

Appendix B: Petroleum

PERCENT OF EAST COAST[1/] OIL[2/] FLOW
HANDLED BY MAJOR PORTS, 1961 - 1968

Port Area	Imports 1961	Imports 1968	Domestic Receipts 1961	Domestic Receipts 1968	Net Inbound[3/] 1961	Net Inbound[3/] 1968
Delaware River	36.0%	33.5%	47.4%	51.4%	41.0%	40.3%
New York	32.0%	37.3%	35.4%	27.3%	32.6%	35.3%
Rest of East Coast	32.0%	29.2%	17.6%	21.3%	26.4%	24.4%
Total East Coast	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

1/ Excludes Portland oil handled for pipeline shipments to Canada.

2/ Crude and residual only.

3/ Imports plus receipts less shipments.

SOURCE: Army Corps of Engineers and Gladstone Associates.

PERCENT INCREASE IN OIL HANDLING[1/] BY MAJOR PORTS, 1961 TO 1968

Port Area	Average Annual Percent Increase In: Imports	Receipts	Net Inbound[2/]
New England	13.80%	10.00%	10.40%
New York	9.24%	- 3.94%	4.70%
Delaware River	4.47%	0.26%	2.94%
Baltimore	6.11%	- 0.75%	2.93%
Hampton Roads and South	8.27%	- 5.56%	2.39%
Total East Coast	5.87%	- 0.89%	3.27%

1/ These figures exclude oil shipments into Portland which are then piped into Canada. Oil includes residual and crude.

2/ Imports plus receipts less shipments.

SOURCE: Army Corps of Engineers and Gladstone Associates.

PROJECTED DOMESTIC OIL PRODUCTION

Year	Actual	Litton[1/]	AAPA[2/]	U.S. Government[3/]	Average of Projections
	(Millions of Long Tons)				
1953	355.7				
1963	432.0				
1973		531.7	530.0	600.0	553.9
1983		652.1	575.0	780.0	669.0
2003		1,000.0	600.0	1,139.0	913.0
	(Average Annual Percent Increase)				
1953-1963	2.2%				
1963-1973		2.3%	2.3%	3.9%	2.8%
1973-1983		2.3%	0.9%	3.0%	2.1%
1983-2003		2.7%	0.2%	2.3%	1.8%
1963-2003		3.3%	1.0%	4.1%	2.8%

1/ Litton Systems, Inc., 1968.

2/ American Association of Port Authorities, 1969.

3/ Unpublished Department of Interior working paper.

PROJECTED DOMESTIC DEMAND FOR PETROLEUM

Year	Actual	Litton[1/]	AAPA[2/]	U.S. Government[3/]	Average of Projections
	(Millions of Long Tons)				
1953	380.2				
1963	527.6				
1973		739.0	647.0	843.0	743.0
1983		1,027.0	774.0	1,088.0	963.0
2003		1,526.0	1,055.0	1,670.0	1,417.0
	(Average Annual Percent Increase)				
1953-1963	3.9%				
1963-1973		4.0%	2.3%	6.0%	4.1%
1973-1983		3.9%	2.0%	2.9%	3.0%
1983-2003		2.4%	1.8%	2.7%	2.4%
1963-2003		4.7%	2.5%	5.4%	4.2%

1/ Litton Systems, Inc., 1968.

2/ American Association of Port Authorities, 1969.

3/ Unpublished Department of Interior working paper.

PROJECTED OIL IMPORTS[1] BY PORT, 1973 TO 2003

(Millions of Long Tons)

Year	Delaware River Projections[2] High[3]	Medium	Low[4]	New York-New Jersey Projections High[3]	Medium	Low[4]
1963 (Actual)		(27.7)			(28.5)	
1968 (Actual)		(29.5)			(33.0)	
1973						
Alternative I[5]	47.8	41.8	32.6	47.8	41.8	32.6
Alternative II[6]	44.3	38.8	30.3	54.9	48.1	37.5
Alternative III[7]	47.9	42.0	32.7	47.8	41.8	32.6
1983						
Alternative I[5]	72.1	57.2	38.6	72.1	57.2	38.6
Alternative II[6]	61.6	48.8	33.0	93.7	74.3	50.2
Alternative III[7]	77.3	61.3	41.4	60.9	48.3	32.6
2003						
Alternative I[5]	114.1	88.0	53.9	114.1	88.0	53.9
Alternative II[6]	81.0	62.5	38.3	182.9	141.1	86.5
Alternative III[7]	138.7	107.0	65.6	61.6	47.5	29.1

1/ Includes crude and residual oils only.

2/ Includes ports from Trenton, New Jersey to Delaware City, Delaware.

3/ Litton Systems, Inc. 1968.

4/ American Association of Port Authorities, 1969.

5/ Alternative I assumes that each port will maintain its average 1960's capture of East Coast imports.

6/ Alternative II assumes each port will increase or decrease its capture of East Coast imports at the same rate as the 1960's.

7/ Alternative III assumes each port will increase or decrease its capture of East Coast imports at the reverse rate of the 1960's.

SOURCE: Gladstone Associates.

AVERAGE ANNUAL CHANGE AND RATE OF GROWTH FOR PROJECTED OIL IMPORTS,[1/] DELAWARE RIVER

1963-2003

	Delaware River Projections[2/]		
Average Annual Change	High[3/]	Medium	Low[4/]
1963-1968	-	+0.36	-
1968-1973	-	-	-
1973-1983			
Alternative I[5/]	+2.43	+1.54	+0.60
Alternative II[6/]	+1.73	+1.00	+0.27
Alternative III[7/]	+2.94	+1.93	+0.87
1983-2003			
Alternative I[5/]	+2.10	+1.54	+0.77
Alternative II[6/]	+0.97	+0.69	+0.27
Alternative III[7/]	+3.07	+2.29	+1.21
Average Annual Rate of Growth			
1963-1968	-	+1.3%	-
1968-1973	-	-	-
1973-1983			
Alternative I[5/]	+5.1%	+3.7%	+1.8%
Alternative II [6/]	+3.9%	+2.6%	+0.9%
Alternative III [7/]	+6.1%	+4.6%	+2.7%
1983-2003			
Alternative I[5/]	+2.9%	+2.7%	+2.0%
Alternative II[6/]	+1.6%	+1.4%	+0.8%
Alternative III[7/]	+4.0%	+3.7%	+2.9%

1/ Includes crude + residual oils only.

2/ Includes ports from Trenton, N.J. to Delaware City, Del.

3/ Litton Systems, Inc. 1968.

4/ American Association of Port Authorities, 1969.

5/ Alternative I assumes that each port will maintain its average 1960's capture of East Coast imports.

6/ Alternative II assumes each port will increase or decrease its capture of East Coast imports at the same rate as the 1960's.

7/ Alternative III assumes each port will increase or decrease its capture of East Coast imports at the reverse rate of the 1960's.

Source: Gladstone Associates

PROJECTED ORIGIN OF U.S. OIL[1/] IMPORTS, 1963 TO 2003

(Millions of Long Tons)

Year	Caribbean Imports		African Imports		Middle East Imports	
	Alter-[2/] native I	Alter-[3/] native II	Alter-[2/] native I	Alter-[3/] native II	Alter-[2/] native I	Alter-[3/] native II
1963 (Actual)	(83)		(0)		(16)	
1973						
High[4/]	134	118	4	24	37	39
Medium[6/]	108	96	3	19	30	32
Low[5/]	95	84	2	17	27	28
1983						
High[4/]	188	138	15	76	77	77
Medium[6/]	131	97	11	54	54	54
Low[5/]	104	76	8	43	43	43
2003						
High[4/]	250	150	50	190	175	150
Medium[6/]	181	109	36	138	127	109
Low[5/]	143	86	28	108	100	86

1/ Includes residual and crude oil only.

2/ Alternative I is based upon percentage projections of the American Association of Port Authorities, 1969. For detailed percentage breakdown see preceeding table.

3/ Alternative II is based upon percentage projections of the Newport News Shipbuilding and Dry Dock Company, 1970. For detailed percentage breakdown see preceeding table.

4/ The high projections are based upon total U.S. Oil import projections of Litton Systems, Inc., 1968.

5/ The low projections are based upon total U.S. oil import projections of the American Association of Port Authorities, 1969.

6/ Medium projections are based upon the average of total U.S. oil imports projected by the American Association of Port Authorities, 1969; the U.S. Government; Litton Systems, Inc., 1968; and Newport News Shipbuilding and Dry Dock Company, 1970.

SOURCE: Gladstone Associates

AVERAGE ANNUAL CHANGE & RATE OF GROWTH
FOR PROJECTED ORIGIN OF U.S. OIL IMPORTS[1/]
1963-2003
(millions of long tons)

	Caribbean Imports		African Imports		Middle East Imports	
	Alternative I[2/]	Alternative II[3/]	Alternative I[2/]	Alternative II[3/]	Alternative I[2/]	Alternative II[3/]
Average Annual Change						
1963-73	-	-	-	-	-	-
1973-83	-	-	-	-	-	-
High [4/]	+5.40	+2.00	+1.10	+5.20	+4.00	+3.80
Medium [6/]	+2.30	+0.10	+0.80	+3.50	+2.40	+2.20
Low [5/]	+0.90	-0.80	+0.60	+2.60	+1.60	+1.50
1983-2003						
High [4/]	+3.10	+0.60	+1.75	+5.70	+4.90	+3.65
Medium [6/]	+2.50	+0.60	+1.25	+4.20	+3.65	+2.75
Low [5/]	+1.95	+0.50	+1.00	+3.25	+2.85	+2.15
Average Annual Rate of Growth						
1963-73						
1973-83						
High [4/]	+4.0%	+1.7%	+27.5%	+21.7%	+10.8%	+9.7%
Medium [6/]	+2.1%	+0.1%	+26.7%	+18.4%	+8.0%	+6.9%
Low [5/]	+0.9%	-1.0%	+30.0%	+15.3%	+5.9%	+5.4%
1983-2003						
High [4/]	+1.6%	+0.4%	+11.7%	+7.5%	+6.4%	+4.7%
Medium [6/]	+1.9%	+0.6%	+11.4%	+7.7%	+6.8%	+5.1%
Low [5/]	+1.9%	+0.7%	+12.5%	+7.6%	+6.6%	+5.0%

1/ Includes residual + crude oil only.

2/ Alternative I is based upon percentage projections of the American Association of Port Authorities, 1969.

3/ Alternative II is based upon percentage projections of the Newport News Shipbuilding & Dry Dock Company 1970.

4/ The high projections are based upon total U.S. Oil import projections of Litton System, Inc. 1968.

5/ The low projections are based upon total U.S. Oil import projections of the American Association of Port Authorities, 1969.

6/ Medium projections are based upon the average of total U.S. oil imports projected by American Association of Port Authorities, 1969; the U.S. Government; Litton Systems Inc., 1968 and Newport News Shipbuilding & Dry Dock Company, 1970.

Source: Gladstone Associates

EAST COAST TRENDS IN CRUDE OIL
CAPACITY SINCE 1960
(Millions of Long Tons)

	1960		1969		
	Capacity	% of Total	Capacity	% of Total	% Increase 1960-1969
Delaware River	47.57	63%	47.10	67%	- 0.99%
New York-New Jersey	19.95	26%	18.88	27%	- 5.41%
Other East Coast	7.84	11%	4.23	6%	-46.05%
Total East Coast	75.35	100%	70.21	100%	- 6.82%

SOURCE: Gladstone Associates and U.S. Bureau of Mines

Appendix C: Dry Bulk Commodities

1966 BITUMINOUS COAL PRODUCTION

(Thousands of Long Tons)

Mine Area	1935-39 Average	1966	Average Annual Percent Change (1936-1966)
U.S. Total	357,300	476,800	1.12%
Maryland	1,367	1,091	-0.67%
Pennsylvania, West	86,190	72,729	-0.52%
Virginia	10,884	31,760	6.39%
Kentucky	38,667	83,188	3.84%
West Virginia	95,980	133,665	1.31%

SOURCE: U.S. Bureau of Mines and Gladstone Associates

UNITED STATES COAL RESERVES 1/

Mine Area	Billions of Long Tons
Total United States	599.3
Maryland	1.1
Pennsylvania, West	51.3
Virginia	8.7
Kentucky	58.9
West Virginia	91.1

1/ Bituminous coal only.

Source: U.S. Geological Survey.

AVERAGE ANNUAL CHANGE & RATE OF GROWTH FOR PRESENT AND PROJECTED COAL EXPORTS 1955-1995

Average Annual Change	Total Exports	Europe	Japan	South America	All Other
	(millions of long tons)				
1955-65	-.38	-.31	.43	.05	-.55
1970-80	1.60	-.03	1.44	.17	.07
1980-95	.49	-.09	.50	.05	.02
1965-95	.78	-.30	.95	.07	.06
Average Annual Rate of Growth	(Average annual percent change)				
1955-65	-1.1%	-1.2%	17.2%	3.8%	-16.4%
1970-80	5.0%	-0.2%	10.7%	6.3%	5.0%
1980-95	1.0%	-0.6%	1.8%	1.6%	1.0%
1965-95	2.5%	-1.3%	14.0%	3.9%	10.0%

Source: Booz-Allen Applied Research and Gladstone Associates.

EAST COAST IMPORTS OF FOREST PRODUCTS, BY PORT, 1961 - 1968

(Imports in Thousands of Long Tons)

	New England	New York	Delaware River	Baltimore	South Atlantic Coast	Total East Coast
1961						
Paper	21.0	437.3	90.4	25.4	121.1	695.1
Lumber	153.7	337.6	199.3	82.3	95.8	868.7
Wood	9.0	12.6	0.6	2.0	10.5	34.7
Pulp	118.5	31.3	34.6	6.6	354.1	545.2
Total	302.2	818.8	324.9	116.3	581.5	2,143.7
1968						
Paper	33.1	485.3	118.8	36.0	222.8	895.9
Lumber	257.5	528.7	376.9	268.3	380.2	1,811.6
Wood	0.5	7.7	0.0	1.5	10.0	19.6
Pulp	55.3	45.7	8.6	0.5	503.4	613.4
Total	346.4	1,067.3	504.3	306.3	1,116.6	3,340.6

(Average Annual Percent Increase in Imports)

	New England	New York	Delaware River	Baltimore	South Atlantic Coast	Total East Coast
1961-1968						
Paper	8.23%	1.57%	4.49%	5.96%	12.00%	4.13%
Lumber	9.65%	8.09%	12.73%	32.29%	42.41%	15.51%
Wood	- 13.49%	- 5.56%	-	- 3.57%	- 0.68%	- 6.22%
Pulp	- 7.62%	6.57%	- 10.73%	- 13.20%	6.02%	1.79%
Total	2.09%	4.34%	7.89%	23.34%	13.15%	7.98%

SOURCE: Derived from Waterborne Commerce of the U.S., Army Corps of Engineers, 1961 and 1968.

EAST COAST EXPORTS OF FOREST PRODUCTS, BY PORT, 1961 - 1968

(Exports in Thousands of Long Tons)

	New England	New York	Delaware River	Baltimore	South Atlantic Coast	Total East Coast
1961						
Paper	23.8	94.0	8.7	16.9	256.9	400.3
Lumber	0.0	8.0	0.6	6.0	64.2	78.9
Wood	0.1	2.4	0.0	8.0	21.9	32.4
Pulp	0.0	0.7	0.5	0.7	415.8	417.7
Total	23.9	105.1	9.8	31.6	758.8	929.3
1968						
Paper	24.2	123.2	6.1	15.2	697.6	866.3
Lumber	0.2	11.0	1.6	3.9	97.5	114.2
Wood	0.1	4.6	0.8	29.7	43.2	78.4
Pulp	23.7	41.8	3.4	1.5	476.5	546.9
Total	48.1	180.6	11.9	50.4	1,314.9	1,605.8

(Average Annual Percent Increase in Exports)

	New England	New York	Delaware River	Baltimore	South Atlantic Coast	Total East Coast
1961-1968						
Paper	0.24%	4.44%	- 4.27%	- 1.44%	24.51%	16.63%
Lumber	-	5.36%	23.81%	- 5.00%	7.41%	6.39%
Wood	0.0%	13.10%	-	38.75%	13.89%	20.28%
Pulp	-	838.78%	82.86%	16.33%	2.09%	4.42%
Total	14.47%	10.26%	3.06%	8.50%	10.47%	10.40%

SOURCE: Derived from Waternborne Commerce of the U.S., Army Corps of Engineers 1961 and 1968.

Appendix D: Summary of Projections

SUMMARY OF EAST COAST WATERBORNE TRADE
BY PORT, 1961-68

	Delaware River & Bay	New York	Balti-more	Hampton Roads
	(millions of long tons)			
1961				
Total Tons	62.1	96.2	28.4	43.2
Tons-foreign trade	36.9	37.1	17.6	26.4
Percent-foreign trade	59.0%	39.0%	62.0%	61.0%
1968				
Total tons	71.1	115.6	31.0	46.8
Tons - Foreign Trade	45.8	53.9	21.8	35.6
Percent-Foreign Trade	65.0%	47.0%	70.0%	76.0%
	(Average annual percent increase)			
1961-1968				
Total Tons	2.07%	2.88%	1.31%	1.19%
Foreign Trade	3.45%	6.47%	3.41%	4.98%

Source: Army Corps of Engineers and Gladstone Associates.

PROJECTED DEEPWATER PORT TRAFFIC
(millions of long tons trans-shipped)

Year	Imports	Exports	Total Trans-shipments
1980	33.5	4.2	37.7
2000	94.1	8.0	102.1

Source: Gladstone Associates

DEFINITIONS

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A. *add-on effect of a deepwater port:* the net change in tonnage going to or coming from a specific port area as a result of commodities being transshipped at a deepwater terminal nearby.

B. *bulk carriers:* ships constructed specifically for the movement of dry bulk commodities permitting minimum handling of cargo and maximum space utilization aboard.

C. *bulk commodities:* products or raw materials normally handled and shipped in bulk without special packaging.

D. *containerization:* the recent innovation in general cargo oceanborne shipping which places cargo in trailer-truck-like containers for easier handling and greater protection. These containers require special ships and port facilities for proper handling in transit.

E. *crude oil:* unrefined natural petroleum.

F. *deadweight ton:* the long ton capacity of a ship.

G. *deepwater port:* a port or transfer terminal capable of servicing ships with drafts in excess of 55 feet.

H. *Delaware River and Bay Ports:* includes all ports south of, and including, Trenton located along the Delaware River and Bay.

I. *draft:* the depth of the bottom of a ship below water when fully loaded.

J. *dry bulk:* products or materials normally handled and shipped in bulk without special packaging, for example iron ore, coal, or grain, but excluding liquid commodities.

K. *general cargo:* a grouping of diverse products in semi-finished or manufactured state which requires special handling and protection while in transit.

L. *Hampton Roads:* the term used for a group of ports which includes Newport News, Norfolk, and Hampton Roads Channel in Virginia.

M. *liquid bulk:* fluid products or materials shipped without packaging, for example crude oil or liquid sulfur.

N. *long ton:* 2,240 pounds (1.12 short tons) or 7.111 barrels of crude oil.

O. *Middle East:* the area surrounding the Persian Gulf.

P. *nautical mile:* 6,080 feet or 1.15 land miles.

Q. *New York Port:* the term applied to a group of ports in the New York area which includes Newark, Elizabeth, Hoboken, Brooklyn, Erie Basin, and Albany.

R. *ore/bulk oil (OBO):* a ship capable of carrying both dry and liquid bulk commodities.

S. *petroleum (POL):* the term used to include crude and residual oils.

T. *petroleum throughput capacity per year:* the amount of crude oil which a refinery can process in one year allowing for maintenance and shut down time.

U. *residual oil:* semi-refined crude oil or natural crude oil of high quality (mainly from Middle East wells) that is either further refined for petro-chemical products or burned as diesel, home heating, or industrial fuel.

V. *short ton:* 2,000 pounds (0.893 long tons) or 6.349 barrels of crude oil.

W. *supertanker:* the name given to a class of oceanborne ships capable of carrying 125,000 long tons of liquid with drafts in excess of 55 feet when fully loaded.

X. *T-2 tanker:* 16,700 deadweight ton liquid bulk carrier.

Y. *tankers:* liquid bulk ocean going vessels.

Z. *ton/mile:* the movement of one ton one mile.

REFERENCES

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United States Government Publications

United States Department of the Army. Corps. of Engineers. Deepwater Terminal in Delaware Bay, Parts I and II. Philadelphia, Pennsylvania: Custom House, 1970.

United States Department of the Army. Corps of Engineers. Harbor and Port Development. Washington, D.C.: Government Printing Office, 1968.

United States Department of the Army. Corps of Engineers. Water Depths Required for Ship Navigation, by Richard G. Waugh, Jr. Washington, D.C.: Government Printing Office, 1969.

United States Department of the Army. Corps of Engineers. Waterborne Commerce of the United States, Part I. Washington, D.C.: Government Printing Office, 1961, 1964 and 1968.

United States Department of Commerce. CMX Project. Bath Iron Works Corporation. Springfield, Virginia: Clearinghouse, 1968.

United States Department of Commerce. Forecasts of United States Oceanborne Foreign Trade. Booz-Allen Applied Research. Springfield, Virginia: Clearinghouse, 1969.

United States Department of Commerce. Oceanborne Shipping. Litton Systems, Incorporated. Springfield, Virginia: Clearinghouse, 1968.

United States Department of Commerce. Projections: Principal U.S. Dry Bulk Commodity Seaborne Imports and Exports for 1975 and 1995. Stanford Research Institute. Springfield, Virginia: Clearinghouse, 1969.

United States Department of Commerce. Research Report. Newport News Shipbuilding and Dry Dock Company. Springfield, Virginia: Clearinghouse, 1970.

United States Department of Commerce. Maritime Administration. A Statistical Analysis of the World's Merchant Fleets. Washington, D.C.: United States Government Printing Office, 1967.

United States Department of Commerce. Maritime Administration. Information and Preliminary Criteria on Planning Container Terminals. Washington, D.C.: 1968.

United States Department of Commerce. Maritime Administration. The Economic Impact of United States Ocean Ports. Washington, D.C.

United States Department of Commerce. Maritime Administration. United States Seaports Atlantic Coast, Part I. Washington, D.C.: United States Government Printing Office, 1965.

United States Department of Interior. Mineral Facts and Problems. "Iron". Bulletin 630. Washington, D.C.: United States Government Printing Office, 1965.

United States Department of the Interior. Bureau of Mines. Mineral Industry Surveys. "Petroleum Refineries in the United States and Puerto Rico – Crude Oil Capacity". Washington, D.C.: United States Government Printing Office, 1960 and 1969.

United States Department of Interior. Office of Coal Research. Annual Report, 1970. Washington, D. C.: United States Government Printing Office, 1970.

United States Department of Interior. Office of Oil and Gas. United States Petroleum Through 1980. Washington, D.C.: United States Government Printing Office, 1968.

United States Geological Survey. U. S. Coal Reserves. Washington, D.C.: United States Government Printing Office, 1966.

Books

Chisholm, Michael. Rural Settlement and Land Uses. London: Hutchinson University Library, 1966.

Christaller, Walter. Central Places in Southern Germany. Jena, Germany: 1933.

Hoover, E.M. The Location of Economic Activity. New York: 1948.

Iasard, Walter. Location and Space Economy. Cambridge, Massachusetts: MIT Press, 1956.

Losch, August. The Economics of Location. 1954.

Manners, Gerald. The Geography of Energy. London: Hutchinson University Library, 1964.

Reports

American Association of Port Authorities. Merchant Vessel Size in United States Offshore Trades by the Year 2000. Washington, D.C.: 1969.

The Annual Report of the Shipbuilders Council of America for 1969. Washington, D.C.: 1969.

Boston Redevelopment Authority. Transportation Facts for the Boston Region. Prepared for the City of Boston. Boston, Massachusetts: 1968.

Hammer, Greene, Siler Associates. The Delaware River Port. Prepared for the Commonwealth of Pennsylvania State Planning Board: 1965.

Hampton Roads Maritime Association. The Ports of Greater Hampton Roads Annual 1970. Norfolk, Virginia: 1969.

Lloyd. Lloyd's Register of Ships. London: 1967.

McKinsey and Company. Study for the British Docks Board. London: 1967.

National Coal Association. Bituminous Coal Facts, 1968. Washington, D.C.: 1968.

National Coal Association. World Coal Trade. Washington, D. C.: 1969.

Port of New York Authority. The Port of New York Foreign Trade 1970. New York: 1970.

Port of New York Authority. Ocean Petroleum Tanker Size and Traffic Forecast, Port of New York. 1975. New York: 1970.

Rawland and MacNeal. Port of Boston, Waterborne Commerce Market and Development Requirements. New York: 1964.

Schenker, Eric. The Effects of Containerization on Great Lakes' Ports. University of Wisconsin at Milwaukee: Center for Great Lakes Studies, 1968.

Sun Oil Company. Analysis of World Tank Ship Fleet. Philadelphia, Pennsylvania: 1969.

Systems Analysis and Research Commission. New England Regional Commission: Regional Transportation Needs, November, 1968. Cambridge: 1968.

Texas Transport and Terminal Company. Directory of Ports, Bulk Liquid Terminals, Grain Elevators and Bulk Handling Facilities. New Orleans, Louisiana: 1969.

Newspapers and Magazines

Japan Daily Shipping and Shipbuilding Gazette. Japan.

World Ports Magazine. Washington, D.C.: Amundsen Publications.

Miscellaneous

Brown, Joel Barry. Russian and Soviet Transportation Policy: A Geographical Appraisal. Unpublished M.A. Thesis, Department of Geography, Syracuse University, Syracuse, New York: 1968.

United States Department of Interior. "Outlook for Petroleum Utilization," Unpublished.