PORT of vancouver

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October 28, 2016

Debra Myles
Panel Manager, Roberts Bank Terminal 2 Project
Canadian Environmental Assessment Agency
22nd Floor, Place Bell
160 Elgin Street
Ottawa, ON, K1A 0H3

Dear Ms. Myles:

Re: Panel Orientation 2: September 16, 2016 – Undertaking #1

The Vancouver Fraser Port Authority is pleased to submit a response to Undertaking #1, per the Review Panel's request at the Orientation Session on September 16, 2016.

Sincerely,
<Original signed by>

Gilles Assier
Director, Infrastructure Sustainability

Cc Review Panel, Roberts Bank Terminal 2 Project
Monica Perry, Executive Project Director, BC Environmental Assessment Office

Encl. (1)

Panel Orientation 2: September 16, 2016

Undertaking #1

Information Required

Vancouver Fraser Port Authority [VFPA] will provide an estimate of the number and percentage of ultra-large ships, as compared to smaller ships, that would call on Roberts Bank Terminal 2 when the terminal opens, and five and ten years later.

Response

The number of container ships by size class and the distribution of vessel capacity (percent of ships) projected to call at Roberts Bank Terminal 2 (RBT2 or Project) at the start of terminal operation and at design capacity operation (2.4 million twenty-foot equivalent units (TEUs)) was presented in the RBT2 Environmental Impact Statement (EIS) and the Marine Shipping Addendum (MSA). Container liner services imply a weekly call, resulting in total vessel calls per year at a terminal coming in multiples of about 52. Therefore, a change in the number of services dramatically affects the vessel size required to achieve the design terminal throughput capacity. The presumption for RBT2 is that it will be a five service operation, hence 260 ship calls annually of vessels with an average of approximately 9,365 TEU capacity. Because the services are all assumed to also call Seattle/Tacoma, only half the vessel capacity in each direction (import/export) can be assumed to be available for RBT2 [e.g., ((52 weeks x 5 services x 9,365 TEUs/service call x 2 directions)/2 port calls = 2.4 million TEUs[1])].

As indicated in MSA Section 4.2.1.1, the RBT2 Project has been designed to accept ultra-large container ships (ships with length greater than 390 m and/or capacity greater than 15,000 TEUs (IHS Fairplay 2016)), but these vessels are not anticipated to call at RBT2 by 2035. EIS Appendix 30-A: Appendix A Figure A-1 and MSA Figure 4-4 show the evolution of container

[1] This formula assumes that all vessels are 9,365 TEU capacity, are at capacity (100% full), and that no calls are cancelled within the year.

ship sizes (from Ashar and Rodrigue 2012), and the Category E size is considered the ultra-large size class.

Future ship size distribution and ship call projections in the EIS and in the MSA relied on two supporting reports (provided in **Appendix A** of this undertaking):

1. For the EIS and MSA – WorleyParsons Canada (WorleyParsons 2011), *Projections of Vessel Calls and Movements at the Roberts Bank Marine Terminals*, provided a review of trends in shipping characteristics (including the ongoing trend to larger container ships) and uses projections of vessel size characteristics to generate predicted numbers ship calls (and movements) for Deltaport and RBT2 terminals.
2. For the MSA – Seaport Consultants Canada Inc. (Seaport 2014), *Update of Projections of Container Ship Characteristics for Roberts Bank Terminal 2*, partially updated the contents of the report above by providing a more recent evaluation of projected container ship size.

EIS Section 4.3.2 stated that "terminal throughput will ramp up gradually after start-up, with design capacity throughput potentially being reached as early as 2025, but more likely by about 2030, depending on demand." For the purposes of assessing the Project and Project-associated shipping (presented in the EIS and MSA, respectively), start-up was assumed to occur in 2025 and at-design capacity operation was assumed to be reached by 2030. The supporting reports provided projections for RBT2 in 2025 and 2030, but not for ten years (2035) after the start of operations. That said, given recent changes in the new vessel orderbook, it seems that shipping line interest in acquiring new ultra-large container ships has abated; there have been no orders placed in 2016 as of the end of August (Alphaliner 2016). While the ship mix in 2035 has not been projected, it is not anticipated to include ultra-large container ships.

Table 1 summarises the number of ships and the distribution of vessel capacity (percent of ships) by size class in 2025 and 2030 used in the EIS and the MSA. The MSA values are the most current projections, and vessel numbers and the distribution of vessel capacity projections in 2035 are expected to be similar.

Table 1 Projected Vessel Numbers by Size Class and Distribution of Vessel Capacity (as percentage) for 2025 and 2030

Vessel Capacity Range (TEUs)	EIS[a]				MSA[b]			
	2025		2030		2025		2030	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
4,000 – 5,999	5	2	0	0	21	8	8	3
6,000 – 7,999	55	21	42	16	8	3	8	3
8,000 – 10,000	135	52	135	52	182	70	169	65
10,000 - 15,000	65	25	83	32	49	19	75	29
>15,000[c]	0	0	0	0	0	0	0	0
Total	**260**	**100**	**260**	**100**	**260**	**100**	**260**	**100**
Average Ship Size (TEUs)	**9,215**	**n/a**	**9,620**	**n/a**	**8,815**	**n/a**	**9,365**	**n/a**

Source:

a. Information from WorleyParsons Canada 2011.

b. Percent information from Seaport 2014. Numbers have been calculated based on the total calls and percent projections.

c. This size class was not provided in WorleyParsons Canada 2011 or Seaport 2014, but ultra-large vessels are not expected to call at RBT2.

Using the projected distribution of vessel sizes described in WorleyParsons Canada (2011), and as stated in EIS Section 4.4.2.1, the Project is anticipated to generate 260 container ship calls annually when the terminal reaches its 2.4 million TEU design capacity around 2030. For the purposes of conservatively assessing the effects of the Project and of Project-associated shipping in the EIS and MSA, respectively, the number of ship calls associated with the design capacity was assumed to occur immediately upon the commencement of operation (i.e., in 2025), instead of at a later date (i.e., in 2030) following a gradual increase in throughput.

Although the number of ships by size class was not re-evaluated in Seaport (2014), for the purposes of the MSA, the number of vessel calls per year was assumed to be 260. The updated information in Seaport (2014) confirms the trend towards larger vessels (8,000 to 10,000 TEU capacity); over time, this trend would actually result in fewer RBT2 ship calls required to achieve throughput capacity. That is, for the purposes of the MSA, the number of ship calls was assumed to be consistent throughout Project operation.

Representative Vessel

Economies of scale have led to an increase in container ship size, as previously described in EIS Appendix 30-A and MSA Section 4.2.1. As shown in **Table 1**, smaller ships are being replaced by larger ships and by 2030, the majority of the container ships are expected to be in the 8,000 to 10,000 TEU range. **Table 1** also shows a redistribution of vessel size predictions since ships previously constrained by their beam width due to limits of the Panama Canal are no longer constrained after opening of the new canal. The characteristics of trans-

Pacific trading involve fewer ports of call and no hub and spoke (distribution) activity at the North America west coast end. Asia-Europe trades employ ultra-large vessels because distances are greater, competitive alternative routings do not exist, and hubs are present along the shipping routes. This drove the trend toward these large vessels and had the effect of cascading previous size vessel classes into other trade routes, such as the Asia-North American west coast route. It is expected that, based on historical trends in fleet management, as the newest and largest ships (similar to or larger than the Maersk EEE size) get put into service on the Asia-Europe routes, the next ship size down (12,000 to 15,000 TEUs) will begin to visit mid-size ports such as Vancouver. As shown in Seaport (2014) Figure 11 (**Appendix A**), ships over 10,000 TEUs are currently visiting Vancouver ports, and although the 8,000 to 10,000 TEU size class is projected to remain dominant, the number of ships ranging between 10,000 TEUs and 15,000 TEUs will continue to increase.

With these trade characteristics, fleet changes, and based on current vessel orders, it is highly unlikely that ultra-large ships greater than 15,000 TEUs will call on RBT2 before 2035, and may likely never enter the trans-Pacific service. Therefore, based on the majority of vessels being within the 8,000 to 10,000 TEU size class in 2030, the representative vessel selected for the effects assessments presented in the MSA is considered to have approximately 9,365 TEU capacity.

Conclusion

Table 2 summarises the estimated number and percentage of ultra-large ships, as compared to smaller ships.

Table 2 Projected Vessel Numbers by Size Class and Distribution of Vessel Capacity (as percentage) for 2025, 2030, and 2035

Vessel Capacity Range (TEUs)	2025[a]		2030[a]		2035[b]	
	Number	Percent	Number	Percent	Number	Percent
4,000 – 5,999	21	8	8	3	8	3
6,000 – 7,999	8	3	8	3	8	3
8,000 – 10,000	182	70	169	65	169	65
10,000 – 15,000	49	19	75	29	75	29
>15,000[c]	0	0	0	0	0	0
Total	**260**	**100**	**260**	**100**	**260**	**100**
Average Ship Size (TEUs)	**8,815**	**n/a**	**9,365**	**n/a**	**9,365**	**n/a**

Source:

a. Percent information from Seaport 2014. Numbers have been calculated based on the total calls and percent projections.
b. Vessel numbers and the distribution of vessel capacity projections in 2035 are expected to be similar to 2030.
c. This size class was not provided in Seaport 2014, but ultra-large vessels are not expected to call at RBT2.

References

Alphaliner. 2016. Orderbook. September 2016.

Ashar and Rodrigue. 2012. The Geography of Transport Systems. Available at http://people.hofstra.edu/geotrans/eng/ch3en/conc3en/containerships.html. Accessed October 2016.

IHS Fairplay. 2016. Available at http://www.ihsfairplay.com/IMO/imo.html. Accessed October 2016.

Seaport Consultants Canada Inc. 2014. Update of projections of Container Ship Characteristics for Roberts Bank Terminal 2. Prepared for Vancouver Fraser Port Authority. Provided in **Appendix A**.

WorleyParsons Canada. 2011. Projections of Vessel Calls and Movements at the Roberts Bank marine Terminals – Terminal 2 (T2). Prepared for Vancouver Fraser Port Authority (formerly Port Metro Vancouver). Provided in **Appendix A**.

APPENDIX A
SUPPORTING REPORTS

WorleyParsons
resources & energy

PORT METRO VANCOUVER

PORT METRO VANCOUVER

Projections of Vessel Calls and Movements at the Roberts Bank Marine Terminals

Terminal 2 (T2)

09409

09409-01-GE-REP-90001-500 - Rev. B

28-Nov-11

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WorleyParsons
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PORT METRO VANCOUVER
PROJECTIONS OF VESSEL CALLS AND MOVEMENTS AT THE ROBERTS BANK MARINE TERMINALS
TERMINAL 2 (T2)

PROJECT 09409 - PROJECTIONS OF VESSEL CALLS AND MOVEMENTS AT THE ROBERTS BANK MARINE TERMINALS

FILE LOC.: BURNABY, BC

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
A	Issued for review	T. Smyth	J. McKinnell	W. Major	02-Aug-11		
B	Issued for Customer Review	T. Smyth	J. McKinnell	W. Major	28-Nov-11		

<Original signed by> <Original signed by> <Original signed by>

Disclaimer

The projections of WorleyParsons Canada Services Ltd. and Seaport Consultants Canada Inc. contained in this report are contingent upon factors over which WorleyParsons Canada Services Ltd. and Seaport Consultants Canada Inc. have no control and the projections are by their nature uncertain. WorleyParsons Canada Services Ltd. and Seaport Consultants Canada Inc. provide no warranties that actual events will not vary from the projections of WorleyParsons Canada Services Ltd. and Seaport Consultants Canada Inc.

EXECUTIVE SUMMARY

This report develops projections of ship movements at the Roberts Bank port area of Port Metro Vancouver (PMV). These include container ships calling at the existing Deltaport and proposed Terminal 2 container terminals and at the coal terminal of Westshore Terminals. The report uses traffic projections in conjunction with projections of vessel size characteristics to generate ship calls and ship movements. Projections for three cases are provided.

The report deals first with container traffic. It uses a base year 2010 ship size distribution for Deltaport and projections of changing ship characteristics over time to develop likely projections of container ship size distributions in future years. Table A summarizes the container ship size distributions that result from this exercise. As one moves out in time to the right in the table, the smaller vessels in the upper left slowly disappear to be replaced by larger vessels to the lower right. The average container ship size at Deltaport in 2010 was approximately 6,000 twenty-foot equivalent container units (TEU); the projected ship size for 2030 is approximately 9,500 TEU.

The trend towards increasing container ship size in Port Metro Vancouver has been evident for at least the last dozen years and it is consistent with the numbers of large container ships that have been delivered in recent years and are on order today. There is a reasonably strong correlation between the average container ship size in PMV and that of the world fleet.

Table A Projected Roberts Bank Container Ship Distributions Actual 2010 to 2030

	Actual	Projected						
	2010	2015	2020		2025		2030	
Item	Deltaport	Deltaport	Deltaport	Termina l 2	Deltaport	Terminal 2	Deltaport	Terminal 2
Distribution of Vessel Capacity (Percent of Ships)								
<= 2,000	0	0	0	0	0	0	0	0
2,000 - 3,000	3	0	0	0	0	0	0	0
3,000 - 4,000	0	0	0	0	0	0	0	0
4,000 - 5,000	12	3	0	0	0	0	0	0
5,000 - 6,000	30	22	12	12	2	2	0	0
6,000 - 7,000	16	16	11	11	6	6	1	1
7,000 - 8,000	9	15	15	15	15	15	15	15
8,000 - 9,000	27	32	35	35	35	35	35	35
9,000 - 10,000	0	5	14	14	17	17	17	17
>10,000	3	7	13	13	25	25	32	32
Total	100	100	100	100	100	100	100	100

Sources: Consultant estimates, 2011.

In the case of ship calls at Westshore Terminals, data was obtained from Westshore on coal shipments and ship calls over the last 30 years. This was used as the basis for projecting the cargo lot sizes (the average tonnage of coal loaded onto each ship), which in recent years has been quite consistently 100,000 tonnes per ship call. The report also briefly reviews the outlook for the coal market and the prospects for increased capacity at Westshore Terminals. The end result is a projection of coal exports and numbers of ship calls and movements.

Table B summarizes the results for all types of vessels calling at the two existing and one proposed terminals at Roberts Bank. The table includes actual numbers for 2010 and projections for 2014 to 2030. It also includes cargo volumes. Projections of vessel calls and movements by vessel type are summarized in Tables R and S of this report. Details of container vessel projections for selected years are in Tables I to K and details of coal ship projections for selected years are in Table Q.

There are three projection cases:

- Case 1: High "Direct" container traffic projection. Deltaport and Terminal 2 have sustainable capacities of 2.4 million TEU. Container vessel sizes are as in Table A. Deltaport has a maximum capacity of 3.0 million TEU in interim years of high demand. Maximum Westshore throughput is 35 million tonnes of coal.
- Case 2: High "Direct" container traffic projection. Deltaport and Terminal 2 have sustainable capacities of 3.0 million TEU. Container vessel sizes are as in Table A. Maximum Westshore throughput is again 35 million tonnes of coal.
- Case 3: High "Direct" container traffic projection. Deltaport and Terminal 2 have sustainable capacities of 3.0 million TEU. Container call size remains at 2010 level of 6,250 TEU per ship call. Maximum Westshore throughput is again 35 million tonnes of coal.

Deltaport in 2010 had a split service that called twice at the terminal: the first call to discharge import containers and the second call to load export containers. Between the Deltaport calls, the vessel visited a U.S. Pacific Northwest port. The split service adds 52 vessel calls and 104 movements for 2010. Although unusual, this practice was assumed to persist at Deltaport in all projection years so as not to understate potential ship movements. The ship movements in the summary table reflect this service.

In 2010, there were approximately 1,100 ship movements at the Roberts Bank terminals. The 2030 projections range from 1,800 vessel movements in Case 1 to 2,700 vessel movements in Case 3.

PORT METRO VANCOUVER
PROJECTIONS OF VESSEL CALLS AND MOVEMENTS AT THE ROBERTS BANK MARINE TERMINALS
TERMINAL 2 (T2)

Table B Summary of Vessel Movement Projections for Deltaport, Westshore and Terminal 2

	Cargo Volume								
	Container (Million TEU)				Average Ship Movements			Peak Ship Movements	
Case / Year	Deltaport	Terminal 2	Total	Coal (Mt)	Annual	Monthly	Daily	Monthly	Daily
Case 1									
2010	1.54		1.54	24.7	1,086	91	3	105	10
2014	1.74		1.74	25.0	1,124	94	3	109	10
2015	2.02		2.02	26.0	1,144	95	3	111	10
2016	2.28		2.28	27.0	1,268	106	3	122	10
2017	2.55		2.55	28.0	1,392	116	4	133	10
2018	2.85		2.85	29.0	1,412	118	4	136	10
2019	3.00		3.00	30.0	1,432	119	4	138	10
2020	2.40	1.10	3.50	31.0	1,660	138	5	158	16
2021	2.40	1.35	3.75	32.0	1,680	140	5	160	16
2022	2.40	1.61	4.01	33.0	1,804	150	5	172	16
2023	2.40	1.88	4.28	34.0	1,824	152	5	174	16
2024	2.40	2.17	4.57	35.0	1,948	162	5	185	16
2025	2.40	2.40	4.80	35.0	1,844	154	5	176	16
2026	2.40	2.40	4.80	35.0	1,844	154	5	176	16
2027	2.40	2.40	4.80	35.0	1,844	154	5	176	16
2028	2.40	2.40	4.80	35.0	1,844	154	5	176	16
2029	2.40	2.40	4.80	35.0	1,844	154	5	176	16
2030	2.40	2.40	4.80	35.0	1,844	154	5	176	16
Case 2									
2010	1.54		1.54	24.7	1,086	91	3	105	10
2014	1.74		1.74	25.0	1,124	94	3	109	10
2015	2.02		2.02	26.0	1,144	95	3	111	10
2016	2.28		2.28	27.0	1,268	106	3	122	10
2017	2.55		2.55	28.0	1,392	116	4	133	10
2018	2.85		2.85	29.0	1,412	118	4	136	10
2019	3.00		3.00	30.0	1,432	119	4	138	10
2020	3.00	0.50	3.50	31.0	1,556	130	4	149	16
2021	3.00	0.75	3.75	32.0	1,680	140	5	160	16
2022	3.00	1.01	4.01	33.0	1,700	142	5	163	16
2023	3.00	1.28	4.28	34.0	1,824	152	5	174	16
2024	3.00	1.57	4.57	35.0	1,948	162	5	185	16
2025	3.00	1.86	4.86	35.0	1,948	162	5	185	16
2026	3.00	2.11	5.11	35.0	2,052	171	6	194	16
2027	3.00	2.36	5.36	35.0	2,052	171	6	194	16
2028	3.00	2.62	5.62	35.0	2,052	171	6	194	16
2029	3.00	2.89	5.89	35.0	2,052	171	6	194	16
2030	3.00	3.00	6.00	35.0	2,052	171	6	194	16
Case 3									
2010	1.54		1.54	24.7	1,086	91	3	105	10
2014	1.74		1.74	25.0	1,228	102	3	118	10
2015	2.02		2.02	26.0	1,248	104	3	120	10
2016	2.28		2.28	27.0	1,372	114	4	131	10
2017	2.55		2.55	28.0	1,496	125	4	143	10

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PROJECTIONS OF VESSEL CALLS AND MOVEMENTS AT THE ROBERTS BANK MARINE TERMINALS
TERMINAL 2 (T2)

	Cargo Volume								
	Container (Million TEU)				Average Ship Movements			Peak Ship Movements	
Case / Year	Deltaport	Terminal 2	Total	Coal (Mt)	Annual	Monthly	Daily	Monthly	Daily
2018	2.85		2.85	29.0	1,620	135	4	154	10
2019	3.00		3.00	30.0	1,640	137	4	156	10
2020	3.00	0.50	3.50	31.0	1,868	156	5	176	16
2021	3.00	0.75	3.75	32.0	1,888	157	5	179	16
2022	3.00	1.01	4.01	33.0	2,012	168	6	190	16
2023	3.00	1.28	4.28	34.0	2,136	178	6	201	16
2024	3.00	1.57	4.57	35.0	2,260	188	6	212	16
2025	3.00	1.86	4.86	35.0	2,364	197	6	221	16
2026	3.00	2.11	5.11	35.0	2,468	206	7	231	16
2027	3.00	2.36	5.36	35.0	2,468	206	7	231	16
2028	3.00	2.62	5.62	35.0	2,572	214	7	240	16
2029	3.00	2.89	5.89	35.0	2,676	223	7	249	16
2030	3.00	3.00	6.00	35.0	2,676	223	7	249	16

Sources: Consultant estimates, 2011.

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PORT METRO VANCOUVER
PROJECTIONS OF VESSEL CALLS AND MOVEMENTS AT THE ROBERTS BANK MARINE TERMINALS TERMINAL 2 (T2)

1. INTRODUCTION

This report deals with shipping services at Port Metro Vancouver (PMV) of relevance to the Container Capacity Improvement Program (CCIP) and trends in their characteristics over time. It first addresses container shipping services for the port as a whole and those calling at Deltaport. It then addresses coal ships calling at the Roberts Bank coal terminal of Westshore Terminals.

The main outputs from this report are:

- Estimates of 2010 and future container shipping services and their characteristics for the Roberts Bank Port area: Deltaport 2010 actual and projections for Deltaport and Terminal 2 for various years out to 2030.
- Estimates of the number of container ship calls and movements at Deltaport and Terminal 2 in 2010 and projections for various years out to 2030.
- Estimates of the number of coal ship calls and movements at Westshore Terminals in 2010 and projections for various years out to 2030.

2. CONTAINER SHIPS

2.1 Port Metro Vancouver Container Vessel Services

This section uses three general sources of data for the evaluations. One is a series of container shipping schedules developed for particular years over the past dozen years for other projects. The other data sources are major statistical databases of the world container ship fleet and the container vessels that called at Port Metro Vancouver in 2010.

This section uses estimates of container shipping schedules for Port Metro Vancouver in early 2011 and previous years to develop characteristics of the container ships over time. The sources of data were published schedules of container services, online databases of shipping schedules from *Containerisation International* and in some cases the online vessel schedules of container shipping lines. The data includes estimates of average vessel size for each service but not the actual sizes of individual vessels in the service strings. The data was created as part of past projects with focuses that differed from those of the CCIP. In general, the previous studies involved market reviews of container shipping services as part of feasibility studies of container terminals and the main focus was on the potential container terminal market. Nevertheless, the data collected for the past shipping services provides reasonable estimates of their characteristics at the time and are useful as a guide to trends in Port Metro Vancouver over time. The data in the earlier years includes Fraser Port and Port of Vancouver together, which is consistent with recent data for Port Metro Vancouver.

Table C begins the review by summarizing the characteristics of the container shipping services calling at Port Metro Vancouver for a sample of four years between1999 and 2010. The schedule characteristics for 2010 were developed from data in early 2011. While there may have been some minor changes in vessel patterns between 2010 and early 2011, they are sufficiently small to ignore for the purposes of this review.

The table uses the term "slot capacity," which is defined as the product of container ship TEU capacity and the number of port calls, yearly in the table. If a ship discharged and loaded its full slot capacity, the vessel would generate container traffic equal to two times its TEU capacity. But this rarely happens: container vessels almost always load and discharge a portion of their TEU capacity in each port of call. Slot capacity is useful primarily as a measure of aggregate container shipping services to a port; it also provides a way to calculate a weighted average size of ships for a service or a port.

The table is broken into three sections. The first deals with all vessels and services in PMV, the second covers larger vessels only, generally those of Panamax size and larger, and the third only the services that called at Deltaport.

For the port as a whole (all vessels and services), slot capacity increased from approximately 2.2 million TEU in 1999 to about 3.7 million TEU in 2010 (growth rate of 4.7% a year). The average ship TEU capacity increased from approximately 2,500 TEU in 1999 to 4,800 TEU in 2010, an increase of 5.9% per year. The number of container ship calls declined, from 842 in 1999 to 739 in 2010. This was due to both the increasing size of ships and the increasing utilization of the slot capacity of the ships. The number of shipping services declined slightly from 18 in 1999 to 16 in 2010 for similar reasons. The table also lists the container traffic in the ports in these years, ranging from 1.1 million TEU in 1999 to 2.5 million TEU in 2010, a growth rate of 7.8% a year over this period. The ratio of container traffic to slot capacity increased from about 50% in 1999 to 70% in 2010. The final line in this section is the TEU volume discharged and loaded per ship call taken from Port Metro Vancouver data. It has increased consistently from about 1,800 TEU in 1999 (Port of Vancouver) to 3,600 TEU in 2011 (Port Metro Vancouver). Note that these volumes are in TEU; it is most common to discuss activity per ship call in terms of container lifts but in this particular study the focus is on container TEU.

In the case of large vessels only, smaller ships, generally the Westwood combined forest products / container carriers and those calling at Fraser Surrey docks, were eliminated from the calculations. The main focus regarding these vessels is on average ship TEU capacity. In this case, it ranged from 2,700 TEU in 1999 to 6,000 TEU in 2010, an increase of 7.6% a year. With this adjustment, the average size of 6,000 TEU for PMV is very close to that of all West Coast ports. An article in *Containerisation International* provided schedule data for the U.S. West Coast ports in April 2011 and from this data it was possible to estimate average ship sizes[1]. The larger ship services between the U.S. West Coast ports and Asia, in both California and Puget Sound, were also about 6,000 TEU. In the case of California, the ship sizes were adjusted by eliminating the small U.S.-flag carriers that provide some services to Asia; this was comparable to removing the Westwood and Fraser Surrey Docks ships from PMV data.

In the case of Deltaport only, slot capacity increased at almost twice the rate for PMV as a whole (8.0% a year) and the average ship capacity increased from about 2,700 TEU in 1999 to about 6,400 TEU in 2010. The number of container ships calls at Deltaport and the number of services remained constant over this period. It should be noted that in 2010 one container shipping service called twice at Deltaport each week: once to discharge containers and the second time to load containers. Between the Deltaport calls, the vessel visited a U.S. Pacific Northwest port. This would add another 52 vessel calls to the 260 in the table but involves only one effective ship call and the 260 number was used for this reason. It would add 104 vessel movements and this is utilized in vessel movement estimates below. The TEU volume per ship call is from TSI Terminal Systems Inc. (TSI) data. It ranges from about 2,000 TEU in 1999 to over 6,000 TEU in 2010. In 2010, the TEU volume per ship call was approximately equal to ship TEU capacity.

[1] Rebecca Moore, "Tug-of-war," *Containerization International*, May 2011.

Table C Port Metro Vancouver Container Services 1999 to 2010

					Growth (%/a)
Item[1]	**1999**	**2003**	**2008**	**2010**	**1999 - 2010**
All Vessels and Services					
Slot Capacity (TEU)	2,156,005	3,642,772	4,070,164	3,567,780	**4.7**
Average Ship TEU Capacity	2,561	3,404	4,615	4,831	**5.9**
Number of Ship Calls	842	1,070	882	739	**-1.2**
Number of Shipping Services	18	22	19	16	**-1.1**
Container Traffic (TEU)	1,102,092	1,791,568	2,492,107	2,514,309	**7.8**
Traffic / Slot Capacity Ratio	51%	49%	61%	70%	**3.0**
TEU / Ship Call[2]	1,802	2,028	2,915	3,551	**6.4**
Large Vessels Only[3]					
Slot Capacity (TEU)	1,927,530	3,063,372	3,608,020	3,139,151	**4.5**
Average Ship TEU Capacity	2,707	3,927	5,337	6,037	**7.6**
Number of Ship Calls	712	780	676	520	**-2.8**
Number of Shipping Services	14	15	13	10	**-3.0**
Deltaport Only					
Slot Capacity (TEU)	709,322	1,487,200	981,708	1,661,845	**8.0**
Average Ship TEU Capacity	2,728	4,086	4,720	6,392	**8.0**
Number of Ship Calls[4]	260	364	208	260	**0.0**
Number of Shipping Services	5	7	4	5	**0.0**
TEU / Ship Call[5]	2,005	2,492	4,965	6,116	**10.7**

Sources: Vessel information from published schedules, *Containerisation International* database and shipping line web sites. Container traffic and TEU per ship call for PMV from Port Metro Vancouver, 2011.

Notes:

[1] Data in most cases is for Port of Vancouver and Fraser Port combined for 1999 and 2003, and for Port Metro Vancouver in 2008 and 2010.

[2] Data is for Port of Vancouver alone for 1999 and 2003, and for Port Metro Vancouver in 2008 and 2010.

[3] Excludes Westwood services and services calling at Fraser Surrey Docks.

[4] One Deltaport service called twice at the terminal in 2010: once to discharge containers and the other to load. The 260 ship calls in the table count this split service only once.

[5] Data from TSI Terminal Systems Inc., 2011.

Table D provides estimates from the data in Table C of the incremental changes between 1999 and 2010 broken down into the three individual periods and the entire period 1999 to 2010. The first section deals with the average ship size for all vessels and services. The increase in each year ranges from 108 TEU to 242 TEU. This means, for example, that between 1999 and 2010 in each year the average ship capacity increased by 206 TEU. For large vessels only, the annual increase is higher, typically between 200 and 400 TEU. For Deltaport, the changes are more volatile but are generally the highest of the three categories summarized in this table. Between 2008 and 2010, for example, the Deltaport ships increased 836 TEU per year and the long-term average was 333 TEU per year.

In terms of increments of TEU handled per ship call for all vessels and services the range was between 57 and 318 depending on the period, and the long-term average was 159 TEU. For Deltaport alone, the increases were much greater: long-term average of 374 TEU and between 2008 and 2010, 575 TEU.

These incremental values are used as a guide later in this report to project average ship size and average TEU call size as part of building up the characteristics of container shipping in future years.

Table D Incremental Changes in Average Ship Size and TEU per Ship Call 1999 to 2010

	Increases by Period (TEU per Year)			
Item	**1999-2003**	**2003-2008**	**2008-2010**	**1999-2010**
Average Ship Size (TEU)				
All Vessels and Services	211	242	108	206
Large Vessels Only	305	282	350	303
Deltaport	339	127	836	333
TEU Handled per Ship Call				
All Vessels and Services	57	177	318	159
Deltaport	122	494	575	374

Source: Calculated from data in Table C.

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Table E again uses the schedule data to provide estimates of numbers of services by ship size between 1999 and 2011. The total number of services is the same as in Table C but the table illustrates the changing pattern of ship sizes. The upper part of the table addresses all vessels and services in PMV; the port lower part addresses Deltaport. In both categories, there is a general shift in the number of vessel services from the upper left of the table (many smaller ships up to a maximum of 6,000 TEU in 1999) to larger ships to the lower right, including those in excess of 8,000 TEU. In the case of Deltaport, all vessels have shifted from less than 5,000 TEU in 1999 to predominantly above 5,000 TEU in 2010. In 2010 the average container vessels of two services are in excess of 7,000 TEU.

Table E Port Metro Vancouver Container Ship Size Distributions 1999 to 2011

	Number of Services by Ship TEU Class				Growth (%/a)
Vessel Size (TEU)	**1999**	**2003**	**2008**	**2010**	**1999 - 2010**
All Vessels and Services					
<= 2,000	7	5	3	3	-6.8
2,000 - 3,000	8	6	2	3	-7.8
3,000 - 4,000	1	5	3	1	0.0
4,000 - 5,000	1	5	2	0	
5,000 - 6,000	1	1	6	5	14.4
6,000 - 7,000	0	0	2	2	
7,000 - 8,000	0	0	1	1	
> 8,000	0	0	0	1	
Total	**18**	**22**	**19**	**16**	**-1.0**
Deltaport					
<= 2,000	2	0	0	0	
2,000 - 3,000	1	2	0	0	
3,000 - 4,000	1	2	1	1	
4,000 - 5,000	1	2	1	0	
5,000 - 6,000	0	1	2	1	
6,000 - 7,000	0	0	0	1	
7,000 - 8,000	0	0	0	1	
> 8,000	0	0	0	1	
Total	**5**	**7**	**4**	**5**	**0.0**

Sources: Estimated from published schedules, *Containerisation International* database and shipping line web sites.

Notes: Data is for Port of Vancouver and Fraser Port combined for 1999 and 2003, and for Port Metro Vancouver in 2008 and 2010.

Figure A repeats the data in Table E. The data, for PMV as a whole, shows the relatively small vessels in 1999, the emergence in 2003 and 2008 of increasingly large ships, and 2010 with a "long tail" that extends to over 8,000 TEU.

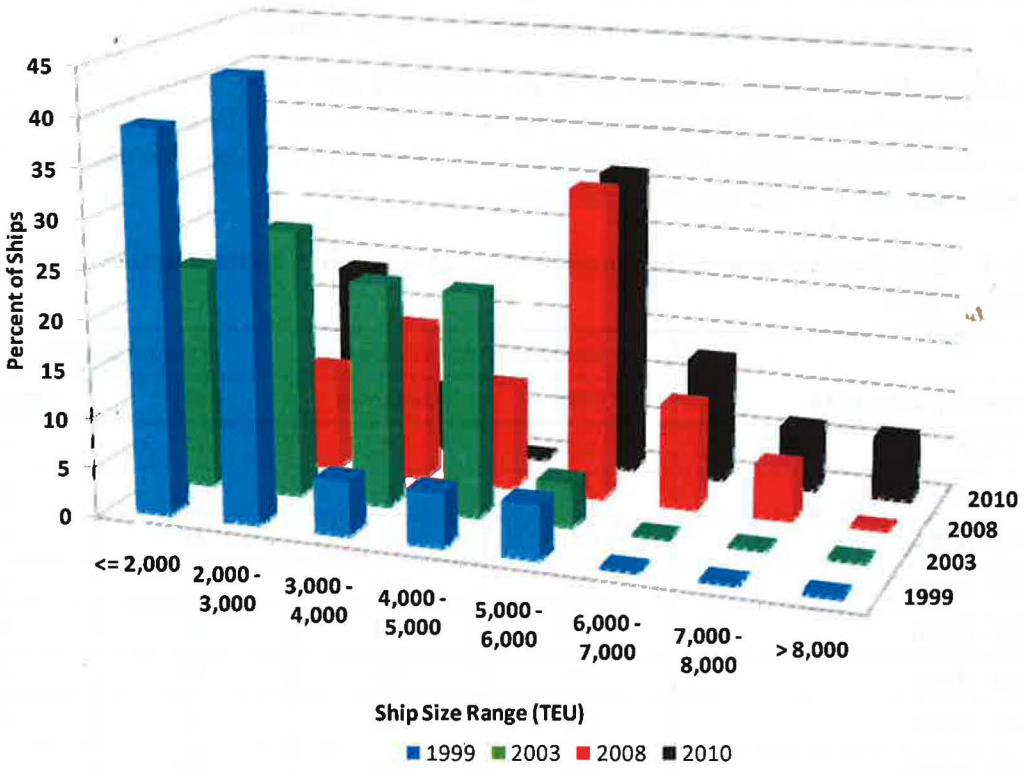

Figure A Port Metro Vancouver Container Ship Size Distributions 1999 to 2010

Sources: Estimated from published schedules, *Containerisation International* database and shipping line web sites.

Notes: Data is for Port of Vancouver and Fraser Port combined for 1999 and 2003, and for Port Metro Vancouver in 2008 and 2010.

Table F utilizes ship call data for Port Metro Vancouver in 2010 broken down into the port as a whole and Deltaport. It presents the data in terms of numbers of ships and percent distributions for these two categories. The table also provides a more detailed breakdown of the larger ships than above: it includes the categories of 8,000 to 9,000 TEU, 9,000 to 10,000 TEU and greater than 10,000 TEU. It shows, for example, that in Deltaport a reasonably large number of ship calls were between 8,000 and 9,000 TEU and a few ships were in excess of 10,000 TEU. The table again shows that Deltaport has few ships under 4,000 TEU (these are particular vessels in a service that mixes a number of smaller ships with significantly more large vessels).

This data set for 2010 provides the basis for the projections later in this report. In general, actual 2010 data from Port Metro Vancouver provides the statistical base for the projection of future vessel characteristics and the schedule-related data discussed above provides background for the changes over time of these ship characteristics.

Table F Size Distributions of Container Ships Calling at Port Metro Vancouver and Deltaport 2010

	Number of Ship Calls		Percent Distribution	
Vessel Capacity TEU)	PMV	Deltaport	PMV	Deltaport
<= 2,000	84	0	12	0
2,000 - 3,000	97	8	14	3
3,000 - 4,000	3	0	0	0
4,000 - 5,000	63	29	9	12
5,000 - 6,000	248	74	36	30
6,000 - 7,000	91	38	13	16
7,000 - 8,000	23	23	3	9
8,000 - 9,000	66	66	10	27
9,000 - 10,000	0	0	0	0
> 10,000	7	7	1	3
Total	**682**	**245**	**100**	**100**

Source: Port Metro Vancouver, 2011.

2.2 The World Container Ship Fleet

This section reviews the broad trends in the composition of the world container ship fleet between 1990 and 2015. The data up to 2010 is for the existing fleet while the data for 2011 to 2015 reflects the vessel order book as it was on December 31, 2010.

Figure B provides the number of ships by year of delivery in the fleet up to 2010 and the 2010 fleet plus ships on order for 2011 to 2015 broken down into the six container ship size ranges that Clarkson Research Services Limited (Clarkson) uses in its container ship registers. These are:

- Feeder: less than 500 TEU.
- Feedermax: 500 TEU to 1,000 TEU.
- Handy: 1,000 TEU to 2,000 TEU.
- Sub-Panamax: 2,000 TEU to 3,000 TEU.
- Panamax: 3,000 TEU to about 5,000 TEU but with beam and length within the present limits of the Panama Canal.
- Post Panamax: vessels which have at least one dimension of beam and length that exceeds the present limits of the Panama Canal.

There has for years been an overlap in TEU capacity between the larger Panamax and smaller post Panamax ships, typically those between about 4,000 and 5,000 TEU. In the last few years, however, a number of smaller container ships have been built with beams that exceed 32.2 m. This is discussed below.

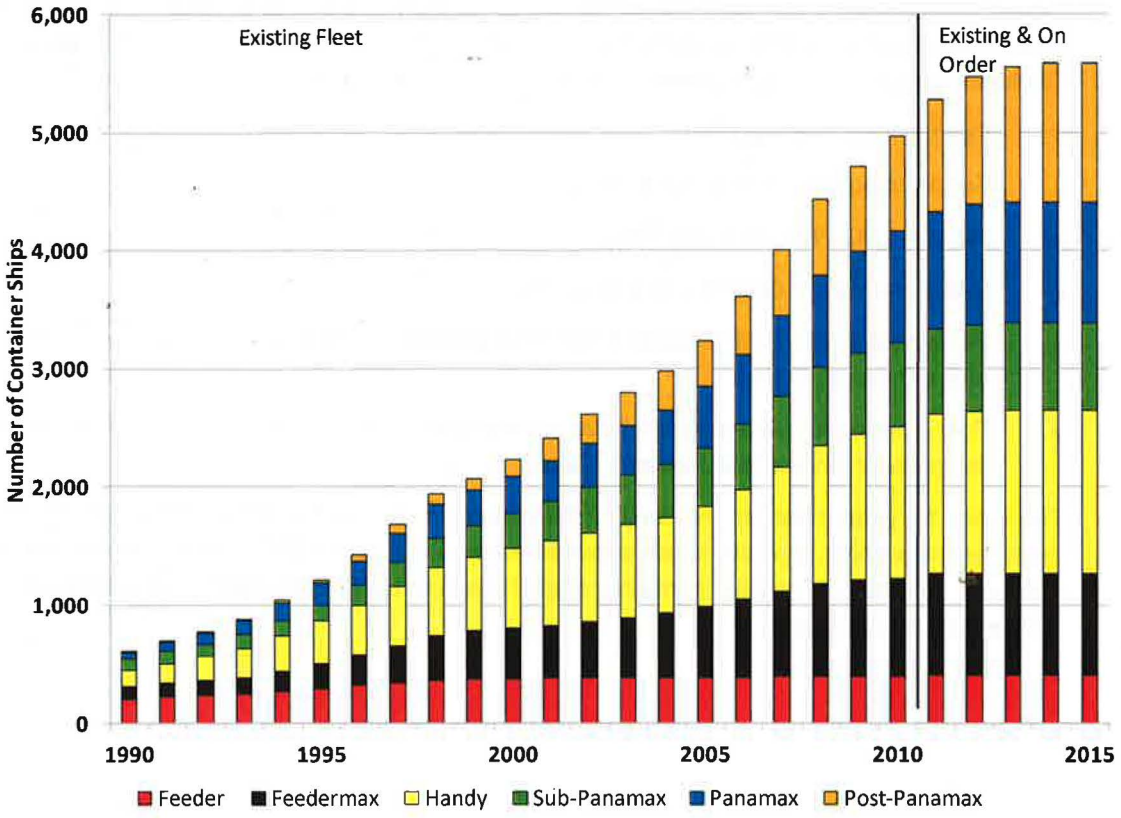

Figure B **Trends in World Container Ship Fleet Composition 1990 to 2015 (Number of Ships)**

Source: Clarkson Container Fleet CD, January 2011.

Figure C repeats the distribution but in terms of the TEU capacity of each category of ships.

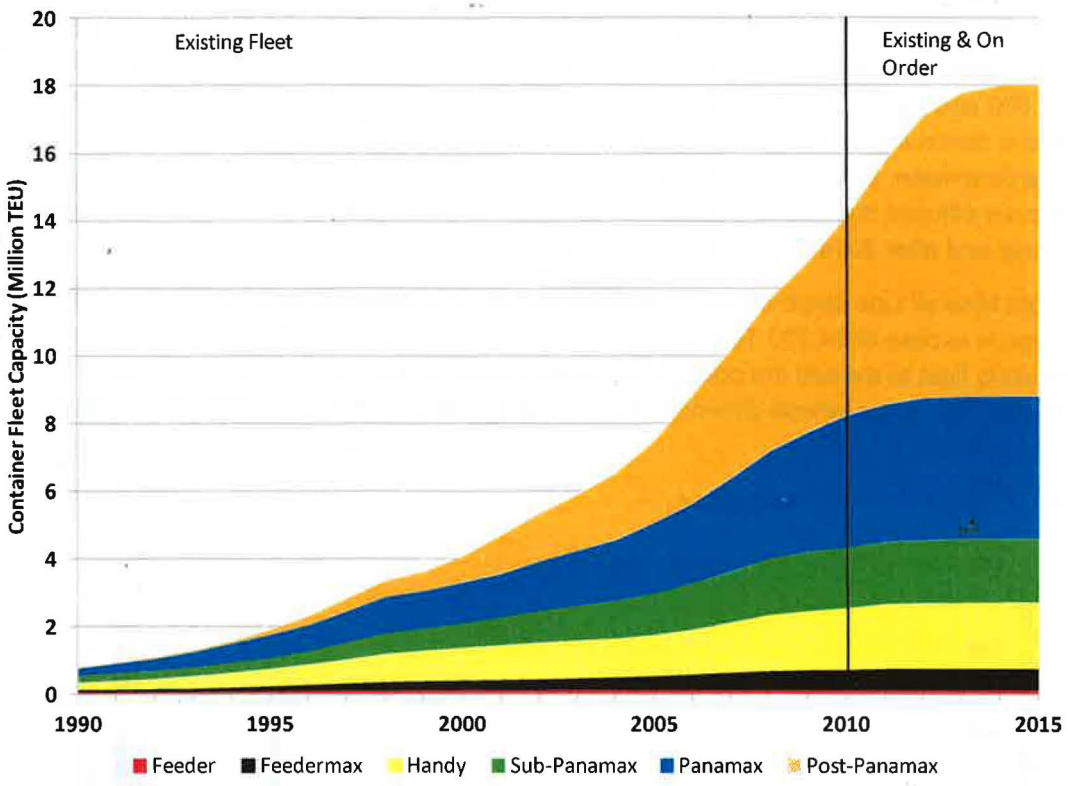

Figure C **Trends in World Container Ship Fleet Composition 1990 to 2015 (TEU Capacity)**

Source: Clarkson Container Fleet CD, January 2011.

Figure D shows the numbers of post-Panamax ships delivered by year broken down into size classes from less than 4,000 TEU to greater than 14,000 TEU and Figure E repeats the exercise in terms of TEU capacity delivered each year.

The number of container ships in service reached about 5,000 in 2010. In terms of numbers, post-Panamax ships are less than 20% of the total. In terms of TEU capacity, however, the picture changes considerably. As of 1990, there were too few post-Panamax ships to show up in the charts. By 2010, post-Panamax ships made up over 40% of the TEU capacity of the world fleet. While there are a few smaller ships on order, the vast majority of the new capacity that will enter service between 2011 and 2015 will be in the post-Panamax category and within the category biased toward larger ships. Between the ships in the fleet and those on order as of December 2010, within two years post-Panamax vessels will exceed 50% of the TEU capacity of the world fleet.

The first post-Panamax ships were delivered in 1988. Although a few post-Panamax ships were built in the early 1990s, ordering of post-Panamax ships did not begin in earnest until 1995 and until the early 2000s these were in the smaller size ranges. The majority of ships delivered since 2005 have been in excess of 8,000 TEU and in recent years the largest size class, between 12,000 and 14,000 TEU, has been dominant. A new but minor phenomenon that began in 2010 and is continuing with deliveries in the next few years is ships of less than 4,000 TEU that have one dimension, beam, in excess of the present Panama Canal limits. These ships are probably of a more efficient design than vessels constrained to the 32.3 m beam limit of the existing Panama Canal and after 2014 their beams will not constrain the deployment of the ships.

Eight Maersk Line ships with a capacity of 15,550 TEU were delivered in 2006 to 2008, the only ships in excess of 14,000 TEU capacity. These vessels plus one other are the only ships in the existing fleet to exceed the post-2014 Panama Canal limits. In 2011, Maersk ordered a number of 18,000 TEU ships whose dimensions also exceed the limits of the expanded Panama Canal.

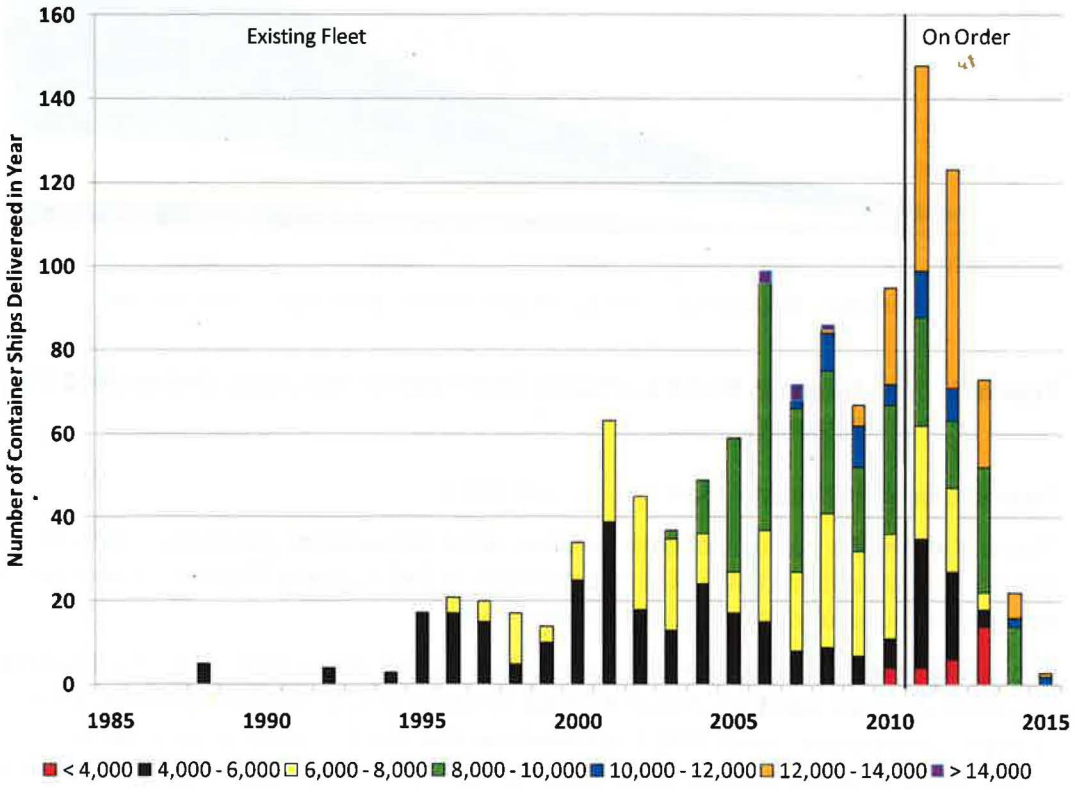

Figure D **Post Panamax Container Ship Deliveries by Year and Size Class 1985 to 2015 (Number of Ships)**

Source: Clarkson Container Fleet CD, January 2011.

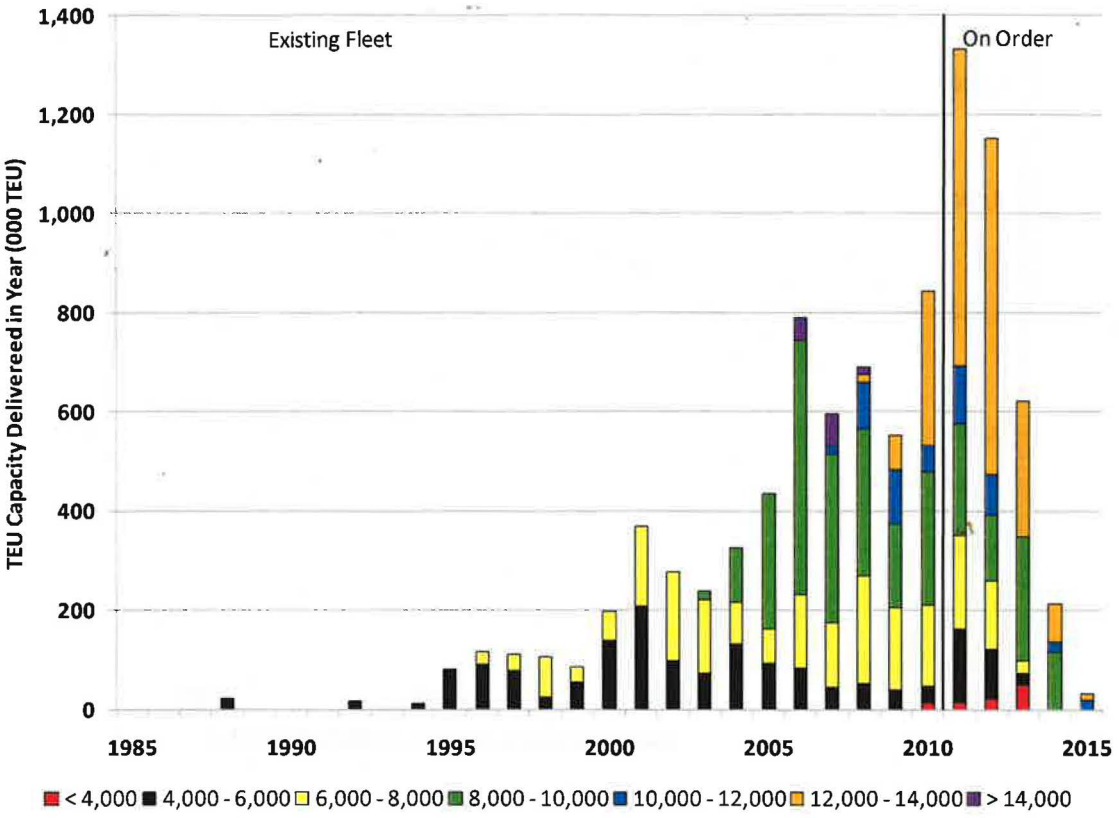

Figure E **Post Panamax Container Ship Deliveries by Year and Size Class 1985 to 2015 (TEU Capacity)**

Source: Clarkson Container Fleet CD, January 2011.

2.3 Port Metro Vancouver Average Container Ship Size and TEU per Call

Figure F utilizes the average container vessel sizes for Port Metro Vancouver from the schedule data discussed above (see Table C) in conjunction with the average container ship size from the world fleet data to show the relationship between the two. In general, there is a high degree of correlation between the average container ship size in Port Metro Vancouver and the average container ship size in the world fleet. The equation, which is shown in the chart, has a coefficient of determination (R^2) of 0.96. This shows that as the world fleet moves toward increasingly large ships, there will be upward pressure on the sizes of Port Metro Vancouver ships.

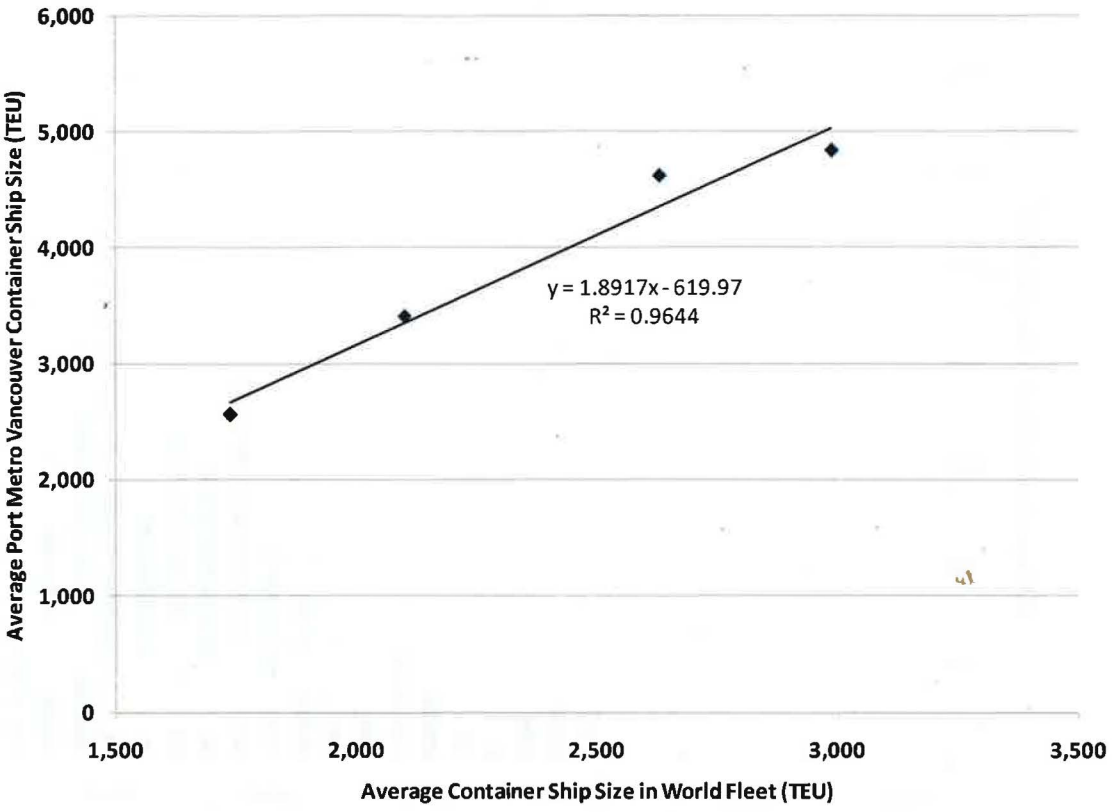

Figure F **Average Container Ship Size: Port Metro Vancouver versus World Fleet**

Sources: Table C above and Clarkson Container Fleet CD, January 2011.

Figure G utilizes the equation in Figure F to develop a projection over time of the average container ship size at Port Metro Vancouver from the average vessel size in the world fleet. It also plots the four points for Port Metro Vancouver. The curve is upward for all years but became increasingly steep beyond 2000 as significant numbers of large post-Panamax container ships were delivered in this period. Beyond 2011, the projected average vessel size for PMV seems to level off, but this is only because the new buildings on order were as of December 31, 2010 and do not reflect the ships that have been ordered since then and will be ordered in future. Orders of large ships continued in 2011.

It is likely that this line will continue upward more or less as shown between 2000 and 2011 for a number of years. At some point, however, growth in ship size will taper off:

The chart is used in an indicative sense, not in a predictive sense, in this report. It provides a strong basis for the assumption of increasingly large container ships in Port Metro Vancouver.

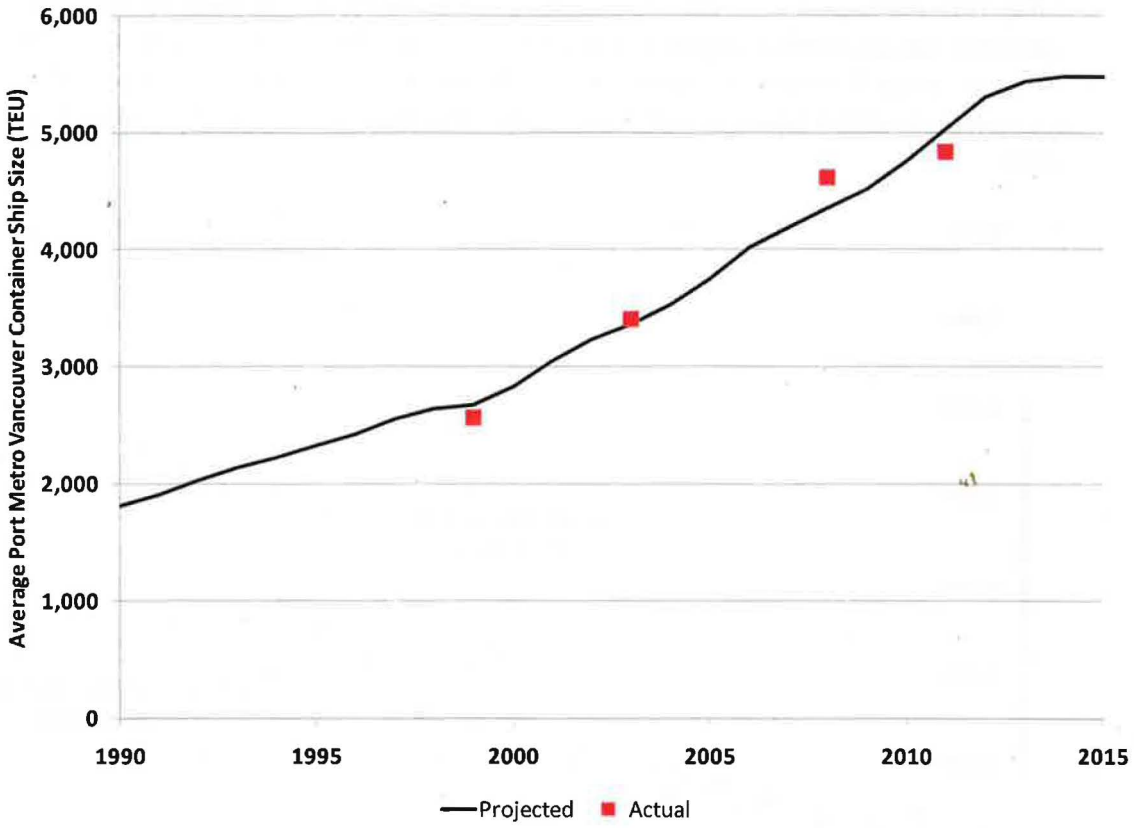

Figure G **Average Port Metro Vancouver Container Ship Size as Function of Average World Fleet Container Ship Size**

Source: Calculated from equation in Figure F and average container ship size in the world fleet.

Figure H deals with the average TEU volumes per ship call for Port Metro Vancouver as a whole and for Deltaport alone. The data for Port Metro Vancouver is for the Port of Vancouver between 1995 and 2007 (i.e., excluding Fraser Port) and for Port Metro Vancouver in 2008 to 2010. Although this creates a distortion in the years between 2000 and 2007, the overall upward trend is evident. The straight line projection from this data for 2015 is approximately 4,000 TEU per ship call.

The Deltaport data from TSI is consistently upwards over the full period between 1998 and 2010. It shows a high rate of increase to 6,000 TEU per ship call in 2010 and a projection for 2015 of about 7,000 TEU. Although a linear trend line is plotted on the chart, the Deltaport data is more consistent with exponential growth at a relatively high rate. The growth rate between 1998 and 2010 was about 11 percent a year (R^2 of 0.97). Nevertheless, a linear approach was chosen for the projections of this report so as not to overstate the rates of increase of call sizes in future years.

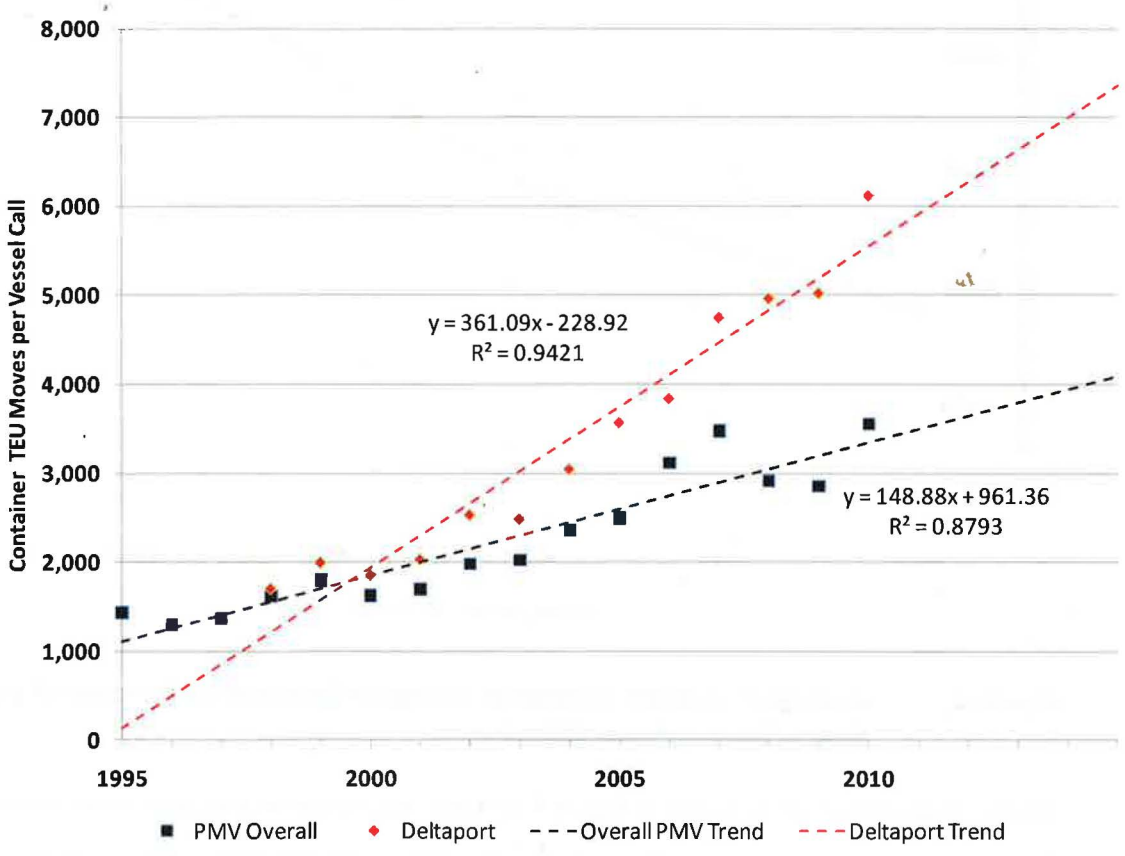

Figure H Port Metro Vancouver TEU Moves per Vessel Call 1995 to 2010

Notes: Data to 2010, projection to 2015.

2.4 Projection of Container Ship Calls and Movements

This section builds up projections of the numbers of container ship calls and distributions of container ship size from the base provided by the 2010 ship call data from PMV. It deals specifically with Deltaport and Terminal 2. Because Deltaport and Terminal 2 will be of similar scale, the projections based on Deltaport data are also used for Terminal 2.

Table G begins this exercise by projecting ship size distributions for Deltaport and Terminal 2 between 2010 and 2030 that reflect the data available. Although the table summarizes five-year intervals beyond 2015, the actual projections were year-by-year.

The general approach to this exercise is described below:

- To project TEU per ship call between 2010 and 2030 (toward the top of the table). From the 2010 base, the projection uses the "projection increments" shown near the centre of the table for TEU per ship call. These range ranging from 200 TEU in 2011 to 150 TEU in 2030. The average TEU per ship call is projected to increase from 6,250 in 2010 to 7,250 in 2015 (essentially as projected by the trend line in Figure H above) and to rise to 9,500 TEU by 2030.
- To project the average ship size between 2010 and 2030 from the actual for 2010 and the trends discussed above. The ship size is projected to increase year-by-year using the increments of average ship size shown near the center of the table: from 6,519 TEU in 2010 to about 9,600 TEU in 2030. The projection of the average container ship size in PMV of just under 10,000 TEU in 2030 is reasonable given the nature of the world container trade:
  - As shown above, many of the new ships on order are very large, in excess of 12,000 TEU in many cases, and there are a significant number of 14,000 TEU ships because this is a natural ship size within the new Panama Canal limits. Maersk Line has several 18,000 TEU ships on order and the ships may actually prove to be larger given Maersk's tendency to understate its ship capacities in public. Other shipping lines have increased the size of their 14,000 TEU ships on order to about 16,000 TEU by changing the specifications of ships under construction.
  - The largest ships will continue to be on the trades between Asia and Europe for a number of reasons. These include the long voyages on this trade and the economies of scale that long voyages bring out, and the high productivity of the major container terminals in Asia, the Middle East, the Mediterranean and northern Europe. High productivity in terms of container moves per ship hour at berth assists the economics of very large ships.

- Ship sizes in the trade between Asia and the West Coast of North America are more constrained in part because of the relatively low productivity of North America's container terminals today and likely in the future. The ship size on the West Coast will increase considerably, but will not reach the maximum in the world trade and in particular that of the Asia – Europe route.

- To project ship size distributions. The approach to ship size distributions must be subjective because there is no firm statistical basis on which to base it. The bottom part of the table includes under "projection increments" the year-to-year change in the percentage of ships in each ship size category, ranging from less than 2,000 TEU (in which the percentage has been zero for years for Deltaport) up to ships in excess of 10,000 TEU. These increments were chosen to reflect a reasonable pattern for changing ship size over 2010 to 2030. From these increments, the container vessel distributions in the upper part of the table were calculated year-by-year from the 2010 base.
  - As a cross check, the weighted average ship sizes were calculated from the resulting vessel size distributions and the means of each ship size range.
  - The results were compared with the projected vessel sizes from the 2010 base and the incremental changes over time. The ship size distributions were adjusted so that the projected ship sizes calculated from the two approaches were consistent.
  - In general, it was possible to get reasonable agreement between the average ship size calculated from the vessel distributions and the values projected out to 2030. For example in 2030, the value projected from the vessel capacity distribution and the mean ship sizes is 9,620 TEU; the projected ship size from the 2010 base plus ship size growth increments is 9,644 TEU.

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Table G Deltaport and Terminal 2 Vessel Size Distributions Actual 2010 to Projected 2030

											Growth Rates (%/a)				
Item	Mean	2010	2011	2012	2013	2014	2015	2020	2025	2030	2010-15	2015-20	2020-25	2025-30	2010-30
TEU / Ship Call		6,250	6,450	6,650	6,850	7,050	7,250	8,000	8,750	9,500	3.0	2.0	1.8	1.7	2.1
Vessel Capacity Distribution															
<= 2,000	1,000	0	0	0	0	0	0	0	0	0					
2,000 - 3,000	2,500	3	2	1	0	0	0	0	0	0					
3,000 - 4,000	3,500	0	0	0	0	0	0	0	0	0					
4,000 - 5,000	4,500	12	11	9	7	5	3	0	0	0					
5,000 - 6,000	5,500	30	29	28	26	24	22	12	2	0					
6,000 - 7,000	6,500	16	16	16	16	16	16	11	6	1					
7,000 - 8,000	7,500	9	10	11	13	14	15	15	15	15					
8,000 - 9,000	8,500	27	28	29	30	31	32	35	35	35					
9,000 - 10,000	9,500	0	1	2	3	4	5	14	17	17					
>10,000	12,000	3	3	4	5	6	7	13	25	32					
Total		**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**					
Average Ship Size															
Calculated from Above		6,620	6,765	6,970	7,195	7,370	7,545	8,365	9,215	9,620	2.6	2.1	2.0	0.9	1.9
Actual 2010 / Projected		6,519	6,719	6,919	7,119	7,319	7,519	8,394	9,144	9,644	2.9	2.2	1.7	1.1	2.0

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											Growth Rates (%/a)				
Item	**Mean**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2020**	**2025**	**2030**	**2010-15**	**2015-20**	**2020-25**	**2025-30**	**2010-30**
Projection Increments															
TEU / Ship Call			200	200	200	200	200	150	150	150					
Average Ship Size			200	200	200	200	200	175	150	100					
Vessel Distributions															
<= 2,000			0	0	0	0	0	0	0	0					
2,000 - 3,000			-1	-1	-1	-1	-1	-1	-1	-1					
3,000 - 4,000			0	0	0	0	0	0	0	0					
4,000 - 5,000			-1	-2	-2	-2	-2	-1	-1	-1					
5,000 - 6,000			-1	-1	-2	-2	-2	-2	-2	-1					
6,000 - 7,000			0	0	0	0	0	-1	-1	-1					
7,000 - 8,000			1	1	2	1	1	0	0	0					
8,000 - 9,000			1	1	1	1	1	0	0	0					
9,000 - 10,000			1	1	1	1	1	1	0	0					
> 10,000			0	1	1	1	1	2	3	1					
Calculated Ratios															
TEU / Call / Average Ship		94%	95%	95%	95%	96%	96%	96%	95%	99%	0.4	-0.1	-0.1	0.8	0.2

Sources: Consultant estimates, 2011.

Figure I plots a summary of the data in Table G to show the size trends of the major container vessel size groups over time. It shows that the smaller vessels (less that 4,000 TEU) are projected to disappear rapidly and that the smaller post-Panamax ships are projected to disappear around 2025. Vessels of over 10,000 TEU are projected to become of increasing importance in line with the numbers of large ships on order today.

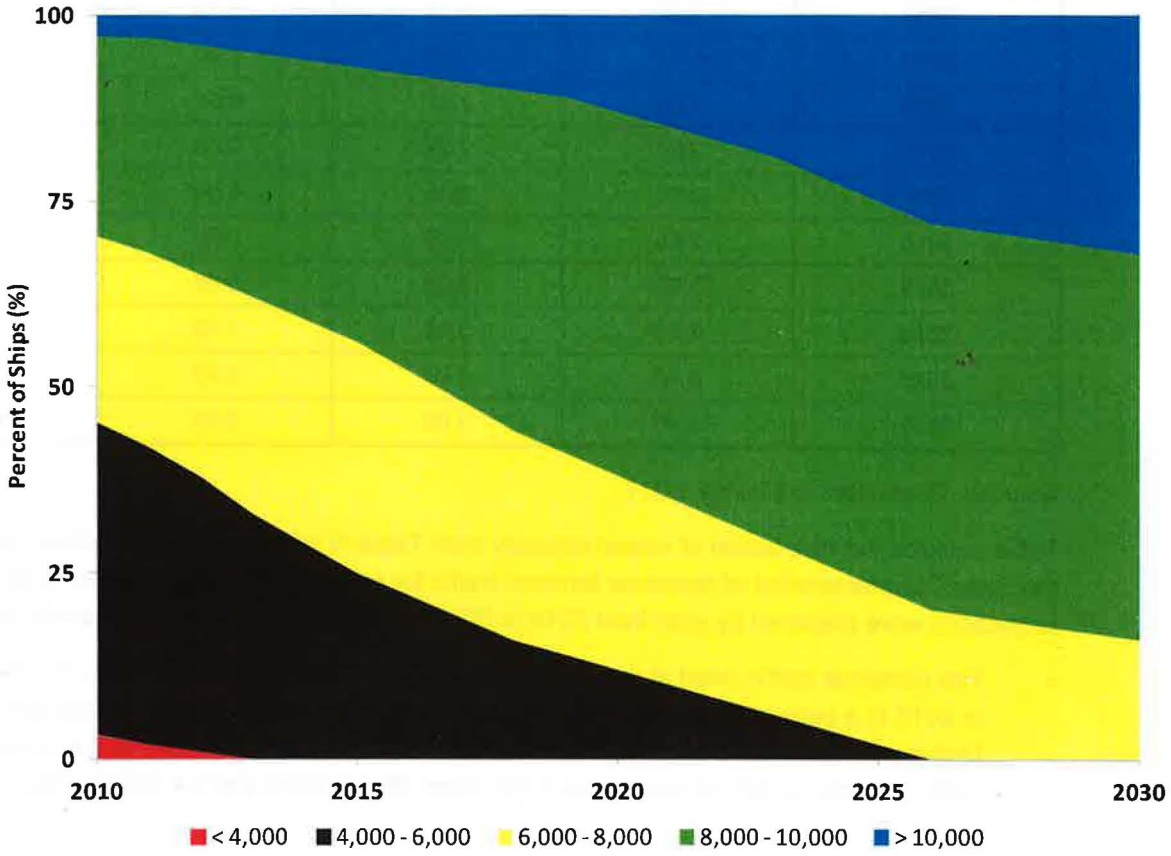

Figure I Projected Container Ship Size Distributions at Deltaport

Source: Consultant estimates, 2011.

Table H summarizes the traffic projections used for the three vessels projection cases. They are based on the highest preliminary traffic projections prepared for PMV as part of the CCIP (the direct approach that utilized the share of PMV in the Canadian market). The cases are summarized below:

- Case 1: Deltaport and Terminal 2 have sustainable capacities of 2.4 million TEU. Deltaport has maximum capacity of 3.0 million TEU in the interim years of high demand up to about 2020.

- Cases 2 and 3: Deltaport and Terminal 2 have sustainable capacities of 3.0 million TEU.

Table H Projected Roberts Bank Container Volumes 2015 to 2030

Year	Deltaport (Million TEU)		Terminal 2 (Million TEU)	
	Case 1	Cases 2 & 3	Case 1	Cases 2 & 3
2010	1.54	1.54	0.00	0.00
2014	1.74	1.74	0.00	0.00
2015	2.02	2.02	0.00	0.00
2016	2.28	2.28	0.00	0.00
2017	2.55	2.55	0.00	0.00
2018	2.85	2.85	0.00	0.00
2019	3.00	3.00	0.00	0.00
2020	2.40	3.00	1.10	0.50
2025	2.40	3.00	2.40	1.86
2030	2.40	3.00	2.40	3.00

Sources: Consultant estimates, 2011.

Table I utilizes the distribution of vessel capacity from Table G in conjunction with other data to build up the Case 1 characteristics of container terminal traffic for selected years between 2010 and 2030 (the projections were prepared by year from 2014 to 2030). The components of the estimates are:

- The container traffic listed at the top of Table I. This ranges from 1.54 million TEU for Deltaport in 2010 to a peak of 3.00 million TEU in years of high demand out to 2020 and ultimately Deltaport's "nameplate" capacity upon expansion of the intermodal yard of 2.4 million TEU. The traffic projections for Terminal 2 are 1.10 million TEU in 2025 and 2.4 million TEU in 2030 as above.
- The TEU per ship call. The container traffic volumes are used in conjunction with the TEU per ship call to calculate the number of ship calls required to meet the traffic volume. From this and the assumption of 52 ship calls per year in each service the number of services is calculated as a fractional number.
- The number of services is then normalized to an even number and the normalized number of ship calls calculated on a 52-call-per-year basis. For example:
  - Deltaport in 2020 with container traffic of 2.4 million TEU and 8,000 TEU per ship call would require 300 vessel calls per year.
  - This results in 5.77 services, which is unlikely; fractional services (i.e., calls other then weekly) are possible but uncommon.

  - This was normalized to six services calling at the terminal, which generates 312 ship calls per year.

- The ship size distribution at the bottom of the page is utilized in conjunction with the annual number of ship calls to calculate the distribution of ship calls by vessel size range.
- The number of ship movements is calculated.

Regarding ship movements, Deltaport in 2010 had a split service that called twice at the terminal: the first call to discharge import containers and the second call to load export containers. Between the Deltaport calls, the vessel visited a U.S. Pacific Northwest port. The split service adds 104 ship movements for 2010. Although unusual, this practice was assumed to persist at Deltaport in all years so as not to understate potential ship movements. The ship movements in Table I reflect this service, but the ship calls are those of a standard service (for example, five services result in 260 calls but 624 ship movements).

PORT METRO VANCOUVER
PROJECTIONS OF VESSEL CALLS AND MOVEMENTS AT THE ROBERTS BANK MARINE TERMINALS
TERMINAL 2 (T2)

Table I Case 1 Roberts Bank Container Shipping Services Actual 2010 to Projected 2030

	Actual	Projected						
	2010	2015	2020		2025		2030	
Item	Deltaport	Deltaport	Deltaport	Terminal 2	Deltaport	Terminal 2	Deltaport	Terminal 2
Container Traffic (Million TEU)	1.54	2.02	2.40	1.10	2.40	2.40	2.40	2.40
TEU / Ship Call	6,250	7,250	8,000	8,000	8,750	8,750	9,500	9,500
Number of Calls	245	278	300	137	274	224	253	253
Number of Services								
Calculated	5.00	5.35	5.77	2.63	5.27	5.27	4.86	4.86
Normalized	5.0	5.0	6.0	3.0	5.0	5.0	5.0	5.0
Normalized No. of Calls		260	312	156	260	260	260	260
Number of Movements[1]	594	624	728	312	624	520	624	520
Number of Ships by Size Class								
<= 2,000	0	0	0	0	0	0	0	0
2,000 - 3,000	8	0	0	0	0	0	0	0
3,000 - 4,000	0	0	0	0	0	0	0	0
4,000 - 5,000	29	8	0	0	0	0	0	0
5,000 - 6,000	74	57	37	19	5	5	0	0
6,000 - 7,000	38	42	34	17	16	16	3	3
7,000 - 8,000	23	39	47	23	39	39	39	39
8,000 - 9,000	66	83	109	55	91	91	91	91
9,000 - 10,000	0	13	44	22	44	44	44	44
> 10,000	7	18	41	20	65	65	83	83
Total	**245**	**260**	**312**	**156**	**260**	**260**	**260**	**260**
Distribution of Vessel Capacity (Percent of Ships)								
<= 2,000	0	0	0	0	0	0	0	0
2,000 - 3,000	3	0	0	0	0	0	0	0

PORT METRO VANCOUVER
PROJECTIONS OF VESSEL CALLS AND MOVEMENTS AT THE ROBERTS BANK MARINE TERMINALS
TERMINAL 2 (T2)

	Actual	Projected						
	2010	2015	2020		2025		2030	
3,000 - 4,000	0	0	0	0	0	0	0	0
4,000 - 5,000	12	3	0	0	0	0	0	0
5,000 - 6,000	30	22	12	12	2	2	0	0
6,000 - 7,000	16	16	11	11	6	6	1	1
7,000 - 8,000	9	15	15	15	15	15	15	15
8,000 - 9,000	27	32	35	35	35	35	35	35
9,000 - 10,000	0	5	14	14	17	17	17	17
>10,000	3	7	13	13	25	25	32	32
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Sources: Consultant estimates, 2011.

Notes: [1]Number of ship movements reflects the Deltaport split service.

Table J summarizes the Case 2 projection of container ship calls. It follows the procedures described above and again uses the distribution of vessel capacity from Table G. Case 2 differs from Case 1 in that Deltaport and Terminal 2 are assumed to have sustainable capacities of 3.0 million TEU.

PORT METRO VANCOUVER
PROJECTIONS OF VESSEL CALLS AND MOVEMENTS AT THE ROBERTS BANK MARINE TERMINALS
TERMINAL 2 (T2)

Table J Case 2 Roberts Bank Container Shipping Services Actual 2010 to Projected 2030

	Actual	Projected						
	2010	2015	2020		2025		2030	
Item	Deltaport	Deltaport	Deltaport	Terminal 2	Deltaport	Terminal 2	Deltaport	Terminal 2
Container Traffic (Million TEU)	1.54	2.02	3.00	0.50	3.00	1.86	3.00	3.00
TEU / Ship Call	6,250	7,250	8,000	8,000	8,750	8,750	9,500	9,500
Number of Calls	245	278	375	62	343	213	316	316
Number of Services								
Calculated	5.00	5.35	7.21	1.19	6.59	4.10	6.07	6.07
Normalized	5.0	5.0	7.0	1.0	7.0	4.0	6.0	6.0
Normalized No. of Calls		260	364	52	364	208	312	312
Number of Movements	594	624	832	104	832	416	728	624
Number of Ships by Size Class								
<= 2,000	0	0	0	0	0	0	0	0
2,000 - 3,000	8	0	0	0	0	0	0	0
3,000 - 4,000	0	0	0	0	0	0	0	0
4,000 - 5,000	29	8	0	0	0	0	0	0
5,000 - 6,000	74	57	44	6	7	4	0	0
6,000 - 7,000	38	42	40	6	22	12	3	3
7,000 - 8,000	23	39	55	8	55	31	47	47
8,000 - 9,000	66	83	127	18	127	74	109	109
9,000 - 10,000	0	13	51	7	62	35	53	53
>10,000	7	18	47	7	91	52	100	100
Total	**245**	**260**	**364**	**52**	**364**	**208**	**312**	**312**

PORT METRO VANCOUVER
PROJECTIONS OF VESSEL CALLS AND MOVEMENTS AT THE ROBERTS BANK MARINE TERMINALS
TERMINAL 2 (T2)

	Actual	Projected						
	2010	2015	2020		2025		2030	
Distribution of Vessel Capacity (Percent of Ships)								
<= 2,000	0	0	0	0	0	0	0	0
2,000 - 3,000	3	0	0	0	0	0	0	0
3,000 - 4,000	0	0	0	0	0	0	0	0
4,000 - 5,000	12	3	0	0	0	0	0	0
5,000 - 6,000	30	22	12	12	2	2	0	0
6,000 - 7,000	16	16	11	11	6	6	1	1
7,000 - 8,000	9	15	15	15	15	15	15	15
8,000 - 9,000	27	32	35	35	35	35	35	35
9,000 - 10,000	0	5	14	14	17	17	17	17
>10,000	3	7	13	13	25	25	32	32
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Sources: Consultant estimates, 2011.

Table K summarizes the Case 3 projections of container vessel calls. These projections utilize the Case 2 traffic assumptions of terminal capacity (3.0 million TEU each) with a constant average call size of 6,250 TEU per ship call as in 2010. The ship size distribution is also assumed to remain the same as in 2010.

Table K Case 3 Roberts Bank Container Shipping Services Actual 2010 to Projected 2030

	Actual	Projected						
	2010	2015	2020		2025		2030	
Item	**Deltaport**	**Delta port**	**Deltaport**	**Terminal 2**	**Deltaport**	**Terminal 2**	**Deltaport**	**Terminal 2**
Container Traffic (Million TEU)	1.54	2.02	3.00	0.50	3.00	1.86	3.00	3.00
TEU / Ship Call	6,250	6,250	6,250	6,250	6,250	6,250	6,250	6,250
Number of Calls	245	323	480	79	480	298	480	480
Number of Services								
Calculated	5.00	6.20	9.23	1.52	9.23	5.74	9.23	9.23
Normalized	5.0	6.0	9.0	2.0	9.0	6.0	9.0	9.0

PORT METRO VANCOUVER
PROJECTIONS OF VESSEL CALLS AND MOVEMENTS AT THE ROBERTS BANK MARINE TERMINALS
TERMINAL 2 (T2)

	Actual	Projected						
	2010	2015	2020		2025		2030	
Normalized No. of Calls		312	468	104	468	312	468	468
Number of Movements	594	728	1,040	208	1,040	624	1,040	936
Number of Ships by Size Class								
<= 2,000	0	0	0	0	0	0	0	0
2,000 - 3,000	8	10	15	3	15	10	15	15
3,000 - 4,000	0	0	0	0	0	0	0	0
4,000 - 5,000	29	37	55	12	55	37	55	55
5,000 - 6,000	74	94	142	31	142	95	142	142
6,000 - 7,000	38	48	73	16	73	48	73	73
7,000 - 8,000	23	29	44	10	44	29	44	44
8,000 - 9,000	66	85	126	29	126	84	126	126
9,000 - 10,000	0	0	0	0	0	0	0	0
>10,000	7	9	13	3	13	9	13	13
Total	**245**	**312**	**468**	**104**	**468**	**312**	**468**	**468**
Distribution of Vessel Capacity (Percent of Ships)								
<= 2,000	0	0	0	0	0	0	0	0
2,000 - 3,000	3	3	3	3	3	3	3	3
3,000 - 4,000	0	0	0	0	0	0	0	0
4,000 - 5,000	12	12	12	12	12	12	12	12
5,000 - 6,000	30	30	30	30	30	30	30	30
6,000 - 7,000	16	16	16	16	16	16	16	16
7,000 - 8,000	9	9	9	9	9	9	9	9
8,000 - 9,000	27	27	27	27	27	27	27	27
9,000 - 10,000	0	0	0	0	0	0	0	0
>10,000	3	3	3	3	3	3	3	3
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Sources: Consultant estimates, 2011.

3. COAL SHIPS AT WESTSHORE TERMINALS

This section addresses coal shipping from the Westshore Terminals coal terminal at Roberts Bank. It begins with an overview of trends in coal shipments through Westshore Terminals and other coal terminals on the West Coast of Canada and goes on to examine the characteristics of Westshore's trade. It also provides a brief overview of trends in the world coal trade as a guide to the outlook for Westshore coal exports. It concludes by developing a projection of coal exports, coal shipment sizes and the numbers of coal ship calls.

3.1 Trends in Coal Shipments

Table L lists the throughput of the two coal terminals in Port Metro Vancouver and the Ridley terminal in the Port of Prince Rupert between 2001 and 2010. With the exception of a jump in coal throughput in 2010, coal exports in recent years were no higher than in 2001.

The table also provides a breakdown of Westshore exports into metallurgical and thermal coal and petroleum coke. The dominant export is metallurgical coal but the tonnages in recent years have been lower than 5 to 10 years ago. Thermal coal exports have increased considerably and a substantial amount of the volume in 2010 was U.S. thermal coal exports. The terminal has handled modest amounts of petroleum coke.

Table L Coal Exports by Terminal 2001 - 2010

	Coal Shipments (Million Tonnes)							Growth Rate (%/a)		
Terminal and Port	**2001**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2001-05**	**2005-10**	**2001-10**
PORT METRO VANCOUVER										
Westshore Terminals										
Metallurgical Coal	20.6	20.0	16.5	18.7	17.3	14.8	16.4	-0.7	-3.9	-2.5
Thermal Coal	2.7	1.9	2.5	2.5	3.7	5.3	8.2	-8.4	34.0	13.1
Petroleum Coke	0.0	0.0	0.0	0.0	0.1	0.0	0.1	NA	NA	NA
Total Westshore	**23.3**	**21.9**	**19.0**	**21.2**	**21.1**	**20.1**	**24.7**	**-1.5**	**2.4**	**0.7**
Neptune Bulk Terminals	3.9	3.4	5.0	3.7	4.8	4.3	5.6	-3.4	10.5	4.1
Total Port Metro Vancouver	**27.2**	**25.3**	**24.0**	**24.9**	**25.9**	**24.4**	**30.3**	**-1.8**	**3.7**	**1.2**
Port of Prince Rupert[1]	2.2	1.0	2.8	5.1	4.8	4.0	6.9	-17.9	47.2	13.5
Total Shipments	**29.4**	**26.3**	**26.8**	**30.0**	**30.7**	**28.4**	**37.2**	**-2.7**	**7.2**	**2.6**

Source: Westshore Terminals Investment Corporation, *Annual Information Form*, March 30, 2011.

Notes: [1]Ridley Terminals Inc. Includes some petroleum coke.

Table M lists Westshore coal shipments by destination in recent years. The dominant and increasing destination is Asia but Europe and South America also receive substantial amounts of coal from this terminal. The volume to Europe and South America in 2008 was approximate 6 million tonnes and in 2010 approximately 5 million tonnes. All of the European shipments and most of the South American shipments transit the Panama Canal. This brings into consideration the expansion of the Panama Canal to be completed in 2014 and its possible impact on bulk carrier size.

Table M Westshore Coal Shipments by Destination 2008 to 2010

Destination	Shipments (000 Tonnes)		
	2008	2009	2010
Asia	14,591	16,306	19,078
Europe	5,488	3,030	3,439
South America	628	317	1,680
Other	372	400	481
Total	**21,079**	**20,053**	**24,678**

Source: Westshore Terminals Investment Corporation, *Annual Information Form*, March 30, 2011.

Table N summarizes Westshore's activity from its opening in 1970 to 2010. It presents the number of ship calls, export tonnage and the tonnes of coal cargo per ship call for this period. In recent years, the number of ship calls has been between 200 and 250. The cargo size per ship call has steadily increased to reach a plateau since 2006 of approximately 100,000 tonnes.

Table N Westshore Coal Export Activity 1970 to 2010

Year	Number of Ship Calls	Export Tonnage (Tonnes)	Tonnes per Ship Call
1970	33	1,427,372	43,254
1980	161	10,596,540	65,817
1990	226	19,054,016	84,310
2000	251	22,502,061	89,650
2005	241	21,873,955	90,763
2006	187	18,958,461	101,382
2007	210	21,159,994	100,762
2008	213	21,078,958	98,962
2009	197	20,052,528	101,789
2010	246	24,678,348	100,318

Source: Westshore Terminals Ltd. Partnership, July 2011.

Figure J presents the number of ship calls at Westshore Terminals since 1970. It shows in more detail than Table N that the number of ship calls over the last 15 years has generally fallen between 200 and 250 with no particular trend.

Over the long term, increasing cargo lot sizes have offset the increasing coal exports. The bulk carrier fleet went through a large transformation from 1970 to the late 1980s in which increasingly large vessels entered the world fleet. The bulk carrier fleet subsequently stabilized and for many years the largest vessels in the fleet were built in the mid-to-late 1980s. In recent years, there has been an increase in the number of large bulk carriers ordered and delivered because of rapid growth in the coal and iron ore trades that use such ships.

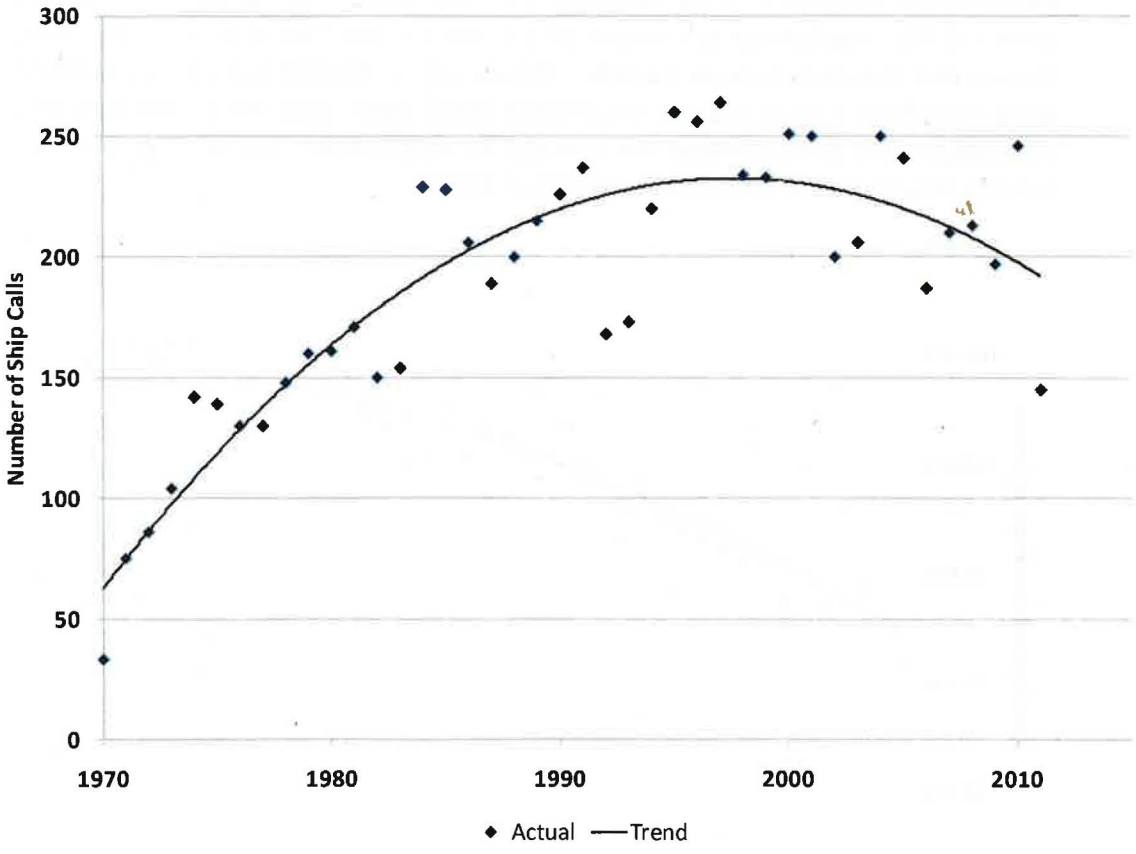

Figure J Westshore Vessel Calls 1970 to 2010

Source: Westshore Terminals Ltd. Partnership, July 2011.

Figure K shows graphically the tonnage of coal shipments per vessel that called at Westshore between 1970 and 2010. It shows again the distinct trend toward the 100,000 tonnes level of recent years. With the existing destinations and mix of ships, it appears that a limit of 100,000 tonnes has been reached.

The Panama Canal Authority announced a few years ago the new Panama Canal dimensions following the completion in 2014 of the current expansion project. The new ship size constraints are: 366 m overall length, 49 m beam and tropical fresh water draft of 15.2 m. The largest of the bulk carriers in the world fleet (excluding ore carriers) have overall lengths somewhat in excess of 300 m, beams of 50 m or greater and typical drafts between 18 and 20 m.

The new Panama Canal constraints will have limited impact on bulk carrier length and beam capability because most bulk carriers are within the post-2014 Canal limits. The most important impact will be on draft. Within the 15.2 m tropical freshwater limit, the maximum size of a fully-laden bulk carrier is a "Capesize" ship of approximately 120,000 deadweight tonnes. The Canal expansion will roughly double the bulk cargo limitation from the typical 55,000 cargo tonnes with Panamax bulk carriers today to some 110,000 cargo tonnes with larger bulk carriers in future. This will improve the ability of Western Canada coal exporters to serve markets in Europe and on the east coast of South America (Brazil has been a consistently larger importer of Canadian metallurgical coal). It may also have a modest impact on average cargo sizes at Westshore, although the Asian market, with no route limits on ship size, is both the largest and the fastest-growing market for coal.

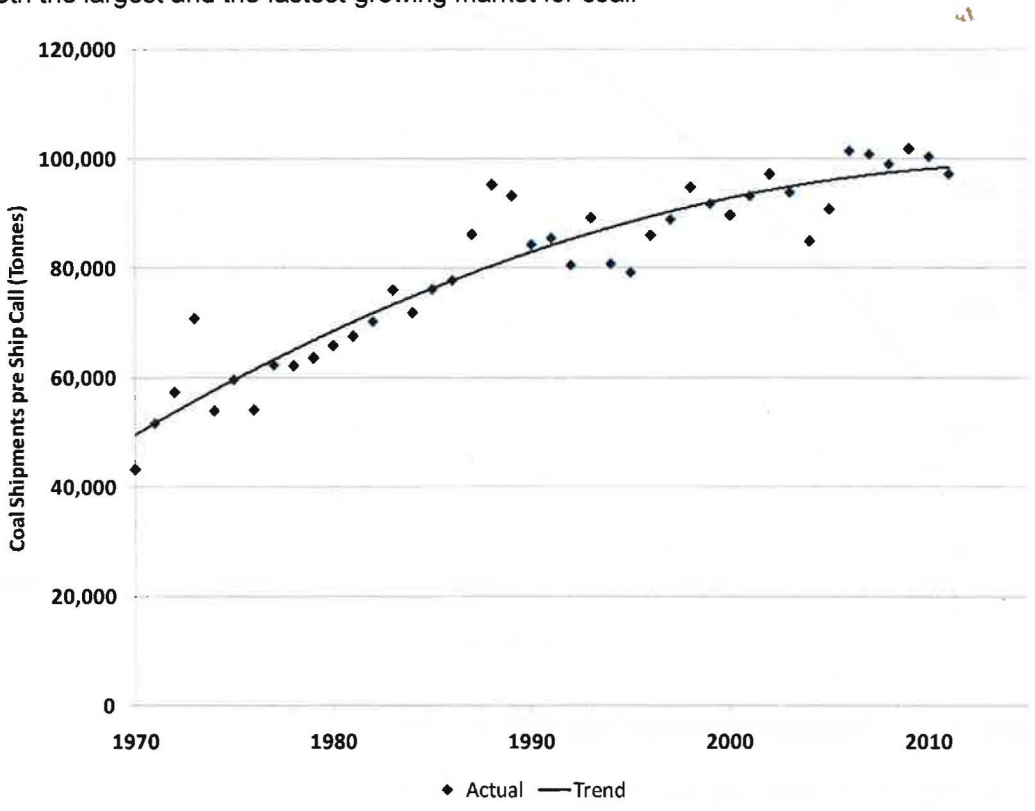

Figure K Westshore Export Tonnage per Vessel Call 1970 to 2010

Source: Westshore Terminals Ltd. Partnership, July 2011.

3.2 Coal Market Outlook

Coal exports from Western Canada and British Columbia in particular are dominantly of the metallurgical variety that is used to make steel. There are also some exports of thermal coal and coal used for pulverized coal injection (PCI) in steelmaking.

Figure L presents on one chart coal production in British Columbia and its nominal and real average selling prices with the coal a mix of metallurgical and thermal coals. This chart brings out the history of the B.C. coal sector since 1980. In the late 1970s to early 1980s, coal prices were relatively high and expansion of metallurgical coal production in Southeast and Northeast British Columbia took place.

The production of B.C. coal more than doubled between 1980 and 1985 as new mines were developed and existing mines were expanded. It was also a period of extensive infrastructure development for the coal sector. This included increases of the Roberts Bank port area in the Port of Vancouver and the expansion of the Westshore coal terminal, the construction of the coal terminal of Ridley Terminals Inc. in the Port of Prince Rupert, the development of a new rail line into north-eastern B.C. and the construction of the town of Tumbler Ridge.

As can be seen on the chart, coal prices fell in nominal terms from approximately $50 a tonne to reach a plateau of around $40 a tonne between the late 1980s and early 2000s. The real price of coal, however, fell to one third of its 1980 level by 2000. By 2004, demand for coal for steelmaking had taken off, largely due to Chinese steel production, and coal prices began to rise. Real prices reached the level of 1980 in about 2007.

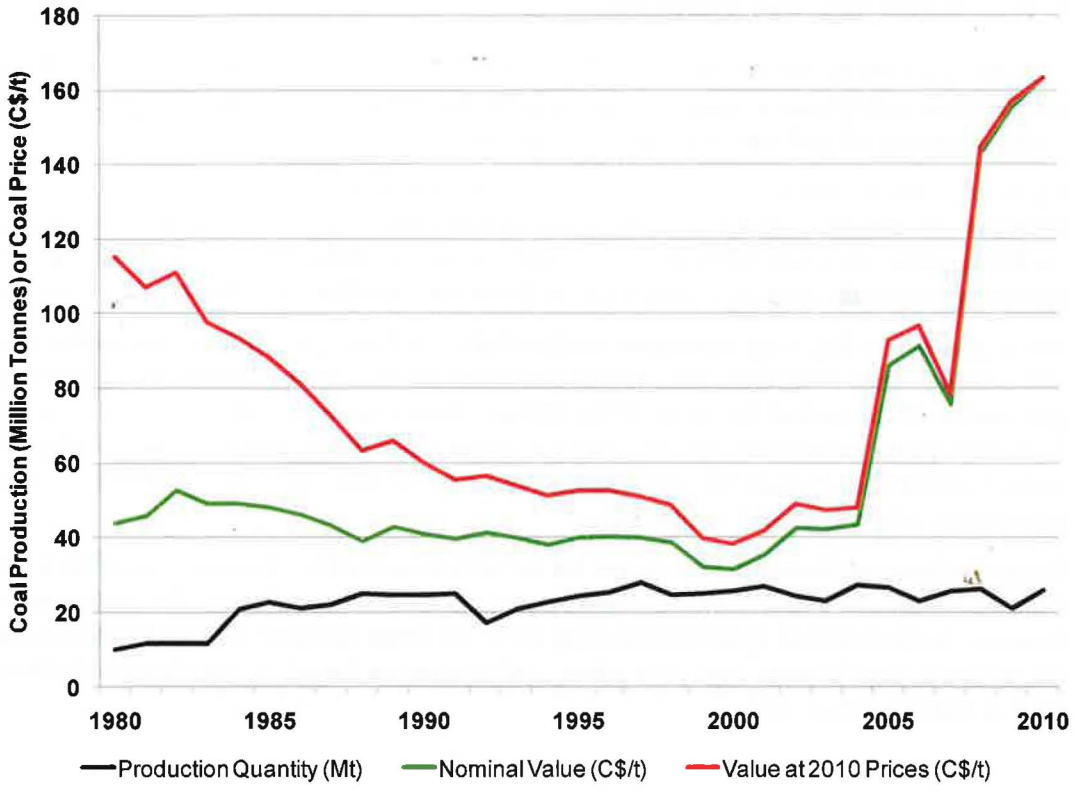

Figure L B.C. Coal Production and Values 1980 to 2010

Source: British Columbia Ministry of Energy, 2011.

Table O provides the outlook of the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) for the world metallurgical coal trade. Between 2010 and 2016, ABARES is projecting that world metallurgical coal imports and exports will grow by 5% a year to reach about 340 million tonnes in 2016. ABARES is also projecting that coal prices will remain relatively high in nominal and real terms but below the peak of 2011. Although the coal exports of both Australia and Canada are projected to grow by a similar 5% a year, in absolute terms the increase in Australian exports is projected at 60 million tonnes while that of Canada is projected at 8 million tonnes. Exports of the Russian Federation are projected to grow in line with world demand while exports from other countries, probably including Mongolia, are projected to grow very rapidly.

Table O World Metallurgical Coal Trade Outlook 2011 to 2016

	Actual		Forecast						Growth (%/a)
	2009	2010	2011	2012	2013	2014	2015	2016	2010-16
Coal Prices (US$/t)[1]									
Nominal	$171.00	$191.00	$256.00	$250.00	$235.00	$208.00	$193.00	$186.00	-0.4
Real (2011 Prices)	176.00	193.00	256.00	245.00	226.00	196.00	178.00	169.00	-2.2
Imports (Mt)									
European Union	41	46	48	50	51	52	54	56	3.3
Japan	46	53	57	59	61	62	63	65	3.5
China	34	44	43	44	50	56	64	73	8.8
South Korea	15	23	26	27	28	29	30	32	5.7
Taiwan	4	6	6	7	7	7	7	7	2.6
India	23	25	28	32	36	41	46	52	13.0
Brazil	9	11	13	14	16	17	19	21	11.4
Other	39	46	43	42	37	40	39	35	-4.5
Total Imports	211	254	264	275	286	304	322	341	5.0
Exports (Mt)									
Australia	135	159	163	174	179	194	207	219	5.5
Canada	22	25	25	27	30	31	32	33	4.7
United States	34	51	45	42	40	38	37	35	-6.1
Russian Federation	13	17	20	21	23	24	24	25	6.6
Other	7	2	11	11	14	17	22	29	56.2
Total Exports	**211**	**254**	**264**	**275**	**286**	**304**	**322**	**341**	**5.0**

Source: Australian Bureau of Agricultural and Resource Economics and Sciences, *Australian Commodity Statistics*, March 2011.

Notes: [1]World contract prices.

Table P provides a comparable review for thermal coal, which is roughly double the trading volume of metallurgical coal. Rapid demand growth is projected in India and rapid increases in production projected for Australia. More moderate growth is projected for Indonesia but it remains the largest exporter of thermal coal.

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PROJECTIONS OF VESSEL CALLS AND MOVEMENTS AT THE ROBERTS BANK MARINE TERMINALS
TERMINAL 2 (T2)

Table P World Thermal Coal Trade Outlook 2011 to 2016

	Actual		Forecast						Growth (%/a)
	2009	2010	2011	2012	2013	2014	2015	2016	2010-16
Coal Prices (US$/t)[1]									
Nominal	$70.35	$98.00	$125.00	$115.00	$110.00	$105.00	$97.00	$90.00	-1.4
Real (2010 Prices)	71.27	98.00	123.09	111.02	104.11	97.43	88.24	80.27	-3.3
Imports (Mt)									
Asia									
China	92	119	115	118	121	124	127	130	1.5
Chinese Taipei	59	62	63	63	65	67	69	70	2.0
India	49	60	77	92	104	112	120	128	13.5
Japan	113	126	127	128	127	127	126	125	-0.1
South Korea	82	94	95	96	97	100	104	107	2.1
Malaysia	16	16	17	18	19	20	20	21	3.8
Other Asia	33	33	36	42	47	55	62	70	13.5
Total Asia	**444**	**511**	**529**	**557**	**580**	**604**	**629**	**651**	**4.1**
Europe									
European Union	170	148	152	155	161	167	173	174	2.8
Other Europe	37	40	41	43	45	47	47	49	3.5
Total Europe	**207**	**187**	**193**	**198**	**205**	**214**	**220**	**223**	**2.9**
Other	74	73	70	74	78	80	84	88	3.2
TOTAL IMPORTS	**725**	**771**	**792**	**829**	**863**	**899**	**933**	**962**	**3.8**
Exports (Mt)									
Australia	139	142	149	170	189	215	232	250	9.8
China	22	18	20	18	17	16	15	15	-3.0
Colombia	63	69	72	77	82	86	89	92	4.9
Indonesia	233	270	280	294	307	315	330	340	3.9
Russian Federation	84	87	90	92	94	95	96	97	1.8
South Africa	67	70	73	74	76	79	82	85	3.3
United States	20	22	25	22	21	20	19	18	-3.3
Other	97	92	84	82	77	72	71	65	-5.6
Total Exports	**725**	**771**	**792**	**829**	**863**	**899**	**933**	**962**	**3.8**

Source: Australian Bureau of Agricultural and Resource Economics and Sciences, *Australian Commodity Statistics*, March 2011.

Notes: [1]World contract prices.

3.3 Outlook for Westshore Exports

The outlook for Westshore exports depends on three factors: the world demand for metallurgical and thermal coal, the availability of coal in Western Canada and the western U.S. for export, and the capacity of the coal terminal.

- The above section has shown that the outlook for internationally-traded coal is one of substantial demand growth. This will create potential demand for exports of metallurgical and thermal coal from Western Canada and thermal coal from the U.S.
- The response of the western Canadian coal industry to the high coal prices of recent years has been modest, especially in comparison with major coal exporting countries such as Australia and Indonesia. Nevertheless, new mines have opened, closed mines have reopened and mine expansions are planned.
- The capacity of Westshore Terminals is discussed below.

Westshore Terminals has just gone through an expansion that has brought its capacity to a nominal 29 million tonnes a year. Westshore considers that its terminal can export a sustained 27 million tonnes a year today and with incremental improvements will approach its expanded capacity of 29 million tonnes. The company has also committed to further expansions that will bring its capacity to 33 million tonnes by 2013. Beyond this, the company is studying ways of increasing the capacity in the longer term but has not provided estimates of its future capacity[2].

With the limited coal terminal capacity in Port Metro Vancouver and essentially no possibility of new coal terminal development other than in Prince Rupert, the capacity of Westshore Terminals will probably be the main determinant of its coal volumes. The terminal should be able to utilize a significant portion of its practical capacity as long as coal markets do not crash.

3.4 Projection of Coal Ship Calls and Movements

Table Q summarizes the projections of ship calls and ship movements for Westshore terminals. It takes into consideration three parameters: the terminal capacity, a projection of export tonnage given that capacity and the tonnes of coal per ship call.

[2] Source: Westshore Terminals Investment Corporation, *Annual Information Form*, March 30, 2011 and "Another major upgrade," *Mining & Exploration*, summer 2011.

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The terminal is assumed to achieve its planned capacity of 33 million tonnes in 2015 and beyond that extend tonnage capacity modestly to a maximum of 35 million tonnes by 2025. The export tonnage is assumed grow incrementally at 1.0 million tonnes a year until it reaches terminal capacity. The coal volume per ship call is assumed to remain at 100,000 tonnes.

The number of ship calls range from about 250 today to 350 in future. Ship movements are estimated at two times the number of ship calls.

Table Q Westshore Terminals Ship Calls and Movements Actual 2010 to Projected 2030

Case and Ship Activity	2010	2015	2020	2025	2030
Base Case Ship Calls					
Export Tonnage (Mt)	24.7	26.0	31.0	35.0	35.0
Tonnes per Ship Call	100,318	100,000	100,000	100,000	100,000
Ship Calls	246	260	310	350	350
Ship Movements	492	520	620	700	700

4. OVERALL SHIP MOVEMENT PROJECTIONS

Table R summarizes the overall annual results for container and coal shipping for 2010 (actual) and 2014 to 2030 (projections). It begins with the traffic projections and develops projections by year of container ship and coal ship annual calls and movements on the bases as discussed above.

Table S summarizes average and peak monthly and daily movements:

- Average monthly movements are annual movements divided by 12 in all cases.
- Peak monthly container ship movements are estimated at 5% above average movements. Container ships are highly scheduled and while container ship arrivals are frequently not exactly as planned, most schedule variations are minor.
- In the case of coal ships, a monthly peaking factor was estimated from 1995 to 2010 PMV data at 30%.
- Average daily movements are annual movements divided by 365 in all cases.
- Peak daily movements are estimated as full turnover of each berth in one day. This is an extreme situation because most container ships and essentially all coal ships require multiple days at berth for cargo handling.

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Table R Annual Vessel Projections for Deltaport, Westshore and Terminal 2

		Cargo Volume				Annual Ship Calls					Annual Ship Movements				
		Container (Million TEU)				Container					Container				
Case/ Year	Actual or Prediction	Deltaport	Terminal 2	Total	Coal	Deltaport	Terminal 2	Total	Coal	Total	Deltaport	Terminal 2	Total	Coal	Total
					(Mt)										
Case 1															
2010	Actual	1.54		1.54	24.7	245		245	246	491	594		594	492	1,086
2014	Prediction	1.74		1.74	25.0	260		260	250	510	624		624	500	1,124
2015	Prediction	2.02		2.02	26.0	260		260	260	520	624		624	520	1,144
2016	Prediction	2.28		2.28	27.0	312		312	270	582	728		728	540	1,268
2017	Prediction	2.55		2.55	28.0	364		364	280	644	832		832	560	1,392
2018	Prediction	2.85		2.85	29.0	364		364	290	654	832		832	580	1,412
2019	Prediction	3.00		3.00	30.0	364		364	300	664	832		832	600	1,432
2020	Prediction	2.40	1.10	3.50	31.0	312	156	468	310	778	728	312	1,040	620	1,660
2021	Prediction	2.40	1.35	3.75	32.0	312	156	468	320	788	728	312	1,040	640	1,680
2022	Prediction	2.40	1.61	4.01	33.0	312	208	520	330	850	728	416	1,144	660	1,804
2023	Prediction	2.40	1.88	4.28	34.0	312	208	520	340	860	728	416	1,144	680	1,824
2024	Prediction	2.40	2.17	4.57	35.0	312	260	572	350	922	728	520	1,248	700	1,948
2025	Prediction	2.40	2.40	4.80	35.0	260	260	520	350	870	624	520	1,144	700	1,844
2026	Prediction	2.40	2.40	4.80	35.0	260	260	520	350	870	624	520	1,144	700	1,844
2027	Prediction	2.40	2.40	4.80	35.0	260	260	520	350	870	624	520	1,144	700	1,844
2028	Prediction	2.40	2.40	4.80	35.0	260	260	520	350	870	624	520	1,144	700	1,844
2029	Prediction	2.40	2.40	4.80	35.0	260	260	520	350	870	624	520	1,144	700	1,844
2030	Prediction	2.40	2.40	4.80	35.0	260	260	520	350	870	624	520	1,144	700	1,844
Case 2															
2010	Actual	1.54		1.54	24.7	245		245	246	491	594		594	492	1,086
2014	Prediction	1.74		1.74	25.0	260		260	250	510	624		624	500	1,124
2015	Prediction	2.02		2.02	26.0	260		260	260	520	624		624	520	1,144
2016	Prediction	2.28		2.28	27.0	312		312	270	582	728		728	540	1,268

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		Cargo Volume				Annual Ship Calls					Annual Ship Movements				
2017	Prediction	2.55		2.55	28.0	364		364	280	644	832		832	560	1,392
2018	Prediction	2.85		2.85	29.0	364		364	290	654	832		832	580	1,412
2019	Prediction	3.00		3.00	30.0	364		364	300	664	832		832	600	1,432
2020	Prediction	3.00	0.50	3.50	31.0	364	52	416	310	726	832	104	936	620	1,556
2021	Prediction	3.00	0.75	3.75	32.0	364	104	468	320	788	832	208	1,040	640	1,680
2022	Prediction	3.00	1.01	4.01	33.0	364	104	468	330	798	832	208	1,040	660	1,700
2023	Prediction	3.00	1.28	4.28	34.0	364	156	520	340	860	832	312	1,144	680	1,824
2024	Prediction	3.00	1.57	4.57	35.0	364	208	572	350	922	832	416	1,248	700	1,948
2025	Prediction	3.00	1.86	4.86	35.0	364	208	572	350	922	832	416	1,248	700	1,948
2026	Prediction	3.00	2.11	5.11	35.0	364	260	624	350	974	832	520	1,352	700	2,052
2027	Prediction	3.00	2.36	5.36	35.0	364	260	624	350	974	832	520	1,352	700	2,052
2028	Prediction	3.00	2.62	5.62	35.0	312	312	624	350	974	728	624	1,352	700	2,052
2029	Prediction	3.00	2.89	5.89	35.0	312	312	624	350	974	728	624	1,352	700	2,052
2030	Prediction	3.00	3.00	6.00	35.0	312	312	624	350	974	728	624	1,352	700	2,052
Case 3															
2010	Actual	1.54		1.54	24.7	245		245	246	491	594		594	492	1,086
2014	Prediction	1.74		1.74	25.0	312		312	250	562	728		728	500	1,228
2015	Prediction	2.02		2.02	26.0	312		312	260	572	728		728	520	1,248
2016	Prediction	2.28		2.28	27.0	364		364	270	634	832		832	540	1,372
2017	Prediction	2.55		2.55	28.0	416		416	280	696	936		936	560	1,496
2018	Prediction	2.85		2.85	29.0	468		468	290	758	1,040		1,040	580	1,620
2019	Prediction	3.00		3.00	30.0	468		468	300	768	1,040		1,040	600	1,640
2020	Prediction	3.00	0.50	3.50	31.0	468	104	572	310	882	1,040	208	1,248	620	1,868
2021	Prediction	3.00	0.75	3.75	32.0	468	104	572	320	892	1,040	208	1,248	640	1,888
2022	Prediction	3.00	1.01	4.01	33.0	468	156	624	330	954	1,040	312	1,352	660	2,012
2023	Prediction	3.00	1.28	4.28	34.0	468	208	676	340	1,016	1,040	416	1,456	680	2,136
2024	Prediction	3.00	1.57	4.57	35.0	468	260	728	350	1,078	1,040	520	1,560	700	2,260
2025	Prediction	3.00	1.86	4.86	35.0	468	312	780	350	1,130	1,040	624	1,664	700	2,364
2026	Prediction	3.00	2.11	5.11	35.0	468	364	832	350	1,182	1,040	728	1,768	700	2,468
2027	Prediction	3.00	2.36	5.36	35.0	468	364	832	350	1,182	1,040	728	1,768	700	2,468

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		Cargo Volume				Annual Ship Calls					Annual Ship Movements				
2028	Prediction	3.00	2.62	5.62	35.0	468	416	884	350	1,234	1,040	832	1,872	700	2,572
2029	Prediction	3.00	2.89	5.89	35.0	468	468	936	350	1,286	1,040	936	1,976	700	2,676
2030	Prediction	3.00	3.00	6.00	35.0	468	468	936	350	1,286	1,040	936	1,976	700	2,676

Sources: Consultant estimates, 2011.

Description of Cases:

- Case 1: High "Direct" container traffic projection. Deltaport and Terminal 2 have sustainable capacities of 2.4 million TEU. Deltaport has a maximum capacity of 3.0 million TEU in interim years of high demand. Container vessel sizes are as in Table G. Maximum Westshore throughput is 35 million tonnes of coal.
- Case 2: High "Direct" container traffic projection. Deltaport and Terminal 2 have sustainable capacities of 3.0 million TEU. Container vessel sizes are as in Table G. Maximum Westshore throughput is again 35 million tonnes of coal.
- Case 3: High "Direct" container traffic projection. Deltaport and Terminal 2 have sustainable capacities of 3.0 million TEU. Container call size remains at 2010 level of 6,250 TEU per ship call. Maximum Westshore throughput is again 35 million tonnes of coal.

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Table S Monthly and Daily Vessel Projections for Deltaport, Westshore and Terminal 2

	Average Monthly Ship Movements					Peak Monthly Ship Movements					Average Daily Ship Movements					Peak Daily Ship Movements				
	Container					Container					Container					Container				
Case / Year	Deltaport	T2	Total	Coal	Total	Deltaport	T2	Total	Coal	Total	Deltaport	T2	Total	Coal	Total	Deltaport	T2	Total	Coal	Total
Case 1																				
2010	50		50	41	91	52		52	53	105	1.6		1.6	1.3	3.0	6.0		6.0	4.0	10.0
2014	52		52	42	94	55		55	54	109	1.7		1.7	1.4	3.1	6.0		6.0	4.0	10.0
2015	52		52	43	95	55		55	56	111	1.7		1.7	1.4	3.1	6.0		6.0	4.0	10.0
2016	61		61	45	106	64		64	59	122	2.0		2.0	1.5	3.5	6.0		6.0	4.0	10.0
2017	69		69	47	116	73		73	61	133	2.3		2.3	1.5	3.8	6.0		6.0	4.0	10.0
2018	69		69	48	118	73		73	63	136	2.3		2.3	1.6	3.9	6.0		6.0	4.0	10.0
2019	69		69	50	119	73		73	65	138	2.3		2.3	1.6	3.9	6.0		6.0	4.0	10.0
2020	61	26	87	52	138	64	27	91	67	158	2.0	0.9	2.8	1.7	4.5	6.0	6.0	12.0	4.0	16.0
2021	61	26	87	53	140	64	27	91	69	160	2.0	0.9	2.8	1.8	4.6	6.0	6.0	12.0	4.0	16.0
2022	61	35	95	55	150	64	36	100	72	172	2.0	1.1	3.1	1.8	4.9	6.0	6.0	12.0	4.0	16.0
2023	61	35	95	57	152	64	36	100	74	174	2.0	1.1	3.1	1.9	5.0	6.0	6.0	12.0	4.0	16.0
2024	61	43	104	58	162	64	46	109	76	185	2.0	1.4	3.4	1.9	5.3	6.0	6.0	12.0	4.0	16.0
2025	52	43	95	58	154	55	46	100	76	176	1.7	1.4	3.1	1.9	5.1	6.0	6.0	12.0	4.0	16.0
2026	52	43	95	58	154	55	46	100	76	176	1.7	1.4	3.1	1.9	5.1	6.0	6.0	12.0	4.0	16.0
2027	52	43	95	58	154	55	46	100	76	176	1.7	1.4	3.1	1.9	5.1	6.0	6.0	12.0	4.0	16.0
2028	52	43	95	58	154	55	46	100	76	176	1.7	1.4	3.1	1.9	5.1	6.0	6.0	12.0	4.0	16.0
2029	52	43	95	58	154	55	46	100	76	176	1.7	1.4	3.1	1.9	5.1	6.0	6.0	12.0	4.0	16.0
2030	52	43	95	58	154	55	46	100	76	176	1.7	1.4	3.1	1.9	5.1	6.0	6.0	12.0	4.0	16.0
Case 2																				
2010	50		50	41	91	52		52	53	105	1.6		1.6	1.3	3.0	6.0		6.0	4.0	10.0
2014	52		52	42	94	55		55	54	109	1.7		1.7	1.4	3.1	6.0		6.0	4.0	10.0
2015	52		52	43	95	55		55	56	111	1.7		1.7	1.4	3.1	6.0		6.0	4.0	10.0
2016	61		61	45	106	64		64	59	122	2.0		2.0	1.5	3.5	6.0		6.0	4.0	10.0
2017	69		69	47	116	73		73	61	133	2.3		2.3	1.5	3.8	6.0		6.0	4.0	10.0
2018	69		69	48	118	73		73	63	136	2.3		2.3	1.6	3.9	6.0		6.0	4.0	10.0
2019	69		69	50	119	73		73	65	138	2.3		2.3	1.6	3.9	6.0		6.0	4.0	10.0
2020	69	9	78	52	130	73	9	82	67	149	2.3	0.3	2.6	1.7	4.3	6.0	6.0	12.0	4.0	16.0
2021	69	17	87	53	140	73	18	91	69	160	2.3	0.6	2.8	1.8	4.6	6.0	6.0	12.0	4.0	16.0
2022	69	17	87	55	142	73	18	91	72	163	2.3	0.6	2.8	1.8	4.7	6.0	6.0	12.0	4.0	16.0

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	Average Monthly Ship Movements					Peak Monthly Ship Movements					Average Daily Ship Movements					Peak Daily Ship Movements				
2023	69	26	95	57	152	73	27	100	74	174	2.3	0.9	3.1	1.9	5.0	6.0	6.0	12.0	4.0	16.0
2024	69	35	104	58	162	73	36	109	76	185	2.3	1.1	3.4	1.9	5.3	6.0	6.0	12.0	4.0	16.0
2025	69	35	104	58	162	73	36	109	76	185	2.3	1.1	3.4	1.9	5.3	6.0	6.0	12.0	4.0	16.0
2026	69	43	113	58	171	73	46	118	76	194	2.3	1.4	3.7	1.9	5.6	6.0	6.0	12.0	4.0	16.0
2027	69	43	113	58	171	73	46	118	76	194	2.3	1.4	3.7	1.9	5.6	6.0	6.0	12.0	4.0	16.0
2028	61	52	113	58	171	64	55	118	76	194	2.0	1.7	3.7	1.9	5.6	6.0	6.0	12.0	4.0	16.0
2029	61	52	113	58	171	64	55	118	76	194	2.0	1.7	3.7	1.9	5.6	6.0	6.0	12.0	4.0	16.0
2030	61	52	113	58	171	64	55	118	76	194	2.0	1.7	3.7	1.9	5.6	6.0	6.0	12.0	4.0	16.0
Case 3																				
2010	50		50	41	91	52		52	53	105	1.6		1.6	1.3	3.0	6.0		6.0	4.0	10.0
2014	61		61	42	102	64		64	54	118	2.0		2.0	1.4	3.4	6.0		6.0	4.0	10.0
2015	61		61	43	104	64		64	56	120	2.0		2.0	1.4	3.4	6.0		6.0	4.0	10.0
2016	69		69	45	114	73		73	59	131	2.3		2.3	1.5	3.8	6.0		6.0	4.0	10.0
2017	78		78	47	125	82		82	61	143	2.6		2.6	1.5	4.1	6.0		6.0	4.0	10.0
2018	87		87	48	135	91		91	63	154	2.8		2.8	1.6	4.4	6.0		6.0	4.0	10.0
2019	87		87	50	137	91		91	65	156	2.8		2.8	1.6	4.5	6.0		6.0	4.0	10.0
2020	87	17	104	52	156	91	18	109	67	176	2.8	0.6	3.4	1.7	5.1	6.0	6.0	12.0	4.0	16.0
2021	87	17	104	53	157	91	18	109	69	179	2.8	0.6	3.4	1.8	5.2	6.0	6.0	12.0	4.0	16.0
2022	87	26	113	55	168	91	27	118	72	190	2.8	0.9	3.7	1.8	5.5	6.0	6.0	12.0	4.0	16.0
2023	87	35	121	57	178	91	36	127	74	201	2.8	1.1	4.0	1.9	5.9	6.0	6.0	12.0	4.0	16.0
2024	87	43	130	58	188	91	46	137	76	212	2.8	1.4	4.3	1.9	6.2	6.0	6.0	12.0	4.0	16.0
2025	87	52	139	58	197	91	55	146	76	221	2.8	1.7	4.6	1.9	6.5	6.0	6.0	12.0	4.0	16.0
2026	87	61	147	58	206	91	64	155	76	231	2.8	2.0	4.8	1.9	6.8	6.0	6.0	12.0	4.0	16.0
2027	87	61	147	58	206	91	64	155	76	231	2.8	2.0	4.8	1.9	6.8	6.0	6.0	12.0	4.0	16.0
2028	87	69	156	58	214	91	73	164	76	240	2.8	2.3	5.1	1.9	7.0	6.0	6.0	12.0	4.0	16.0
2029	87	78	165	58	223	91	82	173	76	249	2.8	2.6	5.4	1.9	7.3	6.0	6.0	12.0	4.0	16.0
2030	87	78	165	58	223	91	82	173	76	249	2.8	2.6	5.4	1.9	7.3	6.0	6.0	12.0	4.0	16.0

Sources: Consultant estimates, 2011.

Description of Cases:

- Case 1: High "Direct" container traffic projection. Deltaport and Terminal 2 have sustainable capacities of 2.4 million TEU. Deltaport has a maximum capacity of 3.0 million TEU in interim years of high demand. Container vessel sizes are as in Table G. Maximum Westshore throughput is 35 million tonnes of coal.

- Case 2: High "Direct" container traffic projection. Deltaport and Terminal 2 have sustainable capacities of 3.0 million TEU. Container vessel sizes are as in Table G. Maximum Westshore throughput is again 35 million tonnes of coal.
- Case 3: High "Direct" container traffic projection. Deltaport and Terminal 2 have sustainable capacities of 3.0 million TEU. Container call size remains at 2010 level of 6,250 TEU per ship call. Maximum Westshore throughput is again 35 million tonnes of coal.

Vancouver Fraser Port Authority

Update of Projections of Container Ship Characteristics for Roberts Bank Terminal 2

Final Report

2 September 2014

Project No. 13004

Seaport Consultants Canada Inc.

Vancouver Fraser Port Authority

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Introduction

Background

This report partially updates reports on container shipping services at Port Metro Vancouver's (PMV) Roberts Bank area that were prepared as part of PMV's Container Capacity Improvement Program (CCIP) in 2011. There were two CCIP reports: one dealt with Deltaport[1] and the other with Roberts Bank Terminal 2 (RBT2)[2]. Both reports addressed container and coal shipping and were similar in content. They reviewed trends in shipping characteristics and projected vessel calls and movements for both types of ship. The projections for the Roberts Bank container terminals (Deltaport and RBT2) were based primarily on data for Deltaport.

This report update takes the evaluations only as far as container ship size and call size.

As one step in developing these projections, the 2011 reports estimated average container ship sizes in twenty-foot equivalent container units (TEU) per ship call or voyage. They also estimated call sizes in TEU per call or TEU per voyage. These two measures of call size evolved as follows:

- The number of ship calls at Deltaport in 2010 (the data year for the 2011 reports) was 292, while the number of voyages was estimated at 245.
- A "voyage" was defined as a vessel arriving at the Vancouver – U.S. Pacific Northwest (PNW) region, calling at one or more ports (two is typical, one at PMV and another at a U.S. PNW port) and returning to its region of origin.
- The difference between calls and voyages arose because some ships in one service called twice at Deltaport, the first to discharge import containers and the second to load export containers.

Such "split services" were not expected to persist in the longer term because of the fixed costs they impose on shipping lines. In addition, the voyage is the better measure of vessel characteristics and cargo patterns because the quantity of cargo carried on a voyage should be relatively stable. The voyage approach was incorporated into the vessel projections of the 2011 reports; the basis of the vessel movement projections in the 2001 reports was the voyage with allowances for the extra vessel movements of a split service continuing at Deltaport.

The spilt service at Deltaport continued to 2013 and into 2014. It is discussed again in this report.

Projections versus Actual Outcomes

The projections to 2013 are compared below for Deltaport with the actual outcomes, with the details behind the 2013 estimates from the evaluations of this report. The results are on a voyage basis as described above.

Table 1 compares the 2011 projections of call size and average vessel size for 2013 with the actual 2013 results, estimated from PMV data on ship calls for the year. In both cases, the 2011 projections were 200 to 300 TEU higher than the actual values for 2013.

Table 1 – Actual 2013 Results for Deltaport versus 2011 Projections

[1] WorleyParsons Canada, "Projections of Vessel Calls and Movements at Deltaport and Westshore Terminals - Deltaport Terminal Road and Rail Improvement Project (DTRRIP)," 28-Nov-11 (edited in July 2012).
[2] WorleyParsons Canada, "Projections of Vessel Calls and Movements at the Roberts Bank Marine Terminals - Terminal 2 (T2)," 28-Nov-11.

Item	2010	2013
2011 Projection		
Call Size (TEU per Voyage)	6,250	6,850
Average Ship Size (TEU)	6,519	7,195
2013 Actual		
Call Size (TEU per Voyage)	6,250	6,547
Average Ship Size (TEU)	6,519	6,969

Sources: WorleyParsons Canada, "Projections of Vessel Calls and Movements at the Roberts Bank Marine Terminals - Terminal 2 (T2)," 28-Nov-11 and estimates in this report from PMV data.

This report takes a similar approach as the 2011 report to trends in container shipping:

- It begins with a general review based on shipping schedules to establish the broad patterns of the container trade.
- It then switches to detailed PMV data for 2010 and 2013 to examine ship trends more closely.
- It reviews briefly trends in the world containership fleet.
- Finally, it reviews trends in call and ship sizes and updates the projections for 2014 to 2030.

Port Metro Vancouver Container Vessel Services

This section uses two general sources of data for the evaluations. One is a series of container shipping schedules developed over the past fifteen years, some for other projects. The other data sources are PMV statistics on the container vessels that called at the port in 2010 and 2013.

Evaluation of Schedule Data

This section uses estimates of container shipping schedules for PMV in early 2014 (representative of 2013), 2011 (representative of 2010) and previous years to develop characteristics of the container ships calling at PMV over time. The sources of data were published schedules of container services, the online database of shipping schedules of Containerisation International, online vessel schedules of container shipping lines, PMV's Container Service Subway Maps of May 2014 and the report on the 2014 container traffic forecast for PMV of Ocean Shipping Consultants (OSC).

The data includes estimates of average vessel size for each service but not the actual sizes of individual vessels in the service strings. The data for 2003 to 2008 was created as part of past projects with focuses that differed from those of this report. In general, the previous studies involved market reviews of container shipping services as part of feasibility studies of container terminals and the main focus was on the potential container terminal market. Nevertheless, the data collected for the past shipping services provides reasonable estimates of their characteristics at the time and are useful as a guide to trends in PMV. The data in the earlier years includes Fraser Port and Port of Vancouver together, which is consistent with recent data for PMV.

Table 2 begins the review by summarizing the characteristics of the container shipping services calling at PMV for a sample of five years between 1999 and 2013. The schedule characteristics for 2013 were developed from data in early 2014. While there may have been some minor changes in vessel patterns between 2013 and early 2014, they are sufficiently small to ignore for the purposes of this review.

The table uses the term "slot capacity," which is defined as the product of container ship TEU capacity and the number of port calls, yearly in the table. If a ship discharged and loaded its full slot capacity, the vessel would generate container traffic equal to two times its TEU capacity. But this rarely happens: container vessels almost always load and discharge a portion of their TEU capacity in each port of call. Slot capacity is useful primarily as a measure of aggregate container shipping services to a port; it also provides a way to calculate a weighted average size of ships for a service or a port (the average TEU capacities in the table are weighted averages).

The table is broken into three sections. The first deals with all vessels and services in PMV, the second covers larger vessels only (generally Panamax size and larger), and the third only the services that called at Deltaport.

Table 2 – Port Metro Vancouver Container Services 1999 to 2013

Item[1]	1999	2003	2008	2010	2013	Growth 1999 - 2013 (%/a)
All Vessels and Services						
Slot Capacity (TEU)	2,156,005	3,642,772	4,070,164	3,567,780	4,434,122	5.3
Average TEU Capacity	2,561	3,404	4,615	4,831	5,881	6.1
Number of Calls	842	1,070	882	739	754	-0.8
Number of Services	18	22	19	16	16	-0.8
Container Traffic (TEU)	1,102,092	1,791,568	2,492,107	2,514,309	2,825,475	7.0
Traffic/Slot Capacity Ratio	51%	49%	61%	70%	64%	1.6
Large Vessels Only[2]						
Slot Capacity (TEU)	1,927,530	3,063,372	3,608,020	3,139,151	4,085,722	5.5
Average TEU Capacity	2,707	3,927	5,337	6,037	6,548	6.5
Number of Calls	712	780	676	520	624	-0.9
Number of Services	14	15	13	10	12	-1.1
Deltaport Only						
Slot Capacity (TEU)	709,322	1,487,200	981,708	1,661,845	1,818,522	7.0
Average TEU Capacity	2,728	4,086	4,720	6,392	6,994	7.0
Number of Calls[3]	260	364	208	260	260	0.0
Number of Services	5	7	4	5	5	0.0

Sources: Vessel information from published schedules, Containerisation International database, shipping line web sites in various years and PMV Container Service Subway Maps, May 2014.

Notes:

[1]Data is for Port of Vancouver and Fraser Port combined for 1999 and 2003, and for Port Metro Vancouver in 2008, 2011 and 2013.

[2]Excludes Westwood services and services calling at Fraser Surrey Docks

[3]One Deltaport service called twice at the terminal in 2010 and 2013: once to discharge containers and the other to load. The 260 ship calls in the table count this split service only once.

For the port as a whole (all vessels and services), slot capacity increased from approximately 2.2 million TEU in 1999 to about 4.4 million TEU in 2013 (growth rate of 5.3% a year). The average ship TEU capacity increased from approximately 2,500 TEU in 1999 to 5,900 TEU in 2013, an increase of 6.1% per year. The number of container ship calls declined, from 842 in 1999 to 754 in 2013. This was due to both the increasing size of ships and the increasing utilization of the slot capacity of the ships. The number of shipping services declined from 18 in 1999 to 16 in 2013 for similar reasons.

The first section of the table also lists PMV container traffic in these years, ranging from 1.1 million TEU in 1999 to 2.8 million TEU in 2013, a growth rate of 7% a year over this period. The ratio of container traffic to slot capacity increased from about 50% in 1999 to 70% in 2010 and was about 64% in 2013.

In the case of large vessels only, smaller ships (the Westwood combined forest products / container carriers that call at Centerm and those calling at Fraser Surrey docks) were eliminated from the calculations. Average TEU capacity ranged from 2,700 TEU in 1999 to 6,500 TEU in 2013, an increase of 6.5% a year.

In the case of Deltaport only, slot capacity increased at 7.0% a year and the average ship capacity increased from about 2,700 TEU in 1999 to about 7,000 TEU in 2013. The number of container ships calls at Deltaport and the number of services remained constant between 1999 and 2013.

Table 3 uses the schedule data to provide estimates of numbers of services by ship size between 1999 and 2013. The total number of services is the same as in Table 2 but the table illustrates the changing pattern of ship sizes. The upper part of the table addresses all vessels and services in PMV; the port lower part addresses Deltaport.

In both categories, there is a general shift in the number of vessel services from the upper left of the table (many smaller ships up to a maximum of 6,000 TEU in 1999) to larger ships at the lower right, including those in excess of 8,000 TEU. In the case of Deltaport, vessels have shifted from less than 5,000 TEU in 1999 to predominantly above 4,000 TEU in 2013. In 2013 the average container vessels of three services are in excess of 8,000 TEU.

Table 3 – Port Metro Vancouver Container Ship Size Distributions 1999 to 2013

	Number of Services by Ship TEU Class					Growth
Vessel Size (TEU)	1999	2003	2008	2010	2013	1999 - 2013
						(%/a)
All Vessels and Services						
<= 2,000	7	5	3	3	2	-8.6
2,000 - 3,000	8	6	2	3	1	-13.8
3,000 - 4,000	1	5	3	1	1	0.0
4,000 - 5,000	1	5	2	0	3	8.2
5,000 - 6,000	1	1	6	5	3	8.2
6,000 - 7,000	0	0	2	2	2	
7,000 - 8,000	0	0	1	1	0	
> 8,000	0	0	0	1	4	
Total	18	22	19	16	16	-0.8
Deltaport						
<= 2,000	2	0	0	0	0	
2,000 - 3,000	1	2	0	0	0	
3,000 - 4,000	1	2	1	1	0	
4,000 - 5,000	1	2	1	0	2	5.1
5,000 - 6,000	0	1	2	1	0	
6,000 - 7,000	0	0	0	1	0	
7,000 - 8,000	0	0	0	1	0	
> 8,000	0	0	0	1	3	
Total	5	7	4	5	5	0.0

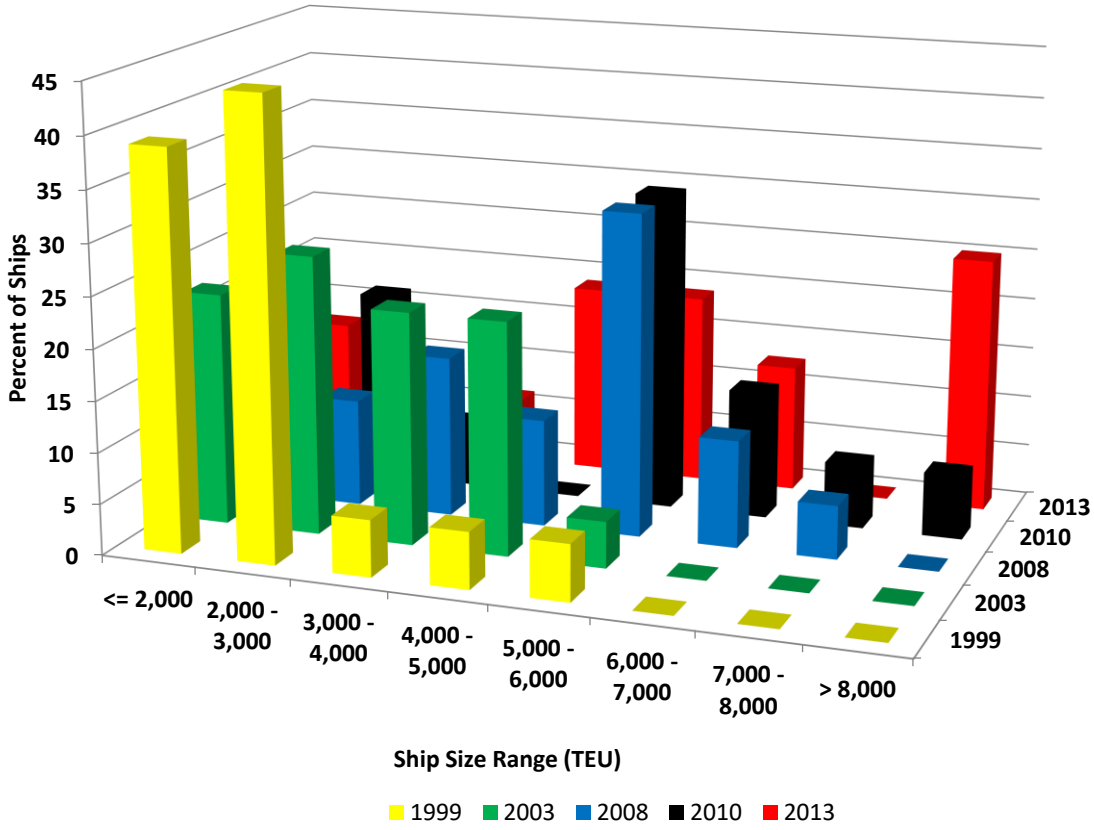
Sources: Vessel information from published schedules, Containerisation International database and shipping line web sites of various years, and PMV Container Service Subway Maps, May 2014.

Figure 1 (PMV as a whole) and Figure 2 (Deltaport) repeat the data in Table 3 .

- The data for PMV shows the relatively small vessels in 1999, the emergence in 2003 and 2008 of increasingly large ships, 2010 with a “long tail” that extends to over 8,000 TEU, and in 2013 a large number of ships of over 8,000 TEU.
- The schedule data is more dramatic for Deltaport: it shows the terminal’s ships bifurcated in 2013 into two broad groups, the 4,000 to 5,000 TEU size group (40%) and those over 8,000 TEU (60%).

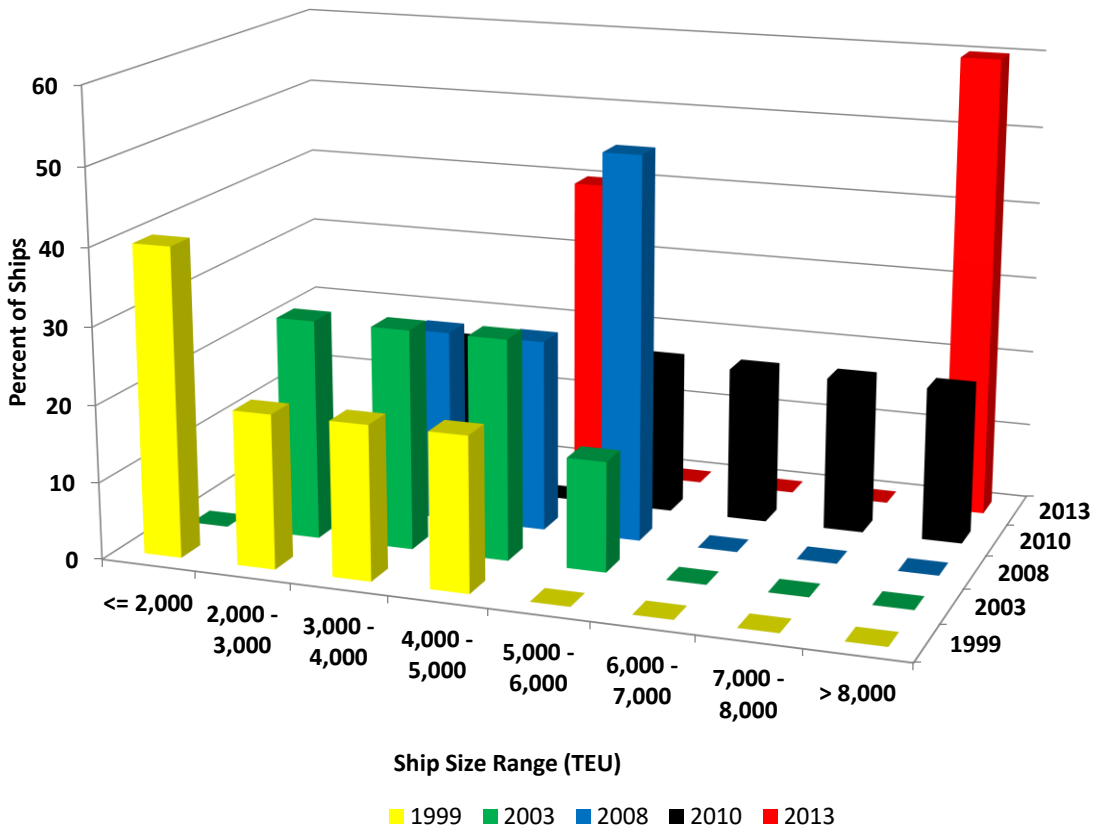
The details of ship size distributions from PMV data are more definitive for 2010 and 2013 than those from the schedules. A review of PMV data appears in the next section of this report.

Figure 1 – Port Metro Vancouver Container Ship Size Distributions 1999 to 2013



Sources: Vessel service information as above.

Figure 2 – Deltaport Container Ship Size Distributions 1999 to 2013

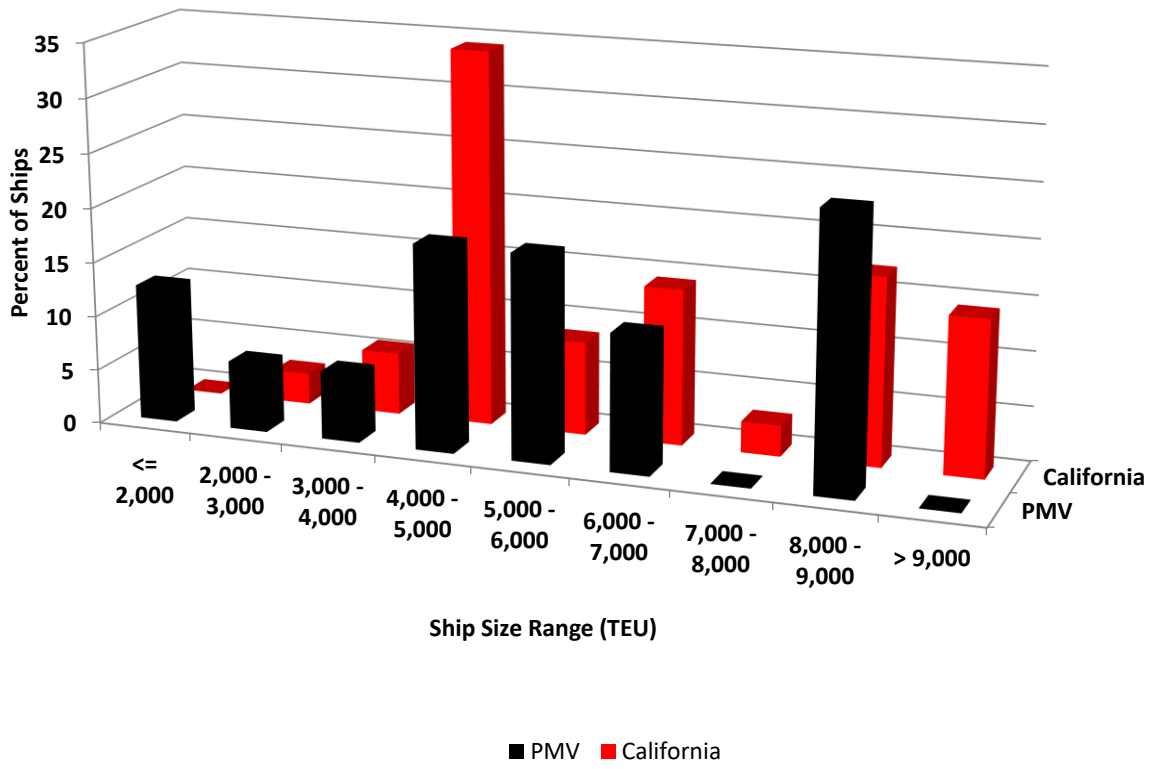


Sources: Vessel service information as above.

One reads in the 2014 trade press of the arrival of much larger container ships at the California ports: ships of up to 13,000 TEU accompanied by speculation about call sizes of up to 18,000 TEU. Schedule data compiled by Ocean Shipping Consultants (OSC) allowed a quick comparison of the comparative size distributions of ships calling at PMV and the California ports (see Figure 3 for the comparison and the source of the data). While not identical to the data behind the above charts and tables, the OSC information, with some adjustments, provided a reasonable comparison. The review showed:

- Un-weighted average ships sizes of 5,400 TEU in PMV versus 6,400 TEU in California. The PMV values in Table 2 are slightly greater at 5,900 TEU because they are weighted averages and OSC had lower estimates for the sizes of some ships calling at PMV.
- While there is a large cluster of PMV ships in the 8,000 to 9.000 TEU range, a significant number of ships calling at the California ports exceed 9.000 TEU and a few California services have ships that average 12,000 TEU to 14,000 TEU.

Figure 3 – Ship Size Distributions in PMV and California in Early 2014



Source: Estimated from Ocean Shipping Consultants, "Container Traffic Forecast Study – Port Metro Vancouver, June 2014," report prepared for Port Metro Vancouver, June 2014.

Evaluation of PMV data

This section uses PMV data to focus in more detail on recent trends. In all cases, the service that calls twice at Deltaport, Grand Alliance NWX, is counted on the basis of voyages and the extra calls eliminated. These Grand Alliance vessels were operated by Hapag-Lloyd AG.

The review begins with Table 4, which compares size distributions of container ships for PMV as a whole and Deltaport for 2010 and 2013. The distribution of ship sizes for Deltaport based on schedules and average ship sizes per service showed Deltaport to have two service clusters in 2013, one 4,000 – 5,000 TEU and the other greater than 8,000 TEU. The impression from the schedules is correct but as shown in Table 4 the situation is more complex. The majority of the Deltaport ships fall in the 8,000 to 9,000 TEU group, with a few ships in the next smaller group and over 10,000 TEU. The smaller ships are more spread out, with the majority in the 4,000 to 5,000 TEU group but also with a number of smaller and larger ships.

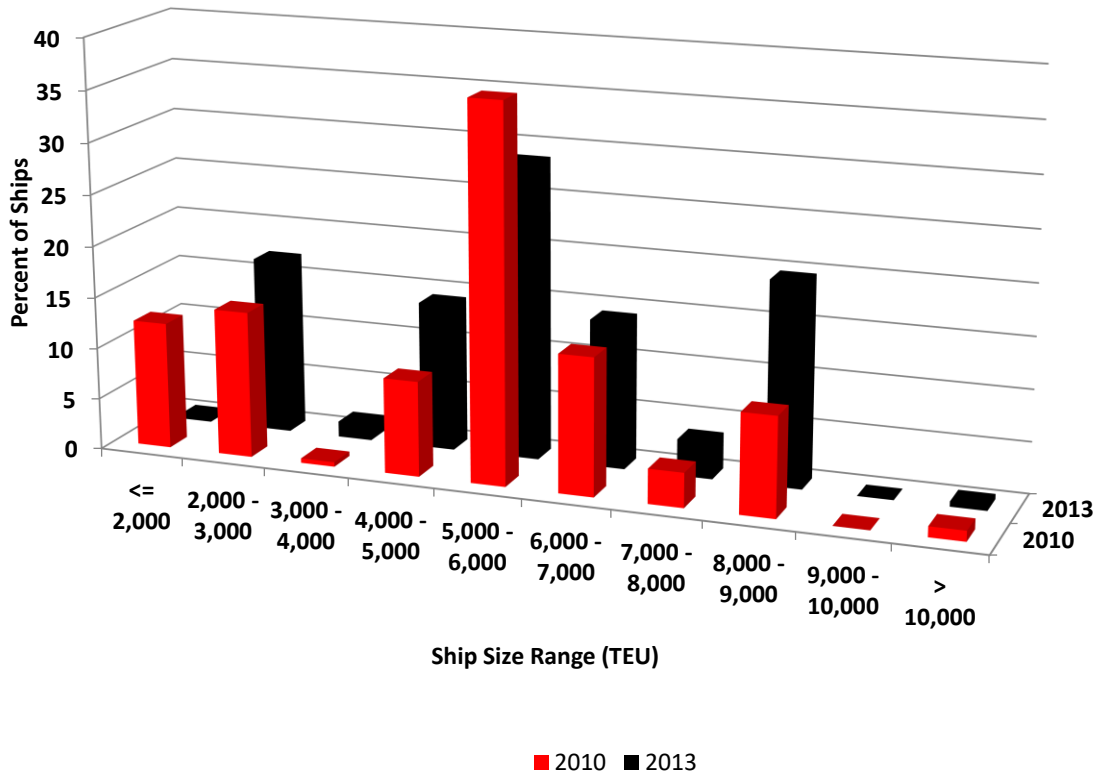
Table 4 – Size Distributions of Container Ships Calling at PMV and Deltaport 2010 and 2013

	Number of Ships		Percent Distribution (%)	
Vessel Capacity TEU)	PMV	Deltaport	PMV	Deltaport
2010				
<= 2,000	84	0	12	0
2,000 - 3,000	97	8	14	3
3,000 - 4,000	3	0	0	0
4,000 - 5,000	63	29	9	12
5,000 - 6,000	248	74	36	30
6,000 - 7,000	91	38	13	16
7,000 - 8,000	23	23	3	9
8,000 - 9,000	66	66	10	27
9,000 - 10,000	0	0	0	0
> 10,000	7	7	1	3
Total	682	245	100	100
2013				
<= 2,000	3	0	0	0
2,000 - 3,000	135	17	17	7
3,000 - 4,000	12	0	2	0
4,000 - 5,000	113	44	14	19
5,000 - 6,000	227	20	29	8
6,000 - 7,000	113	1	14	0
7,000 - 8,000	28	8	4	3
8,000 - 9,000	156	143	20	60
9,000 - 10,000	0	0	0	0
> 10,000	4	4	1	2
Total	791	237	100	100

Source: Estimated from Port Metro Vancouver data, 2011 and 2014.

Figure 4 presents ship size distributions from PMV data for 2010 and 2013 on the same basis as in Table 4 but in percentage terms. It shows that ships have generally shifted to larger size ranges (the 8,000 to 9,000 TEU category stands out) but the dominant size group remains 5,000 to 6,000 TEU.

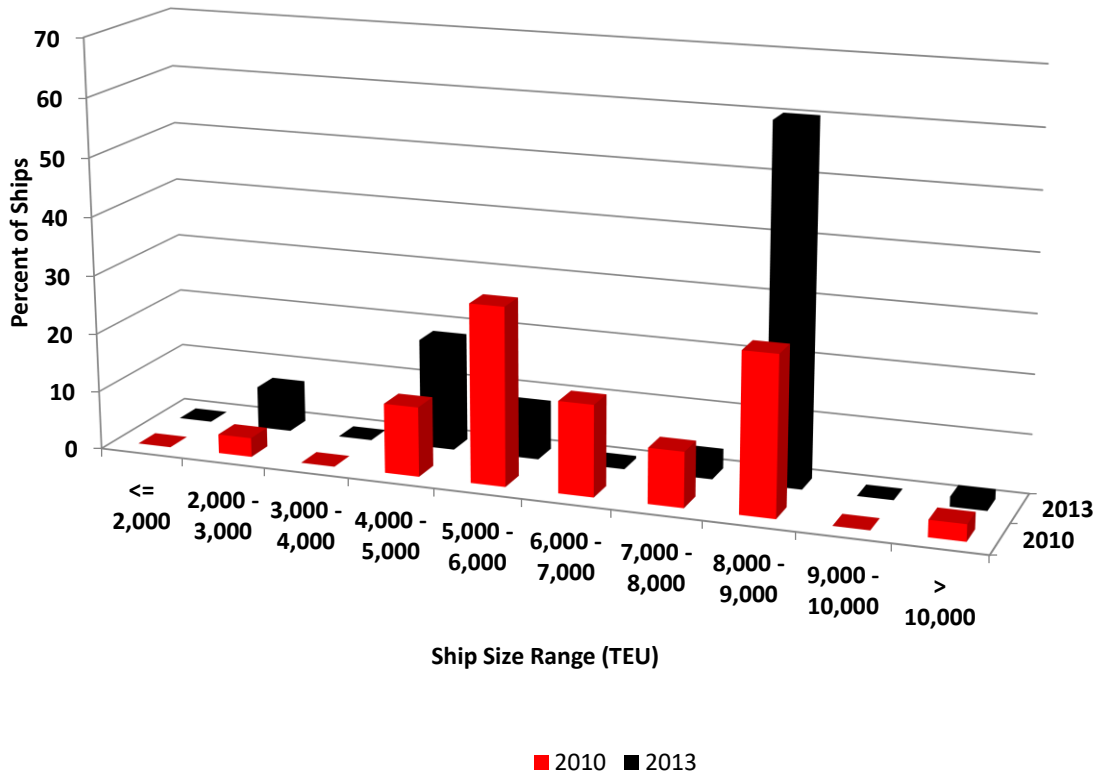
Figure 4 – PMV Ship Size Distributions 2010 and 2013



Source: Estimated from Port Metro Vancouver data, 2014.

In the case of Deltaport, the ship size distribution is very similar to that of the two-cluster distribution developed from schedules in Figure 2. Sixty percent of ship calls fall in the narrow 8,000 to 9,000 TEU category and the other cluster is around 4,000 to 6,000 TEU. There are also more small ships in 2013 than in 2010, which pull down the average ship size. The most dramatic transition is the shift of post-Panamax ships from smaller size groups (5,000 to 8,000 TEU) to the 8,000 to 9,000 group. The largest ship to call at Deltaport in 2013 was the 10,062 TEU *Zim Djibouti*, which called four times in the year. This 2009-built ship also called at Deltaport in 2010, making seven calls in that year.

Figure 5 – Deltaport Ship Size Distributions 2010 and 2013



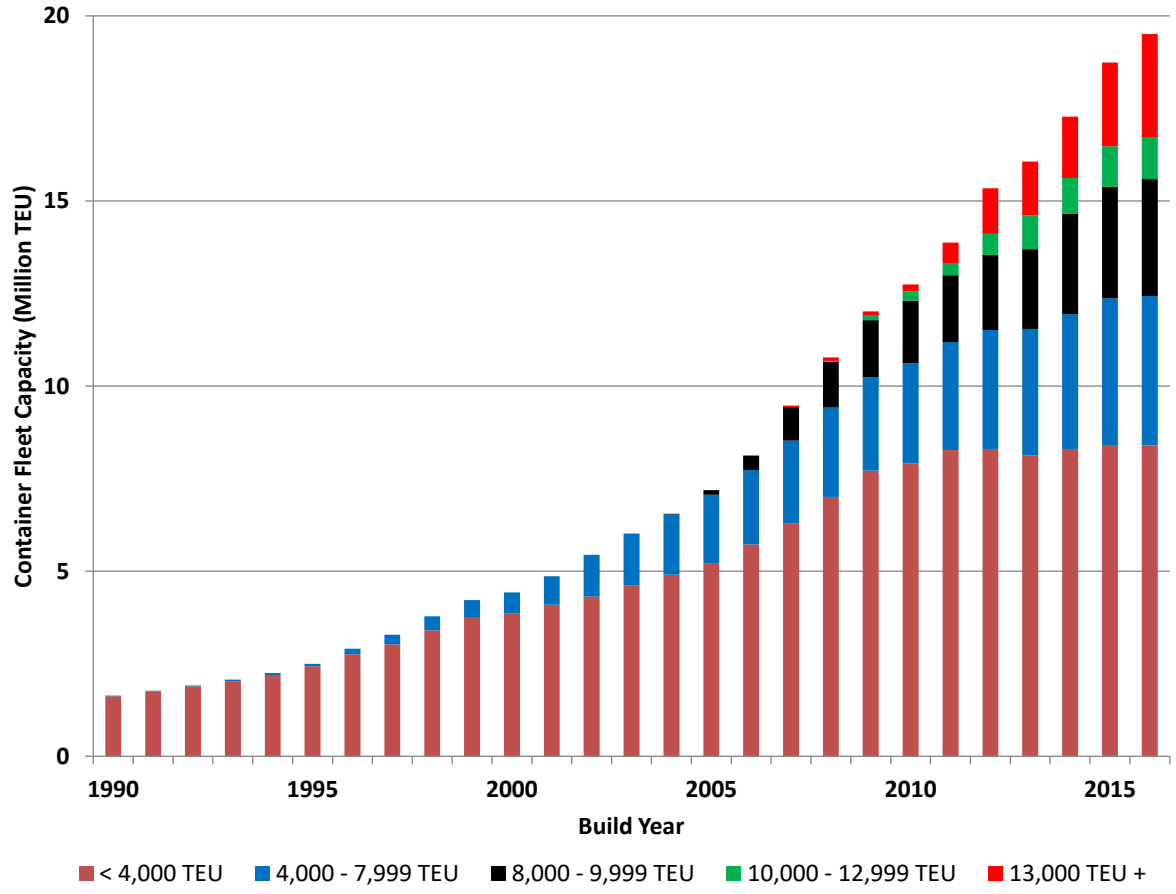
Source: Estimated from Port Metro Vancouver data, 2014.

The World Container Ship Fleet

This section briefly summarizes broad trends in the composition of the world container ship fleet between 1990 and 2016. Figure 6 provides the TEU capacity of ships by year of delivery in the fleet up to 2013 and the 2013 fleet plus ships on order for 2014 to 2016. They are broken down into five size ranges of container ship:

- Less than 4,000 TEU. These are mostly Panamax and smaller ships that can transit the existing Panama Canal. There are a few ships in this size group that have one dimension – usually beam – greater than the present canal limits.
- 4,000 to 7,999 TEU. A number of ships up to about 5,000 TEU with Panamax beams (32.3 m) and overall lengths (290 m) can transit the canal, although in some cases with draft and hence deadweight limitations. Ships of over about 5,000 TEU are generally of post-Panamax dimensions.
- 8,000 to 9,999 TEU. These are post-Panamax ships, virtually all of which entered the fleet since 2005. A relatively large and still-growing group, this is a common size range of the larger ships in PMV and the dominant group at Deltaport.
- 10,000 to 12,999 TEU. Many of these ships are within the dimensional limits of the expanded Panama Canal.
- Ships over 13,000 TEU. All or virtually with dimensions that exceed the limits of the expanded Panama Canal, this size group`s capacity is increasing quite rapidly. Ships of just over 18,000 are now in the world fleet and some ships on order have reported capacities of 19,200 TEU. Most are deployed on the trade routes between Asia and Europe.

Figure 6 – Trends in World Container Ship Fleet Composition 1990 to 2016 (TEU Capacity)



Source: Ocean Shipping Consultants, "Container Traffic Forecast Study – Port Metro Vancouver, June 2014," report prepared for Port Metro Vancouver, June 2014.

The first post-Panamax ships were delivered in 1988. Although a few post-Panamax ships were built in the early 1990s, ordering of post-Panamax ships did not begin in earnest until 1995 and until the early 2000s these were in the smaller size ranges. The majority of ships delivered since 2005 have been in excess of 8,000 TEU.

A new but minor phenomenon that began in 2010 and is continuing with deliveries in the next few years is ships of less than 4,000 TEU that have one dimension, beam, in excess of the present Panama Canal limits. These ships are probably of a more efficient design than vessels constrained to the 32.3 m beam limit of the existing Panama Canal and after 2014 their beams will not constrain the deployment of the ships.

Average Container Ship Size and TEU per Call

This section first reviews trends in ship and call sizes. It then develops projections of these parameters out to 2030. The focus in this section is on Deltaport because of the PMV container terminals it is the most similar in scale, characteristics and location to RBT2.

Trends in Ship and Call Sizes

The review begins with the summary in Table 5 of average ship size and call size (TEU per voyage) for PMV and Deltaport. These were estimated from PMV ship call data and include adjustments to the split service at Deltaport to bring all estimates to a per-voyage basis.

Table 5 – Average Call and Ship Size for PMV and Deltaport 2013

Item	All PMV	Deltaport
Average Ship Size (TEU)	3,569	6,969
Call Size (TEU per Voyage)	5,628	6,547

Source: Estimated from Port Metro Vancouver data, 2014.

Ship Sizes

Table 6 provides estimates from the schedule data in Table 2 of the incremental changes in average ship size between 1999 and 2013. These are broken down into four individual periods and the entire period from 1999 to 2013, and by ship groups:

- For all ships, the increase in each year ranges from 108 TEU to 242 TEU. This means, for example, that between 1999 and 2013 in each year the average ship capacity increased by 237 TEU.
- For large vessels only, the annual increase is slightly higher.
- For Deltaport, the changes are more volatile but in some years are the highest of the three vessel categories. The long-term average for Deltaport was about 300 TEU per year. It was about 200 TEU between 2010 and 2013.

The table also includes estimates of incremental changes in ship sizes from detailed PMV data for 2010 and 2013. These include the adjustment to eliminate the effect of the split service at Deltaport. These result in comparable but somewhat different values than those from the schedule data: about 200 TEU for PMV as a whole and 150 TEU for Deltaport for 2010 to 2013.

Table 6 – Incremental Changes in Average Ship Size 1999 to 2013

Item	1999	2003	2008	2010	2013
Average Vessel Sizes (TEU)					
From Schedule Data					
All PMV Vessels and Services	2,561	3,404	4,615	4,831	5,881
Large Vessels Only	2,707	3,927	5,337	6,037	6,548
Deltaport	2,728	4,086	4,720	6,392	6,994
From Detailed PMV Data					
All PMV Vessels and Services				4,993	5,628
Deltaport				6,519	6,939
Item	1999-2003	2003-2008	2008-2010	2010-2013	1999-2013
Incremental Changes (TEU)					
From Schedule Data					
All Vessels and Services	211	242	108	350	237
Large Vessels Only	305	282	350	170	274
Deltaport	339	127	836	201	305
From Detailed PMV Data					
All PMV Vessels and Services				212	
Deltaport				140	

Source: Calculated from data in Table 2 and estimates from PMV detailed ship call data, 2010 and 2013.

In spite of the ordering and entry into service of large vessels on a worldwide basis, the impact on PMV and Deltaport was relatively modest between 2010 and 2013. The increment in ship size growth was 150 to 200 TEU per year in this period. As discussed above, there has been a strong clustering of Deltaport ships in the 8,000 to 9,000 TEU range. There has been no move to larger ships – the largest ship calling at Deltaport in 2010 (the *Zim Djibouti*) was still the largest ship in 2013 and it made fewer calls in 2013 than in 2010. The incremental values from above are used as a guide later in this report to project average ship size as part of building up the characteristics of container shipping in future years.

Ship size distributions are also projected in this report. As shown in Figure 1 and Figure 4 for PMV as a whole and Figure 2 and Figure 5 for Deltaport, ship size distributions can shift considerably over short periods. The share of the 8,000 to 9,000 TEU size group in total ship calls at Deltaport, for example, increased from 27% in 2010 to 60% in 2013, a rate of increase of about ten percentage points per year. In the same period, ships in the 6,000 to 7,000 TEU size group fell from 16% to zero (about -5% a year).

There will be large shifts in future as in the past. Such large shifts may be somewhat predictable in the short term from detailed reviews of industry plans and consultations with shipping lines. These were not

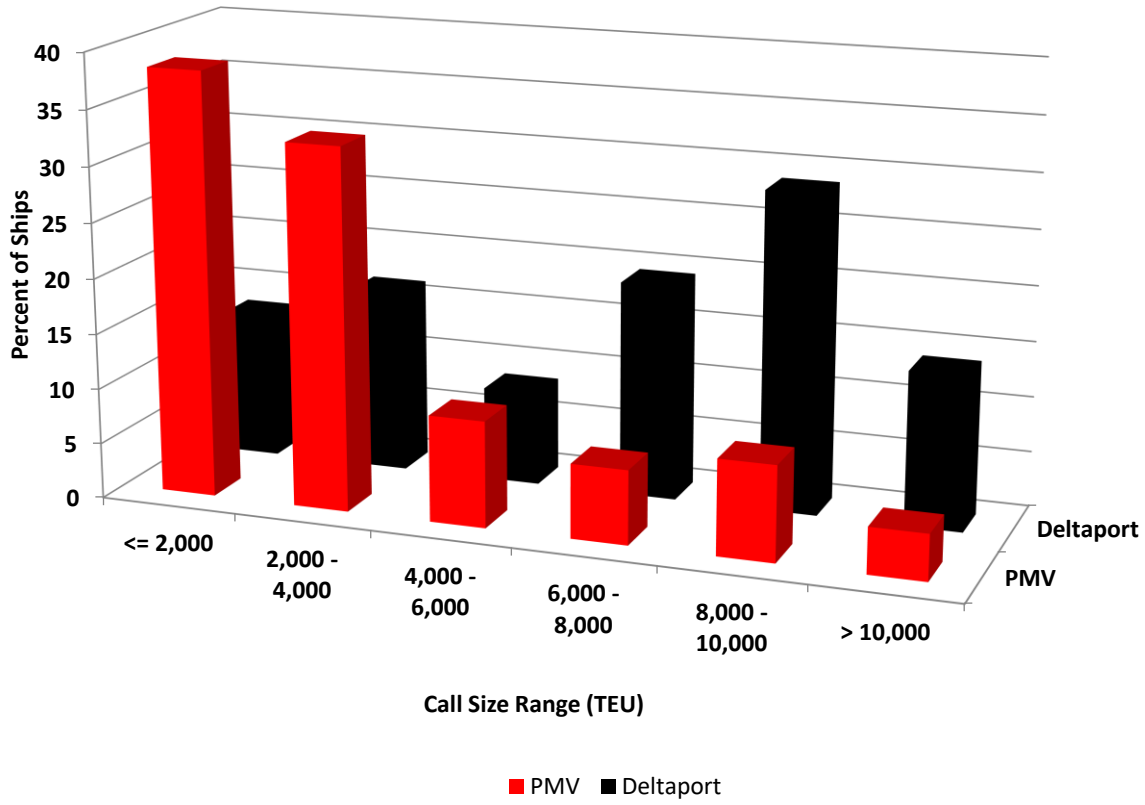
conducted because they would have been very time consuming and projections based on them would often be wrong.

The shifts in ship size distributions averaged over longer time periods, such as 10 to 15 years, tend to be less volatile with changes of plus or minus one to three percentage points a year typical. Since the projections of this study are over a 17-year period, such modest changes are used for them.

Call Sizes

This section begins with a comparison of the distribution of call sizes of PMV as a whole and Deltaport (see Figure 7). As with ship sizes, call sizes for Deltaport are skewed to the right of PMV.

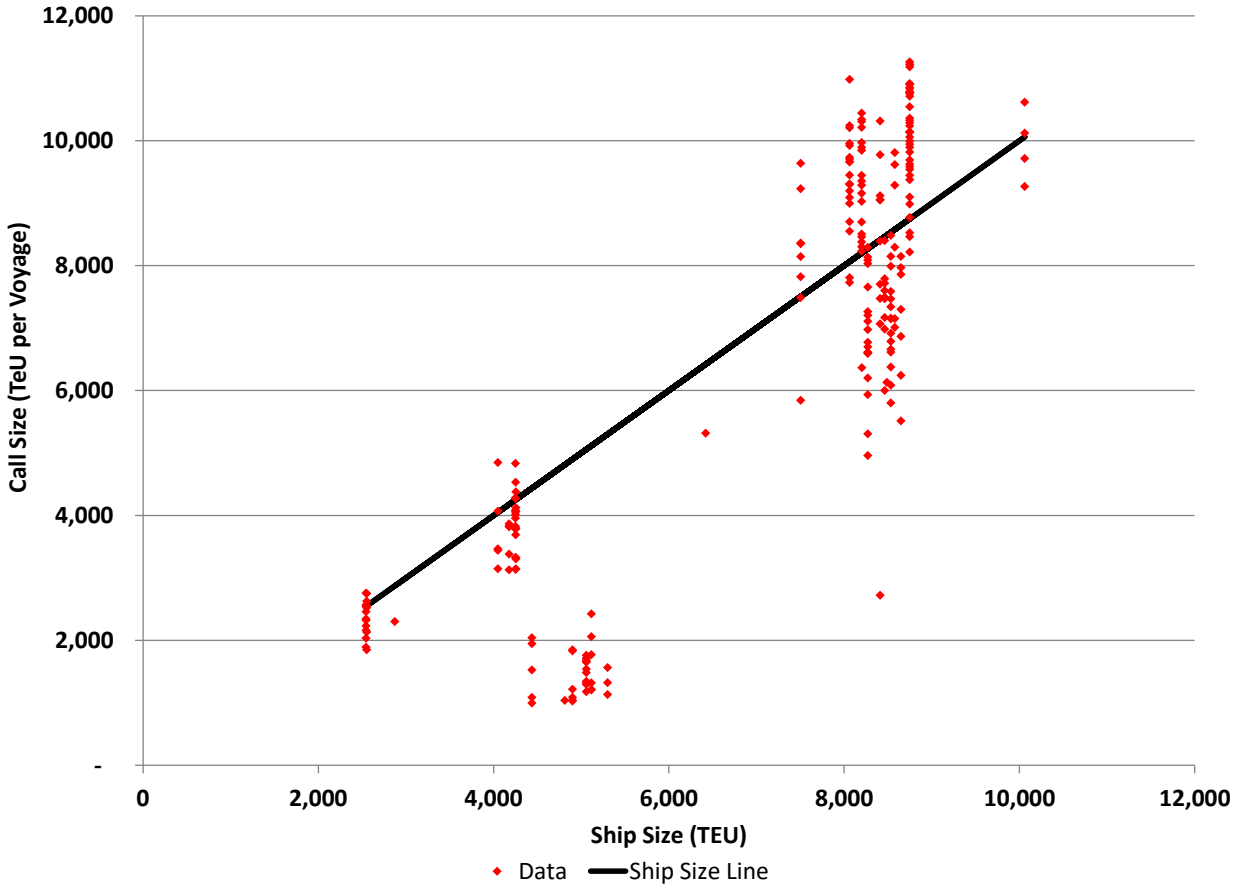
Figure 7 – Call Size Distributions for PMV and Deltaport 2013



Source: Estimated from Port Metro Vancouver data, 2014.

The relationship between call size and ship size is explored in Figure 8 for Deltaport. The "ship size line" equates call size to ship size. It shows that the larger ships (in this case primarily those between 8,000 and 9,000 TEU) tend to handle more than their TEU capacity on each voyage. Smaller ships tend to handle less.

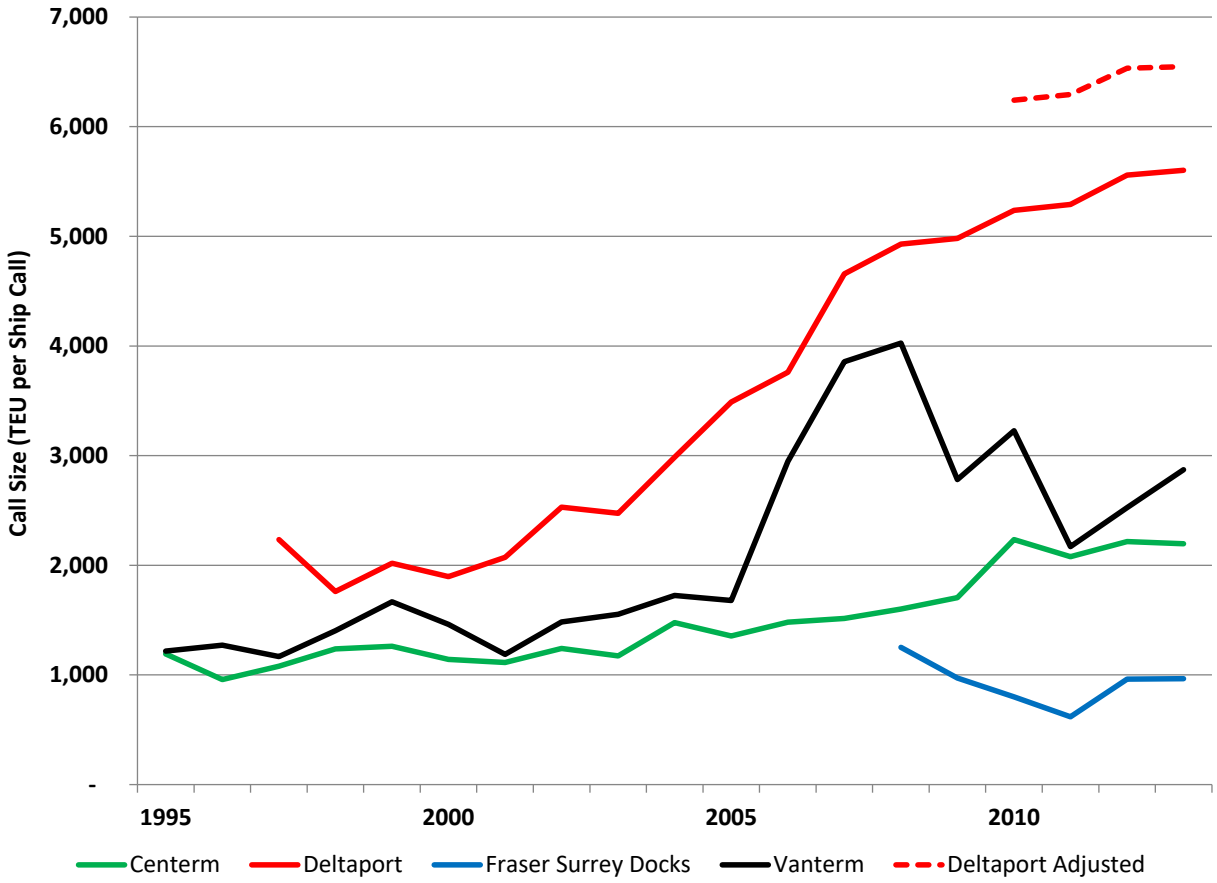
Figure 8 – Deltaport Call Size versus Ship Size 2013



Source: Estimated from Port Metro Vancouver data, 2014.

Figure 9 presents average call sizes by terminal for PMV from 1995 to 2013. With one exception, these reflect the data as PMV collects it and include the effect of the split service at Deltaport. The exception is that labeled "Deltaport Adjusted."

Figure 9 – Call Size Trends 1995 to 2013



Source: Estimated from Port Metro Vancouver data, 2014.

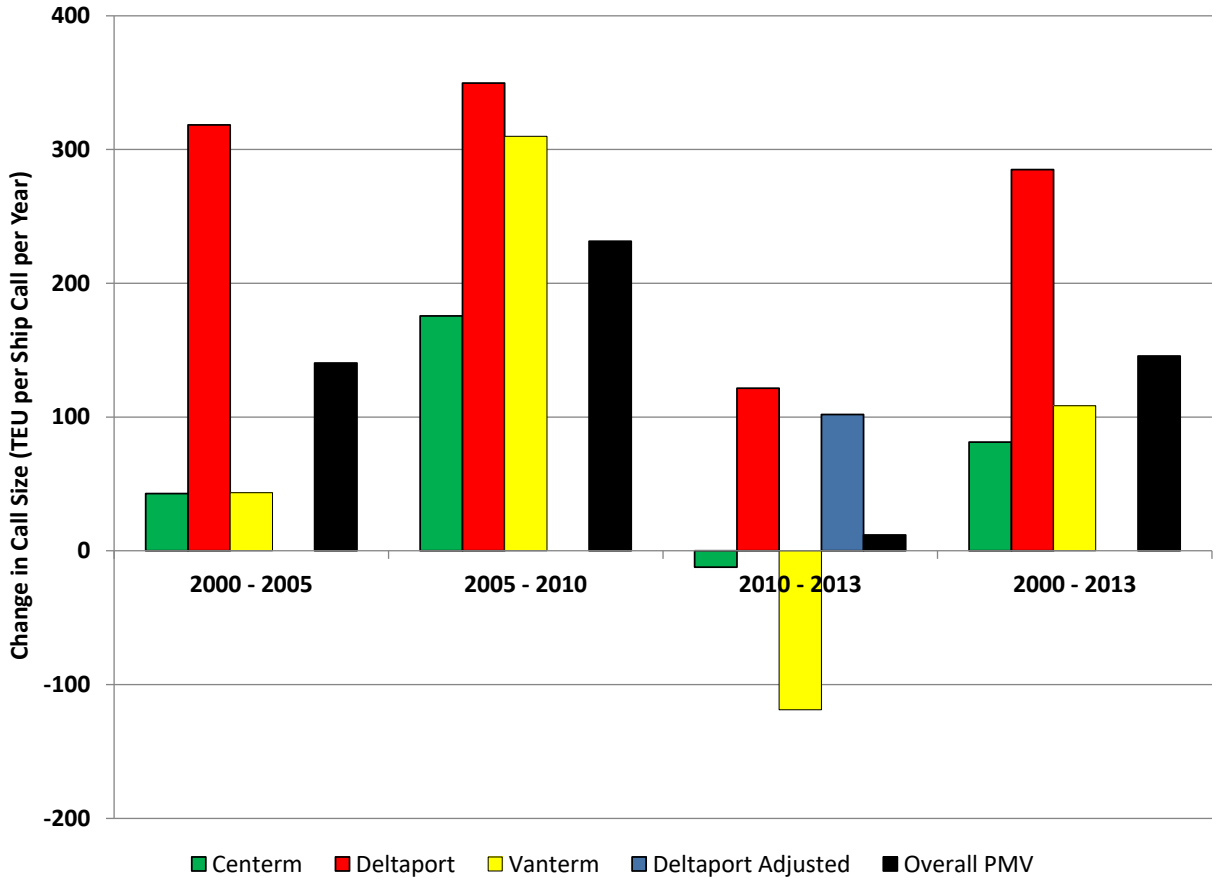
Some trends in the call sizes are:

- Centerm has drifted up over the years but remains at a low level. This is caused in part by the Westwood ships that call at this terminal. While these ships have a container capacity of around 2,000 TEU (which in itself would pull down the call size), they are primarily forest products carriers that handle break-bulk cargo.
- The call size of Vanterm has fluctuated over the years, with the highest levels in 2006 to 2008. This may have been caused by shifts in vessels between Vanterm and Deltaport (both operated by TSI Terminal Systems Inc.) when Deltaport was short of capacity before the third berth opened in 2009.
- Fraser Surrey Docks handles small ships on secondary trade routes and has had a call size of about 1,000 TEU in recent years.
- The unadjusted average call size of Deltaport has increased consistently since 2000. Between 2000 and 2007 the growth in call size followed an exponential growth pattern. Since 2007 it has increased at a lower and generally linear rate.
- The adjusted call size of Deltaport is above all the others and generally follows the linear pattern of the unadjusted Deltaport in 2010 to 2013.

Figure 10 uses the data from Figure 9 to estimate the incremental rates of call size increase between 2000 and 2013. These are the linear rates of increase for each time period. Some patterns that emerge are:

- The rates of increase between 2010 and 2013 were well below those of past periods.
- Deltaport had the highest rates of increase in all periods.
- The Deltaport rates of increase were about 300 TEU per ship call per year up to 2010; they were about 100 TEU for 2010 to 2013.

Figure 10 – Incremental Change in Call Size by Terminal 2000 to 2013



Source: Estimated from Port Metro Vancouver data, 2014.

The above review shows that it is likely that the average call size at Deltaport (and PMV as a whole) will increase. The low rates of increase in recent years and the consolidation of ships in the 8,000 to 9,000 TEU group indicate that the rates of increase are likely to be toward the lower end of the range, some 100 to 200 TEU per year.

Projections of Ship Sizes and Call Sizes

This section builds up projections of average ship sizes and call sizes (TEU per voyage) and distributions of container ship size from the base provided by the 2013 vessel data from PMV. It deals specifically with Deltaport as the basis for the estimates for RBT2.

Table 7 projects average ship sizes and call sizes (TEU per voyage) and ship size distributions for Deltaport between 2014 and 2030 that reflect the above reviews. Although the table summarizes five-year intervals beyond 2015, the actual projections were year-by-year.

The general approach to this exercise was:

- To project TEU per ship voyage (call size) between 2013 and 2030 at the top of the table. From the 2013 base, the projection uses the "projection increments" shown near the centre of the table for TEU per voyage. These were developed from the evaluations above and range from 200 TEU in 2014 to 150 TEU in 2030. The average TEU per voyage is projected to increase from 6,550 TEU in 2013 (the estimated 6,547 TEU rounded) to 9,200 TEU by 2030.
- To project the average ship size between 2013 and 2030 from the actual for 2013 and the trends discussed above. The ship size is projected to increase year-by-year using the increments of average ship size shown near the center of the table: 200 TEU per year in the early years tapering off in stages to 100 TEU in the latter years. Average ship size increases from 7,000 TEU (the estimated 6,969 TEU rounded) in 2013 to about 9,400 TEU in 2030. Considerations in these projections include:
    - As shown above, many of the new ships on order are very large, with the 13,000 + TEU group growing rapidly. Some shipping lines have ships of up to 19,200 TEU on order.
    - The largest ships will continue to be on the trades between Asia and Europe for a number of reasons. These include the long voyages on this trade and the economies of scale that long voyages bring out, and the high productivity of the major container terminals in Asia, the Middle East, the Mediterranean and northern Europe.
    - Ship sizes in the transpacific trade between Asia and the West Coast of North America are more constrained in part because of the relatively low productivity of North America's container terminals today and likely in the future. The ship size on the West Coast will increase considerably, but will not reach the maximum in the world trade and in particular that of the Asia – Europe route.
    - The trends of today in the transpacific trade will probably continue. The largest ships (10,000 to 13,000 TEU) are calling at the California ports and smaller ships (less than 9,000 TEU in most cases) are calling at PMV and the U.S. PNW ports. The relatively modest port traffic in PMV's region of B.C. and the U.S. PNW (about 7 million TEU in 2013 versus California's 17 million TEU) support the continuation of this trend in relative ship sizes.
    - The completion of the Panama Canal expansion may bring changes. Ships of "new Panamax" dimensions, up to some 13,000 TEU, could call at PMV as part of voyages through the canal.
- To project ship size distributions. The approach to ship size distributions is highly subjective because of the limited statistical basis. The above review showed that long-term changes in ship size distributions are quite gradual but short-term changes can be dramatic. The projections used in this study are relatively gradual because of its long-term nature. The bottom part of the table includes under "projection increments" the projected year-to-year change in the percentage of ships in each ship size category, ranging from less than 2,000 TEU (none of which have called at Deltaport for years) up to ships in excess of 10,000 TEU. These increments were chosen to reflect a reasonable pattern for changing ship size over 2013 to 2030. From these increments, the container vessel distributions in the upper part of the table were calculated year-by-year from the 2013 base. In general regarding the pattern:
    - Smaller ships, especially smaller post-Panamax ships, were projected to fade away.

- The existing dominant size group, 8,000 to 9,000 TEU, was projected to continue to grow the most in the early years.
- In 2015 and subsequent years, the 10,000 + TEU group was projected to increase and expand more rapidly in 2020 and subsequent years to reflect the Panama Canal expansion and changes in other container shipping patterns it may drive.

As a cross check, the weighted average ship sizes were calculated from the resulting vessel size distributions and the means of each ship size range. The results were compared with the projected average vessel sizes from the 2013 base and the incremental changes over time. The ship size distributions were adjusted so that the projected ship sizes calculated from the two approaches were consistent.

In general, it was possible to get reasonable agreement between the average ship size calculated from the vessel distributions and the values projected out to 2030. In 2030, the average from the vessel capacity distribution and the mean ship sizes is 9,365 TEU; the projected ship size from the 2013 base plus ship size growth increments is 9,375 TEU.

Table 7 – Deltaport Vessel Size Distributions Actual 2013 to Projected 2030

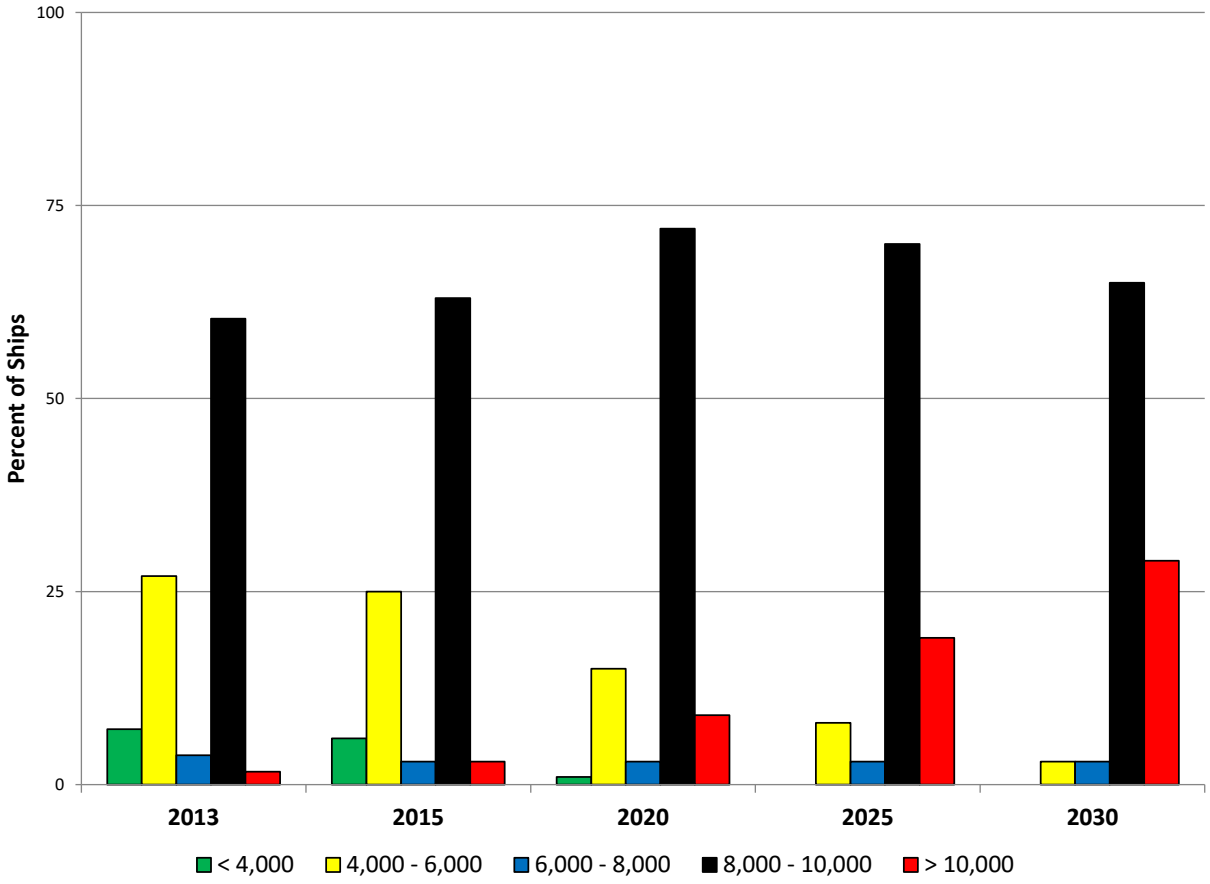
	Mean						Growth Rates (%/a)				
Item	TEU	2013	2015	2020	2025	2030	2013-15	2015-20	2020-25	2025-30	2013-30
TEU per Voyage		6,550	6,950	7,700	8,450	9,200	3.0	2.1	1.9	1.7	2.0
Distribution of Vessel Capacity (%)											
<= 2,000 TEU	1,000	0	0	0	0	0					
2,000 - 3,000	2,500	7	6	1	0	0					
3,000 - 4,000	3,500	0	0	0	0	0					
4,000 - 5,000	4,500	19	18	13	8	3					
5,000 - 6,000	5,500	8	7	2	0	0					
6,000 - 7,000	6,500	0	0	0	0	0					
7,000 - 8,000	7,500	3	3	3	3	3					
8,000 - 9,000	8,500	60	63	72	70	65					
9,000 - 10,000	9,500	0	0	0	0	0					
> 10,000	12,000	2	3	9	19	29					
Total		100	100	100	100	100					
Average Ship Size (TEU)											
Calculated from Above		7,091	7,285	8,145	8,815	9,365	1.4	2.3	1.6	1.2	1.6
Actual 2013 / Projected		7,000	7,400	8,225	8,875	9,375	2.8	2.1	1.5	1.1	1.7
Projection Increments											
TEU per Voyage			200	150	150	150					
Average Ship Size (TEU)			200	150	100	100					
Vessel Distributions (%)											
<= 2,000 TEU			0	0	0	0					
2,000 - 3,000			-1	-1	-1	-1					
3,000 - 4,000			0	0	0	0					
4,000 - 5,000			-1	-1	-1	-1					

Item	Mean TEU	2013	2015	2020	2025	2030	Growth Rates (%/a) 2013-15	2015-20	2020-25	2025-30	2013-30
5,000 - 6,000			-1	-1	-1	-1					
6,000 - 7,000			0	-1	-1	-1					
7,000 - 8,000			0	0	0	0					
8,000 - 9,000			2	1	-1	-1					
9,000 - 10,000			0	0	0	0					
> 10,000			1	2	2	2					
TEU per Voyage / Average Ship		92%	95%	95%	96%	98%	1.6	-0.2	0.3	0.5	0.4

Sources: Consultant projections, 2014.

Figure 11 shows the resulting distributions of ship sizes in 2013 and selected subsequent years. The 8,000 to 10,000 TEU group is projected to remain dominant with increasing numbers of ships of over 10,000 TEU for a few years. Small ships are projected to disappear and the Panamax (existing definition) and small post-Panamax ships in the 4,000 to 6,000 TEU range are projected to decline considerably. Ships of over 10,000 TEU are projected to grow slowly from 2015 to 2020 and more rapidly in 2020 and subsequent years.

Figure 11 – Projected Vessel Size Distributions for Roberts Bank Container Terminals 2013 - 2030



Sources: Consultant projections, 2014.