CHAPTER THREE
NEEDS AND OPPORTUNITIES

3. NEEDS AND OPPORTUNITIES

3.1. Introduction

The level of waterborne commerce on the Columbia River has continued to show steady growth, along with an increase in the size of commercial vessels using the navigation channel. Average vessel size has increased due to the efficiencies gained by shippers using larger vessels to transport both bulk and containerized commodities. With the increased use of larger vessels for transport of bulk commodities such as wheat and corn, limitations posed by the existing channel dimensions now occur with greater frequency. Container vessels are showing a rapid increase in size, and competition exerts pressure to fully load these vessels. Ships with design drafts approaching or greater than the 40-foot depth constraint can not fully utilize their design drafts. This often results in reduced efficiency in the shipping process.

The approach utilized in this analysis to identify potential savings from modification of the existing channel involved a number of elements. One essential element was the projected volume of commodities expected to move to and from the ports on the lower Columbia River. Another critical element was the projected fleet of vessels expected to call on the ports. The projected volume of commodities was matched to the projected fleet in order to evaluate transportation costs under various conditions. Proposed alternatives were then compared to determine the benefits associated with channel improvements.

The major benefit categories associated with the channel improvement would be transportation and delay savings. Transportation savings result from economies of scale that could occur when deeper draft vessels carry more tonnage per vessel. These savings would accrue up to the point where vessels would be constrained by channel depth. In a deeper channel, greater savings would accrue. Transportation benefits measure the magnitude of economies of scale savings between the without- and with-project conditions. Vessel delay costs measure the time delay and associated operating costs that deep-draft vessels could incur when approaching the maximum draft accommodated by the channel depth. Vessel delay benefits would reflect the savings in operating costs between the without- and with-project conditions.

3.2. Commodity Forecast

Commodity forecasts comprise one critical element of the feasibility study. The forecasts would be needed in order to estimate the amount of tonnage that would be moved on the waterway in the future. The commodity forecasts would be used in conjunction with fleet forecasts to determine transportation costs for proposed project alternatives. It is assumed that existing navigation operating practices would be utilized in both the without- and with-project conditions. Commodity projections were made for a 50-year project life (year 2004 to 2054) and include containers, wheat, corn, barley, and alumina. Wheat, corn, and barley are export commodities, alumina is an import commodity, and containers are import and export commodities (although containers are primarily exported). The projections for

each commodity would be estimated for each major trade route (region), and no tonnage would be induced or transferred by any of the proposed alternatives. Additional information regarding commodity forecasts can be found in Appendix C, *Economics*.

3.2.1. Containers

Container cargo represents a significant percentage of the total tonnage moved through the Columbia River. According to the Columbia River Transit Data Base provided by the Port of Portland, container exports from the Columbia River in 1993 were 1,873,020 short tons or approximately 7 percent of the total export tonnage. Added to this were 148,322 short tons of imported container cargoes. The only container port in the lower Columbia River is the Port of Portland. Portland is somewhat unique among the West Coast ports in that it is almost exclusively an outbound container port. Outbound movements are dominated by more resource-based, lower value-added products than are inbound movements, which is consistent with the pattern throughout the West Coast. The Port of Portland has traditionally been a last port-of-call on outbound container voyages across the Pacific Ocean. As a result, exports account for about 90 percent of total container throughput.

The commodities and origins/destinations handled by the Port of Portland would be very similar to those handled in Puget Sound. On the export side, much of the cargo base is composed of forest products (paper, paperboard, lumber, fiberboard, particleboard) and agricultural products (hay, animal feeds, potatoes, corn and meat), as well as waste paper and other manufactured products (auto parts among others). On the import side, consumer goods dominate container trade and include products such as toys, tires, footwear, apparel, computer parts, consumer electronics, and furniture, as well as manufacturing goods.

Table 3-1 displays projections for Columbia River container exports for the period of analysis (2004 to 2054). From 1985 to 1995, outbound container traffic increased from 100,000 to over 225,000. In 1996, container exports remained strong at over 220,000; 1997 and 1998 figures reflect the economic woes in Asia[1]. Using regional container models, the analysis projects an annual growth rate of 3.3 percent for the first decade of the analysis (2004 to 2014). From 2004 to 2054, the annual rate is projected to gradually decline to 2.6 percent.

Table 3-1. Export Projections for Containers

Year	Outbound TEUs*
2004	263,000
2014	359,000
2024	482,000
2034	634,000
2044	829,000
2054	1,045,000

* Twenty-foot Equivalent Units, full and empty.

[1] See Appendix C, *Economics* for more information on the Asian currency crisis.

3.2.2. Wheat

Wheat is the leading commodity, in terms of tonnage, moved by the deep-water ports on the Columbia River. Wheat accounted for over 50 percent of total export tonnage from the ports in 1993. Table 3-2 displays historic wheat shipments from Columbia River ports.

Table 3-2. Historic Wheat Exports

Year	Tons Exported
1987	10,443,000
1988	15,074,000
1989	11,350,000
1990	11,570,000
1991	12,104,000
1992	12,535,000
1993	12,222,000
1994	15,328,000
1995	14,852,000
1996	13,910,000
1997	12,432,000
1998	12,226,000

The Columbia River ports should expect healthy growth in wheat traffic. Growth would be fueled by trade with Asia and somewhat moderated by the low growth rates of Japan. This trend would be expected to continue until sometime between 2024 and 2034 when Asian countries reach their maximum per capita wheat consumption, and population growth rates slow.

There are three major trade routes used in the wheat export projection. The 'rapidly developing Asia' region includes South Korea, Taiwan, Singapore, Malaysia, Indonesia, and Thailand. This region would be expected to see a rapidly rising demand for wheat until 2035 when it should level off. In the near term, this is driven largely by strong economic growth, rising incomes, rapid industrialization and urbanization, and limited ability to produce wheat domestically. The economic growth, which has been fueled largely by exports, provides the foreign exchange necessary to expand wheat imports.

In the 'Southeast Asia' region, wheat use has increased by nearly 50 percent in the 1990s, growing at a rate of almost 10 percent per year from 1990 to 1994. Rising disposable income has resulted in a more diverse diet with the substitution of Japanese-style noodles for rice. Many regional experts believe that the per capita wheat use ceiling for the region would likely be similar to Japan. However, Malaysia is already at this level with one-tenth the per capita income. Indonesia could experience the most rapid growth in import demand since the country's largest flour miller and noodle processor has started a large expansion program. If fully utilized, processing capacity would require nearly 7.0 million tons of wheat, more than doubling the 3.25 million tons imported in 1994 to 1995.

Although the 'other Asia' region contains more than thirty countries in Asia, the Philippines, Pakistan, and Sri Lanka are the three major destination countries. These countries currently receive more than 30 percent of Columbia River wheat exports. Wheat export growth to the Philippines would be expected to remain strong. The Philippines imports its total supply of wheat, and most comes from the United States (91.2 percent market share in 1993-1994). Growth in Philippine wheat consumption is steady and high. Population growth is strong (2.2 percent from 1990-1995) and would likely continue to be among the highest in Asia until slowing to 1.4 percent in 2010 to 2015 (Faucett, 1996). Per capita consumption has also grown steadily, up 50 percent over the last 10 years to about 26 kilograms (about 57 pounds). This trend could continue through the end of this century but should experience some slowing as consumption rates exceed that of the Japanese.

Table 3-3 displays projections for Columbia River wheat exports for the period of analysis. Twelve percent of the wheat would be exported to countries outside of the rapidly developing Asia and the other Asia regions. These exports to countries in Africa, Latin America, and the Middle East would be expected to remain at a steady share of total exports from the Columbia River.

Table 3-3. Export Projections for Wheat

Year	Tons Exported
2004	14,519,000
2014	14,730,000
2024	15,972,000
2034	19,065,000
2044	19,428,000
2054	19,428,000

3.2.3. Corn

After wheat, corn represents the second largest tonnage commodity shipped through the Columbia River ports. According to the Portland Merchants Exchange/Columbia Snake River Marketing Group, in 1993 corn accounted for 12.9 percent of total export tonnage from the ports, which was a relatively weak year for corn exports. Exporting of corn through the ports is a relatively recent phenomenon. The first year of significant corn exports was 1984, with the opening of the Peavey grain elevator at Kalama.

Growth in corn exports from the Columbia River is tied to the high growth in feed grain consumption in the rapidly developing Asia region and Japan. Corn exports from the Columbia River are very concentrated, with Japan, Korea, and Taiwan accounting for all but a very small percentage. Japan's share of Columbia River corn exports would eventually drop to 12 percent, while rapidly developing Asian countries would eventually receive approximately two-thirds of the total.

In China, the feed sector is expanding very rapidly and feed mill output has doubled since 1987. Double-digit growth would be unlikely to continue. Nevertheless, the underlying factors that drive the demand forecasts would continue. Rising consumer incomes, working spouses, and a more open market and social environment raise expectations and generate more demand for meat, eggs, snack, and convenience foods. As discussed for wheat, China has the fastest growing economy in the world with high per capita income growth. However, population growth would be expected to moderate and drop from 1.2 percent annually (1990-1995) to less than 1 percent per year after 2005. Income growth, which has experienced double-digit rates, would moderate but remain relatively high. Most observers see a continuing gap between production and consumption and a need to import. China is projected to receive 15 percent of Columbia River corn exports in 2004, increasing to 21 percent by 2054.

In the rapidly developing Asia region, Taiwan, South Korea, and Malaysia would all be expected to experience economic growth, leading to increased meat consumption and increased demand for feed grains. Many of these countries are also improving infrastructure to allow efficient use of large grain carrying vessels, which should increase the competitive status of United States exports.

Table 3-4 displays the projections for Columbia River corn exports for the period of analysis. In 1998, corn exports were predictably down, at 1.76 million short tons, the result of both the Asian currency crisis and low freight rates from the Gulf to Asia. Revised corn export projections from the Department of Agriculture, however, show a strong expected rebound in the coming decade.

Since 1985, the Columbia has averaged an 8.6 percent share of total U.S. exports. It is expected that this share will increase over time, and for the purposes of this analysis, the projected average annual growth rates have been applied to a 10 percent market share for the Columbia River in 2004.

Table 3-4. Export Projections for Corn

Year	Tons Exported
2004	6,020,000
2014	6,980,000
2024	7,934,000
2034	8,167,000
2044	8,315,000
2054	8,315,000

3.2.4. Barley

Barley represents the third largest tonnage commodity shipped through the ports on the Columbia River. Barley accounted for 1.8 percent of total export tonnage from the ports. As shown in table 3-5, exports of barley from the Columbia River can be highly volatile.

Typically, barley exports were between 450,000 and 950,000 short tons per year. This volatility mirrored United States barley export behavior during the same period.

Barley is used primarily as an alternate feed grain in the world market as well as for malting. Typically, barley represents a relatively small fraction of total United States coarse grain production (5 to 10 percent). Destinations and volume vary from year to year. The export projections for barley are shown in table 3-6 and represent a modest growth rate over the period of analysis.

Table 3-5. Historic Barley Exports

Year	Tons Exported
1985	350,000
1986	911,000
1987	1,872,000
1988	871,000
1989	664,000
1990	722,000
1991	603,000
1992	332,000
1993	461,000
1994	225,000

Table 3-6. Export Projections for Barley

Year	Tons Exported
2004	899,000
2014	983,000
2024	1,086,000
2034	1,043,000
2044	1,064,000
2054	1,064,000

3.2.5. Alumina

Alumina, an import commodity primarily shipped from Australia (86 percent in 1993), is a basic material for aluminum smelters in the area. Alumina is one of the leading import commodities by tonnage moved through the deep-water ports on the Columbia River. Competition with other ports would not be an issue for alumina importation since local smelters use the entire product. In fact, many of the smelters have their own docks. Also, since virtually all of the alumina in the region is imported from Australia, a country-level forecast was not necessary.

Forecasts predict that Pacific Northwest smelters would continue to operate at approximately 85 to 90 percent of their capacity throughout the next 30 years. While some plant modernization would occur to meet environmental regulations and to become more competitive internationally, the projection assumes no expansion of local capacity (table 3-7). Therefore, even in a modest growth scenario there would be limited opportunity to expand alumina imports to meet growing demand as would be possible for other commodities. With increasing competitive pressures, there would be a possibility of further declines in the future, although the current outlook should be at least stable.

Table 3-7. Import Projections for Alumina

Year	Tons Imported
2004	1,345,000
2014	1,345,000
2024	1,345,000
2034	1,345,000
2044	1,345,000
2054	1,345,000

3.3. Fleet Forecast

The fleet forecast attempts to determine the extent that vessels calling at the Columbia River ports will make use of any channel improvement. The fleet forecast reflects the trade-route specific analysis performed for the commodity projections. For each commodity, each major trade route has been examined to determine what forces would dictate the size of vessels calling on the ports. Additional information regarding the fleet forecast can be found in Appendix C, *Economics*.

3.3.1. Container Vessel Fleet

Container vessels calling at the Columbia River ports typically would be vessels on a liner trade, stopping first in Los Angeles or the Puget Sound before heading to Portland to load export cargo destined for Japan and Southeast Asia. The size of these vessels is being dictated by world market forces, which are rapidly pressing the world container fleet into larger vessels with increasing capacity and drafts.

In 1993, 97 percent of container tonnage departed on vessels with design drafts of 38 feet or more. Almost 70 percent of the tonnage was on last port-of-call vessels with design drafts of 38 feet. Some of the major carriers are planning to deploy vessels with design drafts of 41 to 43 feet by 1998. By 2004, it would be anticipated that the majority of container tonnage would occur on vessels with design drafts of 38 to 43 feet. Three of the four major lines expect to bring vessels drafting 42 feet or greater by 2004.

Container vessels serving Portland would continue trafficking predominantly the transpacific routes. Currently, 97 percent of Portland container traffic is transpacific as is 90 percent of West Coast container traffic. The major transpacific trade route would

continue to be Northeast Asia, with the Southeast Asia route increasing over time. In 1995, Northeast Asia accounted for 86 percent of the traffic through Portland. By 2054, Northeast Asia could account for 78 percent of traffic as Southeast Asia increases its market share. Foreign port depths would not likely be a significant limiting factor for Portland container traffic given that most have deeper salt water drafts, and that all ports seem to give priority to maintaining and constructing depths for container vessels.

The Port of Portland would continue to be primarily for export and would continue to be a last port-of-call for 70 percent of cargo loaded. The other 30 percent would move on middle port-of-call vessels. These vessels have historically departed at shallower depths and would likely continue this practice in the future. These vessels call Puget Sound (+49 feet depth) as their last port-of-call, departing there at their maximum draft. Since these vessels would depart their last port-of-call near their design draft, benefits from the proposed channel improvement project could only be claimed for the journey at a deeper draft to the Puget Sound. It is assumed that the container ship would leave Puget Sound at the same draft under the without- and with- project conditions. Since these vessels carry a small percentage of the tonnage, have not historically taken advantage of the current channel depth, and would only benefit on the trip to the Puget Sound, the middle port-of-call vessels make up very little of the benefiting fleet.

Like all container movements in general and more specifically transpacific movements, competition between lines would continue to be intense. Rationalization among carriers should continue and expand in scope. Lines calling Portland would change ports, order of calls, and routing patterns in an attempt to increase profits. Carriers would seek to utilize economies of scale by moving to faster vessels with more carrying capacity. In 1993, average vessel capacity was 2,700 TEUs. Based on interviews with major container lines calling Portland, TEU capacity would likely increase to around 3,500 TEUs by 2004. Vessels with a capacity of fewer than 2,000 TEUs would be phased out in the future and the trend toward increases in TEU capacity would continue. Vessels with design drafts of 38 feet and greater would continue to service Portland. During 1995, 80 percent of the container vessel movements were in vessels with design drafts at or above 38 feet.

Most container vessels would continue to depart at drafts less than the design draft because of cargo capacity constraints, depth constraints, and the availability of cargo. Based on interviews with container lines calling Portland, 4 feet and occasionally 5 feet of underkeel clearance would be requested for both the without- and with-project conditions. As part of the without-project operating practices, vessels would strive to have a departure draft of 36 feet. Most departure drafts would not increase beyond 36 feet in the without-project condition, as few container lines are willing to wait to ride the tides. With a 43-foot channel, few vessels would be expected to depart significantly beyond 39 feet for the same reason. The time dependency of container traffic would not lend itself to delays in operations caused by tides in the without- and with-project conditions.

Container ships operate on demanding schedules that usually require them to arrive at a particular port at a specific time on a specific day of the week. Any delay could have a negative effect on the coordinated rail and truck transportation of cargoes. A ship delay

could have a domino effect delaying other ships scheduled to call at this and other berths. Also, delays could cause unacceptable congestion in the marine terminal. Because of the severe impacts of delays, container ship operators strive to avoid them at the expense of loading the ship less deeply to ensure an unrestricted transit. One container line currently calling Portland is an exception, and targets departure drafts significantly beyond 36 feet despite delays.

3.3.2. Bulk Carrier Fleet

In projecting a future bulk carrier fleet for the Columbia River, the world bulk fleet, draft constraints, and other operating constraints would need to be considered. Trends in the world fleet would generally be followed for the Columbia River, as allowed by various draft constraints, institutional constraints, and other market forces.

For the purposes of this analysis, two major industry expert sources were used to project the trends for the Columbia bulk fleet (DRI/McGraw Hill, 1996; Drewry, 1996). Also, for each commodity and each major destination for that commodity, a fleet forecast was constructed that reflects the trends of the world fleet and the particular characteristics of the trade route.

Of particular interest to the Columbia River fleet projection is the category of bulk carrier termed panamax. These vessels are typically 50,000 tons to 80,000 tons, and represent approximately 25 percent of the world dry bulk fleet. In the grain trades, the use of panamax vessels would likely grow to dominate world markets. While the Japanese wheat trade is institutionally restricted, most other markets would be expected to develop for use of panamax carriers. In discussing the future of bulk vessels, Drewry Shipping Consultants mentions some of the emerging markets which would be particularly important to the Columbia River fleet.

> For the panamax sector of the shipping market, a good deal of attention needs to be taken of the "emerging markets" for grain as many of these have geared themselves up (or intend to do so) in terms of port facilities, cargo handling capabilities, and storage/silo capacities to accept shipments of around 50-55,000 cargo tonnes. In this respect, attention needs to focus on North Africa, the Asian Middle East, Pakistan and South Asia.

Table 3-8 displays a projection of outbound vessel movements from the Pacific Northwest by vessel size. Much of the cargo continues to move in vessels of the 40,000 to 80,000 deadweight tonnage (dwt) sizes, and there is a slight shift from vessels in the 20,000 - 40,000 dwt size to the 80,000 to 100,000 dwt size[2].

[2] As the Pacific Northwest includes the Puget Sound, some cape-size vessels (100,000 to 175,000 dwt) would likely call in the region. However, cape-size vessels would not be expected to play a significant role in the Columbia River.

Table 3-8. US Northwest Routes, 1990 - 2044 Outbound Cargo Projections (in percent)

1,000s dwt	1990	1991	1992	1993	1994	1995	2000	2004	2010-2044
20 - 40	51	51	52	51	50	48	43	39	33
40 - 80	49	49	48	48	49	49	51	51	50
80 - 100	0	0	0	1	1	2	6	8	11
100 – 175	0	0	0	0	0	0	1	3	5
>175	0	0	0	0	0	0	0	0	1
Totals	100	100	100	100	100	100	100	100	100

Source: DRI/McGraw Hill, 1996; numbers do not add because of rounding.

Within the 40,000 to 80,000 dwt range, there would be a variety of vessels in terms of size, draft, and grain carrying capacity. Of interest is whether the vessels calling on Columbia River ports in the future would be of a deep enough draft to benefit from channel improvement. The Drewry report discusses the increasing size of panamax vessels.

> Also evident is the progressive increase in the size of the 'representative' panamax dry bulk carrier. Initially, development centered around 50-55,000 tonners, which were essentially ore carrier derivatives. By the mid-1970s, the typical unit was moving around 60,000 dwt. However, the new building boom seen during the first half of the 1980s took the expectations of the typical panamax unit to 64-65,000 dwt. The late 1980s saw this figure edge toward 68-69,000 dwt while current ideas now centre around 72,000 dwt.

Figure 3-1 displays panamax-class builds by year and deadweight tonnage. The database clearly displays the tendency in recent years toward the 70,000 to 75,000 dwt range. Vessels of this size typically have design drafts ranging from 43 to 45 feet. In 1993, more than 5.5 million short tons of grain left the Columbia on vessels greater than 65,000 dwt.

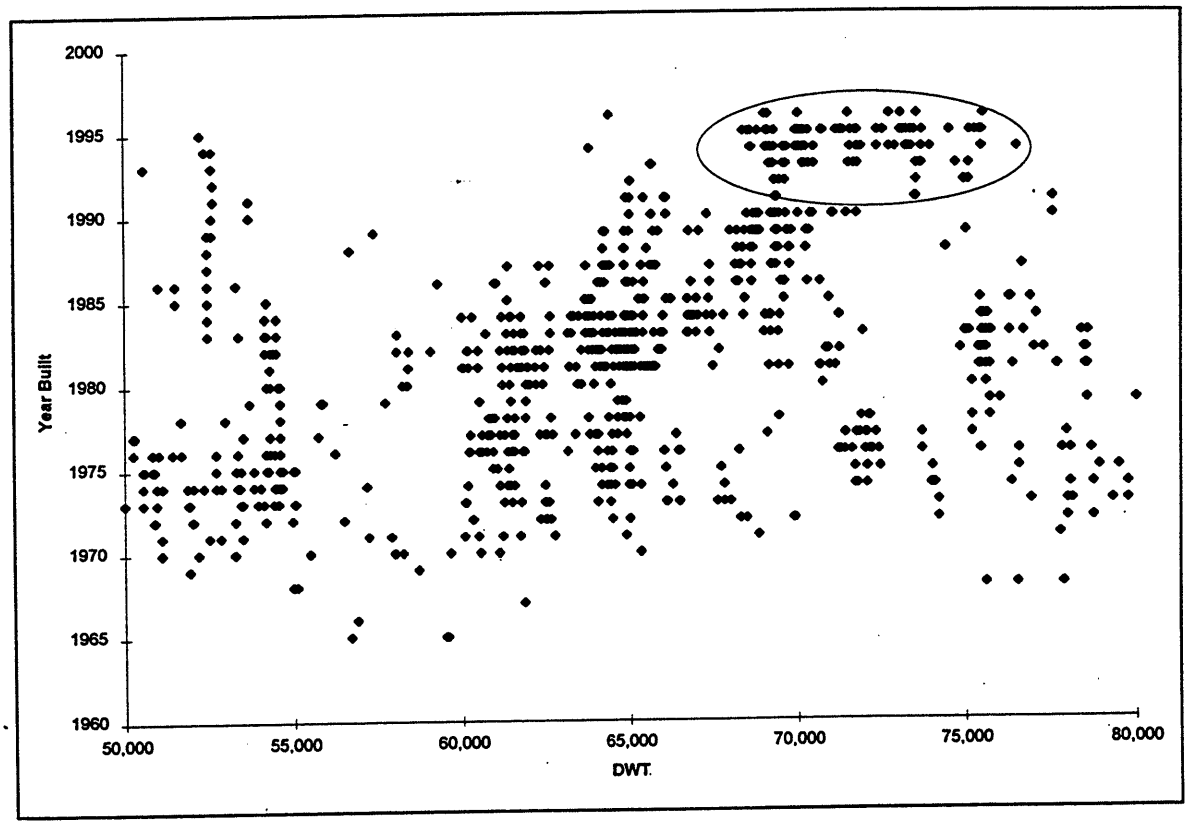
The following sections provide a general description of the vessels projected to move on each trade route by commodity. For most grain trade routes, existing traffic includes vessels with design drafts greater than the current channel depth. This practice would be expected to continue in the future. For all bulk commodities, departure draft would be the only difference between the with-project fleet and the without-project fleet.

3.3.2.1. Wheat

Table 3-9 displays 1993 wheat vessel movements by departure draft and destination. The three major destinations were Japan, South Korea, and the Philippines. Historically, the Japanese have purchased wheat in relatively small lot sizes (approximately 22,000 short tons). The reasons for these small purchases were not clear, although a number of factors have been suggested. The Japanese wheat market is highly regulated, and it is uncertain whether or not there would be any pressure to significantly change the current system. There are a large number of small wheat mills with limited capacity, and the current system supports the continued existence of these smaller, less efficient mills[3].

[3] The Japanese also import corn from the Columbia River. Corn moves in panamax vessels, departing the Columbia at drafts from 38 to 40 feet.

Figure 3-1. Panamax-Class Builds by Year and Deadweight Tonnage



Source: Clarkson's Bulk Register

Sources in the industry have conflicting views as to the likelihood of change in the future. However, for the purposes of this study, it is assumed that no significant change would occur through the period of analysis. Approximately 3 million tons of wheat per year would be shipped to Japan in 22,000-ton lots (in appropriately sized vessels), and would not benefit from the proposed channel improvements.

The rapidly developing Asia region would have increasing importance in Columbia River exports. Unlike Japan, these countries do not impose institutional constraints on lot sizes. In Southeast Asia, wheat use has grown by nearly 50 percent in the 1990s. As these countries experience economic growth, the consumption of wheat would be expected to grow. Economic forces would push towards utilization of larger and more efficient grain handling facilities serviced by vessels drafting 41 to 44 feet.

In the other Asia region, a new deep-draft grain facility in Marivale, Bataan (Philippines) would have the capacity to handle panamax vessels. In 1993, the Philippines received over 1.5 million short tons of wheat, primarily in 35,000 to 45,000 ton lot sizes, departing Portland at drafts of 37 and 38 feet. As the Philippines continues to develop deep draft facilities, lot sizes and vessel departure drafts would generally increase to the channel constraint (in both the with- and without-project conditions).

Table 3-9. 1993 Wheat Vessel Movements by Departure Draft

Foreign Port Destination	Departure Draft (in feet)													
	28	29	30	31	32	33	34	35	36	37	38	39	40	41
Japan			3	2	5	26	44	28	16	10	3			
Republic of Korea				3	5	4	12	20	11	2	3		1	
Philippines							1	1	6	22	8	2		
Taiwan				1		1	1	6	9	6	4	1	1	
Yemen Arab Republic						1	3	3	1	2	2	2	1	
UAR Egypt					1	1					4	2	4	1
Saudi Arabia										2		9		
Thailand					2		3		4				1	
Ceylon (Sri Lanka)							1					3	4	1
Pakistan											4	3	2	
Hong Kong			1	1				2	2	1		1		
Bangladesh							1	1	1	2		1	1	
Malaysia	1						1	1			1		2	
China						1		1	2		1			
Republic of South Africa								1	2		1			1
Egypt												3	1	
Chile							1	1		1				
Kuwait							1	1	1					
New Zealand					1		1	1						
El Salvador				1					1					
Brazil								1						
Colombia			1											
Ethiopia											1			
Indonesia									1					
Jordan										1				
Kenya						1								
Sudan								1						
USSR		1												
Grand Total	1	1	5	8	14	35	70	69	57	49	32	27	18	3

Source: Port of Portland

Shipments of wheat to Pakistan and Sri Lanka have generally moved in 58,000 short ton lot sizes, departing between 38 and 40 feet in draft. Without improving the Columbia River channel, there would likely be little change in these vessels. In 1993, the design drafts of vessels carrying wheat to Pakistan and Sri Lanka varied from 41.8 feet to 43.8 feet, and would unlikely change in the without-project condition. With a channel improvement, it would be expected that both lot and vessel sizes would generally increase to match the average maximum load possible out of the Columbia River.

In general, most of the wheat moving to the other Asia region would benefit from improving the navigation channel because much of the traffic already moves on panamax vessels and because of the planned infrastructure improvements in the Philippines.

About 10 to 15 percent of wheat tonnage would go to countries in Africa and the Middle East, including Egypt, South Africa, Sudan, Ethiopia, Jordan, Kuwait, Saudi Arabia, and Yemen. In 1993, approximately half of this tonnage moved at a departure draft of 39 or 40 feet. Egypt and Saudi Arabia accounted for approximately two-thirds of this tonnage.

Exports to Egypt and Saudi Arabia move on panamax-size vessels in about 58,000 ton lot sizes, with design drafts of 41 to 45 feet and dead weight tonnage in the 65,000 to 73,000 ranges. This would be the average maximum load for the Columbia River.

In the without-project condition, there would likely be little change in these movements. The vessels are already of greater capacity than the current channel can fully utilize. With a channel improvement, two changes would likely occur with the movements to Egypt and Saudi Arabia. First, the average lot size would shift to fully utilize the channel depth. Second, over time the majority of vessels would likely shift to sizes which could fully load in the increased channel depth.

For vessels carrying wheat to other destinations in Africa and the Middle East (approximately four percent of wheat exports), lot sizes and operating drafts vary. Currently, more than two-thirds of this tonnage could benefit from channel improvement. In the future, as some of these countries improve their infrastructure, an increasing amount of this tonnage would likely depart the Columbia on panamax-size vessels, making full use of the channel depth.

3.3.2.2. Corn

Corn is a low-value feed grain and economic forces would always be strong to minimize transportation and processing costs. There is strong pressure to move corn in large quantities in order to take advantage of economies of scale. However, factors such as existing facilities and infrastructure could limit the size of shipments.

The majority of increases in corn exports over the period of analysis would likely result from increases in demand from countries such as Taiwan, Korea, Malaysia, Indonesia, and Thailand (rapidly developing Asia region). Two-thirds of the corn exported from the Columbia would be sold to these countries. As these economies grow, so would their demand for feed grains. Many of these countries have the advantage of being unhampered by old and undersized facilities. As their economies have grown, so has interest in constructing infrastructure that allows for efficiently importing feed grains. Almost all of these countries have either recently completed improvements, or are in the process of improving their grain handling facilities.

Exports to Taiwan have been strong throughout the 1990s, with lot sizes generally ranging from 55,000 to 62,000 short tons, moving on 67,000 to 72,000 dwt vessels. Table 3-10 displays 1993 Columbia River corn exports to Taiwan. Although very little history about commodity movements exists from the Columbia River to many of the other countries in this region, a number of reports deal with development in these countries. Indonesia and Taiwan are constructing grain terminals to handle vessels as large as cape-size (100,000 to

175,000 dwt). Malaysia is planning improvements to handle grain panamax vessels. Thailand's Southern Seaboard Development Program has accelerated their construction of a deep-sea port. As these developments occur, two-thirds of the corn would initially move on vessels that would be constrained by a 40-foot channel depth. By 2024, almost 85 percent of the corn moving on this trade route would be transported on vessels constrained by the existing Columbia channel depth.

Table 3-10. 1993 Columbia River Corn Exports to Taiwan

Design Draft (feet)	Number of Vessels	Avg. Departure Draft (feet)	Tons Carried	Percent of Tons Carried
36	2	35	40,510	2
37	1	33	34,722	2
38-40	0	---	---	---
41	2	40	115,295	7
42	8	40	477,520	27
43	6	40	367,475	21
44	9	40	535,915	31
45	2	40	125,001	7
46	1	39	55,351	3
totals	31	---	1,751,789	100

Source: Port of Portland

China would receive about 20 percent of the corn exported from Columbia River ports. Growth in demand from Southeast Asian markets force countries like China to build new grain terminals to handle the modern fleet of cape-size vessels (*Fairplay*, April 11, 1996). Although grain from the Columbia River would not likely move in cape-size vessels, it would be likely that corn exports would move in large panamax-size vessels. About 30 percent of corn exports to China would likely be constrained by the current channel depth by the year 2004, increasing to more than 80 percent by 2024.

Japan has historically utilized the existing channel depth with a fair degree of efficiency. While much of the existing traffic has moved in design drafts greater than the channel constraint, there has been a portion of the corn tonnage that has moved at drafts from 36 to 37 feet. These movements could be constrained either by destination draft, destination storage, or processing capacity. In 1993, approximately 40 percent of corn exported to Japan moved on vessels with a design draft 42 feet or greater. Over the period of analysis, the constrained portion of corn exports would be expected to increase to 60 percent.

3.3.2.3. Barley

In terms of volume, barley represents a lesser export commodity for the Columbia River. In 1993, there were only eleven vessels moving barley out of the Columbia, carrying the cargo to Cyprus, Japan, Israel, Algeria, and Jordan. As shown in table 3-11, more than half the barley-carrying vessels departed at drafts approaching the channel constraint. Barley would likely shift slightly, but not consistently, to larger vessels if the channel was

improved. Industry experts have stated that although Columbia River barley movements are difficult to predict, 1993 was a relatively normal year and that future exports can reasonably be expected to follow a similar pattern (Faucet, 1996). Given the relatively small number of vessels carrying barley in 1993, the future fleets would be expected to consist of a similar proportion of tonnage moving in vessels with design drafts greater than 40 feet, with the tonnage spread over appropriate ranges of design drafts.

Table 3-11. 1993 Columbia River Barley Exports

Design Draft (ft)	Typical Maximum Draft (ft)	Typical Average Draft (ft)	Percent of Vessels	Percent of Tons	Number of Vessels	Actual Tons	Average dwt	Average Tons Carried
33	33	32	18.18	12.58	2	50,550	29,215	25,275
34	34	33	0	---	---	---	---	---
35	35	34	0	---	---	---	---	---
36	36	35	0	---	---	---	---	---
37	37	36	27.27	21.33	3	85,727	38,617	28,576
38	38	37	0	---	---	---	---	---
39	39	38	9.09	6.73	1	27,046	33,670	27,046
40	40	39	0	---	---	---	---	---
41	40	39	9.09	13.66	1	54,915	67,675	54,915
42	40	39	18.18	26.68	2	107,232	67,585	53,616
43	40	39	0	---	---	---	---	---
44	40	39	0	---	---	---	---	---
45	40	39	18.18	19.02	2	76,421	73,080	38,211
totals	---	---	100	100	11	401,891	---	---

Source: Port of Portland

3.3.2.4. Alumina

Alumina represents an import commodity to the Columbia River for Pacific Northwest smelters. Alumina is generally imported from Australia in lot sizes from 30,000 to 40,000 short tons. Industry sources have stated that the Columbia River channel depth would not a constraint to their operations. Currently, off-loading and storage facilities limit useful vessel size. In this case, unlike the grain bulk commodities, local infrastructure would need to change in order for alumina vessels to make use of a deeper channel.

Forecasts from the Bonneville Power Administration and the Northwest Power Planning Council predict that Pacific Northwest smelters would operate at approximately 85 to 90 percent of their current capacity throughout the next 30 years. While some plant modernization would occur to meet environmental regulations and to become more competitive internationally, this forecast assumes no expansion of local capacity. Alumina imports would be expected to remain about 1.3 million short tons annually, with the majority of the uncertainty in the forecast indicating that alumina imports would be more likely to decrease than to increase. Given these factors, it is anticipated that channel improvement would not affect alumina imports.

3.4. Future Port Development

The Port of Portland, like most container facilities on the West Coast, is expanding and updating their container services to meet the increasing demand. Terminal 6 is a state of the art container facility and compares favorably to other West Coast terminals. The terminal has three berths dedicated to ship loading and unloading and one berth for inbound barged containers. Terminal 6 has open storage of 80 acres. The rail yard used by the container terminal is a 52-acre on-dock facility, expanded in 1995. The on-dock intermodal rail yard has a capacity of 84 double stack cars and direct access by Union Pacific and Burlington Northern Railroads. The existing estimated throughput capacity of Terminal 6 facilities is approximately 560,000 TEUs annually.

Terminal 6 has two post panamax cranes to service container traffic in addition to five other panamax cranes. The Port has prepared plans and specifications for extending the outreach (boom lengthening), raising, and narrowing two of its panamax cranes so that they can be converted to serve post-panamax vessel dimensions.

Terminal 6 has benefited from significant capital investment in the 1990's. During the period 1993-1995, the Port purchased a new post-panamax crane, installed 100-foot gauge crane rails, and relocated an existing post-panamax crane from Terminal 2 on the Willamette River to Terminal 6, all at a total cost of about $20 million.

In 1994, the Port Commission approved a $25 million program to improve the terminal's truck gate, increase the size of the container yard, and improve the efficiency of the layout. In 1995, the Port installed a new computer system to modernize its cargo-receiving, inventory, and vessel planning functions, as well as facilitating automation, electronic data interchange, and related new technologies.

The Port of Portland purchased West Hayden Island, 780 acres of land within the Portland Urban Growth Boundary, with the intent of developing this land for future marine cargo facilities. The Commission adopted a development program for the island in 1997. The development program envisions three phases of development. Phase 1 (1996 to 2005) includes plans for a 120-acre grain export terminal and $30 million highway access bridge. Total private and public investment in Phase 1 will be approximately $132 million. Phase 2 includes an intermodal rail yard and container terminal. This phase of construction will cost approximately $300 million and is scheduled for 2005 to 2010. Phase 3 includes a second container facility with a cost of $186 million. The need for Phase 3 is anticipated after the year 2020.

The Port of St. Helens recently announced plans for a new sheetrock wallboard plant. The plant will begin production in 2001, and is expected to use the navigation channel to import raw materials. The Port of Longview is actively seeking a tenant for its grain loading facility, and is also considering adapting the facility for liquid bulk or building materials. An industrial park development has been recently initiated, and is also likely to bring industry requiring deep draft terminals. The Port is also improving their coal pitch (related to aluminum) import facilities.

The Port of Vancouver plans to develop Columbia Gateway, which contains about 600 acres of industrial zoned land, as a major portion of the Clark County Growth management plan. The Gateway is on the north boundary of the port and is planned for marine bulk and break-bulk facilities, as well as marine and non-marine related industrial development. A master plan has been completed for the area and an EIS is being prepared. The area is scheduled to receive fill form the proposed channel improvement project beginning in 2001-2002 as a requirement for development over the next 10 to 20 years.