Portside
Blundell Road
Improvement Project
Level 1 Air Quality Assessment

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1. Introduction

The purpose of this report is to present an air quality assessment of the Portside Blundell Road Improvement Project (including the Portside Extension component), located within the Fraser Richmond Industrial Lands (FRIL), which is currently in the design development phase. The air quality assessment summarizes existing air quality data from two Metro Vancouver air quality stations that are closest to the FRIL. Emissions of the existing road network were quantified and compared with predicted emissions from design hour volumes (DHV) to project potential changes in future air quality as a result of the project.

2. Regulatory Guidance

This assessment is governed by the Vancouver Fraser Port Authority (VFPA) Project & Environmental Review (PER) Guidelines – Environmental Air Assessment (July 2015). As there are no residents living near[1] the project footprint, a Level 1 air quality assessment was deemed appropriate. Taken from the PER Guidelines, a Level 1 assessment involves:

“Emission estimation – a bottom-up approach for estimating emissions based on activities associated with a project and is required for all assessments. A Level 1 assessment requires a quantification of total emissions and qualification of emission variability (seasonal, daily, hourly) to provide an indication on degree and/or potential that a discharge to the air could affect air quality.”

Ambient Air Quality Objectives (AAQOs) related to vehicle emissions have been established by Metro Vancouver (MV) for Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), Ozone, Particulate Matter 10microns or less (PM_{10}), and Particulate Matter 2.5microns or less ($PM_{2.5}$). Of these pollutants Ozone is not directly emitted from vehicles, but formed in the atmosphere in part as a result of Nitrogen Oxides (NO_X) and Volatile Organic Compound (VOC) emissions. NO_X emissions also react in the atmosphere to form NO_2. For Greenhouse Gases (GHGs), while not regulatory, Metro Vancouver has in place ambitious targets set to reduce GHGs by 45% by 2030 compared to the 2010 levels, and carbon neutral by 2050.

Ambient Air Quality Monitoring data are compared to the criteria adopted by MV and are presented in Table 1 based on current information that is applicable now and potentially in place in 2025 and beyond Criteria within parentheses may be applicable 2025 and beyond. Criteria applicable to the latter period are provided in parentheses in the table. The potential 2025 MV criteria are also consistent with the Canadian Ambient Air Quality standards (CAAQs) that will come into effect in 2025. Except where noted in the table, achievement is based on 100% of validated measurements being at or below the criteria level.

Table 1 Metro Vancouver[2] Ambient Air Quality Objectives (AAQOs) (µg/m^3)

Criteria Air Contaminant	CO		NO_2		SO_2		Ozone		PM_{10}		$PM_{2.5}$	
Averaging Period	1-h	8-h	1-h	Annual	1-h	Annual	1-h	8-h	24-h	Annual	24-h	Annual
Objective 2021-2024 (2025)	14,900	5,700[a]	113 (79)	32[b] (23)	183 (170)	13[c]	161	122[d] (119)	50[a]	20[c]	25[a]	8[c]

a. Achievement for 8-hour CO, 24-hour PM_{10} and 24-hour $PM_{2.5}$ concentrations based on rolling average.
b. Achievement based on annual 98th percentile of the daily maximum 1-hour concentration, averaged over three consecutive years.
c. Achievement for annual SO_2, PM_{10}, and $PM_{2.5}$ concentrations based on one year average of 1-hour concentrations.
d. Achievement based on annual 4th highest daily maximum 8-hour average concentration, over three consecutive years.

[1] Nearest residents estimated 1.4km N from project and 2.6km W from western most end of project in the predominant wind direction.

[2] Current Metro Vancouver AAQOs as of January 2020 http://www.metrovancouver.org/services/air-quality/AirQualityPublications/CurrentAmbientAirQualityObjectives.pdf

3. Existing Conditions

There has been no previous air quality monitoring conducted within the FRIL by MV. MV conducts regional air quality monitoring in its communities to assess the state of (outdoor) air quality in the Lower Fraser Valley. An analysis of regional MV air quality and meteorological monitoring stations for Richmond South and North Delta in the vicinity of FRIL lands was conducted for the most recent readily available 5 years of data and compared to the ambient air quality objectives outlined in Section 2 to establish a baseline of air quality in the vicinity of the project.

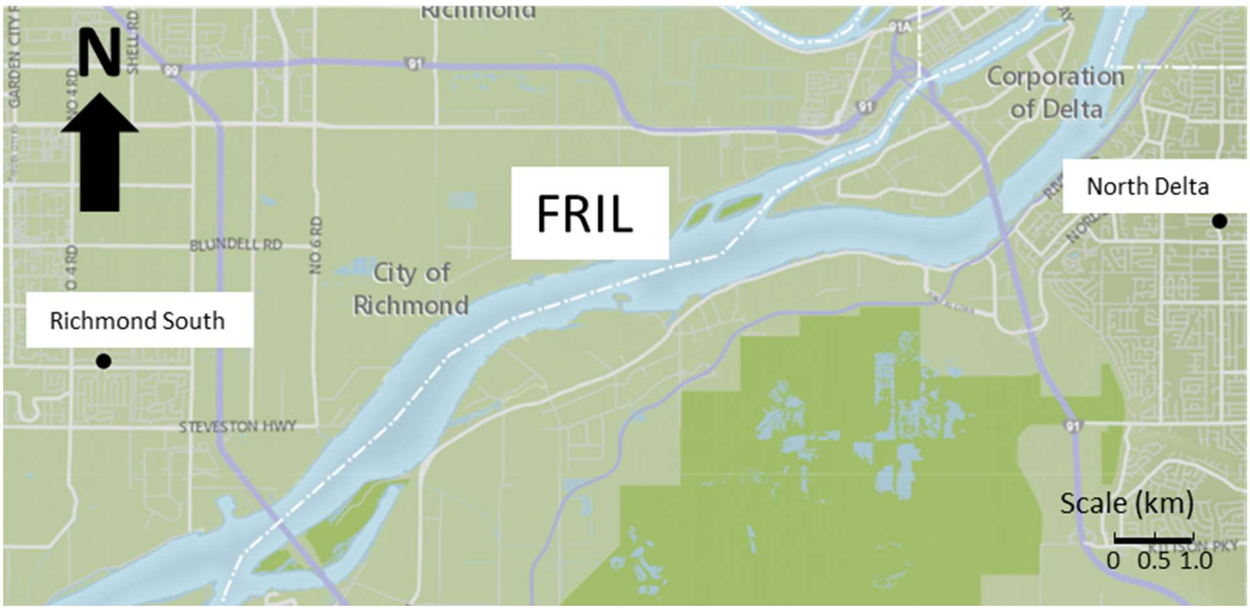

Figure 1 Map showing the location of the two air quality stations in relation to FRIL

The Richmond South Station (T17) is located approximately 5.6km west-southwest of the centre of the FRIL, and 4.5km from the westernmost edge of the FRIL. The North Delta Station (T13) is located approximately 9.6km east of the FRIL and 7km from the easternmost edge of the FRIL. Most vehicle emissions fall out of the atmosphere within 1.5km of a roadway so the air quality conditions monitored at these stations are not expected to be influenced by the project, but instead are used to characterize the baseline air quality in the region.

Ambient Air Quality data for monitored pollutants at Richmond South and North Delta are presented in Tables 2 and 3 respectively. The maximum measured concentration for the applicable objective, along with the annual average, is listed for each year from 2014 to 2018. In general, the average air quality at both stations falls well below AAQO's, with the exception of $PM_{2.5}$, which at times has exceeded the 24-hour objective. Notes on exceedances of $PM_{2.5}$ extracted from MV annual reports and briefings are provided below:

- 2018 Unprecedented 22 days of advisories. For all four advisory events, high levels of $PM_{2.5}$ were primarily due to smoke from wildfires burning outside the region, with a lesser contribution from local fires,
- 2017 Two days in August of advisories for $PM_{2.5}$ due to smoke from wildfires outside the region. Nine days of advisories for both $PM_{2.5}$ and ground-level ozone in August/September,
- 2016 No air quality advisories,
- 2015 Eight days of advisories in July/August with elevated $PM_{2.5}$ due to unprecedented smoke from wildfires outside the region,
- 2014 One day advisory in August with elevated $PM_{2.5}$, primarily due to smoke from wildfires outside the region.

Table 2 Richmond South Ambient Air Quality Data (μg/m³)

Criteria Air Contaminant	Averaging Period[1]	2014	2015	2016	2017	2018	Objective
CO	1-hour	3249	2271	2036	2325	2400	14,900
	8-hour	1512	1337	1349	1368	1284	5,700
NO_2	1-hour	107	85	101	100	97	113
	Annual	25	22	23	25	22	32
SO_2	1-hour	17	35	19	24	16	183
	Annual	1.2	1.0	0.9	0.8	0.7	13
Ozone	1-hour	111	125	103	144	154	161
	8-hour	96	106	95	122	132	122
$PM_{2.5}$	24-hour	28	61	19	46	125	25
	Annual	6	6	5	6	7	8

[1] Maximum concentration measured in the annual period for 1-hour, 8-hour and 24-hour average.

Table 3 North Delta Ambient Air Quality Data (μg/m³)

Criteria Air Contaminant	Averaging Period[1]	2014	2015	2016	2017	2018	Objective
NO_2	1-hour	153	103	118	110	102	113
	Annual	27	26	24	27	26	32
Ozone	1-hour	108	109	99	134	148	161
	8-hour	95	96	86	116	124	122
PM_2	24-hour	27	82	13	53	131	25
	Annual	6	6	4	7	7	8

[1] Maximum concentration measured in the annual period for 1-hour, 8-hour and 24-hour average.

Figures 2 and 3 are windroses of the meteorological stations at North Delta and Richmond South. Windroses show the frequency of wind speed and wind direction. The wind profiles at both stations are similar, showing east as the predominant wind direction from which the wind is blowing. It's expected that wind speeds and direction in the FRIL would be similar. As residents from the predominant wind direction are not near the project, the project would not influence the air quality at the residents.

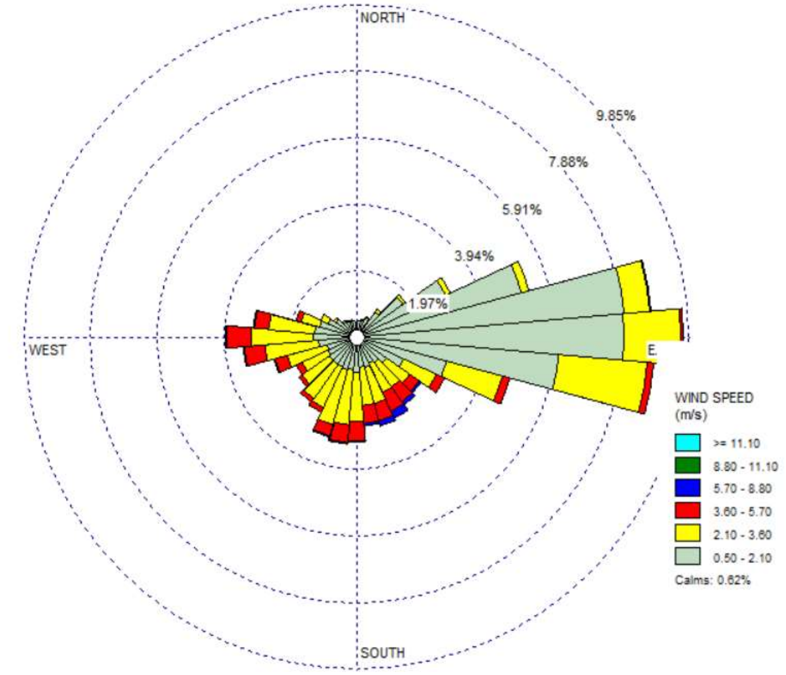

Figure 2 **2014 to 2018 Windrose of North Delta Station T13**

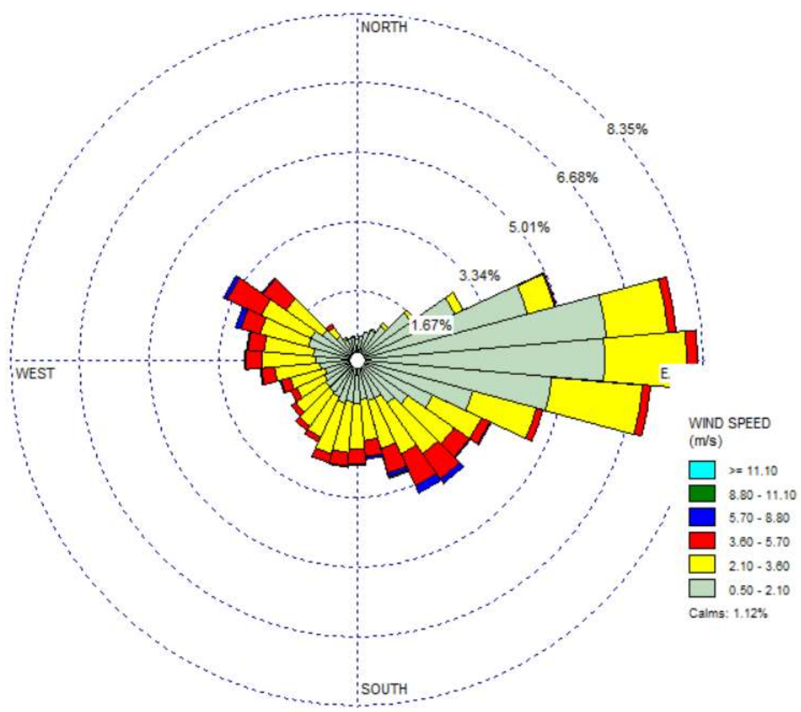

Figure 3 **2014 to 2018 Windrose of Richmond South Station T17**

4. Emission Estimation Methodology

Current City of Richmond data indicates the average weekday traffic volume on Blundell Road west of No. 8 Road is 5300 vehicles per day and 6400 vehicles per day east of No. 8 Road. Peak hourly traffic on Blundell Road peaks at 430 vehicles per hour west of No. 8 Road and 540 vehicles per hour east of No. 8 Road. Current congestion during peak times (mid-day) delays vehicular movement through the corridor, resulting in an average vehicle speed of 15km per hour at peak times. Figure 4 shows the existing (2018) hourly average weekday traffic for Blundell Road east and west of No. 8 Road.

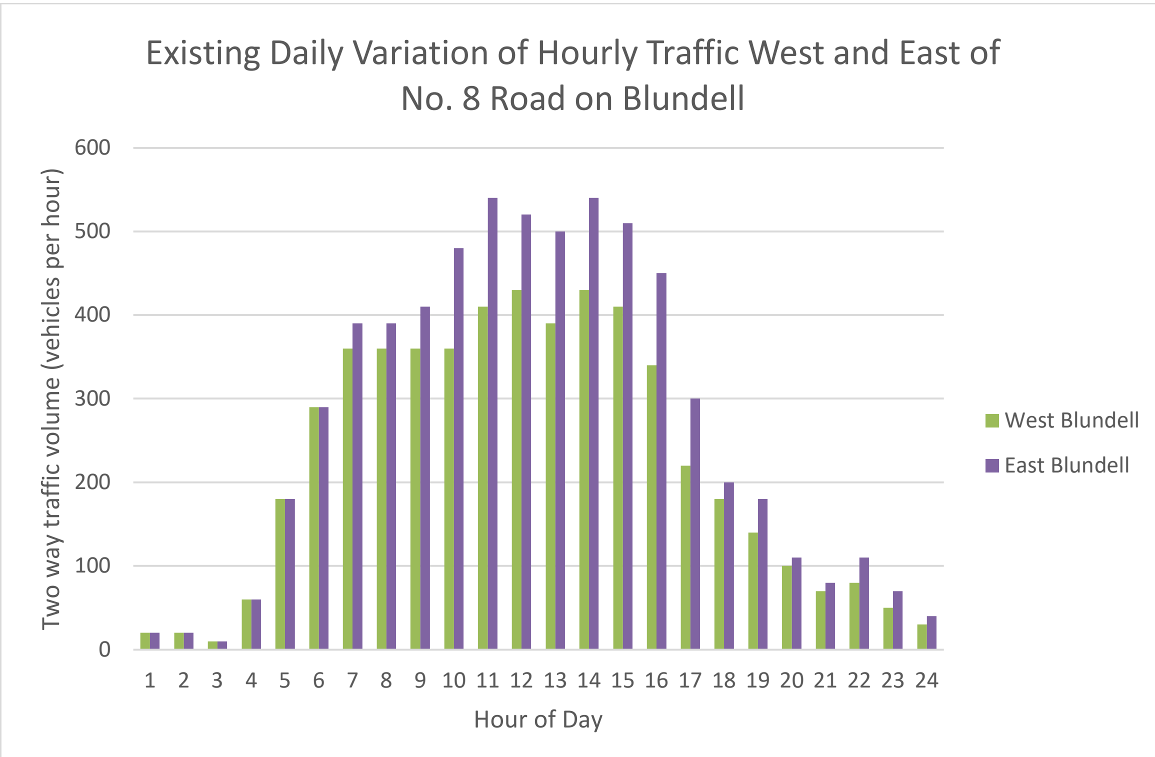

Figure 4 **Existing hourly average weekday traffic on Blundell Road**

Using the percentage profile of average hourly traffic volumes and peak design hourly volumes for the project, annual traffic volumes were estimated for the four roadways in the project area and are presented in Figure 5. Peak design hourly volumes (DHV)'s are presented in Table 4. The DHVs are theoretical numbers that the road could manage at capacity, and are not the initial expected volumes once the project is operational. The project area includes 3.52km of road for existing conditions and 3.82km of road at project buildout. Table 5 shows the annual average trips per road link based on the weekday peak design volumes occurring 365 days per year along with the traffic profile from Figure 5.

Table 4 Peak AM/PM On-road Design Hour Volumes

Peak AM Onroad Design Hour Volumes						
Road Description	SB	NB	EB	WB	Road Length (km/trip)	Road Length with Project (km/trip)
No. 8 Road	494	110	n/a	n/a	0.27	0.27
Blundell East of Portside	n/a	n/a	479	1,100	0.36	0.36
Portside	534	215	n/a	n/a	2.02	2.32
Blundell West of Portside	n/a	n/a	357	1,175	0.87	0.87
Peak PM Onroad Design Hour Volumes						
Road Description	SB	NB	EB	WB	Road Length (km/trip)	Road Length with Project (km/trip)
No. 8 Road	110	673	n/a	n/a	0.27	0.27
Blundell East of Portside	n/a	n/a	1,256	606	0.36	0.36
Portside	269	688	n/a	n/a	2.02	2.32
Blundell West of Portside	n/a	n/a	1,290	496	0.87	0.87

Notes: SB = Southbound, NB=Northbound, EB = Eastbound; WB = Westbound, LDV = Light Duty Vehicle, HDV = Heavy Duty Vehicle

Table 5 Existing Annual Average Trips

Road Description	Road Length (km/trip)	Existing Conditions			Project Peak Design Volumes		
		Annual Traffic Volumes LDV	Annual Traffic Volumes HDV	Annual Total LDV/HDV	Annual Traffic Volumes LDV	Annual Traffic Volumes HDV	Annual Total LDV/HDV
No. 8 Road	0.27	941596	0	941,596	3,387,200	0	3,387,200
Blundell East of Portside	0.36	693473	1,642,527	2,336,000	2,406,221	5,699,257	8,105,479
Portside	2.02 (2.32)[a]	587162	570,994	1,158,156	2,098,853	2,041,058	4,139,911
Blundell West of Portside	0.87	965387	969,113	1,934,500	4,137,440	4,153,409	8,290,849

[a] Additional 300m of road with the project.

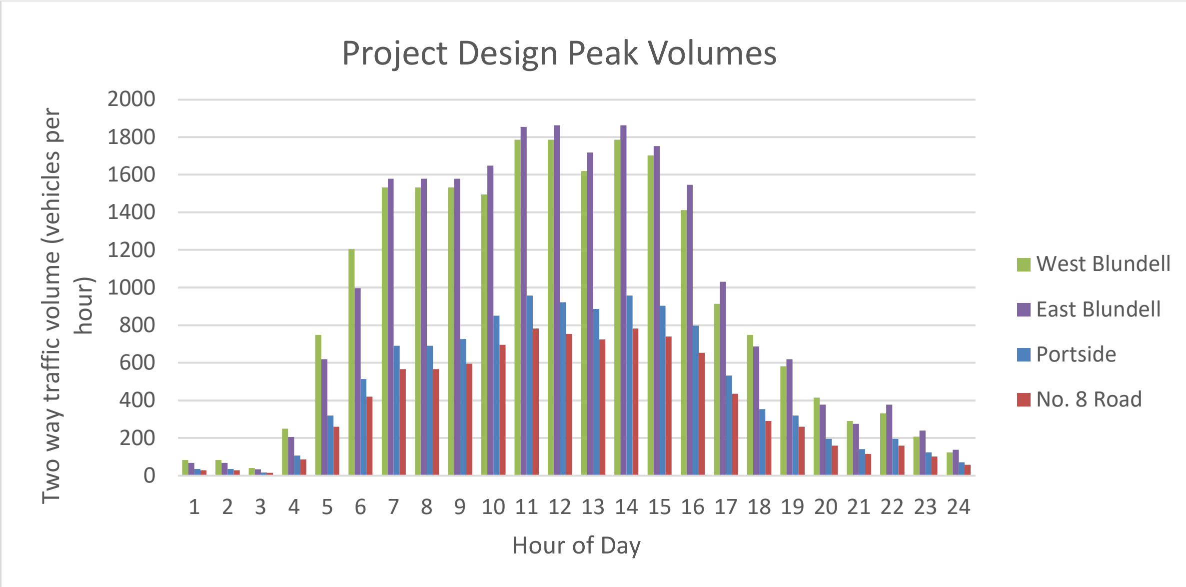

Figure 5 **Project peak design volumes and estimated hourly average weekday traffic**

The United States Environmental Protection Agency (US EPA) Motor Vehicle Emission Simulator (MOVES3) model (November 2020) is a state-of-the-science emission modelling system that estimates emission factors for mobile sources. The following pollutants were modeled:

Criteria Air Contaminants (CAC's)

- Carbon Monoxide (CO)
- Nitrogen Oxides (NO_X)
- Sulphur Dioxide (SO_2)
- Particulate Matter 10 microns or less (PM_{10})
- Particulate Matter 2.5 microns or less ($PM_{2.5}$)
- Volatile Organic Compounds (VOCs)
- Ammonia (NH_3)

Greenhouse Gases (GHGs)

- Carbon Dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Black Carbon

Air Toxics (commonly emitted by vehicles)

- Acrolein
- Benzene
- 1,3-Butadiene
- Acetaldehyde
- Formaldehyde
- Naphthalene
- Benzo(a)pyrene

The MOVES3 model was adapted by WSP Inc. to the Lower Fraser Valley, British Columbia, with 2015 regional on-road activity and meteorological inputs provided by MV in MOVES-ready format for the following data:

- Population by Vehicle Type
- Age Distribution by Vehicle Type and Vehicle Age
- Meteorology (Temperature and Relative Humidity) by Month of the Year and Hour of the Day
- Fuel Supply (Market Share in Fraction) by Fuel Type and Month of the Year

- Fuel Formulation Properties (i.e. Reid Vapour Pressure and Sulphur Level) by Fuel Type
- Fuel Usage Fraction by Fuel Type
- Fraction of AVFT (Alternate Vehicle and Fuel Technology) Fuel Types (i.e. Electric Vehicles)
- Vehicle Mile Travelled (VMT) by Vehicle Type
- VMT Fraction by Road Type
- VMT Fraction by Source Type and Month of the Year
- VMT Fraction by Source Type and Day of the Week; and
- VMT Fraction by Source Type and Hour of the Day

The model was then run for the year 2025 at 15km/hr[3] and 50km/hr, and 2030 at 50km/hr (assume posted speed) to get emission factors (g/km) for CAC's, selected VOC's commonly associated with vehicle traffic, and GHG's.

The emission factors for each pollutant for Light Duty Vehicles (LDVs) for both gasoline and diesel – gasoline vehicles were estimated to make up 96% of the light duty fleet, as well as heavy duty vehicles (HDVs – 100% assumed to be diesel) – are listed in Appendix A for the different speed classes. It was assumed that 50% of the total vehicles on the road in the project area are HDVs for each scenario (described in Section 5) for which emissions were estimated.

Annual emissions were then calculated using the following equation:

Emissions (tonnes) = Road length (km/trip) * Annual volume (trips) * Emission Factor g/km / 10^6 g/tonne

5. Emission Estimation Results

Based on the methodology outlined in Section 4, emissions were estimated for the following scenarios:

- 2025 Existing Conditions – 2018 traffic counts projected to 2025; average vehicle speed of 15km/hr at peak hours (6 hours per day), and 50km/hr posted speed for the remainder of the day.
- 2030 Existing Conditions - 2018 traffic counts projected to 2030; average vehicle speed of 15km/hr at peak hours (6 hours per day), and 50km/hr posted speed for the remainder of the day.
- 2030 without project – design volume vehicle counts; average vehicle speed of 15km/hr at peak hours (6 hours per day), and 50km/hr posted speed for the remainder of the day.
- 2030 with project – design volume vehicle counts; average vehicle speed 50km/hr.

Currently, traffic congestion in the project area increases the amount of time vehicles travelling through the project area, which is about equivalent to reducing the average vehicle speed from the posted 50km/hr to 15km/hr.

The emission estimates for each scenario are presented in Tables 6 through 8. For each pollutant it is anticipated that if the existing volumes of traffic were to continue in 2025 and 2030, emissions would either be the same or reduced by 2030 and air quality would be expected to mildly improve. The reason for the improvement is due to turnover of the vehicle fleet as older models have higher emissions than new vehicles produced today.

Without the project, if traffic continues to grow significantly to peak design conditions (an approximate 3.75 times increase in volume from existing conditions), in 2030 congestion will get worse and emissions would be expected to increase for all roads in the project area relative to the 2025 existing conditions. However, with the project, the predicted increase by 2030 would be less than without the project as vehicles would be able to drive at posted speeds.

[3] The modelled time delay of 674 vehicles per hour in the project area during peak periods is 3.4hours, resulting in an average estimated travel speed through of 15km/hr through the project area.

Table 6 Annual Average Emission Estimates of CAC's for each Scenario

Scenario	Emission Rate (tonnes/year)						
	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	VOC	NH_3
2025 Existing Conditions	8.424	5.115	0.024	0.650	0.149	0.527	0.091
2030 Existing Conditions	7.592	4.775	0.023	0.648	0.131	0.455	0.094
2030 Existing Conditions without Project and with design hourly traffic volumes	29.445	19.142	0.091	2.574	0.522	1.780	0.371
2030 with Project and design hourly volumes	20.376	12.166	0.070	1.423	0.283	1.281	0.283

Table 7 Annual Average Emission Estimates of Selected VOC's for each Scenario

Scenario	Emission Rate (tonnes/year)						
	Acrolein	Benzene	1,3-Butadiene	Acetaldehyde	Formaldehyde	Naphthalene	Benzo(a)pyrene
2025 Existing Conditions	1.57E-03	9.08E-03	1.48E-03	1.45E-02	1.70E-02	1.61E-03	8.38E-06
2030 Existing Conditions	1.29E-03	8.05E-03	1.28E-03	1.29E-02	1.32E-02	1.17E-03	6.14E-06
2030 Existing Conditions without Project and with design hourly traffic volumes	5.16E-03	3.07E-02	4.91E-03	5.13E-02	5.26E-02	4.63E-03	2.40E-05
2030 with Project and design hourly volumes	3.18E-03	2.42E-02	3.76E-03	3.66E-02	2.88E-02	2.24E-03	1.28E-05

Table 8 Annual Average Emission Estimates (tonnes/year) of GHG's for each Scenario

Scenario	Black Carbon	Climate Forcing Particulate		CO_2	CH_4	N_2O	GHGs	
		CO_2e (20-year)	CO_2e (100-year)				CO_2e (20-year)	CO_2e (100-year)
2025 Existing Conditions	0.032	104	29	2719	0.141	0.027	2738	2731
2030 Existing Conditions	0.021	66	19	2687	0.138	0.027	2706	2700
2030 Existing Conditions without Project and with design hourly traffic volumes	0.083	264	74	10635	0.549	0.106	10711	10685
2030 with Project and design hourly volumes	0.026	84	24	8182	0.443	0.082	8242	8221

6. Summary and Recommendations

Ambient air quality conditions at the North Delta and Richmond South stations in general fall well below AAQO's, with the exception of $PM_{2.5}$, which at times has exceeded the 24-hour objective largely due to smoke and wildfires in nearby regions. An incremental increase in traffic volume will increase the emissions in the project area with or without the project, but an increased volume is not expected to influence ambient air quality at the stations as they are relatively too far away to be influenced by vehicle emissions from the project area. As air quality is not expected to be influenced by the project on residences, long-term exposure to residents would be expected to be negligible.

Emissions of pollutants in the project area are expected to stay the same or reduce by 2030, provided traffic volumes in the project area remain the same. If/when the volume of traffic increases in the project area, associated emissions will also increase, but will be higher without the project (due to higher emissions at slower speeds) than with the project, assuming vehicles could operate at the 50km/hour posted speed. The project is expected to reduce congestion in the area, which will result in a relative reduction of emissions.

For each scenario greenhouse gas emissions are expected to be reduced in 2030 relative to the 2025 scenarios with and without the project, which is in the direction of MV's GHG reduction targets for 2030.

Since air emissions are expected to improve with the project, there is no recommendation to conduct a Level 2 assessment, as any air quality dispersion modelling would also show improvement in air quality in 2030 with and without the project, remain within the vicinity of the FRIL, and be negligible by the time a pollutant could potentially get to residents.

7. References

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http://www.metrovancouver.org/services/air-quality/AirQualityPublications/CurrentAmbientAirQualityObjectives.pdf

Parsons, Technical Memorandum Re: Portside Blundell Road Improvements: Basis for Design Hour Volumes Memo – DRAFT, File#476377, January 20, 2020

R.F. Binnie & Associates Ltd. Memorandum RE: Portside Road/Blundell Road Improvement Project, File NO. 19-904-05 from: Jonathan Ho to: Edmond Lee, April 1, 2020

US EPA Motor Vehicle Emissions Simulator (MOVES3), November 2020
https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves

Appendix A – Emission Factors

Table A-1 Annual Average Emission Factors of CAC's

Year	Source	Activity	Fuel Type	Emission Rate (g/km)						
				CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	VOC	NH_3
2025	LDV	15 kph	Gasoline	3.491	0.120	0.008	0.099	0.016	0.138	0.024
2025	LDV	15 kph	Diesel	1.997	1.243	0.004	0.128	0.038	0.162	0.025
2025	HDDV	15 kph	Diesel	2.283	3.701	0.008	0.487	0.104	0.187	0.038
2025	LDV	50 kph	Gasoline	1.783	0.077	0.004	0.031	0.006	0.086	0.011
2025	LDV	50 kph	Diesel	0.878	0.499	0.002	0.043	0.014	0.086	0.010
2025	HDDV	50 kph	Diesel	0.753	1.257	0.004	0.109	0.030	0.080	0.015
2030	LDV	50 kph	Gasoline	1.342	0.051	0.003	0.034	0.007	0.065	0.012
2030	LDV	50 kph	Diesel	0.776	0.332	0.002	0.040	0.008	0.075	0.011
2030	HDDV	50 kph	Diesel	0.742	1.113	0.004	0.106	0.021	0.062	0.016

Table A-2 Annual Average Emission Factors of Selected VOC's

Year	Source	Activity	Fuel Type	Emission Rate (g/km)						
				Acrolein	Benzene	1,3-Butadiene	Acetaldehyde	Formaldehyde	Naphthalene	Benzo(a)pyrene
2025	LDV	15 kph	Gasoline	8.33E-05	4.54E-03	6.19E-04	1.55E-03	1.02E-03	2.05E-04	1.64E-06
2025	LDV	15 kph	Diesel	7.78E-04	5.19E-04	1.78E-04	6.53E-03	8.02E-03	6.36E-04	1.60E-06
2025	HDDV	15 kph	Diesel	9.66E-04	7.64E-04	2.50E-04	7.57E-03	1.07E-02	9.31E-04	4.05E-06
2025	LDV	50 kph	Gasoline	5.42E-05	2.93E-03	4.32E-04	1.04E-03	5.99E-04	1.31E-04	1.03E-06
2025	LDV	50 kph	Diesel	3.89E-04	1.93E-04	6.47E-05	3.54E-03	3.80E-03	2.62E-04	4.79E-07
2025	HDDV	50 kph	Diesel	3.85E-04	2.42E-04	7.74E-05	3.26E-03	4.07E-03	3.14E-04	1.45E-06
2030	LDV	50 kph	Gasoline	4.73E-05	2.55E-03	3.85E-04	9.06E-04	4.86E-04	1.12E-04	9.66E-07
2030	LDV	50 kph	Diesel	2.94E-04	5.49E-05	1.79E-05	3.13E-03	2.44E-03	1.05E-04	1.25E-07
2030	HDDV	50 kph	Diesel	2.53E-04	6.80E-05	1.99E-05	2.60E-03	2.25E-03	1.12E-04	3.69E-07

Table A-3 Annual Average Emission Factors (g/km) of GHG's

Year	Source	Activity	Fuel Type	Black Carbon	Climate Forcing Particulate		CO_2	CH_4	N_2O	GHGs	
					CO_2e (20-year)	CO_2e (100-year)				CO_2e (20-year)	CO_2e (100-year)
2025	LDV	15 kph	Gasoline	0.003	8.559	2.407	492	0.019	0.010	496	495
2025	LDV	15 kph	Diesel	0.016	51.542	14.496	613	0.037	0.005	617	615
2025	HDDV	15 kph	Diesel	0.021	67.810	19.072	1273	0.065	0.009	1280	1277
2025	LDV	50 kph	Gasoline	0.000	0.000	0.000	212	0.011	0.005	214	214
2025	LDV	50 kph	Diesel	0.006	18.807	5.289	275	0.020	0.002	277	276
2025	HDDV	50 kph	Diesel	0.008	26.873	7.558	605	0.033	0.003	609	607
2030	LDV	50 kph	Gasoline	0.000	0.000	0.000	210	0.009	0.005	213	212
2030	LDV	50 kph	Diesel	0.002	6.419	1.805	264	0.020	0.002	266	265
2030	HDDV	50 kph	Diesel	0.002	7.886	2.218	591	0.034	0.003	594	593