BRITISH COLUMBIA | Ministry of Transportation and Infrastructure

November 15, 2016

Mr. Michael Shepard
Project Assessment Manager
Environmental Assessment Office
PO Box 9426 Stn Prov Govt
Victoria, BC V8W 9V1

Dear Michael:

Reference: George Massey Tunnel Replacement Project- Construction-related air emissions

As per the request of the Environmental Assessment Office (EAO), the Ministry of Transportation and Infrastructure (Ministry) is providing additional information on anticipated construction-related air emissions associated with the George Massey Tunnel Replacement Project (Project).

The attached memo provides an overview of anticipated annual emissions of criteria air contaminants (CACs) from assumed Project-related construction activities based on the reference concept provided in the Application for an Environmental Assessment Certificate (Application). This information is provided to further support the conclusions of the air quality assessment presented in Section 4.9 of the Application.

I trust that this provides the information that you need at this time. Please let me know if you have any further questions.

Yours truly,

Liz Staples

Liz Staples
Project Coordinator
George Massey Tunnel Replacement Project

Attachment: Emissions from Construction Activities Memo for the George Massey Tunnel Replacement Project

Copy to: Geoff Freer, Executive Project Director, George Massey Tunnel Replacement Project

MEMO

TO: PROJECT DIRECTOR, GEORGE MASSEY TUNNEL REPLACEMENT PROJECT

FROM: ALEX SCHUTTE, WSP

SUBJECT: GEORGE MASSEY TUNNEL TREPLACEMENT PROJECT CONSTRUCTION-RELATED AIR EMISSIONS

DATE: NOVEMBER 15, 2016

1 EMISSIONS FROM CONSTRUCTION ACTIVITIES

In order to complement the assessment of air quality presented in the Application for an Environmental Assessment Certificate (Application), additional work has been undertaken to quantify the anticipated range of air emissions associated with the construction phase of the George Massey Tunnel Replacement Project (Project). This memo presents the results of this additional work, which focused on construction-related emissions of criteria air contaminants (CACs), which have the potential to affect human health.

An overview of anticipated annual emissions of CACs from Project-related construction activities, in the context of overall emissions in the Lower Fraser Valley (LFV), is presented below. The methodology used in arriving at these numbers, including assumptions and emission factors used, is presented in **Attachment A**. A list of references used in developing this memo is included in **Attachment B**.

Emission estimates provided in this memo are based on the current reference concept for the Project as presented in Section 16.1 of the Application. Detailed construction planning and scheduling will be developed during the final design stage.

Anticipated CAC Emissions during Project Construction

Project construction is planned to commence in 2017 and take approximately four years to complete. Primary sources of Project-related air emissions during this period would be fuel combustion in construction vehicles and equipment, including tugboats that tow barges carrying construction materials to the site and construction equipment such as graders and loaders, and process fuel use in asphalt and concrete plants that may be located on-site. These sources are typical of highway/bridge construction and associated effects on air quality are well-understood, and proven best practices are available to avoid/minimize adverse effects.

Estimated construction-related air emissions based on anticipated level of activity associated with current reference concept are presented in Table 1 below. Corresponding emission forecasts for the Lower Fraser Valley (LFV) (Metro Vancouver, 2013) are included in the table for comparison purposes. The LFV forecast was developed with five year increments, starting in 1990, and emission forecast values for 2020 are used for comparison as they are likely to most closely represent regional conditions during Project construction.

As shown in Table 1, construction-related air emissions represent a minor contribution to regional air emissions–less than 0.3% for all criteria air contaminants–and are anticipated to have a negligible effect on regional air quality. Consistent with standard Best Management Practices, an Air Quality and Dust Control Management Plan will be developed prior to construction commencement to mitigate potential construction-related impacts on ambient air quality in the local assessment area.

Table 1 Summary of Construction Emissions and Comparison with 2020 LFV Regional Emissions

Pollutant	Units	Construction Related Emissions	LFV Emissions – 2020	Percent of LFV Emissions (%)
CO	t/year	53.3	345365.1	0.02%
NOx	t/year	131.7	47659.5	0.28%
SO_2	t/year	0.3	7668.8	0.00%
VOCs	t/year	15.2	85438.8	0.02%
PM_{10}	t/year	9.3	12729.2	0.07%
$PM_{2.5}$	t/year	8.4	7102.6	0.12%
NH_3	t/year	0.1	14431.2	0.00%

ATTACHMENT A – CONSTRUCTION ASSUPTIONS AND EMISSION FACTORS

Assumptions regarding construction fleet profiles and activities that were used to arrive at an approximation of the magnitude of emissions, including numbers and types of construction equipment expected to be operating simultaneously during the construction period, reflects anticipated activities associated with the current reference concept and are consistent with large-scale transportation infrastructure projects. Detailed construction planning and scheduling for the Project will be developed during the final design stage.

Primary sources of Project-related emissions of criterial air contaminants (CACs) during construction are: tugboats that tow barges carrying construction materials to the site; construction vehicles and equipment; and asphalt and concrete plants that may be located on-site. Assumptions and emission factors used in arriving at CAC emissions associated with these sources are discussed in the following sections.

1.1 TUGS

Information pertaining to the tow barges and tugs will be confirmed following completion of the detailed design and construction methodology. To provide an approximation of the magnitude of emissions from large-scale transportation infrastructure projects, the assumed emission parameters were adopted based on anticipated number of tow barges and tugs that could be expected to be operating simultaneously during the construction period.

Based on the reference concept, it is assumed that a total of up to 104 barge movements, each up to one hour in duration, could occur within the Local Assessment Area (LAA) over the course of a construction year. Each barge will be towed by two tugboats. The tug engine specifications and operating profile assumed were based on guidance from Environment Canada (Ly 2014) and are shown in Table 1.

Table 1 Tug Engine Profile

PARAMETER	SPECIFICATION
Engine category	C1 (with Tier 0 Technology)
Engine rating	1,065 kW
Load factor	0.79
Number of engine per tug	1
Total number of tugs per barge	2

Emission factors for tug boat diesel engines were obtained from Environment Canada (Ly 2014, SNC-Lavalin 2012). Emission factors for CACs are shown in Table 2.

Table 2 Emission Factors for Tugs

POLLUTANT	EMISSION FACTOR (G/KWH)
VOCs	0.27
CO	1.60
NOx	10.00
SO_2	<0.01
NH_3	<0.01
PM_{10}	0.34
$PM_{2.5}$	0.33

1.2 CONSTRUCTION VEHICLES AND EQUIPMENT

Information pertaining to the construction fleet, including fleet composition, equipment count, and operating schedule will be confirmed following completion of the detailed design and construction methodology. To provide an approximation of the magnitude of emissions from large-scale transportation infrastructure projects, assumed construction fleet parameters were adopted based on the anticipated number and types of construction equipment that could be expected to be operating simultaneously during the construction period. Assumptions regarding counts, types, and engine characteristics are summarized in Table 3. The equipment was assumed to be operating 12 hours a day for 220 days per year, at 60% capacity, for the total of four years.

Table 3 Estimated Construction Fleet Parameters

EQUIPMENT TYPE	COUNT	HORSEPOWER
Loaders	8	300
Crawler tractors	8	468
Excavators	8	286
Graders	8	275
Haul units - off-highway	4	1,000
Highway trucks – hauling, concrete, flatbeds	*	
Compactors	8	107
VibroCompaction Rigs	4	107
Crane Diesel Generator	4	300
Hydraulic excavators	4	286
Pile Drivers	4	300
Support equipment	4	125

* All highway trucks were assumed to be single-unit short-haul (< 200 miles / 322 km trips) travelling a maximum of 1034 trips per day. The number of trips was based on the quantities of material required on site and the trucks approximate capacity; it is noted that approximately 60% of these trips are associated with construction personnel travelling to and from the site, making the prediction conservative.

For diesel vehicles and equipment, the US EPA non-road engines, equipment, and vehicles (NONROAD2008) model was used to generate CAC emission factors for different categories of equipment. For highway trucks, the US EPA MOVES model was used to generate emissions factors for the same pollutants. These factors are shown in Table 4.

Table 4 NONROAD and MOVES Emission Factors for Construction Vehicles and Equipment

EQUIPMENT TYPE	EMISSION FACTORS (G/HP-H)						
	Criteria Air Contaminants						
	CO	NOx	SO_x	VOCs	PM	PM_{10}	$PM_{2.5}$
Loaders	1.61	3.15	0.01	0.49	0.31	0.31	0.30
Crawler tractors	0.68	1.67	0.00	0.16	0.11	0.11	0.10
Excavators	0.23	0.83	0.00	0.15	0.04	0.04	0.03
Graders	0.31	1.01	0.00	0.15	0.05	0.05	0.05
Haul units - off-highway	1.04	3.51	0.00	0.25	0.14	0.14	0.14
Highway trucks – hauling, concrete and flatbeds	1.34*	2.70*	0.00*	0.28*	0.16*	0.16*	0.14*
Compactors	0.64	1.48	0.00	0.18	0.15	0.15	0.15
VibroCompaction Rigs	0.64	1.48	0.00	0.18	0.15	0.15	0.15
Crane Diesel Generator	0.32	1.43	0.00	0.17	0.06	0.06	0.06
Hydraulic excavators	1.61	3.15	0.01	0.49	0.31	0.31	0.30
Pile Drivers	0.83	3.37	0.00	0.29	0.18	0.18	0.17
Support equipment - small trucks, forklifts, etc.	0.79	1.92	0.00	0.21	0.18	0.18	0.18

* The highway trucks emission factors are in grams per vehicle kilometres travelled (g/vkmt) and assume a travelling speed of 80 km/hr along the length of the air quality local assessment area.

1.3 ASPHALT PLANTS

It is anticipated that an asphalt plant will be required to supply the asphalt for road paving. It was assumed that the asphalt plant could process the amount of material required to build the Project at a constant rate over a three year period. While construction is slated to take four years, it is expected that the first year will not involve any production of asphalt. Emissions from natural gas-fired equipment at these facilities were estimated based on emission factors published by the US EPA (US EPA 2004). It is estimated that 45 m^3 will be produced per day. These factors are provided in Table 5.

Table 5 Emission Factors for Natural Gas-Fired Process Equipment in Hot Mix Asphalt Plants

POLLUTANT	EMISSION FACTOR (KG/TONNE ASPHALT)
VOCs	0.016
CO	0.065
NOx	0.013
SO_2	0.0017
PM	0.0165
PM_{10}	0.0115
$PM_{2.5}$	0.003465

1.4 CONCRETE PLANTS

Two concrete plants were assumed to be needed to supply the concrete for the Project construction. It was assumed that the concrete plants could process the amount of material required to build the Project at a constant rate over the four-year construction period. It is assumed that at each plant 200 m^3 of concrete will be processed per day. Emissions from the associated activities at these facilities were estimated based on emission factors published by the US EPA (US EPA 2006). These factors are provided in Table 6.

Table 6 Emission Factors for Concrete Plants

POLLUTANT	EMISSION FACTOR (KG/MG OF CONCRETE)		
	Cement Unloading to Elevated Storage Silo	Cement Supplement Unloading to Elevated Storage Silo	Mixer Loading (central mix)
PM	0.0005	0.0045	0.0092
PM_{10}	0.00017	0.0024	0.0028
$PM_{2.5}$	0.0001	0.0007	0.0015

ATTACHMENT B - REFERENCES

Ly, J. 2014. Private Communication with Mr. Jim Ly of Environ.

Metro Vancouver. 2013. 2010 Lower Fraser Valley Air Emissions Inventory and Forecast and Backcast, Final Report and Summarized Results. Available at: http://www.metrovancouver.org/about/publications/Publications/2010LowerFraserValleyAirEmissionsInventoryandForecastandBackcast.pdf

US EPA (Environmental Protection Agency). 2004. Hot Mix Asphalt Plants. In *AP 42, Fifth Edition, Vol I, Chapter 11: Mineral Products Industry.* US EPA. Available at http://www.epa.gov/ttn/chief/ap42/ch11/final/c11s01.pdf

US EPA (Environmental Protection Agency). 2006. Concrete Batching. In *AP 42, Fifth Edition, Vol I, Chapter 11: Mineral Products Industry.* US EPA. Available at http://www.epa.gov/ttn/chief/ap42/ch11/final/c11s12.pdf