



REPORT

# AIR EMISSIONS INVENTORY

*Westshore Terminals Limited Partnership*

Prepared for:

**Westshore Terminals Limited Partnership**

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## EXECUTIVE SUMMARY

Westshore Terminals Limited Partnership (WTLP) is planning to diversify their existing coal export terminal in Delta, B.C. to accommodate the export of potash. Referred to as the Westshore New Cargo Export Project (Project), WTLP is working with a Producer who is evaluating opportunities to export potash from the west coast of North America (WTLP, 2020). The estimated emission inventories presented in this report include emissions from the following source groups on-site:

- Marine Vessels
- Rail
- Off-road
- On-road
- Administration
- Material Handling

Emissions associated with the immediate supply chain vicinity/regional study area (RSA) are also estimated. The emission estimates include the following air contaminants:

### Criteria Air Contaminants (CACs)

Nitrogen oxides (NO<sub>x</sub>), sulphur oxides (SO<sub>x</sub>), carbon monoxide (CO), volatile organic compounds (VOCs), particulate matter (PM, as total PM, PM<sub>10</sub> and PM<sub>2.5</sub>) and ammonia (NH<sub>3</sub>)

### Greenhouse Gases (GHGs)

Carbon dioxide equivalent (CO<sub>2e</sub>), carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrous oxide (N<sub>2</sub>O)

### Diesel Particulate Matter (DPM)

This inventory also presents baseline (pre- Project – 2019) emissions and future (with Project – 2026) emissions based on the terminal's export capacity per commodity (outlined/projected below):

- Baseline export capacity: Coal – 36 Mtpa
  - 2019 existing condition data are used, scaled to the current terminal capacity of 36 Mtpa.
- Future export capacity: 36 Mtpa terminal capacity including coal and potash, with potash not exceeding 4.5 Mtpa.
  - 31.5 Mtpa coal and 4.5 Mtpa potash;
  - 36 Mtpa coal and 0 Mtpa potash (with potash infrastructure installed).

Tables ES-1 and ES-2 presents the projected on-site emissions, while Tables ES-3 and ES-4 presents on-site emissions as well as emissions associated with rails and ships in the immediate supply chain vicinity (RSA).

As seen in the tables below, Estimated emissions generally decrease across all contaminants for both on-site and supply chain boundaries for both future scenarios when compared to the baseline. Due to the reduction in coal stockyard area, emissions from the 36 Mtpa coal and 0 Mtpa potash future scenario is expected to decrease from the baseline 36 Mtpa coal scenario. In the future scenario including 4.5 Mtpa potash, PM<sub>10</sub> and PM<sub>2.5</sub> emissions are estimated to increase due to differences in coal and potash handling equipment. However, as emissions across all other contaminants generally decrease or remain the same in both future scenarios (31.5 Mtpa coal / 4.5 Mtpa potash and 36 Mtpa coal / 0 Mtpa potash), it is anticipated the Project will have similar or reduced emissions to current conditions.

**Table ES 1: Estimated On-Site Air Emissions for Baseline/Future (31.5 Mtpa coal and 4.5 Mtpa potash)**

Year	Source group	Contaminant (Tonnes)										
		NO <sub>x</sub>	SO <sub>x</sub>	CO	VOC	PM	PM <sub>10</sub>	PM <sub>2.5</sub>	NH <sub>3</sub>	DPM	BC	CO <sub>2e</sub>
Baseline (36 Mtpa Coal)	Marine	110.72	6.44	14.44	5.16	2.76	2.76	2.55	0.29	2.55	0.63	12172
	Rail	50.64	0.01	10.25	2.24	1.05	1.05	1.02	0.01	1.02	0.74	4342
	Off-road	6.36	0.01	2.58	0.56	0.39	0.39	0.38	0.02	0.38	0.01	1828
	On-road	0.47	0.01	3.84	0.17	0.13	0.13	0.03	0.03	0.01	0.00	576
	Admin	0.20	0.01	0.11	0.02	0.01	0.01	0.01	0.02	0.00	-	188
	Material Handling (Coal)	-	-	-	-	200.24	68.45	11.70	-	-	-	-
	Material Handling (Potash)	-	-	-	-	-	-	-	-	-	-	-
	<b>Total</b>	<b>168.39</b>	<b>6.48</b>	<b>31.22</b>	<b>8.15</b>	<b>204.57</b>	<b>72.79</b>	<b>15.69</b>	<b>0.36</b>	<b>3.96</b>	<b>1.39</b>	<b>19,106</b>
Future**(31.5 Mtpa Coal; 4.5 Mtpa Potash)	Marine	72.02	6.42	14.55	5.17	2.77	2.77	2.56	0.29	2.56	0.64	12221
	Rail	44.18	0.01	10.20	1.94	0.90	0.90	0.88	0.01	0.88	0.64	4322
	Off-road	6.36	0.01	2.58	0.56	0.39	0.39	0.38	0.02	0.38	0.01	1828
	Onroad	0.47	0.01	3.84	0.17	0.13	0.13	0.03	0.03	0.01	0.00	576
	Admin	0.20	0.01	0.11	0.02	0.01	0.01	0.01	0.02	0.00	-	188
	Material Handling (Coal)	-	-	-	-	168.59	58.08	10.01	-	-	-	-
	Material Handling (Potash)	-	-	-	-	31.60	13.60	5.36	-	-	-	-
	<b>Total</b>	<b>123.23</b>	<b>6.46</b>	<b>31.28</b>	<b>7.86</b>	<b>204.39</b>	<b>75.88</b>	<b>19.23</b>	<b>0.36</b>	<b>3.83</b>	<b>1.29</b>	<b>19,136</b>
<b>% Difference</b>	<b>-26.8%</b>	<b>-0.3%</b>	<b>0.2%</b>	<b>-3.5%</b>	<b>-0.1%</b>	<b>4.3%</b>	<b>22.6%</b>	<b>0.0%</b>	<b>-3.3%</b>	<b>-6.7%</b>	<b>0.2%</b>	

\* Including GHGs associated with electricity consumption (e.g., scope 2 sources)

\*\*Future case includes two scenarios: 31.5 Mtpa coal and 4.5 Mtpa potash; and 36 Mtpa coal and 0 Mtpa potash (with potash infrastructure installed).

**Table ES 2: Estimated On-Site Air Emissions for Baseline/Future (36 Mtpa coal and 0 Mtpa potash)**

Year	Source group	Contaminant (Tonnes)										
		NO <sub>x</sub>	SO <sub>x</sub>	CO	VOC	PM	PM <sub>10</sub>	PM <sub>2.5</sub>	NH <sub>3</sub>	DPM	BC	CO <sub>2e</sub>
Baseline (36 Mtpa Coal)	Marine	110.72	6.44	14.44	5.16	2.76	2.76	2.55	0.29	2.55	0.63	12172
	Rail	50.64	0.01	10.25	2.24	1.05	1.05	1.02	0.01	1.02	0.74	4342
	Off-road	6.36	0.01	2.58	0.56	0.39	0.39	0.38	0.02	0.38	0.01	1828
	On-road	0.47	0.01	3.84	0.17	0.13	0.13	0.03	0.03	0.01	0.00	576
	Admin	0.20	0.01	0.11	0.02	0.01	0.01	0.01	0.02	0.00	-	188
	Material Handling (Coal)	-	-	-	-	200.24	68.45	11.70	-	-	-	-
	Material Handling (Potash)	-	-	-	-	-	-	-	-	-	-	-
	<b>Total</b>	<b>168.39</b>	<b>6.48</b>	<b>31.22</b>	<b>8.15</b>	<b>204.57</b>	<b>72.79</b>	<b>15.69</b>	<b>0.36</b>	<b>3.96</b>	<b>1.39</b>	<b>19,106</b>
Future**(36 Mtpa Coal; 0 Mtpa Potash)	Marine	71.41	6.44	14.44	5.16	2.76	2.76	2.55	0.29	2.55	0.63	12,172
	Rail	40.34	0.01	9.32	1.77	0.83	0.83	0.80	0.01	0.80	0.58	3,947
	Off-road	6.36	0.01	2.58	0.56	0.39	0.39	0.38	0.02	0.38	0.01	1,828
	On-road	0.47	0.01	3.84	0.17	0.13	0.13	0.03	0.03	0.01	0.00	576
	Admin	0.20	0.01	0.11	0.02	0.01	0.01	0.01	0.02	0.00	-	188
	Material Handling (Coal)	-	-	-	-	189.90	65.35	11.01	-	-	-	-
	Material Handling (Potash)	-	-	-	-	-	-	-	-	-	-	-
	<b>Total</b>	<b>118.78</b>	<b>6.48</b>	<b>30.28</b>	<b>7.68</b>	<b>194.02</b>	<b>69.46</b>	<b>14.78</b>	<b>0.36</b>	<b>3.74</b>	<b>1.23</b>	<b>18,711</b>
<b>% Difference</b>	<b>-29.5%</b>	<b>0.0%</b>	<b>-3.0%</b>	<b>-5.7%</b>	<b>-5.2%</b>	<b>-4.6%</b>	<b>-5.8%</b>	<b>0.0%</b>	<b>-5.5%</b>	<b>-11.4%</b>	<b>-2.1%</b>	

\* Including GHGs associated with electricity consumption (e.g., scope 2 sources)

\*\*Future case includes two scenarios: 31.5 Mtpa coal and 4.5 Mtpa potash; and 36 Mtpa coal and 0 Mtpa potash (with potash infrastructure installed).

**Table ES 3: Estimated RSA Air Emissions for Baseline/ Future (31.5 Mtpa coal and 4.5 Mtpa potash)**

Year	Source group	Contaminant (Tonnes)										
		NO <sub>x</sub>	SO <sub>x</sub>	CO	VOC	PM	PM <sub>10</sub>	PM <sub>2.5</sub>	NH <sub>3</sub>	DPM	BC	CO <sub>2e</sub>
Baseline (36 Mtpa Coal)	Marine	520.55	28.62	61.93	23.99	11.83	11.83	10.91	1.17	10.91	2.49	50883
	Rail	77.35	0.01	15.65	3.42	1.60	1.60	1.55	0.01	1.55	1.13	6632
	Off-road	6.36	0.01	2.58	0.56	0.39	0.39	0.38	0.02	0.38	0.01	1828
	On-road	0.47	0.01	3.84	0.17	0.13	0.13	0.03	0.03	0.01	0.00	576
	Admin	0.20	0.01	0.11	0.02	0.01	0.01	0.01	0.02	0.00	-	188
	Material Handling (Coal)	-	-	-	-	200.24	68.45	11.70	-	-	-	-
	Material Handling (Potash)	-	-	-	-	-	-	-	-	-	-	-
	<b>Total</b>	<b>604.93</b>	<b>28.67</b>	<b>84.11</b>	<b>28.15</b>	<b>214.20</b>	<b>82.41</b>	<b>24.58</b>	<b>1.24</b>	<b>12.85</b>	<b>3.64</b>	<b>60,107</b>
Future**(31.5 Mtpa Coal; 4.5 Mtpa Potash)	Marine	304.10	29.47	63.99	24.72	12.21	12.21	10.79	1.21	10.79	2.22	52533
	Rail	64.17	0.01	14.82	2.82	1.31	1.31	1.27	0.01	1.27	0.93	6279
	Off-road	6.36	0.01	2.58	0.56	0.39	0.39	0.38	0.02	0.38	0.01	1828
	On-road	0.47	0.01	3.84	0.17	0.13	0.13	0.03	0.03	0.01	0.00	576
	Admin	0.20	0.01	0.11	0.02	0.01	0.01	0.01	0.02	0.00	-	188
	Material Handling (Coal)	-	-	-	-	168.59	58.08	10.01	-	-	-	-
	Material Handling (Potash)	-	-	-	-	31.60	13.60	5.36	-	-	-	-
	<b>Total</b>	<b>375.30</b>	<b>29.51</b>	<b>85.34</b>	<b>28.29</b>	<b>214.24</b>	<b>85.73</b>	<b>27.86</b>	<b>1.28</b>	<b>12.45</b>	<b>3.16</b>	<b>61,404</b>
<b>% Difference</b>	<b>-38.0%</b>	<b>3.0%</b>	<b>1.5%</b>	<b>0.5%</b>	<b>0.0%</b>	<b>4.0%</b>	<b>13.3%</b>	<b>3.3%</b>	<b>-3.1%</b>	<b>-13.2%</b>	<b>2.2%</b>	

\* Including GHGs associated with electricity consumption (e.g., scope 2 sources)

\*\*Future case includes two scenarios: 31.5 Mtpa coal and 4.5 Mtpa potash; and 36 Mtpa coal and 0 Mtpa potash (with potash infrastructure installed).

**Table ES 4: Estimated RSA Air Emissions for Baseline/ Future (36 Mtpa coal and 0 Mtpa potash)**

Year	Source group	Contaminant (Tonnes)										
		NO <sub>x</sub>	SO <sub>x</sub>	CO	VOC	PM	PM <sub>10</sub>	PM <sub>2.5</sub>	NH <sub>3</sub>	DPM	BC	CO <sub>2e</sub>
Baseline (36 Mtpa Coal)	Marine	520.55	28.62	61.93	23.99	11.83	11.83	10.91	1.17	10.91	2.49	50883
	Rail	77.35	0.01	15.65	3.42	1.60	1.60	1.55	0.01	1.55	1.13	6632
	Off-road	6.36	0.01	2.58	0.56	0.39	0.39	0.38	0.02	0.38	0.01	1828
	On-road	0.47	0.01	3.84	0.17	0.13	0.13	0.03	0.03	0.01	0.00	576
	Admin	0.20	0.01	0.11	0.02	0.01	0.01	0.01	0.02	0.00	-	188
	Material Handling (Coal)	-	-	-	-	200.24	68.45	11.70	-	-	-	-
	Material Handling (Potash)	-	-	-	-	-	-	-	-	-	-	-
	<b>Total</b>	<b>604.93</b>	<b>28.67</b>	<b>84.11</b>	<b>28.15</b>	<b>214.20</b>	<b>82.41</b>	<b>24.58</b>	<b>1.24</b>	<b>12.85</b>	<b>3.64</b>	<b>60,107</b>
Future**(36 Mtpa Coal; 0 Mtpa Potash)	Marine	294.02	28.62	61.93	23.99	11.83	11.83	10.91	1.17	10.91	2.49	50,883
	Rail	57.84	0.01	13.36	2.54	1.18	1.18	1.15	0.01	1.15	0.84	5,659
	Off-road	6.36	0.01	2.58	0.56	0.39	0.39	0.38	0.02	0.38	0.01	1,828
	On-road	0.47	0.01	3.84	0.17	0.13	0.13	0.03	0.03	0.01	0.00	576
	Admin	0.20	0.01	0.11	0.02	0.01	0.01	0.01	0.02	0.00	-	188
	Material Handling (Coal)	-	-	-	-	189.90	65.35	11.01	-	-	-	-
	Material Handling (Potash)	-	-	-	-	-	-	-	-	-	-	-
	<b>Total</b>	<b>358.89</b>	<b>28.67</b>	<b>81.81</b>	<b>27.28</b>	<b>203.45</b>	<b>78.89</b>	<b>23.49</b>	<b>1.24</b>	<b>12.45</b>	<b>3.34</b>	<b>59,133</b>
<b>% Difference</b>	<b>-40.7%</b>	<b>0.0%</b>	<b>-2.7%</b>	<b>-3.1%</b>	<b>-5.0%</b>	<b>-4.3%</b>	<b>-4.4%</b>	<b>0.0%</b>	<b>-3.1%</b>	<b>-8.1%</b>	<b>-1.6%</b>	

\* Including GHGs associated with electricity consumption (e.g., scope 2 sources)

\*\*Future case includes two scenarios: 31.5 Mtpa coal and 4.5 Mtpa potash; and 36 Mtpa coal and 0 Mtpa potash (with potash infrastructure installed).

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## GLOSSARY OF ACRONYMS AND ABBREVIATIONS

List of Acronyms	
AE	Auxiliary Engine
AWMA	Air and Waste Management Association
AAQO	Ambient Air Quality Objectives
AQ	Air Quality
ASL	Above Sea Level
B.C.	British Columbia
B.C. MOE	B.C. Ministry of the Environment and Climate Change Strategy
BNSF	Burlington Northern Santa Fe
BSFC	Brake Specific Fuel Consumption
CAAQS	Canadian Ambient Air Quality Standards
CAC	Common Air Contaminant
CN	Canadian Northern Rail
CO <sub>2e</sub>	Carbon Dioxide Equivalent
CPR	Canadian Pacific Rail
DB	Dynamic Breaking
DWT	Dead Weight Tonnage
ECA	Emission Control Area
ECCC	Environment and Climate Change Canada
EF	Emission Factor
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
kWh	Kilowatt-hour
LST	Leaf Surface Temperature
MDO	Marine Diesel Oil
Mtpa	Metric tonnes per annum
ME	Main Engine
MGO	Marine Gas Oil
MV	Metro Vancouver
NAD83	North American Datum of 1983
NIR	National Inventory Report
OGVs	Ocean Going Vessels
PEIT	Port Emissions Inventory Tool
PPM	Part Per Million
RAC	Railway Association of Canada
RH	Relative Humidity
RSA	Regional Study Area

RTK	Revenue Tonne Kilometer
U.S. EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VFPA	Vancouver Fraser Port Authority
WRAP	Western Regional Air Partnership
WTLP	Westshore Terminals Limited Partnership
WS	Wind Speed
WD	Wind Direction
<b>Contaminants</b>	
BC	black carbon
CO	carbon monoxide
CO <sub>2</sub>	carbon dioxide
DPM	diesel particulate matter
GHG	greenhouse gas
NH <sub>3</sub>	ammonia
NO	nitric oxide
NO <sub>2</sub>	nitrogen dioxide
NO <sub>x</sub>	nitrogen oxides
N <sub>2</sub> O	nitrous oxide
TPM	Total particulate matter
PM <sub>10</sub>	inhalable particulate matter (particulate matter up to 10 micrometers in size)
PM <sub>2.5</sub>	fine particulate matter (particulate matter up to 2.5 micrometers in size)
SO <sub>2</sub>	sulphur dioxide
SO <sub>x</sub>	sulphur oxides
VOC	volatile organic compound

## 1.0 INTRODUCTION

Westshore Terminals Limited Partnership (WTLP) is planning to diversify their existing coal export terminal in Delta, B.C. to accommodate the export of potash. Referred to as the Westshore New Cargo Export Project (the Project), WTLP is working with a Producer who is evaluating opportunities to export potash from the west coast of North America (WTLP, 2020). WTLP has applied to the Vancouver Fraser Port Authority (VFPA) and is continuing to move forward with the Project and Environmental Review process. WTLP operates under Metro Vancouver (MV) air permit No. GVA0153 (last amended December 7<sup>th</sup>, 2005).

WTLP currently has a coal export capacity of 36 million tonnes per annum (Mtpa). This study characterizes the emissions associated with WTLP's current permitted capacity, as well as the future scenarios (with the New Cargo Export Project included). A previous air quality study in support of changes to the terminal to support the current capacity was completed in 2013 (SNC-Lavalin, 2013). An aerial view of WTLP operations is shown in **Figure 1**.



**Figure 1: WTLP – Aerial View**

## 1.1 New Cargo Export Project

The Project will handle up to 4.5 Mtpa of standard and granular potash. In order to incorporate potash operations, new infrastructure at WTLP will be required which will broadly include the following items (WTLP, 2020):

- Minor modifications to the existing inbound rail system to connect the new dumper to the existing inner rail loop
- A new potash railcar dumper on the south side of the site adjacent to the existing dumpers
- A new A-frame potash storage building, including tripper conveyor and portal reclaimer located on the northwest corner of the site
- New enclosed gallery style conveyors and transfer towers to transport potash from the railcar dumper to the storage building and from the storage building to the existing Berth #2 shiploaders
- Dust collectors at conveyor transfer points
- Modifications to existing Berth #2 shiploaders and feed conveyors to accommodate loading potash
- Electrical infrastructure and upgrades
- Civil infrastructure and upgrades

Although coal operations will continue at WTLP during and after the construction of the potash facilities, it is anticipated the current maximum area available for coal storage (~40 ha) will be displaced by the area required for the potash project (~5.6 ha) resulting in a reduced coal storage area of 34.4 ha. Berth 1 will continue to be used to exclusively to ship coal while Berth 2 will be designed to accommodate both commodities. Similarly, since potash ships will displace a portion of coal ships at Berth 2, an annual throughput reduction in coal shipped through Berth 2 is expected. The inventory assumes 2026 for the future operations (including both 31.5 Mtpa coal and 4.5 Mtpa potash, and 36 Mtpa coal and 0 Mtpa potash scenarios) when necessary.

## 1.2 Scope of Emission Inventory

The scope for this air emissions inventory includes the development of an inventory for current/baseline WTLP operations (based on a maximum capacity of 36 Mtpa coal), and development of an inventory for future WTLP operations (with the Project, based on a future export capacity of 36 Mtpa terminal capacity for coal and potash, with potash not exceeding 4.5 Mtpa). Emission calculations for future operations include both 31.5 Mtpa coal and 4.5 Mtpa potash, and 36 Mtpa and 0 Mtpa potash scenarios.

For each scenario, emissions are assessed based on both on-site activities only, and on-site activities plus activities in the direct supply chain vicinity (RSA). The terminal itself includes its two water berths, while the RSA constitutes the terminal as well as additional areas on both land and water sides (i.e., marine and rail traffic to/from WTLP, outlined in **Figure 2**). These additional areas include the following:

- Shipping lanes used by ocean going vessels travelling through the Strait of Georgia that make a stop at the WTLP;

- The bulk carriers that arrive at the WTLP that either travel ~5km from the shipping lane into the terminal or go to anchor in English Bay to await an open berth (approximately 30km from the terminal); and,
- The WTLP rail yard located on the Roberts Bank causeway to WTLP. This track length is approximately 5km.



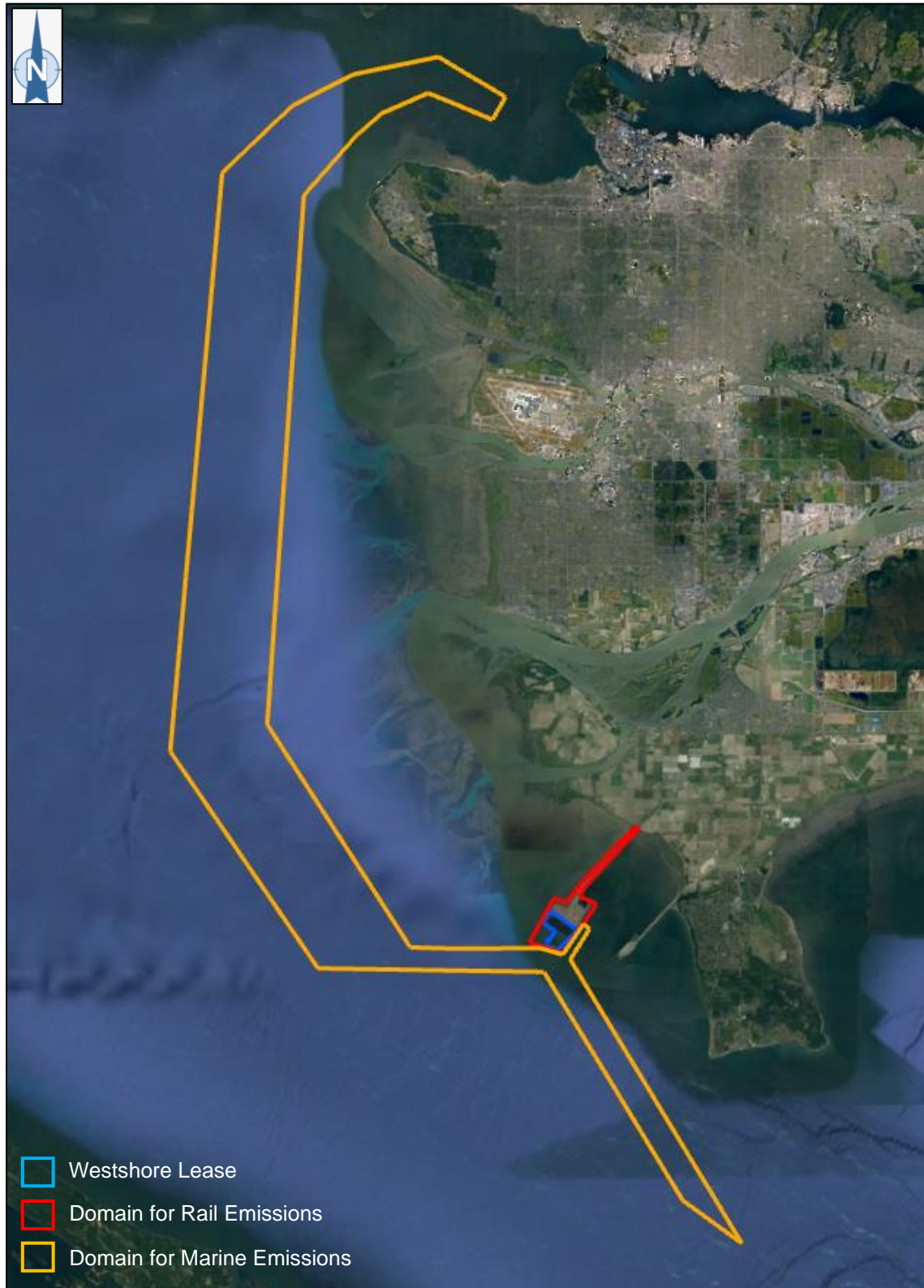


Figure 2: WTLP Air Quality Inventory – Regional Study Area (RSA)



Characterization of the existing air quality in and near WTLP operations is also addressed, based on historical monitoring data and other available information.

The emission estimates include the following air contaminants:

Criteria Air Contaminants (CACs)

Nitrogen oxides (NO<sub>x</sub>), sulphur oxides (SO<sub>x</sub>), carbon monoxide (CO), volatile organic compounds (VOCs), particulate matter (PM, as total PM, PM<sub>10</sub> and PM<sub>2.5</sub>) and ammonia (NH<sub>3</sub>)

Greenhouse Gases (GHGs)

Carbon dioxide equivalent (CO<sub>2e</sub>), carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrous oxide (N<sub>2</sub>O)

Diesel Particulate Matter (DPM)

CO<sub>2e</sub> amounts are consistent with the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report Global Warming Potential values of 1, 25, and 298 for CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O, respectively (IPCC, 2007).

## 2.0 AMBIENT AIR QUALITY

### 2.1 Meteorological Conditions

**Table 1** provides a summary of information for the Tsawwassen Ferry Terminal Monitoring Station (2 km east of the facility) based on 2019 data. For comparison purposes, the most recent available data (2018) from Metro Vancouver (MV) Tsawwassen Monitoring Station (6km east of WTLP) is also provided for reference. Windrose diagrams for each station are also generated (**Figure 4**) to show the frequency distributions for both annual wind speed and wind direction.

**Table 1: Identification of Monitoring Stations and Wind Speed Statistics**

Parameter	Tsawwassen Ferry Terminal Met Station	Tsawwassen MV Met Station
<b>Station information</b>		
Location (Latitude Longitude)	49°0'26.79" N, 123°7'57.32" W	49°0'35.64" N, 123°4'55.22" W
Location (UTM NAD83, Zone 10)	490.467 km E, 5428.230 km N	490.004 km E, 5428.560 km N
Elevation (m ASL)	15.0	52.0
Station Owner	WTLP	Metro Vancouver
<b>Meteorological Data</b>		
Data Period	2019	2018
Parameters Measured	WS, WD, Wind Gust, temperature (max, min, average), relative humidity, precipitation	WS, WD, Wind Gust, temperature (max, min, average), relative humidity, precipitation
Average Data Capture for 2019	100% (WS), 100% (WD)	99% (WS), 99% (WD)
Calms Hours in 2019 (WS < 0.5 m/s)	107 (1.22%)	674 (7.69%)
Annual Mean WS (m/s)	2.96	1.98

Both meteorological monitoring stations demonstrate a high data capture percentage (99%+). Differences in annual mean wind speed (between the two stations) can likely be attributed to differences in geographical location (e.g., by water vs inland). An image showing station locations is also provided for reference (**Figure 3**).

As seen in **Figure 4**, the typical annual distributions of winds by direction are similar for the two stations.

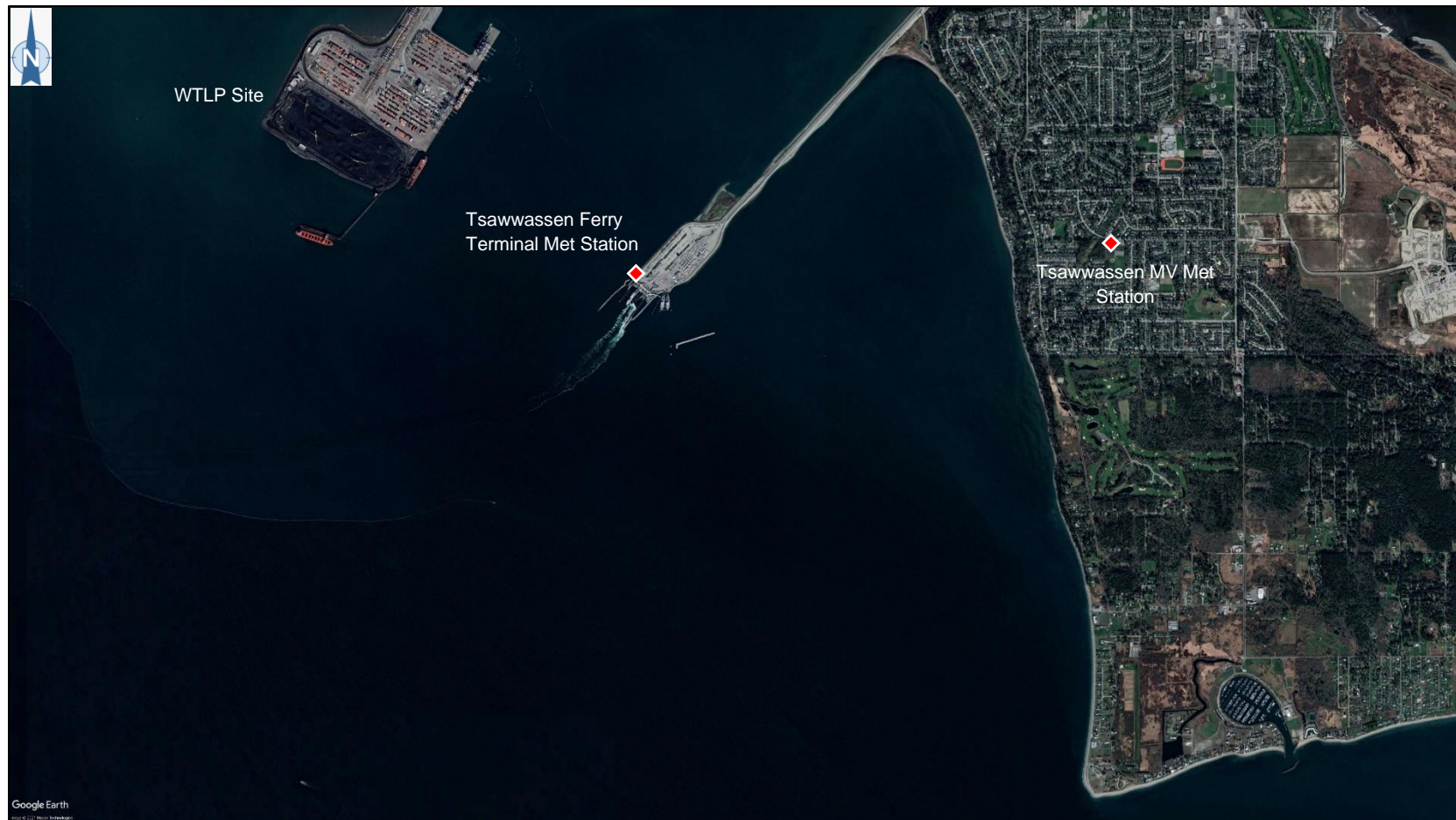
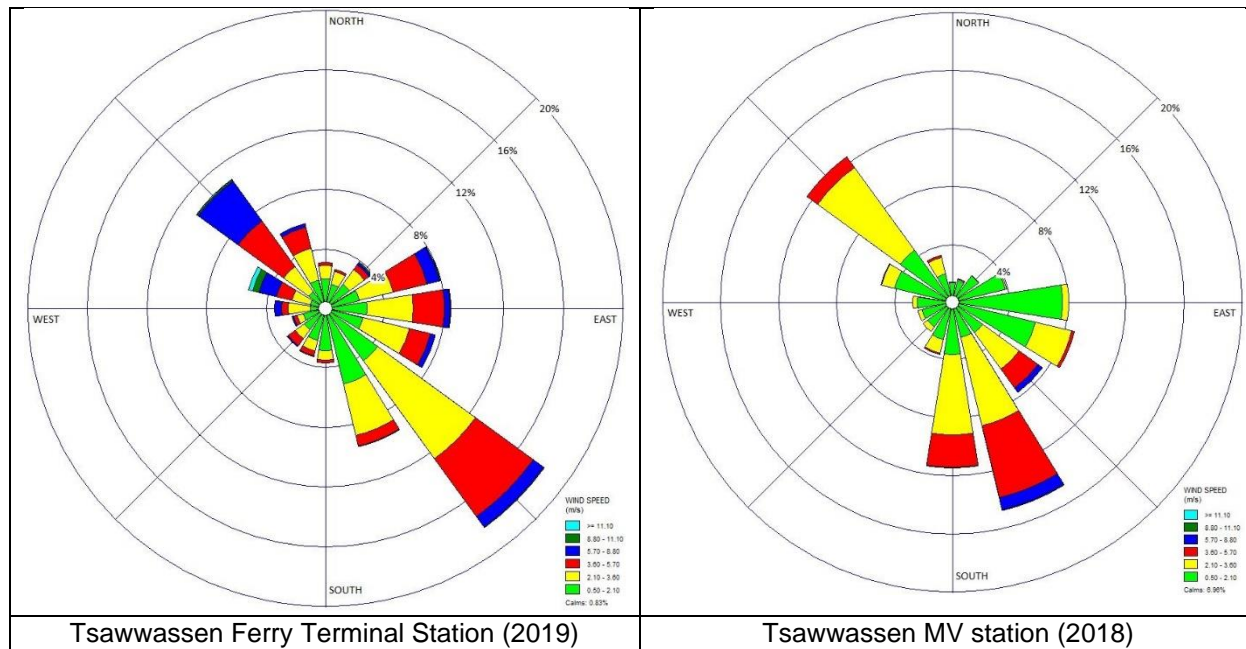


Figure 3: Location of Meteorological and AQ Stations in the Vicinity of WTLP



\*Wind rose indicate direction wind is blowing from

**Figure 4: 2019 Windrose Diagrams for the Tsawwassen Ferry Terminal Monitoring Station (left) and the Nearby MV Station in Tsawwassen (right)\***

Additional meteorological data (e.g., temperature, relative humidity and precipitation) from the two stations is presented in **Table 2**.

**Table 2: Concentrations Statistics of Criteria Air Contaminations at the Tsawwassen Ferry Terminal Station (2019) and the Tsawwassen MV Station (2018)**

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Tsawwassen MV Station (2018)</b>												
Mean RH at 0600LST, %	91.9	82.1	87.8	83.0	81.0	79.4	78.9	90.1	96.4	96.3	97.4	91.1
Mean RH at 1500LST, %	89.6	73.8	71.6	68.5	58.8	62.5	56.7	61.1	76.7	81.2	92.4	85.1
Daily Mean Temp, °C	5.0	3.5	6.2	9.4	14.4	15.2	18.9	18.1	14.1	10.5	7.9	5.2
<b>Tsawwassen Ferry Terminal Station (2019)</b>												
Total Precip. 2019, mm	70.1	27.8	14.7	67.8	26	11.7	21.5	17.6	81.5	86.1	54.1	85.9

## 2.2 Regional Air Quality Objectives

Standards, Objectives and Guidelines are expressed by various levels of Canadian government to ensure the protection of human health and the environment. Applicable ambient air quality objectives (from Metro Vancouver, B.C. MOE, CAAQS) are shown in **Table 3**, noting the applicable averaging periods for each objective. The most stringent objectives/standards are considered applicable for a particular air contaminant and averaging period.

**Table 3: Applicable<sup>(a)</sup> ambient air quality objectives for air contaminants**

Air Contaminant	Averaging Time	Ambient Air Quality Objective	
		( $\mu\text{g}/\text{m}^3$ )	(ppb)
Carbon Monoxide (CO)	1-hour	14,900	13,000
	8-hour	5,700	5,000
Nitrogen dioxide (NO <sub>2</sub> )	1-hour	113	60
	Annual	32	17
Sulphur dioxide (SO <sub>2</sub> )	1-hour	183	70
	Annual	13	5
Total Particulate Matter (TPM) <sup>(a)</sup>	24-hour	120	--
	Annual	60	--
Inhalable particulate matter (PM <sub>10</sub> )	24-hour	50	--
	Annual	20	--
Fine particulate matter (PM <sub>2.5</sub> )	24-hour	25	--
	Annual	8 (6)	--

<sup>a)</sup> Objectives obtained from Metro Vancouver, B.C. MOE, CAAQS

## 2.3 Air Quality Baseline

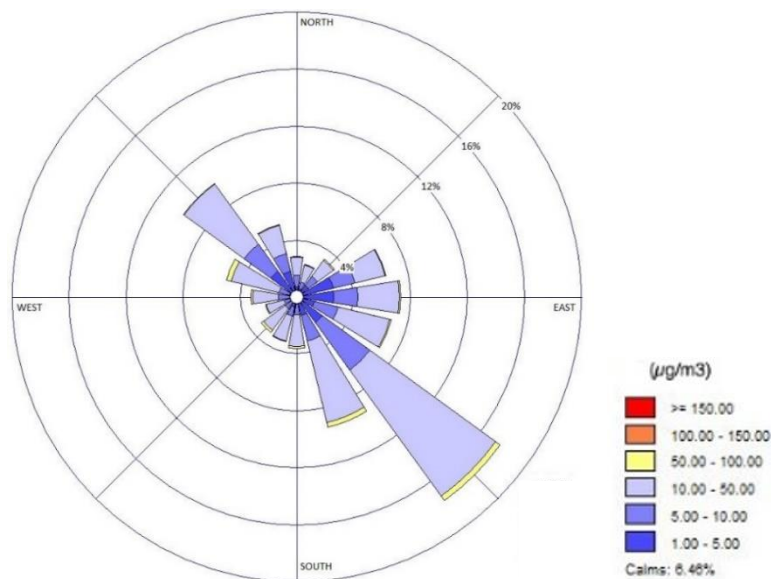
**Table 4** provides a summary of the ambient air quality data collected at the Tsawwassen MV Station (2019 data) and at the Tsawwassen Ferry Terminal Station (2019 data). Percentile values are also shown for the 1-hour concentrations, to identify typical patterns between relatively high concentrations and average values.

**Table 4: Concentrations Statistics of Criteria Air Contaminations at the Tsawwassen Ferry Terminal Station (2019) and the MV Tsawwassen Station (2019)**

Parameters	Concentrations						
	MV Tsawwassen AQ Station						Tsawwassen Ferry Station
	NO	NO <sub>2</sub>	O <sub>3</sub>	CO	SO <sub>2</sub>	PM <sub>2.5</sub>	TPM
Units	ppb	ppb	ppb	ppm	ppb	µg/m <sup>3</sup>	µg/m <sup>3</sup>
1-Hour Maximum (2019)	70.30	43.40	55.60	0.58	4.80	48.40	740.48
1-Hour 99 <sup>th</sup> Percentile (2019)	27.71	24.60	44.05	0.32	1.30	16.60	58.57
1-Hour 98 <sup>th</sup> Percentile (2019)	20.50	22.40	42.40	0.29	0.90	14.10	50.71
1-Hour 95 <sup>th</sup> Percentile (2019)	11.70	18.50	39.40	0.24	0.60	10.70	38.59
1-Hour 90 <sup>th</sup> Percentile (2019)	5.80	15.10	36.60	0.21	0.40	8.10	30.32
1-Hour 70 <sup>th</sup> Percentile (2019)	1.30	8.10	28.80	0.15	0.20	4.88	17.41
Annual Mean (2019)	2.37	6.66	21.78	0.14	0.17	4.34	14.48
8-Hour Maximum (2019) 4th highest			36.91	25.44			
24-Hour Maximum (2019)	24.03	22.63	42.34	0.32	0.95	20.90	152.36

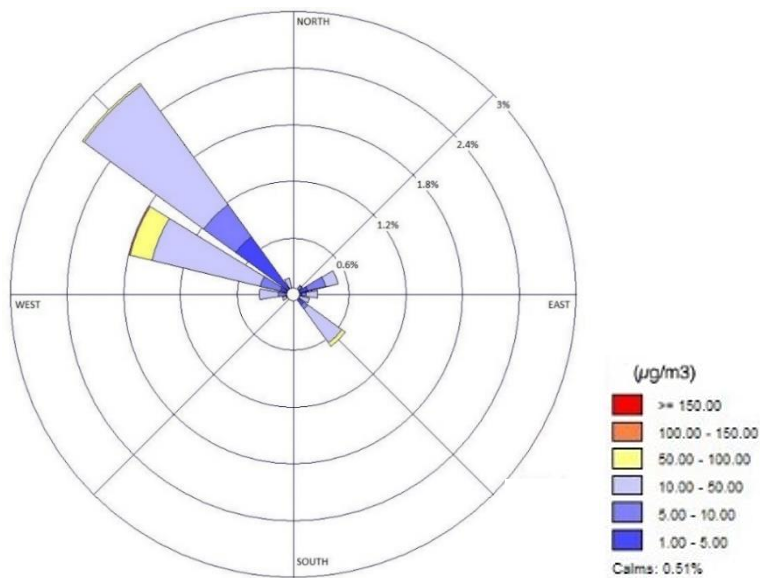
The maximum 24-hr TPM value at the Ferry terminal exceeded the national objective of 120 µg/m<sup>3</sup> on one occasion (observed on October 8<sup>th</sup> to October 9<sup>th</sup>). A simple wind analysis was conducted for the occasion. The mean wind speed for this occasion is 0.97 m/s (standard deviation of 0.46 m/s). Winds blew from the NW, NE, and SE sectors. The analysis indicates winds were light and variable in direction during the hours of exceedances and wind erosion from the stockpile (which is caused by high wind speeds) was not likely significant on this occasion. Traffic and other sources in the vicinity of the monitor can cause elevated TPM readings. It is possible that the exceedance was caused by external sources from outside WTLP.

A 'pollution rose' was constructed for the Tsawwassen Ferry Terminal Station location to provide a view of the dust concentrations allocated to the different wind sectors over 2019. The diagram links the hourly dust concentrations with the hourly average wind direction at the same location.



**Figure 5: Pollution Roses for 1-hr PM (dust) Measurements at Ferry in 2019**

**Figure 5** shows that the highest 1-hour dust measurements occur when ambient winds are from the SE sector. An additional pollution rose was developed for periods when the wind speed at the Ferry Terminal was 6m/s or higher. This diagram shows that the highest 1-hour dust measurements occur when winds (6m/s or higher) are from the NW sector.



**Figure 6: Pollution Roses for 1-hr PM (dust) Measurements at Ferry in 2019 with Wind Speeds of 6 m/s or Higher**



## 2.4 Dust Deposition

Dust deposition is also measured at/near WTLP operations through a dustfall monitoring program. Results of the dustfall monitoring program for 2019 is shown in **Table 5** below. The approximate locations of the two dustfall canisters at the WTLP site are identified in greater detail in **Figure 7** below for reference.



**Figure 7: Location of Dustfall Canisters at WTLP**

**Table 5: Dustfall Data, 2019 (Total Particulate, in mg/dm<sup>2</sup>/day, 30-day Average)**

Year	Measure	Westshore #7	Westshore #8	Station #1 - Ferry Berth 5	Station #4 - Ferry West Fence	Station #5 - Marina SW	Station #6 - Marina NE	MAMU #1	MAMU #2
2019	Maximum	8.36	10.44	5.63	3.71	2.42	2.32	0.60	1.04
	Average	1.76	5.89	1.61	1.21	0.69	0.52	0.47	0.59

Provincial dust deposition objectives include a 'Lower' objective of 1.75 mg/dm<sup>2</sup>/day, and an 'Upper' objective of 2.90 mg/dm<sup>2</sup>/day, averaged over 30 days. These objectives are applicable to off-site areas. Only location #8 (one of two on-site locations) showed high dust deposition values relative to objectives. It should be noted that dustfall measurements can be problematic, due to contamination of the sample with non-dustfall materials (such as bird feces). While efforts are made to visually identify contaminated samples before they are sent to the lab for analysis, there is no fail-proof method to ensure that all contaminated samples are removed from the analysis.



### 3.0 ACTIVITY DESCRIPTION

This emissions inventory is based on current and future export capacities at WTLP. To provide context to the site, ship and rail throughput data to the WTLP are shown in **Table 6** for the last five years. Total fuels and energy to run the terminal is shown in **Table 7**.

**Table 6: WTLP Marine and Rail Activity, 2015 - 2019**

Year	Cargo Vessels			Rail		
	Throughput (Tonnes)	Vessels to Berth	Vessels to Anchor	Throughput (Tonnes)	Total Trains	Total Cars
2015	28,847,504	258	236	28,382,796	1,885	266,470
2016	25,840,844	234	218	25,234,219	1,654	237,538
2017	29,034,435	287	274	28,975,455	1,939	271,027
2018	30,464,300	339	304	30,394,508	2,054	284,619
2019	31,033,388	362	324	30,924,666	2,105	291,563

**Table 7: Annual Terminal Energy Consumption, 2015 - 2019**

Year	Diesel (l)	Gas (l)	Propane (l)	Electricity (kWh)
2015	576,572	217,988	303,702	47,907,623
2016	502,490	179,259	122,230	46,379,286
2017	668,120	192,275	176,162	51,685,754
2018	447,462	186,089	97,705	51,033,071
2019	411,705	205,206	118,486	53,026,010

As seen in **Table 7**, diesel and propane consumption have seen significant reductions from 2015 -2019. Reduced diesel consumption is related primarily to a reduction in bulldozing. Reduced propane usage is due to reduced building heating.

## 4.0 AIR EMISSION SOURCES

The sources of air emissions at the terminal are identified in this chapter, with the data and methods used to estimate emissions. Included sources are those under the direct control of WTLP as well as key transportation used to move cargo (ships, rail). Combustion and fugitive sources are included. GHGs associated with electricity consumption (e.g., a scope 2 source) are also identified. When necessary, actual 2019 activity data was scaled to applicable export capacities.

### 4.1 Marine Vessels

Marine vessel emissions are associated with bulk carriers that arrive to the port, may spend a period of time at anchor, stop at one of WTLP's two berths where they are loaded and then return to sea. Tugboats are used to assist the vessels to and from berth.

Ship emission sources include propulsion engines, auxiliary engines and boilers. A summary of ship activity for vessels to WTLP in 2019 is provided below, by vessel size group.

**Table 8: 2019 Vessels to WTLP**

Ship type	DWT range	# vessels to berth	percentage of fleet
Small	0 – 9,999	4	1.1%
Handysize	10,000 – 34,999	3	0.8%
Handymax	35,000 – 59,999	11	3.0%
Panamax	60,000 – 99,999	177	48.9%
Capesize	100,000 – 199,999	118	32.6%
Capesize largest	200,000 +	49	13.5%

A recent U.S Environmental Protection Agency (U.S. EPA) report was used to identify ship parameters needed for emissions calculations, including ship auxiliary and boiler demand (kW) by mode of activity (U.S. EPA, 2020). Further details on these data are provided in Appendix C.

Bulk carriers will also be used to carry potash, with similar characteristics to those used for coal. The expected size range in DWT for the vessels to WTLP in 2026 is identified in **Table 9**, utilizing a greater number of ship types than those in **Table 8**. Approximately 75 ships are expected per year for potash cargo.

**Table 9: Expected Ship Distribution for Potash Cargo**

Ship Type	Cargo Tonnage Range	# Vessels to Berth
Small	0 – 9,999	Limited use, assumed zero
Handysize	10,000 – 40,000	6%
Handymax	40,000 – 50,000	7%
Supramax	50,000 – 60,000	23%
Ultramax	60,000 – 65,000	17%
Panamax	65,000 – 80,000	20%
Kamsarmax	80,000 – 90,000	25%
Post Panamax	90,000 – 120,000	3%

Tugboat engine criteria are identified in **Table 10**. Two tugs are used for the assist procedures and a third tug acts as a pilot vessel. It is not known what tug may be used for piloting, therefore a 3,000-kW tug built in 2010 was assumed.

**Table 10: Tugboat Characteristics**

Tug type	Engine Power (kW)	Build Year	Operations Profile
Assist 1	4,538	2009	Assist to berth
Assist 2	4,700	2011	Assist to berth
Pilot 1	3,000	2010	Pilot vessel from shipping lane to berth

Emission calculations utilize equation (1) below, also from the U.S. EPA.

Equation 1:

$$E = P \times LF \times T \times EF \times LSR$$

Where:

- E = emissions in kg
- P = engine power rating in kW
- LF = load factor on engine (unitless)
- T = time (hours)
- EF = emission factor (g/kWh)
- LSR = low speed ratio (unitless)

The LSR is relevant for main engines only, when the load on the engine is less than 20% of maximum continuous rating. The LSR parameter effectively increases the engine emission factor, depending on air contaminant (U.S. EPA, 2020). As further discussed below, no assumptions of slow speed movements are made in the analysis.

#### 4.1.1 Baseline/Current Emission Rates

The 2019 vessels to the terminal (scaled to current export capacity) were used to calculate the marine emissions for that year, with the following assumptions shown in **Table 11**.

**Table 11: Activity assumptions used for marine vessel calculations**

Activity	Key Assumption 1	Key Assumption 2
OGV Underway	Vessel speed of 9 knots and ME load of 0.4; AE and BO active at all times, following U.S. EPA 2020 power levels.	Those ships with no anchor stays assumed to travel 5 km from the main shipping lane to the terminal and back. Those with anchor stays assumed to travel an additional 30 km (each way) to a berth in English Bay.
OGV Anchor	Times at berth from WTLP data	No ME use, AE and BO active at all times, at U.S. EPA 2020 power levels.
OGV Berth	Times at berth from WTLP data	No ME use, AE and BO active at all times, at U.S. EPA 2020 power levels.
OGV Manoeuvring	No ME use, AE and BO active at all times, following U.S. EPA 2020 power levels	30 minutes total of manoeuvring assumed for arrival and departure.
Tug Assist	ME load of 0.5 for transit (all 3 tugs), manoeuvre load of 0.5 (assist tugs) and 0.15 (pilot tug)	30 minutes of transit and 30 minutes total of manoeuvring assumed for each OGV arrival and departure.

**Note:** OGV=ocean going vessel; ME=main engine; AE=auxiliary engine; BO=boiler

Emission rates are identified in **Table 12** for the bulk carriers to WTLP, by engine type and year. NO<sub>x</sub> rates differ based on vessel year (keel-laid year) and the PM rates assume MDO fuel with 0.1% sulphur by weight, consistent with the Emissions Control Area (ECA) regulation for the west coast of North America. Emission rates for tugs are identified in **Table 13**, assuming MGO fuel with 15 ppm sulphur by weight, consistent with Canada's sulphur in fuels regulation. Additional rates were applied, based on (U.S. EPA, 2020) as follows:

- OGVs: PM = PM<sub>10</sub>; PM<sub>2.5</sub> = 0.92 \* PM<sub>10</sub>; BC = 0.03 \* PM<sub>2.5</sub> (exception BO); DPM = 0.92 \* PM<sub>10</sub>
- OGVs, BO: BC = 0.77 \* PM<sub>2.5</sub>
- Tugs: PM = PM<sub>10</sub>; PM<sub>2.5</sub> = 0.97 \* PM<sub>10</sub>; BC = 0.77 \* PM<sub>2.5</sub>; DPM = 0.97 \* PM<sub>10</sub>

**Table 12: OGV Emission Rates (U.S. EPA, 2020)**

Engine and Year	Emission Rates in g/kWh									
	BSFC	NO <sub>x</sub>	PM	CO	VOC	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	SO <sub>2</sub>	NH <sub>3</sub>
ME base (pre-2000)	185	17.0	0.18	1.4	0.63	593.11	0.012	0.029	0.362	0.02
ME T1 (2000 - 2010)	185	16.0	0.18	1.4	0.63	593.11	0.012	0.029	0.362	0.02
ME T2 (2011-2015)	185	14.4	0.18	1.4	0.63	593.11	0.012	0.029	0.362	0.02
ME T3 (2016+)	185	3.4	0.18	1.4	0.63	593.11	0.012	0.029	0.362	0.02
AE base (pre-2000)	217	10.9	0.19	1.1	0.42	695.7	0.008	0.029	0.424	0.022
AE T1 (2000 - 2010)	217	9.8	0.19	1.1	0.42	695.7	0.008	0.029	0.424	0.022
AE T2 (2011-2015)	217	7.7	0.19	1.1	0.42	695.7	0.008	0.029	0.424	0.022
AE T3 (2016+)	217	2.0	0.19	1.1	0.42	695.7	0.008	0.029	0.424	0.022
BO	300	2.0	0.16	0.2	0.11	961.8	0.002	0.075	0.587	0.004

Note: BSFC=brake specific fuel consumption; ME=main engine; AE=auxiliary engine; BO=boiler; HC = total hydrocarbons

**Table 13: Tug Emission Rates (U.S. EPA, 2020)**

Tug Type	Emission Rates in g/kWh									
	BSFC	NO <sub>x</sub>	PM	CO	VOC	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	SO <sub>2</sub>	NH <sub>3</sub>
Assist 1/Assist 2/Pilot 1	213	6.000	0.119	1.100	0.200	679.47	0.004	0.033	0.006	0.022

Bulk carrier data for 2019 were assessed to identify the current age distribution of vessels such that appropriate NO<sub>x</sub> emission factors could be chosen for each vessel in 2019. Very few vessels were tier 3 (T3) in 2019 and the great majority were T1 and T2, as identified in the following section.

#### 4.1.2 Future Emission Rates

Bulk Carriers to WTLP in 2019 had an expected age distribution as shown in **Table 14**. Assuming the same relative age distribution exists in 2026 leads to a revised tier distribution as shown. The emission tiers only affect rates of NO<sub>x</sub> emissions (see **Table 12**), with other emission rates staying constant. No changes were applied to the tug emission rates in 2026, although these may change as well (e.g., ship replacement), for more than just NO<sub>x</sub>.

**Table 14: Ship Distribution to WTLP by Age and Emissions Tier**

Tier	Keel-laid Year	Percent in Fleet Baseline Scenario	Percent in Fleet Future Scenarios
Pre-tier	Pre 2000	11.5%	2.1%
T1	2000 - 2010	47.8%	20.6%
T2	2011 – 2015	35.5%	21.0%
T3	2016+	5.2%	56.3%

Fuel consumption and GHG emissions from the marine sector are expected to decrease by 2026, due to international attention being applied to OGV GHG emissions by the International Maritime Organization (IMO) and the port's incentive programs, that currently are being updated. No accounting was made for these expectations, since criteria are not available.

## 4.2 Rail

Coal trains to WTLP are associated with three different rail companies: Canadian Northern Rail (CN), Canadian Pacific Rail (CPR) and Burlington Northern Santa Fe (BNSF). Each coal train to WTLP has a similar activity profile, previously characterized in 2013 (SNC-Lavalin, 2013):

- Each train queues outside the terminal gate (average time 0.5 days)
- A rail car positioner is used to move each train around the terminal for dumping (average time 0.3 days)
- Each train queues before leaving the terminal (average time 0.1 days)

Each train has up to 5 locomotives and these locomotives shut down if inactive for longer than 10 minutes. During dumping, the locomotives idle the entire time to keep systems powered. On average, CPR and CN use 2.5 – 2.7 locomotives per train, whereas BNSF averages 4 (SNC-Lavalin, 2013). On a particular train the number being used would depend on the power rating of each unit as well as the origin of the train. It should be noted that for safety purposes, at least one engine remains idling to keep air on for braking.

The Railway Association of Canada (RAC) publishes a cargo efficiency measure each year, referred to as fuel intensity and expressed in litres/1,000 RTK (litres per 1,000 revenue tonne kilometres). Use of fuel intensity to estimate emissions for train movements is the preferred method identified by the U.S. EPA (U.S. EPA, 2020). The most current fuel intensity value for Canadian rail is 4.74 litres/1,000 RTK (RAC, 2019), although 10% of this value relates to switching activity and not the direct movement of trains. 90% of this value was therefore used to estimate emissions associated with moving the coal and potash trains to and from the terminal. It is expected that this value is higher than actual by 30% or more, since the area around the terminal is flat. This expectation is supported by lower fuel intensity values used in different locations around the U.S. (U.S. EPA, 2019).

Additional fuel consumption rates are needed to estimate locomotive fuel use for specific activities. Assuming a full-size line haul locomotive model GE AC4400, a common model in the Canadian Class 1 fleets, the fuel consumption rates shown in **Table 16** can be used (SNC-Lavalin, 2013).

**Table 15: Locomotive Fuel Consumption by Throttle Notch (GE AC4400)**

Locomotive Type	Idle	N1	N2	N3	N4	N5	N6	N7	N8	DB
GE AC4400	13.5	42	98	204.6	298.6	414.7	527.2	646.6	796.4	22.3

Note: DB = dynamic braking

Equation (2) is used to calculate rail emissions.

Equation 2:

$$E = EF \times FC$$

Where:

- E = emissions in kg
- EF = emission factor (g/litre)
- FC = fuel consumption (litres)

#### 4.2.1 Baseline/Current Emission Rates

Emission factors from the Railway Association of Canada are used (RAC, 2019). BNSF is a U.S. rail company, but locomotive emission factors are expected to be similar since Canada harmonizes its rail emissions regulations with the U.S. GHG emission factors are taken from ECCC (ECCC, 2019), consistent with the RAC publication. The 'freight' emission rates are relevant to the emissions estimates, since all of the work done to move and process the trains to the terminal is done by the line haul locomotives. The emission rate for ammonia was assumed to be 0.005 g/L, identical to the rate used for the Delta port Third Berth Project (SENES 2007).

**Table 16: Rail Emission Factors (g/litre)**

Locomotive Type	NO <sub>2</sub>	PM	CO	VOC	SO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	CO <sub>2</sub>	NH <sub>3</sub>
Freight	34.79	0.72	7.04	1.54	0.02	0.15	1	2,681	0.005
Switch	69.14	1.5	7.35	4.22	0.02	0.15	1	2,681	0.005

Note: Additional scalings applied based on U.S. EPA 2020:  $PM_{10} = PM$ ,  $PM_{2.5} = 0.97 * PM_{10}$ ;  $VOC = 1.053 * HC$ ,  $BC = 0.73 * PM_{2.5}$

The activity assumptions used to estimate fuel consumption for each rail activity are identified in **Table 17**. For baseline/current emissions, four locomotives are assumed with each coal train.

#### 4.2.2 Future Emission Rates

Rail locomotive emissions standards are shown in Appendix C, identifying much lower emission rates for the higher tiers, particularly Tier 4. The annual RAC emissions publications show that higher tier locomotives are introduced to the fleet each year with over 200 tier 4 freight locomotives in the current (2017) fleet. Additional rollover of 2%/year was assumed. To estimate the effect of this, Tier 4 emission rates were assumed to replace Tier 0 emission rates to determine a revised set of emission rates for 2026. These rates are also shown in Appendix C.

**Table 17: Activity assumptions Used for Rail Emission Estimates (per Train)**

Commodity	Rail Activity	Tonnage/Train (Tonnes)	Distance (km)	Time (hours)	Engine notch	# locomotives
Coal	Travel to/from terminal	14,700	5	n/a	n/a	n/a
	Queue at terminal gate (both ways) and idling on-site	-	n/a	12	Idle	1
	Rail car positioner	-	n/a	8	Idle	4
Potash	Travel to/from terminal	18,200	5	n/a	n/a	n/a
	Queue at terminal gate (both ways) and idling on-site	-	n/a	12	Idle	1
	Rail car positioner	-	n/a	8	Idle	5

Four locomotives are assumed with each coal train and five for each potash train (**Table 17**). Each train has a turn-around time of approximately 12 hours. For safety purposes, at least one engine remains idling to keep air on for braking. For the same amount of work performed, future rail fuel consumption will decrease. RAC data show that there has been a decrease in the national fuel intensity of just over 2%/year from 2009 to 2018 (RAC, 2019). This rate of improvement is expected to continue, as evidenced by CN's science-based target of 29% reduction in fuel intensity by 2030, from 2015 level (CN, 2019). Although this target includes all of its operations (including buildings), the majority of energy consumption for the company relates to locomotive operations. A 2%/year decline in the emissions intensity, over a period of seven years, was assumed for future (2026) emissions estimates. This does not affect the locomotive idle rates.

### 4.3 Off-road Equipment

WTLP utilizes various individual off-road equipment pieces fueled by diesel and electricity (indirect, scope 2). A listing of the off-road equipment used in 2019 is provided in Appendix B.

Off-road equipment emissions are calculated using the Transport Canada Port Emissions Inventory Tool (PEIT). For off-road calculations in PEIT, the U.S. EPA NONROAD2008a model data are used. This allows determination of specific rates based on equipment details (e.g., equipment type, engine year). While the U.S. EPA MOVES 2014b model addresses off-road equipment, the NONROAD model itself was incorporated into MOVES, retaining many of the inputs and calculations (U.S. EPA, 2021). While some small differences in total CAC emissions may result between the two models, given the relatively small contribution of off-road to the CAC inventory totals this was not considered significant.

GHG emissions for this source group were estimated by fuel-based emission rates from Canada's National Inventory Report (ECCC, 2019). Black carbon estimates were made based on (U.S. EPA, 2020).

No change is anticipated in the number of mobile equipment on-site as a result of the Project.



#### 4.4 Administration

Emissions attributed to administration are a result electricity usage and propane consumption (for space heating and lighting). The administration electricity consumption was estimated at 1% of the total electricity consumption for the terminal, consistent with assumptions applied in previous studies (SNC-Lavalin, 2013).

Similar to the off-road source group, GHG emissions for administration activities were estimated by fuel-based emission rates from Canada's National Inventory Report (ECCC, 2019). It should be noted that increases in electricity usage efficiency (e.g., from lighting/equipment upgrades) are expected offset the additional lighting requirements needed for the new potash-handling infrastructure (i.e., dumper, conveyor galleries and transfer towers).

#### 4.5 On-road Vehicles

WTLP utilizes various ('on road') vehicles. A listing of the WTLP on-road vehicle fleet is provided in Appendix B for reference. The average travelling speed assumed on-site is 35km/hr.

On-road vehicle emissions are calculated using the Transport Canada Port Emissions Inventory Tool (PEIT). PEIT allows determination of specific rates associated with the type and age of each vehicle. On-road vehicle emission rates in PEIT are derived from the U.S. EPA MOVES2014b model.

Similar to the off-road and administration categories, GHG emissions for this source group were estimated by fuel-based emission rates from Canada's National Inventory Report (ECCC, 2019). Black carbon estimates were made based on (U.S. EPA, 2020).

No change is anticipated in the number of on road vehicles on-site as a result of the Project.

#### 4.6 Material Handling – Coal

WTLP currently has a coal export capacity of 36 Mtpa. With the introduction of potash in the New Cargo Export Project, coal export capacity is expected to reduce to approximately 31.5 Mtpa when the terminal is at its maximum potash capacity (4.5 Mtpa). This section outlines the methodologies for characterizing coal handling emissions sources used for both baseline and future scenarios.

Emission sources/activities associated with coal handling at the WTLP can be broken down into the following categories:

- Rail unloading/dumping;
- Transfer Points/conveyance;
- Marine vessel loading;
- Stacking/Reclaiming;
- Coal pile storage; and
- Bulldozing.

The methodologies for characterizing these emission sources/activities are outlined in Sections 4.6.1 to 4.6.6. The methodologies used to estimate dust emissions require identification of the size distribution of coal dust (total particulate matter (TPM), fraction of total within the PM<sub>10</sub> size range and fraction of total within the PM<sub>2.5</sub> size range). More details for coal material handling are included in Appendix A for reference.

#### 4.6.1 Railcar Unloading/Dumping

The emission factors for railcar dumping/material handling activities are based on AP-42 Section 13.2.4 Aggregate Handling and Storage Piles (U.S. EPA, 2006). Emissions are calculated using the set of equations below (Equation 3).

Equation 3:

$$E_{TPM} = 0.74 \times (0.0016) \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$
$$E_{PM_{10}} = 0.35 \times (0.0016) \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$
$$E_{PM_{2.5}} = 0.072 \times (0.0016) \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

Where:

E = emission factor (kg/tonne of coal handled)

U = mean wind speed (m/s)

M = material moisture content (%)

The resulting emissions factors are applied to annual rail tonnages accounting for moisture content of the coal (8%) and the mean wind speed (2.9 m/s) for the area (**Table 1**).

Since railcar unloading occurs in a semi-enclosed building (open at the ends only), a 70% control efficiency is applied.

#### 4.6.2 Transfer Points

Emissions factors for TPM and PM<sub>10</sub> from conveyor transfers of granular material are based on AP-42 Section 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (U.S. EPA, 2004). An

emission factor for PM<sub>2.5</sub> is not provided for conveyor transfer activities; therefore, the aerodynamic particle size multipliers for aggregate handling contained in AP-42 Section 13.2.4 Aggregate Handling and Storage Piles (U.S. EPA, 2006), reproduced in **Table 18**, is used to convert PM<sub>10</sub> emissions to emissions of PM<sub>2.5</sub>.

**Table 18: PM<sub>2.5</sub> and PM<sub>10</sub> Size Fraction Multipliers**

Size Fraction	Less than 2.5 Microns	Less than 10 Microns	Less than 30 Microns
Multiplier as a Ratio of PM <sub>10</sub>	0.15	1.0	2.1

NOTES: Source: U.S. EPA 2006A

The emission rates used for each size fraction is summarized below.

Equation 4:

$$E_{TPM} = 0.0015$$

$$E_{PM10} = 0.00055$$

$$E_{PM2.5} = 0.0000825$$

Where:

E = emission factor (kg/tonne of material handled)

Approximately 38% of the coal delivered to WTLP is conveyed directly to the ships for loading (direct loading) and the remaining 62% is stockpiled and reclaimed at a later time (indirect loading). Annual throughputs are estimated based on expected material flows, accounting for both direct and indirect loading. All conveyor transfer points at WTLP are enclosed. A control efficiency of 70% is applied to account for conveyor enclosure (AWMA, 2000).

#### 4.6.3 Shiploading

Shiploading is a continuous drop operation and therefore Equation (3) is used to represent this process. The emissions factor resulting from Equation (3) is applied to annual shiploading tonnages accounting for moisture content of the coal (8%) and the mean wind speed (2.9 m/s) for the area (**Table 1**).

Ships are loaded via a telescopic chute. To account for this, a control efficiency of 75% is applied (AWMA, 2000).

#### 4.6.4 Stack-Reclaimer

Equation (3) is also used to represent stacker/reclaimer drop operations associated with moving coal to the storage piles, accounting for moisture content of the coal (8%) and the mean wind speed (2.9 m/s) for the area (**Table 1**). Dust from pile activities is controlled using water suppression and a control efficiency of 75% is applied to account for this (AWMA, 2000).

#### 4.6.5 Coal Pile Storage

The emission factor for TPM emissions from wind erosion is consistent with the recommended methodology for active piles (WRAP Fugitive Dust Handbook – Section 9.3 Emission Estimation: Alternate Methodology, (WRAP, 2006)). The emission fractions for PM<sub>10</sub> and PM<sub>2.5</sub> (0.35 and 0.11 respectively) were determined as a function of the TPM emission factor based on SCC 30501043 - Surface Mining Operations - Open Storage Pile: Coal.

The emission factor used is shown below.

Equation 5:

$$E_{TPM} = 1.9 \left( \frac{s}{1.5} \right) \left( \frac{365[365 - p]}{235} \right) \left( \frac{f}{15} \right)$$

Where: E = emission rate (kg/ha-yr)

s = silt content of material (%)

p = number of days/year where precipitation is > 0.254 mm

f = % of time in the year when wind speed > 5.4 m/s

Emission rates are applied to the terminal's maximum coal stockpile footprint taking into account silt content (6.2%), wind (2.9 m/s) and precipitation data for the area (**Table 1**). A control efficiency of 50% was applied to wind erosion emissions for all PM size fractions to account for water suppression (AWMA, 2000). Since the maximum area available for coal storage (currently ~40 ha) will be displaced by the area required for the potash project (~5.6 ha), the maximum coal storage area for the future case is expected to be ~34.4 ha.

#### 4.6.6 Bulldozing

Emission factors for TPM, PM<sub>10</sub> and PM<sub>2.5</sub> from bulldozing of coal are based on AP-42 Section 11.9 Western Surface Coal Mining (U.S. EPA, 1998). Emission factors take into account the moisture content of the coal (8%) and silt content of 6.2% (U.S. EPA, 2006).

The emission factor used is shown below.

Equation 6:

$$E_{TPM} = \frac{35.6(s)^{1.2}}{(M)^{1.3}}$$

$$E_{PM10} = 0.75 \times \frac{8.44(s)^{1.5}}{(M)^{1.4}}$$
$$E_{PM2.5} = 0.022 \times E_{TPM} = \frac{0.783(s)^{1.2}}{(M)^{1.3}}$$

Where: E = emission rate (kg/hour)  
s = material silt content (%)  
M = material moisture content (%)

Fugitive dust generated from bulldozing operations is related to bulldozing activity. Annual bulldozing activity for each of the three bulldozers used at WTLP has been estimated based on activity/throughput at the terminal and stockpile size for each scenario. A 50% control efficiency is applied to account for water suppression (AWMA, 2000).

## 4.7 Material Handling – Potash

With the introduction of potash in the New Cargo Export Project, WTLP is expected to have a potash export capacity of up to 4.5 Mtpa. Emission sources/activities associated with potash handling at the WTLP can be broken down into the following categories:

- Rail unloading/dumping;
- Transfer Points/conveyance;
- Storage shed;
- Marine vessel loading.

The methodology for characterizing these emission sources/activities is outlined in Sections 4.7.1 to 4.7.4. More details for potash material handling are included in Appendix A for reference.

### 4.7.1 Railcar Unloading/Dumping

Potash railcar unloading/dumping is completed in a new enclosed shed equipped with three (3) baghouses to treat any resulting fugitive emissions. TPM Emission rates are determined using design volumetric flow rates and baghouse filter media performance criteria). The aerodynamic particle size multipliers for PM<sub>10</sub> (0.47) and PM<sub>2.5</sub> (0.18) are based on section 8, potash dryer (U.S. EPA, 1995).

### 4.7.2 Transfer Points

Potash conveyors transfer points are also enclosed and treated with dust collectors (at each point). TPM Emission rates are determined using design volumetric flow rates and baghouse filter media performance criteria). The aerodynamic particle size multipliers for PM<sub>10</sub> (0.43) and PM<sub>2.5</sub> (0.18) are based on section 8, potash dryer (U.S. EPA, 1995).

### 4.7.3 Storage Shed

Stacking, stockpiling, and reclaiming of potash are performed in a fully enclosed storage building and limited emissions are expected from this building.

Emissions factors for TPM and PM<sub>10</sub> from conveyor transfers of potash are based on AP-42 Section 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (U.S. EPA, 2004). An emission factor for PM<sub>2.5</sub> is not provided for conveyor transfer activities; therefore, the aerodynamic particle size multipliers for aggregate handling contained in AP-42 Section 13.2.4 Aggregate Handling and Storage Piles (U.S. EPA, 2006), reproduced in **Table 18**, is used to convert PM<sub>10</sub> emissions to emissions of PM<sub>2.5</sub>. The emission rates used for each size fraction are summarized in Equation 4.

It is assumed that all potash delivered to WTLP will be transferred to the storage shed and later reclaimed for ship loading (indirect loading). While direct loading may occur occasionally in rare instances, conservatively all material is assumed to be handled in the indirect loading scenario for the purposes of this emissions inventory. A control efficiency of 90% is applied to account for the storage building enclosure (WRAP, 2006).

### 4.7.4 Shiploading

Shiploading is a continuous drop operation and therefore Equation (3) is used to represent this process. The emissions factor resulting from Equation (3) is applied to annual shiploading tonnages accounting for moisture content of the potash (0.15%) and the mean wind speed (2.9 m/s) for the area (**Table 1**).

An 80% control efficiency is also applied to account for the application of dedusting oil (based on similar applications of oil for the reduction of grain fugitive dust, World Grain 2013; Illinois U.S. EPA 2016).

Cascade/DCL chutes (or similar) will be installed at the Project, which is considered one of the best available technology not entailing excessive cost technology. The loading duration is scheduled for 26 hours; among them 30 minutes are uncontrolled and the remaining period is assumed at 98% control efficiency based on the following consideration from the Project description from *Fraser Grain Terminal – Project Description and Description of Operations*.

...the loading spout proposed for this Project gently supports the product being loaded all the way down the vertical length of the chute and thus maintains a constant low velocity and keeps the material in a mass-flow form that entraps and holds the dust within; material travelling at low velocity does not pull down with it and therefore, if there is no air to escape, there is no dust emission.

An overall 96% control efficiency was therefore used from the shiploader's telescopic cascade chutes, based on the combination of ship loading fugitive dust control from the compared to the overall loading time:  $(1 - 0.5 \text{ h}/26\text{h}) * 98\% = 96\%$ .

Considering both the control efficiency from the shiploader's telescopic cascade chutes and the oil control efficiency, an overall control efficiency for the ship loading emission factors  $(1 - (1 - 96\%)*(1 - 80\%)) = 99.2\%$  is applied.

## 5.0 SUMMARY OF RESULTS

The resulting emission estimates for baseline and future cases incorporated activity levels for marine vessels, rail locomotives, material handling and processing at WTLP, and also consider adjustments in operations (i.e., material flow, commodity handling capacities) associated with the New Cargo Export Project.

As mentioned above, this air emissions inventory includes the following scenarios:

- A baseline air emissions inventory for WTLP operations (based on a maximum capacity of 36 Mtpa coal)
- A future air emissions inventory for WTLP operations with the Project, including two scenarios:
  - 31.5 Mtpa coal and 4.5 Mtpa potash; and
  - 36 Mtpa coal and 0 Mtpa potash (with potash infrastructure installed) scenarios

When considering the results, note that with the Project operations, WTLP can operate at any combination of coal and potash to a total terminal capacity of 36 Mtpa, with potash not exceeding 4.5 Mtpa. Therefore, the future emissions may range between the 0 Mtpa potash future case and 4.5 Mtpa future case with associated reduction in coal.

**Table 19** and **Table 20** presents projected on-site emissions, while **Table 21** and **Table 22** presents projected RSA emissions (on-site emissions as well as emissions associated with rails and ships in the immediate supply chain vicinity).

As shown in the tables below, NO<sub>x</sub> and other combustion related emissions for both future cases (i.e., on-site, and RSA) decrease substantially. This decrease can be primarily attributed to projected improvement in engines used over time. Overall emissions are also expected to decrease for an 'all coal' future scenario (i.e., 36 Mtpa coal, 0 Mtpa potash) due to engine improvements.

While not formally required, indirect GHG emissions associated with electricity use at the terminal were included with the assessment. However, due to B.C.'s low carbon electricity intensity, indirect GHG emissions associated with electricity use at the terminal were relatively low compared to GHG emissions from combustion sources (accounting for ~3% and 1% of the total estimated CO<sub>2</sub>e emissions for on-site activities and on-site activities including supply chain vicinity respectively).

No assumptions for equipment rollover were made for off-road equipment or facility vehicles and activity levels were held constant for the future case (total maximum capacity of the terminal remains constant – 36 Mtpa of product per annum). Administration activities were also held constant.

**Table 19: Estimated On-Site Air Emissions for Baseline/Future (31.5 Mtpa coal and 4.5 Mtpa potash)**

Year	Source group	Contaminant (Tonnes)										
		NO <sub>x</sub>	SO <sub>x</sub>	CO	VOC	PM	PM <sub>10</sub>	PM <sub>2.5</sub>	NH <sub>3</sub>	DPM	BC	CO <sub>2e</sub>
Baseline (36 Mtpa Coal)	Marine	110.72	6.44	14.44	5.16	2.76	2.76	2.55	0.29	2.55	0.63	12172
	Rail	50.64	0.01	10.25	2.24	1.05	1.05	1.02	0.01	1.02	0.74	4342
	Off-road	6.36	0.01	2.58	0.56	0.39	0.39	0.38	0.02	0.38	0.01	1828
	On-road	0.47	0.01	3.84	0.17	0.13	0.13	0.03	0.03	0.01	0.00	576
	Admin	0.20	0.01	0.11	0.02	0.01	0.01	0.01	0.02	0.00	-	188
	Material Handling (Coal)	-	-	-	-	200.24	68.45	11.70	-	-	-	-
	Material Handling (Potash)	-	-	-	-	-	-	-	-	-	-	-
	<b>Total</b>	<b>168.39</b>	<b>6.48</b>	<b>31.22</b>	<b>8.15</b>	<b>204.57</b>	<b>72.79</b>	<b>15.69</b>	<b>0.36</b>	<b>3.96</b>	<b>1.39</b>	<b>19,106</b>
Future**(31.5 Mtpa Coal; 4.5 Mtpa Potash)	Marine	72.02	6.42	14.55	5.17	2.77	2.77	2.56	0.29	2.56	0.64	12221
	Rail	44.18	0.01	10.20	1.94	0.90	0.90	0.88	0.01	0.88	0.64	4322
	Off-road	6.36	0.01	2.58	0.56	0.39	0.39	0.38	0.02	0.38	0.01	1828
	On-road	0.47	0.01	3.84	0.17	0.13	0.13	0.03	0.03	0.01	0.00	576
	Admin	0.20	0.01	0.11	0.02	0.01	0.01	0.01	0.02	0.00	-	188
	Material Handling (Coal)	-	-	-	-	168.59	58.08	10.01	-	-	-	-
	Material Handling (Potash)	-	-	-	-	31.60	13.60	5.36	-	-	-	-
	<b>Total</b>	<b>123.23</b>	<b>6.46</b>	<b>31.28</b>	<b>7.86</b>	<b>204.39</b>	<b>75.88</b>	<b>19.23</b>	<b>0.36</b>	<b>3.83</b>	<b>1.29</b>	<b>19,136</b>
<b>% Difference</b>		<b>-26.8%</b>	<b>-0.3%</b>	<b>0.2%</b>	<b>-3.5%</b>	<b>-0.1%</b>	<b>4.3%</b>	<b>22.6%</b>	<b>0.0%</b>	<b>-3.3%</b>	<b>-6.7%</b>	<b>0.2%</b>

\* Including GHGs associated with electricity consumption (e.g., scope 2 sources)

\*\*Future case includes two scenarios: 31.5 Mtpa coal and 4.5 Mtpa potash; and 36 Mtpa coal and 0 Mtpa potash (with potash infrastructure installed).



**Table 20: Estimated On-Site Air Emissions for Baseline/Future (36 Mtpa coal and 0 Mtpa potash)**

Year	Source group	Contaminant (Tonnes)										
		NO <sub>x</sub>	SO <sub>x</sub>	CO	VOC	PM	PM <sub>10</sub>	PM <sub>2.5</sub>	NH <sub>3</sub>	DPM	BC	CO <sub>2e</sub>
Baseline (36 Mtpa Coal)	Marine	110.72	6.44	14.44	5.16	2.76	2.76	2.55	0.29	2.55	0.63	12172
	Rail	50.64	0.01	10.25	2.24	1.05	1.05	1.02	0.01	1.02	0.74	4342
	Off-road	6.36	0.01	2.58	0.56	0.39	0.39	0.38	0.02	0.38	0.01	1828
	On-road	0.47	0.01	3.84	0.17	0.13	0.13	0.03	0.03	0.01	0.00	576
	Admin	0.20	0.01	0.11	0.02	0.01	0.01	0.01	0.02	0.00	-	188
	Material Handling (Coal)	-	-	-	-	200.24	68.45	11.70	-	-	-	-
	Material Handling (Potash)	-	-	-	-	-	-	-	-	-	-	-
	<b>Total</b>	<b>168.39</b>	<b>6.48</b>	<b>31.22</b>	<b>8.15</b>	<b>204.57</b>	<b>72.79</b>	<b>15.69</b>	<b>0.36</b>	<b>3.96</b>	<b>1.39</b>	<b>19,106</b>
Future**(36 Mtpa Coal; 0 Mtpa Potash)	Marine	71.41	6.44	14.44	5.16	2.76	2.76	2.55	0.29	2.55	0.63	12,172
	Rail	40.34	0.01	9.32	1.77	0.83	0.83	0.80	0.01	0.80	0.58	3,947
	Off-road	6.36	0.01	2.58	0.56	0.39	0.39	0.38	0.02	0.38	0.01	1,828
	On-road	0.47	0.01	3.84	0.17	0.13	0.13	0.03	0.03	0.01	0.00	576
	Admin	0.20	0.01	0.11	0.02	0.01	0.01	0.01	0.02	0.00	-	188
	Material Handling (Coal)	-	-	-	-	189.90	65.35	11.01	-	-	-	-
	Material Handling (Potash)	-	-	-	-	-	-	-	-	-	-	-
	<b>Total</b>	<b>118.78</b>	<b>6.48</b>	<b>30.28</b>	<b>7.68</b>	<b>194.02</b>	<b>69.46</b>	<b>14.78</b>	<b>0.36</b>	<b>3.74</b>	<b>1.23</b>	<b>18,711</b>
<b>% Difference</b>	<b>-29.5%</b>	<b>0.0%</b>	<b>-3.0%</b>	<b>-5.7%</b>	<b>-5.2%</b>	<b>-4.6%</b>	<b>-5.8%</b>	<b>0.0%</b>	<b>-5.5%</b>	<b>-11.4%</b>	<b>-2.1%</b>	

\* Including GHGs associated with electricity consumption (e.g., scope 2 sources)

\*\*Future case includes two scenarios: 31.5 Mtpa coal and 4.5 Mtpa potash; and 36 Mtpa coal and 0 Mtpa potash (with potash infrastructure installed).

**Table 21: Estimated RSA Air Emissions for Baseline/Future (31.5 Mtpa coal and 4.5 Mtpa potash)**

Year	Source group	Contaminant (Tonnes)										
		NO <sub>x</sub>	SO <sub>x</sub>	CO	VOC	PM	PM <sub>10</sub>	PM <sub>2.5</sub>	NH <sub>3</sub>	DPM	BC	CO <sub>2e</sub>
Baseline (36 Mtpa Coal)	Marine	520.55	28.62	61.93	23.99	11.83	11.83	10.91	1.17	10.91	2.49	50883
	Rail	77.35	0.01	15.65	3.42	1.60	1.60	1.55	0.01	1.55	1.13	6632
	Off-road	6.36	0.01	2.58	0.56	0.39	0.39	0.38	0.02	0.38	0.01	1828
	On-road	0.47	0.01	3.84	0.17	0.13	0.13	0.03	0.03	0.01	0.00	576
	Admin	0.20	0.01	0.11	0.02	0.01	0.01	0.01	0.02	0.00	-	188
	Material Handling (Coal)	-	-	-	-	200.24	68.45	11.70	-	-	-	-
	Material Handling (Potash)	-	-	-	-	-	-	-	-	-	-	-
	<b>Total</b>	<b>604.93</b>	<b>28.67</b>	<b>84.11</b>	<b>28.15</b>	<b>214.20</b>	<b>82.41</b>	<b>24.58</b>	<b>1.24</b>	<b>12.85</b>	<b>3.64</b>	<b>60,107</b>
Future**(31.5 Mtpa Coal; 4.5 Mtpa Potash)	Marine	304.10	29.47	63.99	24.72	12.21	12.21	10.79	1.21	10.79	2.22	52533
	Rail	64.17	0.01	14.82	2.82	1.31	1.31	1.27	0.01	1.27	0.93	6279
	Off-road	6.36	0.01	2.58	0.56	0.39	0.39	0.38	0.02	0.38	0.01	1828
	On-road	0.47	0.01	3.84	0.17	0.13	0.13	0.03	0.03	0.01	0.00	576
	Admin	0.20	0.01	0.11	0.02	0.01	0.01	0.01	0.02	0.00	-	188
	Material Handling (Coal)	-	-	-	-	168.59	58.08	10.01	-	-	-	-
	Material Handling (Potash)	-	-	-	-	31.60	13.60	5.36	-	-	-	-
	<b>Total</b>	<b>375.30</b>	<b>29.51</b>	<b>85.34</b>	<b>28.29</b>	<b>214.24</b>	<b>85.73</b>	<b>27.86</b>	<b>1.28</b>	<b>12.45</b>	<b>3.16</b>	<b>61,404</b>
<b>% Difference</b>		<b>-38.0%</b>	<b>3.0%</b>	<b>1.5%</b>	<b>0.5%</b>	<b>0.0%</b>	<b>4.0%</b>	<b>13.3%</b>	<b>3.3%</b>	<b>-3.1%</b>	<b>-13.2%</b>	<b>2.2%</b>

\* Including GHGs associated with electricity consumption (e.g., scope 2 sources)

\*\*Future case includes two scenarios: 31.5 Mtpa coal and 4.5 Mtpa potash; and 36 Mtpa coal and 0 Mtpa potash (with potash infrastructure installed).

**Table 22: Estimated RSA Air Emissions for Baseline/Future (36 Mtpa coal and 0 Mtpa potash)**

Year	Source group	Contaminant (Tonnes)										
		NO <sub>x</sub>	SO <sub>x</sub>	CO	VOC	PM	PM <sub>10</sub>	PM <sub>2.5</sub>	NH <sub>3</sub>	DPM	BC	CO <sub>2e</sub>
Baseline (36 Mtpa Coal)	Marine	520.55	28.62	61.93	23.99	11.83	11.83	10.91	1.17	10.91	2.49	50883
	Rail	77.35	0.01	15.65	3.42	1.60	1.60	1.55	0.01	1.55	1.13	6632
	Off-road	6.36	0.01	2.58	0.56	0.39	0.39	0.38	0.02	0.38	0.01	1828
	On-road	0.47	0.01	3.84	0.17	0.13	0.13	0.03	0.03	0.01	0.00	576
	Admin	0.20	0.01	0.11	0.02	0.01	0.01	0.01	0.02	0.00	-	188
	Material Handling (Coal)	-	-	-	-	200.24	68.45	11.70	-	-	-	-
	Material Handling (Potash)	-	-	-	-	-	-	-	-	-	-	-
	<b>Total</b>	<b>604.93</b>	<b>28.67</b>	<b>84.11</b>	<b>28.15</b>	<b>214.20</b>	<b>82.41</b>	<b>24.58</b>	<b>1.24</b>	<b>12.85</b>	<b>3.64</b>	<b>60,107</b>
Future**(36 Mtpa Coal; 0 Mtpa Potash)	Marine	294.02	28.62	61.93	23.99	11.83	11.83	10.91	1.17	10.91	2.49	50,883
	Rail	57.84	0.01	13.36	2.54	1.18	1.18	1.15	0.01	1.15	0.84	5,659
	Off-road	6.36	0.01	2.58	0.56	0.39	0.39	0.38	0.02	0.38	0.01	1,828
	On-road	0.47	0.01	3.84	0.17	0.13	0.13	0.03	0.03	0.01	0.00	576
	Admin	0.20	0.01	0.11	0.02	0.01	0.01	0.01	0.02	0.00	-	188
	Material Handling (Coal)	-	-	-	-	189.90	65.35	11.01	-	-	-	-
	Material Handling (Potash)	-	-	-	-	-	-	-	-	-	-	-
	<b>Total</b>	<b>358.89</b>	<b>28.67</b>	<b>81.81</b>	<b>27.28</b>	<b>203.45</b>	<b>78.89</b>	<b>23.49</b>	<b>1.24</b>	<b>12.45</b>	<b>3.34</b>	<b>59,133</b>
<b>% Difference</b>		<b>-40.7%</b>	<b>0.0%</b>	<b>-2.7%</b>	<b>-3.1%</b>	<b>-5.0%</b>	<b>-4.3%</b>	<b>-4.4%</b>	<b>0.0%</b>	<b>-3.1%</b>	<b>-8.1%</b>	<b>-1.6%</b>

\* Including GHGs associated with electricity consumption (e.g., scope 2 sources)

\*\*Future case includes two scenarios: 31.5 Mtpa coal and 4.5 Mtpa potash; and 36 Mtpa coal and 0 Mtpa potash (with potash infrastructure installed).

## 6.0 CONCLUSIONS

WTLP commissioned this emissions inventory to support the New Cargo Expansion Project and inclusion of potash. The Emission Inventory presented in this report supports the application to VFPA to accommodate this expansion.

Total annual air emissions were estimated for WTLP operations for baseline (pre- New Cargo Export Project) and future (with New Cargo Export Project) operations based on the terminal's export capacity per commodity (outlined/projected below):

- Baseline export capacity: Coal – 36 Mtpa
- Future export capacity: 36 Mtpa terminal capacity including coal and potash, with potash not exceeding 4.5 Mtpa.
  - 31.5 Mtpa coal and 4.5 Mtpa potash;
  - 36 Mtpa coal and 0 Mtpa potash (with potash infrastructure installed).

Estimated emissions generally decrease across all contaminants for both on-site and supply chain boundaries for both future scenarios when compared to the baseline. Due to the reduction in coal stockyard area (from planned infrastructure changes), emissions from the 36 Mtpa coal and 0 Mtpa potash future scenario is expected to decrease from the baseline 36 Mtpa coal scenario (due to a reduction in potential wind erosion emissions from available stockyard area). In the future scenario including 4.5 Mtpa potash, PM<sub>10</sub> and PM<sub>2.5</sub> emissions are estimated to increase due to differences in coal and potash handling equipment. However, as emissions across all other contaminants generally decrease or remain the same in both future scenarios (31.5 Mtpa coal / 4.5 Mtpa potash and 36 Mtpa coal / 0 Mtpa potash), it is anticipated the Project will have similar or reduced emissions to current conditions.

## 7.0 REFERENCES

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## **APPENDIX A: EMISSION TABLES**

**Material Handling Emissions – Baseline Export Capacity (Coal)**

Source Description					Maximum Throughput		Emission Factor				Control Efficiency				Annual TPM Emission Rate	Annual PM <sub>10</sub> Emission Rate	Annual PM <sub>2.5</sub> Emission Rate
ES-Designation in MV Permit	Location on Site	Source	Discharge Point	Type of Dust Control Device	Annual	Hourly	TPM	PM <sub>10</sub>	PM <sub>2.5</sub>	Reference	Watering	Enclosure	Telescopic /Load Chute	Overall	(tonnes/Yr)		
					(tonnes/yr)	(tonnes/hr)	(g/tonne)										
3	Berth 1	Coal Loading of marine vessels (SL1)	Ship's Holds and loading area	Telescopic Chute	19,300,000	7,000	0.25	0.12	0.02	AP-42 Sec.13.2.4			75%	75%	1.19	0.56	0.09
	Berth 2	Coal Loading of marine vessels (SL3/4)	Ship's Holds and loading area	Load Chute	16,700,000	7,000	0.25	0.12	0.02				75%	75%	1.03	0.49	0.07
4	South Side of Site	Tandem rail car dumper No. 31	Dumper building	Enclosure	17,700,000	6,000	0.25	0.12	0.02	AP-42 Sec.13.2.4		70%		70%	1.31	0.62	0.09
6	South Side of Site	Tandem rail car dumper No. 32	Dumper building	Enclosure	18,300,000	6,000	0.25	0.12	0.02	AP-42 Sec.13.2.4		70%		70%	1.36	0.64	0.10
7	Conveyor system	Transfer Tower 1	Transfer Point	Enclosure	36,000,000	12,000	1.50	0.55	0.08	AP-42 Sec.11.19.2		70%		70%	16.20	5.94	0.89
		Transfer Tower 2	Transfer Point (indirect loading)		22,320,000	12,000	1.50	0.55	0.08			70%		70%	10.04	3.68	0.55
			Transfer Point (direct loading)		13,680,000										6.16	2.26	0.34
		Transfer Tower 3	Transfer Point (indirect loading)		11,160,000	12,000	1.50	0.55	0.08			70%		70%	5.02	1.84	0.28
			Transfer Point (direct loading)		6,840,000										3.08	1.13	0.17
		Transfer Tower 4	Transfer Point		18,000,000	12,000	1.50	0.55	0.08			70%		70%	8.10	2.97	0.45
		Transfer Tower 5	Transfer Point		16,700,000	12,000	1.50	0.55	0.08			70%		70%	7.52	2.76	0.41
		Transfer Tower 6	Transfer Point		27,650,000	18,000	1.50	0.55	0.08			70%		70%	12.44	4.56	0.68
		Transfer Tower 7	Transfer Point		19,300,000	7,000	1.50	0.55	0.08			70%		70%	8.69	3.18	0.48
		Transfer Tower (12A/B to SL3/4)	Transfer Point		16,700,000	7,000	1.50	0.55	0.08			70%		70%	7.52	2.76	0.41
		Transfer Tower (6B to SL1)	Transfer Point		19,300,000	7,000	1.50	0.55	0.08			70%		70%	8.69	3.18	0.48
		Transfer Tower 6B	Transfer Point		8,350,000	6,000	1.50	0.55	0.08			70%		70%	3.76	1.38	0.21
Transfer Tower (2SB1/2SB2)	Transfer Point	19,300,000	7,000	1.50	0.55	0.08		70%		70%	8.69	3.18	0.48				
7	Coal stock piles	Reclaiming (2 S/R)	Storage Areas	Water suppression	22,320,000	12,000	0.25	0.12	0.02	AP-42 Sec.13.2.4	50%			50%	2.76	1.30	0.20
7	Coal stock piles	Stacking (2 S/R)	Storage Areas	Water Suppression	22,320,000	12,000	0.25	0.12	0.02	AP-42 Sec.13.2.4	50%			50%	2.76	1.30	0.20

**Material Handling Emissions – Baseline Export Capacity (Coal) Cont.**

Source Description					Source Parameters	Emission Factor				Control Efficiency		Annual TPM Emission Rate	Annual PM <sub>10</sub> Emission Rate	Annual PM <sub>2.5</sub> Emission Rate
ES-Designation in MV Permit	Location on Site	Source	Discharge Point	Type of Dust Control Device	Annual Activity	TPM	PM <sub>10</sub>	PM <sub>2.5</sub>	Reference	Watering	Overall	(tonnes/Yr)		
					(hours)	(kg/hr)								
7	Coal stock piles	Bulldozing operations	Storage Areas	Water Suppression	4,380	21.3	5.3	0.5	AP-42 Section 11.9-2	50%	50%	46.64	11.64	1.03

Source Description					Source Parameters	Emission Factor				Control Efficiency		Annual TPM Emission Rate	Annual PM <sub>10</sub> Emission Rate	Annual PM <sub>2.5</sub> Emission Rate
ES-Designation in MV Permit	Location on Site	Source	Discharge Point	Type of Dust Control Device	Applicable Area	TPM	PM <sub>10</sub>	PM <sub>2.5</sub>	Reference	Watering	Overall	(tonnes/Yr)		
					Hectares	kg/ha/yr								
7	Coal stock piles	Wind Erosion	Storage Areas	Water Suppression	40	1865.1	652.8	205.2	WRAP Fugitive Dust Handbook - 9.3 Emission Estimation: Alternate Methodology	50%	50.0%	37.30	13.06	4.10



**Material Handling Emissions – Future Export Capacity 31.5 Mtpa Coal, 4.5 Mtpa Potash Scenario (Coal)**

Source Description					Maximum Throughput		Emission Factor				Control Efficiency				Annual TPM Emission Rate	Annual PM <sub>10</sub> Emission Rate	Annual PM <sub>2.5</sub> Emission Rate
ES-Designation in MV Permit	Location on Site	Source	Discharge Point	Type of Dust Control Device	Annual	Hourly	TPM	PM <sub>10</sub>	PM <sub>2.5</sub>	Reference	Watering	Enclosure	Telescopic /Load Chute	Overall	(tonnes/Yr)		
					(tonnes/yr)	(tonnes/hr)	(g/tonne)										
3	Berth 1	Coal Loading of marine vessels (SL1)	Ship's Holds and loading area	Telescopic Chute	19,300,000	7,000	0.25	0.12	0.02	AP-42 Sec.13.2.4			75%	75%	1.19	0.56	0.09
	Berth 2	Coal Loading of marine vessels (SL3/4)	Ship's Holds and loading area	Load Chute	12,200,000	7,000	0.25	0.12	0.02				75%	75%	0.75	0.36	0.05
4	South Side of Site	Tandem rail car dumper No. 31	Dumper building	Enclosure	15,500,000	6,000	0.25	0.12	0.02	AP-42 Sec.13.2.4		70%		70%	1.15	0.54	0.08
6	South Side of Site	Tandem rail car dumper No. 32	Dumper building	Enclosure	16,000,000	6,000	0.25	0.12	0.02	AP-42 Sec.13.2.4		70%		70%	1.19	0.56	0.08
7	Conveyor system	Transfer Tower 1	Transfer Point)	Enclosure	31,500,000	12,000	1.50	0.55	0.08	AP-42 Sec.11.19.2		70%		70%	14.18	5.20	0.78
		Transfer Tower 2	Transfer Point (indirect loading)		19,530,000	12,000	1.50	0.55	0.08			70%		70%	8.79	3.22	0.48
			Transfer Point (direct loading)		11,970,000										5.39	1.98	0.30
		Transfer Tower 3	Transfer Point (indirect loading)		8,380,000	12,000	1.50	0.55	0.08			70%		70%	3.77	1.38	0.21
			Transfer Point (direct loading)		5,140,000										2.31	0.85	0.13
		Transfer Tower 4	Transfer Point		13,520,000	12,000	1.50	0.55	0.08			70%		70%	6.08	2.23	0.33
		Transfer Tower 5	Transfer Point		12,190,000	10,000	1.50	0.55	0.08			70%		70%	5.49	2.01	0.30
		Transfer Tower 6	Transfer Point		25,400,000	10,000	1.50	0.55	0.08			70%		70%	11.43	4.19	0.63
		Transfer Tower 7	Transfer Point		19,310,000	7,000	1.50	0.55	0.08			70%		70%	8.69	3.19	0.48
		Transfer Tower (12A/B to SL3/4)	Transfer Point		12,190,000	7,000	1.50	0.55	0.08			70%		70%	5.49	2.01	0.30
		Transfer Tower (6B to SL1)	Transfer Point		19,300,000	7,000	1.50	0.55	0.08			70%		70%	8.69	3.18	0.48
		Transfer Tower 6B	Transfer Point		6,100,000	6,000	1.50	0.55	0.08			70%		70%	2.75	1.01	0.15
Transfer Tower (2SB1/2SB2)	Transfer Point	19,310,000	7,000	1.50	0.55	0.08		70%		70%	8.69	3.19	0.48				
7	Coal stock piles	Reclaiming (2 S/R)	Storage Areas	Water suppression	19,530,000	10,000	0.25	0.12	0.02	AP-42 Sec.13.2.4	50%			50%	2.41	1.14	0.17
7	Coal stock piles	Stacking (2 S/R)	Storage Areas	Water Suppression	19,530,000	12,000	0.25	0.12	0.02	AP-42 Sec.13.2.4	50%			50%	2.41	1.14	0.17

**Material Handling Emissions – Future Export Capacity 31.5 Mtpa Coal, 4.5 Mtpa Potash Scenario (Coal) Cont.**

Source Description					Source Parameters		Emission Factor				Control Efficiency			Annual TPM Emission Rate	Annual PM <sub>10</sub> Emission Rate	Annual PM <sub>2.5</sub> Emission Rate
ES-Designation in MV Permit	Location on Site	Source	Discharge Point	Type of Dust Control Device	Annual Activity	TPM	PM <sub>10</sub>	PM <sub>2.5</sub>	Reference	Watering	Overall	Annual TPM Emission Rate	Annual PM <sub>10</sub> Emission Rate	Annual PM <sub>2.5</sub> Emission Rate		
					(hours)	(kg/hr)									(tonnes/Yr)	
7	Coal stockpiles	Bulldozing operations	Storage Areas	Water Suppression	3,350	21.3	5.3	0.5	AP-42 Section 11.9-2	50%	50%	35.67	8.91	0.78		

Source Description					Source Parameters		Emission Factor				Control Efficiency			Annual TPM Emission Rate	Annual PM <sub>10</sub> Emission Rate	Annual PM <sub>2.5</sub> Emission Rate
ES-Designation in MV Permit	Location on Site	Source	Discharge Point	Type of Dust Control Device	Applicable Area	TPM	PM <sub>10</sub>	PM <sub>2.5</sub>	Reference	Watering	Overall	Annual TPM Emission Rate	Annual PM <sub>10</sub> Emission Rate	Annual PM <sub>2.5</sub> Emission Rate		
					Hectares	kg/ha/yr									(tonnes/Yr)	
7	Coal stockpiles	Wind Erosion	Storage Areas	Water Suppression	34.4	1865.1	652.8	205.2	WRAP Fugitive Dust Handbook - 9.3 Emission Estimation: Alternate Methodology	50%	50.0%	32.08	11.23	3.53		

**Material Handling Emissions – Future Export Capacity 31.5 Mtpa Coal, 4.5 Mtpa Potash Scenario (Potash)**

Source Description				Maximum Throughput			Emission Factor				Control Efficiency				Annual TPM Emission Rate	Annual PM <sub>10</sub> Emission Rate	Annual PM <sub>2.5</sub> Emission Rate
Location on Site	Source	Discharge Point	Type of Dust Control Device	Annual	Daily	Hourly	TPM	PM <sub>10</sub>	PM <sub>2.5</sub>	Reference	Building Enclosure	Dedusting Oil	Telescopic Chute	Overall	Annual TPM Emission Rate	Annual PM <sub>10</sub> Emission Rate	Annual PM <sub>2.5</sub> Emission Rate
				(tonnes/yr)	(tonnes/day)	(tonnes/hr)	(g/tonne)										
Berth #2	Potash loading of marine vessels	Ship's holds and loading area	Telescopic Chute	4,500,000	80,000	4,000	64.7	30.6	4.6	AP-42 Sec.13.2.4		80%	96%	99.2%	2.3	1.1	0.2
Potash Storage Building	Material Transfer in Potash Storage Building	Building Openings	Enclosed Building	4,500,000	120,000	5,000	1.5	0.6	0.1	AP-42 Sec.11.19.2	90%			90.0%	0.7	0.4	0.1
	Reclaiming in Potash Storage Building	Note: building is fully enclosed and doors will remain closed during typical operation		4,500,000	80,000	4,000	1.5	0.6	0.1	AP-42 Sec.11.19.2	90%			90.0%	0.7	0.4	0.1

**Material Handling Emissions – Future Export Capacity 31.5 Mtpa Coal, 4.5 Mtpa Potash Scenario (Potash) Cont.**

Source Description				Maximum Flowrate			Activity	Concentration	Annual TPM Emission Rate	Annual PM <sub>10</sub> Emission Rate	Annual PM <sub>2.5</sub> Emission Rate
Location on Site	Source	Dust Control #	Type of Dust Control Device	ACFM	m <sup>3</sup> /min	m <sup>3</sup> /hr	Hours/year	mg/m <sup>3</sup>	(tonnes/Yr)		
Potash Dumper Building	Railcar Dumping and Material Transfer	81300-E0040-7000	Fully enclosed building vent to three baghouses	35,000	991	59,465	2255	20	2.7	1.2	0.5
		81300-E0040-7002		21,000	595	35,679	2255	20	1.6	0.7	0.3
		81300-E0040-7001		35,000	991	59,465	2255	20	2.7	1.2	0.5
Conveyor system	Conveyor P40 to P45 Transfer point	Transfer Tower P42 (85342-E0140-7000)	Covered conveyors, Baghouses	35,000	991	59,465	2255	20	2.7	1.2	0.5
	Conveyor P45 to P50 Transfer point	Transfer Tower P47 (85347-E0140-7000)		35,000	991	59,465	2255	20	2.7	1.2	0.5
	Conveyor P50 to P55 Transfer point	Transfer Tower P52 (85352-E0140-7000)		35,000	991	59,465	2255	20	2.7	1.2	0.5
	Conveyor P55 to P65 Transfer point	Transfer Tower P57 (85357-E0140-7000)		35,000	991	59,465	350	20	0.4	0.2	0.1
	Conveyor P65 to P70/75 Transfer point	Transfer Tower P67 (85667-E0240-7000)		35,000	991	59,465	2255	20	2.7	1.2	0.5
	Conveyor P70 to C11 Transfer point	Transfer Tower P77 (85677-E0340-7000)		35,000	991	59,465	2255	20	2.7	1.2	0.5
	Conveyor C11 to C12A Transfer point	Transfer Tower 30 (82230-E0340-7000)		44,000	1,246	74,756	2255	20	3.4	1.4	0.6
	Conveyor C11 to C12B Transfer point										
	Conveyor C12A to Shiploader #3	C12A Potash Bin Vent (82215-E0340-7000)		22,000	623	37,378	2255	20	1.7	0.7	0.3
	Conveyor C12B to Shiploader #4	C12B Potash Bin Vent (82216-E0340-7000)		22,000	623	37,378	2255	20	1.7	0.7	0.3
Shiploading system	Spout to Ship	Shiploader #3 Spout Integral Dust Collector (82263-E0325-7000)		2,500	71	4,248	2255	20	0.19	0.08	0.08
	Spout to Ship	Shiploader #4 Spout Integral Dust Collector (82264-E0325-7000)		2,500	71	4,248	2255	20	0.19	0.08	0.08

**Material Handling Emissions – Future Export Capacity 36 Mtpa Coal, 0 Mtpa Potash Scenario (Coal)**

Source Description					Maximum Throughput		Emission Factor				Control Efficiency				Annual TPM Emission Rate	Annual PM <sub>10</sub> Emission Rate	Annual PM <sub>2.5</sub> Emission Rate
ES-Designation in MV Permit	Location on Site	Source	Discharge Point	Type of Dust Control Device	Annual	Hourly	TPM	PM <sub>10</sub>	PM <sub>2.5</sub>	Reference	Watering	Enclosure	Telescopic /Load Chute	Overall	(tonnes/Yr)		
					(tonnes/yr)	(tonnes/hr)	(g/tonne)										
3	Berth 1	Coal Loading of marine vessels (SL1)	Ship's Holds and loading area	Telescopic Chute	19,300,000	7,000	0.25	0.12	0.02	AP-42 Sec.13.2.4			75%	75%	1.19	0.56	0.09
	Berth 2	Coal Loading of marine vessels (SL3/4)	Ship's Holds and loading area	Load Chute	16,700,000	7,000	0.25	0.12	0.02				75%	75%	1.03	0.49	0.07
4	South Side of Site	Tandem rail car dumper No. 31	Dumper building	Enclosure	17,700,000	6,000	0.25	0.12	0.02	AP-42 Sec.13.2.4		70%		70%	1.31	0.62	0.09
6	South Side of Site	Tandem rail car dumper No. 32	Dumper building	Enclosure	18,300,000	6,000	0.25	0.12	0.02	AP-42 Sec.13.2.4		70%		70%	1.36	0.64	0.10
7	Conveyor system	Transfer Tower 1	Transfer Point	Enclosure	36,000,000	12,000	1.50	0.55	0.08	AP-42 Sec.11.19.2		70%		70%	16.20	5.94	0.89
		Transfer Tower 2	Transfer Point (indirect loading)		22,320,000	12,000	1.50	0.55	0.08			70%		70%	10.04	3.68	0.55
			Transfer Point (direct loading)		13,680,000										6.16	2.26	0.34
		Transfer Tower 3	Transfer Point (indirect loading)		11,160,000	12,000	1.50	0.55	0.08			70%		70%	5.02	1.84	0.28
			Transfer Point (direct loading)		6,840,000										3.08	1.13	0.17
		Transfer Tower 4	Transfer Point		18,000,000	12,000	1.50	0.55	0.08			70%		70%	8.10	2.97	0.45
		Transfer Tower 5	Transfer Point		16,700,000	12,000	1.50	0.55	0.08			70%		70%	7.52	2.76	0.41
		Transfer Tower 6	Transfer Point		27,650,000	18,000	1.50	0.55	0.08			70%		70%	12.44	4.56	0.68
		Transfer Tower 7	Transfer Point		19,300,000	7,000	1.50	0.55	0.08			70%		70%	8.69	3.18	0.48
		Transfer Tower (12A/B to SL3/4)	Transfer Point		16,700,000	7,000	1.50	0.55	0.08			70%		70%	7.52	2.76	0.41
		Transfer Tower (6B to SL1)	Transfer Point		19,300,000	7,000	1.50	0.55	0.08			70%		70%	8.69	3.18	0.48
		Transfer Tower 6B	Transfer Point		8,350,000	6,000	1.50	0.55	0.08			70%		70%	3.76	1.38	0.21
Transfer Tower (2SB1/2SB2)	Transfer Point	19,300,000	7,000	1.50	0.55	0.08		70%		70%	8.69	3.18	0.48				
7	Coal stock piles	Reclaiming (2 S/R)	Storage Areas	Water suppression	22,320,000	12,000	0.25	0.12	0.02	AP-42 Sec.13.2.4	50%			50%	2.76	1.30	0.20
7	Coal stock piles	Stacking (2 S/R)	Storage Areas	Water Suppression	22,320,000	12,000	0.25	0.12	0.02	AP-42 Sec.13.2.4	50%			50%	2.76	1.30	0.20

**Material Handling Emissions – Future Export Capacity 36 Mtpa Coal, 0 Mtpa Potash Scenario (Coal) Cont.**

Source Description					Source Parameters	Emission Factor				Control Efficiency		Annual TPM Emission Rate	Annual PM <sub>10</sub> Emission Rate	Annual PM <sub>2.5</sub> Emission Rate
ES-Designation in MV Permit	Location on Site	Source	Discharge Point	Type of Dust Control Device	Annual Activity	TPM	PM <sub>10</sub>	PM <sub>2.5</sub>	Reference	Watering	Overall	Annual TPM Emission Rate	Annual PM <sub>10</sub> Emission Rate	Annual PM <sub>2.5</sub> Emission Rate
					(hours)	(kg/hr)								
7	Coal stock piles	Bulldozing operations	Storage Areas	Water Suppression	3,900	21.3	5.3	0.5	AP-42 Section 11.9-2	50%	50%	41.53	10.37	0.91

Source Description					Source Parameters	Emission Factor				Control Efficiency		Annual TPM Emission Rate	Annual PM <sub>10</sub> Emission Rate	Annual PM <sub>2.5</sub> Emission Rate
ES-Designation in MV Permit	Location on Site	Source	Discharge Point	Type of Dust Control Device	Applicable Area	TPM	PM <sub>10</sub>	PM <sub>2.5</sub>	Reference	Watering	Overall	Annual TPM Emission Rate	Annual PM <sub>10</sub> Emission Rate	Annual PM <sub>2.5</sub> Emission Rate
					Hectares	kg/ha/yr								
7	Coal stock piles	Wind Erosion	Storage Areas	Water Suppression	34.4	1865.1	652.8	205.2	WRAP Fugitive Dust Handbook - 9.3 Emission Estimation: Alternate Methodology	50%	50.0%	32.08	11.23	3.53

**Rail Emissions – Baseline Export Capacity**

Activity	NOx	SOx	CO	VOC	PM <sub>10</sub>	PM <sub>2.5</sub>	DPM	BC	CO <sub>2e</sub>	NH <sub>3</sub>
<b>On-site</b>										
Queuing	13.81	0.00	2.79	0.61	0.29	0.28	0.28	0.20	1,184	0.00
Indexing	36.83	0.01	7.45	1.63	0.76	0.74	0.74	0.54	3,158	0.01
Transit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Total</b>	<b>50.64</b>	<b>0.01</b>	<b>10.25</b>	<b>2.24</b>	<b>1.05</b>	<b>1.02</b>	<b>1.02</b>	<b>0.74</b>	<b>4,342</b>	<b>0.01</b>
<b>RSA</b>										
Queuing	13.81	0.00	2.79	0.61	0.29	0.28	0.28	0.20	1,184	0.00
Indexing	36.83	0.01	7.45	1.63	0.76	0.74	0.74	0.54	3,158	0.01
Transit	26.71	0.00	5.41	1.18	0.55	0.54	0.54	0.39	2,290	0.00
<b>Total (tonnes)</b>	<b>77.35</b>	<b>0.01</b>	<b>15.65</b>	<b>3.42</b>	<b>1.60</b>	<b>1.55</b>	<b>1.55</b>	<b>1.13</b>	<b>6,632</b>	<b>0.01</b>

**Rail Emissions – Future Export Capacity 31.5 Mtpa Coal, 4.5 Mtpa Potash Scenario**

Activity	NOx	SOx	CO	VOC	PM <sub>10</sub>	PM <sub>2.5</sub>	DPM	BC	CO <sub>2e</sub>	NH <sub>3</sub>
<b>On-site</b>										
Queuing	11.82	0.00	2.73	0.52	0.24	0.23	0.23	0.17	1,157	0.00
Indexing	32.35	0.01	7.47	1.42	0.66	0.64	0.64	0.47	3,166	0.01
Transit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
<b>Total</b>	<b>44.18</b>	<b>0.01</b>	<b>10.20</b>	<b>1.94</b>	<b>0.90</b>	<b>0.88</b>	<b>0.88</b>	<b>0.64</b>	<b>4,322</b>	<b>0.01</b>
<b>RSA</b>										
Queuing	11.82	0.00	2.73	0.52	0.24	0.23	0.23	0.17	1,157	0.00
Indexing	32.35	0.01	7.47	1.42	0.66	0.64	0.64	0.47	3,166	0.01
Transit	19.99	0.01	4.62	0.88	0.41	0.40	0.40	0.29	1,956	0.00
<b>Total (tonnes)</b>	<b>64.17</b>	<b>0.01</b>	<b>14.82</b>	<b>2.82</b>	<b>1.31</b>	<b>1.27</b>	<b>1.27</b>	<b>0.93</b>	<b>6,279</b>	<b>0.01</b>

**Rail Emissions – Future Export Capacity 36 Mtpa Coal, 0 Mtpa Potash Scenario**

Activity	NOx	SOx	CO	VOC	PM <sub>10</sub>	PM <sub>2.5</sub>	DPM	BC	CO <sub>2e</sub>	NH <sub>3</sub>
<b>On-site</b>										
Queuing	12.10	0.00	2.79	0.53	0.25	0.24	0.24	0.18	1,184	0.00
Indexing	28.24	0.00	6.52	1.24	0.58	0.56	0.56	0.41	2,763	0.01
Transit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
<b>Total</b>	<b>40.34</b>	<b>0.01</b>	<b>9.32</b>	<b>1.77</b>	<b>0.83</b>	<b>0.80</b>	<b>0.80</b>	<b>0.58</b>	<b>3,947</b>	<b>0.01</b>
<b>RSA</b>										
Queuing	12.10	0.00	2.79	0.53	0.25	0.24	0.24	0.18	1,184	0.00
Indexing	28.24	0.00	6.52	1.24	0.58	0.56	0.56	0.41	2,763	0.01
Transit	17.50	0.00	4.04	0.77	0.36	0.35	0.35	0.25	1,712	0.00
<b>Total (tonnes)</b>	<b>57.84</b>	<b>0.01</b>	<b>13.36</b>	<b>2.54</b>	<b>1.18</b>	<b>1.15</b>	<b>1.15</b>	<b>0.84</b>	<b>5,659</b>	<b>0.01</b>

**Marine Emissions – Baseline Export Capacity**

Source	NOx	SOx	CO	VOC	PM <sub>10</sub>	PM <sub>2.5</sub>	DPM	BC	CO <sub>2e</sub>	NH <sub>3</sub>
<b>On-site</b>										
ME	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
AE	91.09	4.40	11.42	4.37	1.96	1.80	1.80	0.05	7,311	0.23
BO	6.91	2.03	0.69	0.36	0.55	0.51	0.51	0.39	3,398	0.01
Tugs	12.73	0.01	2.33	0.42	0.25	0.24	0.24	0.19	1,462	0.05
<b>Total</b>	<b>110.72</b>	<b>6.44</b>	<b>14.44</b>	<b>5.16</b>	<b>2.76</b>	<b>2.55</b>	<b>2.55</b>	<b>0.63</b>	<b>12,172</b>	<b>0.29</b>
<b>RSA</b>										
ME	131.35	3.19	12.35	5.57	1.62	1.49	1.49	0.04	5,309	0.18
AE	328.66	15.89	41.19	15.77	7.06	6.50	6.50	0.19	26,381	0.82
BO	32.44	9.52	3.24	1.71	2.60	2.39	2.39	1.84	15,965	0.06
Tugs	28.09	0.03	5.15	0.94	0.56	0.54	0.54	0.42	3,228	0.10
<b>Total</b>	<b>520.55</b>	<b>28.62</b>	<b>61.93</b>	<b>23.99</b>	<b>11.83</b>	<b>10.91</b>	<b>10.91</b>	<b>2.49</b>	<b>50,883</b>	<b>1.17</b>

**Marine Emissions – Future Export Capacity 31.5 Mtpa Coal, 4.5 Mtpa Potash Scenario**

Source	NOx	SOx	CO	VOC	PM <sub>10</sub>	PM <sub>2.5</sub>	DPM	BC	CO <sub>2e</sub>	NH <sub>3</sub>
<b>On-site</b>										
ME	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
AE	51.68	4.39	11.39	4.36	1.95	1.80	1.80	0.05	7,297	0.23
BO	6.86	2.01	0.69	0.36	0.55	0.50	0.50	0.39	3,375	0.01
Tugs	13.48	0.01	2.47	0.45	0.27	0.26	0.26	0.20	1,549	0.05
<b>Total</b>	<b>72.02</b>	<b>6.42</b>	<b>14.55</b>	<b>5.17</b>	<b>2.77</b>	<b>2.56</b>	<b>2.56</b>	<b>0.64</b>	<b>12,221</b>	<b>0.29</b>
<b>RSA</b>										
ME	47.23	3.23	12.50	5.64	1.64	1.51	1.51	0.05	5,374	0.18
AE	193.36	16.44	42.63	16.32	7.31	6.72	6.72	0.20	27,302	0.85
BO	33.30	9.77	3.33	1.75	2.66	2.45	2.45	1.89	16,385	0.07
Tugs	30.22	0.03	5.54	1.01	0.60	0.11	0.11	0.08	3,472	0.11
<b>Total</b>	<b>304.10</b>	<b>29.47</b>	<b>63.99</b>	<b>24.72</b>	<b>12.21</b>	<b>10.79</b>	<b>10.79</b>	<b>2.22</b>	<b>52,533</b>	<b>1.21</b>

**Marine Emissions – Future Export Capacity 36 Mtpa Coal, 0 Mtpa Potash Scenario**

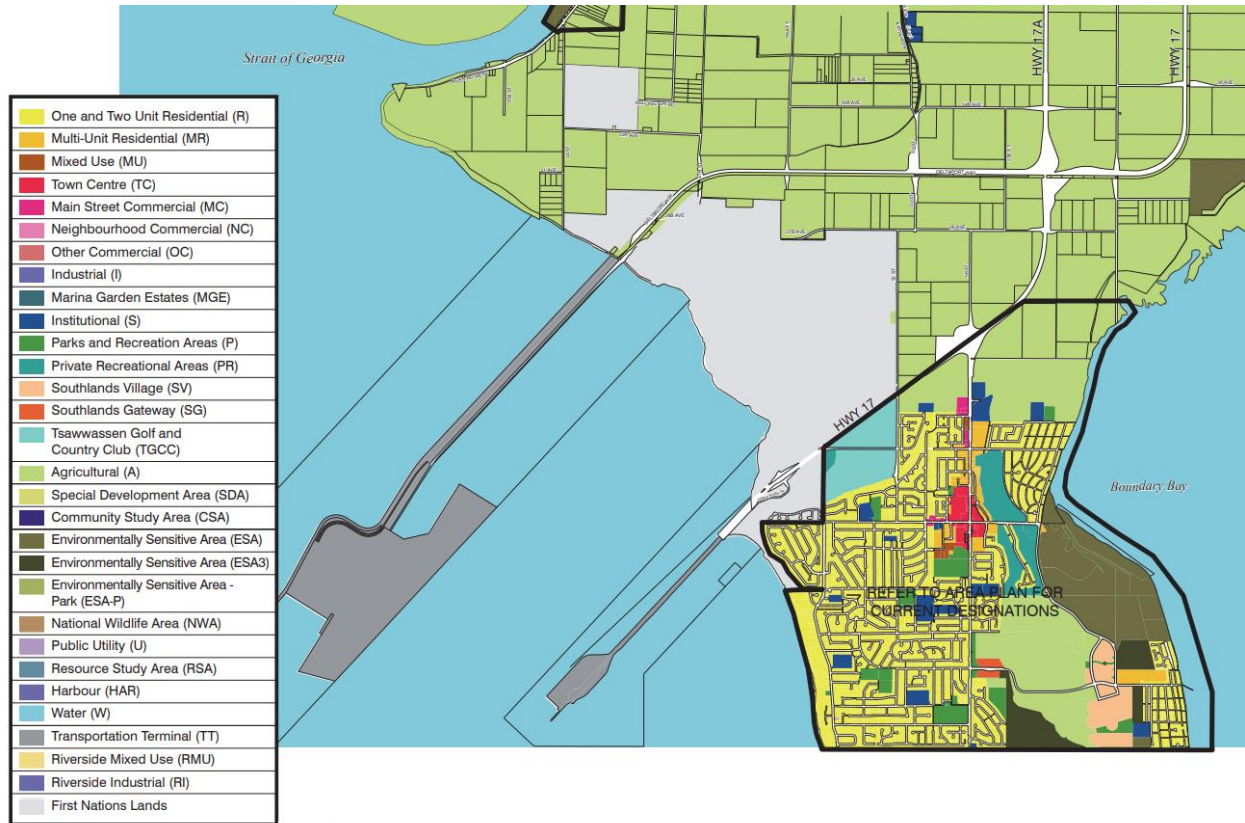
Source	NOx	SOx	CO	VOC	PM <sub>10</sub>	PM <sub>2.5</sub>	DPM	BC	CO <sub>2e</sub>	NH <sub>3</sub>
<b>On-site</b>										
ME	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
AE	51.78	4.40	11.42	4.37	1.96	1.80	1.80	0.05	7,311	0.23
BO	6.91	2.03	0.69	0.36	0.55	0.51	0.51	0.39	3,398	0.01
Tugs	12.73	0.01	2.33	0.42	0.25	0.24	0.24	0.19	1,462	0.05
<b>Total</b>	<b>71.41</b>	<b>6.44</b>	<b>14.44</b>	<b>5.16</b>	<b>2.76</b>	<b>2.55</b>	<b>2.55</b>	<b>0.63</b>	<b>12,172</b>	<b>0.29</b>
<b>RSA</b>										
ME	46.66	3.19	12.35	5.57	1.62	1.49	1.49	0.04	5,309	0.18
AE	186.84	15.89	41.19	15.77	7.06	6.50	6.50	0.19	26,381	0.85
BO	32.44	9.52	3.24	1.71	2.60	2.39	2.39	1.84	15,965	0.07
Tugs	28.09	0.03	5.15	0.94	0.56	0.54	0.54	0.42	3,228	0.11
<b>Total</b>	<b>294.02</b>	<b>28.62</b>	<b>61.93</b>	<b>23.99</b>	<b>11.83</b>	<b>10.91</b>	<b>10.91</b>	<b>2.49</b>	<b>50,883</b>	<b>1.21</b>



## **APPENDIX B: SURROUNDING AREA LAND USE**

**Land Use**

The figure below illustrates the land use around/near the WTLP. This figure shows that WTLP is primarily surrounded by water, with agricultural, first nations lands, and residential areas located further away.



**Figure B- 1: Land Use Surrounding Around/Near WTLTP**

## **APPENDIX C: ON-ROAD VEHICLE AND OFF-ROAD EQUIPMENT LISTS**

**Vehicle List**

Vehicle List
87900-0101 - Administration - 2006 Ford F350 Super Duty Van (Marketing) [UNIVERSAL]
87900-AV006 - 2013 Subaru Forester (Security) [UNIVERSAL]
87900-AV031 - Administration - 2017 Mercedes Sprint 4X4 2500 Marketing Van [UNIVERSAL]
87900-PU044 - 2018 Chevrolet Silverado 1500 2WD Reg Cab (Safety Dept) [UNIVERSAL]
87900-PU053 - 2019 Ford F-150 Crew Cab 2x4 (Engineering) [UNIVERSAL]
87900-PU068 - 2020 Ford F-150 Pick-Up Truck, 4x2, Regular Cab, 6.5 Ft. Box (Engineering) [UNIVERSAL]
87915-EV001L - 2013 Chev Silverado (Environmental Service Vehicle SES) [UNIVERSAL]
87915-PU018 - 2014 Chev Silverado 1/2 Ton PU 2WD (Crew Transport) [UNIVERSAL]
87915-PU020 - 2014 Chevrolet Pickup (Clean-up Crew) [UNIVERSAL]
87915-PU021 - 2014 Chev 1/2 Ton PU 2WD (Crew Transport) [UNIVERSAL]
87915-PU022 - 2014 Chev 1/2 Ton PU 2WD (Crew Transport) [UNIVERSAL]
87915-PU031 - 2016 Chevrolet Silverado 1/2 Ton (Clean up crew) [UNIVERSAL]
87915-PU032 - 2016 Chevrolet Silverado 1/2 Ton (Operations Foreman) [UNIVERSAL]
87915-PU033 - 2016 Chevrolet Silverado 1/2 Ton (Clean-up Crew) [UNIVERSAL]
87915-PU037 - 2017 Chevrolet Silverado 2WD Reg Cab (Operations Foreman) [UNIVERSAL]
87915-PU039 - 2017 Chev Crew Cab 4WD PU (Operations Foreman) [UNIVERSAL]
87915-PU040 - 2017 Chev Crew Cab 4WD PU (Ops Berth 1 Foreman) [UNIVERSAL]
87915-PU049 - 2018 Chevrolet Silverado 1500 Reg Cab 2WD (Clean-up Crew) [UNIVERSAL]
87915-PU052 - 2012 GMC Sierra V6 Shortbox White - Operations Training Truck [UNIVERSAL]
87915-PU060 - 2015 Chev Silverado Crew Cab 2WD (Troubleshooter) [UNIVERSAL]
87915-PU061 - 2012 GMC Sierra 1/2 Ton Pick-Up Truck, 2WD, Regular Cab, (Crew Transport) [UNIVERSAL]
87915-PU066 - 2020 Ford F-150 Pick-Up Truck, 4x2, Regular Cab, 6.5 Box (SES-Environmental Ser) [UNIVE
87915-PU067 - 2020 Ford F-150 Pick-Up Truck, 4x2, Regular Cab, 6.5 Ft. Box (Operations Super) [UNIVERS
87915-PU070 - 2020 Ford F-150 Pick-Up Truck, 4x2, Crew Cab, 5.5 Ft. Box (Spare) [UNIVERSAL]
87950-PU034 - 2017 Chevrolet Silverado 2WD Reg Cab (Operations Foreman) [UNIVERSAL]
87950-PU035 - 2017 Chevrolet Silverado 2WD Reg Cab (Operations Foreman) [UNIVERSAL]
87950-PU038 - 2017 Chevrolet Silverado 2WD Reg Cab (Shift Operator) [UNIVERSAL]
87950-PU041 - 2018 Chevrolet Silverado 1500 2 WD Crew Cab (Ops Troubleshooter) [UNIVERSAL]
87950-PU047 - 2018 Chevrolet Silverado 1500 2WD Crew Cab (Ops Troubleshooter) [UNIVERSAL]
87950-PU051 - 2018 Chevrolet Silverado 1500 Reg Cab 2WD (Crew Transport) [UNIVERSAL]
87950-PU069 - 2020 Ford F-150 Pick-Up Truck, 4x2, Crew Cab, 5.5 Ft. Box (Electrical Project) [UNIVERSAL]
87980-PU045 - 2018 Chevrolet Silverado 1500 2WD Reg Cab (Operations Foreman) [UNIVERSAL]
87980-PU046 - 2018 Chevrolet Silverado 1500 2WD Reg Cab (Operations Foreman) [UNIVERSAL]
87920-0218 - 2006 GMC Water Truck [UNIVERSAL]
87920-0219 - 2006 GMC Water Truck [UNIVERSAL]
87920-0234 - 1995 Ford LTS8000 (Operations Water Truck) [UNIVERSAL]
87920-WT001 - 2009 Finning / CAT, 725 Water Truck [UNIVERSAL]
87920-WT002 - 2016 Peterbilt Water Truck [UNIVERSAL]
87925-0183 - 2001 F350 First Aid Truck / Ambulance [UNIVERSAL]

87925-ER001 - 2007 Ford F350 First Response Truck [UNIVERSAL]
87925-ER002 - 2014 Freightliner Pumper Truck (Fire Truck) [UNIVERSAL]
87915-PU016 - 2012 Chevrolet Silverado 1/2 Ton PU 2WD (Electrical Crew) [UNIVERSAL]
87915-PU048 - 2018 Chevrolet Silverado 1500 Reg Cab 2WD (Electrical Crew) [UNIVERSAL]
87915-PU057 - 2019 Ford F-150 XL Reg. Cab (Electrical Foreman) [UNIVERSAL]
87950-0185 - 2010 GMC 1/2 Ton Pickup (Printman) [UNIVERSAL]
87950-PU029 - 2015 Chevrolet Silverado 1/2 Ton Reg Cab Short Box (Electrical Crew) [UNIVERSAL]
87950-PU030 - 2015 Chevrolet Silverado 1/2 Ton Reg Cab Short Box (Electrical Crew) [UNIVERSAL]
87950-PU036 - 2017 Chevrolet Silverado 2WD Reg Cab (Technologist) [UNIVERSAL]
87950-PU042 - 2018 Chevrolet Silverado 1500 2WD Reg Cab (Electrical Crew) [UNIVERSAL]
87950-PU043 - 2018 Chevrolet Silverado 1500 2WD Reg Cab (Electrical Crew) [UNIVERSAL]
87950-PU054 - 2019 Ford F-150 Crew Cab 2x4 (Electrical Project) [UNIVERSAL]
87950-PU056 - 2019 Ford F-150 XL, Reg Cab (Electrical Foreman) [UNIVERSAL]
87950-PU063 - 2020 Ford F-150 Pick-Up Truck, 4x2, Regular Cab, 6.5 Ft. Box (Electrical Super) [UNIVERSAL]
87975-0233 - 1995 Ford LNT8000 Lube Truck (Lubrication Crew) [UNIVERSAL]
87975-0246 - 2010 Ford F-550 Chassis XL (Lubrication Crew) [UNIVERSAL]
87975-LB001 - 2015 Isuzu Lube Truck (Biodegradable Oil) [UNIVERSAL]
87975-LB002 - 2019 Peterbilt Lube Truck [UNIVERSAL]
87975-LB003 - 2019 Ford F-550, Extended Cab, 4X4 Chassis, Lube Truck [UNIVERSAL]
87980-PU050 - 2018 Chevrolet Silverado 1500 Reg Cab 2WD (Lube Foreman) [UNIVERSAL]
87900-PU062 - 2012 GMC Sierra, 1/2 Ton Pick-up Truck, 2WD, Crew Cab (Mechanical Project) [UNIVERSAL]
87915-PU025 - 2014 Chev Crew cab 4WD PU (Mechanical Project) [UNIVERSAL]
87980-0216 - 1982 Ford LT800 (Mechanical Crew - Belt Splice Shack) [UNIVERSAL]
87980-0251 - 2015 Chev Silverado 1 Ton Flatdeck (Mechanical Crew) - Salt Truck [UNIVERSAL]
87980-0252 - 2015 Chev Silverado 1 Ton Flatdeck (Mechanical Crew - Tidy Tank) [UNIVERSAL]
87980-0253 - 2015 Chev Silverado 1 Ton Flatdeck (Mechanical Crew) [UNIVERSAL]
87980-0254 - 2015 Chev Silverado 1 Ton Flatdeck (Mechanical Crew) [UNIVERSAL]
87980-0255 - 2015 Chev Silverado 1 Ton Flatdeck (Mechanical Crew) [UNIVERSAL]
87980-0256 - 2015 Chev Silverado 1 Ton Flatdeck (Mechanical Crew) [UNIVERSAL]
87980-0257 - 2016 Chevrolet Silverado 1 Ton (Mechanical Crew) [UNIVERSAL]
87980-0258 - 2016 Chevrolet Silverado 1 Ton (Mechanical Crew) [UNIVERSAL]
87980-0259 - 2016 Chevrolet Silverado 1 Ton (Mechanical Crew) [UNIVERSAL]
87980-0260 - 2019 Ford F-350 Flatdeck, 4x2, Regular Cab (Mechanical Crew) [UNIVERSAL]
87980-0261 - 2019 Ford F-350 Flatdeck, 4x2, Regular Cab (Mechanical Crew) [UNIVERSAL]
87980-0262 - 2020 Ford F-350 Flatdeck, 4x2, Regular Cab (Mechanical Crew) [UNIVERSAL]
87980-PU055 - 2019 Ford F-150 XL, Reg Cab (Mechanical Foreman) [UNIVERSAL]
87980-PU058 - 2019 Ford F-150 XL Reg. Cab (Superintendent) [UNIVERSAL]
87980-PU059 - 2019 Ford F-150 XL Reg. Cab (Mechanical Foreman) [UNIVERSAL]
87980-PU064 - 2020 Ford F-150 Pick-Up Truck, 4x2, Regular Cab, 6.5 Ft. Box (Mechanical Super) [UNIVERSAL]
87980-PU065 - 2020 Ford F-150 Pick-Up Truck, 4x2, Regular Cab, 6.5 Ft. Box (Spare) [UNIVERSAL]

**Off-road Equipment List**

Equipment Type	Equipment Manufacturer	Engine Model Year	Rated Engine Power
Crane (not RTG)	Freightliner	2004	250
Crane (not RTG)	Peterbilt	2006	430
Pressure Washer	Caterpillar	2009	320
Pressure Washer	GMC	2006	250
Off-Hwy Truck	GMC	2006	250
Pressure Washer	John Deere	2006	85
Off-Hwy Truck	Ford	1995	250
Pressure Washer	John Deere	2006	85
Off-Hwy Truck	Ford	1995	250
Off-Hwy Truck	Ford	2001	210
Off-Hwy Truck	Ford	2007	325
Off-Hwy Truck	Freightliner	2014	300
Crawler Tractor/Dozer	Caterpillar	2009	520
Crawler Tractor/Dozer	Caterpillar	2011	570
Crawler Tractor/Dozer	Caterpillar	2012	570
Crawler Tractor/Dozer	Caterpillar	2014	570
Forklift	TMC	2008	88
Other	Caterpillar	1983	135
Forklift	JLG	2005	140
Tractor/Loader/Backhoe	Liebherr	2014	268
Rubber Tire Gantry (RTG) cranes	Grove	2005	210
Air Compressor	Leroi	1999	55
Welder	Miller Big Blue	2000	35
Welder	Miller Big Blue	2000	35
Welder	Miller Big Blue	2009	35
Generator Set	Caterpillar	2007	800
Generator Set	Caterpillar	2007	670
Pump - Transfer	-	2007	80
Other	Peterbilt	-	260
Pump - Transfer	John Deere	-	225
Welder	Miller Big Blue	-	20
Pressure Washer	John Deere	2018	85
Other	John Deere	2014	225

## **APPENDIX D: SUPPLEMENTAL MARINE/RAIL INFORMATION**

### **Marine Emissions Data**

2019 ships to WTLP were processed as shown in Table D.1. As noted in the main body of this report, each ship was matched to engine and boiler power demand based on DWT. The product of the power levels with times in mode yields total energy consumption for each ship, which is shown in Table D.2. A sample calculation is shown below for main engine (ME) and auxiliary engines (AE).

$$\text{Total ME kWh (K. Younghung)} = \text{ME} * \text{LF} * \text{T}$$

$$\text{ME kWh} = 15,170 \text{ kW} * 0.40 * (0.30 \text{ h} + 1.80 \text{ h}) * 2 = 25,484 \text{ kWh}$$

Where: LF = load factor (set at 0.40 for all vessels, corresponding to 9 knot speed)

T = time as below:

0.30 h = time for movement from shipping lane into terminal

1.80 h = time for movement from terminal to anchorage

The anchor leg is only added for ships that go to anchor. The movement time is one-way so it is multiplied by two for the total transit time.

$$\text{Total AE kWh (k. Younghung)} = \text{AE} * \text{T}$$

$$\text{AE kWh} = 420 \text{ kW} * (0.30 \text{ h} + 1.80 \text{ h}) * 2 + 600 \text{ kW} * 64.2 \text{ h} + 420 \text{ kW} * 20.4 \text{ h} + 680 \text{ kW} * 0.5 \text{ h} * 2 = 50,213 \text{ kWh}$$

Where: 0.30 h and 1.80 h = time for underway movements to terminal and to anchor

64.2 H = time at berth; 20.4 h = time at anchor

0.5h = manoeuvring time (set to 0.5 h for every vessel to and from berth)



**Table D.1: Total Ship Energy Consumption (kWh)**

Tonnage loaded	Ship DWT	Ship Name	hours at berth	hours at anchor	ME capacity (kW)	AE uway (kW)	AE berth (kW)	AE anch (kW)	AE mano (kW)	BO, all (kW)
137414	151335	K. YOUNGHUNG	64.2	20.4	15,170	420	600	420	680	200
92500	95527	NBA VAN DYCK	46.7	16.1	11,303	420	600	420	680	200
65040	80679	KEY FRONTIER	32.8	66.5	10,274	420	600	420	680	200
165404	182631	OLYMPIC HOPE	77.3	118.3	17,339	420	600	420	680	200
64698	179283	HL PORT HEDLAND	32.7	182.4	17,107	420	600	420	680	200
105696	181366	CAPE EMERALD	49.4	109.7	17,251	420	600	420	680	200
160872	180159	MINERAL HOKKAIDO	81.2	26.1	17,168	420	600	420	680	200
78599	82044	JAG AKSHAY	36.7	54.0	10,368	420	600	420	680	200
88449	179397	MINERAL SUBIC	44.7	60.0	17,115	420	600	420	680	200
91283	95368	HEBEI QINHUANGDAO	42.6	17.9	11,292	420	600	420	680	200
106160	179283	HL PORT HEDLAND	53.6	115.7	17,107	420	600	420	680	200
144622	203200	OCEAN PROMETHEUS	67.6	38.2	18,764	420	600	420	680	200
102661	207933	SHIN-EI	48.0	679.7	19,092	420	600	420	680	200
161594	169056	MAHA ANOSHA	81.6	282.6	16,398	420	600	420	680	200
31378	203200	OCEAN PROMETHEUS	14.7	65.6	18,764	420	600	420	680	200
110000	114536	HL SAMARINDA	55.6	554.5	12,620	420	600	420	680	200
1125	78821	TRITON GANNET	0.6	433.7	10,145	420	600	420	680	200
105147	181056	HERUN GLOBAL	49.1	640.9	17,230	420	600	420	680	200
26866	40299		12.6	0.0	7,475	260	370	260	420	100
76551	179397	MINERAL SUBIC	35.8	248.6	17,115	420	600	420	680	200
74263	111395		37.5	0.0	12,402	420	600	420	680	200
32180	55947	TTM DRAGON	16.3	136.1	8,560	260	370	260	420	100
90090	93038	DEDALOS	42.1	430.8	11,130	420	600	420	680	200
86437	92418	SHORYU	43.7	195.2	11,087	420	600	420	680	200
81964	98704	GL IGUAZU	41.4	123.6	11,523	420	600	420	680	200
162796	181403	CAPE IRIS	76.1	137.3	17,254	420	600	420	680	200
87414	98681	STAR VEGA	44.1	150.1	11,521	420	600	420	680	200
94402	98704	GL LA PAZ	44.1	0.0	11,523	420	600	420	680	200
75494	79372	SEA EMPIRE	38.1	50.4	10,183	420	600	420	680	200
84604	90839	HARAMACHI MARU	39.5	165.4	10,978	420	600	420	680	200
78582	81738	MSXT HERA	39.7	260.8	10,347	420	600	420	680	200
62242	154068	OCEAN TRINITY	31.4	171.3	15,360	420	600	420	680	200
42084	77198	KING MILO	21.3	201.7	10,032	420	600	420	680	200
31006	81993	OCEAN CARRIER *	15.7	52.6	10,365	420	600	420	680	200
197005	207500	CAPE SAPPHIRE	92.0	707.9	19,062	420	600	420	680	200
32295	77198	KING MILO	16.3	18.9	10,032	420	600	420	680	200
87790	154068	OCEAN TRINITY	41.0	51.7	15,360	420	600	420	680	200
55802	93253	DECLAN DUFF	26.1	350.7	11,145	420	600	420	680	200

Tonnage loaded	Ship DWT	Ship Name	hours at berth	hours at anchor	ME capacity (kW)	AE uway (kW)	AE berth (kW)	AE anch (kW)	AE mano (kW)	BO, all (kW)
120629	179656	HL PRIDE	60.9	305.8	17,133	420	600	420	680	200
24487	85025	EVER IMPERIAL	12.4	59.5	10,575	420	600	420	680	200
47215	81993	OCEAN CARRIER *	22.1	75.3	10,365	420	600	420	680	200
33975	93253	DECLAN DUFF	17.2	22.7	11,145	420	600	420	680	200
66000	92071	REIYO	30.8	11.3	11,063	420	600	420	680	200
49641	92655	TOPAS	25.1	583.2	11,104	420	600	420	680	200
76047	181502	HL SHIKOKU	35.5	235.0	17,261	420	600	420	680	200
44000	55614	MEDI PAESTUM	22.2	0.0	8,537	260	370	260	420	100
53904	86392	CORONA QUEEN	27.2	212.2	10,670	420	600	420	680	200
38787	92655	TOPAS	19.6	46.4	11,104	420	600	420	680	200
165249	209935	FOMENTO THREE	77.2	64.1	19,231	420	600	420	680	200
68380	81955	KEY NAVIGATOR	34.5	90.8	10,362	420	600	420	680	200
24155	86392	CORONA QUEEN	12.2	58.4	10,670	420	600	420	680	200
75800	207991	SHIN KORYU	35.4	65.1	19,096	420	600	420	680	200
70950	74362	FORTUNE GENIUS	35.8	34.2	9,836	420	600	420	680	200
145577	207964	OTOTACHIBANA	68.0	596.7	19,095	420	600	420	680	200
50514	85025	EVER IMPERIAL	25.5	213.0	10,575	420	600	420	680	200
24035	81161	AD ASTRA	12.1	245.2	10,307	420	600	420	680	200
24374	74204	OREGON	12.3	7.9	9,825	420	600	420	680	200
90250	177855	ANTONIS ANGELICOUSSIS	42.2	165.6	17,008	420	600	420	680	200
10862	16293		5.1	0.0	5,812	190	280	190	310	50
48269	72403.5		24.4	0.0	9,700	420	600	420	680	200
43323	81691	SAKIZAYA LEADER	20.2	28.6	10,344	420	600	420	680	200
76467	151335	K. YOUNGHUNG	38.6	61.2	15,170	420	600	420	680	200
41100	76000	TIGER EAST	20.8	72.7	9,949	420	600	420	680	200
165000	179258	ALPHA HONESTY	77.1	32.5	17,105	420	600	420	680	200
97257	181395	ORANGE TIGER*	45.4	602.7	17,253	420	600	420	680	200
106080	180784	SM TIGER	49.6	596.7	17,211	420	600	420	680	200
65059	80679	KEY FRONTIER	32.9	86.1	10,274	420	600	420	680	200
57051	151335	K. YOUNGHUNG	26.7	114.9	15,170	420	600	420	680	200
70457	179250	JAG ANAND	35.6	36.3	17,105	420	600	420	680	200
36447	177855	ANTONIS ANGELICOUSSIS	17.0	190.5	17,008	420	600	420	680	200
158919	179221	YOUNGHEUNG	80.3	9.0	17,103	420	600	420	680	200
135599	182511	LEVIATHAN	63.4	201.9	17,331	420	600	420	680	200
34790	52185		17.6	0.0	8,299	260	370	260	420	100
104148	209249	HERA OLDENDORFF	48.7	325.2	19,184	420	600	420	680	200
25118	149989	PAN KOMIPO	11.7	277.7	15,077	420	600	420	680	200
88000	97045	GLOVIS DONGHAE	44.4	260.9	11,408	420	600	420	680	200
64786	80679	KEY FRONTIER	32.7	15.1	10,274	420	600	420	680	200

Tonnage loaded	Ship DWT	Ship Name	hours at berth	hours at anchor	ME capacity (kW)	AE uway (kW)	AE berth (kW)	AE anch (kW)	AE mano (kW)	BO, all (kW)
96842	207684	NSU KEYSTONE	45.2	173.4	19,075	420	600	420	680	200
42031	180528	DREAM CANARY	19.6	481.5	17,193	420	600	420	680	200
112375	149989	PAN KOMIPO	56.8	34.7	15,077	420	600	420	680	200
69976	182718	CAPE TSUBAKI	32.7	151.9	17,345	420	600	420	680	200
57676	180528	DREAM CANARY	26.9	36.9	17,193	420	600	420	680	200
160011	172579	CAPRI	80.8	195.4	16,642	420	600	420	680	200
82475	93234	NANA Z	41.7	491.8	11,144	420	600	420	680	200
175787	203200	OCEAN PROMETHEUS	82.1	462.3	18,764	420	600	420	680	200
62489	81767	MODIGLIANI	29.2	110.2	10,349	420	600	420	680	200
76456	81963	ECOPRIDE G.O.	38.6	104.4	10,363	420	600	420	680	200
88072	92418	HAKUYO	44.5	332.8	11,087	420	600	420	680	200
184462	208025	CAPE AZALEA	86.2	48.2	19,099	420	600	420	680	200
75647	82055	HYUNDAI LEADER	38.2	522.5	10,369	420	600	420	680	200
20502	83375	KEY INTEGRITY	10.4	87.8	10,460	420	600	420	680	200
68615	180528	DREAM CANARY	32.1	257.3	17,193	420	600	420	680	200
54267	207684	NSU KEYSTONE	25.4	430.2	19,075	420	600	420	680	200
15261	81767	MODIGLIANI	7.1	196.9	10,349	420	600	420	680	200
170503	181279	NEW DELIGHT	86.1	406.4	17,245	420	600	420	680	200
80500	95740	BULK PHILIPPINES	40.7	228.7	11,317	420	600	420	680	200
35310	149350	HL RICHARDS BAY	17.8	259.0	15,033	420	600	420	680	200
181500	206104	LOS ANGELES	84.8	521.6	18,966	420	600	420	680	200
21571	208384	PAN DELIGHT	10.1	443.9	19,124	420	600	420	680	200
76036	179742	ROSEMARY	38.4	102.5	17,139	420	600	420	680	200
34129	51193.5		15.9	0.0	8,230	260	370	260	420	100
88795	133193		44.8	0.0	13,913	420	600	420	680	200
22000	56064	TANIKAZE	11.1	208.8	8,568	260	370	260	420	100
97281	149350	HL RICHARDS BAY	49.1	91.8	15,033	420	600	420	680	200
190773	206180	CAPE VANGUARD	89.1	249.8	18,971	420	600	420	680	200
54834	75239	ECOSAND G.O.	27.7	185.8	9,897	420	600	420	680	200
39172	87144	SEA FUTURE	19.8	123.7	10,722	420	600	420	680	200
136270	171128	MINERAL CHINA	63.7	832.6	16,542	420	600	420	680	200
77089	93549	NANAUMI	38.9	5.6	11,166	420	600	420	680	200
38900	87144	SEA FUTURE	19.6	56.3	10,722	420	600	420	680	200
168955	179156	HL SUCCESS	78.9	333.6	17,098	420	600	420	680	200
61782	180176	AQUA BONANZA	31.2	214.6	17,169	420	600	420	680	200
77368	179492	SANTA BARBARA	36.1	0.0	17,121	420	600	420	680	200
84533	91867	SOYO	42.7	18.8	11,049	420	600	420	680	200
60474	181502	HL SHIKOKU	28.3	14.5	17,261	420	600	420	680	200
86216	92389	TAIYO	43.5	0.0	11,085	420	600	420	680	200

Tonnage loaded	Ship DWT	Ship Name	hours at berth	hours at anchor	ME capacity (kW)	AE uway (kW)	AE berth (kW)	AE anch (kW)	AE mano (kW)	BO, all (kW)
74592	76492	AQUA LADY	34.9	405.4	9,983	420	600	420	680	200
92001	209708	BISAN CLOVER	43.0	0.0	19,215	420	600	420	680	200
172238	180202	STAR PRINCESS	87.0	0.0	17,171	420	600	420	680	200
153971	180151	GENCO AUGUSTUS	77.8	153.2	17,167	420	600	420	680	200
193470	207886	CAPE RAINBOW	90.4	155.7	19,089	420	600	420	680	200
4050	180176	AQUA BONANZA	1.9	302.2	17,169	420	600	420	680	200
10509	81119	SSI EXCELLENT	5.3	23.4	10,304	420	600	420	680	200
67249	100874		34.0	0.0	11,673	420	600	420	680	200
102250	153375		47.8	0.0	15,311	420	600	420	680	200
69863	82200	CEMTEX SINCERITY	35.3	455.1	10,379	420	600	420	680	200
164753	209325	TRUST AMITY	77.0	323.6	19,189	420	600	420	680	200
78321	88269	JP VERDURE	39.6	298.5	10,800	420	600	420	680	200
78000	80250	VISHVA PREETI	36.4	358.6	10,244	420	600	420	680	200
42463	82050	PEDHOULAS LEADER	21.4	214.0	10,369	420	600	420	680	200
56248	74716	DIAS	28.4	161.1	9,860	420	600	420	680	200
131149	205888	MARAN COURAGE	61.3	43.7	18,951	420	600	420	680	200
34537	82050	PEDHOULAS LEADER	16.1	53.4	10,369	420	600	420	680	200
79905	203180	SHIN NICHIO	37.3	184.3	18,763	420	600	420	680	200
168018	180784	SM TIGER	84.9	94.1	17,211	420	600	420	680	200
93500	98681	ANGLO MARIMAR	47.2	143.2	11,521	420	600	420	680	200
197966	207500	CAPE SAPPHIRE	92.5	26.8	19,062	420	600	420	680	200
87174	95750	TWINKLE SALUTE	44.0	69.3	11,318	420	600	420	680	200
108585	207362	NSU QUEST	50.7	90.5	19,053	420	600	420	680	200
77234	81616	ARSINOE	39.0	395.9	10,339	420	600	420	680	200
87041	91941	AGIOS SPYRIDONAS	44.0	20.4	11,054	420	600	420	680	200
189541	206306	SPRING BRAVE	88.6	110.1	18,980	420	600	420	680	200
77823	82224	BULK PORTUGAL	39.3	69.5	10,381	420	600	420	680	200
73328	179742	ROSEMARY	34.3	142.2	17,139	420	600	420	680	200
66000	95731	CMB POMEROL	30.8	11.6	11,317	420	600	420	680	200
33530	80655	VISHVA ANAND	15.7	438.2	10,272	420	600	420	680	200
167837	176990	KYMOPOLIA	84.8	131.5	16,948	420	600	420	680	200
82465	87036	MARINA	38.5	0.0	10,714	420	600	420	680	200
44458	80655	VISHVA ANAND	22.5	24.4	10,272	420	600	420	680	200
44976	55592	GLOBAL KOMA	22.7	64.0	8,535	260	370	260	420	100
54247	179742	ROSEMARY	25.3	93.1	17,139	420	600	420	680	200
32453	48679.5		15.2	0.0	8,056	260	370	260	420	100
78966	82938	LORD STAR	39.9	50.1	10,430	420	600	420	680	200
176000	203200	OCEAN PROMETHEUS	82.2	727.6	18,764	420	600	420	680	200
89628	95570	DOUBLE MIRACLE	45.3	0.0	11,306	420	600	420	680	200

Tonnage loaded	Ship DWT	Ship Name	hours at berth	hours at anchor	ME capacity (kW)	AE uway (kW)	AE berth (kW)	AE anch (kW)	AE mano (kW)	BO, all (kW)
76347	81793	ZHENG RONG	35.7	24.3	10,351	420	600	420	680	200
165000	199997	STELLA TESS	77.1	256.5	18,542	420	600	420	680	200
79322	81791	AOM BIANCA	40.1	38.0	10,351	420	600	420	680	200
162852	172572	SUNLIGHT	76.1	330.8	16,642	420	600	420	680	200
91362	99347	DYNA GLOBE	46.1	33.5	11,567	420	600	420	680	200
174343	181415	JUBILANT EXCELLENCE	81.5	146.3	17,255	420	600	420	680	200
82273	87329	YUE DIAN 85	41.6	79.4	10,734	420	600	420	680	200
49500	61693	TCLC LUZHOU	25.0	99.7	8,958	420	600	420	680	200
113402	180387	GENCO LIBERTY	53.0	133.2	17,183	420	600	420	680	200
86192	91439	SHIN SANYO MARU	43.5	39.8	11,019	420	600	420	680	200
82500	95708	ORIENTAL LEADER	41.7	55.3	11,315	420	600	420	680	200
80435	82200	CEMTEX SINCERITY	40.6	21.8	10,379	420	600	420	680	200
162434	180646	CAPE NORMANDY	75.9	118.4	17,201	420	600	420	680	200
87410	91439	NANAKURA	44.1	57.7	11,019	420	600	420	680	200
77961	178854	AQUASURFER	36.4	88.7	17,077	420	600	420	680	200
62342	93318	LM VICTORIA	31.5	0.0	11,150	420	600	420	680	200
87345	207886	CAPE RAINBOW	40.8	127.2	19,089	420	600	420	680	200
3947	5920.5		2.0	0.0	5,093	190	280	190	310	50
83299	180736	PAN FREESIA	42.1	25.8	17,208	420	600	420	680	200
106439	159659		49.7	0.0	15,747	420	600	420	680	200
26858	93318	LM VICTORIA	12.5	77.2	11,150	420	600	420	680	200
89324	91873	ANDREAS K	45.1	81.5	11,049	420	600	420	680	200
84915	180736	PAN FREESIA	39.7	54.8	17,208	420	600	420	680	200
159336	179185	F. SUN	80.5	0.0	17,100	420	600	420	680	200
163109	179120	WILLIAM OLDENDORFF*	76.2	40.6	17,096	420	600	420	680	200
99130	175141	PAN ACACIA	50.1	29.8	16,820	420	600	420	680	200
135273	180736	PAN FREESIA	68.3	220.9	17,208	420	600	420	680	200
4999	7498.5		2.5	0.0	5,202	190	280	190	310	50
89600	93246	CORNELIE OLDENDORFF	41.9	0.0	11,145	420	600	420	680	200
55620	82072	KM KEELUNG	26.0	64.7	10,370	420	600	420	680	200
102903	175010	PAN IRIS	52.0	19.2	16,811	420	600	420	680	200
96401	180274	STAR PAULINE	48.7	20.5	17,176	420	600	420	680	200
70881	181395	ORANGE TIGER*	33.1	261.2	17,253	420	600	420	680	200
68646	82177	PACIFIC KINDNESS	34.7	39.3	10,377	420	600	420	680	200
55241	175010	PAN IRIS	25.8	59.4	16,811	420	600	420	680	200
22341	180784	SM TIGER	10.4	319.6	17,211	420	600	420	680	200
24141	82072	KM KEELUNG	11.3	115.0	10,370	420	600	420	680	200
96450	179250	JAG ANAND	48.7	271.6	17,105	420	600	420	680	200
91787	98704	GL IGUAZU	46.4	64.7	11,523	420	600	420	680	200

Tonnage loaded	Ship DWT	Ship Name	hours at berth	hours at anchor	ME capacity (kW)	AE uway (kW)	AE berth (kW)	AE anch (kW)	AE mano (kW)	BO, all (kW)
165000	206048	MARTHA OLDENDORFF	77.1	231.5	18,962	420	600	420	680	200
149093	171827	ADONIS	75.3	240.1	16,590	420	600	420	680	200
151121	207886	CAPE RAINBOW	70.6	690.3	19,089	420	600	420	680	200
35105	180736	PAN FREESIA	16.4	331.7	17,208	420	600	420	680	200
79895	93549	NANAUMI	40.4	159.6	11,166	420	600	420	680	200
78837	81541	PEDHOULAS BUILDER	36.8	41.7	10,333	420	600	420	680	200
65060	82206	WANGARATTA	30.4	53.8	10,379	420	600	420	680	200
32363	76000	TIGER EAST	15.1	682.3	9,949	420	600	420	680	200
68423	76089	AM ZENICA	34.6	13.6	9,956	420	600	420	680	200
76999	87144	SEA FUTURE	36.0	253.8	10,722	420	600	420	680	200
93231	176827	SHIOSAI	47.1	358.9	16,937	420	600	420	680	200
89527	179062	HL ESPERANCE	41.8	0.0	17,092	420	600	420	680	200
67431	76424	PENTA	34.1	504.4	9,979	420	600	420	680	200
34350	93254	RICSEA	17.3	131.4	11,145	420	600	420	680	200
165000	207562	LINDA OLDENDORFF	77.1	13.0	19,067	420	600	420	680	200
79126	85031	CALYPSO ISLAND	40.0	325.2	10,575	420	600	420	680	200
66477	176827	SHIOSAI	31.1	77.6	16,937	420	600	420	680	200
102429	206180	CAPE VANGUARD	47.9	91.3	18,971	420	600	420	680	200
104690	106507	KUMANO MARU	52.9	590.8	12,064	420	600	420	680	200
56211	93254	RICSEA	28.4	107.6	11,145	420	600	420	680	200
128283	208384	PAN DELIGHT	59.9	132.2	19,124	420	600	420	680	200
64691	175293	PAN CHAMPION	32.7	110.0	16,830	420	600	420	680	200
30975	98697	KATAGALAN WISDOM	15.6	76.1	11,522	420	600	420	680	200
73042	83611	ULTRA TIGER	34.1	88.1	10,477	420	600	420	680	200
64988	95750	TWINKLE SALUTE	32.8	359.9	11,318	420	600	420	680	200
44596	91945	STAR PIERA	20.8	228.7	11,054	420	600	420	680	200
78154	81250	TRANSATLANTIC	39.5	30.5	10,313	420	600	420	680	200
90724	93005	CORA OLDENDORFF	42.4	13.2	11,128	420	600	420	680	200
79054	175293	PAN CHAMPION	39.9	83.6	16,830	420	600	420	680	200
4847	7270.5		2.4	0.0	5,186	190	280	190	310	50
94998	206118	MINA OLDENDORFF*	44.4	377.5	18,967	420	600	420	680	200
20321	95750	TWINKLE SALUTE	10.3	82.6	11,318	420	600	420	680	200
43910	91945	STAR PIERA	20.5	80.2	11,054	420	600	420	680	200
42019	209473	KN ARCADIA	19.6	31.8	19,199	420	600	420	680	200
86486	95708	ORIENTAL LEADER	43.7	398.9	11,315	420	600	420	680	200
83463	86949	SOPHIA	42.2	83.3	10,708	420	600	420	680	200
87202	92418	SHORYU	44.0	271.5	11,087	420	600	420	680	200
165000	209113	HINRICH OLDENDORFF	77.1	22.7	19,174	420	600	420	680	200
36733	93521	MAIZURU DAIKOKU	18.6	268.3	11,164	420	600	420	680	200

Tonnage loaded	Ship DWT	Ship Name	hours at berth	hours at anchor	ME capacity (kW)	AE uway (kW)	AE berth (kW)	AE anch (kW)	AE mano (kW)	BO, all (kW)
36570	206118	MINA OLDENDORFF*	17.1	144.9	18,967	420	600	420	680	200
66000	81600	AM SHRADDHA	33.3	76.8	10,337	420	600	420	680	200
78538	87144	NOZOMI	36.7	357.9	10,722	420	600	420	680	200
52323	85005	ING MAY	26.4	25.7	10,573	420	600	420	680	200
61689	81399	DAEBO GLADSTONE	31.2	21.5	10,324	420	600	420	680	200
119043	180242	LINDA FORTUNE	55.6	352.2	17,173	420	600	420	680	200
17486	26229		8.8	0.0	6,500	190	280	190	310	50
37663	56494.5		17.6	0.0	8,598	260	370	260	420	100
24927	93521	MAIZURU DAIKOKU	12.6	115.1	11,164	420	600	420	680	200
113492	179221	YOUNGHEUNG	53.0	87.0	17,103	420	600	420	680	200
27961	85005	ING MAY	13.1	86.0	10,573	420	600	420	680	200
65678	181050	NEW ADMIRE	33.2	24.1	17,229	420	600	420	680	200
13629	93521	MAIZURU DAIKOKU	6.9	35.6	11,164	420	600	420	680	200
136669	151335	K. YOUNGHUNG	63.9	74.2	15,170	420	600	420	680	200
42900	53021	GMB ALCMENE	21.7	167.2	8,357	260	370	260	420	100
47926	179221	YOUNGHEUNG	22.4	66.3	17,103	420	600	420	680	200
82328	86392	CORONA POWER	41.6	95.0	10,670	420	600	420	680	200
93269	95711	LOWLANDS RISE	43.6	34.1	11,315	420	600	420	680	200
78046	88083	JP CARETTA	36.5	160.8	10,787	420	600	420	680	200
104112	181050	NEW ADMIRE	52.6	98.1	17,229	420	600	420	680	200
78701	82055	HYUNDAI LEADER	36.8	216.5	10,369	420	600	420	680	200
92446	98704	GL IGUAZU	43.2	142.7	11,523	420	600	420	680	200
68763	179185	F. SUN	32.1	114.5	17,100	420	600	420	680	200
115906	179135	HL VISION	58.5	251.3	17,097	420	600	420	680	200
65756	77247	HANABUSA	33.2	89.6	10,036	420	600	420	680	200
191558	206204	CAPE MAPLE**	89.5	553.0	18,973	420	600	420	680	200
101377	176387	NEW EXPEDITION	51.2	253.5	16,906	420	600	420	680	200
71445	76627	CORAL SAPPHIRE	33.4	34.8	9,993	420	600	420	680	200
87355	93201	DENITA WAVE	44.1	96.5	11,141	420	600	420	680	200
55946	179135	HL VISION	26.1	117.5	17,097	420	600	420	680	200
90877	179185	F. SUN	45.9	130.1	17,100	420	600	420	680	200
79275	86392	CORONA QUEEN	40.0	115.7	10,670	420	600	420	680	200
165572	207219	MINERAL EDO	77.4	14.9	19,043	420	600	420	680	200
31750	176387	NEW EXPEDITION	14.8	123.7	16,906	420	600	420	680	200
68920	180242	MINERAL HAIKU	34.8	96.1	17,173	420	600	420	680	200
90426	93254	RICSEA	45.7	157.5	11,145	420	600	420	680	200
44372	106668	FPMC B 103	22.4	87.6	12,075	420	600	420	680	200
169618	178929	ATTIKOS	79.2	42.0	17,082	420	600	420	680	200
37837	180242	MINERAL HAIKU	17.7	66.8	17,173	420	600	420	680	200

Tonnage loaded	Ship DWT	Ship Name	hours at berth	hours at anchor	ME capacity (kW)	AE uway (kW)	AE berth (kW)	AE anch (kW)	AE mano (kW)	BO, all (kW)
135021	180157	STELLA ALICE	68.2	279.8	17,167	420	600	420	680	200
91174	180274	STAR PAULINE	42.6	503.0	17,176	420	600	420	680	200
170347	180736	PAN FREESIA	79.6	116.9	17,208	420	600	420	680	200
6221	180242	MINERAL HAIKU	2.9	133.0	17,173	420	600	420	680	200
88000	93262	PAOLA BOTTIGLIERI	44.4	133.3	11,146	420	600	420	680	200
32500	206237	CAPE ACACIA**	15.2	127.8	18,975	420	600	420	680	200
87369	92418	SHORYU	44.1	210.3	11,087	420	600	420	680	200
78589	82122	ENERGY TRITON	36.7	206.6	10,374	420	600	420	680	200
78572	87144	SEA FUTURE	39.7	593.5	10,722	420	600	420	680	200
47324	206237	CAPE ACACIA**	22.1	44.6	18,975	420	600	420	680	200
81250	87036	MARINA	41.0	256.1	10,714	420	600	420	680	200
133527	181502	HL SHIKOKU	62.4	379.6	17,261	420	600	420	680	200
156758	179742	ROSEMARY	79.2	244.3	17,139	420	600	420	680	200
156292	172940	ORIENTAL NAVIGATOR	78.9	179.5	16,667	420	600	420	680	200
26965	81944	NORD CAPELLA	13.6	58.1	10,361	420	600	420	680	200
165000	199988	LAVINIA OLDENDORFF	77.1	123.5	18,542	420	600	420	680	200
81618	85009	ASAHI MARU *	41.2	121.7	10,574	420	600	420	680	200
73708	75480	GREAT HOPE	37.2	137.3	9,913	420	600	420	680	200
171542	181009	KSL SYDNEY	80.1	115.0	17,227	420	600	420	680	200
73882	98704	GL IGUAZU	37.3	150.3	11,523	420	600	420	680	200
30653	55885	IVY BLUE	15.5	38.3	8,555	260	370	260	420	100
76560	79422	ULUSOY -11	35.8	126.8	10,187	420	600	420	680	200
77628	82146	NORD SUN	39.2	149.4	10,375	420	600	420	680	200
60000	82053	PHAEDRA	28.0	294.6	10,369	420	600	420	680	200
44000	63000	ROYAL MIDORI	22.2	425.5	9,049	420	600	420	680	200
83341	88909	CORONA VICTORY	38.9	52.7	10,844	420	600	420	680	200
72719	76634	DOOYANG JEJU	34.0	47.5	9,993	420	600	420	680	200
85276	175401	PAN BONA	43.1	116.0	16,838	420	600	420	680	200
16001	95790	KIND SALUTE*	8.1	32.2	11,321	420	600	420	680	200
76410	209177	HELENA OLDENDORFF	35.7	48.5	19,179	420	600	420	680	200
63145	94717.5		31.9	0.0	11,247	420	600	420	680	200
5141	7711.5		2.6	0.0	5,217	190	280	190	310	50
109390	164085		51.1	0.0	16,054	420	600	420	680	200
164999	181000	LOWLANDS SPIRIT	77.1	179.8	17,226	420	600	420	680	200
169696	178459	ZAMPA BLUE	85.7	241.4	17,050	420	600	420	680	200
88669	93328	SM CHALLENGER	44.8	26.0	11,150	420	600	420	680	200
195800	207819	NSU OBELISK	91.5	79.6	19,084	420	600	420	680	200
150824	175293	PAN CHAMPION	76.2	6.9	16,830	420	600	420	680	200
171116	179062	HL ESPERANCE	79.9	90.2	17,092	420	600	420	680	200



Tonnage loaded	Ship DWT	Ship Name	hours at berth	hours at anchor	ME capacity (kW)	AE uway (kW)	AE berth (kW)	AE anch (kW)	AE mano (kW)	BO, all (kW)
87004	91861	CORONA YOUTHFUL	43.9	11.8	11,049	420	600	420	680	200
77835	88165	MAIZURU BISHAMON	36.4	31.3	10,792	420	600	420	680	200
73011	100172	TENRYU MARU	36.9	88.0	11,625	420	600	420	680	200
104692	205938	MARAN NOBILITY	48.9	54.7	18,954	420	600	420	680	200
71487	74962	MORNING CLOUD	36.1	22.1	9,877	420	600	420	680	200
87147	91073	SHOHAKU	40.7	224.8	10,994	420	600	420	680	200
78196	82052	ELECTRA	39.5	31.0	10,369	420	600	420	680	200
73574	89499	MEDI KYOTO	34.4	27.4	10,885	420	600	420	680	200
86932	93258	BOTTIGLIERI GIULIO BORRIELLO	43.9	0.0	11,145	420	600	420	680	200
74000	92500	GH HARMONY	37.4	0.0	11,093	420	600	420	680	200
197937	209243	HERMANN OLDENDORFF	92.5	0.0	19,183	420	600	420	680	200
77170	81450	OMIROS L	36.1	40.5	10,327	420	600	420	680	200
85489	93252	GREAT GLEN	43.2	56.3	11,145	420	600	420	680	200
65801	78228	ROBIN WIND	33.2	152.8	10,104	420	600	420	680	200
133126	203248	SHIN ONOE	62.2	133.3	18,768	420	600	420	680	200
65970	77247	HANABUSA	33.3	53.4	10,036	420	600	420	680	200
64886	79449	NEW EXCELLENCE	32.8	49.7	10,188	420	600	420	680	200
134217	149738	HL TAEAN	62.7	106.8	15,059	420	600	420	680	200
68748	81176	BLC SECOND	34.7	0.0	10,308	420	600	420	680	200
26321	180387	GENCO LIBERTY	12.3	47.6	17,183	420	600	420	680	200
7130	10695		3.6	0.0	5,424	190	280	190	310	50
143301	214952		67.0	0.0	19,579	420	600	420	680	200
164732	180181	PANTAGRUEL	83.2	210.6	17,169	420	600	420	680	200
82860	95712	ELEGANT SALUTE	41.8	158.1	11,315	420	600	420	680	200
189737	206306	SEN-OKU	88.6	16.6	18,980	420	600	420	680	200
73581	98704	GL IGUAZU	37.2	140.9	11,523	420	600	420	680	200
89961	95750	TWINKLE SALUTE	45.4	219.0	11,318	420	600	420	680	200
190679	209801	SAMJOHN ODYSSEY	89.1	102.3	19,222	420	600	420	680	200
155319	179742	ROSEMARY	78.4	279.2	17,139	420	600	420	680	200
187000	206331	BAOSTEEL EVOLUTION	87.4	132.1	18,981	420	600	420	680	200
158024	174845	FRONTIER DISCOVERY	79.8	183.8	16,799	420	600	420	680	200
77658	95755	VENUS HORIZON	39.2	9.6	11,318	420	600	420	680	200
122600	180265	NAVIOS FANTASTIKS	57.3	261.9	17,175	420	600	420	680	200
9059	95755	VENUS HORIZON	4.2	24.9	11,318	420	600	420	680	200
84857	92266	SUOH PACIFIC	42.9	183.9	11,077	420	600	420	680	200
84200	86356	CORONA NATURE	39.3	47.3	10,667	420	600	420	680	200
77725	82769	STAR KAMILA	39.3	322.4	10,418	420	600	420	680	200
89048	93254	RICSEA	41.6	45.4	11,145	420	600	420	680	200
79068	82926	KAVO YERAKI	39.9	258.1	10,429	420	600	420	680	200

Tonnage loaded	Ship DWT	Ship Name	hours at berth	hours at anchor	ME capacity (kW)	AE uway (kW)	AE berth (kW)	AE anch (kW)	AE mano (kW)	BO, all (kW)
78112	81902	LAKE DAWN	36.5	98.7	10,358	420	600	420	680	200
55569	75026	PAN VIVA	28.1	272.5	9,882	420	600	420	680	200
83911	88703	CORONA CITRUS	39.2	36.0	10,830	420	600	420	680	200
74452	82158	PEAK PROTEUS	37.6	36.7	10,376	420	600	420	680	200
86967	93478	LOWLANDS HORIZON	43.9	40.1	11,161	420	600	420	680	200
192208	203212	PACIFIC OAK	89.8	5.3	18,765	420	600	420	680	200
82058	88898	CORONA WISDOM	41.4	76.3	10,843	420	600	420	680	200
88407	92803	W-EAGLE	41.3	53.3	11,114	420	600	420	680	200
80209	84790	MG EXPLORER	40.5	27.5	10,559	420	600	420	680	200
77008	81398	HL IBT	36.0	36.4	10,323	420	600	420	680	200
36842	92418	SHORYU	18.6	16.8	11,087	420	600	420	680	200
22389	208384	PAN DELIGHT	10.5	0.0	19,124	420	600	420	680	200
Total			15,050	53,468	4,917,310	148,670	212,430	148,670	240,710	70,250

**Table D.2: Total Energy Consumed by Ships**

Tonnage loaded	Ship DWT	Ship Name	RSA				On-site		
			Total ME kWh	Total AE kWh	Total BO kWh	Total tug kWh	Total AE kWh	Total BO kWh	Total tug kWh
137414	151335	K. YOUNGHUNG	25,484	50,213	18,160	11,188	38,521	12,840	5,069
92500	95527	NBA VAN DYCK	18,987	37,909	13,800	11,188	28,030	9,343	5,069
65040	80679	KEY FRONTIER	17,258	50,770	21,113	11,188	19,709	6,570	5,069
165404	182631	OLYMPIC HOPE	29,127	99,156	40,346	11,188	46,368	15,456	5,069
64698	179283	HL PORT HEDLAND	28,737	99,344	44,258	11,188	19,605	6,535	5,069
105696	181366	CAPE EMERALD	28,980	78,828	33,056	11,188	29,630	9,877	5,069
160872	180159	MINERAL HOKKAIDO	28,839	62,827	22,706	11,188	48,748	16,249	5,069
78599	82044	JAG AKSHAY	17,417	47,837	19,384	11,188	22,034	7,345	5,069
88449	179397	MINERAL SUBIC	28,751	55,140	22,181	11,188	26,802	8,934	5,069
91283	95368	HEBEI QINHUANGDAO	18,968	36,217	13,343	11,188	25,589	8,530	5,069
106160	179283	HL PORT HEDLAND	28,737	83,873	35,096	11,188	32,169	10,723	5,069
144622	203200	OCEAN PROMETHEUS	31,522	59,696	22,387	11,188	40,542	13,514	5,069
102661	207933	SHIN-EI	32,073	317,363	146,766	11,188	28,779	9,593	5,069
161594	169056	MAHA ANOSHA	27,547	170,783	74,082	11,188	48,967	16,322	5,069
31378	203200	OCEAN PROMETHEUS	31,522	39,465	17,289	11,188	8,796	2,932	5,069
110000	114536	HL SAMARINDA	21,200	269,347	123,251	11,188	33,333	11,111	5,069
1125	78821	TRITON GANNET	17,042	185,605	88,087	11,188	341	114	5,069
105147	181056	HERUN GLOBAL	28,944	301,757	139,235	11,188	29,476	9,825	5,069
26866	40299		1,794	5,640	1,515	11,188	4,644	1,255	5,069
76551	179397	MINERAL SUBIC	28,751	128,995	58,113	11,188	21,459	7,153	5,069
74263	111395		2,976	24,115	8,021	11,188	22,503	7,501	5,069
32180	55947	TTM DRAGON	14,379	43,336	15,857	11,188	6,013	1,625	5,069
90090	93038	DEDALOS	18,697	209,329	95,825	11,188	25,255	8,418	5,069
86437	92418	SHORYU	18,625	111,286	49,004	11,188	26,192	8,731	5,069
81964	98704	GL IGUAZU	19,357	79,873	34,239	11,188	24,837	8,279	5,069
162796	181403	CAPE IRIS	28,984	106,405	43,902	11,188	45,636	15,212	5,069
87414	98681	STAR VEGA	19,354	92,668	40,096	11,188	26,489	8,830	5,069
94402	98704	GL LA PAZ	2,765	28,076	9,341	11,188	26,464	8,821	5,069
75494	79372	SEA EMPIRE	17,106	47,147	18,935	11,188	22,876	7,625	5,069
84604	90839	HARAMACHI MARU	18,441	96,323	42,232	11,188	23,717	7,906	5,069
78582	81738	MSXT HERA	17,382	136,472	61,337	11,188	23,812	7,937	5,069
62242	154068	OCEAN TRINITY	25,802	93,910	41,777	11,188	18,861	6,287	5,069
42084	77198	KING MILO	16,853	100,576	45,824	11,188	12,752	4,251	5,069
31006	81993	OCEAN CARRIER *	17,411	34,611	14,892	11,188	9,396	3,132	5,069
197005	207500	CAPE SAPPHIRE	32,022	355,661	161,225	11,188	55,226	18,409	5,069
32295	77198	KING MILO	16,853	20,841	8,279	11,188	9,786	3,262	5,069
87790	154068	OCEAN TRINITY	25,802	49,434	19,777	11,188	24,610	8,203	5,069
55802	93253	DECLAN DUFF	18,722	166,061	76,594	11,188	15,643	5,214	5,069

120629	179656	HL PRIDE	28,781	168,092	74,574	11,188	36,553	12,184	5,069
24487	85025	EVER IMPERIAL	17,764	35,534	15,613	11,188	7,420	2,473	5,069
47215	81993	OCEAN CARRIER *	17,411	47,986	20,712	11,188	13,236	4,412	5,069
33975	93253	DECLAN DUFF	18,722	22,953	9,212	11,188	10,295	3,432	5,069
66000	92071	REIYO	18,585	26,351	9,657	11,188	18,502	6,167	5,069
49641	92655	TOPAS	18,653	263,103	122,891	11,188	15,042	5,014	5,069
76047	181502	HL SHIKOKU	28,996	123,128	55,339	11,188	21,318	7,106	5,069
44000	55614	MEDI PAESTUM	2,049	9,218	2,482	11,188	8,222	2,222	5,069
53904	86392	CORONA QUEEN	17,923	108,575	49,121	11,188	16,334	5,445	5,069
38787	92655	TOPAS	18,653	34,372	14,441	11,188	11,753	3,918	5,069
165249	209935	FOMENTO THREE	32,306	76,363	29,498	11,188	46,324	15,441	5,069
68380	81955	KEY NAVIGATOR	17,407	61,995	26,314	11,188	20,721	6,907	5,069
24155	86392	CORONA QUEEN	17,923	34,978	15,363	11,188	7,320	2,440	5,069
75800	207991	SHIN KORYU	32,079	51,708	21,340	11,188	21,249	7,083	5,069
70950	74362	FORTUNE GENIUS	16,523	38,994	15,250	11,188	21,500	7,167	5,069
145577	207964	OTOTACHIBANA	32,076	294,547	134,183	11,188	40,809	13,603	5,069
50514	85025	EVER IMPERIAL	17,764	107,877	48,936	11,188	15,307	5,102	5,069
24035	81161	AD ASTRA	17,314	113,391	52,708	11,188	7,283	2,428	5,069
24374	74204	OREGON	16,505	13,807	5,272	11,188	7,386	2,462	5,069
90250	177855	ANTONIS ANGELICOUSSIS	28,571	97,990	42,800	11,188	25,300	8,433	5,069
10862	16293		1,395	2,155	384	11,188	1,421	254	5,069
48269	72403.5		2,328	16,239	5,396	11,188	14,627	4,876	5,069
43323	81691	SAKIZAYA LEADER	17,376	27,281	11,008	11,188	12,145	4,048	5,069
76467	151335	K. YOUNGHUNG	25,484	52,006	21,207	11,188	23,171	7,724	5,069
41100	76000	TIGER EAST	16,714	46,105	19,928	11,188	12,454	4,151	5,069
165000	179258	ALPHA HONESTY	28,734	63,028	23,158	11,188	46,254	15,418	5,069
97257	181395	ORANGE TIGER*	28,983	283,508	130,861	11,188	27,264	9,088	5,069
106080	180784	SM TIGER	28,912	283,482	130,496	11,188	29,737	9,912	5,069
65059	80679	KEY FRONTIER	17,258	59,000	25,031	11,188	19,714	6,571	5,069
57051	151335	K. YOUNGHUNG	25,484	67,389	29,558	11,188	15,993	5,331	5,069
70457	179250	JAG ANAND	28,733	39,720	15,617	11,188	21,350	7,117	5,069
36447	177855	ANTONIS ANGELICOUSSIS	28,571	93,351	42,746	11,188	10,217	3,406	5,069
158919	179221	YOUNGHEUNG	28,730	55,060	19,092	11,188	48,156	16,052	5,069
135599	182511	LEVIATHAN	29,113	125,934	54,291	11,188	38,012	12,671	5,069
34790	52185		1,992	7,497	2,017	11,188	6,501	1,757	5,069
104148	209249	HERA OLDENDORFF	32,226	168,890	76,005	11,188	29,196	9,732	5,069
25118	149989	PAN KOMIPO	25,327	126,785	59,120	11,188	7,041	2,347	5,069
88000	97045	GLOVIS DONGHAE	19,164	139,368	62,309	11,188	26,666	8,889	5,069
64786	80679	KEY FRONTIER	17,258	29,098	10,804	11,188	19,632	6,544	5,069
96842	207684	NSU KEYSTONE	32,044	103,106	44,972	11,188	27,148	9,049	5,069
42031	180528	DREAM CANARY	28,882	217,150	101,474	11,188	11,783	3,928	5,069

112375	149989	PAN KOMIPO	25,327	51,736	19,524	11,188	34,052	11,351	5,069
69976	182718	CAPE TSUBAKI	29,137	86,545	38,162	11,188	19,616	6,539	5,069
57676	180528	DREAM CANARY	28,882	34,790	14,009	11,188	16,168	5,389	5,069
160011	172579	CAPRI	27,957	133,665	56,476	11,188	48,487	16,162	5,069
82475	93234	NANA Z	18,720	234,658	107,924	11,188	24,992	8,331	5,069
175787	203200	OCEAN PROMETHEUS	31,522	246,547	110,116	11,188	49,278	16,426	5,069
62489	81767	MODIGLIANI	17,385	66,939	29,126	11,188	17,517	5,839	5,069
76456	81963	ECOPRIDE G.O.	17,408	70,140	29,843	11,188	23,168	7,723	5,069
88072	92418	HAKUYO	18,625	169,567	76,686	11,188	26,688	8,896	5,069
184462	208025	CAPE AZALEA	32,083	75,064	28,110	11,188	51,710	17,237	5,069
75647	82055	HYUNDAI LEADER	17,419	245,497	113,381	11,188	22,923	7,641	5,069
20502	83375	KEY INTEGRITY	17,572	46,226	20,877	11,188	6,213	2,071	5,069
68615	180528	DREAM CANARY	28,882	130,425	59,112	11,188	19,235	6,412	5,069
54267	207684	NSU KEYSTONE	32,044	199,020	92,351	11,188	15,213	5,071	5,069
15261	81767	MODIGLIANI	17,385	90,100	42,046	11,188	4,278	1,426	5,069
170503	181279	NEW DELIGHT	28,970	225,464	99,735	11,188	51,667	17,222	5,069
80500	95740	BULK PHILIPPINES	19,012	123,571	55,111	11,188	24,393	8,131	5,069
35310	149350	HL RICHARDS BAY	25,253	122,604	56,607	11,188	10,700	3,567	5,069
181500	206104	LOS ANGELES	31,860	273,055	122,510	11,188	50,880	16,960	5,069
21571	208384	PAN DELIGHT	32,125	195,616	92,039	11,188	6,047	2,016	5,069
76036	179742	ROSEMARY	28,791	69,229	29,427	11,188	23,041	7,680	5,069
34129	51193.5		1,975	6,896	1,855	11,188	5,900	1,595	5,069
88795	133193		3,339	28,519	9,489	11,188	26,907	8,969	5,069
22000	56064	TANIKAZE	14,393	60,318	22,606	11,188	4,111	1,111	5,069
97281	149350	HL RICHARDS BAY	25,253	71,151	29,423	11,188	29,478	9,826	5,069
190773	206180	CAPE VANGUARD	31,869	161,519	69,026	11,188	53,479	17,826	5,069
54834	75239	ECOSAND G.O.	16,625	97,790	43,945	11,188	16,616	5,539	5,069
39172	87144	SEA FUTURE	18,011	66,934	29,930	11,188	11,870	3,957	5,069
136270	171128	MINERAL CHINA	27,788	391,023	180,497	11,188	38,200	12,733	5,069
77089	93549	NANAUMI	18,757	28,843	10,150	11,188	23,360	7,787	5,069
38900	87144	SEA FUTURE	18,011	38,571	16,436	11,188	11,788	3,929	5,069
168955	179156	HL SUCCESS	28,723	190,578	83,738	11,188	47,363	15,788	5,069
61782	180176	AQUA BONANZA	28,841	111,970	50,397	11,188	18,721	6,240	5,069
77368	179492	SANTA BARBARA	4,109	23,300	7,749	11,188	21,688	7,229	5,069
84533	91867	SOYO	18,561	36,649	13,545	11,188	25,616	8,539	5,069
60474	181502	HL SHIKOKU	28,996	26,180	9,797	11,188	16,953	5,651	5,069
86216	92389	TAIYO	2,660	27,738	9,228	11,188	26,126	8,709	5,069
74592	76492	AQUA LADY	16,771	194,309	89,293	11,188	20,910	6,970	5,069
92001	209708	BISAN CLOVER	4,611	27,403	9,117	11,188	25,791	8,597	5,069
172238	180202	STAR PRINCESS	4,121	53,804	17,917	11,188	52,192	17,397	5,069
153971	180151	GENCO AUGUSTUS	28,838	114,111	47,426	11,188	46,657	15,552	5,069

193470	207886	CAPE RAINBOW	32,067	122,753	50,458	11,188	54,235	18,078	5,069
4050	180176	AQUA BONANZA	28,841	131,183	62,058	11,188	1,135	378	5,069
10509	81119	SSI EXCELLENT	17,310	16,143	6,985	11,188	3,184	1,061	5,069
67249	100874		2,801	21,990	7,313	11,188	20,378	6,793	5,069
102250	153375		3,674	30,276	10,075	11,188	28,664	9,555	5,069
69863	82200	CEMTEX SINCERITY	17,435	215,436	99,317	11,188	21,170	7,057	5,069
164753	209325	TRUST AMITY	32,235	185,200	81,345	11,188	46,185	15,395	5,069
78321	88269	JP VERDURE	18,142	152,227	68,851	11,188	23,733	7,911	5,069
78000	80250	VISHVA PREETI	17,208	175,602	80,248	11,188	21,866	7,289	5,069
42463	82050	PEDHOULAS LEADER	17,418	105,857	48,322	11,188	12,867	4,289	5,069
56248	74716	DIAS	16,564	87,823	39,138	11,188	17,044	5,681	5,069
131149	205888	MARAN COURAGE	31,835	58,229	22,228	11,188	36,765	12,255	5,069
34537	82050	PEDHOULAS LEADER	17,418	35,234	15,147	11,188	9,682	3,227	5,069
79905	203180	SHIN NICHIGO	31,519	102,909	45,556	11,188	22,400	7,467	5,069
168018	180784	SM TIGER	28,912	93,545	37,024	11,188	50,913	16,971	5,069
93500	98681	ANGLO MARIMAR	19,354	91,601	39,324	11,188	28,333	9,444	5,069
197966	207500	CAPE SAPPHIRE	32,022	69,875	25,098	11,188	55,496	18,499	5,069
87174	95750	TWINKLE SALUTE	19,013	58,660	23,912	11,188	26,416	8,805	5,069
108585	207362	NSU QUEST	32,006	71,573	29,486	11,188	30,440	10,147	5,069
77234	81616	ARSINOE	17,367	192,806	88,221	11,188	23,404	7,801	5,069
87041	91941	AGIOS SPYRIDONAS	18,569	38,081	14,118	11,188	26,376	8,792	5,069
189541	206306	SPRING BRAVE	31,883	102,493	40,968	11,188	53,134	17,711	5,069
77823	82224	BULK PORTUGAL	17,438	55,903	23,004	11,188	23,582	7,861	5,069
73328	179742	ROSEMARY	28,791	83,411	36,535	11,188	20,556	6,852	5,069
66000	95731	CMB POMEROL	19,011	26,498	9,727	11,188	18,502	6,167	5,069
33530	80655	VISHVA ANAND	17,256	196,553	92,006	11,188	9,399	3,133	5,069
167837	176990	KYMOPOLIA	28,470	109,199	44,486	11,188	50,859	16,953	5,069
82465	87036	MARINA	2,571	24,729	8,226	11,188	23,117	7,706	5,069
44458	80655	VISHVA ANAND	17,256	26,830	10,604	11,188	13,472	4,491	5,069
44976	55592	GLOBAL KOMA	14,338	26,976	9,291	11,188	8,404	2,271	5,069
54247	179742	ROSEMARY	28,791	57,426	24,926	11,188	15,207	5,069	5,069
32453	48679.5		1,933	6,606	1,776	11,188	5,610	1,516	5,069
78966	82938	LORD STAR	17,521	48,101	19,239	11,188	23,929	7,976	5,069
176000	203200	OCEAN PROMETHEUS	31,522	358,047	163,203	11,188	49,338	16,446	5,069
89628	95570	DOUBLE MIRACLE	2,713	28,771	9,573	11,188	27,159	9,053	5,069
76347	81793	ZHENG RONG	17,388	34,732	13,234	11,188	21,402	7,134	5,069
165000	199997	STELLA TESS	31,149	157,115	67,961	11,188	46,254	15,418	5,069
79322	81791	AOM BIANCA	17,388	43,120	16,852	11,188	24,036	8,012	5,069
162852	172572	SUNLIGHT	27,956	187,712	82,617	11,188	45,652	15,217	5,069
91362	99347	DYNA GLOBE	19,432	44,879	17,168	11,188	27,685	9,228	5,069
174343	181415	JUBILANT EXCELLENCE	28,986	113,422	46,781	11,188	48,873	16,291	5,069

82273	87329	YUE DIAN 85	18,033	61,396	25,427	11,188	24,931	8,310	5,069
49500	61693	TCLC LUZHOU	15,048	59,984	26,173	11,188	15,000	5,000	5,069
113402	180387	GENCO LIBERTY	28,866	90,865	38,480	11,188	31,790	10,597	5,069
86192	91439	SHIN SANYO MARU	18,511	45,972	17,913	11,188	26,118	8,706	5,069
82500	95708	ORIENTAL LEADER	19,008	51,349	20,633	11,188	24,999	8,333	5,069
80435	82200	CEMTEX SINCERITY	17,435	36,654	13,725	11,188	24,374	8,125	5,069
162434	180646	CAPE NORMANDY	28,896	98,401	40,105	11,188	45,535	15,178	5,069
87410	91439	NANAKURA	18,511	53,831	21,602	11,188	26,487	8,829	5,069
77961	178854	AQUASURFER	28,687	62,233	26,265	11,188	21,855	7,285	5,069
62342	93318	LM VICTORIA	2,676	20,503	6,817	11,188	18,891	6,297	5,069
87345	207886	CAPE RAINBOW	32,067	81,033	34,842	11,188	24,485	8,162	5,069
3947	5920.5		1,222	1,292	230	11,188	558	100	5,069
83299	180736	PAN FREESIA	28,906	39,215	14,820	11,188	25,242	8,414	5,069
106439	159659		3,779	31,450	10,466	11,188	29,838	9,946	5,069
26858	93318	LM VICTORIA	18,730	43,056	19,180	11,188	7,529	2,510	5,069
89324	91873	ANDREAS K	18,562	64,421	26,562	11,188	27,067	9,022	5,069
84915	180736	PAN FREESIA	28,906	49,923	20,125	11,188	23,804	7,935	5,069
159336	179185	F. SUN	4,104	49,895	16,614	11,188	48,283	16,094	5,069
163109	179120	WILLIAM OLDENDORFF*	28,718	65,914	24,608	11,188	45,724	15,241	5,069
99130	175141	PAN ACACIA	28,255	45,679	17,213	11,188	30,039	10,013	5,069
135273	180736	PAN FREESIA	28,906	136,900	59,087	11,188	40,991	13,664	5,069
4999	7498.5		1,248	1,441	256	11,188	707	126	5,069
89600	93246	CORNELIE OLDENDORFF	2,674	26,729	8,892	11,188	25,117	8,372	5,069
55620	82072	KM KEELUNG	17,421	45,890	19,377	11,188	15,592	5,197	5,069
102903	175010	PAN IRIS	28,240	42,349	15,464	11,188	31,182	10,394	5,069
96401	180274	STAR PAULINE	28,853	40,946	15,077	11,188	29,212	9,737	5,069
70881	181395	ORANGE TIGER*	28,983	132,684	60,097	11,188	19,870	6,623	5,069
68646	82177	PACIFIC KINDNESS	17,433	40,445	16,040	11,188	20,801	6,934	5,069
55241	175010	PAN IRIS	28,240	43,551	18,278	11,188	15,486	5,162	5,069
22341	180784	SM TIGER	28,912	143,612	67,244	11,188	6,263	2,088	5,069
24141	82072	KM KEELUNG	17,421	58,205	26,502	11,188	6,767	2,256	5,069
96450	179250	JAG ANAND	28,733	146,430	65,305	11,188	29,227	9,742	5,069
91787	98704	GL IGUAZU	19,357	58,112	23,451	11,188	27,814	9,271	5,069
165000	206048	MARTHA OLDENDORFF	31,853	146,587	62,948	11,188	46,254	15,418	5,069
149093	171827	ADONIS	27,869	149,138	64,316	11,188	45,179	15,060	5,069
151121	207886	CAPE RAINBOW	32,067	335,406	153,418	11,188	42,364	14,121	5,069
35105	180736	PAN FREESIA	28,906	152,265	70,854	11,188	9,841	3,280	5,069
79895	93549	NANAUMI	18,757	94,359	41,227	11,188	24,210	8,070	5,069
78837	81541	PEDHOULAS BUILDER	17,359	42,738	16,947	11,188	22,100	7,367	5,069
65060	82206	WANGARATTA	17,436	43,958	18,079	11,188	18,238	6,079	5,069
32363	76000	TIGER EAST	16,714	298,741	140,714	11,188	9,072	3,024	5,069

68423	76089	AM ZENICA	16,724	29,549	10,861	11,188	20,734	6,911	5,069
76999	87144	SEA FUTURE	18,011	131,305	59,195	11,188	21,585	7,195	5,069
93231	176827	SHIOSAI	28,451	182,099	82,430	11,188	28,251	9,417	5,069
89527	179062	HL ESPERANCE	4,102	26,709	8,886	11,188	25,097	8,366	5,069
67431	76424	PENTA	16,763	235,405	108,931	11,188	20,433	6,811	5,069
34350	93254	RICSEA	18,722	68,721	30,990	11,188	10,409	3,470	5,069
165000	207562	LINDA OLDENDORFF	32,029	54,831	19,255	11,188	46,254	15,418	5,069
79126	85031	CALYPSO ISLAND	17,765	163,671	74,266	11,188	23,977	7,992	5,069
66477	176827	SHIOSAI	28,451	54,344	22,968	11,188	18,635	6,212	5,069
102429	206180	CAPE VANGUARD	31,869	70,184	29,071	11,188	28,714	9,571	5,069
104690	106507	KUMANO MARU	20,265	282,997	129,981	11,188	31,724	10,575	5,069
56211	93254	RICSEA	18,722	65,349	28,438	11,188	17,033	5,678	5,069
128283	208384	PAN DELIGHT	32,125	94,616	39,670	11,188	35,961	11,987	5,069
64691	175293	PAN CHAMPION	28,273	68,927	29,774	11,188	19,603	6,534	5,069
30975	98697	KATAGALAN WISDOM	19,356	44,465	19,585	11,188	9,386	3,129	5,069
73042	83611	ULTRA TIGER	17,600	60,602	25,685	11,188	20,476	6,825	5,069
64988	95750	TWINKLE SALUTE	19,013	173,982	79,788	11,188	19,693	6,564	5,069
44596	91945	STAR PIERA	18,570	111,679	51,147	11,188	12,502	4,167	5,069
78154	81250	TRANSATLANTIC	17,325	39,595	15,224	11,188	23,683	7,894	5,069
90724	93005	CORA OLDENDORFF	18,693	34,107	12,361	11,188	25,433	8,478	5,069
79054	175293	PAN CHAMPION	28,273	62,177	25,938	11,188	23,955	7,985	5,069
4847	7270.5		1,245	1,419	252	11,188	685	122	5,069
94998	206118	MINA OLDENDORFF*	31,861	188,305	85,617	11,188	26,631	8,877	5,069
20321	95750	TWINKLE SALUTE	19,013	43,967	19,809	11,188	6,158	2,053	5,069
43910	91945	STAR PIERA	18,570	49,117	21,383	11,188	12,309	4,103	5,069
42019	209473	KN ARCADIA	32,252	28,273	11,533	11,188	11,779	3,926	5,069
86486	95708	ORIENTAL LEADER	19,008	196,862	89,752	11,188	26,207	8,736	5,069
83463	86949	SOPHIA	17,988	63,415	26,337	11,188	25,291	8,430	5,069
87202	92418	SHORYU	18,625	143,578	64,348	11,188	26,424	8,808	5,069
165000	209113	HINRICH OLDENDORFF	32,210	58,891	21,188	11,188	46,254	15,418	5,069
36733	93521	MAIZURU DAIKOKU	18,753	126,955	58,617	11,188	11,131	3,710	5,069
36570	206118	MINA OLDENDORFF*	31,861	74,233	33,637	11,188	10,252	3,417	5,069
66000	81600	AM SHRADDHA	17,366	55,393	23,273	11,188	20,000	6,667	5,069
78538	87144	NOZOMI	18,011	175,458	80,159	11,188	22,016	7,339	5,069
52323	85005	ING MAY	17,762	29,780	11,668	11,188	15,855	5,285	5,069
61689	81399	DAEBO GLADSTONE	17,342	30,833	11,764	11,188	18,693	6,231	5,069
119043	180242	LINDA FORTUNE	28,849	184,405	82,797	11,188	33,371	11,124	5,069
17486	26229		1,560	3,207	572	11,188	2,473	442	5,069
37663	56494.5		2,063	7,507	2,020	11,188	6,511	1,760	5,069
24927	93521	MAIZURU DAIKOKU	18,753	59,012	26,774	11,188	7,553	2,518	5,069
113492	179221	YOUNGHEUNG	28,730	71,479	29,245	11,188	31,815	10,605	5,069



27961	85005	ING MAY	17,762	47,061	21,043	11,188	7,838	2,613	5,069
65678	181050	NEW ADMIRE	28,943	33,148	12,694	11,188	19,902	6,634	5,069
13629	93521	MAIZURU DAIKOKU	18,753	22,199	9,733	11,188	4,130	1,377	5,069
136669	151335	K. YOUNGHUNG	25,484	72,586	28,844	11,188	38,312	12,771	5,069
42900	53021	GMB ALCMENE	14,039	53,412	19,503	11,188	8,017	2,167	5,069
47926	179221	YOUNGHEUNG	28,730	44,419	18,985	11,188	13,435	4,478	5,069
82328	86392	CORONA POWER	17,923	67,971	28,556	11,188	24,947	8,316	5,069
93269	95711	LOWLANDS RISE	19,008	43,592	16,775	11,188	26,146	8,715	5,069
78046	88083	JP CARETTA	18,120	92,545	40,696	11,188	21,879	7,293	5,069
104112	181050	NEW ADMIRE	28,943	75,888	31,383	11,188	31,548	10,516	5,069
78701	82055	HYUNDAI LEADER	17,419	116,102	51,887	11,188	22,062	7,354	5,069
92446	98704	GL IGUAZU	19,357	88,973	38,418	11,188	25,915	8,638	5,069
68763	179185	F. SUN	28,726	70,469	30,555	11,188	19,276	6,425	5,069
115906	179135	HL VISION	28,720	143,778	63,201	11,188	35,122	11,707	5,069
65756	77247	HANABUSA	16,859	60,675	25,798	11,188	19,926	6,642	5,069
191558	206204	CAPE MAPLE**	31,871	289,083	129,740	11,188	53,699	17,900	5,069
101377	176387	NEW EXPEDITION	28,400	140,307	62,176	11,188	30,720	10,240	5,069
71445	76627	CORAL SAPPHIRE	16,787	37,782	14,883	11,188	20,028	6,676	5,069
87355	93201	DENITA WAVE	18,716	70,125	29,363	11,188	26,471	8,824	5,069
55946	179135	HL VISION	28,720	68,171	29,974	11,188	15,683	5,228	5,069
90877	179185	F. SUN	28,726	85,297	36,436	11,188	27,538	9,179	5,069
79275	86392	CORONA QUEEN	17,923	75,747	32,391	11,188	24,022	8,007	5,069
165572	207219	MINERAL EDO	31,989	55,796	19,691	11,188	46,415	15,472	5,069
31750	176387	NEW EXPEDITION	28,400	63,978	28,947	11,188	8,900	2,967	5,069
68920	180242	MINERAL HAIKU	28,849	64,370	27,421	11,188	20,884	6,961	5,069
90426	93254	RICSEA	18,722	96,675	41,874	11,188	27,401	9,134	5,069
44372	106668	FPMC B 103	20,284	53,355	23,239	11,188	13,446	4,482	5,069
169618	178929	ATTIKOS	28,696	68,313	25,490	11,188	47,549	15,850	5,069
37837	180242	MINERAL HAIKU	28,849	41,787	18,136	11,188	10,607	3,536	5,069
135021	180157	STELLA ALICE	28,839	161,561	70,841	11,188	40,915	13,638	5,069
91174	180274	STAR PAULINE	28,853	239,943	110,360	11,188	25,559	8,520	5,069
170347	180736	PAN FREESIA	28,906	99,954	40,528	11,188	47,753	15,918	5,069
6221	180242	MINERAL HAIKU	28,849	60,728	28,421	11,188	1,744	581	5,069
88000	93262	PAOLA BOTTIGLIERI	18,723	85,776	36,789	11,188	26,666	8,889	5,069
32500	206237	CAPE ACACIA**	31,875	65,925	29,843	11,188	9,111	3,037	5,069
87369	92418	SHORYU	18,625	117,939	52,132	11,188	26,475	8,825	5,069
78589	82122	ENERGY TRITON	17,426	111,920	49,900	11,188	22,031	7,344	5,069
78572	87144	SEA FUTURE	18,011	276,203	127,876	11,188	23,809	7,936	5,069
47324	206237	CAPE ACACIA**	31,875	35,122	14,582	11,188	13,266	4,422	5,069
81250	87036	MARINA	17,998	135,307	60,667	11,188	24,621	8,207	5,069
133527	181502	HL SHIKOKU	28,996	199,994	89,640	11,188	37,431	12,477	5,069

156758	179742	ROSEMARY	28,791	153,231	65,934	11,188	47,501	15,834	5,069
156292	172940	ORIENTAL NAVIGATOR	27,999	125,874	52,927	11,188	47,360	15,787	5,069
26965	81944	NORD CAPELLA	17,406	35,711	15,590	11,188	8,171	2,724	5,069
165000	199988	LAVINIA OLDENDORFF	31,148	101,248	41,358	11,188	46,254	15,418	5,069
81618	85009	ASAHI MARU *	17,762	78,956	33,817	11,188	24,732	8,244	5,069
73708	75480	GREAT HOPE	16,653	83,125	36,145	11,188	22,335	7,445	5,069
171542	181009	KSL SYDNEY	28,938	99,526	40,276	11,188	48,088	16,029	5,069
73882	98704	GL IGUAZU	19,357	88,638	38,763	11,188	22,388	7,463	5,069
30653	55885	IVY BLUE	14,372	17,618	5,998	11,188	5,728	1,548	5,069
76560	79422	ULUSOY -11	17,112	77,856	33,761	11,188	21,462	7,154	5,069
77628	82146	NORD SUN	17,429	89,395	38,961	11,188	23,523	7,841	5,069
60000	82053	PHAEDRA	17,418	143,662	65,760	11,188	16,820	5,607	5,069
44000	63000	ROYAL MIDORI	15,200	195,167	90,784	11,188	13,333	4,444	5,069
83341	88909	CORONA VICTORY	18,216	48,621	19,568	11,188	23,363	7,788	5,069
72719	76634	DOOYANG JEJU	16,787	43,473	17,542	11,188	20,385	6,795	5,069
85276	175401	PAN BONA	28,285	77,685	33,053	11,188	25,841	8,614	5,069
16001	95790	KIND SALUTE*	19,018	21,497	9,296	11,188	4,849	1,616	5,069
76410	209177	HELENA OLDENDORFF	32,217	44,928	18,087	11,188	21,420	7,140	5,069
63145	94717.5		2,699	20,746	6,898	11,188	19,134	6,378	5,069
5141	7711.5		1,252	1,461	260	11,188	727	130	5,069
109390	164085		3,853	32,277	10,742	11,188	30,665	10,222	5,069
164999	181000	LOWLANDS SPIRIT	28,937	124,894	52,618	11,188	46,254	15,418	5,069
169696	178459	ZAMPA BLUE	28,641	155,934	66,661	11,188	51,422	17,141	5,069
88669	93328	SM CHALLENGER	18,731	40,913	15,396	11,188	26,869	8,956	5,069
195800	207819	NSU OBELISK	32,059	91,437	35,453	11,188	54,888	18,296	5,069
150824	175293	PAN CHAMPION	28,273	51,718	17,851	11,188	45,703	15,234	5,069
171116	179062	HL ESPERANCE	28,712	88,984	35,273	11,188	47,969	15,990	5,069
87004	91861	CORONA YOUTHFUL	18,560	34,423	12,378	11,188	26,364	8,788	5,069
77835	88165	MAIZURU BISHAMON	18,130	38,103	14,780	11,188	21,819	7,273	5,069
73011	100172	TENRYU MARU	19,528	62,208	26,215	11,188	22,124	7,375	5,069
104692	205938	MARAN NOBILITY	31,840	55,446	21,963	11,188	29,348	9,783	5,069
71487	74962	MORNING CLOUD	16,593	34,075	12,884	11,188	21,662	7,221	5,069
87147	91073	SHOHAKU	18,468	121,977	54,347	11,188	24,430	8,143	5,069
78196	82052	ELECTRA	17,418	39,839	15,338	11,188	23,695	7,898	5,069
73574	89499	MEDI KYOTO	18,285	35,257	13,595	11,188	20,625	6,875	5,069
86932	93258	BOTTIGLIERI GIULIO BORRIELLO	2,675	27,954	9,301	11,188	26,342	8,781	5,069
74000	92500	GH HARMONY	2,662	24,036	7,995	11,188	22,424	7,475	5,069
197937	209243	HERMANN OLDENDORFF	4,604	57,099	19,016	11,188	55,487	18,496	5,069
77170	81450	OMIROS L	17,348	41,767	16,551	11,188	21,633	7,211	5,069
85489	93252	GREAT GLEN	18,722	52,675	21,135	11,188	25,905	8,635	5,069
65801	78228	ROBIN WIND	16,973	87,239	38,446	11,188	19,939	6,646	5,069

133126	203248	SHIN ONOE	31,527	96,408	40,330	11,188	37,319	12,440	5,069
65970	77247	HANABUSA	16,859	45,549	18,587	11,188	19,990	6,663	5,069
64886	79449	NEW EXCELLENCE	17,115	43,674	17,741	11,188	19,662	6,554	5,069
134217	149738	HL TAEAN	25,298	85,612	35,145	11,188	37,625	12,542	5,069
68748	81176	BLC SECOND	2,474	22,444	7,464	11,188	20,832	6,944	5,069
26321	180387	GENCO LIBERTY	28,866	30,487	13,216	11,188	7,379	2,460	5,069
7130	10695		1,302	1,742	310	11,188	1,008	180	5,069
143301	214952		4,699	41,783	13,910	11,188	40,171	13,390	5,069
164732	180181	PANTAGRUEL	28,842	141,494	59,999	11,188	49,918	16,639	5,069
82860	95712	ELEGANT SALUTE	19,008	94,627	41,226	11,188	25,109	8,370	5,069
189737	206306	SEN-OKU	31,883	63,278	22,286	11,188	53,189	17,730	5,069
73581	98704	GL IGUAZU	19,357	84,599	36,852	11,188	22,297	7,432	5,069
89961	95750	TWINKLE SALUTE	19,013	122,364	54,127	11,188	27,260	9,087	5,069
190679	209801	SAMJOHN ODYSSEY	32,290	99,522	39,508	11,188	53,453	17,818	5,069
155319	179742	ROSEMARY	28,791	167,439	72,762	11,188	47,065	15,688	5,069
187000	206331	BAOSTEEL EVOLUTION	31,886	111,020	45,130	11,188	52,422	17,474	5,069
158024	174845	FRONTIER DISCOVERY	28,221	128,184	53,952	11,188	47,885	15,962	5,069
77658	95755	VENUS HORIZON	19,013	30,667	10,994	11,188	23,532	7,844	5,069
122600	180265	NAVIOS FANTASTIKS	28,852	147,497	65,079	11,188	34,368	11,456	5,069
9059	95755	VENUS HORIZON	19,013	16,121	7,066	11,188	2,539	846	5,069
84857	92266	SUOH PACIFIC	18,607	106,083	46,595	11,188	25,714	8,571	5,069
84200	86356	CORONA NATURE	17,919	46,608	18,574	11,188	23,604	7,868	5,069
77725	82769	STAR KAMILA	17,502	162,063	73,561	11,188	23,553	7,851	5,069
89048	93254	RICSEA	18,722	47,169	18,648	11,188	24,963	8,321	5,069
79068	82926	KAVO YERAKI	17,520	135,478	60,843	11,188	23,960	7,987	5,069
78112	81902	LAKE DAWN	17,401	66,461	28,272	11,188	21,897	7,299	5,069
55569	75026	PAN VIVA	16,600	134,406	61,350	11,188	16,839	5,613	5,069
83911	88703	CORONA CITRUS	18,192	41,767	16,281	11,188	23,523	7,841	5,069
74452	82158	PEAK PROTEUS	17,431	41,099	16,100	11,188	22,561	7,520	5,069
86967	93478	LOWLANDS HORIZON	18,748	46,319	18,044	11,188	26,353	8,784	5,069
192208	203212	PACIFIC OAK	31,523	59,210	20,250	11,188	53,881	17,960	5,069
82058	88898	CORONA WISDOM	18,215	60,014	24,778	11,188	24,866	8,289	5,069
88407	92803	W-EAGLE	18,670	50,286	20,158	11,188	24,783	8,261	5,069
80209	84790	MG EXPLORER	17,737	38,979	14,842	11,188	24,305	8,102	5,069
77008	81398	HL IBT	17,342	39,992	15,712	11,188	21,588	7,196	5,069
36842	92418	SHORYU	18,625	21,358	8,328	11,188	11,164	3,721	5,069
22389	208384	PAN DELIGHT	4,589	7,888	2,612	11,188	6,276	2,092	5,069
Total			7,628,681	32,392,888	14,032,963	4,050,056	8,977,629	2,986,981	1,829,909

Potash ships were processed based on the number of ships of specific size range expected. As shown in Table D.3, the mid-point of each cargo tonnage range was chosen for the ship types expected. Time at berth was estimated using the 2019 average ship loading rate for Berth 2 (1,980 t/hr). The number of each ship type over the year was estimated based on the distribution identified in Table 8, such that the total tonnage over the year matches a total of 4.5 million tonnes of potash. 90% of the ships were assumed to go to anchor, similar to the historical coal ships.

All energy consumption calculations were completed as with the coal ships (see prior examples).

**Table D.3: Potash Ship Data Used for Energy Calculations**

Ship type	Tonnage Loaded	# vessels to berth	Total Annual Tonnage Loaded	# Vessels to Anch	ME (kW)	AE uway (kW)	AE berth (kW)	AE anch (kW)	AE mano (kW)	BO all (kW)
Handysize	30000	4	110,400	4	6,762	190	280	280	310	50
Handymax	45000	6	248,400	5	7,801	260	370	260	420	100
Supramax	55000	17	860,200	15	8,494	260	370	260	420	100
Ultramax	62500	14	805,000	13	9,014	420	600	420	680	200
Panamax	72500	15	1,000,500	14	9,707	420	600	420	680	200
Kamsarmax	85000	17	1,329,400	15	10,573	420	600	420	680	200
Post Panamax	105000	2	193,200	2	11,959	420	600	420	680	200
<b>TOTAL</b>		<b>75</b>	<b>4,547,100</b>	<b>68</b>						

**Table D.4: Total Potash Ships Energy Consumption, 2026**

Ship type	loading rate (t/hr)	berth time (h)	anchor time (h)	RSA				On-site		
				Total ME kW	Total AE kW	Total BO kW	tug	Total AE kW	Total BO kW	tug
Handysize	1,980	12.1	165	45,434	202,777	35,636	44,752	14,785	2,619	18,926
Handymax	1,980	18.1	165	67,396	262,908	94,006	67,128	42,792	11,484	28,164
Supramax	1,980	22.2	165	246,649	912,022	324,599	212,572	163,848	44,026	88,211
Ultramax	1,980	25.2	165	199,010	1,145,242	502,402	156,632	221,160	73,347	65,116
Panamax	1,980	29.2	165	249,252	1,376,131	597,834	190,196	309,669	102,770	78,973
Kamsarmax	1,980	34.3	165	342,541	1,796,742	775,196	234,948	446,025	148,115	97,449
Post Panamax	1,980	42.3	165	60,269	291,422	125,009	33,564	78,230	25,997	14,307
<b>TOTAL</b>				<b>1,210,551</b>	<b>5,987,243</b>	<b>2,454,681</b>	<b>939,792</b>	<b>1,276,508</b>	<b>408,357</b>	<b>391,146</b>

The energy consumption for ships in 2019 and 2026 is summarized in Table D.5. These data were used with the ship emission factors shown in **Table 12** and **Table 13** to determine annual emissions estimates. The 2019 consumption data for coal ships were first scaled to match the permitted maximum terminal capacity of 36 million tonnes (scale factor of 1.16). The 2026 coal ship energy consumption data were also scaled from the 2019 data, using scale factors such that the expected maximum coal capacity of 31.5 million tonnes and 36 million tonnes in 2026 would be simulated.

**Table D.5: Total ship energy consumption by source**

Year	Commodity & Boundary	Annual Energy Use by Engines and Boilers			
		kWh ME	kWh AE	kWh BO	kWh tug
Current (2019)	Coal RSA	8,818,236	37,443,963	16,221,152	4,681,588
	Coal on-site	0	10,377,535	3,452,744	2,121,109
Future (2026) 31.5 Mtpa Coal, 4.5 Mtpa Potash Scenario	Coal RSA	7,715,956	32,763,468	14,193,508	4,096,390
	Coal on-site	0	9,080,344	3,021,151	1,855,971
	Potash RSA	1,210,551	5,987,243	2,454,681	939,792
	Potash on-site	0	1,276,508	408,357	391,146
Future (2026) 36 Mtpa Coal, 0 Mtpa Potash Scenario	Coal RSA	8,818,236	37,443,963	16,221,152	4,681,588
	Coal on-site	0	10,377,535	3,452,744	2,121,109

**Rail**

Line haul locomotive emission factors in g/hp-hr are shown in Table D.6 by emissions tier. While these are energy-based emission rates rather than fuel-based, the ratio by which the rates decline can be used to estimate future emission rates for the locomotives that arrive to WTLP. A 2%/year replacement rate was assumed, replacing older locomotives from the fleet (chosen as tier 0) with newer (represented as tier 4). The resultant emission rates used for the 2026 year are shown in Table D.7.

**Table D.6: Line Haul Emission Factors (g/hp-hr) for Key CACs (from U.S. EPA, 2020)**

Tier	NO <sub>x</sub>	PM	HC	CO
0	8.6	0.32	0.48	1.28
1	6.7	0.32	0.47	1.28
2	4.95	0.18	0.26	1.28
3	4.95	0.08	0.13	1.28
4	1.00	0.015	0.04	1.28

**Table D.7: Emission Factors in g/litre**

Year	NO <sub>x</sub>	PM	CO	VOC	SO <sub>2</sub>	NH <sub>3</sub>
2019	34.79	0.72	7.04	1.54	0.02	0.005
2026	30.49	0.62	7.04	1.34	0.02	0.005