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BURNCO AGGREGATE PROJECT

Air Screening

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REPORT

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Acronyms and Abbreviations

-	No value
AAQC	Ambient Air Quality Criteria
As_2O_3	Arsenic trioxide
ATSDR	Agency for Toxic Substances and Disease Registry
AQMS	Air Quality Management System
BC MoE	British Columbia Ministry of Environment
BMC	Benchmark concentration
BMCL	Benchmark concentration level
BMD	Benchmark dose
BMDL	Benchmark dose level
C	Carcinogenic
CAAQS	Canadian Ambient Air Quality Standard
Cal EPA	California Environmental Protection Agency
Cal OEHHA	California Office of Environmental Health Hazard Assessment
CBD	Chronic beryllium disease
CCME	Canadian Council of Ministers of the Environment
CNS	Central nervous system
CO	Carbon Monoxide
COPC	Chemical of potential concern
Cr(0)	Zero valent chromium
Cr(II)	Divalent chromium
Cr(III)	Trivalent chromium
Cr(VI)	Hexavalent chromium
e.g.	*exempli gratia* (for example)
ESL	Effects Screening Level
HEC	Human equivalent concentration
HQ	Hazard quotient
i.e.	*id* est (that is)
ILCR	Incremental lifetime cancer risk
IQ	Intelligence quotient
IUR	Inhalation unit risk
LOAEL	Lowest observed adverse effect level
MRL	Minimal Risk Levels
NAAQO	National Ambient Air Quality Objectives
NAAQS	National Ambient Air Quality Standard
NC	Non-carcinogenic
$NiSO_4$	Nickel Sulphate
NO_2	Nitrogen dioxide
NOAEL	No observed adverse effect level
OMOE	Ontario Ministry of the Environment
O_3	Ozone
PBPK	Physiologically based pharmacokinetic

PM_{10}	Particulate matter with a mean aerodynamic diameter of 10 microns (µm) or smaller
$PM_{2.5}$	Particulate matter with a mean aerodynamic diameter of 2.5 microns (µm) or smaller
POD	Point of departure
The Proposed Project	Burnco Aggregate Project
RDDR	Regional deposited dose ratio
REL	Reference Exposure Level
RfC	Reference concentration
RSL	Regional Screening Level
SO_2	Sulphur dioxide
TCEQ	Texas Commission on Environmental Quality
TERA	Toxicological Excellence for Risk Assessment
TSP	Total suspended particulate
UF	Uncertainty Factor
US EPA	United States Environmental Protection Agency
WHO	World Health Organization

Units of Measure

%	Percent
>	Greater than
±	Plus/minus
µg/m^3	Microgram per cubic metre
g/mol	Gram per mol
hr	Hour
mg/kg/day	Milligram per kilogram per day
mg/m^3	Milligrams per cubic metre
min	Minute
ng/m^3	Nanogram per cubic metre
ppb	Parts per billion
ppm	Parts per million

1.0 INTRODUCTION

This appendix provides the screening values used in the chemical screening process to identify chemicals of potential concern (COPCs), in support of the human health acute and chronic inhalation assessments being completed as part of the overall Environmental Assessment Certificate Application/Environmental Impact Statement (hereafter referred to as the EA) for the Proposed BURNCO Aggregate Project (the Proposed Project).

2.0 SCREENING VALUES USED IN THE HUMAN HEALTH AIR QUALITY RISK ASSESSMENT

2.1 Air Quality Assessment – Acute Inhalation Thresholds

As part of the short-term human health inhalation risk assessment screening process, predicted 1-hour and 24-hour concentrations of substances expected to be emitted by the Proposed Project were compared to selected 1-hour and 24-hour health-based thresholds, respectively. The 1-hour and 24-hour health-based thresholds were preferentially obtained from the following agencies:

- British Columbia Ministry of Environment (BC MoE);
- Canadian Council of Ministers of the Environment (CCME);
- Agency for Toxic Substances and Disease Registry (ATSDR);
- United States Environmental Protection Agency (US EPA) National Ambient Air Quality Standards (NAAQS); and
- World Health Organization (WHO).

The lowest health-based threshold with supporting information was generally selected for use in the screening process. Consideration was also given to relevant test species (i.e., human data versus animal data), study endpoint, quality and date of the study.

Where a health-based screening threshold was not available from the agencies listed above, available health-based thresholds from the following agencies were used:

- Ontario Ministry of the Environment (OMOE);
- California Environmental Protection Agency Office of Environmental Health Hazard Assessment (Cal OEHHA); and
- Texas Commission on Environmental Quality (TCEQ).

Priority was given to health-based screening levels that had supporting documentation.

Further information on the thresholds used in the screening process is provided below.

British Columbia Ministry of the Environment

In British Columbia, the Environmental Management Act provides the authority to the Ministry of the Environment to develop air quality objectives. These objectives were developed using air quality criteria from both provincial and national governing bodies (i.e., BC MOE, BC Department of Lands, Forest and Water Resources, CCME and Metro Vancouver) to help inform decisions with respect to the management of air quality. The BC MOE has defined three levels of ambient air quality objectives (A, B, and C), based on the National Ambient Air Quality Objectives. The levels are defined as follows (BC MoE 2016):

- Level A is the objective for new and proposed discharges, and, within the limits of best the best practicable technology, to existing discharges by planned staged improvements for these operations.
- Level B is the intermediate objective for all existing discharges to meet within a period of time specified by BC MoE, and as an immediate objective for existing discharges that may be increasing in quantity or altered in quality as a result of process expansion or modification.
- Level C is the immediate objective for all existing chemical and petrochemical industries to reach within a minimum technically feasible period of time.

Canadian Council of Ministers of the Environment

Air quality in Canada is regulated by standards set by the CCME, an inter-governmental body of federal, provincial and territorial ministers responsible for the environment. In 2012, a Canada-wide Air Quality Management System (AQMS), an approach for reducing air pollution in Canada, was implemented, and is the product of collaboration by the federal, provincial and territorial governments and stakeholders. The Canadian Ambient Air Quality Standards (CAAQS), which are established as objectives under the Canadian Environmental Protection Act (1999), have been developed for $PM_{2.5}$ and O_3, and in May 2013, replaced the Canada-wide Standards for Particulate Matter and Ozone.

The CCME has developed National Ambient Air Quality Objectives (NAAQOs), which are health-based air quality objectives for pollutant concentrations in outdoor air. NAAQOs have been developed for CO, NO_2 and SO_2 (CCME 1999). Three levels of NAAQOs have been established, 1) maximum desirable levels (long-term goal for air quality and a basis for an anti-degradation policy for the unpolluted parts of the country and for the continuing development of control technology), 2) maximum acceptable levels (intended to provide adequate protection against adverse effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well-being), and 3) maximum tolerable levels (air contaminant concentrations that require mitigation to avoid further deterioration to an air quality that endangers the prevailing Canadian lifestyle, or that pose a substantial risk to human health) (Health Canada 1994).

Agency for Toxic Substances and Disease Registry

ATSDR is a federal public health agency of the US Department of Health and Human Services. ATSDR derives Minimal Risk Levels (MRLs) for non-carcinogenic health effects (ATSDR 2016). The MRLs are based on data that identify the target organ(s) of effect or the most sensitive health effect(s) for a specific duration for a given route of exposure to the substance. ATSDR generally uses the No Observed Adverse Effect Level/Uncertainty Factor (NOAEL/UF) approach to derive MRLs. Physiologically-based pharmacokinetic (PBPK) modelling and benchmark dose (BMD) modelling have also been used in deriving MRLs. The MRLs are set below levels that may cause adverse health effects in sensitive subpopulations of people. The acute MRLs are derived for exposure durations of 1 to 14 days.

The ATSDR MRLs are generally based on the most sensitive endpoint considered to be of relevance to humans. The ATSDR applies a protective approach (i.e., application of margins of safety) to address uncertainty in particular for people who might be most sensitive (e.g., infants, elderly and nutritionally or immunologically compromised). Supporting documentation is available for the MRLs used in this assessment.

United States Environmental Protection Agency National Ambient Air Quality Standards

The US EPA has developed NAAQS for widespread pollutants that are considered harmful to human health as part of the Clean Air Act. The six criteria pollutants include carbon monoxide, lead, NO_2, ozone, particulate matter ($PM_{2.5}$ and PM_{10}), and SO_2. A primary and/or secondary standard is set for each of the criteria pollutants. Primary standards are intended to protect sensitive populations, including children, the elderly, and those with pre-disposed respiratory illnesses (e.g., asthma). Secondary standards are intended to be protective of public welfare (e.g., damage to animals, crops, vegetation, and buildings).

World Health Organization

The WHO has developed air quality guidelines to provide a basis for protecting public health from adverse effects of air pollution. The guidelines are intended to provide background information and guidance to governments in making risk management decisions, particularly in setting standards. These guidelines are also used in planning processes and various kinds of management decisions at a community or regional level. Supporting documentation is available for the WHO guidelines.

The WHO air quality guidelines are provided in the following documents:

- WHO (2000) – Air quality guidelines for Europe, 2nd Edition. WHO Regional Publications, European Series, No. 91.
- WHO (2006) - Air Quality Guidelines. Global Update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide.

Ontario Ministry of the Environment

In the province of Ontario, the Ministry of Environment has developed Ambient Air Quality Criteria (AAQC; OMOE 2012), which may be used in environmental assessments to assess air quality. An AAQC is a desirable concentration of a contaminant in air, based on protection against adverse effects on health or the environment. The AAQC are set with different averaging times (e.g., 24-hour, 1-hour and 10 minutes) appropriate for the effect that they are intended to protect against. The effects considered may be health, odour, vegetation, soiling, visibility, corrosion or other effects.

The OMOE has also derived air quality standards used to assess emissions from non-mobile sources of air pollution in Ontario. The Ontario air quality standards are desirable concentrations of air contaminants set at levels protective of the natural environment and sensitive populations (e.g., children, the elderly). The OMOE considers available toxicological information and supporting environmental information to establish effects-based air standards based on the limiting or critical effect(s) (health or environmental considerations) of that chemical.

California Environmental Protection Agency

The Cal OEHHA Reference Exposure Levels (RELs) are concentrations of a chemical at or below which adverse non-carcinogenic health effects are not anticipated to occur for a specified exposure duration (Cal OEHHA 2015). The RELs are used in risk assessments to evaluate the potential for adverse non-carcinogenic public health effects from facility emissions or similar localized sources in the Air Toxics Hot Spots Program, and from widespread exposures in the Toxic Air Contaminants program. The REL is an exposure at or below which adverse non-carcinogenic health effects are not expected to occur in a human population, including sensitive subgroups (e.g., infants and children). Supporting documentation was available for most of the RELs.

Texas Commission on Environmental Quality

The Texas Commission on Environmental Quality (TCEQ) has developed acute (1-hour) Short-Term Effects Screening Levels (ESLs) that are used in the air permitting process to evaluate short-term emissions predicted by air dispersion modelling. The TCEQ has developed a guidance document titled “TCEQ Guidelines to Develop Toxicity Factors” (TCEQ 2015a) that outlines the approach and methods used to derive the ESLs, and their application. The short-term ESLs are based on health effects, the potential for odours to be a nuisance, effects on vegetation, and corrosive effects. The ESLs are used in the air permit review process, for review of air permit applications, where emissions of one constituent from one site are evaluated at a time (emissions from multiple sites or multiple chemicals are not evaluated).

The TCEQ adjusts short-term reference values to a hazard quotient (HQ) of 0.3 to derive ESLs protective of cumulative and aggregate exposure. Other jurisdictions do not typically use an HQ approach in their derivation of short-term exposure limits or thresholds. The TCEQ ESLs (which are based on an HQ of 0.3) were conservatively used in the screening process without HQ adjustment (to an HQ of 1.0). However, in cases where TCEQ used the same primary study as another jurisdiction in their derivation of an ESL, preference was given to screening thresholds that had not been HQ adjusted.

The TCEQ has also developed acute (24-hour) reference values for chromium VI, benzene, 1,3-butadiene and formaldehyde, for evaluating 24-hour air monitoring data for possible health concerns. The TCEQ outlines the approach and methods used to derive the 24-hour Air Monitoring Comparison Values and their application in Section 4.6 of their guidance document (TCEQ 2015a). The 24-hour reference values are derived for the protection of human health associated with threshold dose-response relationships (typically effects other than cancer) and are defined as "an estimate of an inhalation exposure concentration that is likely to be without an appreciable risk of adverse effects to the human population (including susceptible subgroups) for a single 24-hour exposure" (TCEQ 2015a).

Selected Screening Thresholds and Chemical of Potential Concern Screening Process

The available acute inhalation 1-hour and 24-hour health-based thresholds and the basis of these thresholds are presented in Tables 9.1-B-1 and 9.1-B-2, respectively. The thresholds selected for use in the screening process are bolded and shaded in the tables.

The COPCs were identified as those substances in the Application Case that both exceeded the acute inhalation threshold and exhibited a 10% or greater increase above the Base Case concentration at any location evaluated in the acute inhalation assessment.

Comparison to regulatory threshold values was considered to represent a conservative evaluation of the potential for the predicted concentrations to elicit adverse effects. Comparison to 10% above Base Case concentrations was considered to represent a conservative evaluation of whether a measureable Proposed Project-related impact on environmental quality was likely to occur. Given temporal variability, variability in sampling and laboratory methods, and the uncertainty inherent in estimates from air quality models, a predicted increase of less than 10% above Base Case concentrations was considered unlikely to reflect a meaningful Proposed Project-related change in environmental quality.

The Base Case and predicted 1-hour and 24-hour air concentrations for the Application Case and results of the screening process are provided in Tables 9.1-B-3 (1-hour) and 9.1-B-4 (24-hour).

Table 9.1-B-1: Acute Inhalation Assessment – 1-Hour Thresholds

Parameter	BC MoE Ambient Air Quality Objectives[a]	Canadian CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	WHO Guidelines[f],[g]	Others			Toxicological Endpoints and Derivations
		Desirable	Acceptable	Tolerable				OMOE AAQC[h]	Cal OEHHA RELs[i]	TCEQ ESLs[j]	
Acid Gases and Particulate Matter											
Total Suspended Particulates (TSP)	-	-	-	-	-	-	-	-	-	-	A 1-hour threshold was not available. Acute inhalation exposure to particulate matter is assessed utilizing the 24-hour exposure scenario.
$PM_{2.5}$	-	-	-	-	-	-	-	-	-	-	A 1-hour threshold was not available. Acute inhalation exposure to particulate matter is assessed utilizing the 24-hour exposure scenario.
PM_{10}	-	-	-	-	-	-	-	-	-	-	A 1-hour threshold was not available. Acute inhalation exposure to particulate matter is assessed utilizing the 24-hour exposure scenario.
Sulphur dioxide (SO_2) (10-minute)	-	-	-	-	26 (0.01 ppm)	-	**500**	-	-	-	**ATSDR**: The minimal risk level was based on a minimal lowest observed adverse effect level (LOAEL) of 0.1 ppm for bronchoconstriction in exercising asthmatics (Sheppard et al., 1981; as cited in ATSDR 1998). Uncertainty factors of 3 for use of LOAEL and 3 for human variability were applied to derive the minimal risk level. The minimal risk level of 0.01 ppm was converted to µg/m^3 using a molecular weight of 64.07 g/mol. The minimal risk level is for a 10-minute averaging time. **WHO**: Threshold based on changes in pulmonary function and respiratory symptoms in exercising asthmatics after periods of exposure as short as 10 minutes. WHO recommends that a value of 0.5 mg/m^3 not be exceeded over a 10-minute averaging time. WHO considered the minimum concentration associated with adverse effects in 'extreme' circumstances (i.e., asthmatic patients exercising in chambers). The WHO threshold was selected because it was health based and considered several studies in sensitive individuals, was derived more recently than the ATSDR value, and considered the results of the study used in the derivation of the ATSDR value.
Sulphur Dioxide (SO_2) (1hour)	**200**	450	900	-	-	**200 (75 ppb)**	-	690	660	-	**BC MOE**: Supporting documentation not available for threshold. **CCME NAAQO**: Supporting documentation not available. **US NAAQS**: Threshold based on epidemiological evidence of increased emergency department visits and hospitalizations associated with sulphur dioxide concentrations in the range of 75 to 150 ppb. The NAAQS of 75 ppb was converted to µg/m^3 using a molecular weight of 64.07 g/mol. **OMOE**: Threshold based on health and vegetation endpoints (supporting documentation not available). **Cal OEHHA**: Threshold based on impairment of airway function (bronchoconstriction) especially in asthmatics. After reviewing human several studies on acute exposures of normal, asthmatic, and atopic (susceptible to hypersensitive allergic reactions) individuals to low concentrations of SO_2 (0.25 to 2.0 ppm), Cal OEHHA staff concluded that exposure to 0.25 ppm, the California Ambient Air Quality Standard (Cal AAQS) for SO_2, would not result in respiratory effects causing discomfort in sensitive individuals exposed for one hour. The Cal AAQS for SO_2 is intended to protect sensitive individuals (i.e., exercising asthmatics) from lower respiratory effects of acute exposure. Cal OEHHA concluded that an exposure concentration of 0.25 ppm SO_2 for 1-hour is comparable to a NOAEL in sensitive individuals. It was determined by Cal OEHHA that the NOAEL would be protective of asthmatic individuals because adverse effects are consistently observed only at higher concentrations with participants undertaking moderate exercise and there is also an inconsistency in response to SO_2 exposure at lower concentrations.

Parameter	BC MoE Ambient Air Quality Objectives[a]	Canadian CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	WHO Guidelines[f],[g]	Others			Toxicological Endpoints and Derivations
		Desirable	Acceptable	Tolerable				OMOE AAQC[h]	Cal OEHHA RELs[i]	TCEQ ESLs[j]	
Nitrogen Dioxide (NO_2)	**188**	-	400	1000	-	**190 (100 ppb)**	200	400	470	-	**BC MOE**: Supporting documentation not available for threshold. **CCME NAAQO**: Supporting documentation not available. **US NAAQS**: Threshold based on the 98th percentile of maximum 1-hour daily concentrations, averaged over a three-year period. The NAAQS is protective of a broad range of respiratory effects in sensitive populations, such as those with asthma and those who spend time near major roadways. The NAAQS of 100 ppb was converted to µg/m^3 using a molecular weight of 46.01 g/mol. **WHO**: Threshold based on studies of bronchial responsiveness among asthmatics. **Cal OEHHA**: Threshold is based on a study where sensitive humans (asthmatics) were exposed to 0.25 ppm of NO_2 for 1 hour. The critical effect was an increase in airway reactivity. No uncertainty factors were applied to the NOAEL of 0.25 ppm (470 µg/m^3), which was adopted as the reference exposure level (REL) and California ambient air quality standard to protect against mild adverse effects. **OMOE**: Threshold based on a health endpoint (supporting documentation not available).
Metals											
Aluminum	-	-	-	-	-	-	-	-	-	**20; 50**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), as aluminum soluble salts and aluminum chloride in PM_{10} (20 µg/m^3), and metal and insoluble aluminum (50 µg/m^3).
Antimony	-	-	-	-	-	-	-	-	-	**5**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), as PM_{10}.
Arsenic	-	-	-	-	-	-	-	-	0.2	**3**	**Cal OEHHA**: Threshold based on a study by Nagymajtenyi et. al. (1985; as cited in Cal OEHHA 2014) which found decreased fetal weight in mice following maternal inhalation of As_2O_3 for 4 hours/day during gestation days 9 to 12. A statistically significant decrease in the weight of fetuses was observed in all concentrations used in the study; therefore, no NOAEL was available. A LOAEL of 0.26 mg/m^3 and an uncertainty factor of 1,000 (10 for a lack of a NOAEL value, 10 for interspecies differences between mice and humans, and 10 for human interindividual differences) were used to derive the threshold. **TCEQ:** Threshold based on a study by Holson (1999; as cited in TCEQ 2012) which found maternal toxicity (rales which are an abnormal respiratory sound) in female rats exposed to arsenic trioxide via inhalation for 6 hours/day from gestation days 6 to 15. The NOAEL was 3,000 µg/m^3, extrapolated to a 1-hour exposure (5,451 µg/m^3), and adjusted for a human equivalent concentration (HEC, 3,891 µg/m^3). An uncertainty factor of 300 (3 for interspecies variation, 10 for intraspecies variation and 10 for an incomplete database) was applied. The health-based threshold was adjusted for arsenic because arsenic trioxide was the exposure chemical. The threshold was multiplied by the molecular weight fraction of arsenic in As_2O_3 (76%; As = 2 × 74.9 g/mol, As_2O_3 = 197.8 g/mol; 9.86 µg/m^3) and divided by 3.3 to adjust to an HQ of 0.3. A peer review organized by Toxicology Excellence for Risk Assessment (TERA 2009) indicates that the study by Nagymajtenyi et al. (1985; as cited in TERA 2009) from which the most conservative threshold of 0.2 µg/m^3 was derived, is not an adequate study from which to develop an acute threshold. The panel cited a lack of reliability in the study design as well as a lack of adequate documentation in Nagymajtenyi et al. (1985). The panel instead supports the use of the Holson (1999; as cited in TERA 2009) study in deriving the 1-hour arsenic threshold. Therefore, based on the TERA (2009) review, the TCEQ threshold which was derived from the Holson (1999; as cited in TERA 2009) study was used in this assessment.
Barium	-	-	-	-	-	-	-	-	-	**5**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), for barium and compounds as PM_{10}.
Beryllium	-	-	-	-	-	-	-	-	-	**0.02**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), for beryllium as a particulate.

Parameter	BC MoE Ambient Air Quality Objectives[a]	Canadian CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	WHO Guidelines[f],[g]	Others			Toxicological Endpoints and Derivations
		Desirable	Acceptable	Tolerable				OMOE AAQC[h]	Cal OEHHA RELs[i]	TCEQ ESLs[j]	
Bismuth	-	-	-	-	-	-	-	-	-	**50**	**TCEQ**: Threshold based on health endpoint (interim, supporting documentation not available), as bismuth and compounds in PM_{10}.
Cadmium	-	-	-	-	-	-	-	-	-	**0.1**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), as cadmium and compounds in PM_{10}.
Chromium	-	-	-	-	-	-	-	-	-	**Cr(III) = 3.6**	**TCEQ**: Threshold of 3.6 µg/m^3 for trivalent chromium based on increased acid phosphatase activity in lavage fluid and increased acid phosphatase and beta-glucuronidase activity in lung tissue (precursor to adverse effects) in hamsters exposed to chromium chloride (via inhalation) for 30 minutes (TCEQ 2009a). The NOAEL was 77 mg/m^3 and extrapolated to a 1-hour exposure (38.5 mg/m^3). The human equivalent concentration (HEC) was 10.82 mg/m^3, adjusted to an HQ = 0.3, and an uncertainty factor of 300 (3 for interspecies variability, 10 for intraspecies variability and 10 for an incomplete database) was applied.
										-	A 1-hour threshold for Cr(VI) is not available. Acute inhalation exposure is assessed utilizing the 24-hour exposure scenario.
Cobalt	-	-	-	-	-	-	-	-	-	**0.2**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), as cobalt and inorganic compounds in PM_{10}.
Copper	-	-	-	-	-	-	-	-	100	**10**	**Cal OEHHA**: Threshold based on a NOAEL of 1 mg copper/m^3 in a study where workers indicated exposure to copper dust was detectable by taste but no other symptoms occurred following exposure to 1 to 3 mg/m^3 copper for an unspecified amount of time (Whitman 1957; as cited in Cal OEHHA 2008). No extrapolation for continuous exposure was applied because the exposure duration was not clearly specified in the reports. An uncertainty factor for intraspecies variability (10) was applied.
											TCEQ: Threshold based on a health endpoint (interim, supporting documentation not available), as copper dusts & mists.
Iron	-	-	-	-	-	-	-	-	-	**10**	**TCEQ:** Threshold based on a health endpoint (interim, supporting documentation not available), as iron (III) sulfate and soluble iron salt) in PM_{10}.
Lead	-	-	-	-	-	-	-	-	-	-	A 1-hour threshold is not available. Acute inhalation exposure to is assessed utilizing the 24-hour exposure scenario.
Lithium	-	-	-	-	-	-	-	-	-	**2**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), as elemental lithium and inorganic lithium compounds.
Manganese	-	-	-	-	-	-	-	-	-	**2**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), as dust and inorganic compounds in PM_{10}.
Mercury	-	-	-	-	-	-	-	-	0.6	**0.25**	**Cal OEHHA**: Threshold based on central nervous system disturbances in rat offspring. Maternal rats were exposed to metallic mercury vapour (1.8 mg/m^3) for 3 hours/day during gestation. The offspring displayed significant dose-dependent deficits in behaviour 3 to 7 months after birth compared to controls. The behaviors measured included spontaneous motor activity, performance of a spatial learning task, and habituation to an automated test chamber. An uncertainty factor of 3,000 (10 for using LOAEL for moderate to severe effects in the absence of a NOAEL, 3 for interspecies toxicokinetic differences, 10 for interspecies toxicodynamic differences, 3 for individual variability, and 3 for intraspecies differences in age differences) was used.
											TCEQ: Threshold based on a health endpoint (interim, supporting documentation not available) as mercury metal and inorganic mercury forms in PM_{10}).
Molybdenum	-	-	-	-	-	-	-	-	-	**30**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available) as molybdenum in PM_{10}.

Parameter	BC MoE Ambient Air Quality Objectives[a]	Canadian CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	WHO Guidelines[f],[g]	Others			Toxicological Endpoints and Derivations
		Desirable	Acceptable	Tolerable				OMOE AAQC[h]	Cal OEHHA RELs[i]	TCEQ ESLs[j]	
Nickel	-	-	-	-	-	-	-	-	0.2	**0.33**	**Cal OEHHA**: Threshold based on a mild reduction in antibody response in mice, exposed for 2 hours to nickel and nickel compounds. The 2-hour benchmark dose level (BMDL) was 165 µg/m^3 and was extrapolated to a 1-hour concentration of 233 µg/m^3. An uncertainty factor of 1,000 (3 for benchmark response uncertainty, 10 for interspecies differences, and 30 for intraspecies differences) was applied. **TCEQ:** Threshold based on significant bronchial constriction in 12 metal plating factory workers with occupational asthma exposed to an aerosol of 0.3 mg/m^3 of nickel sulphate (67 µg nickel/m^3) for 30 minutes (TCEQ 2011). Respiratory effects were significant at this level of exposure (LOAEL of 67 µg/m^3) and therefore a NOAEL was not available. The exposure concentration was extrapolated to 1 hour (33.5 µg nickel/m^3) and an uncertainty factor of 30 (10 for using a LOAEL and 3 for an incomplete database) was applied. The resulting concentration (1.1 µg nickel/m^3) was divided by 3.3 to adjust to an HQ = 0.3. The TCEQ value was selected preferentially over the Cal OEHHA value because the threshold is based on a human study.
Selenium	-	-	-	-	-	-	-	-	-	**2**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), as selenium and compounds in PM_{10}.
Silver	-	-	-	-	-	-	-	-	-	**0.1**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), as silver metal and compounds in PM_{10}
Strontium	-	-	-	-	-	-	-	-	-	**20**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available) as strontium and compounds in PM_{10}.
Thallium	-	-	-	-	-	-	-	-	-	**1**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), as PM_{10}.
Tin	-	-	-	-	-	-	-	-	-	**20**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), as tin compounds in PM_{10}: metal, oxide and inorganic compounds.
Titanium	-	-	-	-	-	-	-	-	-	**50**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), as PM_{10}.
Uranium	-	-	-	-	-	-	-	-	-	2; **0.5**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), 2 µg/m^3 as insoluble uranium compounds and 0.5 µg/m^3 as soluble uranium compounds (both as PM_{10}).
Vanadium	-	-	-	-	-	-	-	-	30	**20**	**Cal OEHHA**: Threshold based on respiratory effects (increased respiratory mucus production that was cleared by coughing) in humans exposed to vanadium pentoxide for 8 hours. The LOAEL was 0.25 mg/m^3 and the NOAEL was 0.1 mg/m^3. The equivalent 1-hour concentration was determined to be 0.3 mg/m^3 using the following equation: $C^2 = [0.1\ mg/m^3]^2 * 8\ hours)/1\ hour$). An uncertainty factor of 10 was applied (1 for use of a LOAEL, 1 for interspecies variation, and 10 for intraspecies variation). **TCEQ:** Threshold based on a health endpoint (interim, supporting documentation not available), as vanadium metal and compounds in PM_{10}.

Parameter	BC MoE Ambient Air Quality Objectives[a]	Canadian CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	WHO Guidelines[f],[g]	Others			Toxicological Endpoints and Derivations
		Desirable	Acceptable	Tolerable				OMOE AAQC[h]	Cal OEHHA RELs[i]	TCEQ ESLs[j]	
Zinc	-	-	-	-	-	-	-	-	-	**20**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), as zinc and compounds in PM_{10}.

Notes:
(a) BC MoE 2014.
(b) CCME 1999.
(c) CCME 2012.
(d) ATSDR 2015.
(e) US EPA 2011.
(f) WHO 2006.
(g) WHO 2000.
(h) OMOE 2012.
(i) Cal OEHHA 2015.
(j) TCEQ 2015b. The screening levels derived by TCEQ are based on an HQ = 0.3.
All values are in µg/m^3 unless otherwise noted.
Concentrations in ppm were converted to mg/m^3 by applying the formula: molecular weight (g/mol) x ppm / 24.45.
" – " = no value; µg/m^3= microgram per cubic metre; % = percent; AAQC = Ambient Air Quality Criteria; As_2O_3 = arsenic trioxide; ATSDR = Agency for Toxic Substances and Disease Registry; BC MoE = British Columbia Ministry of Environment; BMDL = benchmark dose level; CAAQS = Canadian Ambient Air Quality Standard ; Cal OEHHA = California Office of Environmental Health Hazard Assessment; CCME = Canadian Council of Ministers of the Environment; CNS = central nervous system; g/mol = gram per mol; HEC = human equivalent concentration; HQ = hazard quotient; LOAEL = lowest observable adverse effect level; mg/m^3 = milligram per cubic metre; MRL = Minimal Risk Level; NAAQO = National Ambient Air Quality Objectives; NAAQS = National Ambient Air Quality Standard; NO_2 = nitrogen dioxide; NOAEL = no observable adverse effect level; OMOE = Ontario Ministry of Environment; PM_{10} = particulate matter less than 10 micrometres; $PM_{2.5}$ = particulate matter less than 2.5 micrometres; ppb = parts per billion; ppm = parts per million; REL = reference exposure level; SO_2 = sulphur dioxide; TCEQ = Texas Commission on Environmental Quality; TERA = Toxicology Excellence for Risk Assessment; TSP = total suspended particulate; WHO = World Health Organization.

Table 9.1-B-2: Acute Inhalation Assessment – 24-Hour Thresholds

Parameter	BC MoE Ambient Air Quality Objectives[a]			Canadian CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	WHO Guidelines[f],[g]	Others		Toxicological Endpoints and Derivations
	Level A	Level B	Level C	Desirable	Acceptable	Tolerable				OMOE AAQC[h]	TCEQ ESLs[i]	
Acid Gases and Particulate Matter												
Total Suspended Particulates (TSP)	**Maximum Desirable Level = 120**	200	260	-	**120**	400	-	-	-	-	-	**BC MOE**: The BC MOE adopts the CCME NAAQO for the Maximum Desirable Level. **CCME NAAQO**: Supporting documentation not available.
$PM_{2.5}$	**Air Quality Objective = 25** CAAQS = 28			28 (Year 2015) 27 (Year 2020)			-	35	**25**	30	-	**BC MOE:** Supporting documentation not available. **CCME CAAQS**: Air screening levels based on Canada Wide Standards, intended for the protection of respiratory effects. CCME has recently updated the Canadian ambient air quality standard (CAAQS) for $PM_{2.5}$, which is intended to be protective of human health and the environment, and is a value of 28 µg/m^3 as of 2015 and 27 µg/m^3 proposed for the year 2020. The metric is the 3-year average of the annual 98th percentile of the daily 24-hour average concentrations. **OMOE:** Air screening level based on Canada Wide Standards, intended for the protection of respiratory effects. OMOE thresholds are based on the CCME Canadian Wide Standard for particulate matter (CCME 2012), which is protective of human health and the environment. As described above, CCME has recently updated the Canadian ambient air quality standard (CAAQS) for $PM_{2.5}$, and these updates have not been incorporated into the OMOE screening criteria. **US NAAQS**: Standard based on the 98th percentile of daily 24-hour concentrations averaged over 3 years and is protective of increased health effects associated with short-term $PM_{2.5}$ exposure, including premature mortality and increased hospital admissions and emergency department visits. **WHO**: The guideline is based on the same toxicological endpoint as PM_{10} where exposure is associated with a 0.46 to 0.62% increase in mortality per 10 µg/m^3 increase in PM_{10}. The PM_{10} guideline is converted using a $PM_{2.5}$:PM_{10} ratio of 0.5. This $PM_{2.5}$:PM_{10} ratio is typical of that found in urban areas of developing countries and is at the bottom of the range found in urban areas in developed countries (0.5 to 0.8).
PM_{10}	**50**	-		-			-	150	**50**	50	-	**BC MOE:** Supporting documentation not available. **US NAAQS**: Air screening level to protect against adverse health effects of inhalable airborne particles that can be deposited in the lower (thoracic) regions of the human respiratory tract. The standard is met when a 24-hr average PM_{10} concentration of 150 mg/m^3 is not exceeded more than one day per year, on average over a three-year period. **WHO**: The guideline is based on a 0.46 to 0.62% increase in mortality per 10 µg/m^3 increase in PM_{10}. The guideline reflects the relationship between the distributions of 24-hour means (and its 99th percentile) and annual average concentrations. **OMOE**: Interim ambient air quality criterion (supporting documentation not available)

Parameter	BC MoE Ambient Air Quality Objectives[a]			Canadian CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	WHO Guidelines[f],[g]	Others		Toxicological Endpoints and Derivations
	Level A	Level B	Level C	Desirable	Acceptable	Tolerable				OMOE AAQC[h]	TCEQ ESLs[i]	
Sulphur Dioxide (SO_2)	-	-	-	150	300	800	-	-	**20**	275	-	**CCME NAAQO**: Supporting documentation not available. **WHO**: The WHO has adopted a guideline of 20 µg/m^3 for SO_2. Various studies were reviewed by the WHO and are summarized below. One study concluded that a reduction in SO_2 linked to reductions in sulphur content in fuels appears to be associated with substantial reductions in health effects including all-age mortality and childhood respiratory disease (Hedley et al. 2002; as cited in WHO 2006). A second study reported that there was no evidence of a threshold for health effects associated with 24-hour SO_2 concentrations ranging from 5 to 40 µg/m^3 (Wong et al. 2002; as cited in WHO 2006). A third study indicated that there may be increases to daily mortality rates from 24-hour average SO_2 concentrations of 5 µg/m^3 (Burnett et al., 2004; as cited in WHO 2006). A fourth study reported significant associations between SO_2 and mortality at mean SO_2 concentrations of 18 µg/m^3 and maximum SO_2 concentrations of 85 µg/m^3 (Pope et al. 2002; as cited in WHO 2006). The WHO concludes that there is uncertainty regarding whether SO_2 is the primary contaminant responsible for the health effects because exposure is often present in combination with other contaminants such as particulate matter. The WHO has applied a precautionary approach and set a 24-hour SO_2 guideline of 20 µg/m^3. **OMOE**: Threshold based on health and vegetation endpoints (supporting documentation not available).
Nitrogen Dioxide (NO_2)	-	-	-	-	**200**	300			-	**200**	-	**CCME NAAQO**: Supporting documentation not available. **OMOE**: Threshold based on a health endpoint (supporting documentation not available).
Metals												
Aluminum	-	-	-	-	-	-	-	-	-	**120**	-	**OMOE**: Threshold for aluminum oxide, based on a health endpoint for chemical sorbed to particulates (supporting documentation not available).
Antimony	-	-	-	-	-	-	-	-	-	**25**	-	**OMOE**: Threshold for antimony and compounds, based on a health endpoint (supporting documentation not available).
Arsenic	-	-	-	-	-	-	-	-	-	**0.3**	-	**OMOE**: Threshold based on a health endpoint (supporting documentation not available).
Barium	-	-	-	-	-	-	-	-	-	**10**	-	**OMOE**: Threshold based on a health endpoint (supporting documentation not available), for total water soluble barium.
Beryllium	-	-	-	-	-	-	-	-	-	**0.01**	-	**OMOE:** Threshold based on a health endpoint (supporting documentation not available), for beryllium and compounds.
Bismuth	-	-	-	-	-	-	-	-	-	**-**	-	A 24-hour threshold was not available. Acute inhalation exposure is assessed utilizing the 1-hour exposure scenario.

Parameter	BC MoE Ambient Air Quality Objectives[a]			Canadian CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	WHO Guidelines[f],[g]	Others		Toxicological Endpoints and Derivations
	Level A	Level B	Level C	Desirable	Acceptable	Tolerable				OMOE AAQC[h]	TCEQ ESLs[i]	
Cadmium	-	-	-	-	-	-	**0.03**	**-**	-	0.025	-	**ATSDR**: Threshold based on a LOAEL of 0.088 mg/m^3 for respiratory effects in rats exposed to cadmium oxide for 6.2 hours/day, 5 days/week for 2 weeks (ATSDR 2012a). A NOAEL was not available from this study because effects were observed in all concentrations tested. The LOAEL was adjusted for continuous exposure (0.088 mg cadmium/m^3 x 6.2 hours/24 hours x 5 days/7 days) and for a regional deposited dose ratio in the pulmonary region of 0.617 to determine a human equivalent concentration (HEC). An uncertainty factor of 300 (3 for extrapolating from animals to humans, 10 for a use of a LOAEL and 10 for human variability) was applied to the HEC (0.01 mg/m^3). **OMOE**: Threshold for cadmium and cadmium compounds, based on kidney effects and carcinogenicity associated with exposure to these compounds (OMOE 2007a). A continuous lifetime exposure of 270 ng/m^3 for the general population was derived from the cumulative occupational exposure of 100 µg/m^3-years. The occupational exposure level was converted into an equivalent continuous lifetime exposure by extrapolating the occupational LOAEL from 8 hours to 24 hours, from 225 working days to 365 days and distributed over an average human lifetime of 75 years (100 µg/m^3-years x 8/24 hours x 225/365 days x 1/75 years = 270 ng/m^3), resulting in a value of 0.27 µg/m^3. An uncertainty factor of 10 for intraspecies variability and a modifying factor of 5 to address carcinogenicity (i.e., uncertainty and additional protection of human health), were applied, resulting in a chronic exposure of 5 ng/m^3 (annual average). The OMOE used a factor of 5 to convert from an annual threshold to a 24-hour threshold.
Chromium	-	-	-	-	-	-	-	-	-	0.5	**0.39**	**OMOE**: Threshold (for metallic Cr(0), Cr(II) and Cr(III)) based on increased total lung and trachea weight relative to body weight in rats associated with exposure to Cr(III). Rats were exposed to chromium sulfate for 13 weeks (5 days/week, 6 hours/day). The point of departure (POD) was 3.45 mg/m^3 (a benchmark concentration lower confidence limit corresponding to a 10% incidence of effect [$BMCL_{10}$]) and adjusted for continuous exposure (0.616 mg/m^3) and the regional deposited dose ratio (to account for differences in deposition pattern of inhaled particles in the respiratory tract in humans and test animals; 1.315). The POD adjusted for a human equivalent concentration (POD_{HEC}) was 0.8086 mg/m^3. An uncertainty factor of 300 (10 for human variability, 10 for extrapolating from subchronic to chronic exposure and 3 for extrapolation from animals to humans) was applied to the POD_{HEC}. **TCEQ**: Threshold based on a benchmark concentration lower confidence limit corresponding to the lower 10% incidence of effect ($BMCL_{10}$) of 16.06 µg Cr(VI)/m^3 for increased relative lung weight in rats exposed to 0, 50, 100, 200, or 400 µg Cr(VI)/m^3, as sodium dichromate, for 22 hours/day for 7 days/week for 30 days (TCEQ 2014). The $BMCL_{10}$ was not adjusted for continuous exposure by TCEQ because the study exposure duration of 22 hours/day, 7 days/week for 30 days is much longer than the acute duration of interest (24-hour). The $BMCL_{10}$ was adjusted for a human equivalent concentration (HEC) using the regional deposited dose ratio for animal to human adjustment of 2.41. Uncertainty factors for interspecies variation (3) and intraspecies variation (10) were applied. The resulting threshold of 1.3 µg Cr(VI)/m^3 was based on an HQ = 1.0. The screening level was derived by adjusting to an HQ = 0.3, by dividing the value of 1.3 µg Cr(VI)/m^3 by 3.3, resulting in a value of 0.39 µg Cr(VI)/m^3.
Cobalt	-	-	-	-	-	-	-	-	-	**0.1**	-	**OMOE**: Threshold based on a health endpoint (supporting document not available).
Copper	-	-	-	-	-	-	-	-	-	**50**	-	**OMOE**: Threshold based on a health endpoint (supporting document not available).
Iron	-	-	-	-	-	-	-	-	-	**4**	-	**OMOE**: Threshold for metallic iron based on a health endpoint (supporting document not available).
Lead	-	-	-	-	-	-	-	-	-	**0.5**	-	**OMOE**: Threshold based on neurological effects in children. The threshold is based on Cal EPA (2001; as cited in OMOE 2007) approach where the airborne lead concentration is based on a 5% probability of children in a reference population exceeding the LOAEL.
Lithium	-	-	-	-	-	-	-	-	-	**20**	-	**OMOE**: Threshold (for lithium other than hydrides) based on health endpoint (supporting documentation not available).

Parameter	BC MoE Ambient Air Quality Objectives[a]			Canadian CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	WHO Guidelines[f],[g]	Others		Toxicological Endpoints and Derivations
	Level A	Level B	Level C	Desirable	Acceptable	Tolerable				OMOE AAQC[h]	TCEQ ESLs[i]	
Manganese	-	-	-	-	-	-	-	-	-	**0.1**	-	**OMOE**: Threshold for manganese as a metal/parameter in $PM_{2.5}$ and based on an occupational study where workers were exposed to MnO_2 dust for an average of 5.3 years in a dry-cell battery factory. The point of departure (POD) was selected as 84 µg/m^3 (benchmark concentration lower confidence limit corresponding to a 5% response level [$BMCL_{05}$]) for a logistic dose-response model of eye-hand coordination scores. The POD was adjusted for continuous exposure (30 µg/m^3) and an uncertainty factor of 300 (10 for human variability, 3 for database limitations and differences in toxicity associated with different species of manganese, 3 for the vulnerability of the developing nervous system and 3 for subchronic to chronic exposure extrapolation) was applied.
Mercury	-	-	-	-	-	-	-	-	-	**2**	-	**OMOE**: Threshold based on a health endpoint (supporting document not available).
Molybdenum	-	-	-	-	-	-	-	-	-	**120**	-	**OMOE**: Threshold based on a particulate endpoint (supporting document not available).
Nickel	-	-	-	-	-	-	-	-	-	**0.1**	-	**OMOE**: Threshold for nickel as a metal/parameter in PM_{10}. Based on carcinogenic and non-carcinogenic effects (supporting documentation available). The 24-hour screening value was derived from the annual screening value (0.02 µg/m^3) and a conversion factor of 5, which is based on empirical monitoring data, ratios of concentrations observed for different averaging times, and meteorological considerations.
Selenium	-	-	-	-	-	-	-	-	-	**10**	-	**OMOE**: Threshold based on a health endpoint (supporting document not available).
Silver	-	-	-	-	-	-	-	-	-	**1**	-	**OMOE**: Threshold based on a health endpoint (supporting document not available).
Strontium	-	-	-	-	-	-	-	-	-	**120**	-	**OMOE**: Threshold based on a health endpoint for chemical sorbed to particulates (supporting documentation not available).
Thallium	-	-	-	-	-	-	-	-	-	-	-	A 24-hour threshold was not available. Acute inhalation exposure is assessed utilizing the 1-hour exposure scenario.
Tin	-	-	-	-	-	-	-	-	-	**10**	-	**OMOE**: Threshold based on a health endpoint (supporting document not available).
Titanium	-	-	-	-	-	-	-	-	-	**120**	-	**OMOE**: Threshold based on a health endpoint for chemical sorbed to particulates (supporting documentation not available).
Uranium	-	-	-	-	-	-	-	-	-	**0.15**	-	**OMOE**: Threshold based on a health endpoint (supporting documentation not available), as uranium in PM_{10}.
Vanadium	-	-	-	-	-	-	0.8	-	**1**	2	-	**ATSDR**: Threshold based on a LOAEL of 0.56 mg/m^3 for lung inflammation in rats exposed to vanadium pentoxide for 6 hours/day, 5 days/week for 13 days. The LOAEL was adjusted for continuous exposure (0.1 mg/m^3) and to a human equivalent concentration (HEC) (0.073 mg/m^3). An uncertainty factor of 90 (3 for using minimal LOAEL, 3 for animal to human extrapolation and 10 for human variability) was applied to the HEC. **WHO**: Threshold based on human occupational studies indicating that the LOAEL for vanadium can be assumed to be 20 µg/m^3, based on chronic upper respiratory tract symptoms. The adverse nature of the observed effects including irritation, coughing, and effects on the pharynx, were minimal at 20 µg/m^3 compared to the higher exposures of 1 mg/m^3 where more serious effects such as chronic bronchitis and pneumonia were observed. A susceptible subpopulation was not identified and an uncertainty factor of 20 (to account for use of a concentration where only minimal effects to the respiratory tract were seen and for lack of identification of a susceptible subpopulation) was selected. The WHO value was selected because the threshold was based on a human study. **OMOE**: Threshold based on a health endpoint (supporting documentation not available).

Parameter	BC MoE Ambient Air Quality Objectives[a]			Canadian CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	WHO Guidelines[f],[g]	Others		Toxicological Endpoints and Derivations
	Level A	Level B	Level C	Desirable	Acceptable	Tolerable				OMOE AAQC[h]	TCEQ ESLs[i]	
Zinc	-	-	-	-	-	-	-	-	-	**120**	-	**OMOE**: Threshold based on a health endpoint for chemical sorbed to particulates (supporting documentation not available).

Notes:

(a) BC MoE 2016.
(b) CCME 1999.
(c) CCME 2012.
(d) ATSDR 2015.
(e) US EPA 2011.
(f) WHO 2006.
(g) WHO 2000.
(h) OMOE 2012.
(i) TCEQ 2015b. The screening levels derived by TCEQ are based on an HQ = 0.3.

All values are in $\mu g/m^3$, unless otherwise noted.

Concentrations in ppm were converted to mg/m^3 by applying the formula: molecular weight (g/mol) x ppm / 24.45.

" – " = no value; $\mu g/m^3$= microgram per cubic metre; % = percent; AAQC = Ambient Air Quality Criteria; ATSDR = Agency for Toxic Substances and Disease Registry; BC MoE = British Columbia Ministry of Environment; BMCL = benchmark concentration lower confidence limit; CAAQS = Canadian Ambient Air Quality Standard ; Cal EPA = California Environmental Protection Agency; CCME = Canadian Council of Ministers of the Environment; Cr(0) = zero valent chromium; Cr(II) = divalent chromium; Cr(III) = trivalent chromium; Cr(VI) = hexavalent chromium; g/mol = gram per mol; HEC = human equivalent concentration; HQ = hazard quotient; LOAEL = lowest observable adverse effect level; mg = milligrams; mg/m^3 = milligram per cubic metre; NAAQO = National Ambient Air Quality Objectives; NAAQS = National Ambient Air Quality Standard; ng/m^3 = nanogram per cubic metre; NO_2 = nitrogen dioxide; NOAEL = no observable adverse effect level; OMOE = Ontario Ministry of Environment; PM_{10} = particulate matter less than 10 micrometres; $PM_{2.5}$ = particulate matter less than 2.5 micrometres; POD = point of departure; ppm = parts per million; RDDR = regional deposited dose ratio; SO_2 = sulphur dioxide; TCEQ = Texas Commission on Environmental Quality; TSP = total suspended particulate; WHO = World Health Organization.

2.2 Air Quality Assessment – Chronic Inhalation Thresholds

As part of the long-term human health inhalation risk assessment screening process, concentrations of substances expected to be emitted by the Proposed Project were compared to selected air quality screening levels or guidelines derived for the protection of chronic inhalation to human health. The chronic health-based thresholds were preferentially obtained from the following agencies:

- BC MoE;
- CCME;
- ATSDR;
- US EPA Residential Air Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites;
- US EPA National Ambient Air Quality Standards (NAAQS); and
- WHO.

The lowest health-based threshold with supporting information was generally selected for use in the screening process. Consideration was also given to relevant species (i.e., human data versus animal data), study endpoint, quality and date of the study.

Where a health-based screening threshold was not available from the agencies listed above, the lowest available health-based thresholds with supporting information, from the following agencies, were used:

- OMOE;
- Cal OEHHA; and
- TCEQ.

The screening levels and guidelines available from the agencies listed above are provided in Table 9.1-B-5. Risk levels for which the screening levels/guidelines were derived were standardized to risk levels considered acceptable by the BC MoE and Health Canada (BC MoE 2008; Health Canada 2010). For non-carcinogens, this involved adjusting to an HQ of 1.0, and for carcinogens this involved adjusting to a risk level of 1×10^{-5} (i.e., 1 in 100,000). Further information on the approach used to develop the screening levels/guidelines/objectives for each of the agencies is provided below.

British Columbia Ministry of the Environment

In British Columbia, the Environmental Management Act provides the authority to the Ministry of Environment to develop air quality objectives. These objectives were developed using air quality criteria from both provincial and national governing bodies (i.e., BC MOE, BC Department of Lands, Forest and Water Resources, CCME and Metro Vancouver) to help inform decisions with respect to the management of air quality. The BC MOE has defined three levels of ambient air quality objectives (A, B, and C), based on the National Ambient Air Quality Objectives. The levels are defined as follows (BC MOE 2016):

- Level A is the objective for new and proposed discharges, and, within the limits of best the best practicable technology, to existing discharges by planned staged improvements for these operations.
- Level B is the intermediate objective for all existing discharges to meet within a period of time specified by BC MoE, and as an immediate objective for existing discharges that may be increasing in quantity or altered in quality as a result of process expansion or modification.
- Level C is the immediate objective for all existing chemical and petrochemical industries to reach within a minimum technically feasible period of time.

Canadian Council of Ministers of the Environment

Air quality in Canada is regulated by standards set by the CCME, an inter-governmental body of federal, provincial and territorial ministers responsible for the environment. In 2012, a Canada-wide AQMS, an approach for reducing air pollution in Canada, was implemented, and is the product of collaboration by the federal, provincial and territorial governments and stakeholders. The CAAQS, which are established as objectives under the Canadian Environmental Protection Act (1999), have been developed for $PM_{2.5}$ and O_3, and in May 2013, replaced the Canada-wide Standards for Particulate Matter and Ozone. Standards for NO_2 and SO_2 are currently under development.

The CCME has developed NAAQOs, which are health-based air quality objectives for pollutant concentrations in outdoor air. NAAQOs have been developed for CO, NO_2 and SO_2 (CCME 1999). Three levels of NAAQOs have been established, 1) maximum desirable levels (long-term goal for air quality and a basis for an anti-degradation policy for the unpolluted parts of the country and for the continuing development of control technology), 2) maximum acceptable levels (intended to provide adequate protection against adverse effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well-being), and 3) maximum tolerable levels (air contaminant concentrations that require mitigation to avoid further deterioration to an air quality that endangers the prevailing Canadian lifestyle, or that pose a substantial risk to human health) (Health Canada 1994).

Agency for Toxic Substances and Disease Registry

The ATSDR derives MRLs (ATSDR 2014) for non-carcinogenic health effects based on data that identify the target organ(s) of effect and/or the most sensitive health effect(s) for a specific duration and route of exposure to the substance. The ATSDR generally uses the NOAEL/UF approach to derive MRLs. Physiologically based pharmacokinetic modelling and BMD modelling have also been used in deriving MRLs. The MRLs are set below levels that may cause adverse health effects in the sensitive subpopulations of people. The chronic MRLs are derived for exposure durations greater than or equal to 365 days.

The MRLs are generally based on the most sensitive substance-induced endpoint considered to be of relevance to humans. The ATSDR applies a protective approach (i.e., application of margins of safety) to address uncertainty, particularly related to people who might be most sensitive (e.g., infants, elderly and nutritionally or immunologically compromised). Supporting documentation was available for the MRLs used in this assessment.

United States Environmental Protection Agency Regional Screening Levels

The US EPA has developed residential air RSLs (US EPA 2015a) for the protection of human health. The RSLs are risk-based concentrations derived from standardized equations combining exposure information assumptions with US EPA toxicity data. The RSLs are considered by the US EPA to be protective for human exposure (including sensitive groups) over a lifetime. Chemical concentrations above the RSL do not automatically constitute a health risk; however, exceeding an RSL suggests that further evaluation of the potential risks is appropriate. The US EPA RSLs for non-carcinogens are based on an HQ of 1.0, and for carcinogens are based on a risk level of 1 in 1,000,000. The carcinogenic RSLs were multiplied by a factor of 10 to adjust to a risk level of 1 in 100,000.

United States Environmental Protection Agency National Ambient Air Quality Standards

The US EPA has developed NAAQS for widespread contaminants that are considered harmful to human health as part of the Clean Air Act (1970). The six criteria contaminants include carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter (PM2.5 and PM10), and sulphur dioxide. A primary and/or secondary standard is set for each of the criteria contaminants. Primary standards are intended to protect sensitive populations, including children, the elderly, and those with pre-disposed respiratory illnesses (e.g., asthma). Secondary standards are intended to be protective of public welfare (e.g., damage to animals, crops, vegetation, and buildings).

World Health Organization

The WHO has developed air quality guidelines that provide a basis for protecting public health from adverse effects of air pollution. The guidelines are intended to provide background information and guidance to governments in making risk management decisions, particularly in setting standards. The guidelines may also be used in planning processes and various kinds of management decisions at a community or regional level. Supporting documentation was provided for all WHO guidelines. The air quality guidelines for non-carcinogens are based on a HQ of 1.0, and for carcinogens, are provided for a cancer risk level of 1 in 100,000.

Ontario Ministry of the Environment

The OMOE has developed AAQC, which may be used in environmental assessments to assess air quality (OMOE 2012). An AAQC is a desirable concentration of a contaminant in air, based on protection against adverse effects on health or the environment. The AAQCs are set with different averaging times (e.g., annual, 24-hour, 1-hour and 10 minutes) appropriate for the effect that they are intended to protect against. The effects considered may be health, odour, vegetation, soiling, visibility, corrosion or other effects.

The OMOE has also developed air quality standards used to assess emissions from all non-mobile sources of air pollution in Ontario. The Ontario air quality standards are generally derived from the AAQC, and are set at levels protective of the natural environment and sensitive populations (e.g., children, the elderly). The OMOE considers available toxicological information and supporting environmental information to establish effects-based air standards based on the limiting or critical effect(s) (health or environmental considerations) of that chemical.

In general, the OMOE air standards for carcinogens are set at an Incremental Lifetime Cancer Risk (ILCR) of one (1) incidence in one million individuals; the OMOE standards were multiplied by a factor of 10 to derive a screening value for a risk level of 1 in 100,000 for the purposes of this screening exercise. Air standards for non-carcinogens are generally derived from reference concentrations (RfC) (chosen based on available peer-reviewed toxicological information and key studies with associated limiting or critical effect[s]). The OMOE air standards for non-carcinogens are set at a target HQ of 1.0.

California Environmental Protection Agency Office of Environmental Health Hazard Assessment

The Cal OEHHA RELs are concentrations of a chemical at or below which adverse non-carcinogenic health effects are not anticipated to occur for a specified exposure duration (Cal OEHHA 2008). The RELs are used in risk assessments to evaluate the potential for adverse non-carcinogenic public health effects from facility emissions or similar localized sources in the Air Toxics Hot Spots Program, and from widespread exposures in the Toxic Air Chemicals program. The REL is an exposure level at or below which adverse non-carcinogenic health effects are not expected to occur in a human population, including sensitive subgroups (e.g., infants and children), exposed to that concentration for a specified duration. Supporting documentation was available for most of the RELs. The chronic RELs for non-carcinogens are based on a HQ of 1.0.

The Cal OEHHA does not develop RELs or air quality guidelines or objectives for carcinogens. Rather, the Cal OEHHA has developed inhalation unit risks (IURs) for use in cancer risk assessments (Cal OEHHA 2009). Cal OEHHA was contacted regarding the use of their inhalation unit risk factors for screening purposes.

Mr. Chris Halm of the California Environmental Protection Agency Air Resources Board indicated that IURs can be adjusted based on an applicable cancer risk level and used as screening values (Halm 2010, pers. comm.). The Cal OEHHA IURs are based on a cancer risk level of 1 in 1,000,000; this level was divided by the IUR and multiplied by a factor of 10 to derive a screening value for a risk level of 1 in 100,000.

Texas Commission on Environmental Quality

The TCEQ has developed chronic ESLs that are used in the air permitting process to evaluate air the effects predicted by dispersion modelling (TCEQ 2015a). The ESLs are used to evaluate the potential for effects to occur as a result of exposure to concentrations of constituents in the air. The long-term ESLs are based on data concerning chronic health and vegetation effects. They are not ambient air standards. If predicted airborne levels of a constituent do not exceed the screening level, adverse health effects are not expected. If predicted ambient levels of constituents in air exceed the screening levels, it does not necessarily indicate a problem but rather triggers a more detailed review.

The TCEQ have developed a guidance document titled, TCEQ Guidelines to Develop Toxicity Factors (TCEQ 2015a), that outlines the approach and methods used to derived the acute and chronic ESLs. The TCEQ chronic ESLs for non-carcinogens are based on an HQ of 0.3, and for carcinogens, the ESLs are based on a risk level of 1 in 100,000. The non-=carcinogenic ESLs were multiplied by a factor of 1.0/0.3 (i.e., 3.333) to adjust to a HQ of 1.0.

Selected Screening Thresholds and Chemical of Potential Concern Screening Process

The available chronic health-based thresholds and the basis of these thresholds are presented in Table 9.1-B-5. The thresholds selected for use in the screening process are bolded and shaded in the table.

COPCs were identified as those substances in the Application Case that both exceeded the chronic inhalation threshold and exhibited a 10% or greater increase above the Base Case concentration at any location.

Comparison to regulatory threshold values was considered to represent a conservative evaluation of the potential for the predicted concentrations to elicit adverse effects. Comparison to 10% above Base Case concentrations was considered to represent a conservative evaluation of whether a measureable Proposed Project-related impact on environmental quality was likely to occur. Given temporal variability, variability in sampling and laboratory methods, and the uncertainty inherent in estimates from air quality models, any predicted increase of less than 10% above Base Case concentrations was considered unlikely to reflect a meaningful Proposed Project-related change in environmental quality.

The predicted Base and Application Case annual air concentrations and results of the screening process are provided in Table 9.1-B-6.

Table 9.1.B-5: Chronic Inhalation Assessment – Air Screening Levels and Guidelines Used in the Chemical Screening Process

Parameter	Carcinogenic/ Non-Carcinogenic	BC MoE Ambient Air Quality Objectives[a]			CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	US EPA RSLs[f],[g],[h],[i]	WHO Guidelines[j],[k]	Others			Toxicological Endpoints and Derivations
		Level A	Level B	Level C	Desirable	Acceptable	Tolerable					OMOE AAQC[l]	Cal OEHHA RELs[m]	TCEQ ESLs[n]	
Acid Gases and Particulate Matter															
Total Suspended Particulates (TSP)	NC	**60**	70	75	**60**	70	-	-	-	-	-	**60**	-	-	**BC MOE**: Supporting documentation not available. **CCME NAAQO**: Supporting documentation not available. **OMOE**: The AAQC is based upon visibility. It is intended to be applied to the geometric mean of the annual measurements.
$PM_{2.5}$	NC	**Provincial Goal = 6[o]** Air Quality Objective = 8 CAAQS = 10			10			-	12	-	10	-	-	-	**BC MOE**: Supporting documentation not available. While the planning goal of 6 µg/m^3 is more conservative, the air quality objective of 8 µg/m^3 is an air management tool used to guide decisions on environmental impact assessments and authorizations, airshed planning efforts and regulatory development (BC MOE 2008; BC Ministry of Healthy Living and Sport [BC MHLS] 2009). BC MOE views the air quality objective as an immediate target for all communities (BC MHLS 2009). The planning goal is a voluntary target used to guide airshed planning efforts and encourage communities to maintain good air quality during economic growth and development (BC MOE 2008; BC MHLS 2009). The $PM_{2.5}$ planning goal of 6 µg/m^3 was conservatively chosen for the air screening in the human health assessment. **CCME NAAQO**: Canadian ambient air quality standard protective of human health and the environment. The standard represents a balance between achieving the best health and environmental protection possible and the feasibility and costs of reducing contaminant emissions. The metric is the 3-year average of the annual average concentrations. **US NAAQS**: Screening level based on annual mean averaged over 3 years for the health protection of "sensitive" populations such as asthmatics, children, and the elderly. **WHO**: This screening level represents the lowest level at which total, cardiopulmonary and lung cancer mortality have been shown to increase with more than 95% confidence in response to long term exposure. The above health effects were reported at concentrations ranging from 11.0 to 29.6 µg/m^3 and 9.0 to 33.5 µg/m^3 in two key studies. WHO determined that health effects can be expected when annual average concentrations are in the range of 11 to 15 µg/m^3. Therefore, a guideline value of 10 µg/m^3 was selected, as it is considered to be less than the mean for the most likely effects.
PM_{10}	NC	-	-	-	-	-	-	-	-	-	**20**	-	-	-	**WHO**: Screening level is based on $PM_{2.5}$ as an indicator. The ratio of $PM_{2.5}$:PM_{10} in developed countries ranges from 0.5 to 0.8. A ratio of 0.5 has been applied to the $PM_{2.5}$ guideline by the WHO to determine the threshold.
Sulphur Dioxide (SO_2)	NC	-	-	-	**30**	60	-	-	-	-	-	55	-	-	**CCME**: The Desirable NAAQO of 30 µg/m^3 is based upon slight chronic effects to natural forests at 21 µg/m^3 on average over a growing season (Linzon 1978; as cited in CCME 1987). The Acceptable NAAQO of 60 µg/m^3 is based upon minimizing the occurrence of chronic effects such as leaf injury in natural forests. **OMOE**: Threshold based on health and vegetation endpoints (supporting documentation not available).

Parameter	Carcinogenic/ Non-Carcinogenic	BC MoE Ambient Air Quality Objectives[a]			CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	US EPA RSLs[f],[g],[h],[i]	WHO Guidelines[j],[k]	Others			Toxicological Endpoints and Derivations
		Level A	Level B	Level C	Desirable	Acceptable	Tolerable					OMOE AAQC[l]	Cal OEHHA RELs[m]	TCEQ ESLs[n]	
Nitrogen Dioxide (NO_2)	NC		60		60	100	-	-	100 (53 ppb)	-	**40**	-	-	-	**BC MOE**: The BC MOE adopts the CCME NAAQO. Threshold is an interim provincial air quality objective. Supporting documentation not available for threshold. **CCME NAAQO**: Supporting documentation not available. **US NAAQS**: Threshold based on a large body of evidence for respiratory effects from exposure to nitrogen oxides. The key clinical studies on human health effects are based on shorter exposure durations (0.5 to 3 hours). The health effects reported include increased airway responsiveness in asthmatics, small decreases in forced vital capacity and forced expiratory volume in one second (FEV_1) with mild exercise in patients with chronic obstructive pulmonary disease, increased airway responsiveness to bronchoconstrictors in healthy adults, and changes in lung function in healthy adults (US EPA 1993). The key epidemiological studies on human health effects indicated increased risk of lower respiratory symptoms/disease in children (aged 5 to 12 years). Exposure to NO_2 in occupational settings was associated with bronchial pneumonia and bronchitis (25 to 100 ppm). In high occupational exposure cases (>200 ppm), effects ranged from hypoxemia/transient airway obstruction to death (US EPA 1993). The NAAQS is a primary and secondary value, which is protective of "sensitive" populations such as asthmatics, children, and the elderly. The NAAQS of 53 ppb was converted to $\mu g/m^3$ using a molecular weight of 46.01 g/mol. **WHO**: Threshold based on a health endpoint. Epidemiological studies show that reduced lung function in children is linked to elevated NO_2 concentrations within communities already at current North American and European urban ambient air levels. Studies indicated that a 28.2 $\mu g/m^3$ increase in nitrogen dioxide is associated with a 20% increase in the odds of lower respiratory symptoms (International Programme on Chemical Safety 1997). World Health Organization states that there is still no robust basis for setting a guideline value based on any direct toxic effect. The threshold was set based on a meta-analysis of indoor air studies; however there is evidence to indicate that there are health effects at the current threshold. The WHO states that the extent to which observed health effects in studies are attributable to NO_2 itself is still unknown.

Parameter	Carcinogenic/ Non-Carcinogenic	BC MoE Ambient Air Quality Objectives[a]			CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	US EPA RSLs[f],[g],[h],[i]	WHO Guidelines[j],[k]	Others			Toxicological Endpoints and Derivations
		Level A	Level B	Level C	Desirable	Acceptable	Tolerable					OMOE AAQC[l]	Cal OEHHA RELs[m]	TCEQ ESLs[n]	
Metals															
Aluminum	NC	-	-	-	-	-	-	-	-	**5.2**	-	-	-	6.7 (2)	**US EPA (PPRTV)**: Threshold based on a provisional reference concentration (RfC) of 0.005 mg/m^3 for neurotoxic effects (psychomotor and cognitive impairment) in occupationally exposed workers (US EPA 2006). Workers were exposed to a time-weighted average concentration of 4.6 to 11.5 mg/m^3 for an average of 12 years. The LOAEL of 4.6 mg/m^3 based on an 8-hour exposure was adjusted for continuous exposure and corrected for a human equivalent concentration (HEC). The $LOAEL_{HEC}$ is 1.64 mg/m^3. An uncertainty factor of 300 (10 for intrahuman variability, 10 for using a LOAEL and 3 for an incomplete database) was applied. A residential scenario exposure factor was applied to the RfC to derive the screening level.
															TCEQ: Threshold based on a health endpoint (supporting documentation not available). The threshold of 2 µg/m^3 is based on aluminum chloride in PM_{10} and is considered to be appropriate for the Project, given that aluminum may be emitted in carbonate, chloride or nitrate forms. The TCEQ also provides a threshold of 5 µg/m^3 for aluminum metals and soluble aluminum salts in PM_{10}; however the more conservative value of 2 µg/m^3 was chosen for screening.
Antimony	NC	-	-	-	-	-	-	-	-	**0.21**	-	-	-	1.7 (0.5)	**US EPA (IRIS)**: Threshold based on a reference concentration (RfC) of 0.0002 mg/m^3 for antimony trioxide, based on pulmonary toxicity and chronic interstitial inflammation in rats exposed to antimony trioxide for 6 hours/day, 5 days/week for 1 year. The NOAEL was 0.51 mg/m^3 and the NOAEL adjusted for a human equivalent concentration ($NOAEL_{HEC}$) was 0.042 mg/m^3. A benchmark concentration corresponding to the lower 10% incidence of effect (BMC_{10}) of 0.87 mg/m^3 and a human equivalent concentration (BMC_{HEC}) of 0.074 mg/m^3 were calculated. An uncertainty factor of 300 (10 to protect sensitive human subpopulations, 3 for interspecies extrapolation, 3 for database inadequacies, and 3 to account for a less-than-lifetime exposure duration) was applied to the BMC_{HEC}. A residential scenario exposure factor was applied to the RfC to derive the screening level.
															TCEQ: Threshold based on a health endpoint (supporting documentation not available), as antimony in PM_{10}.

Parameter	Carcinogenic/ Non-Carcinogenic	BC MoE Ambient Air Quality Objectives[a]			CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	US EPA RSLs[f],[g],[h],[i]	WHO Guidelines[j],[k]	Others			Toxicological Endpoints and Derivations
		Level A	Level B	Level C	Desirable	Acceptable	Tolerable					OMOE AAQC[l]	Cal OEHHA RELs[m]	TCEQ ESLs[n]	
Arsenic	NC	-	-	-	-	-	-	-	-	**0.016**	-	-	0.015	-	**US EPA**: Threshold based on a Cal OEHHA reference concentration (RfC), and a residential scenario exposure factor was applied to the RfC to derive the screening level. **Cal OEHHA**: Threshold based on decrease in intellectual function and adverse effects on neurobehavioural development in humans. An inhalation dose was estimated from an oral dose (drinking water) to give a value of 0.46 µg/m^3. An uncertainty factor of 30 (3 for estimating a LOAEL based on quantitative dose-response analysis and 10 for inter-individual variation) was used.
	C	-	-	-	-	-	-	-	-	**0.0065 (0.00065)**	0.0066	-	0.003	0.067	**US EPA (RSL)**: Screening level based on an inhalation unit risk (IUR) of 4.29 per µg/m^3 based on lung cancer in occupationally-exposed male workers. The risk-based concentration for a cancer risk of 1 in 100,000 is 0.002 µg/m^3. A residential scenario exposure factor was applied to the risk-based concentration to derive the screening level. **WHO**: Screening level based on an estimated incremental lifetime cancer risk of 1 in 100,000 at an air concentration of 0.0066 µg/m^3 and an inhalation unit risk (IUR) of 0.0015 per µg/m^3, derived from lung cancer incidences in exposed workers at metal smelters. **Cal OEHHA**: Screening level based on an inhalation unit risk (IUR) of 0.0033 per µg/m^3 based on lung tumour incidence in occupationally-exposed workers and an incremental lifetime cancer risk of 1 in 100,000. **TCEQ**: Screening level based on respiratory and lung cancer in occupational workers. The threshold is based on an inhalation unit risk (IUR) of 0.00015 per µg/m^3 and an incremental lifetime cancer risk of 1 in 100,000.
Barium	NC	-	-	-	-	-	-	-	-	**0.52**	-	-	-	1.7 (0.5)	**US EPA (RSL)**: Screening level based a reference concentration (RfC) of 0.5 µg/m^3 based on a reproductive study in rats exposed for four months via inhalation (US EPA 1997). The NOAEL was 0.8 mg/m^3, adjusted for continuous exposure, and an uncertainty factor of 1,000 was applied (to derive an RfC of 0.5 µg/m^3). A residential scenario exposure factor was applied to the RfC to derive the screening level. **TCEQ:** Threshold based on a health endpoint (interim, supporting documentation not available), as barium and compounds in PM_{10}.

Parameter	Carcinogenic/ Non-Carcinogenic	BC MoE Ambient Air Quality Objectives[a]			CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	US EPA RSLs[f],[g],[h],[i]	WHO Guidelines[j],[k]	Others			Toxicological Endpoints and Derivations
		Level A	Level B	Level C	Desirable	Acceptable	Tolerable					OMOE AAQC[l]	Cal OEHHA RELs[m]	TCEQ ESLs[n]	
Beryllium	NC	-	-	-	-	-	-	-	-	**0.021**	-	-	0.007	0.0067 (0.002)	**US EPA (RSL)**: Screening level based on beryllium sensitization and progressing to chronic beryllium disease in an occupational study of beryllium and compounds (US EPA 2015b). The human equivalent concentration (HEC) of the lowest observed adverse effect level ($LOAEL_{HEC}$) was 0.2 µg/m^3 and an uncertainty factor of 10 (1 for sensitive individuals in the population, 1 for less than chronic exposure duration, 3 for the sensitive nature of a subclinical endpoint and 3 for database uncertainty to account for the poor quality of exposure monitoring) was applied to derive the reference concentration (RfC) of 0.02 µg/m^3. A NOAEL was not identified in the key study given that exposures for the workers that developed chronic beryllium disease were not statistically different from the workers that did not develop the disease. However, a community exposure study evaluating 11 cases of chronic beryllium disease identified a NOAEL ranging from 0.01 to 0.1 µg/m^3 (US EPA 2015b). The study identifying the LOAEL was used as the basis of the RfC given that the screening method used that in study was more sensitive than that used in the study identifying the NOAEL. A residential scenario exposure factor was applied to the RfC of 0.02 µg/m^3 to derive the screening level. **Cal OEHHA**: Threshold based on beryllium-sensitized (chronic beryllium disease) workers in a ceramics plant, which was the same key study used in the US EPA reference concentration (RfC). However, Cal OEHHA identified the LOAEL as the median exposure concentration of the sensitized workers of 0.55 µg/m^3. Cal OEHHA did not identify a NOAEL. The LOAEL was adjusted by the average experimental exposure to a human equivalent concentration (HEC) of 0.2 µg/m^3. An uncertainty factor of 30 (10 for use of a LOAEL and 3 for intraspecies differences) was applied to 0.2 µg/m^3. Cal OEHHA typically uses an uncertainty factor of 3 to account for use of a LOAEL instead of a NOAEL. However, because chronic beryllium disease is serious, chronic, disabling, usually irreversible, and often fatal (Newman et al. 1997; as cited in Cal OEHHA 2013), Cal OEHHA has applied a higher uncertainty factor to account for the use of a LOAEL. **TCEQ:** Threshold based on a health endpoint (interim, supporting documentation not available), as PM_{10}.
	C	-	-	-	-	-	-	-	-	**0.012 (0.0012)**	-	-	0.0042	-	**US EPA (RSL)**: Screening level based on an inhalation unit risk (IUR) of 0.0024 per µg/m^3 related to an increased incidence of lung cancer in workers. The risk-based concentration for a cancer risk of 1 in 100,000 is 0.0042 µg/m^3. A residential scenario exposure factor was applied to the risk-based concentration to derive the screening level. **Cal OEHHA**: Based on an inhalation unit risk (IUR) of 0.0024 per µg/m^3, based on lung cancer in beryllium processing workers. The risk-based concentration for a cancer risk of 1 in 100,000 is 0.0042 µg/m^3.
Bismuth	NC	-	-	-	-	-	-	-	-	-	-	-	-	**16.7 (5)**	**TCEQ**: Threshold derived based on health effects for bismuth and compounds, supporting documentation not available.

Parameter	Carcinogenic/ Non-Carcinogenic	BC MoE Ambient Air Quality Objectives[a]			CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	US EPA RSLs[f],[g],[h],[i]	WHO Guidelines[j],[k]	Others			Toxicological Endpoints and Derivations
		Level A	Level B	Level C	Desirable	Acceptable	Tolerable					OMOE AAQC[l]	Cal OEHHA RELs[m]	TCEQ ESLs[n]	
Cadmium	NC	-	-	-	-	-	-	0.01	-	0.01	**0.005**	0.005	0.02	0.033 (0.01)	**ATSDR**: Threshold based on a urinary cadmium level associated with 10% extra risk of low molecular weight proteinuria (ATSDR 2012a). A urinary cadmium dose corresponding to a 10% excess risk of low molecular proteinuria of 0.5 µg/m^3 creatinine was calculated from three occupational exposure studies and used as the point of departure (POD). It was estimated that an exposure of 0.1 µg/m^3 in air and 0.3 µg/kg/day in diet would result in urinary cadmium level of 0.5 µg/m^3 creatinine. The inhalation concentration was divided by an uncertainty factor of 9 (3 for human variability and 3 as a modifying factor). **US EPA (RSL)**: Screening level derived from a Cal OEHHA REL. A residential scenario exposure factor was applied to the REL to derive the screening level. **WHO**: Threshold based on data collected in industrial workers with lung cancer and renal effects. Cadmium exposure may result in various renal alterations, whether it is absorbed via inhalation or contaminated food. World Health Organization (2000) indicated that the lowest estimate of the cumulative exposure to airborne cadmium in industrial workers leading to an increased risk of renal dysfunction (low-molecular-weight proteinuria) or lung cancer was 100 µg/m^3-year for an 8-hour exposure, and this was extrapolated to a continuous lifetime exposure estimate of 0.3 µg/m^3. World Health Organization (2000) indicated that existing levels of cadmium in the air of most urban or industrial areas are around one-fiftieth of this value. The threshold was derived to prevent a further increase of cadmium in agricultural soils, which is likely to increase exposure to future generations through dietary intake. **OMOE**: Threshold based on kidney effects and carcinogenicity (OMOE 2007b). Overall, the selection of the final annual AAQC of 0.005 µg/m^3 is described by WHO above, but it is noted that OMOE has considered the extrapolated continuous lifetime exposure estimate of 0.3 µg/m^3 to be representative of a NOAEL, and that an uncertainty factor of 10 for intraspecies variability and a modifying factor of 5 to address carcinogenicity are appropriate. It is also noted that this AAQC is applicable to cadmium in total suspended particulates and not just PM_{10}, as the AAQC considers potential deposition onto agricultural soils and subsequent dietary exposure. **Cal OEHHA**: Threshold based on kidney and respiratory system effects in an occupational study. A LOAEL of 21 µg/m^3 and a NOAEL of 1.4 µg/m^3 were identified. Cal OEHHA derived an average occupational exposure concentration of 0.5 µg/m^3 and assumed exposure occurred 5 days per week, 8 hours per day with an average exposure duration of 4.1 years. The NOAEL was converted to an average occupational exposure of 0.5 µg/m^3 and an uncertainty factor of 30 (3 for use of a subchronic study and 10 for intraspecies uncertainty) was applied. **TCEQ:** Threshold based on a health endpoint (interim, supporting documentation not available), as cadmium and compounds in PM_{10}.

Parameter	Carcinogenic/ Non-Carcinogenic	BC MoE Ambient Air Quality Objectives[a]			CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	US EPA RSLs[f],[g],[h],[i]	WHO Guidelines[j],[k]	Others			Toxicological Endpoints and Derivations
		Level A	Level B	Level C	Desirable	Acceptable	Tolerable					OMOE AAQC[l]	Cal OEHHA RELs[m]	TCEQ ESLs[n]	
	C	-	-	-	-	-	-	-	-	**0.016 (0.0016)**	-	-	0.0024	-	**US EPA (RSL)**: Screening level based on an inhalation unit risk (IUR) of 0.0018 per µg/m^3 for lung, trachea and bronchus cancer deaths in occupational exposure studies. An incremental lifetime cancer risk of 1 in 100,000 was used to convert the IUR to a risk-based concentration of 0.0056 µg/m^3, and a residential scenario exposure factor was applied to the risk-based concentration to derive the screening level. **Cal OEHHA**: Screening criteria based on human occupational exposure lung cancer data; an inhalation unit risk (IUR) of 0.0042 per µg/m^3 was derived and an incremental lifetime cancer risk of 1 in 100,000 was used to convert the IUR to a screening value.
Chromium	NC	-	-	-	-	-	-	-	-	**0.1**	-	-	0.2	Cr(III) = 0.14 (0.041) Cr(VI) = 0.22 (0.066)	**US EPA**: Threshold based on a reference concentration (RfC) of 0.0001 mg/m^3 for lower respiratory effects (lactate dehydrogenase in bronchioalveolar lavage fluid) in rats following inhalation of Cr(VI) particulates, and using a benchmark concentration (BMC) approach. The BMC was 0.016 mg/m^3. The regional deposited dose ratio (RDDR) of 2.1576 was applied to account for differences in the deposition pattern of inhaled Cr(VI) dusts in the respiratory tract of humans and Wistar rat test animals. An uncertainty factor of 300 was applied (10 to account for variation in the human population, 10 to account for using a subchronic study rather than a chronic study, and 3 to account for pharmacodynamic differences not accounted for by the RDDR) [0.016 mg/m^3 x 2.1576 / (300)]. A residential scenario exposure factor was applied to the reference concentration (RfC) to derive the screening level. **Cal OEHHA**: Threshold applies to soluble hexavalent chromium compounds other than chromic trioxide. Sodium dichromate aerosol was inhaled by rats for 22 hours/day, 7 days/week for 90 days. The health effect observed was bronchoalveolar hyperplasia. The LOAEL identified in the study was 50 µg/m^3 and a NOAEL was not observed. The BMC_{05} (the concentration calculated to be associated with a 5% incidence of effect) was 12.50 µg/m^3 and adjusted to a human equivalent concentration (HEC) of 24.47 µg/m^3 and an uncertainty factor of 100 (3 for subchronic uncertainty, 3 for interspecies uncertainty and 10 for intraspecies uncertainty) was applied.

Parameter	Carcinogenic/ Non-Carcinogenic	BC MoE Ambient Air Quality Objectives[a]			CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	US EPA RSLs[f],[g],[h],[i]	WHO Guidelines[j],[k]	Others			Toxicological Endpoints and Derivations
		Level A	Level B	Level C	Desirable	Acceptable	Tolerable					OMOE AAQC[l]	Cal OEHHA RELs[m]	TCEQ ESLs[n]	
															TCEQ: Cr(III): Threshold based on a study where rats were exposed to 0, 17, 54, or 168 mg/m^3 chromic sulphate particulate for 6 hours/day, 5 days/week for 13 weeks (Derelanko et al. 1999; as cited in TCEQ 2009a). The critical effects were increased total lung and trachea weight relative to body weight in male and female rats. The benchmark concentration lower confidence limit corresponding to a 10% increase in effect ($BMCL_{10}$) was 3.45 mg/m^3. The $BMCL_{10}$ was adjusted for continuous exposure (6 hours/24 hours and 5 days/7 days) and a regional deposition dose ratio (of 1.31, resulting in a point of departure [human equivalent concentration]) (POD_{HEC}) of 0.81 mg/m^3. An uncertainty factor of 1,000 for interspecies variability (3), intraspecies variability (10), subchronic duration (10), and database deficiencies (3) was applied. The threshold (0.81 µg/m^3) was then adjusted to an HQ = 0.3, by dividing the value of 0.14 µg/m^3 by 3.3, resulting in a value of 0.041 µg/m^3. **TCEQ**: Cr(VI): Threshold based on NOAEL of 25 µg/m^3 for no observed increase in relative lung weight in rats exposed to 25, 50, 100, or 200 µg Cr(VI)/m^3, as sodium dichromate, for 22 hours/day, 7 days/week for 90 days (Glaser et al. 1985; as cited in TCEQ 2014). The NOAEL was not adjusted for continuous exposure because the exposure duration in the study closely resembled continuous exposure. An uncertainty factor of 270 (3 for interspecies variation, 10 for intraspecies variation, 3 for extrapolation from sub-chronic to chronic exposure, and 3 for database deficiencies) was applied to the point of departure [human equivalent concentration]) (POD_{HEC}) of 60.25 µg Cr(VI)/m^3. The resulting threshold of 0.22 µg/m^3 was based on a HQ = 1.0. The screening level was derived by adjusting to an HQ = 0.3, by dividing the value of 0.22 µg/m^3 by 3.3, resulting in a value of 0.066 µg/m^3.
	C	-	-	-	-	-	-	-	-	**0.00012 (0.000012)**	0.00025	0.0007	0.000067	0.0043	**WHO:** Screening criteria derived from exposed workers to Cr(VI) assuming a linear dose-response relationship between exposure and lung cancer. An inhalation unit risk (IUR) of 0.04 per µg/m^3 was derived from the geometric mean of cancer risk estimates from several occupational studies (epidemiological data sets range from 0.011 to 0.13 per µg/m^3 for a lifetime exposure). The IUR was converted to a screening threshold using an incremental lifetime cancer risk of 1 in 100,000. **OMOE:** Screening level is based on lung cancer mortality in occupationally-exposed workers. The inhalation unit risks (IURs) reported in two epidemiological studies were 3.96x10^{-2} per µg/m^3 (Gibb et al. 2000; as cited in OMOE 2011a) and 9.15x10^{-3} per µg/m^3 (Luippold et al. 2003; as cited in OMOE 2011a). The IURs were converted to screening thresholds using the following equation: threshold (µg/m^3) = target risk/IUR, where target risk = 1x10^{-6}. The average of the exposure range associated with a 1x10^{-6} cancer risk (2.5x10^{-5} µg/m^3 to 1.1x10^{-4} µg/m^3) was selected as the threshold of 0.00007 µg/m^3. The threshold was adjusted for a cancer risk of 1 in 100,000 to 0.0007 µg/m^3. The threshold is applicable to chromium in the PM_{10} size fraction based on the potential for lung deposition, retention and ultimately lung carcinogenicity.

Parameter	Carcinogenic/ Non-Carcinogenic	BC MoE Ambient Air Quality Objectives[a]			CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	US EPA RSLs[f],[g],[h],[i]	WHO Guidelines[j],[k]	Others			Toxicological Endpoints and Derivations
		Level A	Level B	Level C	Desirable	Acceptable	Tolerable					OMOE AAQC[l]	Cal OEHHA RELs[m]	TCEQ ESLs[n]	
															US EPA: Screening level based on an inhalation unit risk (IUR) of 1.2 x 10^{-2} per µg/m^3, which is based on lung cancer mortality in a cohort of chromate workers. The IUR is based on an assumed 1:6 ratio of Cr(VI):Cr(III). **Cal OEHHA**: Screening level based on an inhalation unit risk (IUR) of 0.15 per µg/m^3 and an incremental lifetime cancer risk of 1 in 100,000. The health effects identified were lung cancer mortality in humans occupationally exposed to Cr(VI). **TCEQ**: Screening level based on an inhalation unit risk (IUR) of 2.3 x 10^{-3} per µg Cr(VI)/m^3 (for a risk level of 1 in 100,000) for lung cancer mortality in humans. The IUR was derived by weighting the IURs from two studies (Crump et al. 2003 and Gibb et al. 2000; as cited in TCEQ 2014). A weight of 44.4% was given to the Crump et al. 2003 study, from which an IUR of 1.94 x 10^{-3} was selected, and a weight of 55.6% was given to the Gibb et al. (2000; as cited in TCEQ 2014) study, from which an IUR of 2.56 x 10^{-3} was selected. The IUR was converted to a threshold of 0.0043 µg/m^3 using an incremental lifetime cancer risk of 1 in 100,000.
Cobalt	NC	-	-	-	-	-	-	0.1	-	**0.0063**	-	-	-	0.067 (0.02)	**ATSDR**: Threshold based on a decrease in pulmonary function in occupationally-exposed workers (ATSDR 2004; same key study was used in US EPA 2008). The NOAEL was 5.3 µg/m^3 and adjusted for continuous exposure (1.3 µg/m^3) and an uncertainty factor of 10 (for human variability) was applied. **US EPA (PPRTV)**: Threshold based on a provisional reference concentration (RfC) of 0.006 mg/m^3 based on decreased pulmonary function and respiratory tract irritation in occupationally-exposed workers (US EPA 2008). A NOAEL of 5.3 µg/m^3 was identified and adjusted for continuous exposure (1.9 µg/m^3). An uncertainty factor of 300 (3 for extrapolating from a subchronic to chronic exposure duration, 10 for database insufficiencies and 10 for human variability) was applied to derive a provisional RfC of 0.006 µg/m^3. A residential scenario exposure factor was applied to the RfC to derive the screening level. **TCEQ:** Threshold based on a health endpoint (interim, supporting documentation not available), as cobalt and inorganic cobalt compounds in PM_{10}.
	C	-	-	-	-	-	-	-	-	**0.0031 (0.00031)**	-	-	-	-	**US EPA**: Screening level based on a 2 year rat study where adenoma and carcinoma of the lung was observed. An inhalation unit risk (IUR) of 9 per mg/m^3 and an incremental lifetime cancer risk of 1 in 100,000 was used to derive a risk-based concentration of 0.0011 µg/m^3. A residential scenario exposure factor was applied to the risk-based concentration to derive the screening level.
Copper	NC	-	-	-	-	-	-	-	-	-	-	-	-	**3.3 (1)**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), as copper dusts and mists in PM_{10}.
Iron	NC	-	-	-	-	-	-	-	-	-	-	-	-	**3.3 (1)**	**TCEQ**: Threshold based on health effects (interim, supporting documentation not available), as iron soluble salts.

Parameter	Carcinogenic/ Non-Carcinogenic	BC MoE Ambient Air Quality Objectives[a]			CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	US EPA RSLs[f],[g],[h],[i]	WHO Guidelines[j],[k]	Others			Toxicological Endpoints and Derivations
		Level A	Level B	Level C	Desirable	Acceptable	Tolerable					OMOE AAQC[l]	Cal OEHHA RELs[m]	TCEQ ESLs[n]	
Lead	NC	-	-	-	-	-	-	-	**0.15 (3 months)**	**0.15 (3 months)**	0.5	-	-	-	**US NAAQS**: Threshold is a rolling 3-month average based on neurological effects (decrease of less than 2 IQ points) in children, and the potential for cardiovascular and renal effects in adults. An air concentration of less than 0.15 µg/m^3 of lead would correspond to a blood lead concentration of approximately 1 µg/dL which leads to less than a 2 IQ point decrease in American children based on an air-to-blood ratio of 1:7. **US EPA**: The US EPA adopted the US NAAQS as the regional screening level for lead and compounds. **WHO**: Threshold based on preventing blood lead levels exceeding 100 µg/L to protect 98% of the population including children. Various international expert groups have determined that the earliest signs of adverse effects of lead in young children begin at 100 to 150 µg/L in blood. It also appears that 1 µg/m^3 of lead in air directly contributes approximately 19 µg/L of lead in blood in children and 16 µg/L in adults.
Lithium	NC	-	-	-	-	-	-	-	-	-	-	-	-	**0.67 (0.2)**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available) as elemental lithium and inorganic lithium compounds in PM_{10}.
Manganese	NC	-	-	-	-	-	-	0.3	-	**0.052**	0.15	-	0.09	0.67 (0.2)	**ATSDR**: (For respirable manganese) Threshold based on abnormal performances in eye-hand coordination in an occupational study. The exposure was determined for each employee based on their jobs and the length of time they had worked at the factory. On average, workers were exposed for an average of 5.3 years to an average concentration of respirable manganese of 0.25 mg/m^3. The benchmark concentration lower confidence limit corresponding to a 10% incidence of effect ($BMCL_{10}$) of 142 µg/m^3 was adjusted for continuous exposure and then an uncertainty factor of 100 was applied (10 for human variability and 10 for database deficiencies). **US EPA**: Threshold based on a reference concentration (RfC) of 0.05 µg/m^3 for impairment of neurobehavioural function in occupationally-exposed workers. A NOAEL was not available because a single geometric mean exposure concentration was calculated for this cross-sectional study and effects were observed in workers who had been exposed. The LOAEL was 150 µg/m^3 and the LOAEL adjusted for a human equivalent concentration ($LOAEL_{HEC}$) was 50 µg/m^3. An uncertainty factor of 1,000 (10 to protect sensitive individuals, 10 for using a LOAEL and 10 for database limitations) was applied. A residential scenario exposure factor was applied to the RfC to derive the screening level. **WHO:** Threshold based on neurotoxic effects observed in occupationally-exposed workers and an estimated NOAEL of 30 µg/m^3. The threshold was derived using a benchmark approach and by dividing by a factor of 4.2 for continuous exposure and an uncertainty factor of 50 (10 for interindividual variation and 5 for developmental effects in younger children).

Parameter	Carcinogenic/ Non-Carcinogenic	BC MoE Ambient Air Quality Objectives[a]			CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	US EPA RSLs[f],[g],[h],[i]	WHO Guidelines[j],[k]	Others			Toxicological Endpoints and Derivations
		Level A	Level B	Level C	Desirable	Acceptable	Tolerable					OMOE AAQC[l]	Cal OEHHA RELs[m]	TCEQ ESLs[n]	
															Cal OEHHA: Threshold based on impairment of neurobehavioral function in humans (occupational study) for manganese and compounds. A benchmark concentration lower confidence limit corresponding to a 5% response ($BMCL_{05}$) of 72 µg/m^3 was obtained and adjusted for continuous exposure, resulting in a value of 26 µg/m^3. An uncertainty factor of 300 (3 for subchronic to chronic conversion, 100 for intraspecies differences [10 for adults to children and 10 for the more sensitive developing brains of newborns and infant children]) was used to derive the REL.
															TCEQ: Threshold based on a health endpoint (interim, supporting documentation not available), as manganese dust and inorganic compounds in PM_{10}.
Mercury	NC	-	-	-	-	-	-	**0.2**	-	0.31	1	-	0.03	0.083 (0.025)	**ATSDR**: Threshold based on neurological effects (hand tremors) in 26 male workers exposed to metallic mercury for an average of 15.3±2.6 years (ATSDR 1999b). A NOAEL was not observed in this study as a single mean concentration was calculated from personal air monitors of workers and effects were identified in workers. A LOAEL of 0.026 mg/m^3 associated with an increased frequency of hand tremors was determined and adjusted for continuous exposure (by multiplying 5/7 days and 8/24 hour = 0.0062 mg/m^3). An uncertainty factor of 30 (3 for using a LOAEL and 10 for human variability) was applied.
															US EPA: Threshold based on a reference concentration (RfC) of 0.0003 mg/m^3 for hand tremors, increases in memory disturbance and central nervous system effects in occupational workers. A NOAEL was not observed in this study as a single mean concentration was calculated from personal air monitors of workers and effects were identified in workers. A LOAEL of 0.025 mg/m^3 was calculated as a time weighted average and adjusted using occupational ventilation rates and workweek hours to a LOAEL of 0.009 mg/m^3. An uncertainty factor of 30 (10 to protect sensitive individuals and 3 for a lack of a database) was used. A residential scenario exposure factor was applied to the RfC to derive a screening level.
															WHO: Threshold based on the LOAELs for mercury vapour (15 to 30 µg/m^3, tremors, renal tubular effects, and changes in plasma enzymes) and applying an uncertainty factor of 20 (10 for uncertainty in variable sensitivities in higher risk populations and 2 for extrapolating from LOAEL to NOAEL).
															Cal OEHHA: Threshold based on neurotoxicity as measured by tremor, memory and sleep disturbances, decreased performance on neurobehavioural tests and decreased electroencephalography activity in occupational studies. Humans were exposed to mercury for 8 hours/day, 5 days/week for 13.7 to 15.6 years. A NOAEL was not observed as only a single exposure concentration was assessed and effects were seen at this level. A LOAEL of 0.025 mg/m^3 was adjusted for continuous exposure (0.0009 mg/m^3) and an uncertainty factor of 300 (10 for neurotoxicity being a moderate to severe effect, 3 to reflect interindividual variability and 10 for the higher susceptibility of the developing nervous system) was applied to derive the threshold.

Parameter	Carcinogenic/ Non-Carcinogenic	BC MoE Ambient Air Quality Objectives[a]			CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	US EPA RSLs[f],[g],[h],[i]	WHO Guidelines[j],[k]	Others			Toxicological Endpoints and Derivations
		Level A	Level B	Level C	Desirable	Acceptable	Tolerable					OMOE AAQC[l]	Cal OEHHA RELs[m]	TCEQ ESLs[n]	
															TCEQ: Threshold based on a health endpoint (interim, supporting documentation not available) as metallic mercury and inorganic mercury forms in PM_{10}.
Molybdenum	NC	-	-	-	-	-	-	-	-	-	-	-	-	**10 (3)**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available).
Nickel	NC	-	-	-	-	-	-	0.09	-	**0.015**, 0.094, 0.021	-	0.02	0.014	0.23 (0.07)	**ATSDR**: Threshold based on chronic active inflammation and lung fibrosis in rats exposed to nickel sulphate hexahydrate (6 hours/day, 5 days/week for 2 years, ATSDR 2005). The NOAEL was 0.03 mg/m^3 and adjusted for continuous exposure (5/7 days and 6/24 hours = 0.0054 mg/m^3) and to a human equivalent concentration (HEC) (0.0027 mg/m^3). An uncertainty factor of 30 (3 for animal to human extrapolation and 10 for human variability) was applied to derive the threshold.
															US EPA: For nickel refinery dust and nickel subsulphide (regional screening level [RSL] of 0.015 $\mu g/m^3$), the threshold is based on a Cal OEHHA REL of 0.014 $\mu g/m^3$ (see below). A residential scenario exposure factor was applied by US EPA to derive a screening level. For nickel soluble salts (RSL of 0.094 $\mu g/m^3$), the threshold is based on a chronic ATSDR minimal risk level of 0.09 $\mu g/m^3$ (see below). US EPA applied a residential scenario exposure factor to the ATSDR minimal risk level to derive a screening level. For nickel oxide (RSL of 0.021 $\mu g/m^3$), the threshold is based on a Cal OEHHA REL derivation for nickel oxide. Health effects (active pulmonary inflammation and alveolar proteinosis) were observed in mice following exposure to nickel oxide for 6 hours/day, 5 days/week for 104 weeks. A benchmark concentration lower confidence limit corresponding to a 5% response ($BMCL_{05}$) of 117 $\mu g/m^3$ was obtained and adjusted for continuous exposure, resulting in a value of 20.9 $\mu g/m^3$. This value was then adjusted to a human equivalent concentration (HEC) of 2.0 $\mu g/m^3$. An uncertainty factor of 100 (3 for interspecies variability and 30 for intraspecies variability) was applied to derive an inhalation REL of 0.02 $\mu g/m^3$. A residential scenario exposure factor was applied by US EPA to derive a screening level.
															OMOE: Threshold for nickel as PM_{10}, that is protective of carcinogenic and non-carcinogenic effects. The critical carcinogenic effects were lung and nasal cancer while the critical non-cancer effect was respiratory effects (OMOE 2011b). The OMOE threshold is based on the Scientific Committee for Toxicity, Ecotoxicity and Environment working group (part of the European Commission for Health and Consumer Protection) recommended value. Based on the European Commission's decision, the lower end of the annual mean total airborne nickel concentration range of 10 to 50 ng/m^3 (lung fibrosis from a US National Toxicology Program study with nickel sulphate) was chosen, but because soluble nickel (a contributor to the non-cancer respiratory effects) does not appear to constitute more than 50% of the total airborne nickel concentration, a value of 20 ng/m^3 was chosen.
															Cal OEHHA: Threshold based on pathological changes in lung, lymph nodes and nasal epithelium in rats exposed to nickel and nickel compounds (except nickel oxide) for 6 hours/day, 5

Parameter	Carcinogenic/ Non-Carcinogenic	BC MoE Ambient Air Quality Objectives[a]			CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	US EPA RSLs[f],[g],[h],[i]	WHO Guidelines[j],[k]	Others			Toxicological Endpoints and Derivations
		Level A	Level B	Level C	Desirable	Acceptable	Tolerable					OMOE AAQC[l]	Cal OEHHA RELs[m]	TCEQ ESLs[n]	
															days/week for 104 weeks. The benchmark dose level corresponding to a 5% response level ($BMDL_{05}$) was 30.5 µg/m^3 and the human equivalent concentration ($BMDL_{HEC05}$) was 1.4 µg/m^3. An uncertainty factor of 100 (3 for interspecies differences and 30 for intraspecies differences) was applied.
															TCEQ: Threshold based on chronic active lung inflammation and associated lesions in rats exposed to nickel sulphate hexahydrate for 6 hours/day, 5 days/week for 2 years (NTP 1996c; as cited in TCEQ 2011). The NOAEL/point of departure (POD) was 0.03 mg nickel/m^3, the POD adjusted for continuous exposure was 5.357 µg nickel/m^3 and the human equivalent concentration (HEC) was 7.034 µg/m^3. An uncertainty factor of 30 (3 for interspecies variability and 10 for intraspecies variability) was applied.
	C	-	-	-	-	-	-	-	-	0.12 (0.012); 0.11 (0.011); 0.058 (0.0058)	**0.025**	0.2 (0.02)	0.038	0.059	**US EPA**: Screening level for nickel refinery dust (RSL of 0.12 µg/m^3) is based on an inhalation unit risk (IUR) of 0.00024 per µg/m^3 which was derived from several epidemiological studies (excess lung cancer mortality in four studies of nickel refinery workers). The risk-based concentration for a cancer risk of 1 in 100,000 is 0.042 µg/m^3. A residential scenario exposure factor was applied to the risk-based concentration to derive the screening level. Threshold for nickel soluble salts (RSL of 0.11 µg/m^3) is based on an IUR of 0.00026 per µg/m^3 from Cal OEHHA (see below). A residential scenario exposure factor was applied to the risk-based concentration to derive the screening level. Threshold for nickel subsulphide (RSL of 0.058 µg/m^3) is based on an IUR of 0.00048 per µg/m^3, which was based on excess lung cancer mortality observed in four (4) studies of workers exposed to nickel compounds. The IUR was the incremental unit risk estimate of nickel refinery dust (2.4 x 10^{-4} per µg/m^3) used with a multiplication factor of 2.0 to account for a nickel subsulphide composition of about 50% in the refinery dust. The risk-based concentration for a cancer risk of 1 in 100,000 is 0.021 µg/m^3. A residential scenario exposure factor was applied to the risk-based concentration to derive the screening level.
															WHO: Screening level based on an inhalation unit risk (IUR) of 0.00038 µg/m^3 for 1 µg/m^3 of nickel in the air, based on lung cancer incidences in exposed human workers. The concentration corresponding to an incremental lifetime risk of 1 in 100,000 is about 0.025 µg/m^3.
															OMOE: Screening level of 0.02 µg/m^3 based on an incremental lifetime cancer risk of 1 in one million and on carcinogenic effects from inhaling nickel oxide and nickel hydroxide (the two predominant nickel oxide species in Ontario) in PM_{10}.
															Cal OEHHA: Threshold based on an inhalation unit risk (IUR) of 0.00026 per µg/m^3 and an incremental lifetime cancer risk of 1 in 100,000. The IUR is calculated from Ontario nickel refinery worker lung cancer mortality data.
															TCEQ: Screening level based on lung cancer in workers exposed to various forms of nickel in air (Grimsrud et al. 2003; and Enterline and Marsh 1983; as cited in TCEQ 2011). The inhalation unit risk (IUR) was 0.00017 per µg/m^3 and the ESL was based on an incremental lifetime risk of 1 in 100,000.

Parameter	Carcinogenic/ Non-Carcinogenic	BC MoE Ambient Air Quality Objectives[a]			CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	US EPA RSLs[f],[g],[h],[i]	WHO Guidelines[j],[k]	Others			Toxicological Endpoints and Derivations
		Level A	Level B	Level C	Desirable	Acceptable	Tolerable					OMOE AAQC[l]	Cal OEHHA RELs[m]	TCEQ ESLs[n]	
Selenium	NC	-	-	-	-	-	-	-	-	**21**	-	-	20	0.67 (0.2)	**US EPA**: Threshold based on the REL from Cal OEHHA (see below). A residential scenario exposure factor was applied by US EPA to derive a screening level. **Cal OEHHA**: Threshold based on environmental exposure of selenium (in soil and food supplies) to people in China over a lifetime in their diets (as selenium subsulphide). Health effects were clinical selenosis (liver, blood, skin and central nervous system). The LOAEL was 0.023 mg/kg/day and the NOAEL was 0.015 mg/kg/day. The inhalation chronic REL is based on the oral chronic REL and an inhalation extrapolation factor of 3,500 µg/m^3 per mg/kg/day. An uncertainty factor of 3 to account for intraspecies differences was applied. One of the assumptions of route-to-route extrapolation assumes that a chemical is equally absorbed by both oral and inhalation routes; Cal OEHHA indicated that the available data are not adequate to depart from the default assumption of equal absorption across the lungs and gastrointestinal tract. **TCEQ:** Threshold based on a health endpoint (interim, supporting documentation not available), as selenium, selenium oxide and selenium compounds in PM_{10}.
Silver	NC	-	-	-	-	-	-	-	-	-	-	-	-	**0.033 (0.01)**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), as PM_{10}.
Strontium	NC	-	-	-	-	-	-	-	-	-	-	-	-	**6.7 (2)**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), as PM_{10}.
Thallium	NC	-	-	-	-	-	-	-	-	-	-	-	-	**0.33 (0.1)**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), as PM_{10}.
Tin	NC	-	-	-	-	-	-	-	-	-	-	-	-	**6.7 (2)**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), as tin compounds: metal, oxide and inorganic.
Titanium	NC	-	-	-	-	-	-	**0.1**	-	**0.1**	-	-	-	17 (5)	**ATSDR**: Threshold based on increased incidence of inflammation of the trachea and mucous membrane of the nose in rats exposed to titanium tetrachloride for 6 hours/day, 5 days/week for 104 weeks (ATSDR 1997). A NOAEL was not observed in this study as all exposure concentrations evaluated caused effects to the respiratory system. A LOAEL of 0.1 mg/m^3 was used converted to a human equivalent concentration ($LOAEL_{HEC}$; 0.012 mg/m^3) and an uncertainty factor of 90 (3 for using a LOAEL, 3 for extrapolating from animals to humans and 10 for human variability) was applied to derive the threshold. **US EPA**: Threshold based on the ATSDR minimal risk level for titanium tetrachloride (see above). A residential scenario exposure factor was applied to the ATSDR minimal risk level to derive the screening level. **TCEQ:** Threshold (16.7 µg/m^3) based on a health endpoint (interim, supporting documentation not available), as titanium, titanium oxide and titanium dioxide compounds in PM_{10}.
Uranium	NC	-	-	-	-	-	-	**0.04;** 0.8	-	0.042	-	0.03	-	0.67; 0.17 (0.2; 0.05)	**ATSDR**: The threshold for soluble forms of uranium (0.04 µg/m^3) is based on renal tubular atrophy in dogs exposed to uranium tetrachloride for 33 hours/week for 1 year (ATSDR 2013). The benchmark concentration lower confidence limit corresponding to the lower 10% incidence of effect ($BMCL_{10}$) was 0.019 mg/m^3 and adjusted for continuous exposure

Parameter	Carcinogenic/ Non-Carcinogenic	BC MoE Ambient Air Quality Objectives[a]			CCME NAAQO/CAAQS[b],[c]			ATSDR MRLs[d]	US NAAQS[e]	US EPA RSLs[f],[g],[h],[i]	WHO Guidelines[j],[k]	Others			Toxicological Endpoints and Derivations
		Level A	Level B	Level C	Desirable	Acceptable	Tolerable					OMOE AAQC[l]	Cal OEHHA RELs[m]	TCEQ ESLs[n]	
															(multiplied by 33/168 hours = 0.0037 mg/m^3) and an uncertainty factor of 100 (10 for extrapolating from animals to humans and 10 for human variability) was applied to give 0.04 µg/m^3 as the threshold for soluble uranium. Threshold for insoluble uranium (0.8 µg/m^3) based on fibrosis in the lungs and tracheobronchial lymph nodes in monkeys exposed to insoluble forms of uranium for 5.4 hours/day, 5 days/week for 5 years (ATSDR 2013). The LOAEL (5.1 mg/m^3) was adjusted for intermittent exposure (5.1 mg/m^3 x 5.4 hours/24 hour x 5 days/7 days) and an uncertainty factor of 1,000 (10 for using a LOAEL, 10 for extrapolating from animals to humans and 10 for human variability) was applied to give 0.8 µg/m^3 as the threshold for insoluble uranium. **US EPA**: Threshold based on ATSDR minimal risk level (see above). A residential scenario exposure factor was applied by US EPA to derive a screening level. **OMOE**: Threshold based on a health endpoint and will take effect after July 1, 2016 (as uranium in PM_{10}, supporting documentation not available). **TCEQ:** Threshold based on a health endpoint (interim, supporting documentation not available) as insoluble uranium compounds in PM_{10} (0.67 µg/m^3) and as soluble uranium compounds in PM_{10} (0.167 µg/m^3).
Vanadium	NC	-	-	-	-	-	-	**0.1**	-	**0.1**	-	-	-	0.17 (0.05)	**ATSDR**: Threshold based on degeneration of respiratory epithelium of the epiglottis in mice exposed to vanadium pentoxide for 6 hours/day, 5 days/week for 104 weeks (ATSDR 2012b). The human equivalent benchmark concentration lower confidence limit corresponding to the lower 10% incidence of effect ($BMCL_{10[HEC]}$) of 0.003 mg/m^3 was used and an uncertainty factor of 30 (3 for extrapolating from animals to humans and 10 for human variability) was applied to calculate 0.1 µg/m^3 as the threshold for vanadium pentoxide. **US EPA**: Threshold based on ATSDR (see above). **TCEQ:** Threshold based on a health endpoint (interim, supporting documentation not available) as vanadium, metal and compounds in PM_{10}.
Zinc	NC	-	-	-	-	-	-	-	-	-	-	-	-	**6.7 (2)**	**TCEQ**: Threshold based on a health endpoint (interim, supporting documentation not available), as zinc and compounds in PM_{10}.

(a) BC MOE 2016.
(b) CCME 1999.
(c) CCME 2012.
(d) ATSDR 2015
(e) US EPA 2011
(f) US EPA 2014
(g) US EPA 2015a. Carcinogens have been adjusted from an ILCR of 1 in 1,000,000 (10^{-6}) to an ILCR of 1 in 100,000 (10^{-5}) to be consistent with WHO Guidelines. The original value from US EPA is given in parenthesis next to the adjusted value.
(h) US EPA 2015b.
(i) US EPA 1997
(j) WHO 2006
(k) WHO 2000
(l) OMOE 2012
(m) Cal OEHHA 2015
(n) TCEQ 2015b. The screening levels derived by TCEQ are based on an HQ = 0.3 for non-carcinogens, and an ILCR of 1 in 100,000 (10-5) cancer risk for carcinogens. Guidelines for non-carcinogens have been adjusted to a HQ = 1.0. Values for carcinogens remain unchanged. The original value from TCEQ is given in parentheses next to the adjusted value.

(o) The screening value utilized in the Air Quality Section (Part B, Section 5.7) is the Air Quality Objective (8 µg/m3), as this value was consistent with their model plan that was approved by BC MoE.

All values are in $\mu g/m^3$, unless otherwise noted.

Concentrations in ppm were converted to mg/m^3 by applying the formula: molecular weight (g/mol) x ppm / 24.45.

" – " = no value; > = greater than; $\mu g/m^3$ = microgram per cubic metre; % = percent; ± = plus/minus; AAQC = Ambient Air Quality Criteria; ATSDR = Agency of Toxic Substances and Disease Registry; BC MoE = British Columbia Ministry of Environment; BMC = benchmark concentration; BMCL = benchmark concentration level; BMDL = benchmark dose level; C = carcinogenic; CAAQS = Canadian Ambient Air Quality Standard; Cal OEHHA = California Office of Environmental Health Hazard Assessment; CBD = chronic beryllium disease; CCME = Canadian Council of Ministers of the Environment; CNS = central nervous system; Cr(III) = trivalent chromium; Cr(VI) = hexavalent chromium; ESL = Effects Screening Level; g/mol = gram per mol; HEC = human equivalent concentration; HQ = hazard quotient; ILCR = incremental lifetime cancer risk; IQ = intelligence quotient; IUR inhalation unit risk; LOAEL = lowest observable adverse effect level; mg/kg/day = milligram per kilogram per day; mg/m^3 = milligram per cubic metre; MRL = Minimal Risk Level; NAAQO = National Ambient Air Quality Objective; NAAQS = National Ambient Air Quality Standard; NC = non-carcinogenic; ng/m^3 = nanogram per cubic metre; $NiSO_4$ = Nickel sulfate; NO_2 = nitrogen dioxide; NOAEL = no observable adverse effect level; OMOE = Ontario Ministry of Environment; PM_{10} = particulate matter less than 10 micrometres; $PM_{2.5}$ = particulate matter less than 2.5 micrometres; POD = point of departure; ppb = parts per billion; ppm = parts per million; RDDR = regional deposited dose ratio; REL = Reference Exposure Level; RfC = reference concentration; RSL = Regional Screening Level; SO_2 = sulphur dioxide; TCEQ = Texas Commission on Environmental Quality; TSP = total suspended particulate; US EPA = United States Environmental Protection Agency; WHO = World Health Organization.

3.0 SUMMARY OF CHEMICALS OF POTENTIAL CONCERN IDENTIFIED FOR THE HUMAN HEALTH RISK ASSESSMENT

3.1 Short-Term Inhalation Risk Assessment

3.1.1 1-Hour Inhalation Risk Assessment

The predicted 1-hour air concentrations for selected receptor locations screened against the selected thresholds are presented in Table 9.1-B-3. Based on the screening process, aluminum and iron were retained as COPCs for the acute inhalation assessment.

3.1.2 24-Hour Inhalation Risk Assessment

The predicted 24-hour air concentrations for selected receptor locations screened against the selected thresholds are presented in Table 9.1-B-4. Based on the screening process, iron and manganese were retained as COPCs for the acute inhalation assessment.

3.2 Long-Term Inhalation Risk Assessment

The predicted annual air concentrations for selected receptor locations screened against the selected thresholds are presented in Table 9.1-B-6. Based on the screening process, no COPCs were retained for the long-term (chronic) inhalation risk assessment.

3.3 Particulate Matter Assessment

The predicted 1-hour, 24-hour and annual air concentrations for selected receptor locations screened against the selected thresholds and baseline are presented in Tables 9.1-B-3, 9.1-B-4, and 9.1-B-6. For short-term inhalation exposure, $PM_{2.5}$ and PM_{10} were retained for evaluation under the Application Case. For the long-term inhalation exposure, although $PM_{2.5}$ did not increase by more than 10% above background and concentrations at all receptor locations were below the regulatory air quality objective of 8 µg/m^3, $PM_{2.5}$ was conservatively retained for further assessment. The applicable screening threshold was selected from the BC MoE, which provides three values for $PM_{2.5}$ (see Table 9.1-B-5). The Planning Goal of 6 µg/m^3 although not a regulatory objective, was conservatively selected as the screening threshold for the human health assessment, and $PM_{2.5}$ was retained as a COPC for the following reasons:

a) Concentrations of $PM_{2.5}$ exceeded the BC MoE Planning Goal at all receptor locations assessed;

b) The maximum predicted increase was close to 10% at one receptor location; and

c) A threshold below which no adverse effects are expected is not likely to exist for $PM_{2.5}$ (WHO 2006).

There are no health-based standards available for total suspended particulates; therefore, it was assessed as part of the overall particulate matter assessment.

3.4 Elimination of Non-Toxic Substances

Calcium, sodium, potassium, magnesium, and phosphorus are essential minerals that serve a variety of biochemical, intracellular, and ion balance purposes in human tissues. These parameters are naturally occurring substances are included in routine analytical chemical analyses. Government agencies often do not develop regulatory criteria for these and other innocuous substances. As these substances are not known or expected to be associated with on-site activities, they have been excluded from the risk assessment.

4.0 CLOSURE

We trust this information is sufficient for your needs at this time. Should you have any questions or concerns, please do not hesitate to contact the undersigned at 604-296-4200.

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6.0 GLOSSARY

Acute	A stimulus severe enough to rapidly induce an effect; in aquatic toxicity tests, an effect observed in 96 hours or less is typically considered acute. When referring to aquatic toxicology or human health, an acute effect is not always measured in terms of lethality.
Ambient air	The air in the surrounding atmosphere.
Baseline	A surveyed or predicted condition that serves as a reference point to which later surveys are coordinated or correlated.
Benchmark dose or concentration level (BMDL or BMCL)	The statistical lower confidence limit of the exposure dose or concentration at the BMD or BMC, respectively.
Benchmark dose or concentration (BMD or BMC)	The exposure dose or concentration associated with a specific magnitude of response (i.e., 5 or 15% incidence within the study population).
Carcinogen (C)	An agent that is reactive or toxic enough to act directly to cause cancer.
Chemical of potential concern (COPC)	A chemical that is emitted or released into the environment and poses a potential risk of exposure to humans.
Chronic	The development of adverse effects after extended exposure to a given substance. In chronic toxicity tests, the measurement of a chronic effect can be reduced growth, reduced reproduction or other non-lethal effects, in addition to lethality. Chronic should be considered a relative term depending on the life span of the organism.
Concentration	Quantifiable amount of a chemical in environmental media.
Dose	A measure of integral exposure. Examples include: (1) the amount of chemical ingested; (2) the amount of a chemical taken up; and (3) the product of ambient exposure concentration and the duration of exposure.
Environmental and Social Impact Assessment	A review of the effects that a proposed development will have on the local and regional environment.
Forced expiratory volume 1	The volume of air exhaled in the first second of forced expiration and is a common lung function test.
Hazard quotient (HQ)	A comparison between total exposure from all predicted routes of exposure and the exposure limits for chemicals of potential concern. This comparison is calculated by dividing the predicted exposure by the exposure limit. Also referred to as hazard quotient (HQ).
Human equivalent concentration (HEC)	The conversion factor used in toxicological studies to extrapolate a chemical concentration or dose from animals to humans.

Incremental lifetime cancer risk (ILCR)	Refers to the number of non-project related cancer cases that could potentially result from the estimated exposures to carcinogenic chemicals in a population of 100,000 people.
Lowest observed adverse effect level (LOAEL)	In toxicity testing, it is the lowest concentration at which adverse effects on the measurement end point are observed. The minimal LOAEL is one where the magnitude of changes is small.
Nitrogen dioxide (NO_2)	One of the component gases of oxides of nitrogen which also includes nitric oxide. In burning natural gas, coal, oil and gasoline, atmospheric nitrogen may combine with molecular oxygen to form nitric oxide, an ingredient in the brown haze observed near large cities. Nitric oxide is converted to nitrogen dioxide in the atmosphere. Cars, trucks, trains and planes are the major source of oxides of nitrogen in Alberta. Other major sources include oil and gas industries and power plants.
No observed adverse effect level (NOAEL)	In toxicity testing, it is the highest concentration at which no adverse effects on the measurement end point are observed.
Non-carcinogen (NC)	A chemical that does not cause cancer and has a threshold concentration, below which adverse effects are unlikely.
Point of departure (POD)	The lowest dose that is associated with an adverse effect in a dose-response curve. It is the point that marks the beginning of a low-dose extrapolation.
The Project	Burnco Project
Regional deposited dose ratio (RDDR)	In toxicological studies, the RDDR is the ratio used to convert the regional deposited dose for a given exposure in animals to the same exposure in humans.
Reference concentration (RfC)	For a specific chemical that is conceptually equivalent to an air quality objective, and is expressed in $\mu g/m^3$. It is an exposure limit that is established for chemicals which are locally acting (e.g., irritant chemicals), whose toxicity is dependent solely on the air concentration and not on the total internal dose received via multiple exposure pathways.
Sulphur dioxide (SO_2)	Sulphur dioxide is a colourless gas with a pungent odour. In Alberta, natural gas processing plants are responsible for close to half of the emissions of this gas. Oil sands facilities and power plants are also major sources. Others include gas plant flares, oil refineries, pulp and paper mills and fertilizer plants.
Toxicity	The inherent potential or capacity of a material to cause adverse effects in a living organism.
Unit risk estimate	Expression of the slope factor in terms of "per $\mu g/L$" in drinking water or "per $\mu g/m^3$" in air.

Table 9.1-B-3: Screening of Predicted 1-Hour Application Case Air Concentrations
Public Health Assessment
Proposed Burnco Aggregate Project

Parameter	Air Screening Value	Receptor Location											
		Squamish	Porteau Cove	Bowen Island	Lions Bay	Langdale	Horseshoe Bay	New Brighton	Britannia Beach	Furry Creek	Gibsons	Ch'iyakmesh	Unknown First Nations
Criteria Air Contaminants													
$PM_{2.5}$	-	20	21	20	20	21	20	21	20	21	20	20	20
PM_{10}	-	31	32	31	31	32	31	32	31	32	32	31	31
Sulphur Dioxide (SO_2)	**200**	34	34	34	34	34	34	34	34	34	34	34	34
Nitrogen Dioxide (NO_2)	**188**	41	42	41	41	42	41	42	42	41	41	41	42
TSP	-	66	66	66	66	67	65	67	66	66	66	65	66
Metals													
Aluminum (Al)	**20**	0.33	0.34	0.33	0.33	0.34	0.33	0.35	0.34	0.34	0.34	0.33	0.34
Antimony (Sb)	**5**	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
Arsenic (As)	**3**	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
Barium (Ba)	**5**	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
Beryllium (Be)	**0.02**	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
Bismuth (Bi)	**50**	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Cadmium (Cd)	**0.1**	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083
Chromium (Cr)	**3.6**	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Cobalt (Co)	**0.2**	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
Copper (Cu)	**10**	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
Iron (Fe)	**10**	0.34	0.35	0.34	0.34	0.36	0.34	0.38	0.35	0.35	0.35	0.33	0.35
Lead (Pb)	-	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Lithium (Li)	**2**	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Manganese (Mn)	**2**	0.0084	0.0085	0.0084	0.0084	0.0087	0.0083	0.0088	0.0085	0.0085	0.0085	0.0083	0.0085
Mercury (Hg)	**0.25**	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017
Molybdenum (Mo)	**30**	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Nickel (Ni)	**0.33**	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Selenium (Se)	**2**	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Silver (Ag)	**0.1**	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
Strontium (Sr)	**20**	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0084	0.0083	0.0083	0.0083	0.0083	0.0083
Thallium (Tl)	**1**	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083
Tin (Sn)	**20**	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Titanium (Ti)	**50**	0.083	0.084	0.083	0.083	0.084	0.083	0.085	0.083	0.084	0.083	0.083	0.083
Uranium (U)	**0.5**	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083
Vanadium (V)	**20**	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Zinc (Zn)	**20**	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083

Notes:

Units in µg/m^3

"-" means that no screening value is available; MPOI - maximum point of impingement, a hypothetical "worst-case" location outside the Proposed Project area; TSP - total suspended particulates.

"-" indicates no guideline available

a. Air screening value is for trivalent chromium.

value Exceeds air screening value

1. At all receptor locations except the MPOI.

2. A parameter is retained as a COPC (chemical of potential concern) if the predicted maximum concentration is greater than the air screening value and is also greater than 10% above the Base Case concentration, or if an air threshold was not available and the predicted maximum concentration was greater than 10% above the Base Case concentration.

3. Not retained as a COPC for the 1-hour assessment scenario due to the absence of a screening value. The acute exposure assessment for this parameter is evaluated under the 24-hour scenario.

4. Particulate matter was used as a surrogate for the assessment of TSP, as no health-based guidelines are available and the smaller diameter particles (e.g., PM_{10} and $PM_{2.5}$) are the greatest contributors to potential health risks.

Table 9.1-B-3: Screening of Predicted 1-Hour Application Case Air Concentrations
Public Health Assessment
Proposed Burnco Aggregate Project

Parameter	Air Screening Value	Receptor Location											
		Unknown residence	Potlach Creek	KWUM KWUM	Tetrahedron Park	Anvil Island	Ekin's Point	Kaikalahun	McNab Creek Strata	Camp Artaban	Camp Latona	Residence on Gambier Island	MPOI
Criteria Air Contaminants													
$PM_{2.5}$	-	21	21	21	20	21	24	21	28	21	24	21	288
PM_{10}	-	32	32	32	31	33	47	32	54	32	49	32	547
Sulphur Dioxide (SO_2)	**200**	34	34	34	34	34	34	34	34	34	34	34	34
Nitrogen Dioxide (NO_2)	**188**	42	42	42	41	42	43	42	43	42	43	43	57
TSP	-	66	68	67	65	69	103	67	131	66	105	67	2240
Metals													
Aluminum (Al)	**20**	0.34	0.35	0.35	0.33	0.36	0.53	0.34	1.1	0.34	0.54	0.35	**33**
Antimony (Sb)	**5**	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0066
Arsenic (As)	**3**	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.044
Barium (Ba)	**5**	0.017	0.017	0.017	0.017	0.017	0.020	0.017	0.022	0.017	0.020	0.017	0.17
Beryllium (Be)	**0.02**	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
Bismuth (Bi)	**50**	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Cadmium (Cd)	**0.1**	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0086
Chromium (Cr)	**3.6**	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.22
Cobalt (Co)	**0.2**	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.032
Copper (Cu)	**10**	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.018	0.017	0.017	0.017	0.070
Iron (Fe)	**10**	0.35	0.38	0.37	0.34	0.40	1.1	0.37	1.6	0.35	1.2	0.36	**40**
Lead (Pb)	-	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.052	0.050	0.050	0.050	0.14
Lithium (Li)	**2**	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.084	0.083	0.084	0.083	0.11
Manganese (Mn)	**2**	0.0085	0.0089	0.0088	0.0083	0.0092	0.0184	0.0088	0.0255	0.0085	0.0191	0.0087	0.56
Mercury (Hg)	**0.25**	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0023
Molybdenum (Mo)	**30**	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.051
Nickel (Ni)	**0.33**	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.051	0.050	0.050	0.050	0.085
Selenium (Se)	**2**	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.084
Silver (Ag)	**0.1**	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0053
Strontium (Sr)	**20**	0.0083	0.0084	0.0083	0.0083	0.0084	0.010	0.0083	0.010	0.0083	0.010	0.0083	0.061
Thallium (Tl)	**1**	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0085
Tin (Sn)	**20**	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.054
Titanium (Ti)	**50**	0.084	0.085	0.084	0.083	0.086	0.12	0.084	0.13	0.083	0.12	0.084	1.5
Uranium (U)	**0.5**	0.00083	0.00083	0.00083	0.00083	0.00083	0.00088	0.00083	0.00095	0.00083	0.00088	0.00083	0.0054
Vanadium (V)	**20**	0.083	0.083	0.083	0.083	0.083	0.085	0.083	0.086	0.083	0.085	0.083	0.20
Zinc (Zn)	**20**	0.083	0.083	0.083	0.083	0.083	0.084	0.083	0.085	0.083	0.084	0.083	0.17

Notes:

Units in $\mu g/m^3$

"-" means that no screening value is available; MPOI - maximum point of impingement, a hypothetical “worst-case” location outside the Proposed Project area; TSP - total suspended particulates.

"-" indicates no guideline available

a. Air screening value is for trivalent chromium.

value Exceeds air screening value

1. At all receptor locations except the MPOI.

2. A parameter is retained as a COPC (chemical of potential concern) if the predicted maximum concentration is greater than the air screening value and is also greater than 10% above the Base Case concentration, or if an air threshold was not available and the predicted maximum concentration was greater than 10% above the Base Case concentration.

3. Not retained as a COPC for the 1-hour assessment scenario due to the absence of a screening value. The acute exposure assessment for this parameter is evaluated under the 24-hour scenario.

4. Particulate matter was used as a surrogate for the assessment of TSP, as no health-based guidelines are available and the smaller diameter particles (e.g., PM_{10} and $PM_{2.5}$) are the greatest contributors to potential health risks.

Table 9.1-B-3: Screening of Predicted 1-Hour Application Case Air Concentrations
Public Health Assessment
Proposed Burnco Aggregate Project

Parameter	Air Screening Value	Maximum Predicted Concentration	Base Case Concentration	Range of Predicted Increase[1] (Percent Change from Base Case) (%)	Predicted Increase at MPOI (Percent Change from Base Case) (%)	Is Percent Change from Base Case >10%?	Predicted Maximum Concentration Above Air Threshold?	Retained as a COPC?[2]
Criteria Air Contaminants								
$PM_{2.5}$	-	288	20	0.10% to 36%	1311%	Yes	NG	No[3]
PM_{10}	-	547	31	0.19% to 75%	1655%	Yes	NG	No[3]
Sulphur Dioxide (SO_2)	**200**	34	34	0.000028% to 0.0022%	0.0051%	No	No	No
Nitrogen Dioxide (NO_2)	**188**	57	41	0.062% to 5%	38%	Yes MPOI Only	No	No
TSP	-	2240	65	0.30% to 101%	3336%	Yes	NG	No[4]
Metals								
Aluminum (Al)	**20**	**33**	0.33	0.43% to 242%	9987%	Yes	Yes	**Yes**
Antimony (Sb)	**5**	0.0066	0.0050	0.0017% to 0.86%	32%	Yes MPOI Only	No	No
Arsenic (As)	**3**	0.044	0.017	0.010% to 5%	165%	Yes MPOI Only	No	No
Barium (Ba)	**5**	0.17	0.017	0.088% to 32%	954%	Yes	No	No
Beryllium (Be)	**0.02**	0.017	0.017	0.00018% to 0.073%	2%	No	No	No
Bismuth (Bi)	**50**	0.050	0.050	0.000063% to 0.031%	1%	No	No	No
Cadmium (Cd)	**0.1**	0.0086	0.0083	0.00020% to 0.10%	4%	No	No	No
Chromium (Cr)	**3.6**	0.22	0.17	0.0050% to 2%	34%	Yes MPOI Only	No	No
Cobalt (Co)	**0.2**	0.032	0.017	0.0076% to 3%	96%	Yes MPOI Only	No	No
Copper (Cu)	**10**	0.070	0.017	0.023% to 10%	321%	Yes MPOI Only	No	No
Iron (Fe)	**10**	**40**	0.33	1% to 390%	11997%	Yes	Yes	**Yes**
Lead (Pb)	-	0.14	0.050	0.0079% to 4%	178%	Yes MPOI Only	NG	No[3]
Lithium (Li)	**2**	0.11	0.083	0.0033% to 1%	33%	Yes MPOI Only	No	No
Manganese (Mn)	**2**	0.56	0.0083	0.54% to 208%	6616%	Yes	No	No
Mercury (Hg)	**0.25**	0.0023	0.0017	0.0016% to 0.88%	36%	Yes MPOI Only	No	No
Molybdenum (Mo)	**30**	0.051	0.050	0.00031% to 0.11%	3%	No	No	No
Nickel (Ni)	**0.33**	0.085	0.050	0.0064% to 2%	70%	Yes MPOI Only	No	No
Selenium (Se)	**2**	0.084	0.083	0.000082% to 0.037%	1%	No	No	No
Silver (Ag)	**0.1**	0.0053	0.0050	0.00030% to 0.15%	6%	No	No	No
Strontium (Sr)	**20**	0.061	0.0083	0.072% to 24%	640%	Yes	No	No
Thallium (Tl)	**1**	0.0085	0.0083	0.00027% to 0.094%	3%	No	No	No
Tin (Sn)	**20**	0.054	0.050	0.00038% to 0.21%	8%	No	No	No
Titanium (Ti)	**50**	1.5	0.083	0.17% to 60%	1733%	Yes	No	No
Uranium (U)	**0.5**	0.0054	0.00083	0.032% to 15%	551%	Yes	No	No
Vanadium (V)	**20**	0.20	0.083	0.012% to 4%	140%	Yes MPOI Only	No	No
Zinc (Zn)	**20**	0.17	0.083	0.0081% to 3%	104%	Yes MPOI Only	No	No

Notes:

Units in $\mu g/m^3$

"-" means that no screening value is available; MPOI - maximum point of impingement, a hypothetical "worst-case" location outside the Proposed Project area; TSP - total suspended particulates.

"-" indicates no guideline available

a. Air screening value is for trivalent chromium.

value Exceeds air screening value

1. At all receptor locations except the MPOI.

2. A parameter is retained as a COPC (chemical of potential concern) if the predicted maximum concentration is greater than the air screening value and is also greater than 10% above the Base Case concentration, or if an air threshold was not available and the predicted maximum concentration was greater than 10% above the Base Case concentration.

3. Not retained as a COPC for the 1-hour assessment scenario due to the absence of a screening value. The acute exposure assessment for this parameter is evaluated under the 24-hour scenario.

4. Particulate matter was used as a surrogate for the assessment of TSP, as no health-based guidelines are available and the smaller diameter particles (e.g., PM_{10} and $PM_{2.5}$) are the greatest contributors to potential health risks.

Table 9.1-B-4: Screening of Predicted 24-Hour Application Case Air Concentrations
Public Health Assessment
Proposed Burnco Aggregate Project

Parameter	Air Screening Value	Receptor Location											
		Squamish	Porteau Cove	Bowen Island	Lions Bay	Langdale	Horseshoe Bay	New Brighton	Britannia Beach	Furry Creek	Gibsons	Ch'iyakmesh	Unknown First Nations
Criteria Air Contaminants													
$PM_{2.5}$	**25**	14	14	14	14	14	14	14	14	14	14	14	14
PM_{10}	**50**	26	26	26	26	26	26	26	26	26	26	26	26
Sulphur Dioxide (SO_2)	**20**	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Nitrogen Dioxide (NO_2)	**200**	19	19	19	19	19	19	19	19	19	19	19	19
TSP	**120**	55	55	55	55	55	55	55	55	55	55	55	55
Metals													
Aluminum (Al)	**120**	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Antimony (Sb)	**25**	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042
Arsenic (As)	**0.3**	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Barium (Ba)	**10**	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Beryllium (Be)	**0.01**	**0.014**	**0.014**	**0.014**	**0.014**	**0.014**	**0.014**	**0.014**	**0.014**	**0.014**	**0.014**	**0.014**	**0.014**
Bismuth (Bi)	-	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042
Cadmium (Cd)	**0.03**	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070
Chromium (Cr)	**0.39** [a]	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Cobalt (Co)	**0.1**	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Copper (Cu)	**50**	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Iron (Fe)	**4**	0.28	0.29	0.28	0.28	0.29	0.28	0.29	0.28	0.29	0.28	0.28	0.28
Lead (Pb)	**0.5**	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042
Lithium (Li)	**20**	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070
Manganese (Mn)	**0.1**	0.0070	0.0071	0.0070	0.0070	0.0071	0.0070	0.0071	0.0070	0.0071	0.0070	0.0070	0.0070
Mercury (Hg)	**2**	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014
Molybdenum (Mo)	**120**	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042
Nickel (Ni)	**0.1**	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042
Selenium (Se)	**10**	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070
Silver (Ag)	**1**	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042
Strontium (Sr)	**120**	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070
Thallium (Tl)	-	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070
Tin (Sn)	**10**	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042
Titanium (Ti)	**120**	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070
Uranium (U)	**0.15**	0.00070	0.00070	0.00070	0.00070	0.00070	0.00070	0.00070	0.00070	0.00070	0.00070	0.00070	0.00070
Vanadium (V)	**1**	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070
Zinc (Zn)	**120**	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070

Notes:

Units in $\mu g/m^3$

NG - no guideline available; MPOI - maximum point of impingement, a hypothetical “worst-case” location outside the Proposed Project area; TSP - total suspended particulates.

"-" indicates no guideline available

a. Screening value for chromium is for Cr(VI)

value Exceeds air screening value

1. At all receptor locations except the MPOI.

2. A parameter is retained as a COPC (chemical) of potential concern) if the predicted maximum concentration is greater than the air screening value and is also more than 10% above the Base Case concentration, or if an air threshold was not available and the predicted maximum concentration was more than 10% above the Base Case concentration.

3. Particulate matter was used as a surrogate for the assessment of TSP, as no health-based guidelines are available and the smaller diameter particles (e.g., PM_{10} and $PM_{2.5}$) are the greatest contributors to potential health risks.

Table 9.1-B-4: Screening of Predicted 24-Hour Application Case Air Concentrations
Public Health Assessment
Proposed Burnco Aggregate Project

Parameter	Air Screening Value	Receptor Locatin											
		Unknown residence	Potlach Creek	KWUM KWUM	Tetrahedron Park	Anvil Island	Ekin's Point	Kaikalahun	McNab Creek Strata	Camp Artaban	Camp Latona	Residence on Gambier Island	MPOI
Criteria Air Contaminants													
$PM_{2.5}$	**25**	14	14	14	14	14	16	14	17	14	15	14	**75**
PM_{10}	**50**	27	27	26	26	27	32	26	37	26	31	26	**171**
Sulphur Dioxide (SO_2)	**20**	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Nitrogen Dioxide (NO_2)	**200**	19	19	19	19	19	19	19	19	19	19	19	35
TSP	**120**	55	56	56	55	56	64	55	80	55	66	55	**650**
Metals													
Aluminum (Al)	**120**	0.28	0.29	0.28	0.28	0.28	0.33	0.28	0.56	0.28	0.34	0.28	9.4
Antimony (Sb)	**25**	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0046
Arsenic (As)	**0.3**	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.021
Barium (Ba)	**10**	0.014	0.014	0.014	0.014	0.014	0.015	0.014	0.016	0.014	0.015	0.014	0.058
Beryllium (Be)	**0.01**	**0.014**	**0.014**	**0.014**	**0.014**	**0.014**	**0.014**	**0.014**	**0.014**	**0.014**	**0.014**	**0.014**	**0.014**
Bismuth (Bi)	-	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042
Cadmium (Cd)	**0.03**	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070
Chromium (Cr)	**0.39** [a]	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.16
Cobalt (Co)	**0.1**	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.018
Copper (Cu)	**50**	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.029
Iron (Fe)	**4**	0.29	0.30	0.29	0.28	0.29	0.47	0.29	0.78	0.28	0.51	0.29	**11**
Lead (Pb)	**0.5**	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.043	0.042	0.042	0.042	0.066
Lithium (Li)	**20**	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.077
Manganese (Mn)	**0.1**	0.0071	0.0072	0.0072	0.0070	0.0072	0.0093	0.0071	0.014	0.0070	0.010	0.0071	**0.16**
Mercury (Hg)	**2**	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0016
Molybdenum (Mo)	**120**	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042
Nickel (Ni)	**0.1**	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.051
Selenium (Se)	**10**	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070
Silver (Ag)	**1**	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0042	0.0043
Strontium (Sr)	**120**	0.0070	0.0070	0.0070	0.0070	0.0070	0.0073	0.0070	0.0078	0.0070	0.0074	0.0070	0.022
Thallium (Tl)	**-**	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070	0.0070
Tin (Sn)	**10**	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.043
Titanium (Ti)	**120**	0.070	0.070	0.070	0.070	0.070	0.078	0.070	0.090	0.070	0.079	0.070	0.47
Uranium (U)	**0.15**	0.00070	0.00070	0.00070	0.00070	0.00070	0.00071	0.00070	0.00074	0.00070	0.00071	0.00070	0.0020
Vanadium (V)	**1**	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.071	0.070	0.070	0.070	0.10
Zinc (Zn)	**120**	0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.071	0.070	0.070	0.070	0.093

Notes:

Units in µg/m^3

NG - no guideline available; MPOI - maximum point of impingement, a hypothetical “worst-case” location outside the Proposed Project area; TSP - total suspended particulates.

"-" indicates no guideline available

a. Screening value for chromium is for Cr(VI)

value Exceeds air screening value

1. At all receptor locations except the MPOI.

2. A parameter is retained as a COPC (chemical) of potential concern) if the predicted maximum concentration is greater than the air screening value and is also more than 10% above the Base Case concentration, or if an air threshold was not available and the predicted maximum concentration was more than 10% above the Base Case concentration.

3. Particulate matter was used as a surrogate for the assessment of TSP, as no health-based guidelines are available and the smaller diameter particles (e.g., PM_{10} and $PM_{2.5}$) are the greatest contributors to potential health risks.

Table 9.1-B-4: Screening of Predicted 24-Hour Application Case Air Concentrations
Public Health Assessment
Proposed Burnco Aggregate Project

Parameter	Air Screening Value	Maximum Predicted Concentration	Base Case Concentration	Range of Predicted Increase[1] (Percent Change from Base Case) (%)	Predicted Increase at MPOI (Percent Change from Base Case) (%)	Is Percent Change from Base Case >10%?	Predicted Maximum Concentration Above Air Threshold?	Retained as a COPC?[2]
Criteria Air Contaminants								
$PM_{2.5}$	**25**	**75**	14	0.041% to 20%	427%	Yes	Yes	**Yes**
PM_{10}	**50**	**171**	26	0.090% to 40%	554%	Yes	Yes	**Yes**
Sulphur Dioxide (SO_2)	**20**	6.3	6.3	0.000040% to 0.0045%	0%	No	No	No
Nitrogen Dioxide (NO_2)	**200**	35	19	0.037% to 4%	87%	Yes MPOI Only	No	No
TSP	**120**	**650**	55	0.36% to 46%	1087%	Yes	Yes	No[3]
Metals								
Aluminum (Al)	**120**	9.4	0.28	0.36% to 102%	3282%	Yes	No	No
Antimony (Sb)	**25**	0.0046	0.0042	-0.064% to 0.28%	10%	Yes MPOI Only	No	No
Arsenic (As)	**0.3**	0.021	0.014	0.18% to 2%	55%	Yes MPOI Only	No	No
Barium (Ba)	**10**	0.058	0.014	0.21% to 15%	314%	Yes	No	No
Beryllium (Be)	**0.01**	**0.014**	0.014	0.18% to 0.21%	1%	No	Yes	No
Bismuth (Bi)	-	0.042	0.042	-0.064% to -0.052%	0%	No	NG	No
Cadmium (Cd)	**0.03**	0.0070	0.007	0.031% to 0.072%	1%	No	No	No
Chromium (Cr)	**0.39** [a]	0.16	0.14	0.18% to 1%	13%	Yes MPOI Only	No	No
Cobalt (Co)	**0.1**	0.018	0.014	0.18% to 1%	32%	Yes MPOI Only	No	No
Copper (Cu)	**50**	0.029	0.014	0.19% to 4%	106%	Yes MPOI Only	No	No
Iron (Fe)	**4**	**11**	0.28	0.64% to 182%	3945%	Yes	Yes	**Yes**
Lead (Pb)	**0.5**	0.066	0.042	-0.061% to 2%	58%	Yes MPOI Only	No	No
Lithium (Li)	**20**	0.077	0.070	0.033% to 0.58%	11%	Yes MPOI Only	No	No
Manganese (Mn)	**0.1**	**0.16**	0.0070	0.27% to 94%	2172%	Yes	Yes	**Yes**
Mercury (Hg)	**2**	0.0016	0.0014	0.18% to 0.55%	12%	Yes MPOI Only	No	No
Molybdenum (Mo)	**120**	0.042	0.042	-0.064% to -0.013%	1%	No	No	No
Nickel (Ni)	**0.1**	0.051	0.042	-0.062% to 1%	23%	Yes MPOI Only	No	No
Selenium (Se)	**10**	0.070	0.070	0.031% to 0.046%	0%	No	No	No
Silver (Ag)	**1**	0.0043	0.0042	-0.064% to -0.0042%	2%	No	No	No
Strontium (Sr)	**120**	0.022	0.0070	0.062% to 12%	217%	Yes	No	No
Thallium (Tl)	**-**	0.0070	0.0070	0.031% to 0.077%	1%	No	NG	No
Tin (Sn)	**10**	0.043	0.042	-0.064% to 0.020%	3%	No	No	No
Titanium (Ti)	**120**	0.47	0.070	0.11% to 29%	569%	Yes	No	No
Uranium (U)	**0.15**	0.0020	0.00070	0.046% to 6%	181%	Yes MPOI Only	No	No
Vanadium (V)	**1**	0.10	0.070	0.036% to 2%	46%	Yes MPOI Only	No	No
Zinc (Zn)	**120**	0.093	0.070	0.035% to 1%	34%	Yes MPOI Only	No	No

Notes:

Units in $\mu g/m^3$

NG - no guideline available; MPOI - maximum point of impingement, a hypothetical “worst-case” location outside the Proposed Project area; TSP - total suspended particulates.

"-" indicates no guideline available

a. Screening value for chromium is for Cr(VI)

value Exceeds air screening value

1. At all receptor locations except the MPOI.

2. A parameter is retained as a COPC (chemical) of potential concern) if the predicted maximum concentration is greater than the air screening value and is also more than 10% above the Base Case concentration, or if an air threshold was not available and the predicted maximum concentration was more than 10% above the Base Case concentration.

3. Particulate matter was used as a surrogate for the assessment of TSP, as no health-based guidelines are available and the smaller diameter particles (e.g., PM_{10} and $PM_{2.5}$) are the greatest contributors to potential health risks.

Table 9.1-B-6: Screening of Predicted Annual Application Case Air Concentrations
Public Health Assessment
Proposed Burnco Aggregate Project

Parameter	Air Screening Value		Receptor Location											
	Non-Carcinogenic	Carcinogenic	Squamish	Porteau Cove	Bowen Island	Lions Bay	Langdale	Horseshoe Bay	New Brighton	Britannia Beach	Furry Creek	Gibsons	Ch'iyakmesh	Unknown First Nations
Criteria Air Contaminants														
$PM_{2.5}$[a]	**6**	-	**6.2**	**6.2**	**6.2**	**6.2**	**6.2**	**6.2**	**6.2**	**6.2**	**6.2**	**6.2**	**6.2**	**6.2**
PM_{10}	**20**	-	10	10	10	10	10	10	10	10	10	10	10	10
Sulphur Dioxide (SO_2)	**30**	-	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Nitrogen Dioxide (NO_2)	**40**	-	10	10	10	10	10	10	10	10	10	10	10	10
TSP	**60**	-	21	21	21	21	21	21	21	21	21	21	21	21
Metals														
Aluminum (Al)	**5.2**	-	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Antimony (Sb)	**0.21**	-	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016
Arsenic (As)	**0.016**	0.0065	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Barium (Ba)	**0.52**	-	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Beryllium (Be)	**0.021**	0.012	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Bismuth (Bi)	**16.7**	-	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
Cadmium (Cd)	**0.005**	0.016	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026
Chromium (Cr)	**0.1**[b]	0.00012[b]	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053
Cobalt (Co)	**0.0063**	0.0031	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Copper (Cu)	**3.3**	-	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Iron (Fe)	**3.3**	-	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Lead (Pb)	**0.15**	-	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
Lithium (Li)	**0.67**	-	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
Manganese (Mn)	**0.052**	-	0.0026	0.0027	0.0026	0.0026	0.0027	0.0026	0.0027	0.0027	0.0027	0.0026	0.0026	0.0027
Mercury (Hg)	**0.2**	-	0.00053	0.00053	0.00053	0.00053	0.00053	0.00053	0.00053	0.00053	0.00053	0.00053	0.00053	0.00053
Molybdenum (Mo)	**10**	-	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
Nickel (Ni)	**0.015**	0.025	**0.016**	**0.016**	**0.016**	**0.016**	**0.016**	**0.016**	**0.016**	**0.016**	**0.016**	**0.016**	**0.016**	**0.016**
Selenium (Se)	**21**	-	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
Silver (Ag)	**0.033**	-	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016
Strontium (Sr)	**6.7**	-	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026
Thallium (Tl)	**0.33**	-	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026
Tin (Sn)	**6.7**	-	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
Titanium (Ti)	**0.1**	-	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
Uranium (U)	**0.04**	-	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026
Vanadium (V)	**0.1**	-	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
Zinc (Zn)	**6.7**	-	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026

Notes:

Units in µg/m^3

TSP - total suspended particulates.

"-" indicates no guideline available

a. The screening value utilized in the Air Quality Section (Part B, Section 5.7) is the Air Quality Objective (8 µg/m^3), as this value was consistent with their model plan that was approved by BC MoE. The value

b. Screening value for chromium is for Cr(VI)

value	Exceeds air screening value for Non-Carcinogenic effects
value	Exceeds air screening value for Carcinogenic effects

1. A parameter is retained as a COPC (chemical of potential concern) if the predicted maximum concentration is greater than the air screening value and is also more than 10% above the Base Case concentration, or if an air threshold was not available and the predicted maximum concentration was more than 10% above the Base Case concentration.

2. Although the maximum predicted increase for $PM_{2.5}$ was less than 10%, it was conservatively retained as a COPC because it exceeds the BC MoE Planning Goal and a threshold below which no adverse effects are expected does not currently exist.

Table 9.1-B-6: Screening of Predicted Annual Application Case Air Concentrations
Public Health Assessment
Proposed Burnco Aggregate Project

Parameter	Air Screening Value		Receptor Location										
	Non-Carcinogenic	Carcinogenic	Unknown residence	Potlach Creek	KWUM KWUM	Tetrahedron Park	Anvil Island	Ekin's Point	Kaikalahun	McNab Creek Strata	Camp Artaban	Camp Latona	Residence on Gambier Island
Criteria Air Contaminants													
$PM_{2.5}$[a]	**6**	-	**6.2**	**6.2**	**6.2**	**6.2**	**6.2**	**6.3**	**6.2**	**6.7**	**6.2**	**6.3**	**6.2**
PM_{10}	**20**	-	10	10	10	10	10	11	10	12	10	11	10
Sulphur Dioxide (SO_2)	**30**	-	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Nitrogen Dioxide (NO_2)	**40**	-	10	10	10	10	10	10	10	10	10	10	10
TSP	**60**	-	21	21	21	21	21	22	21	26	21	22	21
Metals													
Aluminum (Al)	**5.2**	-	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.15	0.11	0.11	0.11
Antimony (Sb)	**0.21**	-	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016
Arsenic (As)	**0.016**	0.0065	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Barium (Ba)	**0.52**	-	0.0053	0.0053	0.0053	0.0053	0.0053	0.0054	0.0053	0.0057	0.0053	0.0054	0.0053
Beryllium (Be)	**0.021**	0.012	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Bismuth (Bi)	**16.7**	-	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
Cadmium (Cd)	**0.005**	0.016	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026
Chromium (Cr)	**0.1**[b]	0.00012[b]	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053
Cobalt (Co)	**0.0063**	0.0031	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Copper (Cu)	**3.3**	-	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0054	0.0053	0.0053	0.0053
Iron (Fe)	**3.3**	-	0.11	0.11	0.11	0.11	0.11	0.13	0.11	0.20	0.11	0.14	0.11
Lead (Pb)	**0.15**	-	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
Lithium (Li)	**0.67**	-	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.027	0.026	0.026	0.026
Manganese (Mn)	**0.052**	-	0.0027	0.0027	0.0027	0.0026	0.0027	0.0030	0.0027	0.0039	0.0027	0.0030	0.0027
Mercury (Hg)	**0.2**	-	0.00053	0.00053	0.00053	0.00053	0.00053	0.00053	0.00053	0.00053	0.00053	0.00053	0.00053
Molybdenum (Mo)	**10**	-	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
Nickel (Ni)	**0.015**	0.025	**0.016**	**0.016**	**0.016**	**0.016**	**0.016**	**0.016**	**0.016**	**0.016**	**0.016**	**0.016**	**0.016**
Selenium (Se)	**21**	-	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
Silver (Ag)	**0.033**	-	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016
Strontium (Sr)	**6.7**	-	0.0026	0.0026	0.0026	0.0026	0.0026	0.0027	0.0026	0.0028	0.0026	0.0027	0.0026
Thallium (Tl)	**0.33**	-	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026
Tin (Sn)	**6.7**	-	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
Titanium (Ti)	**0.1**	-	0.026	0.027	0.027	0.026	0.026	0.028	0.026	0.030	0.026	0.028	0.026
Uranium (U)	**0.04**	-	0.00026	0.00026	0.00026	0.00026	0.00026	0.00027	0.00026	0.00027	0.00026	0.00027	0.00026
Vanadium (V)	**0.1**	-	0.026	0.026	0.026	0.026	0.026	0.027	0.026	0.027	0.026	0.027	0.026
Zinc (Zn)	**6.7**	-	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.027	0.026	0.027	0.026

Notes:

Units in µg/m^3

TSP - total suspended particulates.

"-" indicates no guideline available

a. The screening value utilized in the Air Quality Section (Part B, Section 5.7) is the Air Quality Objective (8 µg/m^3), as this value was consistent with their model plan that was approved by BC MoE. The value

b. Screening value for chromium is for Cr(VI)

value	Exceeds air screening value for Non-Carcinogenic effe
value	Exceeds air screening value for Carcinogenic effects

1. A parameter is retained as a COPC (chemical of potential concern) if the predicted maximum concentration is greater than the air screening value and is also more than 10% above the Base Case concentration, or if an air threshold was not available and the predicted maximum concentration was more than 10% above the Base Case concentration.

2. Although the maximum predicted increase for $PM_{2.5}$ was less than 10%, it was conservatively retained as a COPC because it exceeds the BC MoE Planning Goal and a threshold below which no adverse effects are expected does not currently exist.

Table 9.1-B-6: Screening of Predicted Annual Application Case Air Concentrations
Public Health Assessment
Proposed Burnco Aggregate Project

Parameter	Air Screening Value		Maximum Predicted Concentration	Base Case Concentration	Range of Predicted Increase (Percent Change from Base Case) (%)	Maximum Predicted Increase (Percent Change from Base Case) (%)	Is Percent Change from Base Case >10%?	Predicted Maximum Concentration Above Air Threshold?	Retained as a COPC?[1]
	Non-Carcinogenic	Carcinogenic							
Criteria Air Contaminants									
$PM_{2.5}$[a]	**6**	-	**6.7**	6.2	0.012% to 9%	9%	No	Yes	**Yes**[2]
PM_{10}	**20**	-	12	10	0.027% to 19%	19%	Yes	No	No
Sulphur Dioxide (SO_2)	**30**	-	2.6	2.6	0.0000086% to 0.0023%	0.0023%	No	No	No
Nitrogen Dioxide (NO_2)	**40**	-	10	10	0.0062% to 2%	2%	No	No	No
TSP	**60**	-	26	21	1.4% to 26%	26%	Yes	No	No
Metals									
Aluminum (Al)	**5.2**	-	0.2	0.11	-0.14% to 42%	42%	Yes	No	No
Antimony (Sb)	**0.21**	-	0.0016	0.0016	-0.18% to -0.014%	-0.014%	No	No	No
Arsenic (As)	**0.016**	0.0065	0.0053	0.0053	0.0076% to 0.92%	0.92%	No	No	No
Barium (Ba)	**0.52**	-	0.006	0.0053	0.016% to 8%	8%	No	No	No
Beryllium (Be)	**0.021**	0.012	0.0053	0.0053	0.0065% to 0.023%	0.023%	No	No	No
Bismuth (Bi)	**16.7**	-	0.016	0.016	-0.18% to -0.18%	-0.18%	No	No	No
Cadmium (Cd)	**0.005**	0.016	0.0026	0.0027	-0.18% to -0.16%	-0.16%	No	No	No
Chromium (Cr)	**0.1**[b]	0.00012[b]	0.053	0.053	0.0071% to 0.42%	0.42%	No	Yes	No
Cobalt (Co)	**0.0063**	0.0031	0.0053	0.0053	0.0074% to 0.69%	0.69%	No	Yes	No
Copper (Cu)	**3.3**	-	0.005	0.0053	0.0091% to 2%	2%	No	No	No
Iron (Fe)	**3.3**	-	0.2	0.11	-0.066% to 93%	93%	Yes	No	No
Lead (Pb)	**0.15**	-	0.016	0.016	-0.18% to 0.60%	0.60%	No	No	No
Lithium (Li)	**0.67**	-	0.027	0.027	-0.18% to 0.10%	0.10%	No	No	No
Manganese (Mn)	**0.052**	-	0.004	0.0027	-0.12% to 48%	48%	Yes	No	No
Mercury (Hg)	**0.2**	-	0.00053	0.00053	0.0067% to 0.16%	0.16%	No	No	No
Molybdenum (Mo)	**10**	-	0.016	0.016	-0.18% to -0.16%	-0.16%	No	No	No
Nickel (Ni)	**0.015**	0.025	**0.016**	0.016	-0.18% to 0.37%	0.37%	No	Yes	No
Selenium (Se)	**21**	-	0.026	0.027	-0.18% to -0.17%	-0.17%	No	No	No
Silver (Ag)	**0.033**	-	0.0016	0.0016	-0.18% to -0.15%	-0.15%	No	No	No
Strontium (Sr)	**6.7**	-	0.0028	0.0027	-0.17% to 6%	6%	No	No	No
Thallium (Tl)	**0.33**	-	0.0026	0.0027	-0.18% to -0.16%	-0.16%	No	No	No
Tin (Sn)	**6.7**	-	0.016	0.016	-0.18% to -0.14%	-0.14%	No	No	No
Titanium (Ti)	**0.1**	-	0.03	0.027	-0.16% to 15%	15%	Yes	No	No
Uranium (U)	**0.04**	-	0.00027	0.00027	-0.18% to 3%	3%	No	No	No
Vanadium (V)	**0.1**	-	0.027	0.027	-0.18% to 0.85%	1%	No	No	No
Zinc (Zn)	**6.7**	-	0.027	0.027	-0.18% to 0.54%	1%	No	No	No

Notes:

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