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Analysis of Probable Impacts of Users' Fees on Minnesota's Great Lakes Shipping

M.W. NEWSTRAND AND STEPHEN THORP

Proposed user charges present perplexing questions of economic impact on major bulk commodity movements and for individual ports on the Great Lakes. Minnesota has a major stake in Great Lakes shipping, and user fees in whatever form will create additional difficulties for the state's commercial navigation activities. Full recovery of U.S. Army Corps of Engineers operations and maintenance expenditures on the Great Lakes would result in a substantial increase in the cost of Minnesota-Great Lakes shipping. This analysis based on a site-specific, per ton charge and applied to Minnesota's share of principal bulk commodity traffic on the Great Lakes indicates that the annual cost recovery burden for the state would amount to more than $22 million. Among the major bulk commodities affected, iron ore and ore concentrates and grain would incur more than 95 percent of the total projected user charges. Increases in ore transportation costs related to user fees would increase domestic steel prices and make foreign steel more competitive in U.S. markets. As a consequence, U.S. ore production may decline. The additional grain transportation costs resulting from user fees would complicate the marketing situation for Upper Midwest grain producers and merchants especially when combined with increased St. Lawrence Seaway tolls. Another consequence for grain movements may be diversion to other transportation modes or other ports.

In recent years, there has been a growing move to create new user fees for commercial navigation in the United States. In 1980 the first tax ever imposed on the shallow draft inland river system was implemented. Since then additional taxes and new charges for deepwater systems including the Great Lakes have been proposed. User fees are not new to commercial shipping on the Great Lakes-St. Lawrence Seaway system, however. Since the opening of the Seaway in 1959, ships have been paying fees to move through the system. The fees include vessel and cargo tonnage tolls, pilot fees, and handling charges. Seaway charges are scheduled for increases and include new lockage fees for the Welland Canal.

In addition to escalating Seaway tolls there are also proposals for adding user fees intended to recover U.S. Army Corps of Engineers expenditures for operations and maintenance (O&M) and, in some cases, costs of new construction on the Great Lakes (U.S. Senate S.809, Deep Draft Recovery). This cost recovery would be for expenditures made at ports, locks, and in the connecting channels of the system. Many other proposals for deep draft user fees are being considered by the Congress. One innovative approach intended to maintain stability within the deep draft port system entails a nationwide, uniform fee. Other ideas that have received attention include an assessment procedure for Canadian vessel traffic on the Great Lakes that uses U.S. maintained segments, eliminating all U.S. Seaway tolls as part of a deep draft user fee, and tapping customs revenue to help defray federal navigation expenditures.

A major consideration is the need for careful attention to the structure and scope of the charges. For example, a flat fee applied to harbor, channel, or lock transit would discriminate against the smaller vessels and impose a penalty on empty vessels. A fee involving multiple assessments would be burdensome to domestic shipments that must pass through connecting channels or use transshipment terminals. A fee based entirely on tonnage would not account for commodity value and has the potential for charging a high fee for a low value shipment. On the other hand commodity value taxes if based on a port-specific plan would be inequitable for ports that handle a large proportion of low value shipments.

Another issue in the tax proposal is the recovery of costs incurred in Corps operations that are not directly attributable to commercial navigation. Corps budget items such as marinas and visitor center operations cannot logically be placed in the commercial navigation column. Although this expenditure for the Great Lakes is not as large an element of total Corps expense as it is for the river system, it is, nevertheless, important. Another cost allocation consideration is the cost of complying with environmental regulations that create additional expenditures for dredging operations. It is important that these costs be allocated among all of the users according to their respective benefits.

The imposition of user fees will raise shipping costs throughout the Great Lakes system. The probable impact of a Great Lakes cost recovery program on Minnesota's commerical shipping is assessed in this paper.

GENERAL METHODOLOGY

A proposal for full recovery of Corps O&M costs on the Great Lakes provides the basis for determining the potential user charges presented in this analysis. In the method used, Corps expenditures for a specific site were divided by the annual tonnage at the assessment point. This tonnage charge was applied to Minnesota's share of major bulk commodity traffic throughout the Great Lakes. Each year the tonnage charge would have to be revised to reflect changes in O&M expenditures and the tonnage base. The Corps expenditures used in this study are those associated with the ports, connecting channels, and locks that are used by most Minnesota-Great Lakes vessel traffic.

For this analysis, only Corps O&M expenditures were included. Capital costs for new or rehabilitation construction programs are difficult to forecast and are not included. Also, recovery of Coast Guard costs is not included. There is no doubt that recovery of such costs would increase user fees for the specific project area.

Data for Corps O&M expenditures used in the analysis are for fiscal years 1980 and 1981 (U.S. Army Corps of Engineers North Central Division data for 1979-1981). In addition to these data, 5-year (FY 1977-1982) average O&M costs were used; FY 1982 is a Corps projection. This information was obtained from a 1981 document, "Cost Recovery Analysis," prepared by the staff of the Senate Subcommittee on Water Resources, and from the Senate Committee on Environment and Public Works, Report on National Harbors Improvement and Maintenance Act of 1981. The most current tonnage figures available for the analysis were from the U.S. Army Corps of Engineers (1) (see Table 1), and port-to-port movement statistics were made available from the Corps' North Central Division.

Total assessment of this problem is not feasible because of the great number of potential Minnesota-Great Lakes commercial navigation connections. Nonetheless this survey includes the major bulk commodity shipments originating in the state and ac-

Table 1. Major bulk commodity tonnage for Minnesota commercial ports (1) (short tons, 1978).

Port	Raw or Pelletized Iron Ore	Grain[a]	Coal	Cement and Limestone	Fresh Fish
Duluth-Superior	28,975,319	10,171,691	4,019,807	1,708,379	1,071
Two Harbors	10,517,247				16
Silver Bay	10,828,845		288,546		25
Taconite Harbor	9,809,054		341,567		
Grand Marais					132
Total	60,130,465	10,171,691	4,649,920	1,708,379	1,244

[a]Grain category includes oilseeds.

Table 2. O&M expenditures for Minnesota, Lake Superior ports, Soo Locks, St. Mary's River, Detroit area channels, and selected lower lake ports (dollars).

Site	Operation and Maintenance	
	1 Year[a]	5-Year Average[b]
Duluth-Superior	2,170,000	2,508,300
Two Harbors	45,000	46,400
Grand Marais	11,000	28,900
Soo Locks and St. Mary's River	8,922,400	NA[c]
St. Clair River	728,000	755,500
Lake St. Clair	237,000	514,000
Detroit River	8,187,000	13,984,800
Cleveland	6,003,000	14,130,100
Buffalo	1,835,000	2,068,600
Calumet Harbor, River	529,000	1,085,600
Indiana Harbor	281,000	156,600
Burns Waterway Harbor	1,002,000	546,700
Ashtabula	NA	608,600
Conneaut	NA	474,100
Toledo	NA	3,519,600
Huron	NA	379,800
Lorain	NA	2,011,200

[a]O&M for Minnesota ports, Soo area, and Detroit area channels is for FY 1981; lower lake ports is FY 1980.
[b]1977-1982 is reported in 1982 constant dollars.
[c]NA indicates that cost data were not available.

counts for more than 90 percent of Minnesota-Great Lakes traffic. Minnesota ports that are essentially recreational in nature were not included. The proportionate shares of O&M costs for Minnesota are given in Table 2; these costs can vary widely on a geographic basis and also over time. For example, the naturally deep harbor at Two Harbors, Minnesota, has been maintained at an average annual (1977-1982 average) expense of $46,000 compared with $14,130,000 for the Cleveland, Ohio, harbor (U.S. Senate, "Cost Recovery Analyses"). The high cost for Cleveland is largely attributable to the regular dredging of the Cuyahoga River and breakwater maintenance. Variable conditions affecting sediment accumulation and the undertaking of major dredging as well as special maintenance projects can cause O&M costs for a particular year to differ substantially from avereage figures. It is emphasized that this variability will be reflected in fluctuations in costs and potential user fee levels; and, therefore, any effort to estimate recovery costs will be subject to this inherent uncertainty.

Canada-to-Canada traffic was not included in the tonnage base from which the user fee was derived because most current user fee proposals exempt it. As a consequence the cost-recovery burden for U.S. connecting channel traffic is somewhat higher than it would have been if the Canadian shipments had been included.

Because a few bulk commodities make up nearly all of the Great Lakes traffic, it was not considered necessary to project a user fee for small tonnage commodities; however, they probably would be charged. The result of this approach is that in this study complete O&M recovery is distributed over most of the traffic but not quite all of it. Even if all of the traffic had been included, the difference in the increased user fees for each bulk commodity would not have been significant. For Minnesota-Great Lakes traffic, five principal bulk commodities were considered: ore, grain, coal, cement, and limestone. These commodities comprise 98.7 percent of the tonnage moving on Lake Superior to and from Minnesota ports. A sixth commodity, fresh fish, has been included to determine the impact of a user charge on Grand Marais, Minnesota, where fish was the only reported commodity for a Corps-maintained harbor for 1978. Although current overall traffic levels, particularly for ore and grain, are running below those of 1978, the figures (when compared with historic averages and certain government study projections) represent a reasonable basis for projecting the future impact of user taxes.

Table 3 gives possible annual user fees for Minnesota origin and destination traffic based on 1- and 5-year average O&M costs from Table 2. Also given in Table 3 are the user fees for Minnesota vessel traffic that would accrue under a partial (25 percent) cost recovery user fee program that incorporates a tax cap of 6.9 cents per ton. The purpose of presenting fees calculated from 1- and 5-year average O&M costs was to show single year variation from a multiple year average and thereby demonstrate that user fees are likely to fluctuate annually. It should be noted that variations in annual tonnage will probably cause even greater fluctuations in user fee levels.

Raw and Pelletized Iron Ore

Minnesota ore and taconite pellet shipments from the North Shore to other Great Lakes ports would incur substantial user fees. In this analysis of full cost recovery, annual user fees assessed against Minnesota based ore traffic would comprise more than four-fifths of the total Minnesota Great Lakes user fee of about $22.4 million, or an average additional transportation-related cost of 31 cents per ton of ore.

Minnesota ships more iron ore and concentrate than any other state. In 1978 Minnesota shipped more than 60 million tons or about 73 percent of the total U.S. ore transported by water (2). Nearly all Minnesota ore is hauled by unit train from northeastern Minnesota mines to four Lake Superior ports for shipment to lower Great Lakes ports. Except for small amounts of ore shipped to Algoma Steel at Sault Ste. Marie, Ontario, all of Minnesota's Great Lakes ore shipments must pass through the Soo Locks and the St. Mary's River which connect Lake Superior with Lake Huron. The O&M costs for this segment are high; therefore, a substantial user fee would be charged, which could range between 7 and 12 cents per ton depending on annual O&M costs and shipping volume. Not all the U.S. ore that passes through the Soo area is from Minnesota--in 1978 about 5 million tons came from Upper Michigan. This Michigan ore helps reduce user fees for Minnesota traffic by creating a larger tonnage base for Soo O&M costs.

After passage through the Soo region, Minnesota ore shipments diverge, some to lower Lake Michigan mills (40 percent in 1978) and the remainder through Lake Huron to the Detroit area or to Lake Erie and Lake Ontario points (Corps North Central Division data). Shipments from Minnesota to the Detroit area and beyond would be potentially subject to competitive inroads from other ore sources because of the high recovery costs associated with the Detroit area channels.

Table 3. Potential annual user fees for Minnesota-Great Lakes bulk commodity traffic (dollars).

Site	O&M Costs per Ton		Ore		Grain		Coal[a]		Cement and Limestone		Fish	
	1 Year	5-Year Average	1 Year[b]	5-Year Average[c]	1 Year	5-Year Average	1 Year	5-Year Average	1 Year	5-Year Average	1 Year	5-Year Average
Minnesota Ports[d]												
Duluth-Superior	0.0473	0.055	1,370,535	1,593,643	481,479	559,643	190,137	221,089	80,806	93,960	50	59
Two Harbors	0.00427	0.004	44,709	42,069							0.07	0.06
Grand Marais	83.33	218.930									11,000	28,899
Fees for Soo Locks and St. Mary's River Allocated to Minnesota Ports of Origin												
Duluth-Superior	0.1006	NA[e]	2,884,737	NA	1,023,272	NA	299,546	NA	161,826	NA		
Two Harbors	0.1006	NA	1,058,035	NA								
Silver Bay	0.1006	NA	1,089,382	NA			29,028	NA				
Taconite Harbor	0.1006	NA	986,791	NA			34,362	NA				
Fees for Detroit Area Channels[f] Allocated to Minnesota Ports of Origin												
Duluth-Superior	0.085	0.0683	1,389,750	1,116,705	864,594	694,726	28,139	28,139				
Two Harbors	0.085	0.0683	221,425	177,922								
Silver Bay	0.085	0.0683	829,500	717,150			24,526	19,708				
Taconite Harbor	0.085	0.0683	399,500	321,010			29,033	23,329				
Fees for Lower Lake Ports												
Calumet	0.0209	0.043	106,590	219,300								
Indiana Harbor	0.0121	0.008	83,490	55,200								
Burns Harbor	0.1371	0.075	699,210	382,500								
Huron	NA	0.156	NA	192,080								
Toledo	NA	0.128	NA	680,320								
Lorain	NA	0.244	NA	1,095,000								
Cleveland	0.3053	0.719	2,228,690	5,248,700	30,530	71,900						
Ashtabula	NA	0.047	NA	127,840			NA	9,222				
Conneaut	NA	0.027	NA	103,400			NA	7,791				
Buffalo	0.2008	0.226	572,280	644,100	281,120	316,400						
Totals[g,h]			16,163,264	18,735,884	2,680,995	2,665,741	651,784	672,214	242,632	255,786	11,050	28,958
Cost Recovery[i] at the Rate of 25 Percent with a Cap of 6.9 Cents per Ton			2,612,319		512,569		156,715		51,162		9	

[a] The user fee for Duluth-Superior western coal shipments is based entirely on the per ton charge for the St. Clair River.
[b] 1-year O&M costs at Minnesota ports, Soo area, and Detroit area channels are for FY 1981; O&M costs at lower lake ports are for FY 1980.
[c] 5-year average costs (1977-1982) are reported in constant 1982 dollars.
[d] Silver Bay and Taconite Harbor are privately maintained and would not have recovery costs at the port.
[e] NA = cost data were not available.
[f] The tonnage fee for Lake St. Clair was used in computing this fee.
[g] Total cost recovery burden for all commodities for 1 year would be $19,749,725; 5-year average would be $22,358,583.
[h] Totals were obtained by substituting 1-year or 5-year costs as appropriate for missing data.
[i] Total cost recovery burden for all commodities at the rate of 25 percent with a cap of 6.9 cents per ton was $3,332,774.

The impact of user fees on Minnesota ore traffic will be felt throughout the ore mining and steel industries, but some ports and shipping patterns will suffer more than others. Ore shipments from Duluth-Superior accounted for nearly half of Minnesota ore traffic in 1978. Within the port itself, shipments of ore were 63 percent of the total traffic. During the 1978 shipping season, more than half of the ore tonnage shipped from the Twin Ports was destined for the Detroit area, Lake Erie ports, or Hamilton, Ontario.

Table 4 gives the total user fees that would be assessed against Minnesota for ore shipments in the Great Lakes. For Duluth-Superior ore shipments, the annual user fee total could amount to $9,005,685 or 48 percent of the total potential user fee assessment against Minnesota ore. The remainder of Minnesota ore traffic in 1978 was divided among Two Harbors, Silver Bay, and Taconite Harbor. Although these ports had similar shipping volumes in 1978, the potential user fees for each port are considerably different. User fees for ore shipments from Silver Bay would be almost three and a half times those for Two Harbors and more than double those for Taconite Harbor. These large differences reflect the distribution patterns for steel companies and variations in maintenance costs at receiving ports.

Of these three ports, only Two Harbors has a user fee obligation for Corps O&M costs. The other two are privately maintained and port maintenance costs are included in regular operating costs. The Soo area user fee is similar for the three ports, but the user fees for the Detroit area and the lower lake operations are substantially different for each port. For example, nearly all of the ore tonnage shipped from Silver Bay in 1978 was unloaded in Lake Erie ports and about 40 percent of this ore was unloaded in Cleveland, where the maintenance costs are high. This situation contributes to a disproportionately high cost recovery burden for shipments originating at Silver Bay compared with the other two North Shore ports.

User fees would be an additional transportation cost for the American ore and steel industry. The average increase of 31 cents per ton on Minnesota ore would certainly be added to the costs of operations, but its long-range effect on shipping volume and distribution patterns is not clear. However, the specter of enhanced foreign competition is always present. Other studies of the movement of ore in the Great Lakes region have shown only a small difference among the delivered prices of foreign, Canadian, and domestic ore. Additional transportation costs would increase the cost of Minnesota ore and thereby reduce its competitive position.

Although the user fee for some ports and shipping routes would be higher than for others, there is little likelihood of substantial logistical change

Table 4. Annual user fees for Minnesota ore traffic by port of origin (dollars).

Assessment Point	Port of Origin			
	Duluth-Superior	Two Harbors	Silver Bay	Taconite Harbor
Duluth-Superior	1,593,643	–	–	–
Two Harbors	–	42,069	–	–
Soo Area	2,884,737	1,058,035	1,089,382	986,791
Detroit Area Channels	1,116,705	177,922	717,150	321,010
Cleveland	1,869,400	71,900	3,019,800	287,600
Buffalo	56,500	–	45,200	542,400
Calumet	64,500	103,200	8,600	43,000
Indiana Harbor	9,600	17,600	800	27,200
Burns Waterway Harbor	360,000	–	–	22,500
Ashtabula	75,200	940	18,800	32,900
Conneaut	27,800	45,900	21,600	8,100
Toledo	102,400	1,920	550,400	25,600
Huron	140,600	4,680	46,800	–
Lorain	704,600	170,800	73,200	146,400
Total	9,005,685	1,694,966	5,591,732	2,443,501

Note: User fees are based on 1978 traffic levels and 5-year (1977-1982) O&M averages except for the Soo area where FY 1981 costs are used.

on a port-by-port basis because of capital investments in physical plant and intracompany supply commitments. The possibility does exist for greater use of certain lower lake transshipment facilities; this would reduce delivery through high cost ports and reduce reliance on higher cost transshipment points. The threat to Minnesota of competition from domestic ore production is less than that from foreign ore. Even though Minnesota ore has generally higher lake transportation costs than Michigan ore, the other major U.S. source, its overall cost is competitive (2). Thus, if domestic sources are to be relied on, the large volume of taconite ore in Minnesota compared with the available resources in Michigan will assure a continued demand for Minnesota ore.

A greater competitive threat to Minnesota ore production comes from foreign ore. Currently, American ore supplies about two-thirds of domestic steel-making needs. Of the U.S. imported ore supply, 90 percent comes from three countries: Canada, Venezuela, and Brazil. The use of South American ore is concentrated in the southern and East Coast steel production districts, and very little of it is delivered to mills near the Great Lakes. About 10 to 15 percent of U.S. Great Lakes region ore requirements are met by Canadian companies; this is about 63 percent of total 1978 Canadian-to-U.S. exports of ore. Some Canadian ore originates in Ontario and is shipped by vessel through Thunder Bay or by rail to Sault Ste. Marie and other Canadian steel centers, but most of the ore is mined in Labrador and Quebec and transshipped via rail-vessel movements to both U.S. and Canadian mills. Even though Canadian ore has generally higher transportation costs, other cost factors allow essentially competitive prices with American ore at U.S. mills (2). Major increases in St. Lawrence Seaway tolls for the 1982 and 1983 navigation seasons will increase vessel transportation costs for eastern Canada ore that is shipped to Great Lakes ports. These toll increases could help Minnesota ore to remain in a competitive position if a Great Lakes recovery program were enacted.

It must be emphasized that this analysis was unable to take into consideration slack shipment-demand years when the O&M costs would be spread over fewer shipments causing user fees per shipment to rise considerably. The uncertainties of demand, whether from variations in domestic demand or the level of foreign steel imports, would be a controlling factor in determining the actual impact of user fees on the ore industry in Minnesota. Domestic steel prices would reflect the additional costs of user fees, thus increasing the price differential between foreign and domestic steel. As foreign steel becomes more competitive in domestic markets, U.S. ore production would decline. Therefore, user fees would not only increase the price of U.S. steel but may significantly reduce U.S. ore production.

Grain

The impact of user fees is potentially greater for Minnesota-Great Lakes grain shipments than it is for ore. Along with probable increases in Seaway tolls, user fees assessed against grain traffic could divert Great Lakes-Seaway shipments to rail for transport to coastal terminals or may shift Duluth-Superior shipments to elevators in other Great Lakes ports. Fluctuating annual grain shipments from individual Great Lakes ports demonstrate the delicate balance between delivered price and foreign demand.

All of Minnesota's Great Lakes grain shipments originate at Duluth-Superior which has eight large elevator systems with a storage capacity of 70 million bushels. About 22 percent of the 1978 waterborne traffic was comprised of grain and oilseeds. This traffic included both direct overseas shipments and shipments to U.S. elevators and mills and Canadian export terminals on the St. Lawrence River. The user fees for Minnesota-Great Lakes grain will accrue at Duluth-Superior, the Soo area, the Detroit area channels, and a few lower lake ports. Table 3 indicates that annual user fees for grain traffic could amount to 29 cents a metric ton for a total of $2,665,741 or about 12 percent of annual Minnesota bulk commodity user fees. This amount is based on the 1978 tonnage data and 5-year O&M cost figures used in this study.

Even though the potential impact of user fees is greater for grain than for ore, increased user fees on shipments of ore would have a greater overall effect on Minnesota. Ore traffic user fees are more than seven times those for grain but the ore tonnage is only six times that of grain. The principal explanation for the discrepancy in the tonnage-to-fee ratios is the relatively few unloadings of grain at lower lake ports where the user fee would be high.

Most Minnesota-based bulk commodity traffic, whether shipments or receipts, realizes some benefit from other commercial waterway traffic on the system because of the larger tonnage base. However, the route structure of some non-Minnesota shipments may give a port or group of ports an advantage over Minnesota ports. Grain exports illustrate such a case. Although the distance from Duluth-Superior to the Atlantic is about the same as it is from Chicago, Minnesota shipments must pass through the Soo area and incur a user fee whereas Lake Michigan-based shipments bypass this costly segment.

The average user fee for Minnesota-Great Lakes grain would amount to about 1 cent per bushel. This additional cost complicates the marketing situation for Upper Midwest grain merchants. The international grain trade operates on small margins and a penny increase per bushel can have a major influence on market demand and distribution patterns. With possible diversions to rail and other ports, some changes in the domestic Great Lakes movement of grain may occur. Minnesota vessel shipments to the lower lake ports of Cleveland and Buffalo could be jeopardized because of high maintenance costs and user fees at these ports. For export-bound shipments, an increase in Seaway tolls would exacerbate the grain price difficulties resulting from user

fees. As with ore and other bulk commodities, any decrease in shipments or receipts at Minnesota ports would result in higher user fees and, therefore, a greater impact on the cost of shipping grain than has been projected in this analysis. Likewise, an increase in grain shipments would increase the share of Corps O&M costs allocated to grain.

Coal

Most of the coal moved through Minnesota ports is western subbituminous coal which is transported by rail to Superior and by ship to Detroit area power plants; smaller amounts go to upper Michigan (3). In 1978, 727,739 tons or 13.5 percent of the total coal traffic was shipped from lower lake ports up to Silver Bay and Taconite Harbor for use in taconite pellet processing plants and for generating electric power. Other local shipments include those inbound to Duluth and between Minnesota ports. Projected annual user fees for coal shipments other than western coal amount to $123,440.

Western coal shipments from Duluth-Superior would be charged a 5-year annual average of $520,635. In addition, $28,139 would be added for the Detroit area annual user fee. The latter amount is derived not from the 5-year average Detroit area fee of 6.83 cents per ton, but from the higher 1-year fee of 8.5 cents per ton, which represents a reasonable estimate of a St. Clair River user charge. The higher charge is used because Minnesota origin coal shipments go to points along the St. Clair River and do not usually go beyond the river. Because the charges at St. Clair are higher than those beyond the river, the use of the average Detroit area fee would not be accurate for this particular commodity movement. Future changes in coal transportation patterns could be caused by contractual arrangements, technological advances, and regulatory reform. Changes in either domestic regulations or foreign coal burning technology could create significant increases in western coal movements on the Great Lakes. As with ore and grain, changes in coal shipment levels would cause changes in user fees for other commodities.

Limestone and Cement

The potential impact of any type of user tax on limestone and cement movement does not appear to be significant when compared with other major bulk commodities. Nearly all of this traffic for Minnesota originates on Lake Huron at privately maintained ports and is delivered at Duluth-Superior (4). According to this analysis, the total annual user fee burden would come to $255,786 for cement and limestone, divided fairly evenly.

Fish

The commercial harvest of fish from Minnesota's North Shore is approximately a million pounds a year. Most of the catch is from ports where other commodities absorb the larger share of recovery costs and there would be little impact on fish as a separate commodity. At Grand Marais, however, commercial fishing operations could be severely affected. Full recovery of federal port expenditures would overwhelm the small volume of traffic and cripple commercial fishing. Using the Corps 5-year O&M average, the user fee per pound of fish would be about 11 cents. This would create an even less competitive position for Grand Marais fisheries compared with other U.S. and Canadian fisheries. Canadian Government subsidies to their fishermen are 7 to 10 cents per pound. According to Dale Baker of the Lake Superior Basin Studies Center at Duluth, any additional costs for American fishermen that are not also incurred by their Canadian counterparts would exacerbate an already unbalanced competitive situation.

OVERVIEW

The projected cost recovery burden for Minnesota's five principal bulk commodities involved in Great Lakes commerce would amount to more than $22 million based on this site-specific analysis. Annual fluctuations in tonnage levels and O&M expenditures that would cause variations in user charges have been accounted for in the study methodology.

The possibility that the effects of user fees would snowball because of periodic fluctuations in traffic levels is a major potential problem. For example, a decline in tonnage for one commodity would cause proportionately higher taxes on other traffic. As the fees increase on specific commodities, the prospect for modal or port diversion grows, creating the probability of greater fee increases on the remaining traffic and still more diversions.

The degree of impact of a user fee on particular commodities is affected by a number of factors including value of goods, potential for substitution, competitiveness of market, route structure, and shipment levels for major commodity traffic. This last factor deserves some elaboration, because levels for the 1981 navigation season were somewhat below those for 1978.

Total 1981 waterborne commodity tonnage at Duluth-Superior was about 5-1/2 million short tons less than it was during the 1978 sample year. However, the total traffic was only slightly less than the average for the last 5 years. A continuation of this decline would have a substantial effect on user charge levels and total cost recovery burden. Even though the tonnage base declines, O&M costs do not and may increase at or beyond inflationary rates resulting in significantly higher user fees. A new Duluth-Superior user fee calculated by using the 5-year O&M average and the 1981 traffic level would be about 6.25 cents per ton or 0.75 cent more than using the 1978 tonnage base.

Another major user fee question concerns the treatment of Canada-based vessel traffic. Under several legislative proposals, some types of Canadian vessel movements would be exempt from fees assessed at connecting channels and locks. It is apparent that United States O&M expenditures at these connections benefit Canadian traffic as well as U.S. traffic and that exempting foreign tonnage from fee assessment would increase user charges for the remaining traffic.

Cost recovery allocation presents another difficult problem regarding the implementation of a user fee program on the Great Lakes. As with the inland river system, effective cost recovery is dependent on an accurate assessment of the user population and an allocation of respective costs to users according to relative benefit. The Corps O&M budget contains nonnavigation expenditures such as visitor center operations, and these special costs cannot be legitimately assigned to commercial navigation. An equally perplexing matter concerns environmental related costs and to what extent these costs should be borne by the general public. For example, environmental regulations that create additional expenditures for dredging and material disposal add greatly to the Corps O&M budget for some ports and would result in higher user fees for those ports. It has been argued that such additional costs should be considered as a legitimate business expense. How-

ever, if large cost differences result from excessively strict local regulation, there is a need for further consideration. Before any cost recovery program is implemented, it is important that a thorough study be made to devise a cost allocation program equitable to all the system beneficiaries.

One factor that will certainly exacerbate the negative effects of possible user fees for Great Lakes navigation and Minnesota based vessel traffic is increases in the toll level for the St. Lawrence Seaway. Grain shipments from Duluth-Superior will be the principal commodity traffic affected. Scheduled toll increases for the 1982 and 1983 navigation seasons will range between 0.5 and 1 cent per bushel of grain depending on vessel load and size. Global grain prices and shipment activity are especially sensitive to the vagaries of demand in the marketplace. Transportation costs are a large component of the delivered price for grain and as a result factors such as differential user fees, including tolls that give one origin-destination combination an advantage over another, strongly influence route patterns and schedule frequency.

In addition to the impact on grain, higher tolls combined with proposed user fees would seriously handicap general cargo including containerized shipments. Even though historical tonnage levels for general cargo are not large, these shipments are quite important to the ports because of their labor intensive and high value characteristics.

SUMMARY

This analysis of user fees is based on site specific or segmentized user charges applied in the form of a tonnage fee to Minnesota's share of Great Lakes bulk commodity traffic. Minnesota commercial traffic could incur annual user charges in excess of $22 million under proposals for full recovery of the U.S. Army Corps of Engineers operations and maintenance expenditures on the Great Lakes. Under a partial recovery user fee program representing 25 percent of O&M costs and incorporating a 6.9 cent per ton limit, the user fee total would come to about $3.4 million. These amounts represent the accrual of user charges at nearly all potential assessment points: ports, connecting channels, and the lock complex at Sault Ste. Marie.

Iron ore and taconite shipments from the four ore ports would incur about 80 percent of the cost recovery burden for Minnesota. Under a full recovery program, this would amount to an average of about 31 cents per short ton. Variations in user fee totals at the four ore ports reflect port-to-port movement patterns. Higher ore and other raw material transportation costs would result in higher prices for U.S. steel and enhance the competitive position of foreign steel. This could reduce the demand for U.S. ore and create higher user charges for the remaining ore and other commodity shipments.

Additional grain transportation costs created by user fees could produce a problem more serious than for ore. The analysis shows that a full recovery user charge would amount to about 29 cents a metric ton or about 1 cent per bushel. Because grain markets react quickly to slight cost increases, modal and port diversion prospects are much greater for grain than for other commodities. Export grain is particularly vulnerable because it must also absorb increasing St. Lawrence Seaway tolls.

Full recovery of Corps O&M costs on both inbound and outbound Minnesota coal shipments would amount to 14 cents a ton. This additional cost would accrue mostly to electricity generating plants, and their customer base is so large that little individual impact would be felt.

Limestone and cement shipments would be charged an additional $255,000 under full cost recovery. Higher commodity cost and no diversion are expected.

The Great Lakes commercial fish catch for Minnesota averages about a million pounds a year. Little overall impact from user fees is anticipated except in Grand Marais, Minnesota, where it is expected that the tax could reach 11 cents per pound. At that level of tax, the port's commercial fishing activity could be eliminated.

General cargo and containerized shipments would be adversely affected by an increase in Seaway tolls and a user charge, As for grain shipments, these high value cargoes could be subject to diversion to other transportation modes or ports if transportation costs were increased substantially.

Proposed user charges and Seaway toll increases present perplexing questions regarding economic impact for particular commodity movements and for individual ports on the Great Lakes. A complete assessment of user fees and their economic impact for Great Lakes commerical navigation must await a specific determination of the structure and exact level of such fees. Minnesota, at the head of the Great Lakes-St. Lawrence Seaway system, is at a distinct geographical disadvantage because of distance from major markets and related higher transportation costs. Higher user charges in whatever form can only create additional difficulties for Minnesota's commercial navigation activities.

REFERENCES

1. Waterborne Commerce of the United States-Part 3, U.S. Army Corps of Engineers, 1978.
2. T.D. Monson. The Effects of Domestic and International Competition Upon Michigan's Iron Ore and Steel Industries. Michigan Technological Univ., Houghton, Mich., Mar. 1980.
3. J.O. Greenwood. Guide to Great Lakes Shipping. Freshwater Press, Inc., Cleveland, Ohio, 1981.
4. E. Schenker, H. Mayer, and H. Brockel. The Great Lakes Transportation System. Univ. of Wisconsin Sea Grant College Program, Green Bay, Tech. Rept. 230, 1976.

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Abridgment

RCTFC—Freight Terminal Network of the Intermodal Age

JOHN T. NORRIS AND A.M. YEN

Contemporary concepts in freight handling are incorporated in an intermodal freight center designed to provide an efficient and effective interface with domestic commerce and international trade markets for a large region. One such concept, referred to as a Regional Cargo Transportation Facilitation Center (RCTFC), would provide efficiencies through such means as increases in freight aggregation into unit trains, multiple trailer truck operations for inter-regional and international movement, integration of the inland waterways into the total intermodal freight system, and dedicated facilities to increase all-cargo flights to and from distant continental and intercontinental markets. Unit train and multi-bottom trailer movement can be dispatched directly to and from coastal and inland waterway ports of transfer for through international movement. The concept deals with terminal and interface requirements of both commercial and military (national security) aspects of the national system. It seeks to bring together, under optimized ownership, management, and operating conditions, all modes and forms of freight transportation (as appropriate in specific regions) in a national set of regional freight terminals. A nationwide network of up to five such terminals is envisioned. The concept embodies advanced management techniques, communications and data processing systems, materials handling technology, and terminal operating procedures on a multimodally compatible basis.

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A few years ago, a Presidential message on transportation stated, "America lacks a coordinated transportation system that permits cargo to move conveniently and efficiently from one point to another, from one means of transport to another--thus enabling us to use the best characteristics of each."

The technical question for transport professions is: Can an approach to freight terminals be found that will meet the efficiency and performance requirements of the nation's total transportation system? Some have suggested using a newly emerging role of freight terminals as a network for the total transportation system. This network can be expected to consist of all transportation modes functioning intermodally and modally. In this paper an attempt is made to answer this question and offer an outline of how such a network can be accomplished.

Certain public acknowledgments and activities of the past are worth noting. For example, as the result of a survey of railway terminals done in 1935 by Boatner for the Federal Coordinator of Transportation, Mr. Joseph B. Eastman estimated that from terminal unification alone savings of as much as $50,000,000 could be realized. Eastman also believed that terminal unification would improve the financial and competitive health of the railroads and enable them to build up their traffic and that "communities would have more to gain than lose."

Then, in a 1936 statement on terminal coordination, Commissioner Eastman and other experts said that the outstanding problem in translating good coordination plans for terminals into actuality is the difficulty of obtaining the cooperation of the various transportation interests involved. At one time the Interstate Commerce Commission believed that in order to effect efficient and economic operation and the free movement of traffic all terminal properties should be thrown open to all users on fair and equal terms. The Commission also proposed the unification of all terminal lines in the respective terminals.

Later, according to the findings of the National Transportation Inquiry conducted by the Special Subcommittee on Transportation, 79th Congress, 2nd Session (House Report 2735, USGPO, Wash., 1946), it was found that "many plans for freight terminal coordination had been proposed, but few have been carried out." Interestingly, the subject of that investigation was "Plans for greater coordination of terminal facilities between the carriers of the same and other types."

In Wilfred Owen's "The Metropolitan Transportation Problem," published by The Brookings Institution in 1946, "we find . . . terminal problems mean high costs and delays for all forms of transportation. The scattered location and obsolete design of freight terminals and the absence of satisfactory physical relationships among the several methods of transportation create a heavy volume of unnecessary traffic as well as delay and high costs that penalize business, the consumer, and the community." The coordination and integration of all modes of transportation are key factors in the fullest possible industrial and agricultural development of our country and in national security. That is true for both the domestic and international commerce of our nation.

Authorities recognize that in the true concept of modern day transport systems, ports and terminals as a group are categorized as interface or connectivity centers and as infrastructure. Those ports and terminals include seaports, airports, inland waterway ports, truck terminals, and rail heads or yards including rail piggyback and container terminals. It is no longer appropriate to consider freight terminals and ports as serving one transportation company or mode or as serving only the nation's transport system. They now represent a major and fundamental element of the total public and national security interests of the nation.

Shippers have long known that most of their shipping problems occur in the terminal area. The major problems are (a) increased delivery time as a result of delays that occur at the terminals and (b) increased loss and damage. The physical problems affecting the efficiency of terminal operations include terminal location, terminal age, and the number of terminals that must handle a shipment between the shipper and consignee. The factors of age and location apply mainly to the railroad industry. Because cities and towns literally grew up around the rail terminal, today many of these facilities are trapped in congested urban areas with little room for expansion. Thus, history and events of today make it clear that the problems associated with freight terminals have been with our national transport system for a long time. Congestion disruptive to the freeflow of commodities usually does not originate in the line haul segment of any transportation mode.

An understanding of the role of freight terminals calls for the recognition of terminals as more than freight processing stations where freight vehicles

of one mode, both line haul and pick up and delivery, meet for the purpose of transferring shipments enroute from the shipper to the consignee. It must also be recognized that decision making at the terminal level establishes a commitment to either efficiency or inefficiency of the terminal function as it relates to the total system, the shipper, the consignee, and public needs.

Further, speculation is appropriate as to the labor aspect of freight terminals. The question is whether terminals can remain labor intensive (particularly those terminals where general cargo is processed) while the rest of the transportation and distribution network is investing increasing amounts in capital technical advances. Of course, this leads to speculation about what is required to assure a qualified labor force for the new technological era. Thus, improvement programs for terminals must focus on positive areas of productivity and must provide the assurance to investors, carriers, shippers, consignees, and governments that the program provides efficient economical facilities capable of coping with the future demands of commerce.

Contemporary concepts of freight handling have been incorporated in a proposed intermodal freight center designed to provide an efficient and effective interface for domestic commerce and international trade for a large region. Such a center is called a Regional Cargo Transportation Facilitation Center (RCTFC). It would provide the basis for increased freight aggregation into unit trains, containerization, and multiple bottom trailer operations for interregional and international movement. It would provide for integration of the inland waterways into the total intermodal freight system and for dedicated ground facilities to increase all-cargo flights to and from distant continental and intercontinental markets.

The concept deals with terminal and interface requirements of both commercial and military (national security) aspects of the national system. It seeks to bring together under optimized ownership, management, and operating conditions all modes and forms of freight transportation (as appropriate in specific regions) in a national set of regional freight terminals. A nationwide network of five such terminals is envisioned. The concept is based on advanced management techniques, communications, and data processing systems, advanced materials handling technology, and terminal operating procedures on a multimodally compatible basis and all linked together as a network. RCTFCs would be expected to be activity centers of substantial capital investment and would occupy considerable land; the centers would attract and demand labor; and they would require direct and peripherally supporting businesses to provide services and supplies. Basic analysis suggests that RCTFCs would have a significant, broad-based economic impact on surrounding areas.

In short, RCTFC is a unique concept created to address longstanding freight terminal issues and interface requirements of the intermodal age. This concept has been found to be feasible in terms of its ability to increase efficiency in the total freight system and in terms of a consistent geographical structure in which such freight centers could function. A demonstration project was found to be feasible provided there is an adequate demand for such services.

For the potential user of an RCTFC the question of whether it is economical can be answered by a comparative cost-effectiveness calculation for alternative transportation modes. For the carrier, the RCTFC would provide unique service and cost advantages. For example, within modal line haul, such as region-to-region or foreign-to-region operations where the RCTFCs would serve as preliminary origin and destination focal points, it is to be expected that more efficient transportation services could be provided. Those services that could be increased along these routes include unit trains, multiple cars, multiple trailer units, and all-cargo airlifts. An increase in such unit operations would provide the user with more service at a lower cost.

On an implementation level, the challenge of economic trade-offs occurs at every level of design. A particularly crucial area involves automation. Because the RCTFC was conceived from the beginning as a high-volume, continuous operation center, the opportunity exists to include the highest level of automation that is available.

The economics of feasibility are arithmetically not difficult. For a given commodity in a given volume, the costs of providing facilities and services must be balanced by revenues from tonnage fees and from ancillary operations such as storage or processing. Because of the conceptual flexibility of an RCTFC, virtually every economic model will show profitability, given adequate growth and minimal commodity volumes. To support a modern, efficient, and comprehensive intermodal regional terminal as contemplated in the RCTFC concept, a typical region would include several cities and the major agricultural, industrial, and mineral productivity of the region between, and surrounding, the cities. Several such regions can be readily envisioned and are referred to in the study report.

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The Use of High-Speed Vessels in Urban Ferry Service: Issues and Economic Evaluation

ROGER P. ROESS AND PHILIP J. GREALY

The economic aspects of high-speed ferry operations are discussed and compared to conventional ferry services. The economic viability of high-speed service is demonstrated using conventional economic analysis techniques. Issues related to high-speed ferry operations such as safety, efficiency, and ridership attraction are discussed in more general terms. The paper concludes that high-speed ferry operations can compare favorably with conventional services and hold the potential for attracting larger numbers of passengers and charging premium fares.

In March 1979 the Transportation Training and Research Center of the Polytechnic Institute of New York began work on a series of studies related to the planning of urban ferry services. This work continued under contract to the Maritime Administration of the U.S. Department of Transportation until November 1981 (1,2).

In this paper the focus is on an issue that proved central to every facet of the project: the potential use of high-speed vessels in urban ferry service.

HIGH-SPEED TECHNOLOGY

A high-speed vessel is defined as any vessel that operates at speeds of 25 knots or greater. There are a variety of basic technologies that provide for such speeds. Some vessels producing speeds far in excess of this limit are hydrofoils, hovercraft, and high-speed catamarans.

There are two major benefits to the potential use of high-speed vessels:

1. The combination of straight-line, minimum distance connections over water with high-speed operation can shorten the travel time significantly compared with alternative land routes.
2. High-speed vessels can be used more efficiently than slower conventional vessels and usually require significantly smaller crews.

These benefits, however, must produce a service capable of attracting ridership and of operating economically. The following sections address the latter issue in some detail.

COST OF OPERATIONS

The costs of operating a ferry service include the terminal and vessel-related expenses. For purposes of comparing vessel economics, terminal costs were considered to be relatively constant although different vessel types may require different terminal design configurations. In general the vessel costs of interest include

1. Capital costs. The cost to buy the vessel, usually expressed as an equivalent annual cost amortized over the service life of the vessel at an appropriate interest rate (15 percent was assumed for these calculations).
2. Variable operating costs. The three major subcategories of operating cost that vary with vessel use are (a) crew costs, (b) fuel consumption, and (c) maintenance.

Table 1 gives the basic statistics for the different vessel types that are compared. All are models now in operation. For convenience only vessels that carry passengers are compared, and vehicle-carrying models are not included.

Capital Costs

The equivalent annual cost of a vessel may be computed from the following equation:

$$ACV = IC \times CRF(sl,i)$$

where

ACV = annual cost per vessel, dollars,
IC = initial cost of the vessel, dollars, and
CRF (sl,i) = capital recovery factor for the service life of the vessel (sl) at interest rate (i).

The results of this computation for the vessels shown in Table 1 are given below.

Vessel Code	Annual Cost of Vessel (1981 $)
A	910,860
B	1,741,820
C	2,716,600
D	2,165,800
E	204,204
F	753,389
G	495,040

Crew Costs

Complete details of the crew cost computations are not shown because of their complexity. The crew size for each vessel is given in Table 1, and the hourly crew cost per vessel is computed as

$$C = \sum_{i=1}^{n} N_i W_i$$

where

C = crew cost per vessel-hour,
N_i = number of crew members in category i,
W_i = hourly wage plus benefits for category i, and
n = number of labor categories included in the crew.

As the crew size required becomes smaller, the crew members tend to be in higher wage categories; thus, the average wage per crew member is higher for vessels with smaller crews. Crew costs per vessel-hour for the various vessels being compared are given below. Wage and benefit scales may vary significantly by location.

Vessel Code	Crew Cost per Vessel-Hour (1981 $)
A	60
B	144
C	245
D	71
E	35
F	61
G	80

Table 1. Vessels used in comparisons.

ID Code	Vessel Name	Vessel Type	Capital Cost ($)	Service Life (yr)	Crew Size	Operating Speed (mph)	Terminal Time (hr)	Fuel (gal/hr)	Maintenance Cost ($/hr)	Passenger Capacity
A	Vancouver SEABUS	Conventional	5,700,000	25	4	15.5	0.05	75	50	400
B	Golden Gate Ferry	Semi-planing	10,900,000	25	10	28.0	0.17	642	125	750
C	Staten Island Ferry	Conventional	17,000,000	25	15	16.0	0.15	300	69	5,700
D	Boeing Jetfoil	Hydrofoil	14,000,000	20	5	46.0	0.11	540	219	242
E	HM2-Mark III	Hovercraft (amphibious)	1,320,000	20	2	31.0	0.05	35	31	60
F	Bell Halter SES	Hovercraft	4,870,000	20	4	35.0	0.11	176	75	240
G	Westermaran	High-speed catamaran	3,200,000	20	5	29.0	0.07	540	75	175

Note: All prices based upon 1981 levels. All vessels carry passengers only.

Fuel Costs

Fuel consumption is one of the more controversial aspects of high-speed vessels. With the exception of the Bell-Halter SES, virtually all high-speed vessels have gas-turbine engines instead of the more conventional diesel engines. Although gas-turbine engines produce far more power per unit of engine weight, they also consume far more fuel, a significant economic factor.

The standard unit for vessel fuel consumption is gallons per vessel-hour of operation. For planning purposes, however, fuel consumption per passenger-mile is a more meaningful number. The conversion can be made as follows:

$$F_{PM} = F_{VH}/(CAP \times OS)$$

where

F_{PM} = fuel consumption per passenger-mile,
F_{VH} = fuel consumption per vessel-hour,
CAP = passenger capacity of the vessel, and
OS = operating speed of the vessel in mph.

This conversion assumes that vessels are 100 percent loaded and gives a passenger-mile fuel consumption rate based on full capacity. Table 2 gives the fuel consumption rates for the vessels studied.

In general higher-speed vessels will consume more fuel per hour and per passenger-mile than conventional vessels. Thus, high fuel costs must be considered to be a significant deterrent to the use of high-speed vessels.

Maintenance Costs

Maintenance costs vary with both the age and type of vessel and the quality of the maintenance standards of a particular system. Gas-turbine engines usually cost more to maintain than diesel engines; therefore maintenance costs are higher for most high-speed vessels as shown below.

Vessel Code	Maintenance Cost per Vessel-Hour (1981 $)
A	50
B	125
C	69
D	219
E	31
F	75
G	75

Total Variable Operating Cost

The estimated crew, fuel, and maintenance costs are combined in Table 3. Total variable operating costs are shown by cost per vessel-hour and cost per passenger-mile.

Note that on a passenger-mile basis conventional vessels have lower operating costs than their higher-speed counterparts. The high-speed catamaran is extremely costly because its hull remains submerged during operation and high speed is accomplished by overcoming friction and drag. The Boeing Jetfoil (vessel D), the fastest craft included, has the next highest operating costs.

The effect of speed on the cost comparison is most strikingly illustrated by vessels A and B: A is a conventional vessel used for the Vancouver SEABUS, and B is a semi-planing high-speed vessel used in San Francisco. Although vessel B has an operating cost per vessel-hour that is 4.9 times that of vessel A, its cost per passenger-mile is only 1.3 times that of vessel A because of its speed and larger passenger capacity.

Table 2. Fuel consumption rates.

Vessel Code	Gallons per Vessel-Hour	Gallons per Passenger-Mile
A	75	0.012
B	642	0.031
C	300	0.003
D	540	0.049
E	35	0.019
F	176	0.021
G	540	0.108

Note: 1981 vessel fuel averaged $1.00 per gallon. Thus, these figures also represent dollars.

Table 3. Total variable operating costs of vessels (1981 dollars).

Vessel Code	Vessel Type	Cost per Vessel-Hour	Rank[a]	Cost per Passenger-Mile	Rank
A	Conventional	187	6	0.03	6
B	Semi-planing	910	1	0.04	4-5
C	Conventional	614	4	0.01	7
D	Hydrofoil	830	2	0.08	2
E	Hovercraft	101	7	0.05	3
F	Hovercraft	312	5	0.04	4-5
G	High-speed catamaran	695	3	0.14	1

[a]From most costly to least costly.

Nevertheless, Table 3 clearly indicates that the cost of providing passenger service by high-speed vessels will be more than the cost by conventional vessels and that economic viability will depend on other factors to offset this cost.

ECONOMIC COMPARISONS OF HIGH-SPEED VESSELS

The critical factors that offset the higher cost of high-speed vessels are the number of vessels that must be used to provide service and the number of hours they must operate. With higher speeds, vessels make a trip in less time and can make more trips in a given schedule period. This translates into fewer vessels needed and fewer man-hours of labor needed to operate them.

The trade-offs are best illustrated by example. Consider that the service given below is to be initiated.

Route length = 2 miles one way
Operating schedule = 12 hours per day, weekdays only
Demand
Peak hours = 2,000 passengers per hour for one-peak hour in each direction (2 hours), in peak direction of travel
Off-peak hours = 500 passengers per hour for 10 off-peak hours in peak direction of travel.

Vessels A, E, and G will be compared for this service.

Number of Vessels Needed

The number of vessels purchased will be the number needed to provide peak-hour service plus extra vessels to cover breakdowns. For the purposes of this analysis, one extra vessel will be assumed for each type of craft considered.

Critical to the number of vessels required is the total round-trip time. This establishes the time between repeat trips and includes the route travel time plus the time spent in each terminal. The round-trip time is computed as

$$T_i = (L/OS_i) + nt_i$$

where

T_i = round-trip travel time for vessel i,
L = round-trip length, miles,
OS_i = operating speed of vessel i, mph,
n = number of terminals at which vessel stops, and
t_i = terminal time, hours.

Thus, for the vessels under consideration

$T_A = (4/15.5) + 2\ (0.05) = 0.36$ hour,
$T_E = (4/31) + 2\ (0.05) = 0.23$ hour, and
$T_G = (4/29) + 2\ (0.07) = 0.28$ hour.

The number of vessels needed in peak-hour operations depends on whether a vessel can make more than one trip in 1 hour. Where T_i is less than 1 hour, some vessels will make two or more trips during the peak hour.

Specifically the vessels will make the following number of trips in an hour:

$N_A = 1/0.36 = 2.78$ trips,
$N_E = 1/0.23 = 4.35$ trips, and
$N_G = 1/0.28 = 3.57$ trips.

Fractional values are acceptable because a vessel may make five trips in 2 hours, for an average of 2.5 trips per hour.

On the average, the number of passengers that can be processed during an hour is given by

$$P_i = N_i \times CAP_i$$

where

P_i = number of passengers per hour served by one vessel (type i),
N_i = number of trips per hour for vessel i, and
CAP_i = passenger capacity of vessel i;

and

$P_A = 2.78 \times 400 = 1112$,
$P_E = 4.35 \times 60 = 261$, and
$P_G = 3.57 \times 175 = 625$.

The number of vessels to be purchased may now be expressed as

$$NV_i = (D_p/P_i) + 1$$

where

NV_i = number of vessels of type i needed,
D_p = peak-hour passenger demand in peak direction,
P_i = number passengers per hour serviced by vessel i, and
1 = one extra vessel;

and

$NV_A = (2000/1112) + 1 = 2.8$ (or 3),
$NV_E = (2000/261) + 1 = 8.7$ (or 9), and
$NV_G = (2000/626) + 1 = 4.2$ (or 4).

Vessel-Hours of Operation

During peak periods vessels may be expected to be fully loaded, and the number of round trips made during the two daily peak hours may be expressed as

$$NTP_i = (D_p/CAP_i) \times 2 = 2D_p/CAP_i$$

where

NTP_i = number of round trips made by vessels of type i during peak hours;

and

$NTP_A = (2000x2)/400 = 10$,
$NTP_S = (2000x2)/60 = 67$, and
$NTP_G = (2000x2)/240 = 17$.

During off-peak periods vessels will not be fully loaded. A load factor of 0.60 is assumed for this study, and the number of round trips made during off-peak periods is expressed as

$$NTO_i = (D_o/0.6\ CAP_i) \times 10 = 10D_o/0.6\ CAP_i = 16.7(D_o/CAP_i)$$

where

NTO_i = number of round trips made by vessels of type i during off-peak hours, and
D_o = demand per hour during off-peak hours;

and

$NTO_A = 16.7\ (500/400) = 21$,
$NTO_E = 16.7\ (500/60) = 139$, and
$NTO_G = 16.7\ (500/240) = 35$.

The number of annual vessel-hours of operation is then found by

$$AVH_i = (NTP_i + NTO_i) \times T_i \times 260$$

where

AVH_i = annual vessel-hours of operation (vessel type i);
NTP_i, NTO_i, and T_i are as previously defined; and
260 = number of weekday per year;

and

$AVH_A = (10+21)\ (0.36)\ (260) = 2,901.6$,
$AVH_E = (67+139)\ (0.23)\ (260) = 12,318.8$, and
$AVH_G = (17+35)\ (0.28)\ (260) = 3,785.6$.

Final Comparisons

The total annual cost of operating the service with the three vessel types is given by

$$AOC_i = (NV_i \times AC_i) + (AVH_i \times CVH_i)$$

where

AOC_i = total annual operating cost for vessel type i,
NV_i = number of vessels purchased of type i,
AC_i = annual cost of amortizing vessel type i,
AVH_i = annual vehicle-hours for vessel type i,
CVH_i = cost per vessel-hour for vessel type i (Table 3);

and

$AOC_A = (3 \times 910,860) + (2901.6 \times 187) = \$3,275,179$,
$AOC_E = (9 \times 204,204) + (12,318.8 \times 101) = \$3,082,034$, and
$AOC_G = (4 \times 495,040) + (3,785.6 \times 695) = \$4,611,152$.

Although the final comparison is close, vessel E, a high-speed hovercraft, is the most economic choice--despite its high operating cost per passenger-mile and low capacity. Although more vessels are needed, their lower initial cost and the increase in the number of trips per hour more than make up for higher operating costs.

Additional Factors

The previous analysis has demonstrated that the economics of high-speed vessels in urban ferry use can be favorable. The analysis, however, is based on a constant passenger demand. This ignores the potential impact of high-speed vessels on ridership.

Countless studies of modal split behavior have indicated that travel time is a major factor in mode selection. It is reasonable to assume that the use of high-speed vessels as opposed to conventional vessels could attract larger numbers of passengers. This can result in higher load factors or in the need for more service.

Additional work is now being performed that will link a demand forecasting model to an economic analysis such as this one to assess an economically optimized service.

CONCLUSIONS

The principal conclusion of this study is that high-speed ferry services can be feasible. The high costs of high-speed vessel operation do not automatically dictate that conventional ferry services are more economical.

Waterborne options, particularly those involving high-speed vessel technology, warrant careful consideration where they exist. This paper has primarily treated vessel costs and economics, but the costs for water terminals are, in many cases, much less than the cost of fixed facilities required for land-based modal alternatives.

Lastly, modern high-speed vessels have a potential for attracting riders that has not been fully assessed in this country. The widespread use of these vessels throughout the world suggests that there is a role for them in the United States as well.

REFERENCES

1. P.A. Habib, A.J. Bloch, and R.P. Roess. Functional Design of Ferry Systems, Phase I Final Rept. Maritime Administration, Polytechnic Institute of New York, July 1980.
2. R.P. Roess, P.J. Grealy, and C. Berkowitz. Some Critical Aspects of Ferry Planning, Phase II Final Rept. Maritime Administration, Polytechnic Institute of New York, Nov. 1981.

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Economic Viability of the Great Lakes-St. Lawrence Seaway System with Particular Reference to the Growth Potential of Burns Waterway Harbor, Indiana

SAMUEL EWER EASTMAN

Historical traffic on the Great Lakes—St. Lawrence Seaway System is presented, along with a projection showing traffic growth to the year 2000. Burns Waterway Harbor, Indiana, the newest (1973) and most modern deepwater harbor located on Lake Michigan 30 miles east of Chicago, is shown to have experienced more rapid traffic growth (1979-1981) than the Seaway System generally. This has been because of the ability of port management to attract new, replacement cargoes. The future growth and development of Burns Harbor (and in most cases that of the Great Lakes—St. Lawrence Seaway as a whole) will be affected by success in expanding the navigation season, Seaway tolls, relaxed federal regulatory environment for domestic surface transportation, permission for greater cooperative action among water carriers in the conference structure, inland waterway user charges to develop and maintain ports and waterways, and the changing role of state and federal governments. The Staggers Rail Act of 1980 has had an adverse effect on PL 480 relief cargo at Burns Harbor, at least initially. The Indiana Port Commission should identify a set of ground rules for further port development that are most likely to yield the maximum economic benefit to the state.

Economic viability and growth potential studies usually start with an overview of the area to be considered, bringing to light such matters as the size and characteristics of the population, a description of the labor force including type of employment, manufacturing value added by industry, and so forth. In transportation studies such as this, where the focus is on a particular facility, Burns Waterway Harbor, Indiana (Burns Harbor), the overview should include both a definition and description of the trading area.

Barriers and impediments to trade--called challenges to further development by some--exist everywhere as the result of laws, regulations, trade practice, and sometimes can be explained only by history. The task of the researcher is to come up with some suggestions that will improve the position of the study subject, here Burns Harbor. The material is presented below in three sections: overview of the Burns Harbor trading area; activity at Burns Harbor; and barriers, impediments, or challenges to traffic growth.

OVERVIEW OF THE BURNS HARBOR TRADING AREA

The trading area of Burns Harbor encompasses the industrial and agricultural producing areas of the Midwest (see Figure 1). Although this 19-state region generates about 25 percent of the entire U.S. export general cargo traffic, only 5 percent of the country's general cargo exports move by the Great Lakes-St. Lawrence Seaway System (1, p. I-3). Another study points out that growth in Great Lakes-St. Lawrence Seaway traffic has lagged growth in the standard economic indicators for the entire country. Thus, there was a 1.38 percent average annual decrease from 1968 to 1975 in total U.S. foreign commerce moving through the Great Lakes. During that period the U.S. gross national product increased at an annual rate of 1.92 percent, and total annual U.S. exports of dry cargoes increased at a rate of 5.03 percent (2, p. 2-5). It was also demonstrated that the Great Lakes region was experiencing growth but at a slower rate than other sections of the country.

Traffic on the St. Lawrence Seaway has been growing over the years, as shown in Table 1 (3, pp. 72-73), but growth has been uneven and subject to wide fluctuations from year to year. This is because most of the Seaway traffic is in bulk commodities the movement of which is frequently tied to the health of particular industries or directly influenced by international political objectives of the United States. Depressed economic activity levels and Russian grain embargoes imposed by the United States for political purposes affect Seaway traffic directly. Grains are no longer exported in the same quantities; and ores, ore concentrates, limestone, and coal are not moved in the former quantities because of the economic recession.

One study predicts relatively stable growth in both upbound and downbound traffic on both sections of the Seaway to the year 2000. The results of this study are shown in Table 2 (4, p. 1). Within this overall positive forecast, fluctuations can be expected to continue from year to year.

TODAY'S ACTIVITY AT BURNS HARBOR

Burns Waterway harbor is the newest and most modern deepwater harbor on the Great Lakes. It started operations in 1973, and it is located on the shore of Lake Michigan about 30 miles east of Chicago; it was specifically designed and built for St. Lawrence Seaway traffic. Unlike Chicago and other Great Lakes ports there are no bridges, restrictive channels, or other hazards to navigation. Freighters approach through open water and can dock under their own power without tug assistance. Modern sprinkler-equipped transit sheds are available, and around-the-clock security is provided by a specially trained contingent of the Indiana State Police.

As shown in Figure 2, public berth space for eight freighters is available in three docking areas. More than 300 acres are available for further expansion at the port. Midwest Steel and Bethlehem Steel adjoin the port to the west and east and have their own private, proprietary shipping and handling facilities. The port is adjacent to I-94 with connections to I-80, I-95, and I-65. This provides unobstructed access for inbound and outbound motor carrier freight of all kinds of bulk and general merchandise. The port is now served by a single railroad, Conrail. A spur of the South Shore Line serves the Bethlehem steel plant on the east, and the tracks of that line (part of the CSX System) parallel those of Conrail. These rail lines currently have no access to the port.

Traffic has been growing more rapidly at Burns Harbor than for the Seaway as a whole in recent years. Here again, most of the traffic is in bulk commodities tied to particular industries or economic activities. Burns Harbor has been able to develop new or replacement cargoes to make up for the loss of particular cargoes due to changes in U.S. and world economic and political situations. Thus, from 1979 to 1980 there was a dramatic drop in steel imports from 273,978 tons to 63,019 tons--a

Figure 1. St. Lawrence Seaway System.

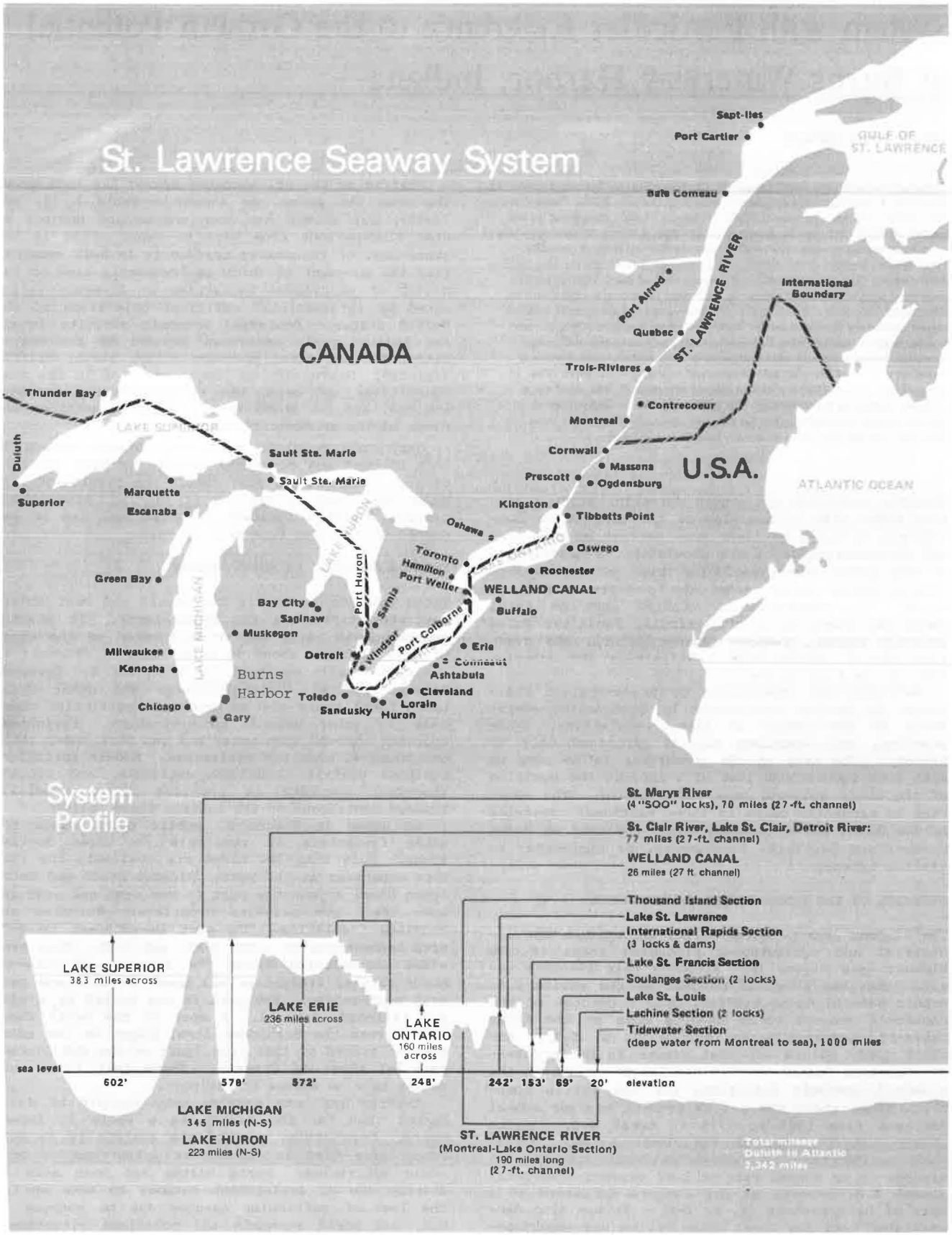


Table 1. Traffic on the St. Lawrence Seaway (tonnage for selected years).

Traffic	1960 Tons	1960 Percentage of Total	1965 Tons	1965 Percentage of Total	1970 Tons	1970 Percentage of Total	1975 Tons	1975 Percentage of Total	1980 Tons	1980 Percentage of Total	1981 Tons	1981 Percentage of Total
Montreal-Lake Ontario Section: Tonnage for Selected Years												
Total tonnage	18,425,235	100.0	39,356,271	100.0	46,421,434	100.0	43,554,303	100.0	49,454,109	100.0	50,569,257	100.0
Direction												
Upbound	7,966,552	43.2	20,062,880	51.0	22,872,888	49.3	19,899,874	45.7	14,925,615	30.2	18,822,201	37.2
Downbound	10,458,683	56.8	19,293,391	49.0	23,548,546	50.7	23,654,429	54.3	34,528,494	69.8	31,747,056	62.8
Type												
Bulk	16,380,534	88.9	34,294,717	87.1	40,481,680	87.2	40,272,182	92.5	46,775,186	94.6	47,098,991	93.1
General	2,044,701	11.1	5,061,554	12.9	5,939,754	12.8	3,282,121	7.5	2,678,923	5.4	3,470,266	6.9
Origin or destination												
U.S.	10,219,772	42.1	24,647,367	45.0	28,160,584	43.8	26,053,713	43.1	25,648,162	38.9	28,936,751	41.0
Canada	14,010,289	57.8	30,103,635	55.0	36,164,931	56.2	34,397,147	56.9	40,347,121	61.1	41,713,974	59.0
Welland Canal Section: Tonnage for Selected Years												
Total tonnage	26,534,870	100.0	48,461,969	100.0	57,118,846	100.0	54,294,121	100.0	59,605,981	100.0	58,850,875	100.0
Direction												
Upbound	7,595,598	28.6	18,097,086	37.3	19,208,782	33.6	17,137,559	31.6	11,986,348	20.1	16,601,880	28.2
Downbound	18,939,272	71.4	30,364,883	62.7	37,910,064	66.4	37,156,562	68.4	47,619,633	79.9	42,248,995	71.8
Type												
Bulk	24,818,852	93.5	44,198,339	91.2	51,806,382	90.7	51,542,946	94.9	57,910,302	97.2	56,084,190	95.3
General	1,716,018	6.5	4,263,630	8.8	5,312,464	9.3	2,751,175	5.1	1,695,679	2.8	2,766,685	4.7
Origin or destination												
U.S.	19,593,773	48.0	37,186,510	49.1	41,738,376	47.5	37,769,520	45.7	39,039,892	43.8	39,012,418	43.9
Canada	21,252,598	52.0	38,576,957	50.9	46,141,529	52.5	44,957,094	54.3	50,189,988	56.2	49,828,323	56.1

Note: Information was taken from (3), pp. 72 and 73.

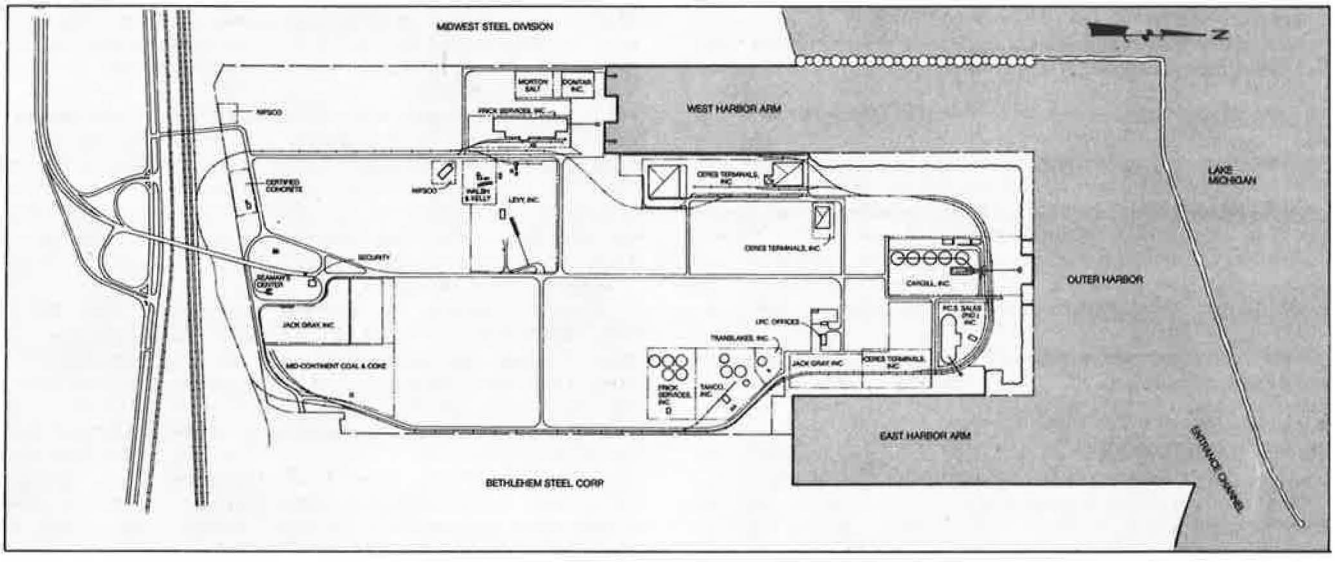
Table 2. St. Lawrence Seaway System: forecast of traffic 1985-2000.

Year	Total Traffic (million tonnes) Upbound MLO[a]	Upbound Welland[b]	Downbound MLO	Downbound Welland	Total MLO	Total Welland
1978-1980[c]	21.20	17.80	32.50	46.10	53.70	63.90
1985	23.67	19.67	36.55	49.90	60.22	69.57
1990	25.59	21.10	41.29	54.65	66.88	75.75
1995	25.90	21.97	46.46	60.94	72.36	82.91
2000	27.79	23.69	52.34	65.96	80.13	89.65

Note: Source of this forecast is (4).

[a]Montreal-Lake Ontario Section.
[b]Welland section.
[c]Actual average.

Figure 2. Burns Waterway Harbor, Indiana.



loss of 210,959 tons which was almost 20 percent of all 1979 cargoes (see Tables 3 and 4). This was more than made up by the introduction of 126,898 tons of potash (new cargo to Burns Harbor in 1980) and an increase from 216,877 tons of slag and fly ash in 1979 to 370,157 tons in 1980. Slag and fly ash traffic declined in 1981 even more than steel imports had dropped the year before, but it was made up by 182,928 tons of grain (a new cargo to Burns Harbor in 1981), substantial growth in potash, and a sizable increase in liquid fertilizer and caustics.

Clearly, the success of Burns Harbor to date has been the development of a number of specialized bulk cargoes, many of which are associated with processing and storage facilities within the port complex itself. General cargo, including PL 480 relief cargo discussed in more detail below, has played a minor role particularly in terms of revenue to the Indiana Port Commission which must have earnings adequate to cover the maintenance and operations expenses of the port.

BARRIERS, IMPEDIMENTS, OR CHALLENGES TO TRAFFIC GROWTH

There are a number of barriers or impediments--some people prefer to say challenges--to the future growth and development of Burns Harbor. Some of these exist as limitations on the St. Lawrence Seaway System, and some are unique to Burns Harbor. These will be discussed in turn, not necessarily in order of importance and impact on Burns Harbor.

Limited Navigation Season

The current shipping season on the Seaway System is limited to the 8.5 months of the year when the system is free of ice and open to navigation. This limited navigation season discourages vessel owners from committing vessels to a service on the Seaway System (including Burns Harbor) because it means a 3.5 month lay-up of their vessels, a period when their investment is unproductive. As long as there are other trades in which they can operate their vessels year round, the Seaway is a less competitive and less efficient use of their investment. The lack of stability that results from the limited navigation season and the unwillingness of vessel owners to commit ships to the trade on regular scheduled service, year in and year out, discourages shippers from using Burns Harbor. An expanded navigation season for the Seaway has been studied. There is little doubt that such an extension would encourage ship owners to dedicate vessels to the Seaway trades, including Burns Harbor (5).

Voyage Times

All things being equal, equivalent voyages between U.S. east coast ports and ports in western Europe can be made in less time than voyages from ports west of the Welland Canal on the Seaway. The difficulty with such comparisons is that voyages are rarely equivalent. It is therefore difficult to generalize--each voyage must be looked at individually.

Generally a sailing from the Great Lakes calls at more ports than a sailing from the east coast. A cooperative effort among ports on the Lakes to reduce the number of ports at which calls are made is in the planning stage. The difficulty with this approach for Burns Harbor is that, in such planning, it is considered a tributary port to Chicago (2, p. 5-8) and no vessels would call there. It is hard to see how this effort would add significantly to the revenues for Burns Harbor.

Table 3. Cargo comparison for Burns Waterway Harbor 1979-1981.

Cargo	1981 (%)	1980 (%)	1979 (%)
Incoming	46	48	71.3
Outgoing	54	52	28.7
Foreign, including Canadian	65.6	50.3	58
Domestic	34.4	49.7	42
By ship	66.2	74.2	70
By barge	33.8	25.8	30
Type			
Bulk dry	56.8	67.8	43.7
General	19.8	13.1	37.7
Container	0.1	0.3	0.3
Bulk liquid	23.3	18.8	18.3

Note: Information was obtained from Indiana Port Commission, Portage (6).

Table 4. Cargo for Burns Waterway Harbor 1979-1981 (tons).

Class	1981	1980	1979
Steel	218,471	63,019	273,978
Slag and fly ash	100,886	370,157	216,877
Liquid fertilizer and caustic	314,751	230,717	210,013
General	20,672	45,764	82,220
Pig iron	80,142	38,681	55,780
Cobble plate	2,492	38,403	47,725
Coke	55,028	142,482	177,303
AID (PL 480)	26,877	17,722	30,896
Coal	8,734	–	–
Scrap metal	22,883	28,859	19,535
Scrap motors	2,421	7,000	16,143
Salt	33,091	92,825	15,100
Flux stone	–	2,785	–
Grain	182,928	–	–
Potash	276,289	126,898	–
Total	1,345,665	1,205,312	1,145,570

Note: Information was obtained from Indiana Port Commission, Portage, (6).

Comparative Transportation Costs

The subject of comparative costs for export shipments from Great Lakes ports, including Burns Harbor, and from Atlantic Coast ports must, today, be approached with a great deal of caution. As recently as 1972, a consultant's study prepared for the Indiana Port Commission demonstrated that the combination of inland rail and truck rates plus ocean freight to western European ports was often less for shipments originating in the Midwest when routed via Burns Harbor than when routed via New York or Baltimore (1, p. 3-1). Much was made in the study of the transportation cost advantage of the Burns Harbor routing.

The Burns Harbor cost advantage for those export shipments where it was found to exist was based on rail and water carrier port equalization policies then in practice. This cost advantage was simply the difference between the higher rail or truck rate to New York from the Midwest origin and the lower rail or truck rate from that origin to Burns Harbor, a much shorter distance.

This situation has changed markedly. The Staggers Rail Act of 1980 deregulated the railroads to some degree and gave them new pricing flexibility, free from regulation by the Interstate Commerce Commission. In addition new legislation introduced in the Congress will, when enacted, give international water carriers much greater freedom to price and operate in concert, free from the operation of the antitrust laws. Finally legislation is pending that would reverse the role of the federal government in the development and maintenance of ports and waterways by imposing user charges, and there is pressure

Table 5. Rail rates from origin to port (dollars per hundredweight).

Supplier (Origin of Cargo)	Burns Waterway Harbor		Chicago		Milwaukee		U.S. Gulf Ports	Mississippi River Ports
	New Rate	Old Rate[a]	New Rate	Old Rate[a]	New Rate	Old Rate[a]		
Lauhoff (Crete, Neb.)	1.82	1.76	1.37	1.49	1.37	1.49	1.37	1.37
CONAGRA (Omaha, Neb.)	1.55	1.26	1.06	1.26	1.06	1.26	1.37	1.37
ADM, Cereal Foods, International Multifoods (North Kansas City, Mo.)	1.98	1.26	1.06	1.26	1.37	1.26	1.26	1.26
CONAGRA (Minneapolis, Minn.)	1.74	1.04	1.25	1.04	1.25	1.04	3.18	2.64
Lauhoff (Danville, Ill.)	0.73	0.60	0.60	0.55	1.12	1.03	1.53	1.37

Note: Information was provided in a letter from Christos N. Kritikos, President, Ceres Maine Terminals Inc., to Honorable Adam Benjamin, Jr., Member of Congress, dated February 6, 1982.

[a]Rates in effect before Conrail's cancellation of joint rates.

for the states to undertake a greater role in financing public works--the New Federalism. The forces for change that these new developments have unleashed are only beginning to be felt and understood. Each subject merits careful attention.

Rail Deregulation

The cancellation by Conrail of its participation in making joint rail rates with western railroads for cargo originating west of Chicago has already affected Burns Harbor. In making a joint rate with a western road, Conrail received a small proportion of the total rate because (a) the cargo did not originate on its line and (b) the length of haul on Conrail was, typically, only a few miles (Burns Harbor is only 30 miles east of Chicago). Congress has told Conrail it must become profitable or be sold. The Staggers Act gave Conrail the authority to cancel its participation in joint rates when it believed its share of the division was not large enough to meet its standards for profitability; this it did. Rates quoted today are the sum of two local rates, the western railroad's to its interchange with Conrail and Conrail's local rate from the interchange to Burns Harbor. Together the rate is higher than the old joint rate and high enough to take Burns Harbor out of the competition for PL 480 relief cargo routed by the Department of Agriculture standard of "lowest landed cost."

In addition rail rates to Chicago and Milwaukee, ports that compete with Burns Harbor, have been reduced from previous levels from some shipping points (Table 5). Therefore, not only has the rail rate to Burns Harbor been increased but the rate to competing ports has been reduced. Railroads have also established train loading stations in Indiana where unit train loads are accumulated (100 cars or more for low-cost rail transportation to east coast ports for export). These practices, encouraged by the Staggers Act to help the railroads, have adversely affected export shipments from Burns Harbor of grains originating in Indiana.

The foregoing discussion suggests that Burns Harbor might benefit if served by another railroad in addition to Conrail. The Indiana Port Commission is aware of this and is attempting to do something about it.

Seaway Tolls

No discussion of comparative transportation costs would be complete without consideration of the toll charges against vessels and cargoes for using the St. Lawrence Seaway System (which ranges from about $1.00 to $2.50 per ton). Present law requires the St. Lawrence Seaway Development Corporation to charge tolls that cover its costs of operation.

The whole question of federal government waterway user charges--for deepening existing harbors, new construction, maintenance, and operation conducted by the U.S. Army Corps of Engineers and for some services provided by the U.S. Coast Guard--has been under debate by Congress during 1980, 1981, and 1982. So far there has been no new legislation. Tolls on the Seaway System may be affected by what Congress ultimately decides to do about user charges for waterways in general. There is no question, however, that the current toll is an added cost to shippers for use of the Seaway System.

New Services and New Maritime Policy

In "The Requisites for Recovery," 1981, the Great Lakes Task Force argues that the growth and development of the Great Lakes area is held back because of the failure of policies of the federal government to provide adequate shipping services on the St. Lawrence Seaway System. It argues that billions of public tax dollars are spent to build and operate the American flag merchant marine, virtually none of which has benefited the Seaway and the Lakes. Of 1,400 American flag sailings from all American coastlines in 1980, only five sailings originated from or terminated at all Great Lakes ports combined--the nation's legally constituted fourth coast. Because of the lack of American flag sailings from the area, cargo preference laws, which require a certain percentage of some government cargoes to be carried in American bottoms, prescribe that such cargoes originating in the Great Lakes area be routed via Atlantic and Gulf ports where American flag vessels are available. The task force also advocated, among other things, changes in the availability of operating and construction differential subsidies that would make Great Lakes cargoes attractive to American flag vessels.

A fundamental difficulty with these proposals stems from the way the trades between the North Atlantic/Gulf and western Europe/Mediterranean trades are developing. First the shift has been, and continues to be, toward more and more containerization. Vessels developed and under construction for these trades are large containerships--2,000 to 3,000 TEU (20-foot container equivalents). These large, fast ships are powered by low-speed diesel engines that are quite fuel efficient. They call at as few ports as possible on fast turnaround schedules that are dictated by the huge investment and desire for maximum productivity.

The vessels are too large for the Seaway and would have to be fed by a laker service. This would require establishment of a container terminal that would accumulate enough cargo to make a call by the large containership worthwhile. It would have to be price competitive with the container traffic now

moving by rail from the U.S. Midwest to Montreal and Halifax for deep-water loading. Such a feeder service was established on the Great Lakes exclusively for container trades, without U.S. maritime subsidy, but was abandoned as unprofitable at the end of the 1980 shipping season.

A final development must be noted even though the ultimate effect is largely unknown (as in the case of rail deregulation, tolls and user charges, and larger containerships). U.S. maritime policy is undergoing major changes. In an effort to reduce operating subsidies in foreign trades, legislation has been introduced in Congress (1982) that would partly free liner operators from the antitrust laws and allow them to pool operations and revenues among conference members more freely than they are allowed to do today. Although no final legislation has been passed, the general effect of this new policy is clearly to reduce competition in foreign commerce. History shows such arrangements typically result in less service while maintaining prices to make operations more profitable. That same history also shows that such practices often invite nonconference competition offering lower than conference rates, particularly if the conference is successful in keeping its rates high. Such a situation, should it occur, might attract new services to the Great Lakes where there are no conferences.

The Changing Role of Government

Mention was previously made of Seaway tolls and the possibility of waterway user charges for services provided by the federal government. If enacted these would, in effect, shift expenditures, in whole or in part, for public works from the general tax fund to the waterway users. Rates would go up and waterway transportation might be less competitive with other surface modes than before.

The changing role of government will affect Burns Harbor day-to-day operations and, more important, will affect the rules of the game which define how, when, and where port development can take place. These changes may bring new barriers and challenges, but they may also present new opportunities. It will not be possible to ignore them even though it is not possible at the moment to determine what will happen or what the effect will be.

Optimizing the Total Economic Benefits of Burns Harbor

Positive economic effects or benefits are both direct and indirect (or induced). Wages paid stevedores to handle general cargo processed or manufactured elsewhere create more direct benefit to the state of Indiana when they are in addition to the dockage and wharfage fees collected for the mooring of ships and the handling of bulk cargoes. However, bulk cargoes (and general cargoes as well) may be part of a local processing or manufacturing activity, possibly carried on at the port itself; this provides jobs and investment in plant and equipment--more economic benefit. Beyond the direct benefits of wages paid at the port, dockage, and wharfage revenues is the indirect economic benefit determined by how these moneys are spent. Also, the processing or manufacturing may use local goods and services thus generating additional economic benefits.

Burns Harbor is an economic resource of the state of Indiana, one which provides the state positive economic benefits well beyond the direct impact of the port operation alone (6). The Indiana Port Commission has limited resources to develop new cargoes for the port simply as cargoes or to further develop land for processing and manufacturing facilities that would provide new cargoes. Where a choice is to be made among several possible projects, the objective should be to maximize all positive economic benefits to the state, both direct and indirect. It is often difficult to quantify these benefits among projects competing for Indiana's financial support, but a careful analysis should be worth the effort.

SUMMARY AND CONCLUSIONS

Traffic on the Great Lakes-St. Lawrence Seaway System is predicted to grow every year to the end of the century, primarily in bulk cargoes. The traffic growth rate at Burns Harbor exceeded that of the Seaway System in the years studied (1979-1981). Burns Harbor's superior performance resulted from the ability of port management to attract new, replacement cargoes. Much of this cargo is processed and stored at facilities at the port.

Trade on the Great Lakes-St. Lawrence Seaway System suffers from the lack of scheduled, reliable services by vessels dedicated to the Seaway. In addition railroad deregulation has, at least initially, adversely affected the movement of PL 480 relief cargoes, and possibly other cargoes, at Burns Harbor.

Possible increases in waterway user charges for services provided by federal government agencies, proposed changes in the role of state and federal government in financing public works, and changes in maritime policy and ocean liner services provided by conference carriers--in addition to rail deregulation--will affect growth and development at Burns Harbor, not necessarily adversely.

Several proposals are currently under study to expand trade at the port that will enhance the positive economic benefits the port already provides the state of Indiana. These require further study and follow-up, as does the development of a set of ground rules that would indicate the kind of port development activity most likely to yield the maximum economic benefit to the state.

ACKNOWLEDGMENT

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REFERENCES

1. Port of Indiana, Burns Waterway Harbor. Moshman Associates, Inc., Wash., D.C., Nov. 1972.
2. Great Lakes Cooperative Port Planning Study, Volume I: Strategy Report. U.S. Department of Transportation, Maritime Commission, Wash., D.C., undated.
3. The St. Lawrence Seaway Traffic Report for the 1981 Navigation Season. U.S. Department of Transportation, St. Lawrence Seaway Development Corp., 800 Independence Avenue, S.W., Wash., D.C., pp. 72-73.
4. Seaway Commodity Flow Forecast, 1980 to 2000, Executive Summary. Acres Consulting Services Limited, Data Resources, Inc., Wash., D.C., Feb. 1982.
5. The Requisites for Recovery, The View from the Lakes. Great Lakes Task Force, 2200 Bonisteel Boulevard, Ann Arbor, Mich., 1981.
6. Burns Waterway Harbor, A Dream That Pays Dividends. Indiana Port Commission, Post Office Box 189, Portage, Ind., Dec. 1981.

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Potential Revenues for Inland Ports to Match Federal Maintenance Costs

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User fees and matching maintenance costs are subjects of crucial importance to many ports at this time. The federal government, both Congress and the Administration, are closely examining the possibility of requiring ports to match at least in some proportion the cost of maintaining channels within port boundaries where, in the past, the work has been conducted by, and the costs borne by, the U.S. Army Corps of Engineers. Ports operate as both public and private entities. Some ports conduct all channel maintenance and bear all the cost; others are totally dependent on the U.S. Army Corps of Engineers. The purpose of this study was to develop a list of potential revenue sources to generate funds to match the federal cost of maintaining channels used specifically for port operations. A discussion of each potential source points out some of the advantages, disadvantages, and complications. Illustrative examples are given that point out some of the major differences in port operations and functions. The basic element of any discussion of ports is competition: competition between ports, between public and private operations, and as a mode of transportation.

In the future ports may have to assume all or part of the cost now borne by the federal government for maintaining channels that provide access to their facilities. Federal legislation is being considered and may be enacted during the 1983 session of Congress. This cost will be essentially for dredging operations now performed by the U.S. Army Corps of Engineers. For clarification, in this paper on port channel maintenance no portion of the operations, dredging or otherwise, necessary to maintain mainstream channels is considered. Ports must confront this issue; therefore, an effort has been made here to avoid the pros and cons of whether or not it is valid.

Some of the problems will be examined to develop the focus. Potential revenue sources and methods of generating revenue along with the advantages and disadvantages are discussed as candidly as possible. It may be impossible to determine and evaluate every source of revenue on the first effort, but a preliminary list has been developed that will aid ports in generating funds to match the federal maintenance cost, if needed, or will aid in generating revenues for other purposes.

Before selecting a revenue source, thought should be given to who will perform the maintenance and what portion of the cost will have to be absorbed. Then all potential revenue sources should be carefully evaluated. The U.S. Army Corps of Engineers could conduct the work and bill the port authority/commission for its share. If a port must bear all the cost, the port may consider acquiring the necessary equipment and doing the dredging itself or letting the work to contractors. Later, these elements will be discussed further. The share of the cost that must be borne and the methods of accomplishing the work can substantially influence the selection of a revenue source.

Some questions regarding channel maintenance go beyond the generation of funds and include operational procedures and economics. A port considering acquiring dredging equipment or hiring contractors may encounter problems that will necessitate a feasibility analysis that evaluates the benefits, cost, environmental impact, and administrative problems. In many instances, dredged materials can be disposed of readily, profitably, and beneficially for rather long periods; in other instances, disposal of dredged material will cause environmental problems and other concerns.

All elements of channel maintenance can usually be done by contractors, eliminating the necessity of acquiring equipment and hiring personnel. However, reimbursing the Corps for work done may be the only feasible approach for many ports as long as this is a possibility. As potential revenue sources are considered, some of these questions will be discussed but not necessarily from the standpoint of feasibility and economics. The cumulative effect will be realized by the user who is the ultimate beneficiary of water transportation.

THE PROBLEM

The problem does not appear to be so much one of the imposition of a charge for maintenance performed by the Corps as one of hardship imposed on those ports with a long-standing precedent of dependence on the Corps to perform certain elements of maintenance. Many of these ports also received a great deal of assistance and encouragement from the Corps in their original development. The other extreme are those ports which received no development assistance and no maintenance assistance from the Corps except for being near a Corps developed navigable channel. Other ports are somewhere between these two extremes. An examination of some examples may help in understanding these cost allocation problems.

The Port of Catoosa at Tulsa, Oklahoma, operating under the city of Tulsa-Rodgers County Port Authority (see Figure 1), dredged a harbor consisting of approximately a 1.5-mile channel and turning basin. The Port Authority bore the cost of dredging the channel and harbor and is fully responsible for its maintenance. The channel was dredged inland from the head of the Arkansas River navigation system on the Verdigris River.

In contrast, Presidents Island on the Mississippi River at Memphis, Tennessee (see Figure 2), which operates under the Memphis and Shelby County Port Commission, was developed with the assistance of the U.S. Army Corps of Engineers. The level of the island was raised using material dredged by the Corps, and the cutoff of the sluice was constructed by the Corps. The channel along the old sluice was dredged to navigable depth by the Corps, and the navigable channel in the harbor has been consistently maintained by the Corps. From Figure 2 two other interesting developments are perceptible which further add to the dilemma. A private port, Rivergate Industrial Port, has been developed off the main harbor channel. The secondary harbor was dredged and is fully maintained by the private port. The second complication is the Tennessee Valley Authority's (TVA) T.H. Allen steam generating plant. TVA is an agency of the federal government. There are also many other private terminals operating on or from the main harbor channel. The complicating factor is how these entities will provide their share of the matching funds and how their share will be determined.

A third contrasting example is the private port (see Figure 3) operating totally outside the auspices of a public port authority or commission. These private ports, often a single terminal, are usually developed and maintained with private funds.

Some of these ports operate on a dredged harbor, and some are located directly on mainstreams.

A fourth example is a demonstration project owned by a public state agency and developed at the encouragement of and with the assistance of a federal agency. This example is an interesting study of the economic impact of channel maintenance on a port operation. For this example, the Yellow Creek Port shown in Figure 4 will be used. It is located on the Yellow Creek embayment of the TVA Pickwick Landing Reservoir on the Tennessee River in Mississippi. This port facility was developed with the full assistance and guidance of TVA and is owned and operated by the State of Mississippi. The port has its own dredging equipment because of the potential for considerable silting around the wharfs; however, the equipment may be too small for maintaining large channels. The total economic impact on this site will probably not be known until the Corps determines the exact width of the Tombigbee Waterway to be maintained at this point.

These contrasting examples serve as the basis for this paper.

POTENTIAL REVENUE SOURCES

From research and discussions with port personnel, it is apparent that many potential revenue sources exist; all have advantages and disadvantages. The list given below is not exhaustive nor is it probable that any one will serve all needs. A combination of sources may be required for any one port.

- Front-foot assessment
- Tonnage assessment
- Fuel assessment
- Assessment on barges
- Docking fee

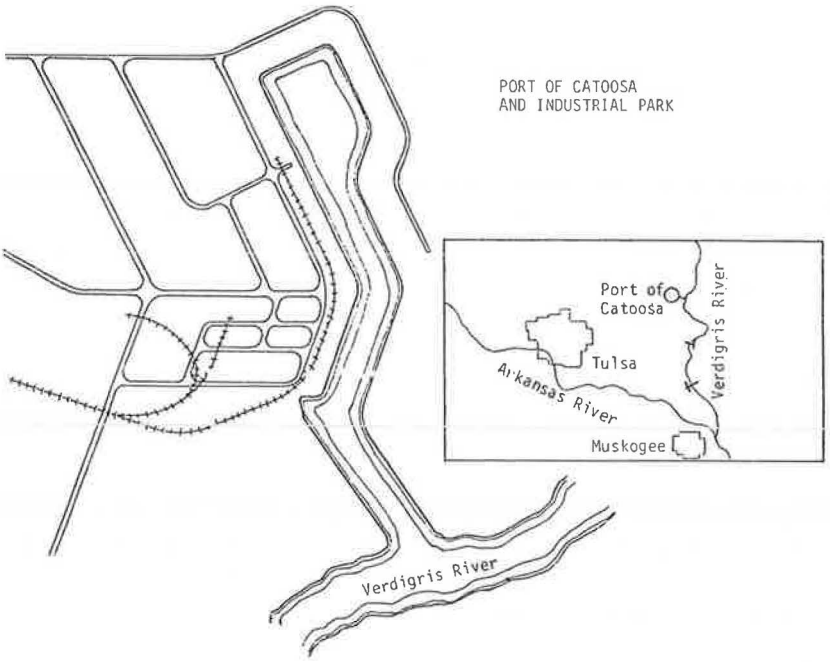

Figure 1. Port of Catoosa operation under the Tulsa-Rodger County Port Authority.

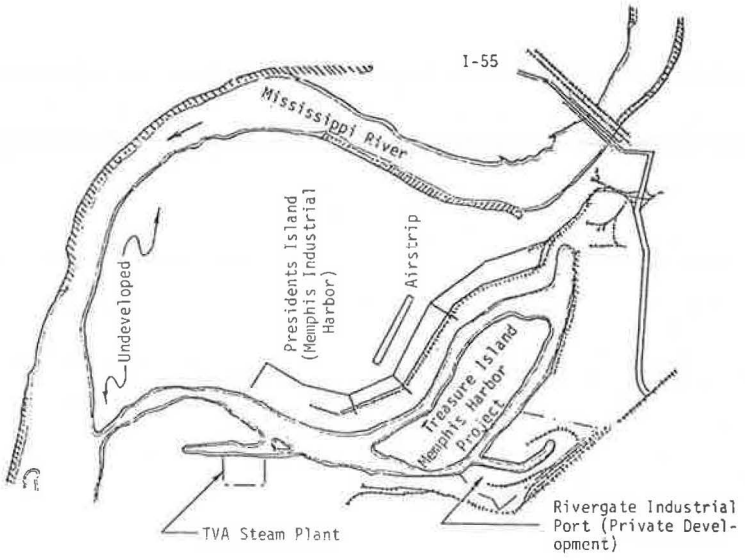

Figure 2. Presidents Island-Memphis and Shelby County Port Commission.

General tax revenue: property, sales, and other
Personal property tax
Excise tax
Fleeting and vendor gross receipts assessment
Revenue generated from commercial disposal of dredged material
Offsetting cost (enhancement of port-owned real estate)
Assessments on receipts of sales other than fuel
Export tax
Add-on to leases or increased leasing fees
Perpetual maintenance fund
Employment privilege assessment

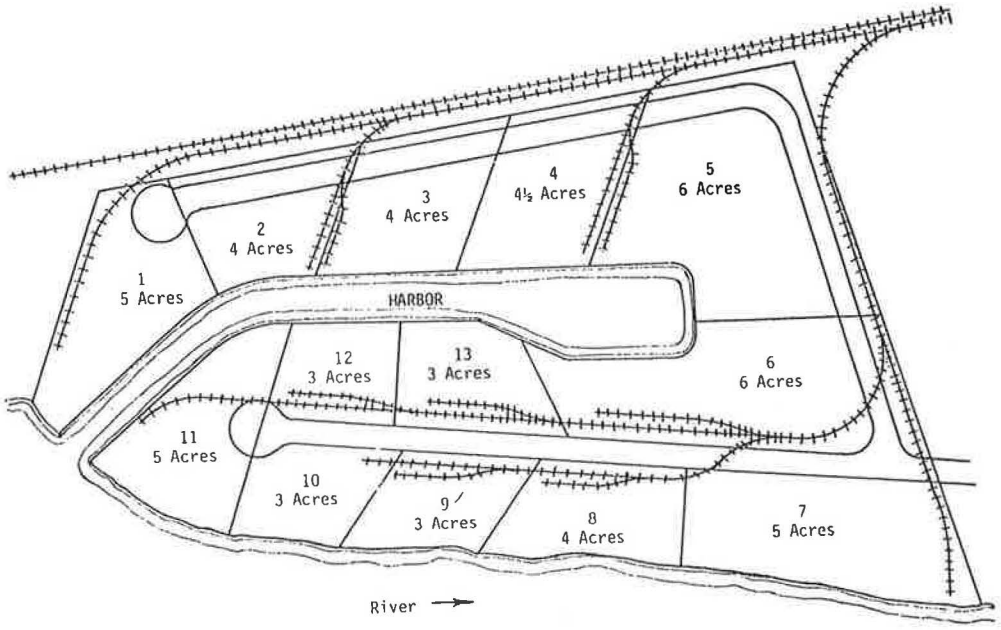

Figure 3. Illustration of a possible privately developed port with terminal and industrial potential.

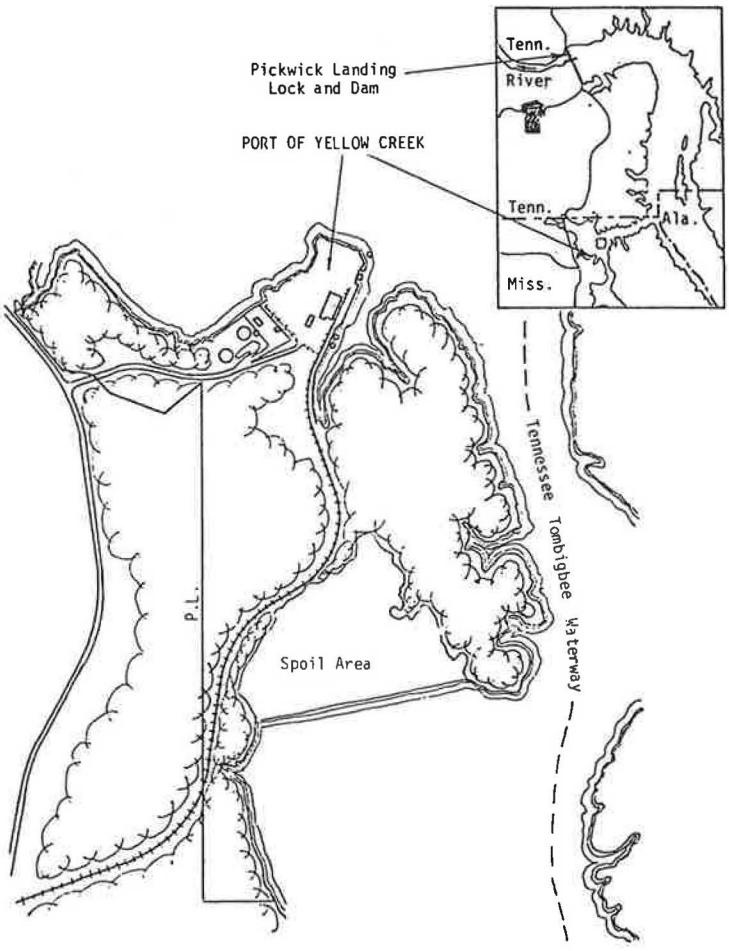

Figure 4. Yellow Creek, state inland port and industrial properties.

Evaluation of this tentative list of potential revenue sources should take into consideration fairness, collection procedures, potential loopholes, and the potential for cheating or escaping the assessment. Unethical practices must be carefully guarded against.

Three definitions are given below to provide a clear understanding of the terminology used in this paper.

Port--a complex of terminals and other possible commercial and industrial activities operating under some kind of organized control.

Terminal--land and facilities required for docking, mooring, loading and unloading of barges, and for the storage and/or transfer of goods.

Front-foot--a linear foot of property measured along the water's edge unless otherwise defined.

A discussion of each of the potential revenue sources follows.

Front-foot Assessment

This may appear to be the easiest source for a port to administer. Those tracts abutting the water are assessed a fee for each linear foot of property fronting on the water. The front-foot fee can be adjusted at given time intervals. It is straightforward and, unless loopholes are found, everyone pays the same front-foot fee. However, using the preceding definition for port, the possibility of complications is inherent.

An examination of Figure 5 illustrates some of the complications. The 20-foot right-of-way serving tract 9 is excellent use of waterfront property if tracts 3 and 5 can afford the encroachment of barges serving tracts 4 and 9. The tonnage passing through to tract 9 may far exceed that generated by any other tract in the complex. Will the users of tract 4 pay the same front-foot fee as tracts 1, 2, 3, and 5 or will they share part of the assessment assigned to tracts 3 and 5 because of barge encroachments? Suppose tract 9 handles twice the tonnage of tract 1, but tract 1 requires the water frontage because of the size of its product; or suppose tract 4 handles four barges per week compared with one barge per week for tract 1. To complicate matters further, tracts 6, 7, and 8, although dependent on water transportation, may be able to use the public terminal.

The public terminal further complicates the discussion. Assume it is owned and operated by the port authority/commission and is not subsidized. The terminal must recover its cost and make a reasonable return on its investment. The investment should include such things as the value of the land at the set-aside or appropriation date, interest, building and development costs, other costs including utilities costs, operating costs, and the front-foot assessment for channel maintenance. The question then is whether tract 2 pays any of the channel maintenance cost or whether the cost is passed on to tracts 6, 7, and 8. Something interesting is revealed in a close examination of tracts 6, 7, and 8. An efficient public terminal operating at near capacity can possibly handle more tonnage than tracts 1, 3, and 5 combined; and any one of tracts 6, 7, or 8 may use water transportation far more than either tracts 1, 3, or 5. Even though tracts 6, 7, and 8 may be paying all of the front-foot assessments for tract 2, are they paying more or less than their fair shares of the channel maintenance?

Now consider the position that any business within the development should pay some portion of the maintenance cost because of its proximity to the water. Then, the highway front-footage could also be assessed. Tracts 1 through 5 may have an advantage over tracts 6 through 10 on the theory that tracts 1 through 5 require water frontage and that the added independence of operation has a value even with the added cost of wharf and mooring cells or dolphins. It may be more economical for tracts 6 through 10 to access the water by indirect pass-through or via a narrow right-of-way provided by tract 4. Possibly tracts 1 through 5 should pay a surcharge based on water-front footage. There may be many such problems requiring full evaluation.

Tract 10 is not a water user, but it is in the same complex and under the umbrella of the port. The tenant of tract 10 is there at the discretion of the port administration based on a management decision. If the original agreement stated clearly the

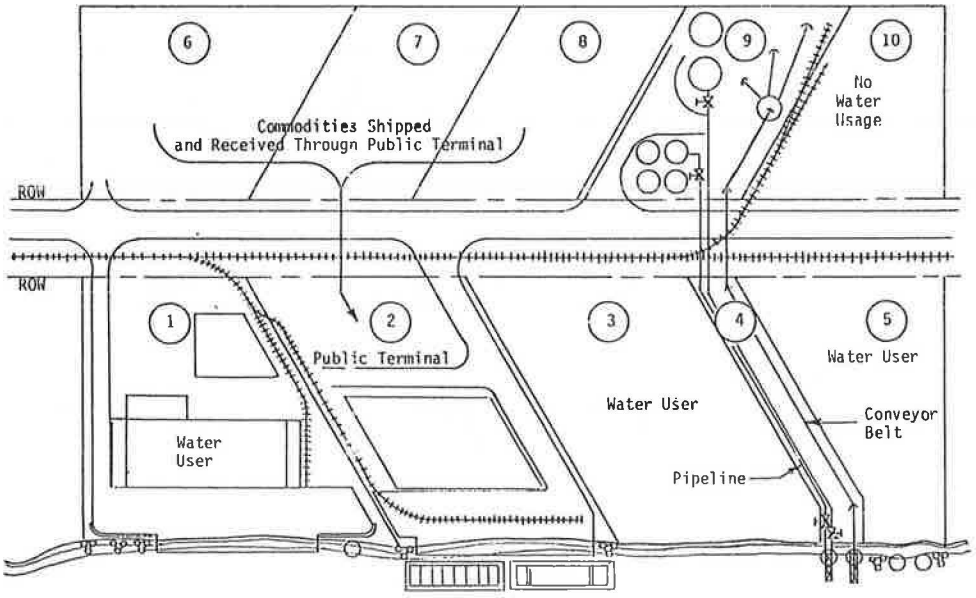

Figure 5. Hypothetical illustration of port industrial complex.

conditions for occupancy for these tracts, no problem would occur. If not and a charge was not originally required for channel maintenance, there is definitely a problem. The greatest advantage of the front-foot fee is that a known quantity is being worked with, and fee variances can be negotiated.

From another example, the Port of Catoosa management knew from the beginning that it would be responsible for all channel maintenance and could make provision in the original lease or sales agreements for funding the maintenance cost. Problems developing later can be related to oversights or management error. Presidents Island, on the other hand, originally developed by the U.S. Army Corps of Engineers, functions under the assumption that maintenance will always be provided by the Corps. It can be argued that for long-range planning purposes such assumptions should always be supported with contingency plans. Yet the situation exists that some ports began operating under prevailing conditions that are now difficult to change.

One of the conditions, based on an old typical tradition, was that land must be owned in fee simple because "it has always been done that way." Other subtle reasons played a part in fee simple sales such as real estate agent fees for land sales, interest on bank loans for land acquisition, and the extra element of control inherent with land ownership. All of these factors make for a difficult solution in collecting fees for maintaining the channel. It could be argued that the channel should be allowed to silt up so that the proprietors would have to reach some agreement.

Now consider another situation. A private development under way across the river and located on the main channel is maintained by the Corps by virtue of its location on the main stream, and the riverbanks are virtually self-cleaning. A tenant on Presidents Island could conduct a quick economic analysis based on relocating across the river. This would place operations such as Presidents Island in an awkward bargaining position because of the threat of a sudden increase in operating costs.

Another problem that could be encountered arises through the configuration of a lot such as lot 11 in Figure 3, which has excess water frontage. A lot may also have unusable water frontage. How should a front-foot fee be assessed for such lots, and how can it be decided what is excess or unusable? There also may be a number of users operating as a direct result of the port who will escape paying any share of the matching maintenance cost.

Tonnage Assessment

A tonnage assessment is simple and can be administered solely by the port administration; however, collection is not simple. Every ton entering and leaving the port's jurisdiction via water may be assessed a fixed fee to cover channel maintenance. Whose ton will be assessed--the shipper's the receiver's the tow operator's? How will the tonnage be computed--by scale weight, liquid conversion from metered gallons, estimates based on barge drafts, or cubic feet metered and converted? Suppose one industrial tenant receives a raw product and ships out a finished product, all by water. Assessing every ton entering and leaving represents a double charge. Another concern is the fairness of assessing a tonnage fee for commodities entering or leaving by other modes. Such cross-subsidization has caused many problems in other areas.

The difficulty with this approach arises with collection. It appears simple to check the waybills of each tenant each month, total the tonnage, compute the assessment, and collect the revenues. But this information could be leaked to competitors; and no matter how one looks at it, an examination of business records is an infringement. To depend on the tenant to submit gross, raw tonnage with no breakdown could invite cheating. Even supporting documents such as waybills could be hidden or suppressed. If everything moved through one terminal, collection may be simplified somewhat; but this does not occur often. Uniform application may be the best asset of the tonnage assessment, and the opportunity for conniving may be its worst liability.

The Presidents Island operation can be used to illustrate the tonnage assessment approach. The harbor channel is approximately 12 miles long with a minimum channel width of about 300 feet and a minimum draft of 12 feet. The Corps of Engineers allocates approximately $1,250,000 annually for dredging the harbor channel. Approximately 11,000,000 tons of cargo passes through the harbor annually. To cover the Corps' dredging cost would require approximately $.12 per ton or about $360 to $480 per barge.

Assessment on Fuel

In many states the mechanism is already in place for administering a fuel assessment. Tennessee, for example, collects a $.04 per gallon sales tax on fuel sold for marine use; this tax now goes directly into its general fund. The present tax could be diverted to or increased specifically for channel maintenance and would provide a reasonably dependable source of funds. It would probably be futile for a port to levy such an assessment because of competition from refuelers operating outside the port jurisdiction and from other states. Also, the boundaries of authority could quickly be brought into litigation if, as has occurred in Louisiana, the port authority/commission attempted to extend its authority to questionable limits.

Many problems are inherent to state-collected fuel taxes. First, it becomes a political issue. The legislature has the responsibility for setting tax rates, allocating funds, determining how funds are to be used, and determining who will be taxed. The state administration must collect the tax, bank it, and distribute it. The trade-off potential is enormous in both the legislative body and the administrative body and does not end with passage of the law creating the tax. The remoteness of collection and administration makes diversion of the funds possible as far down as the port authority/commission. As a consequence the port would receive little of its allocation and would have to fight nearly insurmountable odds on an annual basis to get sufficient operating funds. Such a pass through of funds is always subject to controversy; and collection and administration are costly. When the state or federal government enters a program, intervention, at least in the form of controls and regulations, is inevitable.

The fairness of such a tax is also open to debate. For example, should a mainstream tow on the Mississippi River operating between New Orleans and St. Louis that never docks at a Tennessee terminal but refuels near Memphis have to pay a fuel tax to support the Presidents Island complex? Possibly such a tax would equal out among the states using this method of funding. Also private developments that may not receive tax funds would probably be put at an unfair disadvantage. Recreational boats operating outside the port jurisdiction may also have to pay the tax. Boat owners operating on nonnavigable lakes and streams probably would not enjoy paying for commercial water transportation. At best it seems that funds received through this source will have to be supplemented with funds from other

sources. However, some ports will probably receive excess funds while others are faced with a shortfall and left without a contingency unless the state does the work or reimburses the Corps directly. Of course, state or federal involvement may increase river transportation of pulpwood substantially.

Assessment on Barges

This approach is essentially a toll charge and may work well in a constricted entrance-exit point with a booth that has radio contact with towing vessels for identification, and someone to count and record the number of passing barges. The shipper or receiver could then be billed for the toll charges. No fleeter would want the responsibility for collecting the toll and the additional recordkeeping involved. Unless compensated for the additional recordkeeping, a marginal fleeter could suffer severely. If the responsibility were placed on terminals for the recordkeeping and collections the same would be true. A toll probably would not be charged for both entering and exiting barges because this would result in double recordkeeping and appear as a double charge. Barges built or scrapped within the port would be exceptions.

A barge toll may be a fair and equitable approach; however, the tenant with large waterfrontage and only a few barges processed annually may still escape paying for benefits received. For example, a manufacturer who may build nuclear reactors with a weight of only about a thousand tons, but worth hundreds of thousands of dollars, may make only one or two shipments per year and receive a small number of barge loads of material annually. Water transportation is essential, yet the firm could conceivably pay little toward the maintenance of the channel. Another problem with this approach is that some operators may escape the assessment in a similar manner as explained later under fleeting and vendor gross receipts assessments.

Docking Fee

A docking fee is not as easily administered with barges and tow boats as with single unit ships. Barges may be dropped off at a wharf in clusters or single units. They may remain at the wharf from a few hours to several days. The barges may be owned by the firm that owns the terminal or may be owned by a dedicated barge line. Tow boats (power units) may also be owned by the firm that owns or operates the terminal. Tow boats, especially harbor boats, may be operating in and out of the wharf continuously, remaining for a few minutes or for long periods. Many barges go from the tow to the fleeter, to the terminal, back to the fleeter, and then to the tow.

The difficulties with docking fees are who will pay the fee--the tow operator, the fleeter, or the terminal--and which unit will be assessed? How will the fee be determined--on length of time at the wharf, a fixed fee for each barge anchored at the wharf, or a fee on each tow boat maneuvering into or anchoring at the wharf? Who will collect the fee and which firm(s) will be responsible for the fee? There is little difference in toll fees and docking fees. Each will be difficult to administer, but the docking fee may be subject to more abuse.

General Tax: Property, Sales, and Other

In many states there may be legal problems with this approach. Some areas may be able to work out the problems legislatively, but this is an era of rebellion against increasing taxes. Because property taxes as well as some sales taxes are assessed locally, these may have built-in regional restrictions. Arguments have been advanced that everyone in a region benefits from a thriving commercial business that provides employment opportunities and an increased tax base; however, there are just as many arguments to the contrary.

A general tax raises serious questions about subsidization, and it can be harmful to some people, such as those on fixed incomes. Probably, the main reason the issue of channel maintenance charges has been raised is that many believe that national taxes collected to fund the U.S. Army Corps of Engineers should not be used to subsidize port operations on navigable river systems, particularly in the realm of free enterprise competition. The other problem is that the private ports and some public ports (such as the Port of Catoosa) with full channel maintenance responsibilities must continue to pay their own way without aid from a general tax base.

A general tax would be an alternative source, and the increase in tax could be miniscule. For instance, in Shelby County, Tennessee (Memphis), a $.005 increase in the local sales tax would generate approximately $1,895,000 in revenues, and a 1.5 mill increase in the property tax assessment would generate approximately $1,500,000 compared with the Corps expenditure of about $1,500,000 for harbor channel maintenance in the jurisdiction of the Memphis and Shelby County Port Commission. The property tax is collected by the county, and the sales tax is collected by the state and returned to the local governments.

The structure is in place, and the effort to get the tax increases may require less energy than any other approach depending on the sensitivity of the issue and how much it is advertised or becomes general public knowledge. On the other hand, such an attempt could raise questions as to why a public entity is in competition with private enterprise and why the general public should be taxed, especially on a statewide or national basis, instead of the user or beneficiary.

Personal Property Tax

A tax on personal property--machinery, furnishings, and so forth--is a possibility. There has been some success with businesses but not much. A business must either declare its personal property and its value or submit to an inventory and appraisal. A declared inventory and evaluation is always questionable, and forced submission to an inventory and appraisal is an infringement; either way a personal property tax is probably not feasible. The tax would have to be imposed and administered by a governmental agency because a port authority or commission would be unlikely to have the authority to levy such a tax. The problems encountered could cause considerable disharmony in the port commission.

Excise Tax

Such a tax could be levied on commodities manufactured, sold, or consumed that were transported on the water system. The shipper or receiver would have to be responsible for at least reporting if not also collecting. How to assess the tax would pose problems. Some items could be assessed on unit value, others on a tonnage basis, and others on volume. This may require itemization, a difficult task. The tax would probably have to be administered at the state level to be effective and probably would also have to be collected at private ports also to prevent deliberate avoidance of public ports.

A fee for the privilege of operating on the waterways could probably be more easily administered than a tax on commodities. It could be levied on all users based on volume of business. The problems would include the probability that it would have to be levied on all waterway users for the benefit of a few, and it probably would have to be administered by the state.

An excise tax could be viewed by businesses as a nuisance tax and another add-on tax, and it might be strenuously opposed by private ports as a tax against them for the benefit of public ports. It could drive business away, especially where a river forms the boundary between two states.

Fleeter and Vendor Gross Receipts Assessment

There are operators such as fleeters, suppliers, refuelers, contractors, dredgers, and repair vendors who could seemingly escape participation in the maintenance cost. Fleeters, for example, can operate outside the jurisdication of a port but derive most of their income as a result of the port operation. However, fleeters may also derive a great deal of income from operations outside the port jurisdiction. Vendors may operate directly from the port without any tie to the port authority/commission through a secondary lease or by paying a small privilege or mooring fee to a waterfront tenant. Some vendors could operate from water access ramps using small pleasure craft without paying any fees; however, these operations may be so small that the effort necessary to collect an assessment would not be worthwhile. The only way to administer the collections may be to conduct a thorough inventory and collect on gross receipts derived from port jurisdictional operations.

There is also the problem of what to do about the state, county/parish, and city boundary in the middle of the main channel; this is common with inland waterways. Assessments could be apportioned between cooperating entities as fuel assessments and license fees are apportioned between states for trucks based on miles of operation in each participating state (reciprocity). These states have strong laws regulating revenue collection and a contingent of enforcement agents. Some states have not reconciled differences and do not participate in the apportionment process. Cities and counties may find it even more difficult to work out differences. The greatest complication, however, is that all port jurisdictions may not impose the assessment on the same source and in the same manner; the problem is not with the fee structure but rather with what is assessed. Between two cooperating entities this could probably be worked out by distributing the revenue on a proportional basis.

The potential problems to be encountered with this particular source of revenue are a good reason for the state to impose a sales tax or some other type tax, such as a gross receipts tax on activities deriving income from commercial marine operations. The problems inherent to state involvement are more fully discussed under fuel assessments. The difficulty in this area appears to be with the ports collecting the assessments, administering the assessment program, and keeping up with the businesses without driving them away.

Revenue Derived from Commercial Disposal of Dredge Material

There is a possibility of disposing of some or all of the dredge material for a fee. This approach may not be viable for many ports because there are so many variables. Disposal of dredge material may even result in a cost. However, if there is land within a reasonable distance that needs to be filled for development purposes and that is environmentally acceptable for filling, some revenues may be generated. A slurry pipeline from the dredge may be the only way to transport the dredged material economically. Occasionally, the material may be stockpiled if space is available, permitted to drain for a period, and sold for fill material.

The engineering qualities of the dredged material are also important when commercial disposal is being considered. A soils engineer should assess the qualities of the material before a sales campaign is begun. At least the prospects for selling the dredged material should be known even if the work is to be let to contractors in which case spoil may be used to negotiate a better contract.

Offsetting Cost

A port may own considerable acreage that can be used for disposal of dredged material and may benefit from a direct enhancement of the land by raising it above the critical flood stage, by leveling it out, by stabilizing it, or by increasing the waterfront. A port would have to absorb some long-range costs associated with the dredging operation in order to realize the benefits. Again, the expertise and advice of soils engineers would be beneficial. The type and kind of soil to be disposed of, how it is spread, and the potential of self-drainage or mechanical dewatering are important considerations. Even if dredged material has been disposed of on port property under the Corps maintenance program, a future benefit may be derived that will either offset port cost or enhance the port's receipts.

The offsetting benefits should be carried on the account books, and a definite plan for use of the improved property should be developed and pursued. This approach may be available only to a small number of ports but is certainly worth considering. Presidents Island (Figure 2) and the Yellow Creek Port (Figure 4) are good examples of the beneficial use of dredged material.

A port authority/commission may also assume responsibility for maintenance dredging around terminal wharfs, mooring cells, and dolphins in order to keep dredging equipment, or contractors on retainer, operating to offset cost. Not all of the possibilities can be instituted in a fully functional port because of the competition with other port businesses such as those dredging around terminal facilities. Newly developed ports have, in most instances, a broader range of alternatives to consider, including ways of competing with other ports.

Assessment on Sales Other than Fuel

Within a port's jurisdiction there may be sales other than fuel, including food, repair stock, parts, potable water, oil, and others. In this same context, but as a separate consideration, is the sale of water-derived commodities such as sand, gravel, and shells that have their origin of operation within or through the port. A port alone may be unable to administer an assessment on sales of this type, and these businesses can easily move out of the port's jurisdiction. A local government--city or county--may be the agency to administer the assessments in view of the complications discussed under fuel assessments.

Another possibility would be to assess utility sales within the port. Utilities are a legitimate business expense subject to review and taxation in many localities. The assessment would be easy to administer and to collect. It would reach most of

the users but not all. There would be an added cost to the utility companies for collecting the assessment and the appearance of an increase in utility bills. It is probable that none of these types of sales assessments could be relied on to generate all of the needed revenue and may have to be coupled with some other type of assessment.

Export Tax

There always appears to be a willingness, even a desire, to tax something that does not directly affect us, or only slightly so, or to tax things used for pleasure or amusement. An example applicable to water transportation is a tax on commodities to be exported, especially to foreign countries, such as coal, grain, and wood products. Alabama imposes a tax on coal extraction specifically for export (taxed at point of origin). It should be noted that the tax has the effect of increasing the price of the commodity or else the competitive edge may be negated. These are taxes that would have to be handled by governmental agencies. Some states, Montana for example, tax coal and other minerals that are exported to other states. A serious concern with such a tax is the potential for reprisals.

Add-ons to Leases

If property under the port's jurisdiction is leased, a surcharge for channel maintenance can be added as the lease fees are renegotiated. This should work best with short-term leases to be renegotiated on a 1- to 3-year basis. To solve the problem of staggered leases, the beginning date for collections could be established with the renegotiation of the last lease. Catchall clauses written into lease agreements and fee simple deeds to cover unexpected developments are flag raisers and generally unacceptable. Specific clauses to cover possible and probable future actions are more acceptable. One problem seems to be that in the past a great deal of property was sold in fee simple when the idea of user charges had not been considered. Collection of lease add-on fees only requires additional accounting.

The problems of administering the maintenance program remain no matter what approach is taken to generating the necessary revenue, but the burden is on the port. Fee simple titles can include clauses to the effect that fees for specific purposes can be assessed at some future time if needed. However, fee simple titles are not renegotiable. Both leases and fee simple titles have good and bad points, but it is not the purpose of this paper to take a position or debate the issues on this subject.

Perpetual Maintenance Fund

Many operations--probably the most notable are cemeteries, water treatment facilities, and sewage treatment plants--establish a perpetual maintenance fund with a specified amount deposited directly into the fund. The fund is invested and the income is kept in the perpetual fund until it increases to an amount that will provide an income sufficient to cover maintenance. Ports are faced with two major problems that are basic to the creation of such a fund: how to generate the fund and how to hold onto it.

To generate the fund, a specific amount could be added to or hidden in the per-acre price of rentals or sales. Cemeteries usually specify an amount for the perpetual fund in the sales agreement for each lot. The responsible governmental agency could also appropriate a fixed amount to the fund annually for a given period. Double assessments could be collected in the first few years until the fund becomes large enough to support the maintenance requirements. It is, however, difficult to convince a tenant or user that an assessment or user charge will ever be removed or reduced.

Maintaining a perpetual fund intact is not an easy task, especially with an account large enough to generate millions of dollars. The continual fight to prevent tapping, especially by local governmental agencies, may not be worth the effort. However, consultants are available for administering such funds providing both investment capabilities and protection. Managing such a fund could be an overwhelming job for a port administrator, but it would work equally well for a public or private port.

Employment Privilege Assessment

Probably the most unpopular tax would be one on the captive employee for the privilege of working within the port boundaries on the assumption that the port provides employment opportunities. Unions representing employees would also benefit from the port operation and could be considered as a potential revenue source. When all other viable sources have been tapped for a fair and equitable share, this approach might be considered. There would, however, be numerous legal ramifications that might eliminate this potential source of revenue. The outcry of those assessed, particularly the unions, could be the major deterrent in view of their political clout. This probably would be totally outside the realm of consideration for a private port and perhaps for any port.

SUMMARY

What constitutes a potential source of revenue? The word potential means something that can develop or become actual. The word was taken literally in preparing this list of potential sources of revenue, no matter how remote. Further consideration of any potential source will depend a great deal on the status of any particular port. There is probably no absolute way to rely on one source that will be totally equitable in all situations. For a specific set of circumstances, one revenue source may be adequate. Most likely a combination will be required. There is no pretense that this list of potential sources is complete or noncontroversial. Nor is it claimed that all the advantages and disadvantages are included. The actual application is outside the scope of this paper but probably the foremost concern is how to generate required revenue without driving out existing businesses or scaring away new businesses.

Transportation is a competitive field, and with deregulation it is becoming even more competitive. The institution of user charges in water transportation creates another competitive factor that must be accounted for. Ports are a segment of the overall water transportation system. Many ports already assume responsibility for maintaining channels within their jurisdictions. In those instances where the Corps of Engineers, funded from national taxes, now performs the maintenance, local ports may be required to assume the maintenance cost or the entire maintenance program; and the subject must be addressed even though it is unpopular. How to raise the necessary revenues and remain competitive as a port operation and as a viable transportation mode is a major topic for discussion.

The matter of charging the user received little direct discussion but is the major underlying fac-

tor. How to define the user causes some difficulty. There may be a need to separate users and beneficiaries and to trace any potential charges to the final bearer. In the end the customer at the end of the list, the person who eats the bread, puts the sugar in coffee, or reads the paper, is the one who bears the charges. Taxed employees may absorb some, but this cost is passed on in the form of higher salaries that are added to the cost of production. However, the final recipient of the commodity, the one for whom the commodity was produced, is the beneficiary. Can the revenue necessary to maintain the channel be passed on to and borne by that beneficiary in such a way that water transportation can remain competitive with rail, truck, pipeline, and air and the port continue operating? To be viable, a port must remain flexible, competitive, and receptive.

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