Human Health Risk Assessment Technical Data Report

LNG Canada Export Terminal

October 2014

LNG CANADA

Opportunity for British Columbia. Energy for the world

Joint venture companies

Mitsubishi Corporation

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EXECUTIVE SUMMARY

LNG Canada Development Inc. is proposing to construct and operate a liquefied natural gas (LNG) facility (including an LNG processing and storage site and marine terminal) in the District of Kitimat, British Columbia (BC), and to export LNG from the facility by shipping. This proposed project is called the LNG Canada Export Terminal (the Project). The Application Information Requirements for the Project identified human health as a valued component. This Human Health Risk Assessment Technical Data Report (TDR) presents baseline information, methods, and results of the human health risk assessment conducted for the Project to support the anticipated Application for the Environmental Assessment Certificate.

This TDR considers the potential ways that people living in the Kitimat area could come into contact with chemical emissions from the Project through consumption of terrestrial and marine country foods as well as direct inhalation exposures to criteria air contaminants, including sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), and fine particulate matter ($PM_{2.5}$). While the assessment determined that the potential for residual effects associated with the Project were limited to direct inhalation exposures to SO_2, the potential human health risks associated with combined exposures to SO_2 and NO_2 were also evaluated to address specific concerns raised by Health Canada and the BC Ministry of Health.

The assessment of potential health risks was evaluated for five areas within the Kitimat River Valley that contain most of the population and were considered representative of potential human exposures in the entire area. An additional 29 special receptor locations identified as being of particular concern to the community were also included. Of these 29 special receptor locations, 21 were located within the five study areas and were incorporated into the assessment of these areas. The remaining eight special receptors, which were located outside the five study areas, were assessed individually.

Air quality modelling for each of the five human health study areas was completed on a 50 m by 50 m grid providing approximately 1,000 grid points within each study area. For each study area, air quality modelling predictions of the hourly SO_2 and NO_2 and the 5-minute SO_2 concentrations were used to estimate potential human health risks associated with exposures to these chemicals for the base case (which includes the Rio Tinto Alcan upgrade), Project-alone case, application case, and cumulative case. Details of the air modelling are provided in the Air Quality TDR.

To evaluate the worst-case scenario in the human health evaluation it was conservatively assumed that the grid location with the maximum modelled concentration represented the concentration occurring within each of the five study areas. For each respective area, the grid point with the highest hourly SO_2 and NO_2 data was identified, and the three-year dataset were extracted and used to represent the SO_2

and NO_2 concentrations in that area. Because the SO_2 and NO_2 grid points are not in the same location, this approach provides a reasonable worst-case estimate of potential exposures for each of the respective study areas.

The modelled air quality concentrations were compared with human health–based air quality standards or guidelines. This comparison showed that the maximum predicted concentrations of CO, $PM_{2.5}$, and NO_2 were below their respective guidelines for the base, Project-alone, application, and cumulative cases, indicating that the predicted maximum concentrations of these chemicals do not represent a potential concern to human health. The predicted maximum concentrations of SO_2 for the base, application, and cumulative cases exceeded the human health–based air quality guideline. However, the predicted maximum SO_2 concentration for the Project-alone case did not exceed the air quality guideline. The potential human health risks associated with the predicted SO_2 concentrations were examined in more detail and the results showed that, although the maximum predicted SO_2 concentrations exceeded the health-based air quality guideline, the exceedances were rare (generally fewer than 10 exceedances per three-year period) for the base, application, and cumulative cases. The SO_2 concentrations predicted for the application and cumulative cases showed marginal increases over those predicted for the base case. In addition, the predicted increases in respiratory events associated with 5-minute SO_2 exposures, between the base, application, and cumulative cases were less than 0.01%.

Based on these results, the assessment concluded that Project residual effects are not predicted to result in a change in human health as a result of changes in air quality related to SO_2 emissions or changes in air quality related to combined SO_2 and NO_2 emissions.

Changes in criteria air contaminant concentrations in the Kitimat River Valley air shed that occur between the base case and cumulative case do not present potential human health concerns either from direct inhalation exposures to PM, CO, and NO_2, or through the consumption of terrestrial or marine country foods.

Cumulative effects from existing projects, including the expected increases from the Rio Tinto Alcan modernization project, are expected to cause an incremental increase in SO_2 concentrations from the base case to the cumulative case. Because the increase in potential respiratory events from the base case to the cumulative case is anticipated to be less than 0.01%, changes in human health associated with changes in SO_2 exposures are considered to be negligible, and the effects would be reversible.

ACRONYMS AND ABBREVIATIONS

AAQO ..... ambient air quality objectives
BC ..... British Columbia
Alcan ..... Aluminum Company of Canada
BC ..... British Columbia
CAC ..... criteria air contaminants
CCME ..... Canadian Council of Ministers of the Environment
CO ..... carbon monoxide
COC ..... contaminant of concern
COPC ..... contaminant of potential concern
COPD ..... chronic obstructive pulmonary disease
CO_2 ..... carbon dioxide
CR ..... concentration ratio
CSM ..... conceptual site model
DFO ..... Fisheries and Oceans Canada
EDI ..... estimated daily intake
ESRD ..... Alberta Environment and Sustainable Resource Development
ha ..... hectares
HHRA ..... Human Health Risk Assessment
ISQG ..... interim sediment quality guideline
LNG ..... liquefied natural gas
LNG Canada ..... LNG Canada Development Inc.
LSA ..... local study area
km ..... kilometres
MOE ..... Ministry of Environment
mtpa ..... millions tonnes per annum
NAAQS ..... National Ambient Air Quality Standards
NO ..... nitric oxide

NO_x ..... oxides of nitrogen
NO_2 ..... nitrogen dioxide
PAH ..... polycyclic aromatic hydrocarbon
PCB ..... polychlorinated biphenyl
PCDD/F ..... polychlorinated dibenzo-para-dioxins and furans
PEL ..... probable effects level
PM ..... particulate matter
$PM_{2.5}$ ..... particulate matter with diameters less than 2.5 µm
$PM_{2.5}$ ..... particulate matter with diameters less than 10 µm
ppm ..... parts per million
Project ..... LNG Canada Export Terminal
RSA ..... regional study area
RTA ..... Rio Tinto Alcan
SO_2 ..... sulphur dioxide
Stantec Consulting Ltd. ..... Stantec
STAR ..... *Sulphur Dioxide Technical Assessment Report*
TDR ..... technical data report
TEQ ..... toxic equivalencies
TRV ..... toxicity reference value
U.S. EPA ..... United States Environmental Protection Agency
VC ..... valued component
WHO ..... World Health Organization

GLOSSARY OF TECHNICAL TERMS

Term	Definition
Criteria Air Contaminant	Chemical contaminants that are identified by government agencies as being the primary contaminants of concern associated with combustion sources.
Concentration Ratio (CR)	The ratio between the predicted Project-related concentration of a chemical in air or water and the concentration of the chemical considered to be protective of human health.
Contaminant of Concern (COC)	Chemical contaminants that are identified as being present at concentrations that could represent a potential concern to human health. Chemicals that are identified as COCs undergo quantitative assessment in the human health risk assessment.
Contaminant of Potential Concern	Chemical contaminants that are identified as being present at concentrations that exceed an established regulatory guideline. Chemicals that are identified as COPCs undergo a second screening to determine if they are present at concentrations that would classify them as COCs.
Human Health–Based Ambient Air Quality Criteria	The concentration of a chemical in air considered to be protective of human health
Human Health Risk Assessment	A process that evaluates the potential human health risks associated with predicted exposures to chemicals in the environment.
Toxicity	The ability of a chemical to cause biological harm.
Toxic Equivalencies	A means of relating the toxicities to a group of chemicals that cause the same biological effect to toxicity of a chemical from within that group whose toxic equivalency is set at a value of 1.0. Chemicals within the groups whose toxicities are greater than that of the chosen chemical will have toxic equivalencies that are higher than 1.0. Likewise, chemicals within the group whose toxicities are lower than the chosen chemical will have toxic equivalencies that are lower than 1.0
Toxicity Reference Value	The daily-averaged exposure limit for a chemical below which there will be no concern for adverse human health effects. This is sometimes referred to as the *"allowable daily intake."*

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1 INTRODUCTION

1.1 Overview

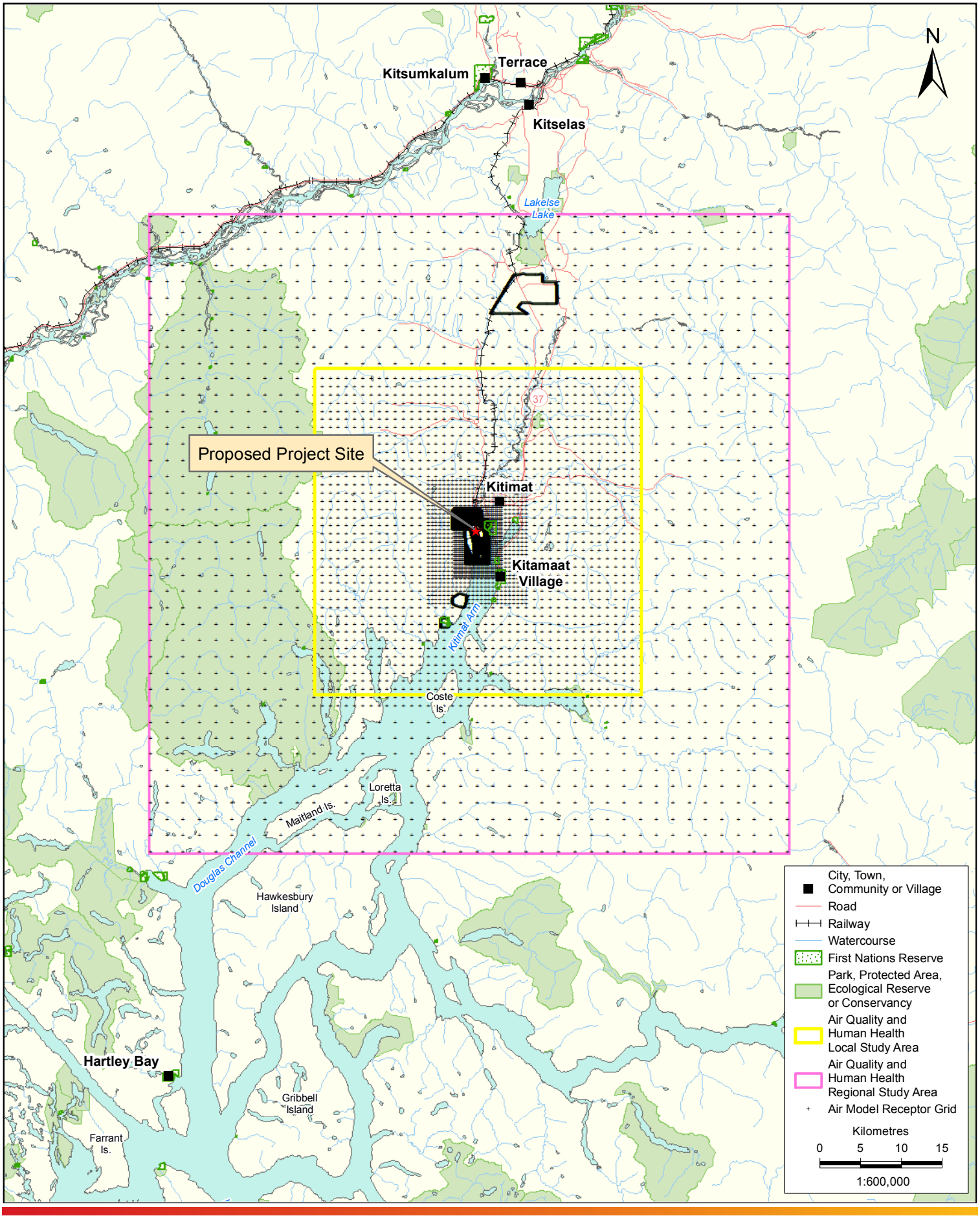
LNG Canada Development Inc. (LNG Canada) is proposing to construct and operate a liquefied natural gas (LNG) facility (including an LNG processing and storage site and marine terminal) in the District of Kitimat, British Columbia (BC), and to export LNG from the facility by shipping. This proposed project is called the LNG Canada Export Terminal (the Project).

Stantec Consulting Ltd. (Stantec) was retained by LNG Canada to conduct a Human Health Risk Assessment (HHRA) in support of the environmental assessment for the Project. The Project is located in the industrial-zoned-area, adjacent to the Rio Tinto Alcan (RTA) facility, approximately 4 km from the service centre of Kitimat and approximately 6 km from Kitamaat Village (Figure 1.1-1).

1.2 Project Background

The Proponent for the Project, LNG Canada, is an operating entity established by its four Project Participants: Shell Canada Energy, Diamond LNG Canada Ltd. (an affiliate of Mitsubishi Corporation), KOGAS Canada LNG Ltd. (an affiliate of Korea Gas Corporation), and Phoenix Energy Holdings Ltd. (an affiliate of PetroChina Investment [Hong Kong] Ltd.).

The Project will be constructed in two or three stages. Following the first phase of development, the Project is anticipated to have a capacity of approximately 13 million tonnes of LNG per annum (mtpa); a further 13 mtpa of design capacity will be added in one or two subsequent phases. Construction of the first phase of the Project will take approximately five to six years. Commission of the first phase will follow the completion of construction. Subsequent phase(s) will be developed as market demand requires and would take an additional one to three years of construction. At full build-out (including all phases), the Project will process approximately 96 million m^3/day of natural gas (3.4 billion standard cubic feet per day or 3.57 PetaJoules [PJ] per day) supplied by a third-party-owned and operated pipeline, a processing and shipping capacity of approximately 26 mtpa of LNG to global markets, and a storage capacity of 450,000 m^3 of LNG, equivalent to approximately 10.5 PJ of potential energy.



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HUMAN HEALTH RISK ASSESSMENT TECHNICAL DATA REPORT

AIR QUALITY AND HUMAN HEALTH LSA AND RSA

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

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1.3 Regulatory and Policy Setting

The Application for an Environmental Assessment Certificate (EAC) focuses on a suite of valued components (VC). The VCs are components of the natural and human environment that are considered by the proponent, public, Aboriginal Groups, scientists and other technical specialists, and government agencies involved in the assessment process to have scientific, ecological, economic, social, cultural, archaeological, historical, or other importance. Human health is identified as a VC, and human health risk assessment (HHRA) is a systematic and well documented process to define and quantify potential human health risks.

In BC, public health is the responsibility of the provincial Minister of Health in accordance with the *Public Health Act*. Health Canada also has a mandate to protect humans from exposure to chemicals. Health Canada provides guidance on human health risk assessments and evaluates human health issues for major projects regulated under the *Canadian Environmental Assessment Act*. Federal and provincial guidance has been used in the assessment of potential human health risks associated with baseline and Project-related conditions including:

- Health Canada: Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (Health Canada 2010a)
- Health Canada: Federal Contaminated Site Risk Assessment in Canada, Part V: Guidance on Human Health Detailed Quantitative Risk Assessment for Chemicals (Health Canada 2010b), and
- Ministry of Environment (MOE): Contaminated Sites Regulation (BCMOE 2014).

1.4 Scope of the Assessment

A HHRA was completed to evaluate the potential health risks associated with human exposures to chemical emissions from the Project for people in the Kitimat River Valley. Emissions from the Project have the potential to affect the atmospheric, freshwater aquatic, and terrestrial environments. The release of criteria air contaminants (CACs) from construction and operation of the facility have the potential to affect the atmospheric and terrestrial environments. The release of dust during construction has the potential to affect the terrestrial environment. The resuspension of sediment-bound chemicals during dredging in preparation for shipping has the potential to affect the marine aquatic environment.

The CACs associated with Project emissions do not represent a potential inhalation exposure concern for terrestrial animal receptors. Fugitive dusts released by Project activities are not expected to alter the consumption of dirt by terrestrial receptors either as dirt adhered to vegetation or prey items. In addition, dredging activities are not anticipated to alter the exposure to chemicals experienced by marine ecological receptors. Thus, Project activities are not expected to represent a change in chemical

exposures experienced by terrestrial and marine ecological receptors beyond what currently occurs. Therefore, an ecological risk assessment to evaluate changes in chemical exposures and the associated risks to ecological receptors has not been undertaken. Evaluation of the potential physical risks to terrestrial and marine ecological receptors is provided in the marine resources and wildlife assessments completed as part of the Project Application submission.

This HHRA technical data report (TDR) presents background information, methods, and results for the human health baseline and potential-effects studies conducted for the Project. The professional judgment of the study team and input from consultation with regulators, Aboriginal Groups, and the public guided the scope of the study. The study was initiated with a review of existing information.

The HHRA is designed to overestimate, rather than underestimate, the potential health risk for people who live in the Kitimat River Valley, including Aboriginal Groups who rely on the viability of the local habitat and ecological resources in area, and where necessary suggest mitigation measures to prevent unacceptable health risk associated with exposures to chemicals released from the Project facility. The HHRA follows a standard framework consisting of five primary components:

- **Problem Formation:** The problem formation stage involves the identification of the chemicals, exposure pathways, and human receptors. The objective of the problem formulation stage is to develop a conceptual site model (CSM). The CSM is the foundation of the HHRA, identifying the human receptors to evaluate and the chemicals and exposure pathways that have the potential to influence the human health risk associated with the Project.
- **Toxicity Assessment**: The toxicity assessment is conducted for each chemical of potential concern (COPC) identified in the problem formulation stage. The toxicity assessment identifies the toxicity reference values (TRVs) that are to be used to assess the potential human health risk associated with exposures to the COPCs and the source agencies from which the TRVs have been selected. For each COPC, the toxicity assessment also identifies the health effect that is the basis for the TRV and identifies whether the COPC is considered to be non-carcinogenic or carcinogenic.
- **Exposure Assessment**: The exposure assessment provides estimates of the potential exposure to each COPC for each of the exposure pathways that are identified in the CSM as having the potential to influence human health risk. The exposure assessment is completed for each of the human receptors identified in the CSM for each phase of the Project.
- **Risk Characterization**: The risk characterization stage involves quantifying the potential risk to human receptors from each operable pathway for each phase of the Project. The risk characterization compares the results of the exposure assessment with the TRVs established in the toxicity assessment to define the level of human health risk against risk thresholds established by Health Canada and other regulatory agencies such as the United States Environmental Protection Agency (U.S. EPA), the World Health Organization (WHO) and the

MOE. If the risk thresholds are exceeded, the risk is further characterized by magnitude and risk type.

- **Uncertainty Assessment**: The uncertainty assessment provides an indication of the validity and confidence of risk estimates by identifying the uncertainties associated with the data that affects the final risk estimate. Uncertainties may exist in numerous areas including the collection and analysis of samples, estimates of exposure, derivation of TRVs, and assumptions used when best professional judgment is applied.

This HHRA evaluates potential risk for four scenarios:

- Base case–corresponds to baseline concentrations present in Kitimat River Valley in the absence of the Project (includes proposed modernization upgrades to RTA)
- Project-alone case–increase in concentrations related to Project activities
- Application case–includes baseline concentrations as well as contributions from the Project
- Cumulative case–includes baseline concentrations, contributions from the Project, and contributions for anticipated future developments that might affect the quality of environmental media in the Kitimat River Valley.

2 PROBLEM FORMULATION

2.1 Introduction

The problem formulation is composed of four main components:

- site characterization
- receptor identification
- exposure pathway analysis, and
- identification of relevant COPC concentrations against regulatory benchmarks.

These four components of the problem formulation stage are integrated to develop a CSM, which is the foundation of the HHRA.

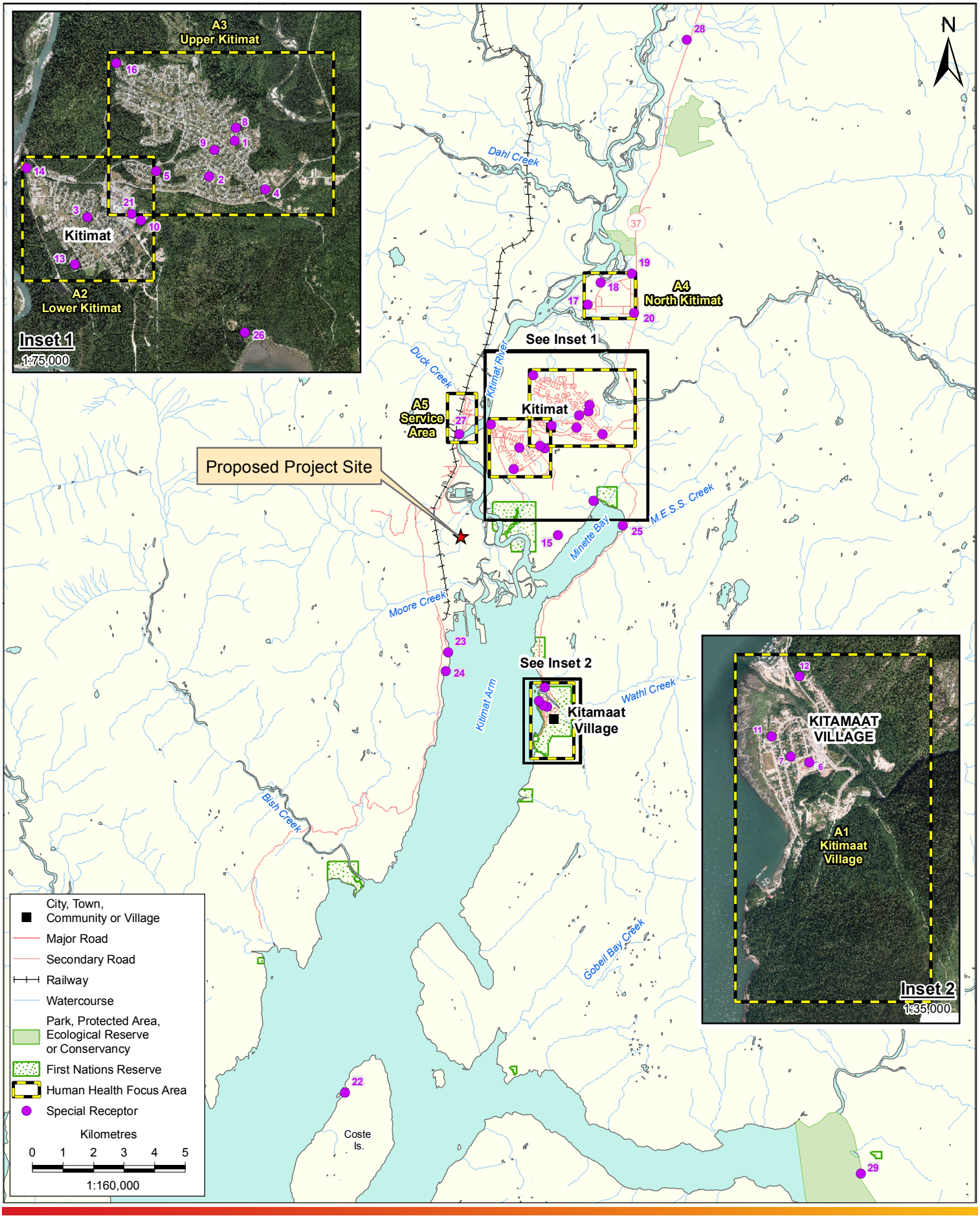
2.2 Site Characterization

The site characterization provides a description of the assessment area for the Project that is relevant to the HHRA. This includes descriptions of land and marine resource use, and the baseline quality of environmental media (e.g., air, water, soil, and country food). The site characterization provides the context for how the Project could affect the environment in a manner that may result in a change in human health risk.

2.2.1 Land and Marine Resource Use

The Project is located in an industrial zone adjacent to the RTA facility approximately 2 km north of the Kitimat Arm of Douglas Channel (Figure 1.1-1 and Figure 2.2-1) in the Kitimat River Valley in northwest BC. Current industrial shipping traffic in the area is primarily associated with the RTA facility. The nearest residential areas are Kitimat (approximately 2 km to the northeast) and Kitamaat Village (approximately 6 km to the south across Kitimat Arm) (see Figure 2.2-1)

The Project is located in the traditional territory of Haisla First Nation (Powell 2013), and local people (both Aboriginals and non-Aboriginals) harvest terrestrial country foods (plants and animals) from the areas around the Project. Local people (including Aboriginals) also harvest marine country foods. Fisheries and Oceans Canada (DFO) has issued a permanent year-round ban on harvesting and consumption of shellfish in Kitimat Arm because of the presence of potential marine biotoxins.



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HUMAN HEALTH RISK ASSESSMENT TECHNICAL DATA REPORT

HUMAN HEALTH FOCUS AREAS AND SPECIAL RECEPTOR LOCATIONS

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

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2.2.2 Baseline Information

2.2.2.1 Baseline Data Sources

To support the evaluation of Project effects on human health, baseline conditions were identified using multiple sources, including technical reports and other available literature. Traditional knowledge information was acquired from a variety of sources, such as traditional-use studies provided by potentially affected Aboriginal Groups, ethnographic and ethno-historic sources (see Sections 13 and 14 of the Application), academic papers, and sources from other environmental assessments.

Baseline information for each applicable media (air, surface water, sediment, country foods) is provided below.

2.2.2.2 Air Quality

This section contains a description of the general modelling approach used to estimate the concentrations of CACs in air, and applies to the base, Project-alone, application, and cumulative cases. This description is an overview of the modelling approach as it pertains to the assessment of potential human health effects. Detailed information on air quality modelling is provided in the Air Quality TDR (Stantec 2014a).

2.2.2.3 Criteria Air Contaminants

For this HHRA, CACs include:

- Particulate matter ($PM_{2.5}$ and PM_{10}): Project emissions will be from vehicle and marine vessel exhaust and equipment. Facility stack emissions may also be a source of PM.
- Carbon monoxide (CO): Construction equipment, gas turbines, and other onsite combustion processes will be the primary sources of CO. Marine activities could also lead to small amounts of CO emissions.
- Nitrogen dioxide (NO_2): Project emissions of NO_2 will be from gas turbines and other onsite combustion processes. Flaring and marine activities could also lead to small amounts of NO_2 emissions.
- Sulfur dioxide (SO_2): Project emissions of SO_2 will be from gas turbines and other onsite combustion processes. Small amounts of SO_2 emissions will result from flaring and marine activities. During normal operations, vent gases are not expected to be routed to the flares; and flare emissions will be limited to the combustion of pilot and purge gas only. A higher rate of SO_2 emissions will occur for short periods of time during emergency or upset flaring.

General Approach for Predicting Air Quality

Air quality under all cases (base, Project-alone, application, and cumulative cases) is based on CALPUFF air dispersion modelling. Air modelling incorporated the anticipated CACs for the Project (PM, SO_2, NO_2, and CO) and was based on three years of air data (2008, 2009, and 2010) collected from the areas

around the proposed Project location. Air modelling for the base case included all current sources of CACs as well as the planned RTA modernization project, which is anticipated to increase the concentrations of CACs in the Kitimat airshed. The proposed location of the Project is adjacent to the current RTA facility.

Air modelling was conducted for five human health focus areas, including four residential areas, numbered A1 (Kitamaat Village), A2 (lower Kitimat), A3 (upper Kitimat), and A4 (north Kitimat), and A5, the service area, defined as the commercial/industrial area located across the Kitimat River from lower Kitimat. In addition, of the 29 special receptor locations considered in the assessment, 8 lie outside of these five areas. Additional detail on the selection of these locations is provided in Section 2.3.1. In the human health focus areas, modelling was conducted on a 50 m by 50 m grid spacing. This provided approximately 1,000 grid points in each of the five study areas. Concentrations of CACs (including $PM_{2.5}$, CO, NO_2, and SO_2) were modelled for each hour for a period of three years (January 1, 2008, through December 31, 2010), providing 26,304 (24 h/d, 365 d/y, 3 y) hourly estimated air concentrations for each CAC for each grid point within each human health focus area and approximately 26,000,000 data points per CAC per focus area. Air quality modelling was also conducted for each of the eight special receptor points located outside the five human health focus areas, over the same three-year period providing approximately 26,000 data points per CAC per special receptor location.

Further technical details related to the modelling methods are provided in the Air Quality TDR (Stantec 2014a). The 1-hour modelling data were used to provide summary 1-hour, 8-hour, 24-hour, and annual maximum estimated air concentrations for each of the CACs. The selection of averaging periods used in the HHRA was determined by the exposure averaging periods set by regulatory agencies in the derivation of the human health–based exposure limits.

The combined NO_2 and SO_2 concentrations were not modelled directly but were calculated by summing the SO_2 and NO_2 concentrations predicted by the air quality modelling. In each of the five human health focus areas, the grid point where the maximum predicted SO_2 concentration was identified and the full three-year set of 1-hour air quality modelling predictions (approximately 26,300 1-hour SO_2 predicted concentrations) were extracted from the larger data set of approximately 1,000 grid points for that area. The same process was used to select the 1-hour NO_2 concentration data from within each human health focus area. The predicted SO_2 and NO_2 concentrations were summed for each 1-hour time increment across the full three-year period. This approach provides a conservative estimate of potential combined exposures by assuming that the maximum SO_2 and NO_2 concentrations occur at the same geographic location within each of the human health study areas. Because the maximum SO_2 and NO_2 concentrations seldom occur at the same location, this approach overestimates the potential combined concentration which, in turn, will result in an overestimation of potential health risks. For the eight special

receptor locations outside the human health focus areas, the predicted hourly SO_2 and NO_2 concentrations were summed to provide the combined estimated SO_2 and NO_2 concentrations.

Predicted Base Case Air Quality

The maximum concentrations for $PM_{2.5}$ (24-hour, annual average), CO (1-hour, 8-hour), NO_2 (1-hour, 8-hour), SO_2 (1-hour, 24-hour, and annual average), and combined NO_2 and SO_2 modelled for baseline (base case) conditions for the five human health focus areas and the eight special receptor locations are summarized in Table 2.2-1 through Table 2.2-4.

Table 2.2-1: Modelled Concentrations of $PM_{2.5}$ and CO for Base Case

AREA	$PM_{2.5}$ Concentrations (µg/m^3)		CO Concentrations (µg/m^3)	
	24-h Max	Annual Max	1-h Max	8-h Max
Human Health Focus Areas				
A1 - Kitamaat Village	6.61	0.21	34.05	0.83
A2 - lower Kitimat	4.25	0.51	27.22	8.51
A3 - upper Kitimat	4.39	0.38	15.94	7.15
A4 - north Kitimat	2.54	0.26	7.22	2.19
A5 - service area	4.30	0.83	10.10	3.26
Special Receptor Locations				
15 - southeast residence	2.7	0.16	10.4	4.0
22 - Coste Island	1.2	0.07	9.8	2.1
23 - southwest dockyard	10.2	1.14	7.4	2.7
24 - Half Moon Bay	7.7	0.86	8.1	2.9
25 - Minette Bay	2.5	0.15	16.9	6.4
26 - Minette Bay Lodge	2.7	0.16	15.7	6.2
28 - Kitimat Airport	2.9	0.31	7.4	4.1
29 - Kildala Beach	0.59	0.02	6.76	1.71

Table 2.2-2: Modelled Concentrations of NO_2 for Base Case

Area	NO_2 Concentrations (µg/m^3)	
	1-h Max	Annual Max
Human Health Focus Areas		
A1 - Kitamaat Village	27.5	0.24
A2 - lower Kitimat	30.2	0.40
A3 - upper Kitimat	14.8	0.37
A4 - north Kitimat	6.7	0.22
A5 - service area	21.1	0.46
Human Health Focus Areas		
15 - southeast residence	8.9	0.18
22 - Coste Island	6.1	0.05
23 - southwest dockyard	23.5	0.31
24 - Half Moon Bay	18.0	0.30
25 - Minette Bay1	9.0	0.12
26 - Minette Bay Lodge	8.4	0.18
28 - Kitimat Airport	6.4	0.21
29 - Kildala Beach	5.2	0.022

Table 2.2-3: Modelled Concentrations of SO_2 for Base Case

Area	SO_2 Concentrations (µg/m^3)		
	1-h Max	24-h Max	Annual Max
Human Health Focus Areas			
A1 - Kitamaat Village	734.8	85.3	1.54
A2 - lower Kitimat	674.0	53.5	5.06
A3 - upper Kitimat	678.2	54.9	4.56
A4 - north Kitimat	181.4	40.5	3.36
A5 - service area	461.6	50.3	8.50
Special Receptor Locations			
15 - southeast residence	186.9	40.2	1.27
22 - Coste Island	62.1	10.2	0.49
23 - southwest dockyard	393.0	67.4	3.7
24 - Half Moon Bay	449.5	50.9	3.0
25 - Minette Bay1	341.7	32.2	1.4
26 - Minette Bay Lodge	204.1	38.7	1.3
28 - Kitimat Airport	172.9	38.3	5.0
29 - Kildala Beach	20.1	3.9	0.16

Table 2.2-4: Modelled Combined Concentrations of NO_2 and SO_2 for Base Case

AREA	Combined NO_2 and SO_2 Concentrations ($\mu g/m^3$)
	1-h Max
Human Health Focus Areas	
A1 - Kitamaat Village	735.9
A2 - lower Kitimat	678.1
A3 - upper Kitimat	679.1
A4 - north Kitimat	182.6
A5 - service area	462.7
Special Receptor Locations	
15 - southeast residence	259.4
22 - Coste Island	136.7
23 - southwest dockyard	415.6
24 - Half Moon Bay	464.7
25 - Minette Bay1	345.9
26 - Minette Bay Lodge	218.5
28 - Kitimat Airport	179.7
29 - Kildala Beach	31.0

2.2.2.4 Marine Water Quality

Baseline conditions for water quality are discussed in detail in the Marine Resources TDR (Stantec 2014b).

Air emissions and effluent discharges from various industrial sources in the human health assessment area (including the RTA facility) have influenced water quality in Kitimat Arm since the 1950s, resulting in elevated concentrations of fluoride, metals, and polycyclic aromatic hydrocarbons (PAHs). In the 1980s, fluoride concentrations of up to 15 mg/L were recorded in Kitimat Harbour (location of the Project), which are ten times higher than the BC water quality guideline (WQG) of 1.5 mg/L (Warrington 1987). A study from the late 1970s reported elevated PAH concentrations in water from the human health study area, attributed to a variety of sources including air emissions and effluent discharges from the RTA facility, woodstove exhaust, and residential waste (Warrington 1987; Harris 1999). Samples of bottom water taken at eight locations south of Kitimat, on the west and east shores (north of Bish Cove, 7 km from the RTA facility) in February 2006 were generally below BC WQGs. The exceptions were cadmium (slightly above the BC WQG of 0.00012 mg/L at five sites), zinc (above the BC WQG of 0.01 mg/L at one site, with a value of 0.02 mg/L), and the PAHs chrysene (1 µg/L) and benzo(a)pyrene (0.1 µg/L) at several sites in 2009 (Whitford 2010).

2.2.2.5 Sediment Quality

Baseline conditions for marine sediment quality are described in the Marine Resources TDR (Stantec 2014b).

Sediment quality in the lower Kitimat River and estuary has been influenced by industrial activities since the 1950s, including an aluminum facility, pulp and paper mill, methanol facility, and a log storage area (Levings 1976; MacDonald and Shepherd 1983). The municipal wastewater treatment facility also discharges effluent in the lower Kitimat River. These facilities have been known to input PAHs and certain metals into the marine environment of Kitimat Arm since the 1950s. However, recently PAH concentrations have declined, particularly near the RTA aluminum facility (NOAA 2009).

Golder Associates Ltd (2013, 2014) conducted a marine sediment study (PAHs, polychlorinated biphenyls [PCBs], polychlorinated dibenzo-para-dioxin and furan [PCDD/F] metals) on behalf of LNG Canada to support the analysis of dredging at the proposed marine terminal site and dredgate disposal options (Table 2.2-5). Sixty-four evenly distributed cores were collected in the dredge berth pocket at a depth ranging from 0.3 m to 2.5 m below the mudline (for a total of 133 samples). Additional samples were taken at depths down to 14.3 m at five locations (for a total of 26 samples). Samples were collected at an additional 42 sites within the dredge berth pocket in 2014 (Golder Associates Ltd. 2014). The Canadian Council of Ministers of the Environment (CCME) interim sediment quality guideline (ISQG), probable effects level (PEL), and Canadian disposal at sea criteria were used to screen against chemical concentrations in the sediment samples. While the PEL is an indicator that potential adverse effects could exist for aquatic life, the disposal at sea criteria are used to screen sediments to help establish whether dredged material could be suitable for disposal at sea.

Overall, sediment quality was characterized by elevated concentrations of PAHs and some metals in the surface sediments to a depth of approximately 2.5 m. Sediments from 2.5 m to 14.3 m had substantially lower concentrations of these substances.

Total PAHs were highest in the surface sediments and decreased with depth. Approximately 35% of sediment samples in the upper 2.5 m were above disposal at sea criteria. Among these surface samples, 3 of 133 samples were above the PEL. Sediment samples from 2.5 m to 14.3 m did not exceed any of the applicable guidelines with the exception of one sample.

Table 2.2-5: Marine Sediment Quality in Kitimat Harbour

Contaminants	Guidelines	Surficial Sediment (0.3–2.5 m below mudline)	Deep sediment (2.5–14.3 m below mudline)
PAHs (mg/kg)		<0.05–163.4	1.37–5.86
Guideline Exceedances:	Disposal at Sea = 2.5	46 locations	1 location
	CCME PEL[a]	3 locations	none
PCBs (mg/kg)		<0.03	<0.03
Guideline Exceedances:	Disposal at Sea = 0.1	none	none
	CCME PEL = 0.189	none	none
	CCME ISQG = 0.0215	none	none
PCDD/F (ng/kg TEQ)		0.01–5.89	not analyzed
Guideline Exceedances:	CCME PEL = 21.5	none	not analyzed
	CCME ISQG = 0.85	3 locations	not analyzed
Cadmium (mg/kg)		<0.05–1.62	<0.05–0.205
Guideline Exceedances:	Disposal at Sea = 0.6	3 locations	none
	CCME PEL = 4.2	none	none
	CCME ISQG = 0.7	3 locations	none
Copper (mg/kg)		**11.2–176**	**14.1–42.1**
Guideline Exceedances:	Disposal at Sea = 18.7	64 locations	5 locations
	CCME PEL = 108	2 locations	none
	CCME ISQG = 18.7	64 locations	5 locations
Zinc (mg/kg)		**27.2–391**	**29.3–62.6**
Guideline Exceedances:	Disposal at Sea = 124	2 locations	none
	CCME PEL = 271	1 location	none
	CCME ISQG = 124	2 locations	none

NOTE:
[a] CCME PEL values are not reported because there are multiple values for individual PAHs.

PCB concentrations were analyzed in all sediment samples collected by Golder Associates Ltd. (2013) and contained concentrations below the reported detection limit of 0.030 mg/kg. This detection limit is greater than the IQSG; however, it is below all other relevant provincial and federal sediment quality guidelines. Golder Associates Ltd. (2014) submitted 10 sediment samples for analysis of PCB concentrations. All samples submitted for analysis contained concentrations below the reported detection limit of <0.020 mg/kg, with the exception of one sample collected between 0 m and 0.25 m below the mudline, which contained PCB concentrations greater than the IQSG of 0.0215 mg/kg.

PCDD/F were analyzed in six sediment samples collected by Golder Associates Ltd. (2013) and seven samples collected by Golder Associates Ltd. (2014). Nine of the 13 samples submitted for analysis contained concentrations greater than the ISQG (0.85 pg/g toxic equivalencies [TEQ]), but well below the PEL guideline (21.5 pg/g TEQ).

All sediment samples were analyzed for a suite of 30 metals. Most metals were below the detection limit; however, cadmium, copper, and zinc were detected at concentrations that exceeded the disposal at sea criteria. Cadmium and zinc concentrations from 0.0 m to 2.5 m exceeded disposal at sea criteria in less than 3% of samples, with none above any guidelines in deeper samples to a depth of 14.3 m. Copper is naturally elevated in the region when compared with reference sites. Approximately 34% of surface sediment samples had copper concentrations above disposal at sea criteria. Less than 2% of samples exceeded the PEL. In sediments to a depth of 14.3 m, copper concentrations occasionally exceeded the ISQG and disposal at sea criteria but were well below the PEL.

2.2.2.6 Country Foods

The area where the Project is located includes the traditional territories of Haisla Nation, Gitga'at First Nation, Gitxaala First Nation, Kitselas First Nation, Kitsumkalum First Nation, Lax Kw'alaams First Nation, and Metlakatla First Nation. For these Aboriginal Groups, terrestrial wildlife, marine wildlife, and vegetation are important ecological, cultural, and economic resources. In addition, traditional-use activities such as gathering and consumption of country foods are important for nutritional health. Species richness is therefore inherently linked to the health and well-being of these Aboriginal Groups. The marine and terrestrial environments provide a variety of species for harvest; the terrestrial environment also provides various medicinal and culturally important plants.

Traditional knowledge and traditional use information was gathered from Project studies submitted to LNG Canada and from publicly available sources. Project studies undertaken as part of the Application are discussed in Sections 6, 7.2, and 7.5 of the Application. This material informed the baseline conditions for the assessment. Information from these studies also contributed to the identification of the marine country foods considered in the assessment.

Terrestrial animals used by Aboriginal Groups for food include deer, moose, mountain goat, black bear, duck, goose, swan, quail and small furbearing animals (beaver, marten, fisher, land otter, mink, weasel, and muskrat). Vegetation collected for food, medicinal, or cultural purposes include berries, crab apples, wild rice, various tubers, and roots.

Marine fish harvested for food include salmon, herring, eulachon, halibut, and cod. Marine invertebrates include shellfish, octopus, shrimp, prawn, and crab. Aboriginal Groups also use seaweed and kelp. Some marine mammal species have a spiritual and cultural use, such as sea lions, river otters, porpoises, grey

sharks, orcas, and other whale species (fin, grey, sperm, and humpback), but only harbour seals and sea lions are hunted. PAH levels reported in Kitimat Arm had raised concerns in the local communities regarding the potential effect on the quality of marine country foods, resulting in several studies on contaminant levels in the tissue of marine organisms. Pelagic fish (e.g., juvenile chinook salmon), demersal fish (e.g., yellowfin sole, English sole), and benthic organisms that live in or on sediments or filter feed near the benthos (e.g., clams, mussels, crabs) are considered most likely to be exposed to and accumulate contaminants (NOAA 2009).

Disturbance of sediments as a result of dredging represents the highest potential for a change in fish health as a result of the Project. However, several studies have shown that PAHs in sediment from the Kitimat Arm have low bioavailability and that effects on fish and other marine biota are limited. Paine et al. (1996) reported that sediment from Kitimat Harbour did not cause toxicity in sand dollars (*Dendraster excentricus*) or amphipods (*Rhepoxynius abronius*), despite total PAH concentrations up to 9,890 mg/kg (in comparison, the highest total PAH value recorded in Golder's 2012 program was 163 mg/kg). Paine et al. 1996) found minimal differences in the health of crabs from Kitimat Harbour and a reference site. Using lower analytical detection limits, Eickhoff et al. (2003) reported higher PAH concentrations in Dungeness crabs from near the aluminum facility than in crabs from the rest of Douglas Channel; but, the differences in concentrations were not statistically significant. A study of PAH accumulation in soft-shell clams, sampled from 1995 to 2000, found that aluminum-facility-derived PAHs were not bioavailable, but PAHs associated with effluent from the pulp mill on the Kitimat River (closed in 2010) were bioavailable (Yunker et al. 2011). Low uptake and associated low bioavailability of PAHs has been attributed to PAHs being associated with large particle sizes (Paine et al. 1996) and presence of the PAHs in pitch or soot particles (Yunker et al. 2011). Previous studies found no evidence of metal bio-accumulation in fish from the area (NOAA 2009).

Some evidence of PAH bioavailability has been found in fish in the human health study area. A study conducted from 2000 to 2004 found elevated total PAH concentrations in the stomachs and bile of flatfish and juvenile chinook salmon (NOAA 2009). However, only flatfish showed evidence of toxicity (increased incidence of DNA damage and liver lesions compared with reference sites). Juvenile chinook salmon were relatively unaffected, likely because of their wider range and pelagic rather than benthic habitat use. No effect on reproduction was found for either species. The NOAA study concluded that adverse effects associated with the elevated PAH levels in Kitimat Arm were notably lower than reported for other areas with similar concentrations, but different sources of PAHs (e.g., Puget Sound, with urban and industrial sources, rather than the aluminum facility sources in Kitimat).

2.3 Human Receptor Identification

Human health has been selected as a VC and evaluated using a human health risk assessment (HHRA) framework because there is potential for the Project to change the chemical conditions of the environment (air, water, soil, sediment, and country foods). The Project might interact with human health in the following ways:

- Changes in ambient air quality could result in changes in health risks associated with inhalation exposures.
- Changes in ambient air quality could result in acidification of surface waterbodies altering water quality, which could result in changes in health risks associated with consumption of, or contact with, surface water.
- Changes in ambient air quality could result in changes in the quality of terrestrial country foods.
- Resuspension of historical sediment-bound contaminants during dredging and construction of marine wharves could lead to contaminant uptake in marine biota that might be consumed by people.

Chemicals in the environment could be transferred to human receptors through direct exposure or through the consumption of country foods.

The HHRA evaluates the relationship between exposure to chemical stressors and potential effects on health. Project stressors include chemical emissions into the terrestrial, aquatic, and atmospheric environments.

Human receptors are people in the assessment area who could be exposed to a COPC associated with Project activities. The HHRA must be sufficiently comprehensive to take into account human receptors with the greatest potential for exposures to COPCs and those who have the greatest sensitivity for potential health risks resulting from COPC exposures. To provide a comprehensive assessment, the HHRA has considered people of all ages from Aboriginal and non-aboriginal communities who live in the communities of Kitimat or who may work or engage in recreational or traditional activities in the Kitimat area. This includes sensitive members of the population such as young children and the elderly. Because inhalation exposures to CACs is a particular concern, additional consideration has been given to people with pre-existing respiratory conditions such as asthma or chronic obstructive pulmonary disease (COPD).

2.3.1 Human Receptor Locations

The local assessment area (LSA) for assessing potential health risks to humans from potential changes in ambient air quality from facility emissions of CACs is a 40 km by 40 km square centred on the facility (Figure 1.1-1). The HHRA identified five human health focus areas—four residential areas (Kitamaat Village, lower Kitimat, upper Kitimat, and north Kitimat), and the service area (defined as the commercial/industrial area located across the Kitimat River from lower Kitimat)—that represent the locations in the LSA where most of the population is expected to live and work and where the greatest potential for exposure to CAC emissions from the facility is expected to occur (Figure 2.2-1). These areas are numbered A1 (Kitamaat Village), A2 (lower Kitimat), A3 (upper Kitimat), A4 (north Kitimat), and A5 (service area). In addition to these general areas, the HHRA considers potential exposures to CACs at 29 special receptor locations identified as being of particular concern to the communities (Table 2.3-1). These include schools, daycares, seniors' care facilities, health care facilities, and recreational areas. Of these 29 special receptor locations, 8 are outside the boundaries of the human health focus areas identified above, and potential health risks associated with changes in air quality were evaluated for these on an individual location basis. Special receptor locations are identified in Figure 2.2-1.

The regional study area (RSA) used to assess potential health effects beyond the five human health focus areas is a 60 km by 60 km area centred on the facility (Figure 1.1-1). The RSA boundaries to assess air quality effects of shipping on human health are the same as those used to assess shipping effects on air quality and extend 5 km on either side of the marine access route (Stantec 2014a).

The RSA to assess marine contaminant exposure on human health is the same as for marine resources (Marine Resources TDR; Stantec 2014b). The RSA to assess effects of human exposures to CACs in terrestrial and freshwater aquatic country foods is the combined RSAs for vegetation resources (1,279 km^2) (Vegetation Resources TDR; Stantec 2014c), wildlife resources (31,000 km^2, extending from lower Kitimat River to high alpine habitat; Wildlife Resources TDR; Stantec 2014d), and freshwater and estuarine fish and fish habitat VCs (3,780 km^2; Freshwater and Estuarine Fish and Fish Habitat TDR; Stantec 2014e).

The LSA for the potential uptake of CACs into terrestrial and freshwater aquatic, estuarine, and marine country foods, which are consumed by local people, is the same as the combined RSAs for vegetation resources, wildlife resources, and freshwater and estuarine fish and fish habitat VCs and the LSA for marine resources for the LNG facility.

Table 2.3-1: Special Receptor Locations

Number	Name	Outside Human Health focus Areas (Y/N)
Schools		
1	Mount Elizabeth Secondary School	N
2	Nechako Elementary School	N
3	Kildala Elementary School	N
4	St. Anthony's Catholic Elementary School	N
5	Kitimat City High School	N
6	Haisla Community School	N
Daycares		
7	C'Imo'Ca Child Care Centre	N
8	Kitimat Child Development Centre	N
9	Stepping Stones Preschool	N
Health Care		
10	Kitimat General Hospital and Health Centre	N
11	Haisla Recovery Centre - Kitamaat Village	N
Residential/Recreational		
12	Nearest resident - Kitamaat Village (Haisla)	N
13	Nearest resident - Kitimat town	N
14	Kitimat residence(2)	N
15	Southeast residence	Y
16	Kitimat residence (N)	N
17	N Kitimat (SW)	N
18	N Kitimat (NW)	N
19	N Kitimat (NE)	N
20	N Kitimat (SE)	N
Senior Centres		
21	Kiwanis Senior Society	N
Other		
22	Coste Island	Y
23	Southwest dockyard	Y
24	Half Moon Bay	Y
25	Minette Bay1	Y
26	Minette Bay Lodge	Y
27	Kitimat service area	N
28	Kitimat Airport	Y
29	Kildala Beach	Y

2.4 Screening for Chemicals of Concern

2.4.1 Air Quality Screening

For the five human health focus areas and the eight special receptor locations located outside of these focus areas, CAC concentrations were modelled for the base case, Project-alone case, application case, and cumulative case. Assessing the potential human health risk associated with the Project-alone case would not provide a conservative evaluation of the potential change in human health associated with Project-related emissions to the Kitimat River Valley air shed because it does not take existing air quality and exposure conditions into account. Focusing on the changes in air quality that occur between the base case and the application and cumulative cases provides a better understanding of the Project's contribution to air quality and potential human health risks than looking at the Project in isolation. Therefore, the HHRA focusses on evaluating the changes in air quality and associated health risks that occur between the base case, application case, and cumulative case.

2.4.2 Selection of Human Health–Based Air Quality Criteria

The human health–based air quality criteria considered applicable for comparison with maximum concentrations of CACs are:

- BC Ambient Air Quality Objectives (BC AAQOs 2013)
- United States National Ambient Air Quality Standards (2010) (NAAQS 2010)
- Alberta Ambient Air Quality Objectives and Guidelines (2013) (ESRD 2013), and
- WHO Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide. Global update 2005 (WHO AAQ Guidelines 2005)

For each of the CACs, the most conservative (lowest) criterion listed by these agencies was selected (Table 2.4-1). BC is in the process of developing interim AAQOs for NO_2 and SO_2 that will be available in 2014. In the interim, BC has selected a value of 200 µg/m^3 for the 1-hour SO_2 criterion. There is no health-based criterion for the combined concentrations of NO_2 and SO_2; in the absence of a criterion for combined NO_2 and SO_2 concentrations, maximum combined NO_2 and SO_2 concentration was compared to the 1-hour criterion for NO_2 (188 µg/m^3), which is more conservative than the criterion for SO_2 (200 µg/m^3).

Table 2.4-1: Human Health–Based Air Quality Criteria

Contaminants	Human Health–Based Air Quality Criteria (µg/m^3)	Reference
$PM_{2.5}$		
24-hour Max	25	BC Objective (2013)
Annual Max	8	BC Objective (2013)
CO		
1-hour Max	14,300	BC Objective (2013)
8-hour Max	5,500	BC Objective (2013)
NO_2		
1-hour Max	188	U.S. EPA NAAQS (2010)
Annual Max	40	WHO AAQ Guidelines (2005)
SO_2		
1-hour Max	200	BC Interim (2014)
24-hour Max	20	WHO AAQ Guidelines (2005)
Annual Max	20	Alberta AAQO (2013)
(SO_2+NO_2)		
1-hour Max for NO_2	188	U.S. EPA NAAQS (2010)

2.4.3 Primary Screening of Air Quality Data

A primary screening of the air quality modelling data was completed to identify whether the predicted maximum concentrations of the CACs in the five human health focus areas and the eight special receptor locations outside of these study areas represent potential concerns for human health. In each of the five areas, the maximum predicted concentration for each CAC across the approximately 1,000 grid points in that area was selected and compared with the appropriate human health–based air quality criterion. The maximum predicted CAC concentrations for each of the eight special receptor locations located outside the five human health focus areas were also compared with the human health–based criteria.

Maximum modelled concentrations of $PM_{2.5}$, CO, and NO_2 for all averaging periods (1-hour, 24-hour, and or annual) and locations (including human health focus area and special receptor locations) were below applicable guidelines for the base case, application case, and cumulative case (Table 2.4-2 to Table 2.4-5). As a result, potential health concerns resulting from exposure to maximum concentrations of these CACs are not expected.

Table 2.4-2: Modelled Concentrations of $PM_{2.5}$ and CO in the Human Health Focus Areas

Area	$PM_{2.5}$ Concentrations (µg/m^3)				CO Concentrations (µg/m^3)			
	BC objective (2013) 24-h	24-h Max	BC objective (2013) Annual	Annual Max	BC objective (2013) 1-h	1-h Max	BC objective (2013) 8-h	8-h Max
A1 - Kitamaat Village								
Base Case[a]	25	6.61	8	0.21	14,300	34.05	5,500	0.83
Application Case[b]		8.70		0.27		249.30		1.08
Cumulative Case[c]		8.72		0.29		249.50		1.11
A2 - lower Kitimat								
Base Case	25	4.25	8	0.51	14,300	27.22	5,500	8.51
Application Case		5.18		0.71		336.30		66.29
Cumulative Case		5.20		0.74		336.45		66.46
A3 - upper Kitimat								
Base Case	25	4.39	8	0.38	14,300	15.94	5,500	7.15
Application Case		5.46		0.51		131.75		42.88
Cumulative Case		5.48		0.53		131.94		42.95
A4 - north Kitimat								
Base Case	25	2.54	8	0.26	14,300	7.22	5,500	2.19
Application Case		3.15		0.36		47.91		19.00
Cumulative Case		3.29		0.38		47.92		19.03
A5 - service area								
Base Case	25	4.30	8	0.83	14,300	10.10	5,500	3.26
Application Case		4.85		1.08		160.67		49.74
Cumulative Case		4.93		1.11		160.71		49.96

NOTES:

[a] Base case–corresponds to concentrations present in Kitimat River Valley in the absence of the Project (includes proposed modernization upgrades to RTA)

[b] Application case–includes baseline concentrations as well as contributions from the Project

[c] Cumulative case–includes baseline concentrations, contributions from the Project, and contributions for anticipated future developments that might affect the quality of environmental media in the Kitimat River Valley.

Table 2.4-3: Modelled Concentrations of $PM_{2.5}$ and CO for the Special Receptor Locations

Area	$PM_{2.5}$ Concentrations ($\mu g/m^3$)				CO Concentrations ($\mu g/m^3$)			
	BC objective (2013) 24-h	24-h Max	BC objective (2013) Annual	Annual Max	BC objective (2013) 1-h	1-h Max	BC objective (2013) 8-h	8-h Max
15 - Southeast Residence								
Base Case	25	2.7	8	0.16	14,300	10.4	5,500	4.0
Application Case		4.1		0.22		66.9		36.4
Cumulative Case		4.4		0.24		67.0		36.9
22 - Coste Island								
Base Case	25	1.2	8	0.07	14,300	9.8	5,500	2.1
Application Case		1.5		0.09		34.0		8.8
Cumulative Case		1.6		0.10		34.7		9.1
23 - Southwest Dockyard								
Base Case	25	10.2	8	1.14	14,300	7.4	5,500	2.7
Application Case		10.6		1.25		116.0		36.3
Cumulative Case		10.7		1.29		116.0		36.6
24 - Half Moon Bay								
Base Case	25	7.7	8	0.86	14,300	8.1	5,500	2.9
Application Case		8.6		0.96		95.7		40.7
Cumulative Case		8.7		1.01		95.8		41.0
25 - Minette Bay1								
Base Case	25	2.5	8	0.15	14,300	16.9	5,500	6.4
Application Case		3.8		0.20		115.5		42.9
Cumulative Case		4.2		0.21		115.7		43.1
26 - Minette Bay Lodge								
Base Case	25	2.7	8	0.16	14,300	15.7	5,500	6.2
Application Case		4.1		0.22		102.5		41.3
Cumulative Case		4.5		0.25		102.5		41.9
28 - Kitimat Airport								
Base Case	25	2.9	8	0.31	14,300	7.4	5,500	4.1
Application Case		3.8		0.43		56.1		21.9
Cumulative Case		3.9		0.49		56.2		22.1
29 - Kildala Beach								
Base Case	25	0.59	8	0.02	14,300	6.76	5,500	1.71
Application Case		0.67		0.03		8.16		3.86
Cumulative Case		0.69		0.03		8.43		4.06

Table 2.4-4: Modelled Concentrations of NO_2 for the Human Health Focus Areas

Area	NO_2 Concentrations ($\mu g/m^3$)			
	U.S. EPA NAAQS (2010)	1-h Max	WHO AAQ Guidelines (2005)	Annual Max
A1 - Kitamaat Village				
Base Case	188	27.5	40	0.24
Application Case		77.3		0.67
Cumulative Case		78.3		0.76
A2 - lower Kitimat				
Base Case	188	30.2	40	0.40
Application Case		66.1		2.83
Cumulative Case		67.6		3.13
A3 - upper Kitimat				
Base Case	188	14.8	40	0.37
Application Case		65.6		1.99
Cumulative Case		66.9		2.25
A4 - north Kitimat				
Base Case	188	6.7	40	0.22
Application Case		34.7		1.13
Cumulative Case		35.3		1.27
A5 - service area				
Base Case	188	21.1	40	0.46
Application Case		79.5		3.42
Cumulative Case		79.5		3.77

Table 2.4-5: Modelled Concentrations of NO_2 for the Special Receptor Locations

Area	NO_2 Concentrations (µg/m^3)			
	U.S. EPA NAAQS (2010)	1-h Max	WHO AAQ Guidelines (2005)	Annual Max
15 - Southeast Residence				
Base Case	188	8.9	40	0.18
Application Case		47.9		0.73
Cumulative Case		48.6		0.92
22 - Coste Island				
Base Case	188	6.1	40	0.05
Application Case		21.9		0.20
Cumulative Case		24.0		0.25
23 - Southwest Dockyard				
Base Case	188	23.5	40	0.31
Application Case		65.0		1.42
Cumulative Case		65.4		2.12
24 - Half Moon Bay				
Base Case	188	18.0	40	0.30
Application Case		58.6		1.35
Cumulative Case		58.7		2.12
25 - Minette Bay1				
Base Case	188	9.0	40	0.12
Application Case		42.9		0.50
Cumulative Case		44.1		0.58
26 - Minette Bay Lodge				
Base Case	188	8.4	40	0.18
Application Case		44.62		0.81
Cumulative Case		44.64		0.97
28 - Kitimat Airport				
Base Case	188	6.4	40	0.21
Application Case		36.8		1.20
Cumulative Case		37.8		1.34
29 - Kildala Beach				
Base Case	188	5.2	40	0.022
Application Case		8.7		0.057
Cumulative Case		9.9		0.064

The 1- hour maximum concentrations of SO_2 exceeded the applicable guideline for the base case, application case, and cumulative case for human health focus areas A1 to A5 and special receptor locations 15 and 23 to 28 (Table 2.4-6 and Table 2.4-7). The 24-hour maximum concentrations of SO_2 exceeded the applicable criteria for the base case, application case, and cumulative case for human health focus areas A1 to A3 and A5, and special receptor locations 23 to 26. Table 2.4-6 and Table 2.4-7 also provide maximum concentrations of SO_2 for the Project-alone case for the human health focus areas and the eight special receptor locations. The results demonstrate that the predicted concentration for the Project-alone case is not simply the difference between the base case and the application case. Modelled concentrations for the Project-alone case were below applicable criteria indicating that the Project on its own does not constitute a potential inhalation health concern. However, because of the noted exceedances under base case, application case, and cumulative case, SO_2 is carried forward for further evaluation. Assessing the Project-alone case is not representative of the exposures that could be experienced by residents of Kitimat; therefore, health effects associated with the Project-alone case have not been evaluated further. The potential human health risks associated with the base case, application case, and cumulative case are evaluated further to provide means of evaluating the potential human health risks associated with SO_2 emissions from the Project.

The 1-hour maximum combined concentrations of NO_2 and SO_2 for human health focus areas A1 to A3 and A5 and special receptor locations 15 and 23 to 26 exceeded the guideline for NO_2 for the base case, application case, and the cumulative case (Table 2.4-8 and Table 2.4-9). The 1-hour maximum combined concentrations of NO_2 and SO_2 for human health focus area A4 and special receptor location 28 exceeded the guideline for NO_2 for the application case and cumulative case, but not for the base case. Based on the results presented in Table 2.4-10, the exceedances of the criterion for NO_2 is primarily attributable to contributions from SO_2. These exceedances are evaluated further in the Exposure Assessment in Section 4.

Table 2.4-6: Modelled Concentrations of SO_2 for the Human Health Focus Areas

Area	SO_2 Concentrations (µg/m^3)					
	BC Interim (2014)	1-h Max	WHO AAQ Guidelines (2005)	24-h Max	Alberta AAQO (2013)	Annual Max
A1 - Kitamaat Village						
Base Case	200	***734.8***	20	***85.3***	20	1.54
Project-alone Case		28.40		3.27		0.10
Application Case		***735.8***		***85.5***		1.64
Cumulative Case		***736.9***		***85.6***		1.67
A2 - lower Kitimat						
Base Case	200	***674.0***	20	***53.54***	20	5.06
Project-alone Case		87.75		8.68		0.49
Application Case		***720.8***		***57.79***		5.55
Cumulative Case		***720.9***		***57.82***		5.60
A3 - upper Kitimat						
Base Case	200	***678.2***	20	***54.94***	20	4.56
Project-alone Case		73.81		5.75		0.36
Application Case		***679.3***		***59.14***		4.92
Cumulative Case		***679.3***		***59.18***		4.98
A4 - north Kitimat						
Base Case	200	181.4	20	***40.46***	20	3.36
Project-alone Case		10.5		2.49		0.25
Application Case		183.8		***42.67***		3.61
Cumulative Case		184.0		***42.82***		3.68
A5 - service area						
Base Case	200	***461.63***	20	***50.28***	20	8.50
Project-alone Case		44.25		7.60		0.72
Application Case		***474.88***		***52.63***		9.23
Cumulative Case		***474.89***		***52.67***		9.28

NOTES:
Bold Italics – Maximum modelled concentration exceeds applicable criteria.

Table 2.4-7: Modelled Concentrations of SO_2 for the Special Receptor Locations

AREA	SO_2 Concentrations ($\mu g/m^3$)					
	BC Interim (2014)	1-h Max	WHO AAQ Guidelines (2005)	24-h Max	Alberta AAQO (2013)	Annual Max
15 - Southeast Residence						
Base Case	200	186.9	20	***40.2***	20	1.27
Project-alone Case		17.5		2.2		0.09
Application Case		192.89		***42.4***		1.35
Cumulative Case		192.91		***43.0***		1.40
22 - Coste Island						
Base Case	200	62.1	20	10.2	20	0.49
Project-alone Case		5.46		0.6		0.03
Application Case		65.81		10.8		0.52
Cumulative Case		66.84		10.9		0.54
23 - Southwest Dockyard						
Base Case	200	***393.01***	20	***67.35***	20	3.7
Project-alone Case		31.8		3.4		0.2
Application Case		***403.92***		***69.33***		3.9
Cumulative Case		***403.92***		***69.60***		4.0
24 - Half Moon Bay						
Base Case	200	***449.45***	20	***50.9***	20	3.0
Project-alone Case		26.67		3.0		0.1
Application Case		***470.37***		***52.7***		3.15
Cumulative Case		***470.76***		***53.0***		3.21
25 - Minette Bay1						
Base Case	200	***341.7***	20	***32.2***	20	1.4
Project-alone Case		44.14		4.7		0.1
Application Case		***385.9***		***34.3***		1.51
Cumulative Case		***386.0***		***34.8***		1.54
26 - Minette Bay Lodge						
Base Case	200	***204.1***	20	***38.7***	20	1.3
Project-alone Case		15.6		2.45		0.1
Application Case		***209.80***		***41.1***		1.44
Cumulative Case		***209.82***		***41.7***		1.49
28 - Kitimat Airport						
Base Case	200	172.9	20	***38.3***	20	5.0
Project-alone Case		11.5		2.1		0.3
Application Case		184.33		***40.47***		5.3
Cumulative Case		184.40		***40.49***		5.4

AREA	SO_2 Concentrations (µg/m^3)					
	BC Interim (2014)	1-h Max	WHO AAQ Guidelines (2005)	24-h Max	Alberta AAQO (2013)	Annual Max
29 - Kildala Beach						
Base Case	200	20.1	20	3.9	20	0.158
Project-alone Case		2.1		0.35		0.01
Application Case		20.75		4.26		0.166
Cumulative Case		20.76		4.32		0.170

NOTES:
Bold Italics – Maximum modelled concentration exceeds applicable criteria.

Table 2.4-8: Modelled Concentrations of Combined NO_2 and SO_2 for the Human Health Focus Areas

AREA	Combined NO_2 and SO_2 Concentrations (µg/m^3)	
	U.S. EPA NAAQS (2010)[a]	1-h Max
A1 - Kitamaat Village		
Base Case	188	***735.9***
Application Case		***738.9***
Cumulative Case		***739.6***
A2 - lower Kitimat		
Base Case	188	***678.1***
Application Case		***755.6***
Cumulative Case		***755.9***
A3 - upper Kitimat		
Base Case	188	***679.1***
Application Case		***717.8***
Cumulative Case		***718.4***
A4 - north Kitimat		
Base Case	188	182.6
Application Case		***200.4***
Cumulative Case		***201.1***
A5 - service area		
Base Case	188	***462.7***
Application Case		***499.3***
Cumulative Case		***499.3***

NOTES:
[a] The sum of the concentration of NO_2 and SO_2 was compared with the guideline for NO_2.
Bold Italics **–** Maximum modelled concentration exceeds applicable criteria.

Table 2.4-9: Modelled Concentrations of Combined NO_2 and SO_2 for the Special Receptor Locations

AREA	Combined NO_2 and SO_2 Concentrations (µg/m^3)	
	U.S. EPA NAAQS (2010) [a]	1-h Max
15 - Southeast Residence		
Base Case	188	***259.4***
Application Case		***349.6***
Cumulative Case		***349.6***
22 - Coste Island		
Base Case	188	136.7
Application Case		144.6
Cumulative Case		145.4
23 - Southwest Dockyard		
Base Case	188	***415.6***
Application Case		***450.8***
Cumulative Case		***451.1***
24 - Half Moon Bay		
Base Case	188	***464.7***
Application Case		***496.5***
Cumulative Case		***497.0***
25 - Minette Bay1		
Base Case	188	***345.9***
Application Case		***398.8***
Cumulative Case		***399.1***
26 - Minette Bay Lodge		
Base Case	188	***218.5***
Application Case		***255.9***
Cumulative Case		***257.5***
28 - Kitimat Airport		
Base Case	188	179.7
Application Case		***218.0***
Cumulative Case		***219.1***
29 - Kildala Beach		
Base Case	188	31.0
Application Case		36.7
Cumulative Case		37.2

NOTES:

[a] The sum of the concentration of NO_2 and SO_2 was compared with the guideline for NO_2.

Bold Italics **–** Maximum modelled concentration exceeds applicable criteria.

Table 2.4-10: Comparison of Maximum Concentration of SO_2, Maximum Concentration of NO_2, and Maximum Concentration of Combined NO_2 and SO_2

AREA	SO_2 Concentrations ($\mu g/m^3$)		NO_2 Concentrations ($\mu g/m^3$)		Combined NO_2 and SO_2 Concentrations ($\mu g/m^3$)[b]	
	BC Interim (2014)	1-h Max	U.S. EPA NAAQS (2010)[a]	1-h Max	U.S. EPA NAAQS (2010)[a]	1-h Max
A1 - Kitamaat Village						
Base Case	200	***734.75***	188	27.49	188	***735.86***
Application Case		***735.83***		77.33		***738.87***
Cumulative Assessment		***736.86***		78.32		***739.56***
A2 - lower Kitimat						
Base Case	200	***674.04***	188	30.24	188	***678.11***
Application Case		***720.81***		66.06		***755.58***
Cumulative Assessment		***720.92***		67.60		***755.88***
A3 - upper Kitimat						
Base Case	200	***678.24***	188	14.84	188	***679.09***
Application Case		***679.29***		65.56		***717.80***
Cumulative Assessment		***679.33***		66.90		***718.43***
A4 - north Kitimat						
Base Case	200	181.40	188	6.73	188	182.60
Application Case		183.81		34.68		***200.38***
Cumulative Assessment		184.02		35.31		***201.10***
A5 - service area						
Base Case	200	***461.63***	188	21.09	188	***462.66***
Application Case		***474.88***		79.47		***499.30***
Cumulative Assessment		***474.89***		79.50		***499.31***

NOTES:

[a] The sum of the concentrations of NO_2 and SO_2 were compared with the criteria for NO_2.

[b] The maximum concentrations of NO_2 and SO_2 typically occurred at different times during the day, which is why the maximum combined concentration is not simply the addition of the two maximums.

Bold Italics – Maximum modelled concentration exceeds applicable criteria.

2.5 Identification of Exposure Pathways

2.5.1 Conceptual Site Models

The CSM is a core component of the HHRA. The CSM illustrates the pathways by which human receptors could be exposed to COPCs that are released as a result of Project activities. The CSM combines key information regarding COPC sources, human receptors, and exposure pathways by which people could be exposed to Project-related chemicals. Exposure pathways that could result in unacceptable human exposure are identified as *complete* and need to be evaluated further in the HHRA process. Exposure pathways that do not provide a means whereby people could come into contact with a chemical are identified as *incomplete* and are not evaluated further in the HHRA. The objective of the CSM is to identify the exposure pathways where Project-related activities have the potential to increase existing (baseline) exposures to chemical emissions from the Project. The CSM is also used to identify exposure pathways that are not affected by Project-related activities or chemical emissions. Complete exposure pathways where Project-related activities have the potential to alter existing exposure conditions are defined as *contributing exposure pathways* and are evaluated further to provide quantitative estimates of the incremental changes in exposure that may result from the Project. Complete exposure pathways where Project-related activities do not have the potential to alter existing exposure conditions will not contribute to changes in predicted health risks are defined as *non-contributing exposure* pathways, and quantitative exposure estimates are not developed in the HHRA.

2.5.2 Project Interaction with Human Health

The Project might interact with human health in the following ways:

- Changes in ambient air quality could result in changes in human health risks associated with inhalation exposures.
- Resuspension of historical sediment-bound contaminants during dredging and construction of marine wharves could lead to contaminant uptake in marine biota that might be consumed by people.
- Changes in ambient air could result in changes in health risks associated with consumption of freshwater and terrestrial country foods.
- Changes in ambient air quality could result in acidification of surface waterbodies, altering water quality, which could result in changes in health risks associated with consumption of or contact with surface water.

2.5.2.1 Human Exposure to CACs from Inhalation

During construction, the main sources of air emissions will include ground disturbance, site clearing, operation of heavy construction equipment, and the delivery of equipment and supplies to the Project site. Following commissioning, the primary emission sources during routine operations will include land and marine Project-related activities. Land-based emissions will be produced by gas turbines, thermal oxidizers, and flares, and marine-based sources of air emissions will include LNG carrier vessels and assisting tug boats. Emissions of CACs are expected to be higher during the operation phase than during the construction phase because the facility would be operating 24 hours per days for 365 days a year.

CACs will disperse into the atmosphere. Large particulates such as dust will settle out in the general vicinity where they are produced. Finer particulate matter can remain in the atmosphere for days and travel long distances. Humans could be exposed to CACs through inhalation; therefore, this pathway is considered complete. Figure 2.5-1 presents the CSM for human inhalation exposure to CACs generated by the Project. Based on this CSM, Project emissions of CACs have the potential to alter existing exposure conditions by altering ambient air quality; therefore, inhalation exposure to CACs has been identified as a *contributing exposure pathway* and has been evaluated further in the HHRA.

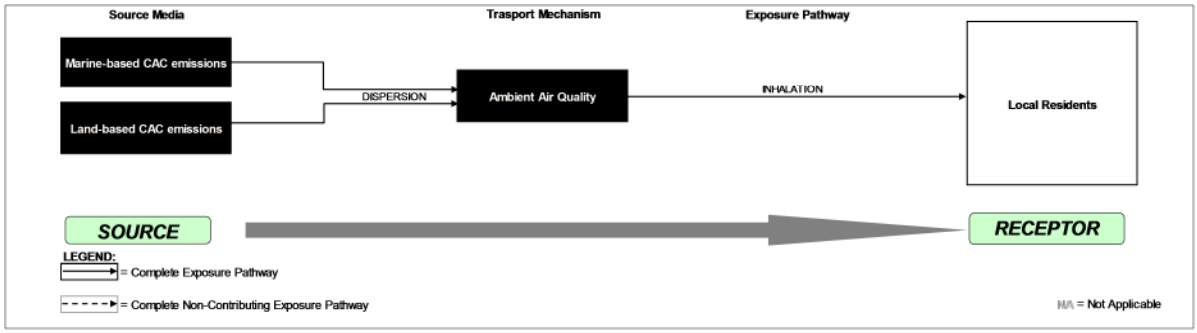


Figure 2.5-1: Conceptual Site Model for Human Exposure to CACs

2.5.2.2 Human Exposure to COPCs from Consuming Country Foods

The quality of country foods refers to the chemical content in the tissues that are consumed. High-quality country foods are those with lower concentrations of PAHs, PCDD/Fs, and metals in their tissues.

Several activities might interact with the quality of country foods during the construction and operation phases, including site preparation, onshore construction, dredging, marine terminal construction, waste management, vehicle and rail traffic, and the initial commissioning and start-up of the facilities and LNG production.

Terrestrial Country Foods

People in the Kitimat area harvest and consume local terrestrial country foods, including wildlife and vegetation. Interactions that might affect the quality of country foods include land-based activities such as construction and the use of roads and rail lines. These activities might generate fugitive dust that could settle on the surrounding area, including on vegetation used as a country food. Coarse dust particles generated at ground level would not be transported over long distances, but fine dust particles can deposit a few hundred metres downwind of the source (Countess et al. 2001).

Road dust is composed of inert earthen material that is chemically similar to the surrounding soils and ground material. Therefore, the presence of this material on plants will not alter chemical uptake into plants from what is transferred to the plants from the soil. Washing all types of country foods is recommended by Health Canada (Health Canada 2014). Project activities that generate road dust are not expected to appreciably change the quality of the soil or road material from which dust may be mechanically generated; therefore, they are not expected to alter the quality of the dust that may adhere to terrestrial country foods.

Terrestrial animals normally consume dirt by consuming vegetation to which soil or dust has adhered or by consuming dirt adhered to prey. Project activities are not expected to alter the consumption of dirt by terrestrial species used as country foods.

The consumption of terrestrial country foods is a complete exposure pathway. However, based on the rationale outlined above, Project activities are not expected to affect the quality of terrestrial country foods and therefore do not have the potential to alter existing exposure conditions. Therefore, the ingestion of terrestrial country foods has been identified as a *non-contributing exposure pathway* and has not been evaluated further in the HHRA.

Marine Country Foods

Human receptors harvest and consume local marine country foods, including crabs, prawns, clams, fish, seaweed, and various marine mammals. During consultation for the Project, concerns were raised regarding the potential effect that dredging could have on the quality of marine country foods.

Marine sediment quality in Kitimat Arm has been influenced by a variety of past and current industries or activities. Contaminants include PAHs, metals, dioxins, furans, and fluoride. These contaminants may be taken up by marine species used as food in the area.

During the construction phase, the berth pocket will be dredged to accommodate LNG carriers and support vessels. A sheet pile wall constructed along RTA Wharf “B” will require in-water construction and pile driving that will also disturb sediments. Most surface sediments that contain industrial pollutants will be removed from the marine environment during the initial dredging period. Sediments dredged from the

upper 2.5 m layer that do not meet disposal at sea criteria will be disposed of on land that is zoned for industrial use, thereby sequestering them from interactions with marine country foods. This initial dredging will expose the underlying clean sediments that will be dredged and disposed at sea.

Two mechanisms of interaction could affect the quality of marine country foods. The first mechanism involves dredging and pile driving, which will generate a plume of suspended sediments in the water column to which pelagic species of country food (e.g., fish) might be exposed. Pelagic species exposed to the plume could take up chemicals through their gills or skin, or could ingest suspended sediment particles. The degree of uptake and retention depends on factors such as the physiochemical properties of a chemical, bioavailability, and concentration in the water column.

The potential change in fish health as a result of exposure to sediment-bound pollutants is assessed in the marine resources assessment (Section 5.8.5.3 of the Application). Short-term exposure to suspended sediments originating from the initial dredging of the upper layer of sediment might result in a temporary increase in PAH concentrations in the water column. However, these increases are not anticipated to result in long-term changes in PAH levels in fish tissue. Fish have high rates of PAH metabolism and low rates of bioaccumulation where tissue concentrations do not reflect environmental exposure levels (Dunn 1991; van der Oost et al. 2003). Dredging below the depths of the PAH-affected sediment layer will not adversely affect the quality of fish tissue because increases in PAHs in the water column that result from dredging will be temporary and, therefore, are not anticipated to alter tissue PAH concentrations in fish in the area where dredging occurs.

The second mechanism involves suspended sediments depositing onto the surrounding area to which benthic species (e.g., prawns, clams, and crabs) might be exposed. These species already interact closely with the sediment; filter-feeding organisms such as bivalves could ingest suspended sediment particles containing PAHs.

During dredging activities, most of the coarse sediment particles escaping the dredge bucket will deposit in the immediate dredge zone. The benthic species in the dredge berth pocket are not considered because they would be taken up as part of the dredged material during the dredging process. The potential for increased PAH exposures will be to benthic organisms outside of the dredging zone, where finer sediment particles may disperse longer distances before settling. Because of the low bioavailability of PAHs in these sediments, benthic organisms will not take up these chemicals (Golder Associates Ltd. 2013, 2014). The exposure duration is short term because, after the surface layer of sediment has been removed, the underlying layers of sediment contain PAH concentrations that are below the ISQG.

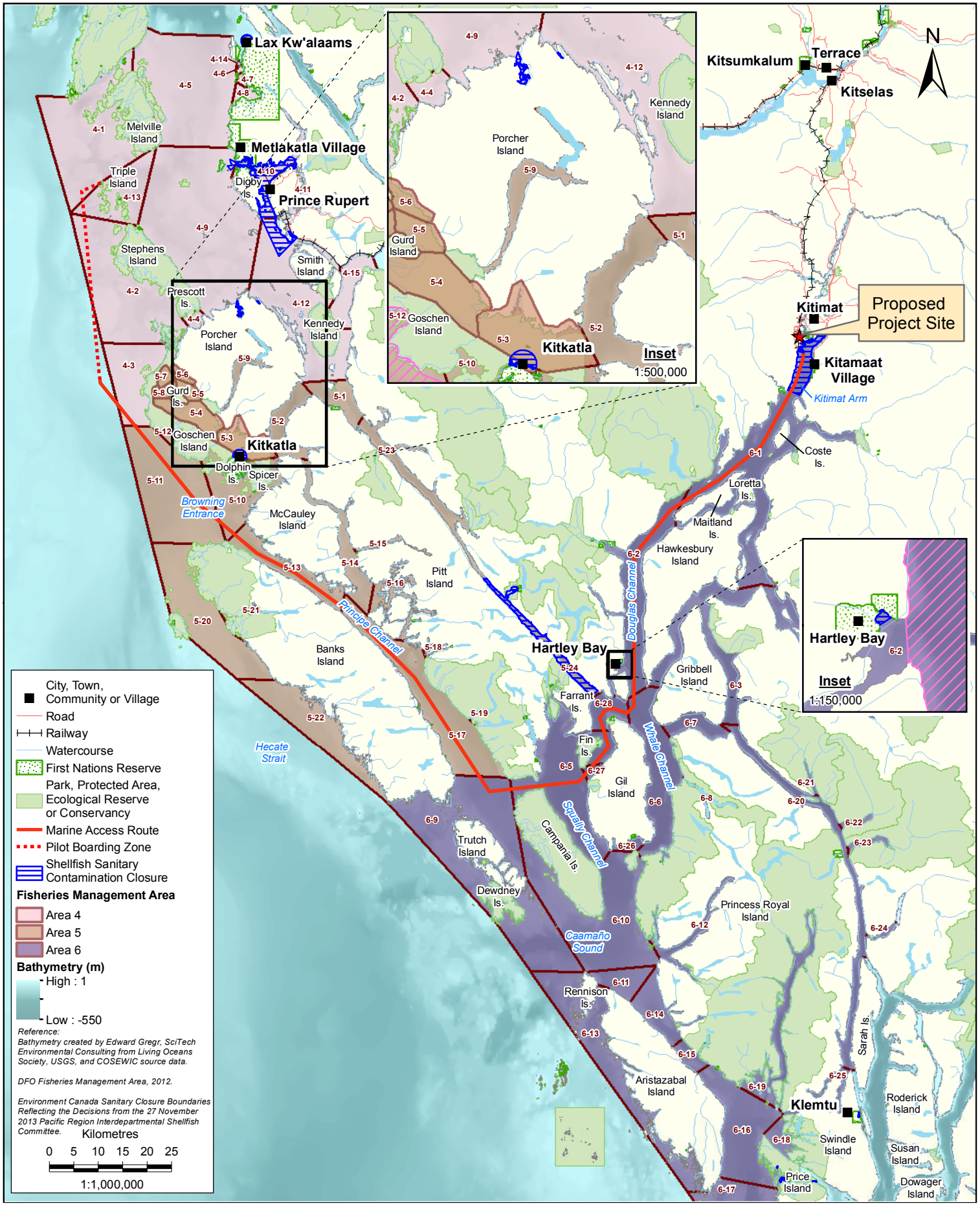
Kitimat Arm is in Area 6, designated by DFO, for which there is a permanent year-round ban on shellfish harvesting and consumption. This ban results from the potential for domoic acid and paralytic shellfish poisoning, which are marine biotoxins unrelated to industrial pollutants (DFO 2013a). The administrative boundaries for the locations included in the ban are provided in Figure 2.5-2 and Figure 2.5-3. It is noted that Area 6-1 also has an additional permanent ban on all harvested marine country foods (DFO 2013b).

During construction, some facility components will require hydrostatic testing to test for leaks before operation commences. Hydrostatic testing might involve the use of inert nitrogen gas and water mixed with biocides. Hydrostatic test water would be released to the marine environment after the testing is complete.

During operation, the natural process of sedimentation over time from upstream processes will gradually fill the dredged pocket. The Kitimat River estuary is strongly influenced by heavy sediment loads carried by the river during spring freshet and periods of high precipitation, which increase turbidity and sediment deposition (MacDonald and Shepherd 1983). Maintenance dredging approximately every 10 years is expected to maintain the channel depth. The dredge volume would be substantially lower than during the construction phase and would only remove newly deposited sediments, which are predicted to have a more limited exposure to historical contaminants.

No interactions with the quality of marine country foods are anticipated for the decommissioning phase.

The CSM that identifies the consumption of marine country foods as a complete exposure pathway is provided in Figure 2.5-4. However, based on the rationale outlined above, Project activities are not expected to have an effect on the quality of marine country foods and thus do not have the potential to alter existing exposure conditions and will not result in a Project-related incremental increase in human health risk. Therefore, the ingestion of marine country foods has been identified as a *non-contributing exposure pathway* and has not been evaluated further in the HHRA.



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HUMAN HEALTH RISK ASSESSMENT TECHNICAL DATA REPORT

ADMINISTRATIVE BOUNDARIES IN THE SHIPPING RSA

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION	DRAWN BY
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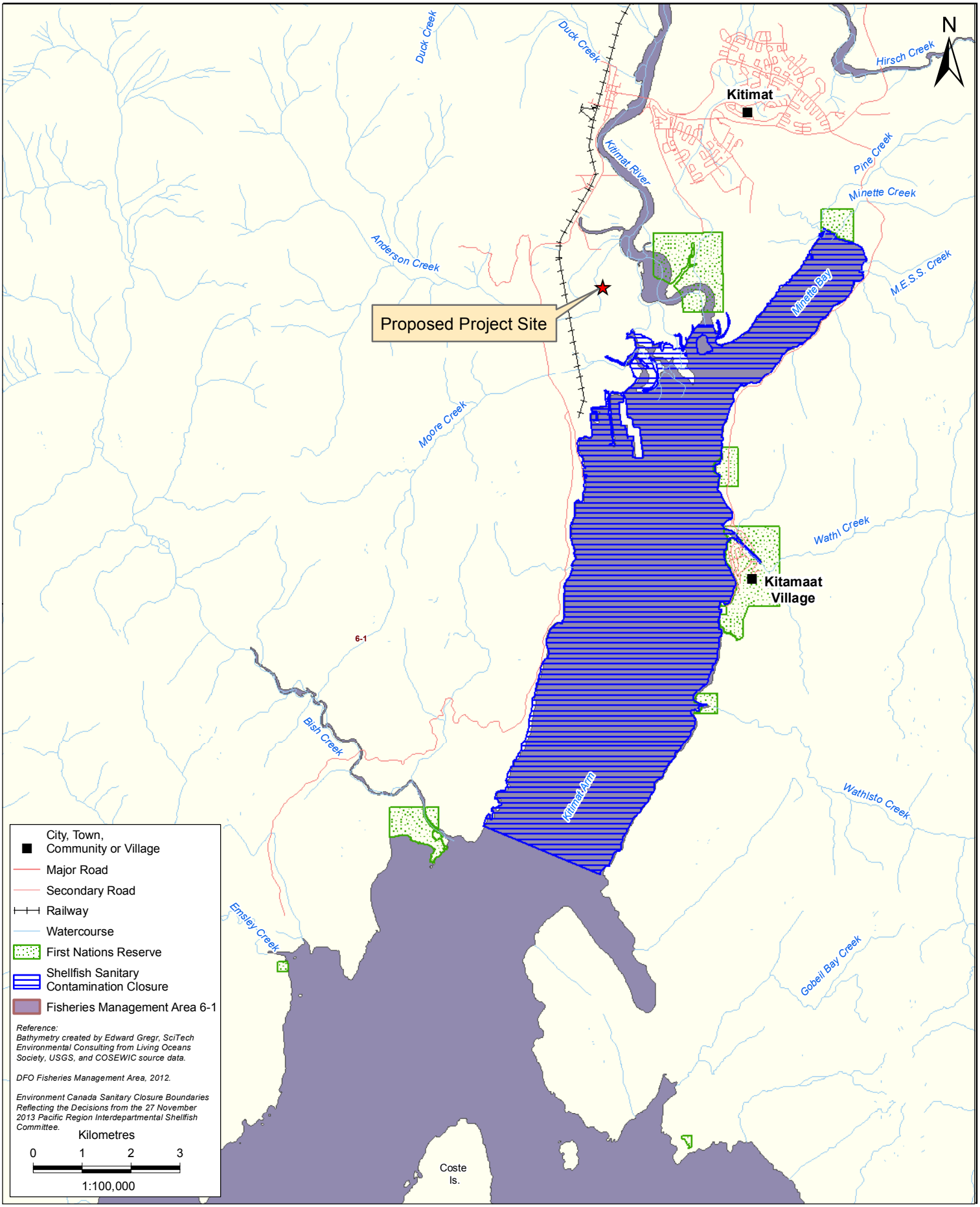

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HUMAN HEALTH RISK ASSESSMENT TECHNICAL DATA REPORT

ADMINISTRATIVE BOUNDARIES IN THE FACILITY RSA

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION	DRAWN BY
UTM9	SS
DATUM	CHECKED BY
NAD 83	SW
DATE	FIGURE NO.
29-AUG-14	**2.5-3**

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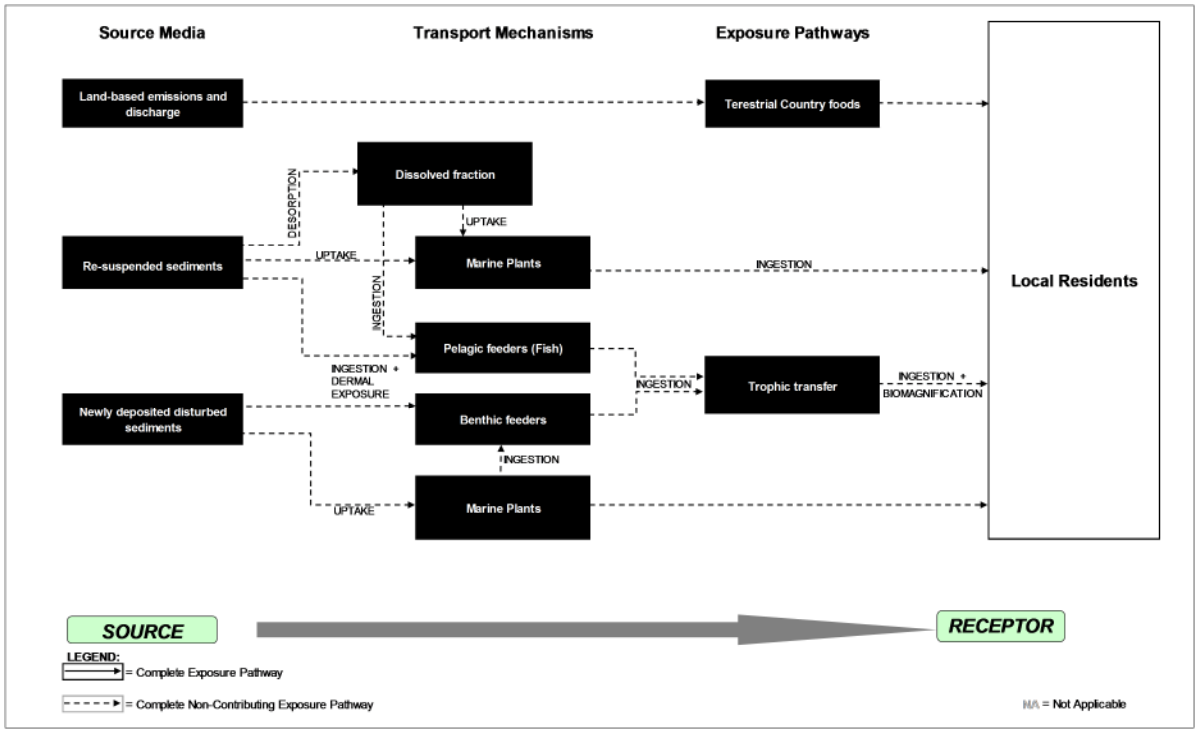

Figure 2.5-4: Conceptual Site Model for Human Receptor Exposure to COPCs from Consuming Country Foods

2.5.2.3 Human Exposure to COPCs from Ingestion of Water

The quality of drinking water refers to the levels of chemicals in water that is used as a source of potable water compared with the BC drinking water standards as defined under the BC Contaminated Sites Regulation (BCMOE 2014). Emissions of SO_2 and NO_2 by the Project have the potential to alter the acidity of surface waterbodies (e.g., lakes), which in turn could mobilize metals from sediments and other materials in the lakes, resulting in increases in metal levels in the surface water. This potential increase in metal concentrations could alter human health risks should these waterbodies be used as a daily supply of potable water. The water quality assessment (Section 5.9 of the Application) determined that the acidification potential between base and application cases is not significant (see Section 5.9.5.2 of the Application). These results indicate that changes in acidification related to the Project would not alter the metal concentrations in surface water from what currently exists under baseline conditions. Therefore, occasional or infrequent use of surface waters for drinking water represents a very limited exposure that would not pose an increased risk to human health.

In areas where municipal drinking water is provided, the municipal supply is required to meet the established drinking water quality standards, so the raw water is processed to meet these standards. As a result, although Project emissions are not anticipated to result in changes in metal levels in the raw surface water, should minor changes occur, these would not alter the metal concentrations in the final processed water and, therefore, would not result in a change in human health risk for people using the municipal water supply for potable water. Drinking water sourced from groundwater, which would not be influenced by Project emissions, likewise would not be a concern for human health. Potential acidification of water resulting from Project activities would be limited to effects on surface water and would not be expected to alter the quality of groundwater-sourced drinking water.

Based on this rationale, the Project is not expected to affect drinking water quality; therefore, the drinking water pathway is considered incomplete and has not been assessed further.

3 TOXICITY ASSESSMENT

3.1 Introduction

One of the essential parts of the risk assessment process is the identification of toxicologically based toxicity values against which exposures can be compared. TRVs have been established by several regulatory agencies including Health Canada, U.S. EPA, WHO, and the Agency for Toxic Substances and Disease Registry. When selecting TRVs for CACs, health-based air quality objectives of a number of regulatory agencies were considered: the proposed BC human health–based ambient air quality objectives, national ambient air quality objectives, U.S. EPA NAAQS, and WHO air quality objectives. In selecting TRVs, preference was given to the human health–based air quality standards proposed by MOE (BCMOE 2014). When TRVs were not available from BC, TRVs developed by the U.S. EPA, WHO, and or Health Canada were used.

The toxicological profiles outline the toxicological effects associated with chronic inhalation of contaminants of concern (COCs). The objectives are:

- to provide the reader with a brief understanding of the toxicological effects that have been reported to be associated with exposure to the COCs
- to identify whether each COC should be considered as being carcinogenic or non-carcinogenic, and
- to identify suitable toxicity values against which exposures can be compared with provide estimates of potential human health risks.

The toxicological profiles are not intended to:

- be exhaustive examinations of all of the toxicological information available for each of the COC or
- critically review or modify currently existing toxicity values.

The individual toxicological profiles identify the toxicity values available from primary and secondary sources (see Section 9 for sources used in the profiles) and provide a rationale for the selection of each toxicity value used in the risk assessment. The type of toxicity value selected depends on whether a compound is considered to be non-carcinogenic or carcinogenic. The types of toxicity values associated with both types of compounds are discussed below.

3.2 Toxicity Profiles and Toxicity Reference Values

There are several COPCs expected from Project-related emissions and existing air quality. These COPCs were chosen based on professional judgment from previous project experience and on guidance of the AAQOs established by Canada and the BC regulatory agencies. For the study of the air quality effects in the base, application, and cumulative cases, the identified COPCs were limited to the CACs, which included $PM_{2.5}$, CO, NO_2, SO_2, and combined NO_2 and SO_2. Predicted maximum concentrations of $PM_{2.5}$ and CO for all cases were below applicable criteria; therefore, a discussion of the toxicity of these CACs is not required. Maximum concentrations of SO_2 exceeded the applicable criteria for multiple locations and cases; therefore, a discussion of the toxicity of SO_2 is provided. There is no criterion for the combined concentration of NO_2 and SO_2; therefore, the criterion for NO_2 was chosen because it is lower than the criterion of SO_2, providing a more conservative estimate of potential human health risks associated with combined exposures. Maximum combined concentrations of NO_2 and SO_2 exceeded the guideline for NO_2 for multiple locations and cases; therefore, a discussion of the toxicity of NO_2 is also provided.

3.2.1 Sulphur Dioxide

The acute inhalation TRV suggested for use in the interim by the MOE and defined by the U.S. EPA NAAQS is 200 µg/m^3 for 1-hour exposure to SO_2, and the WHO AAQ guideline recommends a TRV of 20 µg/m^3 for a 24-hour exposure period. The U.S. EPA NAAQS were based on epidemiological and controlled human exposure studies, as well as air quality and exposure analyses. In these studies, a positive association between SO_2 levels and respiratory morbidity, emergency department visits, and hospital admissions was observed. This 200 µg/m^3 for 1-hour exposure ensures the protection of susceptible populations at increased risk for adverse respiratory effects from short-term exposure to SO_2 for which the evidence supports a causal relationship with SO_2 exposures.

SO_2 is a colourless gas with a pungent sulphur odour. Its production is the result of the combustion processes by the oxidation of sulphur compounds in fuel. It has been shown that at high enough concentration levels SO_2 can result in adverse effects on plant and animal health, and particularly on the respiratory system. If SO_2 is further oxidized and combined with water, there is potential to form the sulphuric acid component of “acid rain.”

A large percentage of global atmospheric SO_2 emissions is produced by anthropogenic activities, primarily the industrial and utility combustion of heavy oils and coal. The oxidization of reduced sulphur compounds emitted by oceans’ surfaces accounts for nearly all biogenic emissions, with volcanic activity accounting for much of the remainder. It has been shown that motor vehicles make up a relatively small percentage of the SO_2 content in the atmosphere (Wayne 1991).

Project emissions of SO_2 will result from power generation, compression, and other onsite combustion processes. Small amounts of SO_2 emissions will result from flaring and marine activities. There is the potential for higher rates of SO_2 emissions for short durations during upset or emergency flaring.

Research by the U.S. EPA suggests that, while the standard 24-hour and 1-hour exposures is protective of human health, people with asthma or COPD can have respiratory effects that occur at SO_2 concentrations that are below the established standards (U.S. EPA 2009). As SO_2 concentrations in ambient air decrease, the probability of people with asthma or COPD having a respiratory event decreases (U.S. EPA 2009). The U.S. EPA has used empirical human exposure data to develop an exposure response function to predict the change in respiratory response (includes both asthma and COPD) resulting from changes in exposure to 5-minute SO_2 concentrations (U.S. EPA 2009). A survey conducted by the Public Health Agency of Canada (2010) indicated that the combined prevalence of asthma and COPD in the general population is 12%. To be protective of this sensitive population, 5-minute SO_2 concentrations were calculated from the modelled data to analyze the potential effect.

SO_2 is not classified as a carcinogen by Health Canada, U.S. EPA, or WHO. Therefore, it is not evaluated for carcinogenic health risks in the HHRA.

3.2.2 Nitrogen Dioxide

The acute inhalation TRVs suggested for use in the interim by the MOE and included in the U.S. EPA NAAQS 1-hour objective for NO_2 is 188 µg/m^3 (pressure and temperature corrected conversion), and the 24-hour NAAQO is 200 µg/m^3. The chronic inhalation TRV is based on the WHO annual objective of 40 µg/m^3 and represents the air quality management goal for protection of the general public.

Nitrogen oxides (NO_x) result from most combustion processes. They comprise mostly nitric oxide (NO) and NO_2. Together, they are referred to as NO_x. NO_2 is an orange-reddish gas that can be toxic at high concentration and is corrosive. Most atmospheric NO_2 is formed by the oxidation of NO, which is emitted directly by combustion processes. This happens particularly with high temperature and pressure combustion, such as with internal combustion engines.

Total atmospheric emissions of NO_x mostly comprise anthropogenic emissions. The combustion of fuels such as natural gas, oil, and coal accounts for the largest anthropogenic contribution to atmospheric NO_x. Nearly all biogenic emissions are the result of forest fires, lightning, and anaerobic processes (Wayne 1991). Anticipated Project emissions of NO_x will be from power generation, compression, and other onsite combustion processes, which include flaring.

NO_2, like SO_2, is not classified as a carcinogen; therefore, the combined concentrations of NO_2 and SO_2 are not evaluated for carcinogenic health risks in this HHRA.

3.3 Summary of Toxicity Reference Values

Table 3.3-1 summarizes the TRVs selected for the HHRA. These TRVs are integrated with the results of the exposure assessment in the risk characterization stage.

Table 3.3-1: TRVs Selected for Use in this Risk Assessment

Contaminants	Human Health–Based Air Quality Criteria TRV (µg/m^3)	Reference
SO_2		
1-hour Max	200	BC Interim (2014)
24-hour Max	20	WHO AAQ Guidelines (2005)
Annual Max	20	Alberta AAQO (2013)
NO_2 + SO_2		
1-hour Max for NO_2	188	U.S. EPA NAAQS (2010)

4 EXPOSURE ASSESSMENT

4.1 Introduction

The exposure assessment defines the estimated daily intakes predicted for the human receptor for each of the operable pathways:

- the concentration of COCs in the environment (e.g., air) to which people are exposed
- human receptor characteristics (e.g., body weight), and
- frequency and duration of exposure.

These factors are integrated in the calculation of the estimated daily intake (EDI) of COCs through the various exposure pathways. For this risk assessment, COCs are limited to the CACs associated with Project emissions.

4.2 Methods

4.2.1 Human Receptor Characteristics

Human receptors included in this assessment are located in the five human health focus areas and the eight special receptor locations outside of these focus areas. These areas were selected to include sensitive individuals including the elderly, young, and those with pre-existing cardio-respiratory conditions.

Air quality dispersion model simulations were used to predict the effects of Project emissions on baseline air quality within the human health assessment area. The three modelling scenarios used for this analysis include:

- Base case: considers current emission sources including vehicle and shipping traffic, the current RTA facility, and the planned modernization upgrade of the facility
- Application case: considers both the current sources of emissions as well as the Project at full build-out, and
- Cumulative case: combines the results of the application case with the effects of reasonably foreseeable future projects that could have an effect on air quality in the Kitimat area. Anticipated developments that could affect air quality in the Kitimat area include:
    - Coastal GasLink Pipeline Project
    - Douglas Channel LNG Terminal (also known as BC LNG)
    - Enbridge Northern Gateway Project
    - Former Methanex/Cenovus Terminal

- Kitimat LNG Terminal Project
- Pacific Northern Gas Pipeline
- Pacific Trail Pipelines Project
- Rio Tinto Alcan Aluminium Smelter and Modernization Project, and
- Sandhill Materials – Aggregate Processing.

The largest contributor to potential cumulative effects on air quality is the RTA facility, located at the head of Kitimat Arm. It has been operating since the 1950s and is currently being modernized. Construction of the modernization project is planned for 2013 to 2015; existing operations will continue during this period. The modernized infrastructure is expected to increase its overall output of specific emissions, which might have negative effects on health in the region. During the course of the HHRA, the projected increase in emissions was incorporated into the air model for base case conditions.

The Kitimat LNG Terminal at Bish Cove, on the west shore of Kitimat Arm, is 11.6 km from Kitimat (BCEAO 2006). Construction is underway (planned for 2012 to 2015/2016), and operation is planned for 2015/2016 to 2040/2041. Infrastructure construction and operation is expected to affect air emissions through the same mechanisms identified for the LNG Canada Export Terminal.

The Enbridge Northern Gateway Project, on the west shore of Kitimat Arm, is 8.8 km from the LNG Canada Export Terminal. Operation is planned for 2018 to 2048 (Enbridge Northern Gateway Project 2010). Infrastructure construction is expected to affect air emissions through the same mechanisms identified for the LNG Canada Export Terminal.

The Douglas Channel LNG Terminal is a small-scale LNG facility proposed for the west shore of Kitimat Arm, near Moon Bay, 5.6 km from the LNG Canada Export Terminal. The construction and operation timelines are uncertain, but they are assumed to overlap with the construction phase of the LNG Canada Export Terminal.

The Sandhill Materials – Aggregate Processing will include operation of the existing facility in Kitimat. These activities are expected to overlap with the construction and operation phases of the LNG Canada Export Terminal.

Within the HHRA, most activities and works for the Project involve air emissions from infrastructure construction and facility operation that contribute or will contribute to regional ambient air levels.

During modelling, no distinction is made between time spent indoors and time spent outdoors. It is assumed that exposure to CACs would occur for 24 hours a day, 7 days a week, and 365 days a year. The estimated chemical concentrations in air provided in the air quality assessment are assumed to represent the concentrations of these chemicals in both indoor and outdoor air. Decreases in chemical

concentrations that typically occur between outdoor and indoor air have not be incorporated into the assessment. As a result, exposure will be overestimated to be more protective of human health.

Also, no distinction has been made for the time of day (i.e., the probability of exposure is assumed to be the same during a 24-hour period). Air quality estimates between 10 p.m. and 6 a.m. have not been removed from the dataset used to estimate possible exposures. This assumption will overestimate the human exposures.

4.3 Results

4.3.1 Concentrations of Criteria Air Contaminants

The screening results provided in Section 2.4.3 identified the following exceedances:

- The 1-hour maximum concentrations of SO_2 exceeded the applicable guideline for the base case, application case, and cumulative case for human health focus areas A1 to A5 and special receptor locations 15 and 23 to 28.
- The 24-hour maximum concentrations of SO_2 exceeded the applicable criteria for the base case, application case, and cumulative case for human health focus areas A1 to A3 and A5, and special receptor locations 23 to 26.
- The 1-hour maximum concentrations for the 1-hour maximum combined concentrations of NO_2 and SO_2 for human health focus areas A1 to A3 and A5, and special receptor locations 15 and 23 to 26 exceeded the guideline for NO_2 for the base case, application case, and the cumulative case.
- The 1-hour maximum concentrations of combined NO_2 and SO_2 for human health focus area A4 and special receptor location 28 exceeded the guideline for NO_2 for the application case and cumulative case, but not for the base case.

4.3.1.1 $PM_{2.5}$ and CO – Human Health Areas

Use of the maximum concentration to estimate the risk of a human receptor exposed to CACs in each human health focus area and special receptor location will result in an overestimation of risk because the maximum concentration represents the concentration during a short time period (e.g., 1-hour, 24-hour) over the course of three years. When these estimates show that the CACs do not pose a potential human health concern, there is no need for further evaluation. However, when the worst-case exposure scenarios indicate a potential human health concern, it is necessary to refine the exposure scenarios to better reflect conditions in the areas being considered and, therefore, better quantify the potential health risks.

4.3.1.2 Estimated 1-hour Average SO_2 Concentrations

To understand the range and frequency of 1-hour SO_2 concentrations that could occur, an assessment of the reasonable worst-case potential health risk in each human health area was completed. This was done by identifying the grid point in each area where the maximum modelled SO_2 concentration was identified and extracting the full three years of air quality modelling data for that grid point from the air quality modelling dataset. The 1-hour average SO_2 concentrations were derived from the approximately 26,300 1-hour SO_2 concentration estimates for the maximum SO_2 grid point. The 1-hour average concentrations were then grouped into concentration ranges or "bins" in increments of 10 µg/m^3 (e.g., 0 to 10 µg/m^3, 11 to 20 µg/m^3, 21 to 30 µg/m^3) across the entire range of concentration data for each of the five areas. The frequency of occurrence for each predicted 1-hour average SO_2 concentration range was multiplied by the upper concentration limit for each concentration bin to determine a weighted sum for each concentration range (or "bin"). These were then added together and divided by the total number of the count of CAC measurements (26,304). This result is the weighted average of the CAC for the human health focus area. Table 4.3-1 provides an example of the methods used to estimate the weighted average.

Table 4.3-1: Calculating the Weighted-Average SO_2 Concentration for the Base Case in Human Health Focus Area A4

A4 - Base Case Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit (µg/m^3)**	**Weighted Sum (µg/m^3)**
0–10	23,966	10	239,660
10–20	1,186	20	23,720
20–30	550	30	16,500
30–40	247	40	9,880
40–50	151	50	7,550
50–60	73	60	4,380
60–70	55	70	3,850
70–80	24	80	1,920
80–90	21	90	1,890
90–100	8	100	800
100–110	10	110	1,100
110–120	5	120	600
120–130	2	130	260
130–140	2	140	280
140–150	3	150	450
150–160	0	160	0

A4 - Base Case Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit (µg/m^3)**	**Weighted Sum (µg/m^3)**
160–170	0	170	0
170–180	0	180	0
180–190	1	190	190
>190	0	200	0
Total	**26,304**	**Total**	**313,030**
		Weighted Avg.	**11.90**

NOTE:
1-hour maximum for SO_2 in A4 was 181.40 µg/m^3.

The weighted averages for the eight special receptor locations were estimated using a similar approach to that used for the human health focus areas, with one exception: because each special receptor location is a single point (rather than a grid of points as for the focus areas), it was not necessary to select a worst-case location. Instead, all data from each special receptor location was used to estimate a weighted-average concentration for that location.

The 1-hour maximum and 1-hour weighted-average concentrations of SO_2 for the base, application, and cumulative cases for each human health focus area and special receptor location are provided in Table 4.3-2 and Table 4.3-3; the detailed results (including the "binned" data) are provided in Appendix A. The human health–based air quality guidelines have also been provided. These values are used in conjunction with the predicted 1-hour SO_2 concentrations to calculate the concentration ratios (CRs) used to characterize the potential health risks associated with the predicted SO_2 concentrations. The interpretation of potential health risks is discussed in Section 5.

Table 4.3-2: 1-hour Maximum and Weighted-Average SO_2 Concentrations in the Human Health Focus Areas

AREA	SO_2 Concentrations (µg/m^3)		
	BC Interim (2014)	1-h Max	1-h Weighted Avg.
A1 - Kitamaat Village			
Base Case	200	***734.75***	10.86
Application Case		***735.83***	10.91
Cumulative Case		***736.86***	10.91
A2 - lower Kitimat			
Base Case	200	***674.04***	12.35
Application Case		***720.81***	12.56
Cumulative Case		***720.92***	12.57
A3 - upper Kitimat			
Base Case	200	***678.24***	11.68
Application Case		***679.29***	11.83
Cumulative Case		***679.33***	11.83
A4 - north Kitimat			
Base Case	200	181.40	11.90
Application Case		183.81	12.09
Cumulative Case		184.02	12.09
A5 - service area			
Base Case	200	***461.63***	14.75
Application Case		***474.88***	15.11
Cumulative Case		***474.89***	15.12

NOTES:
Bold Italics – Concentration exceeds applicable guideline.

Table 4.3-3: 1-hour Maximum and Weighted-Average SO_2 Concentrations for the Special Receptor Locations

AREA	SO_2 Concentrations (µg/m^3)		
	BC Interim (2014)	1-h Max	Weighted Avg.
15 - Southeast Residence			
Base Case	200	186.9	10.6
Application Case		192.89	10.7
Cumulative Case		192.91	10.7
22 - Coste Island			
Base Case	200	62.1	10.1
Application Case		65.81	10.2
Cumulative Case		66.84	10.2
23 - Southwest Dockyard			
Base Case	200	***393.01***	11.8
Application Case		***403.92***	11.9
Cumulative Case		***403.92***	11.9
24 - Half Moon Bay			
Base Case	200	***449.45***	11.3
Application Case		***470.37***	11.4
Cumulative Case		***470.76***	11.4
25 - Minette Bay1			
Base Case	200	***341.7***	10.8
Application Case		***385.9***	10.9
Cumulative Case		***386.0***	10.9
26 - Minette Bay Lodge			
Base Case	200	***204.1***	10.6
Application Case		***209.80***	10.7
Cumulative Case		***209.82***	10.7
28 - Kitimat Airport			
Base Case	200	172.9	13.5
Application Case		184.33	13.7
Cumulative Case		184.40	13.7
29 - Kildala Beach			
Base Case	200	20.1	10.0
Application Case		20.75	10.0
Cumulative Case		20.76	10.0

NOTES:
Bold Italics – Concentration exceeds applicable guideline.

4.3.1.3 Estimated 24-hour Average SO_2 Concentrations

The 24-hour weighted-average concentrations of SO_2 were also estimated for each human health focus area and special receptor location. This was done by selecting the grid point in each area where the maximum modelled 1-hour SO_2 concentration was identified and extracting the full three years of air quality modelling data for that grid point from the air quality modelling dataset. The 24-hour average SO_2 concentrations were derived from approximately 26,300 1-hour SO_2 concentration estimates for the maximum SO_2 grid point. The 24-hour average SO_2 concentration for each day was calculated by averaging the 24 1-hour SO_2 concentrations for each day. The 24-hour average concentrations were then grouped into concentration ranges of 10 µg/m^3 (e.g., 0 to 10 µg/m^3, 11 to 20 µg/m^3, 21 to 30 µg/m^3) across the entire range of concentration data for each of the five areas. The frequency of occurrence for each predicted 24-hour average SO_2 concentration range was multiplied by the upper concentration limit for each concentration range to determine a weighted-average 24-hour SO_2 concentration for each of the five areas. The 24-hour weighted-average concentrations for the special receptor locations were calculated in the same manner.

The 24-hour weighted-average concentrations of SO_2 for each human health focus area and special receptor location are provided in Table 4.3-4 and Table 4.3-5; the detailed results (including the range data) are provided in Appendix A. The 24-hour average human health–based air quality guideline has also been provided. The interpretation of potential health risks associated with the predicted 24-hour average SO_2 concentrations is provided in Section 5.

Table 4.3-4: 24-hour Maximum and Weighted-Average SO_2 Concentrations in the Human Health Focus Areas

Area	24-h SO_2 Concentrations (µg/m^3)		
	WHO AAQ Guidelines (2005)	24-h Max	Weighted Avg.
A1 - Kitamaat Village			
Base Case	20	***85.3***	10.42
Application Case		***85.5***	10.45
Cumulative Case		***85.6***	10.45
A2 - lower Kitimat			
Base Case	20	***53.54***	11.03
Application Case		***57.79***	11.21
Cumulative Case		***57.82***	11.26
A3 - upper Kitimat			
Base Case	20	***54.94***	10.59
Application Case		***59.14***	10.69
Cumulative Case		***59.18***	10.69

Area	24-h SO_2 Concentrations (µg/m^3)		
	WHO AAQ Guidelines (2005)	24-h Max	Weighted Avg.
A4 - north Kitimat			
Base Case	20	***40.46***	10.77
Application Case		***42.67***	10.85
Cumulative Case		***42.82***	10.87
A5 - service area			
Base Case	20	***50.28***	13.18
Application Case		***52.63***	13.53
Cumulative Case		***52.67***	13.54

NOTES:
Bold Italics **–** Concentration exceeds applicable guideline.

Table 4.3-5: 24-hour Maximum and Weighted-Average SO_2 Concentrations for the Special Receptor Locations

AREA	24-h SO_2 Concentrations (µg/m^3)		
	WHO AAQ Guidelines (2005)	24-h Max	24-h Weighted Avg.
15 - Southeast Residence			
Base Case	20	***40.2***	10.24
Application Case		***42.4***	10.27
Cumulative Case		***43.0***	10.27
22 - Coste Island			
Base Case	20	10.2	10.02
Application Case		10.8	10.02
Cumulative Case		10.9	10.02
23 - Southwest Dockyard			
Base Case	20	***67.35***	10.97
Application Case		***69.33***	11.00
Cumulative Case		***69.60***	11.02
24 - Half Moon Bay			
Base Case	20	***50.9***	10.62
Application Case		***52.7***	10.73
Cumulative Case		***53.0***	10.74
25 - Minette Bay1			
Base Case	20	***32.2***	10.32
Application Case		***34.3***	10.41

AREA	24-h SO_2 Concentrations (µg/m^3)		
	WHO AAQ Guidelines (2005)	24-h Max	24-h Weighted Avg.
Cumulative Case		***34.8***	10.41
26 - Minette Bay Lodge			
Base Case	20	***38.7***	10.65
Application Case		***41.1***	10.70
Cumulative Case		***41.7***	10.71
28 - Kitimat Airport			
Base Case	20	***38.3***	13.46
Application Case		***40.47***	13.72
Cumulative Case		***40.49***	13.73
29 - Kildala Beach			
Base Case	20	3.9	10.03
Application Case		4.26	10.03
Cumulative Case		4.32	10.03

NOTES:
Bold Italics – Concentration exceeds applicable guideline.

4.3.1.4 Estimated 5-minute Average SO_2 Concentrations

The air quality modelling data provide estimates of 1-hour SO_2 concentrations but do not provide 5-minute SO_2 concentrations because of the computational complexity of providing such data in the air quality models (see the Air Quality TDR; Stantec 2014a). The 5-minute SO_2 concentrations were calculated from the 1-hour SO_2 concentration data once the air quality modelling was complete. The derivation of the 5-minute SO_2 concentrations is discussed in Section 5.2.1.2.

4.3.1.5 Estimated 1-hour Average Combined NO_2 and SO_2 Concentrations

The 1-hour weighted-average concentrations of combined NO_2 and SO_2 were estimated for each human health focus area and the eight special receptor locations outside the focus areas using an approach that was similar to that used to estimate the 1-hour weighted-average concentration of SO_2. The method used to generate the dataset for the combined concentrations of NO_2 and SO_2 was described in Section 2.2.2.2. The amalgamated dataset contained approximately 26,300 of summed 1-hour concentrations of NO_2 and SO_2 in air. The combined concentrations were grouped into concentration ranges of 10 µg/m^3 to determine the overall range and frequency of occurrence of the various combined concentrations. The determined frequencies were multiplied by the upper concentration limits of each concentration range to provide a frequency weighting for each concentration range. The individual

frequency weightings were then combined to provide a weighted-average concentration of combined SO_2 and NO_2 concentrations in each of the five human health areas.

The 1-hour weighted-average concentrations of combined NO_2 and SO_2 for each human health focus area and special receptor location are provided in Table 4.3-6 and Table 4.3-7; the detailed results (including the "binned" data) are provided in Appendix A. The interpretation of potential health risks associated with the predicted 1-hour combined NO_2 and SO_2 concentrations is provided in Section 5.

Table 4.3-6: 1-hour Maximum and Weighted-Average Concentrations of Combined NO_2 and SO_2 in the Human Health Focus Areas

AREA	Combined NO_2 and SO_2 Concentrations (µg/m^3)		
	U.S. EPA NAAQS (2010)[a]	1-h Max	1-h Weighted Avg.
A1 - Kitamaat Village			
Base Case	188	***735.9***	10.92
Application Case		***738.9***	11.19
Cumulative Case		***739.6***	11.23
A2 - lower Kitimat			
Base Case	188	***678.1***	12.47
Application Case		***755.6***	13.67
Cumulative Case		***755.9***	13.80
A3 - upper Kitimat			
Base Case	188	***679.1***	11.85
Application Case		***717.8***	12.80
Cumulative Case		***718.4***	12.93
A4 - north Kitimat			
Base Case	188	182.6	11.96
Application Case		***200.4***	12.78
Cumulative Case		***201.1***	12.83
A5 - service area			
Base Case	188	***462.7***	14.96
Application Case		***499.3***	17.38
Cumulative Case		***499.3***	17.61

NOTES:
Bold Italics **–** Concentration exceeds applicable guideline.

Table 4.3-7: 1-hour Maximum and Weighted-Average Concentrations of Combined NO_2 and SO_2 for the Special Receptor Locations

AREA	Combined SO_2 and NO_2 Concentrations (µg/m^3)		
	U.S. EPA NAAQS (2010)	1-h Max	1-h Weighted Avg.
15 - Southeast Residence			
Base Case	188	***259.4***	10.64
Application Case		***349.6***	11.00
Cumulative Case		***349.6***	11.05
22 - Coste Island			
Base Case	188	136.7	10.15
Application Case		144.6	10.22
Cumulative Case		145.4	10.24
23 - Southwest Dockyard			
Base Case	188	***415.6***	11.86
Application Case		***450.8***	12.73
Cumulative Case		***451.1***	12.84
24 - Half Moon Bay			
Base Case	188	***464.7***	11.34
Application Case		***496.5***	12.07
Cumulative Case		***497.0***	12.23
25 - Minette Bay1			
Base Case	188	***345.9***	10.82
Application Case		***398.8***	11.14
Cumulative Case		***399.1***	11.17
26 - Minette Bay Lodge			
Base Case	188	***218.5***	10.70
Application Case		***255.9***	11.13
Cumulative Case		***257.5***	11.23
28 - Kitimat Airport			
Base Case	188	179.7	13.61
Application Case		***218.0***	14.78
Cumulative Case		***219.1***	14.87
29 - Kildala Beach			
Base Case	188	31.0	10.03
Application Case		36.7	10.05
Cumulative Case		37.2	10.05

NOTES:
Bold Italics – Concentration exceeds applicable guideline.

5 RISK CHARACTERIZATION

The risk characterization stage provides a quantitative measure of risk to human receptors from the inhalation of CACs.

5.1 Methods

5.1.1 Estimating Non-carcinogenic Risk

The CR has been used to assess the potential for non-carcinogenic human health risk as a result of inhalation of Project-related releases of CACs. The CR is calculated using the following equation:

$$Concentration\ Ratio\ (CR) = \frac{Predicted\ CAC\ Concentration}{Human\ Health - based\ Air\ Quality\ Criterion}$$

The human health–based air quality criterion represents the level of exposure (for the specified exposure averaging period, for example, 1-hour, 24-hour, or annual average) below which health effects are not expected to occur. In BC, the threshold CR of 1 represents exposure that does not pose a significant health risk to human receptors (BCMOE 2014). A CR that exceeds 1 does not necessarily indicate that health effects would be expected to occur; however, the potential that a health effect might occur increases as the CR rises above 1. The value of 1 assumes that there is a single exposure pathway for the CACs, which is appropriate in the case of human receptor exposures to CACs. Because the existing baseline conditions of SO_2 result in a CR above 1, an incremental increase in the CR of 0.2 above the baseline CR has been chosen as the benchmark for determining whether Project emissions of SO_2 represent a potential concern for human health.

5.1.2 Estimating Carcinogenic Risk

None of the CACs have been identified as carcinogenic; therefore, carcinogenic risk was not calculated.

5.2 Estimation of Non-Carcinogenic Risk

5.2.1 Health Risks from Exposure to SO_2

5.2.1.1 Evaluation of 1-Hour and 24-Hour Exposures to SO_2

The CR based on the maximum concentration of 1-hour, 24-hour, and annual SO_2 in each human health focus area and special receptor location for the base, application, and cumulative cases are provided in Table 5.2-1 and Table 5.2-2. The 1-hour maximum CRs for SO_2 exceed the benchmark of 1 for the base, application, and cumulative cases for all human health focus areas, with the exception of A4 and special receptor locations 23 to 26. The 24-hour maximum CRs exceed the benchmark of 1 for the base, application, and cumulative cases for all human health focus areas and for special receptor locations 15, 23 to 26, and 28. These CRs are based on the maximum modelled SO_2 concentrations, which occur infrequently (fewer than 20 times in each of the human health focus areas across the three years of modelled data; see data in Appendix A) and overestimate potential human health risks associated with exposure to SO_2 in the Kitimat River Valley.

To compare results in this assessment with those provided in the *Rio Tinto Alcan Sulphur Dioxide Technical Report* (RTA 2013), the weighted-average concentration of SO_2 over the three-year period is a better measure of potential exposure for humans than the maximum concentration. CRs calculated based on the weighted average for 1-hour and 24-hour SO_2 concentrations under base, application, and cumulative cases are provided in Table 5.2-1 and Table 5.2-2 for the five areas and the eight special receptor locations. Weighted-average CRs were not estimated for annual average SO_2 because CRs based on the maximum predicted annual average concentrations were below the applicable criterion. Weighted-average CRs based on 1-hour and 24-hour SO_2 concentrations were below applicable criteria for all human health areas and special receptor locations for base, application, and cumulative cases; this finding indicates that predicted SO_2 concentrations do not represent a potential concern for human health.

Table 5.2-1: Concentration Ratios for the Human Health Focus Areas based on Maximum Concentrations and Weighted-Average Concentrations of SO_2

Area and Scenario	Units	Maximum SO_2 CR			Weighted-Average SO_2 CR	
		1-h Max	24-h Max	Annual Max	1-h Weighted Avg.	24-h Weighted Avg.
A1 - Kitamaat Village						
Base Case	µg/m^3	***3.7***	***4.3***	0.077	0.0543	0.521
Application Case	µg/m^3	***3.7***	***4.3***	0.082	0.0546	0.523
Cumulative Case	µg/m^3	***3.7***	***4.3***	0.084	0.0546	0.523
A2 - lower Kitimat						
Base Case	µg/m^3	***3.4***	***2.7***	0.25	0.0618	0.552
Application Case	µg/m^3	***3.6***	***2.9***	0.28	0.0628	0.561
Cumulative Case	µg/m^3	***3.6***	***2.9***	0.28	0.0629	0.563
A3 - upper Kitimat						
Base Case	µg/m^3	***3.4***	***2.8***	0.23	0.0584	0.530
Application Case	µg/m^3	***3.4***	***3***	0.25	0.0592	0.535
Cumulative Case	µg/m^3	***3.4***	***3***	0.25	0.0592	0.535
A4 - north Kitimat						
Base Case	µg/m^3	0.91	***2***	0.17	0.0595	0.539
Application Case	µg/m^3	0.92	***2.1***	0.18	0.0605	0.543
Cumulative Case	µg/m^3	0.92	***2.1***	0.18	0.0605	0.544
A5 - service area						
Base Case	µg/m^3	***2.3***	***2.5***	0.43	0.0738	0.659
Application Case	µg/m^3	***2.4***	***2.6***	0.46	0.0756	0.677
Cumulative Case	µg/m^3	***2.4***	***2.6***	0.46	0.0756	0.677

NOTES:
Bold Italics – Concentration ratio exceeds benchmark of 1.

Table 5.2-2: Concentration Ratios for the Special Receptor Locations based on Maximum Concentrations and Weighted-Average Concentrations of SO_2

AREA	Maximum SO_2 CR			Weighted-Average SO_2 CR	
	1-hr	24-hr	Annual	1-hr	24-h
15 - Southeast Residence					
Base Case	0.93	***2.01***	0.06	0.053	0.512
Application Case	0.96	***2.12***	0.07	0.0532	0.514
Cumulative Case	1	***2.15***	0.07	0.0533	0.514
22 - Coste Island					
Base Case	0.31	0.51	0.02	0.0507	0.501
Application Case	0.33	0.54	0.03	0.0508	0.501
Cumulative Case	0.33	0.55	0.03	0.0508	0.501
23 - Southwest Dockyard					
Base Case	***1.97***	***3.37***	0.19	0.0589	0.548
Application Case	***2.02***	***3.47***	0.19	0.0594	0.550
Cumulative Case	***2.02***	***3.48***	0.2	0.0595	0.551
24 - Half Moon Bay					
Base Case	***2.2***	***2.55***	0.15	0.0563	0.531
Application Case	***2.4***	***2.64***	0.16	0.0568	0.536
Cumulative Case	***2.35***	***2.65***	0.16	0.0569	0.537
25 - Minette Bay1					
Base Case	***1.7***	***1.61***	0.07	0.0539	0.516
Application Case	***1.9***	***1.72***	0.08	0.0543	0.521
Cumulative Case	***1.93***	***1.74***	0.08	0.0543	0.521
26 - Minette Bay Lodge					
Base Case	***1.02***	***1.93***	0.07	0.0532	0.511
Application Case	***1.05***	***2.06***	0.07	0.0535	0.513
Cumulative Case	***1.05***	***2.09***	0.07	0.0535	0.513
28 - Kitimat Airport					
Base Case	0.86	***1.92***	0.25	0.0673	0.611
Application Case	0.92	***2.02***	0.26	0.0686	0.620
Cumulative Case	0.92	***2.03***	0.27	0.0687	0.621
29 - Kildala Beach					
Base Case	0.101	0.2	0.0079	0.0502	0.50
Application Case	0.104	0.21	0.0083	0.0502	0.50
Cumulative Case	0.104	0.22	0.0085	0.0502	0.50

NOTES:
Bold Italics – Concentration ratio exceeds benchmark of 1.

The 1-hour and 24-hour weighted-average SO_2 CRs for the application and cumulative cases were compared with the base case to evaluate the percent increase in risk (Table 5.2-3 to Table 5.2-6). The increase in 1-hour weighted-average CRs between the base case and application case for the human health focus areas ranged from 0.46% in area A1 to 2.4% in area A5, whereas the increase in CRs for the special receptor locations ranged from 0.035% in location 29 to 1.9% in location 28. The increase in 1-hour weighted-average CRs between the base case and cumulative case for the human health focus areas ranged from 0.48% in area A1 to 2.52% in area A5, whereas the increase in CRs for the special receptor locations ranged from 0.03% in location 29 to 2.0% in location 28. Similar increases were also identified between the base and application cases and the base and cumulative cases for the 24-hour weighted-average CRs. These small increases in CRs between the base case and the application and cumulative cases suggests that the contributions to SO_2 levels from the Project and anticipated future development will not measurably alter human health risks related to SO_2 exposures beyond what exists in the base case.

Table 5.2-3: Comparison of the 1-hour Weighted-Average SO_2 Concentrations Ratios for Base Case and Application Case

Area	1-hour Weighted-Average SO_2 CR		
	Base Case	Application Case	Percent Difference (%)
Human Health Focus Areas			
A1 - Kitamaat Village	0.05430	0.05455	0.46%
A2 - lower Kitimat	0.06175	0.0628	1.7%
A3 - upper Kitimat	0.05840	0.05915	1.3%
A4 - north Kitimat	0.05950	0.06045	1.6%
A5 - service area	0.07375	0.07555	2.4%
Special Receptor Locations			
15 - southeast residence	0.05300	0.05328	0.52%
22 - Coste Island	0.05067	0.05076	0.17%
23 - southwest dockyard	0.05895	0.05942	0.81%
24 - Half Moon Bay	0.05630	0.05677	0.83%
25 - Minette Bay1	0.05386	0.05427	0.75%
26 - Minette Bay Lodge	0.05324	0.05352	0.52%
28 - Kitimat Airport	0.06731	0.06858	1.9%
29 - Kildala Beach	0.05015	0.05017	0.035%

Table 5.2-4: Comparison of the 1-hour Weighted-Average SO_2 Concentrations Ratios for Base Case and Cumulative Case

AREA	1-hour Weighted-Average SO_2 CR		
	Base Case	Cumulative Case	% Increase
Human Health Focus Areas			
A1 - Kitamaat Village	0.05430	0.05456	0.48%
A2 - lower Kitimat	0.06175	0.06283	1.75%
A3 - upper Kitimat	0.05840	0.05916	1.30%
A4 - north Kitimat	0.05950	0.06047	1.63%
A5 - service area	0.07375	0.07561	2.52%
Special Receptor Locations			
15 - southeast residence	0.05300	0.05331	0.58%
22 - Coste Island	0.05067	0.05076	0.17%
23 - southwest dockyard	0.05895	0.05949	0.92%
24 - Half Moon Bay	0.05630	0.05686	0.99%
25 - Minette Bay1	0.05386	0.05428	0.77%
26 - Minette Bay Lodge	0.05324	0.05354	0.57%
28 - Kitimat Airport	0.06731	0.06865	2.00%
29 - Kildala Beach	0.05015	0.05017	0.03%

Table 5.2-5: Comparison of the 24-hour Weighted-Average SO_2 Concentrations Ratios for Base Case and Application Case

AREA	24-hour SO_2 Weighted-Average CR		
	Base Case	Application Case	% Increase
Human Health Focus Areas			
A1 - Kitamaat Village	0.521	0.522	0.27%
A2 - lower Kitimat	0.5516	0.5607	1.7%
A3 - upper Kitimat	0.5297	0.5347	0.95%
A4 - north Kitimat	0.5383	0.5424	0.76%
A5 - service area	0.6588	0.6766	2.7%
Special Receptor Locations			
15 - southeast residence	0.5119	0.5137	0.36%
22 - Coste Island	0.50092	0.50095	0.01%
23 - southwest dockyard	0.5484	0.5509	0.33%
24 - Half Moon Bay	0.5310	0.5365	1.0%
25 - Minette Bay1	0.5160	0.5205	0.88%
26 - Minette Bay Lodge	0.5109	0.5128	0.36%

AREA	24-hour SO_2 Weighted-Average CR		
	Base Case	Application Case	% Increase
28 - Kitimat Airport	0.6111	0.6198	1.4%
29 - Kildala Beach	0.500	0.500	0%

Table 5.2-6: Comparison of the 24-hour Weighted-Average SO_2 Concentrations Ratios for Base Case and Cumulative Case

AREA	24-hour SO_2 Weighted-Average CR		
	Base Case	Cumulative Case	% Increase
Human Health Focus Areas			
A1 - Kitamaat Village	0.5210	0.5224	0.27%
A2 - lower Kitimat	0.5516	0.5630	2.08%
A3 - upper Kitimat	0.5297	0.5347	0.95%
A4 - north Kitimat	0.5383	0.5434	0.94%
A5 - service area	0.6588	0.6772	2.79%
Special Receptor Locations			
15 - southeast residence	0.5119	0.5137	0.36%
22 - Coste Island	0.5009	0.5009	0.00%
23 - southwest dockyard	0.5484	0.5511	0.50%
24 - Half Moon Bay	0.5310	0.5370	1.12%
25 - Minette Bay1	0.5160	0.5205	0.88%
26 - Minette Bay Lodge	0.5109	0.5128	0.36%
28 - Kitimat Airport	0.6111	0.6207	1.57%
29 - Kildala Beach	0.5000	0.5000	0.00%

5.2.1.2 Evaluation of 5-minute Exposure to SO_2

The standard 24-hour and 1-hour assessments of potential health effects associated with inhalation exposures to SO_2 are based on the assumption that exposure to SO_2 concentrations below the established human health-based air quality standards do not represent potential concerns for human health. Recent evaluations of SO_2 by U.S. EPA and other agencies have suggested that for people with asthma or COPD respiratory effects can occur even at SO_2 concentrations that are below the established standards (U.S. EPA 2009). As SO_2 concentrations in ambient air decrease, the probability of people with asthma or COPD having a respiratory event decreases (U.S. EPA 2009). The U.S. EPA has used empirical human exposure data to develop an exposure response function to predict the change in respiratory response (includes both asthma and COPD) resulting from changes in exposure to 5-minute

SO_2 concentrations (U.S. EPA 2009). Potential changes in respiratory responses for people with asthma or COPD in the Kitimat River Valley area are included in the assessment to better evaluate the potential effects the Project could have on human health.

The air quality modelling data provide estimates of 1-hour SO_2 concentrations but do not provide 5-minute SO_2 concentrations because of the computational complexity of providing such data (see the Air Quality TDR; Stantec 2014b). Because the respiratory response function is based on 5-minute SO_2 concentrations, the hourly modelled SO_2 data were converted to 5-minute SO_2 data using the following equation (Beychok 1994):

$$\frac{C_x}{C_p} = \left(\frac{tp}{tx}\right)^n$$

Where: C_p and C_x = ground-level centreline concentrations
tp, tx = any two averaging times (min)
n = multiple possible values depending on the practitioner and approach (value of 0.20 selected for this assessment)

This equation was used to convert the approximately 26,300 1-hour SO_2 concentrations from the maximum SO_2 concentration grid point for each of the five human health areas and the eight special receptors located outside these areas into 26,300 5-min SO_2 concentrations. These data are provided in Appendix A.

In evaluating the potential for respiratory responses, the U.S. EPA considered two different forms of the exposure-response function: a two-parameter logistic model and a probit model (U.S. EPA 2009). Although the limited data used by the U.S. EPA fit equally well to both types of functions (Figure 5.2-1), the two-parameter logistic model was used to estimate potential changes in respiratory responses in this assessment because in the low SO_2 concentration range it is more conservative (predicts a greater likelihood of response) than the probit model. See Figure 5.2-1 for the equation for the two-parameter logistic model used to predict respiratory responses. The equation used to estimate the respiratory response rate associated with a given 5-minute SO_2 concentration was derived from the two-parameter logistic model used by the U.S. EPA (Equation 9-3 from U.S. EPA 2009) as shown in the following equation:

$$y = \frac{1}{1 + e^{\beta + \gamma * \ln(x)}}$$

Where:

y	= probability of lung response
x	= 5-minute SO_2 concentration in ppm
ß	= parameter whose values range between -10 and 0
γ	= parameter whose values range between -10 and 0

The probability of respiratory response curve was derived using the SO_2 concentration and corresponding probability of response data provided in Table 3.3 of Appendix C of U.S. EPA 2009, and the values of β and γ were varied between -10 and 0 until the resulting curve (red line in Figure 5.2-1) provided a reasonable approximation of the curve developed by the U.S. EPA (black line in Figure 5.2-1). The equation describing this curve is provided in the following equation.

$$y = \frac{1}{1 + e^{(-0.45 + -1.613 * (\ln(x)/2620))}}$$

Where:

y	= probability of lung response
x	= 5–minute SO_2 concentration in ppm
ß	= parameter whose value is -0.45
γ	= parameter whose value is -1.613
2620	= ppm to µg/m^3 conversion factor

This equation has been used to estimate potential increases in respiratory responses associated with predicted 5-minute SO_2 concentrations for the base, application and cumulative cases. As shown from the curves provided in Figure 5.2-1, the equation derived for use in this assessment over-predicts potential respiratory responses when 5-miunte SO_2 concentrations are below 500 µg/m^3 and above 2,000 µg/m^3 (red line is above U.S. EPA curve) and mirrors the response frequency predicted by the U.S. EPA when 5-minute SO_2 concentrations are between 500 µg/m^3 and 2,000 µg/m^3. Therefore, using this equation will overestimate potential respiratory responses associated with changes in SO_2 concentrations compared with what would be predicted from the U.S. EPA when the 5-minute SO_2 concentrations are less than 500 µg/m^3 and above 2,000 µg/m^3, and will agree with the predictions from the U.S. EPA when changes in SO_2 concentrations range between 500 µg/m^3 and 2,000 µg/m^3. Therefore, it is reasonable to expect that this equation will provide representative estimates of potential changes in respiratory responses associated with changes in 5-minute SO_2 concentrations.

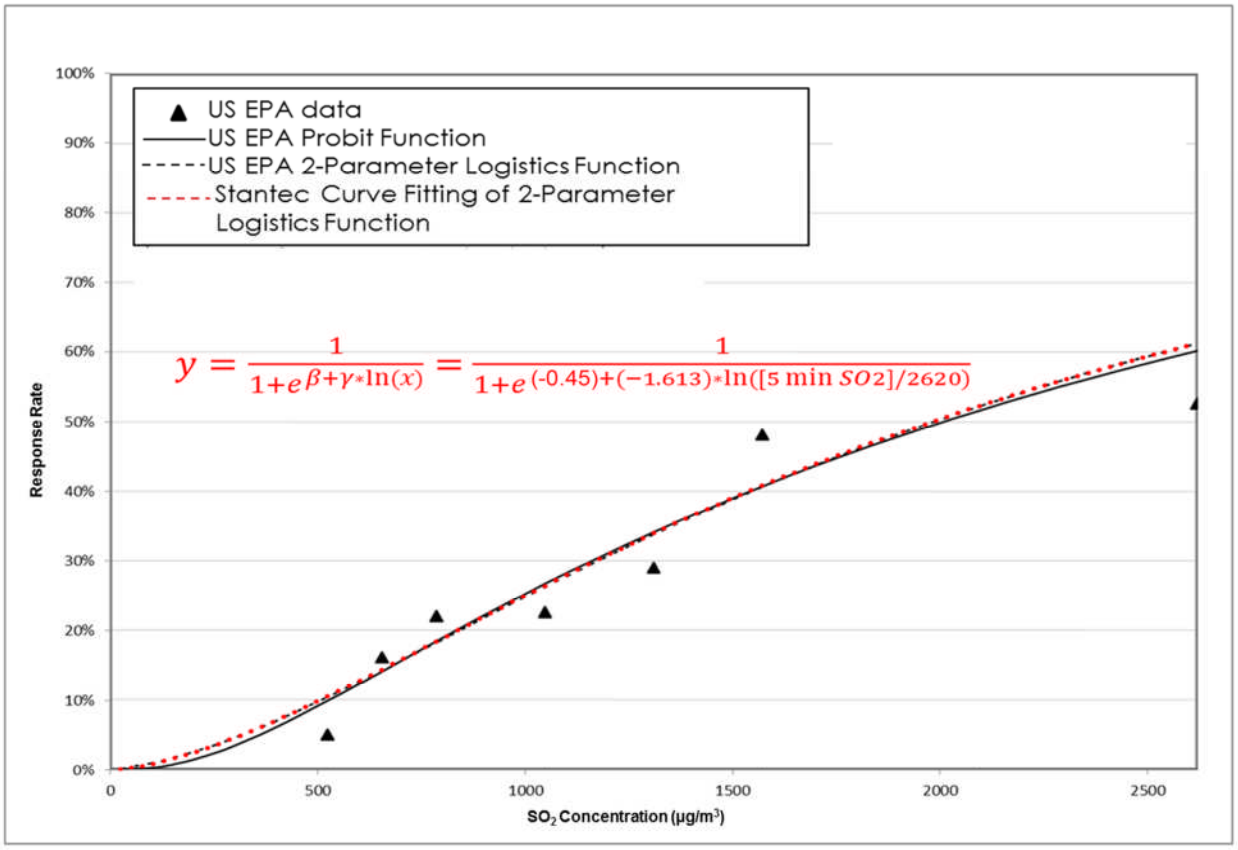

Figure 5.2-1: Respiratory Response Rate Function for 5-minute Exposure to SO_2

To predict the potential change in the frequency of respiratory events experienced by people with asthma or COPD, it is necessary to understand the prevalence of these conditions in the community and the frequency of respiratory events that would typically be expected in a given community in the absence of specific sources of SO_2. For the Kitimat River Valley, the expected frequency of events was estimated based on the information and approach provided in *Sulphur Dioxide Technical Assessment Report* (STAR) (RTA 2013), which supported the application to modernize the RTA facility. A survey conducted by the Public Health Agency of Canada (2010) indicated that the combined prevalence of asthma and COPD in the general population is 12%. To maintain consistency with the STAR (RTA 2013), Kitimat was assumed to have the same prevalence. Individuals with pre-existing respiratory conditions such as asthma and COPD are considered "well-controlled" if they have less than one event per week (RTA 2013). For the purposes of this assessment and to maintain consistency with the STAR, it was further assumed that the population (12%) in the Kitimat River Valley with asthma or COPD is "well

controlled," and individuals are assumed to experience one respiratory event per week 50 weeks per year (50 events per individual per year). Based on these assumptions and the populations of the five human health focus areas, the number of likely respiratory events per year in each of the five areas was predicted. A summary of the predicted underlying number of respiratory events in each area is provided in Table 5.2-7. The (A5) service area is an industrial/commercial area and does not contain any residential housing. A population of 100 was assigned to this area for analysis to account for people who work in this area.

Table 5.2-7: Frequency of Background Respiratory Events – Human Health Areas

Area	Population	Frequency of Asthma and COPD in Population (%)	Population with Asthma and COPD	No. of Events per Person per Year	Expected No. of Events
A1 - Kitamaat Village	167	12	20	50	1,000
A2 - lower Kitimat	3,338	12	401	50	20,050
A3 - upper Kitimat	4,590	12	551	50	27,550
A4 - north Kitimat	250	12	30	50	1,500
A5 - service area	100	12	12	50	600

To understand and evaluate changes in the frequencies of respiratory events that could occur in the community as a result of Project activities, it is necessary to understand the frequency of respiratory events that might occur in the community under base case conditions (includes operation of the RTA upgrade project). The change in respiratory event frequency that might occur as a result of operation of the Project (application case) is then evaluated as the difference in predicted respiratory event frequency between the base and application cases.

For the assessment of potential health effects associated with exposures to the predicted 5-minute SO_2 concentrations, the 5-minute data are grouped using the same concentration ranges used to group the 1-hour data. The predicted frequency of respiratory events for the base and application cases was calculated as a function of the probability of a respiratory response for a given concentration range and the frequency of SO_2 concentrations within a given concentration range. The probability of a respiratory event occurring was determined for the upper limit concentration for each concentration range using the two-parameter logistic equation. The number of predicted respiratory responses in a given human health focus area was calculated by multiplying the probability of response for a given SO_2 concentration by the frequency of occurrence of that concentration and by the predicted population of people with asthma or COPD in each of the five areas. The total number of predicted respiratory responses in a given area was calculated as the sum of the predicted responses for each SO_2 concentration range. This approach is consistent with the approach used by the U.S. EPA (2009).

The predicted number of additional respiratory events for each area for the application case is provided in Table 5.2-8. The additional number of events expected in each area is estimated by subtracting the number of events predicted under the base case from the number of events predicted from either the application case or cumulative case, as applicable. The percent increase in events resulting from the Project was estimated relative to the sum of the background events and the number of additional events predicted under the base case. The percent increases in respiratory events ranged from 0.0009% to 0.0065% (Table 5.2-8). These small increases suggest that the contribution of the Project to the overall concentration of SO_2 is inconsequential compared with the contribution from the base case. The Project is not expected to result in SO_2 concentrations that would indicate potential health concerns greater than what may or may not already be present (in the base case).

The potential increases in respiratory events that might occur have not been calculated for the eight special receptor locations that exist outside the five human health focus areas. As discussed above, the calculation of potential increases in respiratory events is based on the population in a given area. The eight locations are individual locations that do not have populations directly associated with them. Assessment of the potential health effects associated with 24-hour and 1-hour SO_2 concentrations shows that predicted human health risks at these locations are lower than those predicted for the five human health areas. Therefore, it is reasonable to conclude that the increase in respiratory events that could be experienced by people who spend time at the eight locations would be lower than those predicted for the five areas where it has been assumed that people are present on a on a continuous basis.

In addition to the direct comparison of predicted exposures to the human health–based 1-hour and 24-hour criteria, the assessment of cumulative effects considered the potential increases in respiratory events that could be expected to result from changes in the estimated 5-minute SO_2 concentrations between the base and cumulative cases. The assessment of changes in respiratory events for people with asthma and or COPD in the cumulative case was conducted as described for the application case. The expected increase in the number of respiratory events ranges between less than 1.0 in Kitamaat Village and the service area to approximately 14 additional events in upper and lower Kitimat (Table 5.2-9). When compared with the number of events predicted to occur in these areas under base case conditions, these changes represent less than a 0.01% increase over the base case (Table 5.2-9).

Table 5.2-8: Increase in Respiratory Response between Base and Application Cases based on 5–minute SO_2 Concentrations

Area	No. of Expected Respiratory Events[a]	Base Case		Application Case		Predicted Health Effect		
		Increase in Predicted Respiratory Response Rate (%)	Expected No. of Events	Increase in Predicted Respiratory Response Rate (%)	Expected No. of Events	Increase in No. Events between Base and Application	No. of Base Events[b]	Percent Increase in Events from Base to Application (%)
A1 - Kitamaat Village	1,000	0.00038	0.38	0.00039	0.39	0.0088	1,000.38	0.0009
A2 - lower Kitimat	20,050	0.00061	12.2	0.00066	13.1	0.89	20,062.25	0.0045
A3 - upper Kitimat	27,550	0.00046	12.7	0.00048	13.3	0.67	27,562.7	0.0024
A4 - north Kitimat	1,500	0.00046	0.70	0.00049	0.74	0.045	1,500.7	0.0030
A5 - service area	600	0.00095	0.57	0.0010	0.61	0.039	600.6	0.0065

NOTES:

[a] The number of expected events is based on the average number of respiratory response events expected per year for a person with COPD or asthma (50) multiplied by the percentage of people who have a respiratory illnesses (approx. 12% of the population of each area).

[b] The base number of expected respiratory events per year is a function of the expected number of respiratory events with the addition of baseline concentrations of SO_2. The probable response curve is used to derive the base response numbers for the baseline SO_2 concentrations.

Table 5.2-9: Increase in Respiratory Response between Base and Cumulative Cases based on 5–minute SO_2 Concentrations

Area	No. of Expected Respiratory Events[a]	Base Case		Cumulative Case		Increase in Events		
		Increase in Predicted Respiratory Response Rate (%)	Expected No. of Events	Increase in Predicted Respiratory Response Rate (%)	Expected No. of Events	Increase in No. of Events between Base and Cumulative Cases	No. of Base Events[b]	Percent Increase in Events from Base to Cumulative Cases
A1 - Kitamaat Village	1,000	0.00038	0.38	0.00039	0.39	0.0090	1,000.38	0.0098
A2 - lower Kitimat	20,050	0.00061	12.2	0.00066	13.2	0.93	20,062.25	0.0046
A3 - upper Kitimat	27,550	0.00046	12.7	0.00049	13.4	0.70	27,562.7	0.0025
A4 - north Kitimat	1,500	0.00046	0.70	0.00049	0.74	0.046	1,500.7	0.0031
A5 - service area	600	0.00095	0.57	0.0010	0.61	0.041	600.6	0.0067

NOTES:

[a] The number of expected events is based on the average number of respiratory response events expected per year for a person with COPD or asthma (50) multiplied by the percentage of people who have a respiratory illnesses (approx. 12% of the population of each area).

[b] The base number of expected respiratory events per year is a function of the expected number of respiratory events with the addition of baseline concentrations of SO_2. The probable response curve is used to derive the base response numbers for the baseline SO_2 concentrations.

Based on these results, it is reasonable to conclude that changes in human health associated with changes in SO_2 exposures in the cumulative case, beyond what would exist under the base case, would likely be negligible, and the effects would be reversible should SO_2 emissions for industrial operations decline, either through closure and decommissioning or through the application of more stringent SO_2 emission regulations. Therefore, cumulative changes in human health resulting from changes in air quality associated with the residual effects from the Project and other activities incorporated in the cumulative effects assessment are assessed as not significant.

5.2.1.3 Assessment of Risk due to Combined Exposure to NO_2 and SO_2

The primary screening of the air quality modelling data shows that the predicted levels of NO_2 are well below the human health–based air quality criterion for the base and application cases (Section 2.4.3). Based on these results, exposure to NO_2 would not be considered to be a potential concern for human health. However, NO_2 and SO_2 both have the potential to cause respiratory effects when inhaled. Because NO_2 and SO_2 are associated with Project emissions, the assessment of health effects incorporates an assessment of the potential health risks associated with combined inhalation exposures to NO_2 and SO_2.

The evaluation of potential changes in respiratory health risk associated with combined exposures to NO_2 and SO_2 is based on the 1-hour NO_2 and SO_2 air quality modelling data for each of the five human health focus areas and the eight special receptor locations for base, application, and cumulative cases. The method used to estimate the 1-hour maximum and 1-hour weighted-average concentrations for combined NO_2 and SO_2 were previously described in Section 2.2.2.2. CRs were calculated based on these predicted concentrations. The CRs calculated for the 1-hour maximum and the weighted-average combined NO_2 and SO_2 concentrations for the base, application, and cumulative cases for the human health focus areas and the special receptor locations are provided in Table 5.2-10 and Table 5.2-11. The CRs calculated for the 1-hour maximum combined NO_2 and SO_2 concentrations exceed the benchmark of 1 for the base, application, and cumulative cases for areas A1 to A3 and A5, and exceed the benchmark of 1 for the application and cumulative cases for area A4. As discussed in Section 5.2.1, the maximum modelled SO_2 concentrations occur infrequently and represent overestimates of potential human health risks associated with exposure to combined NO_2 and SO_2. Consequently, CRs based on these maximum concentrations do not provide a realistic estimate of the health risks associated with the Project. The weighted-average concentration of NO_2 and SO_2 over the three-year period is a better measure of potential exposure for humans than the maximum concentration. CRs calculated based on the weighted-average 1-hour combined NO_2 and SO_2 concentrations under base, application, and cumulative cases are provided in Table 5.2-10 and Table 5.2-11 for the five human health focus areas and the eight special receptor locations. CRs calculated from the weighted-average 1-hour combined NO_2 and SO_2

concentrations were below the benchmark of 1 for all human health focus areas and special receptor locations for the base, application, and cumulative cases; this finding indicates that predicted SO_2 concentrations do not represent a potential concern for human health.

The 1-hour weighted-average CRs for the application and cumulative cases were compared with the base case to evaluate the percent increase in risk (Table 5.2-12 and Table 5.2-13). The increase in 1-hour weighted-average CRs between the base case and application case for the human health focus areas ranged from 2.47% in area A1 to 16.1% in area A5, whereas the increase in CRs for the special receptor locations ranged from 0.013% in location 29 to 8.6% in location 28. The increase in 1-hour weighted-average CRs between the base case and cumulative case for the human health focus areas ranged from 2.8% in area A1 to 17.7% in area A5, while the increase in CRs for the special receptor locations ranged from 0.15% in location 29 to 9.25% in location 28. A review of the underlying NO_2 and SO_2 data shows that increases in NO_2 levels between base and application cases is the primary contributor to the observed increases in CR. However, the primary screening of CACs shows that predicted concentrations of NO_2 for the base, application, and cumulative cases are well below the human health–based air quality criterion for NO_2; thus, the increase in NO_2 is not a concern for human health.

The CRs calculated from the weighted-average 1-hour combined NO_2 and SO_2 concentrations are less than 20% (<0.2) of the exposure acceptability benchmark (i.e., 1) for the base, application, and cumulative cases for all human health focus areas and special receptor locations. The data presented in Table 5.2-12 and Table 5.2-13 demonstrate that the combined exposures to NO_2 and SO_2 are being driven by air quality in the base case and not by Project-related contributions to air quality in the application case or by future development contributions in the cumulative case. Based on these results, it is reasonable to conclude that simultaneous exposures to NO_2 and SO_2 would not be expected to result in an increase in respiratory effects for people living in the Kitimat River Valley.

Table 5.2-10: Concentration Ratios for the Human Health Focus Areas based on Maximum Concentrations and Weighted-Average Concentrations of Combined NO_2 and SO_2

AREA	NO_2-SO_2 Combined CR	
	1-h Max CR	1-h Weighted-Avg. CR
A1 - Kitamaat Village		
Base Case	***3.9142***	0.0581
Application Case	***3.9302***	0.0595
Cumulative Case	***3.9338***	0.0597
A2 - lower Kitimat		
Base Case	***3.6070***	0.0663
Application Case	***4.0191***	0.0727
Cumulative Case	***4.0206***	0.0734
A3 - upper Kitimat		
Base Case	***3.6122***	0.0630
Application Case	***3.8181***	0.0681
Cumulative Case	***3.8214***	0.0688
A4 - north Kitimat		
Base Case	0.9713	0.0636
Application Case	***1.0659***	0.0680
Cumulative Case	***1.0697***	0.0682
A5 - service area		
Base Case	***2.4610***	0.0796
Application Case	***2.6559***	0.0924
Cumulative Case	***2.6559***	0.0937

NOTES:
Bold Italics – Concentration ratio exceeds benchmark of 1.

Table 5.2-11: Concentration Ratios for the Special Receptor Locations based on Maximum Concentrations and Weighted-Average Concentrations of Combined NO_2 and SO_2

AREA	NO_2-SO_2 Combined CR	
	1-h Max CR	1-h Weighted-Avg. CR
15 - Southeast Residence		
Base Case	***1.3796***	0.0566
Application Case	***1.8594***	0.0585
Cumulative Case	***1.8597***	0.0588
22 - Coste Island		
Base Case	0.7274	0.0540
Application Case	0.7693	0.0544
Cumulative Case	0.7732	0.0545
23 - Southwest Dockyard		
Base Case	***2.2107***	0.0631
Application Case	***2.3976***	0.0677
Cumulative Case	***2.3997***	0.0683
24 - Half Moon Bay		
Base Case	***2.4718***	0.0603
Application Case	***2.4976***	0.0642
Cumulative Case	***2.6434***	0.0651
25 - Minette Bay1		
Base Case	***1.8400***	0.0575
Application Case	***2.1212***	0.0592
Cumulative Case	***2.1227***	0.0594
26 - Minette Bay Lodge		
Base Case	***1.1623***	0.0569
Application Case	***1.3611***	0.0592
Cumulative Case	***1.3697***	0.0597
28 - Kitimat Airport		
Base Case	0.9559	0.0724
Application Case	***1.1595***	0.0786
Cumulative Case	***1.1653***	0.0791
29 - Kildala Beach		
Base Case	0.1652	0.0534
Application Case	0.1952	0.0534
Cumulative Case	0.1976	0.0535

NOTES:
Bold Italics – Concentration ratio exceeds benchmark of 1.

Table 5.2-12 Comparison of the 1-hour Weighted-Average Combined NO_2 and SO_2 Concentrations Ratios for Base Case and Application Case

Area	1-hour Weighted-Average Combined NO_2 and SO_2 CRs		
	Base Case	Application Case	Percent Increase (%)
Human Health Focus Areas			
A1 - Kitamaat Village	0.0581	0.0595	2.47%
A2 - lower Kitimat	0.0663	0.0727	9.62%
A3 - upper Kitimat	0.0630	0.0681	8.02%
A4 - north Kitimat	0.0636	0.0680	6.86%
A5 - service area	0.0796	0.0924	16.2%
Special Receptor Locations			
15 - southeast residence	0.0566	0.0585	3.34%
22 - Coste Island	0.0540	0.0544	0.70%
23 - southwest dockyard	0.0631	0.0677	7.25%
24 - Half Moon Bay	0.0603	0.0642	6.47%
25 - Minette Bay1	0.0575	0.0592	2.97%
26 - Minette Bay Lodge	0.0569	0.0592	4.02%
28 - Kitimat Airport	0.0724	0.0786	8.62%
29 - Kildala Beach	0.0534	0.0534	0.13%

Table 5.2-13: Comparison of the 1-hour Weighted-Average Combined NO_2 and SO_2 Concentrations Ratios for Base Case and Cumulative Case

AREA	1-hour Weighted-Average Combined NO_2 and SO_2 CRs		
	Base Case	Application Case	Percent Increase (%)
Human Health Focus Areas			
A1 - Kitamaat Village	0.0581	0.0597	2.84%
A2 - lower Kitimat	0.0663	0.0734	10.67%
A3 - upper Kitimat	0.0630	0.0688	9.11%
A4 - north Kitimat	0.0636	0.0682	7.23%
A5 - service area	0.0796	0.0937	17.7%
Special Receptor Locations			
15 - southeast residence	0.0566	0.0588	3.85%
22 - Coste Island	0.0540	0.0545	0.87%
23 - southwest dockyard	0.0631	0.0683	8.21%
24 - Half Moon Bay	0.0603	0.0651	7.91%
25 - Minette Bay1	0.0575	0.0594	3.22%
26 - Minette Bay Lodge	0.0569	0.0597	4.90%

AREA	1-hour Weighted-Average Combined NO_2 and SO_2 CRs		
	Base Case	Application Case	Percent Increase (%)
28 - Kitimat Airport	0.0724	0.0791	9.26%
29 - Kildala Beach	0.0534	0.0535	0.16%

5.2.1.4 Summary of Risk Characterization

The risk characterization stage evaluated the potential human health risks from the inhalation of CACs under the base, application, and cumulative cases. Changes in CAC concentrations in the Kitimat River Valley air shed that occur between the base, application, and cumulative cases do not present potential human health concerns from human exposure to PM, CO, and NO_2.

The results also indicate that Project residual effects are not predicted to result in a change in human health as a result of changes in air quality related to SO_2 emissions or changes in air quality related to combined SO_2 and NO_2 emissions. Residual effects from the LNG facility are expected to be negligible, long term in duration, limited to the LSA, and reversible.

Cumulative effects from existing projects, including the expected increases from the RTA modernization project, are expected to cause an incremental increase in SO_2 concentrations from the base case to the cumulative case. The increase in potential respiratory events from the base case to the cumulative case is anticipated to be less than 0.01%. Therefore, changes in human health associated with changes in SO_2 exposures are negligible, and the effects will be reversible.

6 DISCUSSION OF UNCERTAINTIES

6.1 Introduction

The process of evaluating human health risks involves multiple steps. Inherent in each of these steps are uncertainties that affect the final assessment of human health risk. These uncertainties may include data gaps, estimated or modelled data, or the derivation and applicability of TRVs from different regulatory agencies. Where uncertainties existed, a conservative approach was taken, where appropriate, to overestimate the potential risk. This section describes each of the identified uncertainties and its influence on the characterization of potential human health risk.

6.2 Health Risk Uncertainties with Air Quality

6.2.1 Modelled Air Quality

The air quality assessment was based on modelled air data. This approach introduces several uncertainties because the accuracy of the modelled data largely depends on the quality of the data used. Emission rates used in the modelling were based on a combination of available baseline air quality data from provincial databases or regional monitoring stations, meteorological data, and emission factors from the Project inventory of equipment, vehicles, and machines. For the cumulative assessment, there are the added uncertainties associated with incorporating publicly available information for other projects that may be incorrect.

In addition, the modelling program and its limitations also influence the output. In the present assessment, the air dispersion model followed guidance provided by MOE. While such models use assumptions to simplify the random behaviour of the atmosphere into short periods of average behaviour, they are designed to have a bias towards overestimation of contaminant concentrations (i.e., to be conservative under most conditions).

Despite these uncertainties associated with air modelling, the health risks associated with air emissions are conservative, reporting only the maximum predicted concentrations for each CAC. This approach is widely used and accepted by the regulatory community.

6.2.2 Toxicity Reference Values

There is limited toxicological information on the effects associated with human exposure to low levels of CACs in the environment. The information available is usually based on epidemiological and controlled human exposure studies, which are limited in scope and provide results that may not be applicable to chronic or continuous exposures to low levels of CACs.

In this HHRA, only human health–related TRVs were used, resulting in the combination of information from multiple regulatory agencies. Inconsistencies arise when various agencies use different methods to derive health-based guidelines such as site-specific or country-specific objectives. Objectives for the same chemical and averaging period may differ between Canada, United States, and other international guidelines. In addition, the guideline may be defined and applied differently, such as the maximum acceptable level, maximum desirable level, or maximum tolerable level from the BC AAQO. However, where TRVs were available for the same averaging period from multiple agencies, the lowest of these values was selected for use in the assessment.

6.2.3 Health Risk Associated with Multiple COPCs

The current understanding of the toxicity of certain compounds is based primarily on toxicity studies performed in laboratory animals exposed to a single toxic agent. However, the human population is exposed to complex mixtures of contaminants generally at much lower concentrations than those routinely examined in animal toxicity studies, and the effects of any interactions between such substances on their toxicity is virtually unknown. As a result, guidelines for the protection of human health are almost exclusively based on exposure to single substances.

Substances in a mixture may interact in five general ways to elicit a biological response:

- Non-interacting: when substances have no effect in combination with each other, the toxicity of the mixture is the same as the toxicity of the most toxic substance in the mixture
- Additive: when substances have similar targets and modes of action, but do not interact, the hazard for exposure to the mixture is simply the sum of hazards for the individual substances
- Potentiation: when a non-toxic substance enhances the toxicity of another
- Synergistic: when there is a positive interaction among the substances such that the response is greater than would be expected if the substances acted independently, and
- Antagonistic: when there is a negative interaction among the substances such that the response is less than would be expected if the substances acted independently.

There is no clear guidance on how to evaluate the interaction among substances in a mixture and their potential effects on human health risk. There are exceptions for chemicals such as PCDD/Fs, PCBs, and PAHs, where variants of a chemical group have the exact mode of action and toxic endpoint, but at different levels of potency. In such cases, regulatory agencies provide guidance in the form of equivalency factors, as is the case for PCDD/Fs, which are converted into a TEQ based on the WHO mammalian TEQ factors. However, there is no clear guidance provided by any provincial, federal, or international regulatory agency (e.g., U.S. EPA, WHO) on evaluating CACs in a similar manner. In the absence of regulatory guidance on the methods to assess the combined health risk of a mixture, risk can sometimes simply be based on the addition of the risks of the individual mixture components, unless

there is information indicating that the interaction is other than additive in nature. However, such an approach can only be used if it is determined that the various substances have a similar mode of action and toxic endpoints in the body.

In evaluating combined exposures to SO_2 and NO_2, it has been assumed that the two compounds act in an additive manner. Applying the lower of the two TRVs for SO_2 and NO_2 in assessing potential health effects provides a conservative assessment of the potential human health effects associated with the combined exposure because it assumes that the two compounds have the toxicological potency. Therefore, it overestimates the potential effects associated with exposure to SO_2, which has a higher TRV and would be considered less toxicologically active than NO_2.

6.3 Summary of Uncertainties

Table 6.3-1 presents a summary of the uncertainties associated with the HHRA and the effect it would have on either overestimating or underestimating the level of risk. When possible, a conservative approach was used to overestimate the risk.

Table 6.3-1: Summary of Uncertainties

Source of Uncertainty	Influence of the Uncertainties on Human Health Risk		
	Over Estimation	Under Estimation	Unknown
Air Dispersion Modelling	✓		
Toxicity Reference Value	✓		
Multiple COPC exposure			✓

7 CONCLUSION

Changes in CAC concentrations in the Kitimat River Valley air shed that occur between the base case and cumulative case do not present potential human health concerns from human exposure to PM, CO, and NO_2.

Project residual effects are not predicted to result in a change in human health as a result of changes in air quality related to SO_2 emissions or changes in air quality related to combined SO_2 and NO_2 emissions. Residual effects from the Project are expected to be negligible, of long-term duration, limited to the human health assessment area, and reversible. Project activities are not anticipated to affect terrestrial or marine ecological receptors; therefore, Project activities will not result in a change in human exposures to Project emissions through the consumption of terrestrial or marine country foods.

Cumulative effects from existing projects, including the expected increases from the RTA modernization project, are expected to cause an incremental increase in SO_2 concentrations from the base case to the cumulative case. The increase in potential respiratory events from the base case to the cumulative case is anticipated to be less than 0.01%. Therefore, changes in human health associated with changes in SO_2 exposures are negligible, and the effects will be reversible.

8 CLOSURE

This report has been prepared for the sole benefit of LNG Canada Development Inc. and their representatives. The report may not be relied upon by any other person or entity without the express written consent of Stantec and LNG Canada Development Inc.

Any use which a third party makes of this report, or any reliance on decisions made based on it, is the responsibility of such third parties. Stantec accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Should additional information become available that differs substantially from our understanding of conditions presented in this report, we request that this information be brought to our attention so that we may reassess the conclusions provided herein.

This report was prepared by a number of Stantec staff, identified in the Authorship section preceding the Executive Summary. We trust that the above information meets with your present requirements. Should you have any questions or require further information, please contact Bryan Leece directly at (905) 381-3264.

Respectfully submitted,

Stantec Consulting Ltd.

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APPENDIX A

HHRA Air Quality Analysis

1-h Weighted-Average SO_2 Concentrations for the HHRA Areas

Table A–1: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A1 – Project-alone Case

A1 – Project-alone Case – 1-h SO_2 Data			
Maximum Concentration: 28.40485 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,277	10	262,770
10–20	25	20	500
20–30	2	30	60
>30	0		0
Total	**26,304**	**Weighted Average**	**10.01**

Table A–2: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A1 – Base Case

A1 – Base Case – 1-h SO_2 Data			
Maximum Concentration: 734.75115 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,622	10	256,220
10–20	333	20	6,660
20–30	133	30	3,990
30–40	67	40	2,680
40–50	41	50	2,050
50–60	16	60	960
60–70	15	70	1,050
70–80	18	80	1,440
80–90	10	90	900
90–100	3	100	300
100–110	5	110	550
110–120	7	120	840
120–130	2	130	260
130–140	3	140	420
140–150	2	150	300
150–160	6	160	960
160–170	2	170	340
170–180	3	180	540

A1 – Base Case – 1-h SO_2 Data			
Maximum Concentration: 734.75115 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
180–190	0	190	0
190–200	2	200	400
200–210	1	210	210
210–220	1	220	220
220–230	1	230	230
230–240	1	240	240
240–250	0	250	0
250–260	0	260	0
260–270	2	270	540
270–280	0	280	0
280–290	1	290	290
290–300	0	300	0
300–310	0	310	0
310–320	1	320	320
320–330	0	330	0
330–340	0	340	0
340–350	1	350	350
350–360	1	360	360
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	1	440	440
440–450	0	450	0
450–460	1	460	460
460–470	0	470	0
470–480	0	480	0
480–490	0	490	0
490–500	0	500	0
500–510	0	510	0

A1 – Base Case – 1-h SO_2 Data			
Maximum Concentration: 734.75115 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
510–520	1	520	520
520–530	0	530	0
530–540	0	540	0
540–550	0	550	0
550–560	0	560	0
560–570	0	570	0
570–580	0	580	0
580–590	0	590	0
590–600	0	600	0
600–610	0	610	0
610–620	0	620	0
620–630	0	630	0
630–640	0	640	0
640–650	0	650	0
650–660	0	660	0
660–670	0	670	0
670–680	0	680	0
680–690	0	690	0
690–700	0	700	0
700–710	0	710	0
710–720	0	720	0
720–730	0	730	0
730–740	1	740	740
>740	0	750	0
Total	**26,304**	**Weighted Average**	**10.86**

Table A–3: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A1 – Application Case

A1 – Application Case – 1-h SO_2 Data			
Maximum Concentration: 735.83197 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,587	10	255,870
10–20	348	20	6,960
20–30	131	30	3,930
30–40	80	40	3,200
40–50	46	50	2,300
50–60	18	60	1,080
60–70	12	70	840
70–80	18	80	1,440
80–90	11	90	990
90–100	4	100	400
100–110	7	110	770
110–120	6	120	720
120–130	3	130	390
130–140	4	140	560
140–150	2	150	300
150–160	6	160	960
160–170	2	170	340
170–180	2	180	360
180–190	1	190	190
190–200	2	200	400
200–210	1	210	210
210–220	0	220	0
220–230	2	230	460
230–240	1	240	240
240–250	0	250	0
250–260	0	260	0
260–270	1	270	270
270–280	0	280	0
280–290	2	290	580
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0

A1 – Application Case – 1-h SO_2 Data			
Maximum Concentration: 735.83197 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
320–330	1	330	330
330–340	0	340	0
340–350	1	350	350
350–360	1	360	360
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	1	440	440
440–450	0	450	0
450–460	1	460	460
460–470	0	470	0
470–480	0	480	0
480–490	0	490	0
490–500	0	500	0
500–510	0	510	0
510–520	1	520	520
520–530	0	530	0
530–540	0	540	0
540–550	0	550	0
550–560	0	560	0
560–570	0	570	0
570–580	0	580	0
580–590	0	590	0
590–600	0	600	0
600–610	0	610	0
610–620	0	620	0
620–630	0	630	0
630–640	0	640	0
640–650	0	650	0

A1 – Application Case – 1-h SO_2 Data			
Maximum Concentration: 735.83197 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
650–660	0	660	0
660–670	0	670	0
670–680	0	680	0
680–690	0	690	0
690–700	0	700	0
700–710	0	710	0
710–720	0	720	0
720–730	0	730	0
730–740	1	740	740
>740	0	750	0
Total	**26,304**	**Weighted Average**	**10.91**

Table A–4: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A1 – Cumulative Case

A1 – Cumulative Case – 1-h SO_2 Data			
Maximum Concentration: 735.85754 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,583	10	255,830
10–20	350	20	7,000
20–30	133	30	3,990
30–40	80	40	3,200
40–50	46	50	2,300
50–60	18	60	1,080
60–70	11	70	770
70–80	19	80	1,520
80–90	11	90	990
90–100	4	100	400
100–110	6	110	660
110–120	7	120	840
120–130	3	130	390
130–140	4	140	560

A1 – Cumulative Case – 1-h SO_2 Data			
Maximum Concentration: 735.85754 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
140–150	2	150	300
150–160	6	160	960
160–170	2	170	340
170–180	2	180	360
180–190	1	190	190
190–200	2	200	400
200–210	1	210	210
210–220	0	220	0
220–230	2	230	460
230–240	1	240	240
240–250	0	250	0
250–260	0	260	0
260–270	1	270	270
270–280	0	280	0
280–290	2	290	580
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0
320–330	1	330	330
330–340	0	340	0
340–350	1	350	350
350–360	1	360	360
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	1	440	440
440–450	0	450	0
450–460	1	460	460

A1 – Cumulative Case – 1-h SO_2 Data			
Maximum Concentration: 735.85754 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
460–470	0	470	0
470–480	0	480	0
480–490	0	490	0
490–500	0	500	0
500–510	0	510	0
510–520	1	520	520
520–530	0	530	0
530–540	0	540	0
540–550	0	550	0
550–560	0	560	0
560–570	0	570	0
570–580	0	580	0
580–590	0	590	0
590–600	0	600	0
600–610	0	610	0
610–620	0	620	0
620–630	0	630	0
630–640	0	640	0
640–650	0	650	0
650–660	0	660	0
660–670	0	670	0
670–680	0	680	0
680–690	0	690	0
690–700	0	700	0
700–710	0	710	0
710–720	0	720	0
720–730	0	730	0
730–740	1	740	740
>740	0	750	0
Total	**26,304**	**Weighted Average**	**10.91**

Table A–5: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A2 – Project-alone Case

A2 – Project-alone Case – 1-h SO_2 Data			
Maximum Concentration: 87.74927 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,239	10	262,390
10–20	51	20	1,020
20–30	8	30	240
30–40	1	40	40
40–50	3	50	150
50–60	0	60	0
60–70	0	70	0
70–80	0	80	0
80–90	2	90	180
>90	0	100	0
Total	**26,304**	**Weighted Average**	**10.04**

Table A–6: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A2 – Base Case

A2 – Base Case – 1-h SO_2 Data			
Maximum Concentration: 674.03687 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	24,151	10	241,510
10–20	961	20	19,220
20–30	483	30	14,490
30–40	238	40	9,520
40–50	131	50	6,550
50–60	105	60	6,300
60–70	57	70	3,990
70–80	44	80	3,520
80–90	28	90	2,520
90–100	20	100	2,000
100–110	21	110	2,310
110–120	9	120	1,080
120–130	12	130	1,560
130–140	6	140	840

A2 – Base Case – 1-h SO_2 Data			
Maximum Concentration: 674.03687 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
140–150	6	150	900
150–160	3	160	480
160–170	3	170	510
170–180	2	180	360
180–190	3	190	570
190–200	1	200	200
200–210	1	210	210
210–220	1	220	220
220–230	3	230	690
230–240	1	240	240
240–250	2	250	500
250–260	0	260	0
260–270	1	270	270
270–280	3	280	840
280–290	1	290	290
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0
330–340	2	340	680
340–350	1	350	350
350–360	0	360	0
360–370	0	370	0
370–380	1	380	380
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	1	470	470

A2 – Base Case – 1-h SO_2 Data			
Maximum Concentration: 674.03687 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
470–480	0	480	0
480–490	1	490	490
490–500	0	500	0
500–510	0	510	0
510–520	0	520	0
520–530	0	530	0
530–540	0	540	0
540–550	0	550	0
550–560	0	560	0
560–570	0	570	0
570–580	0	580	0
580–590	0	590	0
590–600	0	600	0
600–610	0	610	0
610–620	0	620	0
620–630	0	630	0
630–640	0	640	0
640–650	0	650	0
650–660	0	660	0
660–670	0	670	0
670–680	1	680	680
>680	0	690	0
Total	**26,304**	**Weighted Average**	**12.35**

Table A–7: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A2 – Application Case

A2 – Application Case – 1-h SO_2 Data			
Maximum Concentration: 720.81110 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	24,018	10	240,180
10–20	1,008	20	20,160
20–30	510	30	15,300
30–40	244	40	9,760
40–50	148	50	7,400
50–60	111	60	6,660
60–70	69	70	4,830
70–80	38	80	3,040
80–90	38	90	3,420
90–100	20	100	2,000
100–110	21	110	2,310
110–120	21	120	2,520
120–130	8	130	1,040
130–140	5	140	700
140–150	9	150	1,350
150–160	2	160	320
160–170	4	170	680
170–180	2	180	360
180–190	2	190	380
190–200	3	200	600
200–210	2	210	420
210–220	1	220	220
220–230	1	230	230
230–240	2	240	480
240–250	3	250	750
250–260	2	260	520
260–270	0	270	0
270–280	0	280	0
280–290	2	290	580
290–300	2	300	600
300–310	0	310	0
310–320	0	320	0

A2 – Application Case – 1-h SO_2 Data			
Maximum Concentration: 720.81110 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
320–330	0	330	0
330–340	0	340	0
340–350	3	350	1,050
350–360	0	360	0
360–370	1	370	370
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	1	410	410
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	0	470	0
470–480	0	480	0
480–490	0	490	0
490–500	1	500	500
500–510	1	510	510
510–520	0	520	0
520–530	0	530	0
530–540	0	540	0
540–550	0	550	0
550–560	0	560	0
560–570	0	570	0
570–580	0	580	0
580–590	0	590	0
590–600	0	600	0
600–610	0	610	0
610–620	0	620	0
620–630	0	630	0
630–640	0	640	0
640–650	0	650	0

A2 – Application Case – 1-h SO_2 Data			
Maximum Concentration: 720.81110 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
650–660	0	660	0
660–670	0	670	0
670–680	0	680	0
680–690	0	690	0
690–700	0	700	0
700–710	0	710	0
710–720	0	720	0
720–730	1	730	730
>730	0	740	0
Total	**26,304**	**Weighted Average**	**12.56**

Table A–8: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A2 – Cumulative Case

A2 – Cumulative Case – 1-h SO_2 Data			
Maximum Concentration: 720.92426 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	24,012	10	240,120
10–20	1,008	20	20,160
20–30	514	30	15,420
30–40	246	40	9,840
40–50	148	50	7,400
50–60	111	60	6,660
60–70	68	70	4,760
70–80	39	80	3,120
80–90	38	90	3,420
90–100	20	100	2,000
100–110	21	110	2,310
110–120	21	120	2,520
120–130	8	130	1,040
130–140	5	140	700
140–150	9	150	1,350

A2 – Cumulative Case – 1-h SO_2 Data			
Maximum Concentration: 720.92426 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
150–160	2	160	320
160–170	4	170	680
170–180	2	180	360
180–190	2	190	380
190–200	3	200	600
200–210	2	210	420
210–220	1	220	220
220–230	1	230	230
230–240	2	240	480
240–250	3	250	750
250–260	2	260	520
260–270	0	270	0
270–280	0	280	0
280–290	2	290	580
290–300	2	300	600
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0
330–340	0	340	0
340–350	3	350	1,050
350–360	0	360	0
360–370	1	370	370
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	1	410	410
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	0	470	0
470–480	0	480	0

A2 – Cumulative Case – 1-h SO_2 Data			
Maximum Concentration: 720.92426 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
480–490	0	490	0
490–500	1	500	500
500–510	1	510	510
510–520	0	520	0
520–530	0	530	0
530–540	0	540	0
540–550	0	550	0
550–560	0	560	0
560–570	0	570	0
570–580	0	580	0
580–590	0	590	0
590–600	0	600	0
600–610	0	610	0
610–620	0	620	0
620–630	0	630	0
630–640	0	640	0
640–650	0	650	0
650–660	0	660	0
660–670	0	670	0
670–680	0	680	0
680–690	0	690	0
690–700	0	700	0
700–710	0	710	0
710–720	0	720	0
720–730	1	730	730
>730	0	740	0
Total	**26,304**	**Weighted Average**	**12.57**

Table A–9: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A3 – Project-alone Case

A3 – Project-alone Case – 1-h SO_2 Data			
Maximum Concentration: 73.81 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,204	10	262,040
10–20	78	20	1,560
20–30	20	30	600
30–40	1	40	40
40–50	0	50	0
50–60	0	60	0
60–70	0	70	0
70–80	1	80	80
>80	0	90	0
Total	**26,304**	**Weighted Average**	**10.05**

Table A–10: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A3 – Base Case

A3 – Base Case – 1-h SO_2 Data			
Maximum Concentration: 678.24 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	24,436	10	244,360
10–20	950	20	19,000
20–30	411	30	12,330
30–40	201	40	8,040
40–50	97	50	4,850
50–60	69	60	4,140
60–70	33	70	2,310
70–80	25	80	2,000
80–90	19	90	1,710
90–100	11	100	1,100
100–110	18	110	1,980
110–120	8	120	960
120–130	7	130	910
130–140	8	140	1,120
140–150	4	150	600

A3 – Base Case – 1-h SO_2 Data			
Maximum Concentration: 678.24 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
150–160	2	160	320
160–170	1	170	170
170–180	2	180	360
180–190	0	190	0
190–200	0	200	0
200–210	0	210	0
210–220	1	220	220
220–230	0	230	0
230–240	0	240	0
240–250	0	250	0
250–260	0	260	0
260–270	0	270	0
270–280	0	280	0
280–290	0	290	0
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0
330–340	0	340	0
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	0	470	0
470–480	0	480	0

A3 – Base Case – 1-h SO_2 Data			
Maximum Concentration: 678.24 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
480–490	0	490	0
490–500	0	500	0
500–510	0	510	0
510–520	0	520	0
520–530	0	530	0
530–540	0	540	0
540–550	0	550	0
550–560	0	560	0
560–570	0	570	0
570–580	0	580	0
580–590	0	590	0
590–600	0	600	0
600–610	0	610	0
610–620	0	620	0
620–630	0	630	0
630–640	0	640	0
640–650	0	650	0
650–660	0	660	0
660–670	0	670	0
670–680	1	680	680
>680	0	690	0
Total	**26,304**	**Weighted Average**	**11.68**

Table A–11: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A3 – Application Case

A3 – Application Case – 1-h SO_2 Data			
Maximum Concentration: 679.29 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	24,320	10	243,200
10–20	986	20	19,720
20–30	443	30	13,290
30–40	215	40	8,600
40–50	106	50	5,300
50–60	66	60	3,960
60–70	52	70	3,640
70–80	24	80	1,920
80–90	18	90	1,620
90–100	17	100	1,700
100–110	13	110	1,430
110–120	12	120	1,440
120–130	10	130	1,300
130–140	8	140	1,120
140–150	5	150	750
150–160	3	160	480
160–170	1	170	170
170–180	2	180	360
180–190	1	190	190
190–200	0	200	0
200–210	0	210	0
210–220	0	220	0
220–230	1	230	230
230–240	0	240	0
240–250	0	250	0
250–260	0	260	0
260–270	0	270	0
270–280	0	280	0
280–290	0	290	0
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0

A3 – Application Case – 1-h SO_2 Data			
Maximum Concentration: 679.29 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
320–330	0	330	0
330–340	0	340	0
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	0	470	0
470–480	0	480	0
480–490	0	490	0
490–500	0	500	0
500–510	0	510	0
510–520	0	520	0
520–530	0	530	0
530–540	0	540	0
540–550	0	550	0
550–560	0	560	0
560–570	0	570	0
570–580	0	580	0
580–590	0	590	0
590–600	0	600	0
600–610	0	610	0
610–620	0	620	0
620–630	0	630	0
630–640	0	640	0
640–650	0	650	0

A3 – Application Case – 1-h SO_2 Data			
Maximum Concentration: 679.29 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
650–660	0	660	0
660–670	0	670	0
670–680	1	680	680
>680	0	690	0
Total	**26,304**	**Weighted Average**	**11.83**

Table A–12: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A3 – Cumulative Case

A3 – Cumulative Case – 1-h SO_2 Data			
Maximum Concentration: 679.33 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	24,312	10	243,120
10–20	992	20	19,840
20–30	444	30	13,320
30–40	216	40	8,640
40–50	106	50	5,300
50–60	66	60	3,960
60–70	52	70	3,640
70–80	24	80	1,920
80–90	17	90	1,530
90–100	18	100	1,800
100–110	13	110	1,430
110–120	12	120	1,440
120–130	10	130	1,300
130–140	8	140	1,120
140–150	5	150	750
150–160	3	160	480
160–170	1	170	170
170–180	2	180	360
180–190	1	190	190
190–200	0	200	0

A3 – Cumulative Case – 1-h SO_2 Data			
Maximum Concentration: 679.33 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
200–210	0	210	0
210–220	0	220	0
220–230	1	230	230
230–240	0	240	0
240–250	0	250	0
250–260	0	260	0
260–270	0	270	0
270–280	0	280	0
280–290	0	290	0
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0
330–340	0	340	0
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	0	470	0
470–480	0	480	0
480–490	0	490	0
490–500	0	500	0
500–510	0	510	0
510–520	0	520	0
520–530	0	530	0

A3 – Cumulative Case – 1-h SO_2 Data			
Maximum Concentration: 679.33 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
530–540	0	540	0
540–550	0	550	0
550–560	0	560	0
560–570	0	570	0
570–580	0	580	0
580–590	0	590	0
590–600	0	600	0
600–610	0	610	0
610–620	0	620	0
620–630	0	630	0
630–640	0	640	0
640–650	0	650	0
650–660	0	660	0
660–670	0	670	0
670–680	1	680	680
>680	0	690	0
Total	**26,304**	**Weighted Average**	**11.83**

Table A–13: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A4 – Project-alone Case

A4 – Project-alone Case – 1-h SO_2 Data			
Maximum Concentration. 10.45 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,302	10	263,020
10–20	2	20	40
>20	0	30	0
Total	**26,304**	**Weighted Average**	**10.00**

Table A–14: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A4 – Base Case

A4 – Base Case – 1-h SO_2 Data			
Maximum Concentration. 181.40 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	23,966	10	239,660
10–20	1,186	20	23,720
20–30	550	30	16,500
30–40	247	40	9,880
40–50	151	50	7,550
50–60	73	60	4,380
60–70	55	70	3,850
70–80	24	80	1,920
80–90	21	90	1,890
90–100	8	100	800
100–110	10	110	1,100
110–120	5	120	600
120–130	2	130	260
130–140	2	140	280
140–150	3	150	450
150–160	0	160	0
160–170	0	170	0
170–180	0	180	0
180–190	1	190	190
>190	0	200	0
Total	**26,304**	**Weighted Average**	**11.90**

Table A–15: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A4 – Application Case

A4 – Application Case – 1-h SO_2 Data			
Maximum Concentration. 183.81 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	23,825	10	238,250
10–20	1,213	20	24,260
20–30	580	30	17,400
30–40	294	40	11,760
40–50	153	50	7,650
50–60	86	60	5,160
60–70	61	70	4,270
70–80	29	80	2,320
80–90	24	90	2,160
90–100	10	100	1,000
100–110	8	110	880
110–120	11	120	1,320
120–130	3	130	390
130–140	2	140	280
140–150	3	150	450
150–160	1	160	160
160–170	0	170	0
170–180	0	180	0
180–190	1	190	190
>190	0	200	0
Total	**26,304**	**Weighted Average**	**12.09**

Table A–16: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A4 – Cumulative Case

A4 – Cumulative Case – 1-h SO_2 Data			
Maximum Concentration. 184.02 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	23,813	10	238,130
10–20	1,220	20	24,400
20–30	584	30	17,520
30–40	293	40	11,720
40–50	154	50	7,700
50–60	87	60	5,220
60–70	60	70	4,200
70–80	30	80	2,400
80–90	24	90	2,160
90–100	10	100	1,000
100–110	8	110	880
110–120	11	120	1,320
120–130	3	130	390
130–140	2	140	280
140–150	2	150	300
150–160	2	160	320
160–170	0	170	0
170–180	0	180	0
180–190	1	190	190
>190	0	200	0
Total	**26,304**	**Weighted Average**	**12.09**

Table A–17: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A5 – Project-alone Case

A5 – Project-alone Case – 1-h SO_2 Data			
Maximum Concentration. 44.25 µg/m^3			
Concentration Range (µg/m^3)	Count	Upper Bin Limit	Weighted Sum
0–10	26,225	10	262,250
10–20	72	20	1,440
20–30	4	30	120
30–40	2	40	80
40–50	1	50	50
>50	0	60	0
Total	**26,304**	**Weighted Average**	**10.03**

Table A–18: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A5 – Base Case

A5 – Base Case – 1-h SO_2 Data			
Maximum Concentration. 461.63 µg/m^3			
Concentration Range (µg/m^3)	Count	Upper Bin Limit	Weighted Sum
0–10	22,004	10	220,040
10–20	1,814	20	36,280
20–30	794	30	23,820
30–40	458	40	18,320
40–50	346	50	17,300
50–60	233	60	13,980
60–70	208	70	14,560
70–80	158	80	12,640
80–90	105	90	9,450
90–100	76	100	7,600
100–110	42	110	4,620
110–120	27	120	3,240
120–130	17	130	2,210
130–140	7	140	980
140–150	4	150	600
150–160	5	160	800
160–170	1	170	170
170–180	1	180	180

A5 – Base Case – 1-h SO_2 Data			
Maximum Concentration. 461.63 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
180–190	0	190	0
190–200	0	200	0
200–210	0	210	0
210–220	0	220	0
220–230	0	230	0
230–240	0	240	0
240–250	1	250	250
250–260	1	260	260
260–270	0	270	0
270–280	1	280	280
280–290	0	290	0
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0
330–340	0	340	0
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	1	470	470
>470	0	480	0
Total	**26,304**	**Weighted Average**	**14.75**

Table A–19: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A5 – Application Case

A5 – Application Case – 1-h SO_2 Data			
Maximum Concentration. 474.88 µg/m^3			
Concentration Range (µg/m^3)	Count	Upper Bin Limit	Weighted Sum
0–10	21,774	10	217,740
10–20	1,871	20	37,420
20–30	837	30	25,110
30–40	500	40	20,000
40–50	340	50	17,000
50–60	268	60	16,080
60–70	212	70	14,840
70–80	171	80	13,680
80–90	128	90	11,520
90–100	75	100	7,500
100–110	47	110	5,170
110–120	35	120	4,200
120–130	20	130	2,600
130–140	8	140	1,120
140–150	6	150	900
150–160	2	160	320
160–170	5	170	850
170–180	1	180	180
180–190	0	190	0
190–200	0	200	0
200–210	0	210	0
210–220	0	220	0
220–230	0	230	0
230–240	0	240	0
240–250	1	250	250
250–260	1	260	260
260–270	0	270	0
270–280	1	280	280
280–290	0	290	0
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0

A5 – Application Case – 1-h SO_2 Data			
Maximum Concentration. 474.88 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
320–330	0	330	0
330–340	0	340	0
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	0	470	0
470–480	1	480	480
>480	0	490	0
Total	**26,304**	**Weighted Average**	**15.11**

Table A–20: 1-h Weighted-Average Concentrations of SO_2 for HHRA Areas – A5 – Cumulative Case

A5 – Cumulative Case – 1-h SO_2 Data			
Maximum Concentration. 474.89 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	21,760	10	217,600
10–20	1,882	20	37,640
20–30	837	30	25,110
30–40	501	40	20,040
40–50	342	50	17,100
50–60	267	60	16,020
60–70	212	70	14,840

A5 – Cumulative Case – 1-h SO_2 Data			
Maximum Concentration. 474.89 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
70–80	171	80	13,680
80–90	129	90	11,610
90–100	74	100	7,400
100–110	48	110	5,280
110–120	35	120	4,200
120–130	20	130	2,600
130–140	8	140	1,120
140–150	6	150	900
150–160	2	160	320
160–170	5	170	850
170–180	1	180	180
180–190	0	190	0
190–200	0	200	0
200–210	0	210	0
210–220	0	220	0
220–230	0	230	0
230–240	0	240	0
240–250	1	250	250
250–260	1	260	260
260–270	0	270	0
270–280	1	280	280
280–290	0	290	0
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0
330–340	0	340	0
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0

A5 – Cumulative Case – 1-h SO_2 Data			
Maximum Concentration. 474.89 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	0	470	0
470–480	1	480	480
>480	0	490	0
Total	**26,304**	**Weighted Average**	**15.12**

1-h Weighted-Average SO_2 Concentrations for the Special Receptor Locations

Table A–21: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 15 – Base Case

SR 15 – Base Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,684	10	256,840
10–20	324	20	6,480
20–30	114	30	3,420
30–40	54	40	2,160
40–50	37	50	1,850
50–60	29	60	1,740
60–70	17	70	1,190
70–80	11	80	880
80–90	8	90	720
90–100	4	100	400
100–110	4	110	440
110–120	7	120	840
120–130	2	130	260
130–140	3	140	420
140–150	0	150	0
150–160	1	160	160
160–170	1	170	170
170–180	1	180	180
180–190	1	190	190
190–200	0	200	0
200–210	0	210	0
210–220	1	220	220
220–230	0	230	0
230–240	0	240	0
240–250	0	250	0
250–260	1	260	260
>260	0	270	0
Total	**26,304**	**Weighted Average**	**10.599909**

Table A–22: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 15 – Application Case

SR 15 – Application Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,644	10	256,440
10–20	338	20	6,760
20–30	122	30	3,660
30–40	67	40	2,680
40–50	31	50	1,550
50–60	33	60	1,980
60–70	15	70	1,050
70–80	18	80	1,440
80–90	6	90	540
90–100	5	100	500
100–110	4	110	440
110–120	3	120	360
120–130	7	130	910
130–140	4	140	560
140–150	1	150	150
150–160	0	160	0
160–170	1	170	170
170–180	1	180	180
180–190	1	190	190
190–200	1	200	200
200–210	0	210	0
210–220	0	220	0
220–230	1	230	230
230–240	0	240	0
240–250	0	250	0
250–260	0	260	0
260–270	0	270	0
270–280	1	280	280
>280	0	290	0
Total	**26,304**	**Weighted Average**	**10.655033**

Table A–23: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 15 – Cumulative Case

SR 15 – Cumulative Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,635	10	256,350
10–20	346	20	6,920
20–30	123	30	3,690
30–40	64	40	2,560
40–50	33	50	1,650
50–60	33	60	1,980
60–70	16	70	1,120
70–80	18	80	1,440
80–90	6	90	540
90–100	5	100	500
100–110	4	110	440
110–120	3	120	360
120–130	7	130	910
130–140	3	140	420
140–150	2	150	300
150–160	0	160	0
160–170	1	170	170
170–180	1	180	180
180–190	1	190	190
190–200	1	200	200
200–210	0	210	0
210–220	0	220	0
220–230	1	230	230
230–240	0	240	0
240–250	0	250	0
250–260	0	260	0
260–270	0	270	0
270–280	1	280	280
>280	0	290	0
Total	**26,304**	**Weighted Average**	**10.66111618**

Table A–24: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 22 – Base Case

SR 22 – Base Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,093	10	260,930
10–20	135	20	2,700
20–30	41	30	1,230
30–40	18	40	720
40–50	11	50	550
50–60	3	60	180
60–70	2	70	140
70–80	0	80	0
80–90	0	90	0
90–100	0	100	0
100–110	0	110	0
110–120	0	120	0
120–130	0	130	0
130–140	1	140	140
>140	0	150	0
Total	**26,304**	**Weighted Average**	**10.1349605**

Table A–25: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 22 – Application Case

SR 22 – Application Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,074	10	260,740
10–20	144	20	2,880
20–30	45	30	1,350
30–40	17	40	680
40–50	16	50	800
50–60	5	60	300
60–70	1	70	70
70–80	1	80	80
80–90	0	90	0
90–100	0	100	0

SR 22 – Application Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
100–110	0	110	0
110–120	0	120	0
120–130	0	130	0
130–140	0	140	0
140–150	1	150	150
>150	0	160	0
Total	**26,304**	**Weighted Average**	**10.152448**

Table A–26: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 22 – Cumulative Case

SR 22 – Cumulative Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,074	10	260,740
10–20	144	20	2,880
20–30	45	30	1,350
30–40	17	40	680
40–50	16	50	800
50–60	5	60	300
60–70	1	70	70
70–80	1	80	80
80–90	0	90	0
90–100	0	100	0
100–110	0	110	0
110–120	0	120	0
120–130	0	130	0
130–140	0	140	0
140–150	1	150	150
>150	0	160	0
Total	**26,304**	**Weighted Average**	**10.15245**

Table A–27: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 23 – Base Case

SR 23 – Base Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	24,035	10	240,350
10–20	1,378	20	27,560
20–30	536	30	16,080
30–40	150	40	6,000
40–50	55	50	2,750
50–60	30	60	1,800
60–70	22	70	1,540
70–80	24	80	1,920
80–90	10	90	900
90–100	13	100	1,300
100–110	5	110	550
110–120	4	120	480
120–130	2	130	260
130–140	8	140	1,120
140–150	4	150	600
150–160	2	160	320
160–170	3	170	510
170–180	1	180	180
180–190	1	190	190
190–200	2	200	400
200–210	2	210	420
210–220	0	220	0
220–230	3	230	690
230–240	4	240	960
240–250	1	250	250
250–260	0	260	0
260–270	2	270	540
270–280	0	280	0
280–290	1	290	290
290–300	1	300	300
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0

SR 23 – Base Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
330–340	2	340	680
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	1	380	380
380–390	1	390	390
390–400	1	400	400
>400	0	410	0
Total	**26,304**	**Weighted Average**	**11.78946**

Table A–28: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 23 – Application Case

SR 23 – Application Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	23,945	10	239,450
10–20	1,424	20	28,480
20–30	552	30	16,560
30–40	163	40	6,520
40–50	55	50	2,750
50–60	39	60	2,340
60–70	19	70	1,330
70–80	28	80	2,240
80–90	14	90	1,260
90–100	12	100	1,200
100–110	5	110	550
110–120	4	120	480
120–130	3	130	390
130–140	6	140	840
140–150	6	150	900
150–160	0	160	0
160–170	5	170	850
170–180	2	180	360

SR 23 – Application Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
180–190	0	190	0
190–200	2	200	400
200–210	1	210	210
210–220	1	220	220
220–230	1	230	230
230–240	4	240	960
240–250	3	250	750
250–260	1	260	260
260–270	0	270	0
270–280	2	280	560
280–290	0	290	0
290–300	2	300	600
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0
330–340	0	340	0
340–350	1	350	350
350–360	1	360	360
360–370	0	370	0
370–380	0	380	0
380–390	1	390	390
390–400	0	400	0
400–410	2	410	820
>410	0	420	0
Total	**26,304**	**Weighted Average**	**11.884504**

Table A–29: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 23 – Cumulative Case

SR 23 – Cumulative Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	23,928	10	239,280
10–20	1,432	20	28,640
20–30	557	30	16,710
30–40	164	40	6,560
40–50	58	50	2,900
50–60	39	60	2,340
60–70	19	70	1,330
70–80	28	80	2,240
80–90	14	90	1,260
90–100	12	100	1,200
100–110	5	110	550
110–120	4	120	480
120–130	3	130	390
130–140	6	140	840
140–150	6	150	900
150–160	0	160	0
160–170	5	170	850
170–180	2	180	360
180–190	0	190	0
190–200	2	200	400
200–210	1	210	210
210–220	1	220	220
220–230	1	230	230
230–240	4	240	960
240–250	3	250	750
250–260	1	260	260
260–270	0	270	0
270–280	2	280	560
280–290	0	290	0
290–300	2	300	600
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0

SR 23 – Cumulative Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
330–340	0	340	0
340–350	0	350	0
350–360	2	360	720
360–370	0	370	0
370–380	0	380	0
380–390	1	390	390
390–400	0	400	0
400–410	2	410	820
>410	0	420	0
Total	**26,304**	**Weighted Average**	**11.89743**

Table A–30: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 24 – Base Case

SR 24 – Base Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	24,652	10	246,520
10–20	1,134	20	22,680
20–30	254	30	7,620
30–40	97	40	3,880
40–50	42	50	2,100
50–60	31	60	1,860
60–70	26	70	1,820
70–80	12	80	960
80–90	8	90	720
90–100	6	100	600
100–110	5	110	550
110–120	9	120	1,080
120–130	1	130	130
130–140	2	140	280
140–150	2	150	300
150–160	5	160	800
160–170	0	170	0

SR 24 – Base Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
170–180	3	180	540
180–190	3	190	570
190–200	1	200	200
200–210	2	210	420
210–220	1	220	220
220–230	1	230	230
230–240	0	240	0
240–250	0	250	0
250–260	2	260	520
260–270	1	270	270
270–280	0	280	0
280–290	2	290	580
290–300	1	300	300
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0
330–340	0	340	0
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	1	450	450
>450	0	460	0
Total	**26,304**	**Weighted Average**	**11.260645**

Table A–31: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 24 – Application Case

SR 24 – Application Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	24,565	10	245,650
10–20	1,172	20	23,440
20–30	278	30	8,340
30–40	103	40	4,120
40–50	50	50	2,500
50–60	35	60	2,100
60–70	26	70	1,820
70–80	15	80	1,200
80–90	7	90	630
90–100	6	100	600
100–110	9	110	990
110–120	6	120	720
120–130	4	130	520
130–140	1	140	140
140–150	3	150	450
150–160	4	160	640
160–170	2	170	340
170–180	3	180	540
180–190	1	190	190
190–200	2	200	400
200–210	2	210	420
210–220	1	220	220
220–230	0	230	0
230–240	2	240	480
240–250	0	250	0
250–260	0	260	0
260–270	1	270	270
270–280	2	280	560
280–290	0	290	0
290–300	2	300	600
300–310	1	310	310
310–320	0	320	0
320–330	0	330	0

SR 24 – Application Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
330–340	0	340	0
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	0	470	0
470–480	1	480	480
>480	0	490	0
Total	**26,304**	**Weighted Average**	**11.35455**

Table A–32: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 24 – Cumulative Case

SR 24 – Cumulative Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	24,539	10	245,390
10–20	1,189	20	23,780
20–30	284	30	8,520
30–40	102	40	4,080
40–50	53	50	2,650
50–60	36	60	2,160
60–70	26	70	1,820
70–80	14	80	1,120
80–90	8	90	720
90–100	6	100	600

SR 24 – Cumulative Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
100–110	9	110	990
110–120	6	120	720
120–130	4	130	520
130–140	1	140	140
140–150	3	150	450
150–160	4	160	640
160–170	2	170	340
170–180	3	180	540
180–190	1	190	190
190–200	1	200	200
200–210	3	210	630
210–220	1	220	220
220–230	0	230	0
230–240	2	240	480
240–250	0	250	0
250–260	0	260	0
260–270	1	270	270
270–280	2	280	560
280–290	0	290	0
290–300	1	300	300
300–310	2	310	620
310–320	0	320	0
320–330	0	330	0
330–340	0	340	0
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0

SR 24 – Cumulative Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
440–450	0	450	0
450–460	0	460	0
460–470	0	470	0
470–480	1	480	480
>480	0	490	0
Total	**26,304**	**Weighted Average**	**11.37203467**

Table A–33: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 25 – Base Case

SR 25 – Base Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,617	10	256,170
10–20	327	20	6,540
20–30	123	30	3,690
30–40	76	40	3,040
40–50	39	50	1,950
50–60	21	60	1,260
60–70	21	70	1,470
70–80	19	80	1,520
80–90	14	90	1,260
90–100	12	100	1,200
100–110	6	110	660
110–120	8	120	960
120–130	2	130	260
130–140	5	140	700
140–150	5	150	750
150–160	2	160	320
160–170	2	170	340
170–180	0	180	0
180–190	0	190	0
190–200	1	200	200
200–210	0	210	0

SR 25 – Base Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
210–220	2	220	440
220–230	0	230	0
230–240	0	240	0
240–250	0	250	0
250–260	0	260	0
260–270	0	270	0
270–280	0	280	0
280–290	1	290	290
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0
330–340	0	340	0
340–350	1	350	350
>350	0	360	0
Total	**26,304**	**Weighted Average**	**10.77289**

Table A–34: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 25 – Application Case

SR 25 – Application Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,559	10	255,590
10–20	356	20	7,120
20–30	128	30	3,840
30–40	82	40	3,280
40–50	40	50	2,000
50–60	29	60	1,740
60–70	20	70	1,400
70–80	19	80	1,520
80–90	17	90	1,530
90–100	12	100	1,200
100–110	9	110	990

SR 25 – Application Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
110–120	9	120	1,080
120–130	5	130	650
130–140	3	140	420
140–150	5	150	750
150–160	3	160	480
160–170	1	170	170
170–180	2	180	360
180–190	0	190	0
190–200	0	200	0
200–210	0	210	0
210–220	1	220	220
220–230	2	230	460
230–240	0	240	0
240–250	0	250	0
250–260	0	260	0
260–270	0	270	0
270–280	0	280	0
280–290	0	290	0
290–300	1	300	300
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0
330–340	0	340	0
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	1	390	390
>390	0	400	0
Total	**26,304**	**Weighted Average**	**10.853482**

Table A–35: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 25 – Cumulative Case

SR 25 – Cumulative Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,556	10	255,560
10–20	358	20	7,160
20–30	128	30	3,840
30–40	82	40	3,280
40–50	41	50	2,050
50–60	28	60	1,680
60–70	21	70	1,470
70–80	19	80	1,520
80–90	17	90	1,530
90–100	12	100	1,200
100–110	9	110	990
110–120	9	120	1,080
120–130	5	130	650
130–140	3	140	420
140–150	5	150	750
150–160	3	160	480
160–170	1	170	170
170–180	2	180	360
180–190	0	190	0
190–200	0	200	0
200–210	0	210	0
210–220	1	220	220
220–230	2	230	460
230–240	0	240	0
240–250	0	250	0
250–260	0	260	0
260–270	0	270	0
270–280	0	280	0
280–290	0	290	0
290–300	1	300	300
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0

SR 25 – Cumulative Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
330–340	0	340	0
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	1	390	390
>390	0	400	0
Total	**26,304**	**Weighted Average**	**10.856144**

Table A–36: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 26 – Base Case

SR 26 – Base Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,604	10	256,040
10–20	360	20	7,200
20–30	129	30	3,870
30–40	76	40	3,040
40–50	55	50	2,750
50–60	21	60	1,260
60–70	14	70	980
70–80	9	80	720
80–90	9	90	810
90–100	11	100	1,100
100–110	4	110	440
110–120	2	120	240
120–130	2	130	260
130–140	2	140	280
140–150	3	150	450
150–160	0	160	0
160–170	0	170	0
170–180	0	180	0
180–190	0	190	0

SR 26 – Base Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
190–200	0	200	0
200–210	2	210	420
210–220	1	220	220
>220	0	230	0
Total	**26,304**	**Weighted Average**	**10.64781**

Table A–37: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 26 – Application Case

SR 26 – Application Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,560	10	255,600
10–20	377	20	7,540
20–30	140	30	4,200
30–40	76	40	3,040
40–50	61	50	3,050
50–60	24	60	1,440
60–70	16	70	1,120
70–80	8	80	640
80–90	9	90	810
90–100	13	100	1,300
100–110	6	110	660
110–120	4	120	480
120–130	2	130	260
130–140	2	140	280
140–150	2	150	300
150–160	1	160	160
160–170	0	170	0
170–180	0	180	0
180–190	0	190	0
190–200	0	200	0
200–210	1	210	210
210–220	2	220	440

SR 26 – Application Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
>220	0	230	0
Total	**26,304**	**Weighted Average**	**10.702935**

Table A–38: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 26 – Cumulative Case

SR 26 – Cumulative Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,553	10	255,530
10–20	383	20	7,660
20–30	140	30	4,200
30–40	74	40	2,960
40–50	63	50	3,150
50–60	24	60	1,440
60–70	16	70	1,120
70–80	9	80	720
80–90	9	90	810
90–100	13	100	1,300
100–110	6	110	660
110–120	4	120	480
120–130	2	130	260
130–140	2	140	280
140–150	2	150	300
150–160	1	160	160
160–170	0	170	0
170–180	0	180	0
180–190	0	190	0
190–200	0	200	0
200–210	1	210	210
210–220	2	220	440
>220	0	230	0
Total	**26,304**	**Weighted Average**	**10.708637**

Table A–39: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 28 – Base Case

SR 28 – Base Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	22,344	10	223,440
10–20	2,024	20	40,480
20–30	865	30	25,950
30–40	393	40	15,720
40–50	206	50	10,300
50–60	138	60	8,280
60–70	97	70	6,790
70–80	89	80	7,120
80–90	59	90	5,310
90–100	27	100	2,700
100–110	21	110	2,310
110–120	13	120	1,560
120–130	10	130	1,300
130–140	7	140	980
140–150	3	150	450
150–160	2	160	320
160–170	1	170	170
170–180	5	180	900
>180	0	190	0
Total	**26,304**	**Weighted Average**	**13.4610706**

Table A–40: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 28 – Application Case

SR 28 – Application Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	22,177	10	221,770
10–20	2,067	20	41,340
20–30	890	30	26,700
30–40	439	40	17,560
40–50	206	50	10,300
50–60	152	60	9,120

SR 28 – Application Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
60–70	102	70	7,140
70–80	97	80	7,760
80–90	55	90	4,950
90–100	47	100	4,700
100–110	23	110	2,530
110–120	14	120	1,680
120–130	11	130	1,430
130–140	7	140	980
140–150	7	150	1,050
150–160	2	160	320
160–170	2	170	340
170–180	1	180	180
180–190	5	190	950
>190	0	200	0
Total	**26,304**	**Weighted Average**	**13.716545**

Table A–41: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 28 – Cumulative Case

SR 28 – Cumulative Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	22,148	10	221,480
10–20	2,092	20	41,840
20–30	893	30	26,790
30–40	439	40	17,560
40–50	207	50	10,350
50–60	151	60	9,060
60–70	103	70	7,210
70–80	97	80	7,760
80–90	55	90	4,950
90–100	47	100	4,700
100–110	22	110	2,420
110–120	15	120	1,800

SR 28 – Cumulative Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
120–130	11	130	1,430
130–140	7	140	980
140–150	7	150	1,050
150–160	2	160	320
160–170	2	170	340
170–180	1	180	180
180–190	5	190	950
>190	0	200	0
Total	**26,304**	**Weighted Average**	**13.73061131**

Table A–42: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 29 – Base Case

SR 29 – Base Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,232	10	262,320
10–20	66	20	1,320
20–30	5	30	150
30–40	1	40	40
>40	0	50	0
Total	**26,304**	**Weighted Average**	**10.03003345**

Table A–43: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 29 – Application Case

SR 29 – Application Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,225	10	262,250
10–20	72	20	1,440
20–30	5	30	150
30–40	2	40	80
>40	0	50	0
Total	**26,304**	**Weighted Average**	**10.03345499**

Table A–44: 1-h Weighted-Average Concentrations of SO_2 for Special Receptor Areas – SR 29 – Cumulative Case

SR 29 – Cumulative Case – Hourly SO_2 Data			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,225	10	262,250
10–20	72	20	1,440
20–30	5	30	150
30–40	2	40	80
>40	0	50	0
Total	**26,304**	**Weighted Average**	**10.03345499**

1-h Weighted-Average NO_2 Concentrations for the HHRA Areas

Table A–45: 1-h Weighted–Average Concentrations of NO_2 for HHRA Areas – A1 – Project-alone Case

A1 – Project-alone Case – 1-h NO_2 Data			
Maximum Concentration: 76.22683 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,154	10	261,540
10–20	111	20	2,220
20–30	22	30	660
30–40	12	40	480
40–50	3	50	150
50–60	1	60	60
60–70	0	70	0
70–80	1	80	80
>80	0	90	0
Total	**26,304**	**Weighted Average**	**10.08**

Table A–46: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A1 – Base Case

A1 – Base Case – 1-h NO_2 Data			
Maximum Concentration: 27.49245 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,263	10	262,630
10–20	38	20	760
20–30	3	30	90
>30	0	40	0
Total	**26,304**	**Weighted Average**	**10.02**

Table A–47: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A1 – Application Case

A1 – Application Case – 1-h NO_2 Data			
Maximum Concentration: 77.33190 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,120	10	261,200
10–20	136	20	2,720
20–30	28	30	840
30–40	13	40	520
40–50	5	50	250
50–60	1	60	60
60–70	0	70	0
70–80	1	80	80
>80	0	90	0
Total	**26,304**	**Weighted Average**	**10.10**

Table A–48: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A1 – Cumulative Case

A1 – Cumulative Case – 1-h NO_2 Data			
Maximum Concentration: 78.31561 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,087	10	260,870
10–20	156	20	3,120
20–30	41	30	1,230
30–40	11	40	440
40–50	5	50	250
50–60	3	60	180
60–70	0	70	0
70–80	1	80	80
>80	0	90	0
Total	**26,304**	**Weighted Average**	**10.12**

Table A–49: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A2 – Project-alone Case

A2 – Project-alone Case – 1-h NO_2 Data			
Maximum Concentration: 63.12702 µg/m^3			
Concentration Range (µg/m^3)	Count	Upper Bin Limit	Weighted Sum
0–10	25,617	10	256,170
10–20	587	20	11,740
20–30	74	30	2,220
30–40	13	40	520
40–50	10	50	500
50–60	2	60	120
60–70	1	70	70
>70	0	80	0
Total	**26,304**	**Weighted Average**	**10.32**

Table A–50: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A2 – Base Case

A2 – Base Case – 1-h NO_2 Data			
Maximum Concentration: 30.24120 µg/m^3			
Concentration Range (µg/m^3)	Count	Upper Bin Limit	Weighted Sum
0–10	26,299	10	262,990
10–20	4	20	80
20–30	0	30	0
30–40	1	40	40
>40	0	50	0
Total	**26,304**	**Weighted Average**	**10.00**

Table A–51: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A2 – Application Case

A2 – Application Case – 1-h NO_2 Data			
Maximum Concentration: 66.05933 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,270	10	252,700
10–20	874	20	17,480
20–30	116	30	3,480
30–40	28	40	1,120
40–50	12	50	600
50–60	2	60	120
60–70	2	70	140
>70	0	80	0
Total	**26,304**	**Weighted Average**	**10.48**

Table A–52: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A2 – Cumulative Case

A2 – Cumulative Case – 1-h NO_2 Data			
Maximum Concentration: 67.59721 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,049	10	250,490
10–20	1,083	20	21,660
20–30	126	30	3,780
30–40	30	40	1,200
40–50	12	50	600
50–60	2	60	120
60–70	2	70	140
>70	0	80	0
Total	**26,304**	**Weighted Average**	**10.57**

Table A–53: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A3 – Project-alone Case

A3 – Project-alone Case – 1-h NO_2 Data			
Maximum Concentration: 60.92 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,603	10	256,030
10–20	607	20	12,140
20–30	60	30	1,800
30–40	23	40	920
40–50	8	50	400
50–60	2	60	120
60–70	1	70	70
>70	0	80	0
Total	**26,304**	**Weighted Average**	**10.32**

Table A–54: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A3 – Base Case

A3 – Base Case – 1-h NO_2 Data			
Maximum Concentration: 14.84 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	23,235	10	232,350
10–20	1,132	20	22,640
>20	554	30	16,620
Total	**26,304**	**Weighted Average**	**10.01**

Table A–55: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A3 – Application Case

A3 – Application Case – 1-h NO_2 Data			
Maximum Concentration: 65.56 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	23,235	10	232,350
10–20	1,132	20	22,640
20–30	554	30	16,620
30–40	384	40	15,360

A3 – Application Case – 1-h NO_2 Data			
Maximum Concentration: 65.56 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
40–50	263	50	13,150
50–60	148	60	8,880
60–70	129	70	9,030
>70	78	80	6,240
Total	**26,304**	**Weighted Average**	**10.46**

Table A–56: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A3 – Cumulative Case

A3 – Cumulative Case – 1-h NO_2 Data			
Maximum Concentration: 66.9 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	23,235	10	232,350
10–20	1,132	20	22,640
20–30	554	30	16,620
30–40	384	40	15,360
40–50	263	50	13,150
50–60	148	60	8,880
60–70	129	70	9,030
>70	78	80	6,240
Total	**26,304**	**Weighted Average**	**10.56**

Table A–57: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A4 – Project-alone Case

A4 – Project-alone Case – 1-h NO_2 Data			
Maximum Concentration 32.42 (µg/m^3)			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,052	10	260,520
10–20	241	20	4,820
20–30	10	30	300
30–40	1	40	40
>40	0	50	0
Total	**26,304**	**Weighted Average**	**10.10**

Table A–58: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A4 – Base Case

A4 – Base Case – 1-h NO_2 Data			
Maximum Concentration: 6.73 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,304	10	263,040
>10	0	20	0
Total	**26,304**	**Weighted Average**	**10.00**

Table A–59: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A4 – Application Case

A4 – Application Case – 1-h NO_2 Data			
Maximum Concentration: 34.68 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,970	10	259,700
10–20	317	20	6,340
20–30	16	30	480
30–40	1	40	40
>40	0	50	0
Total	**26,304**	**Weighted Average**	**10.13**

Table A–60: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A4 – Cumulative Case

A4 – Cumulative Case – 1-h NO_2 Data			
Maximum Concentration: 35.31 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,914	10	259,140
10–20	369	20	7,380
20–30	20	30	600
30–40	1	40	40
>40	0	50	0
Total	**26,304**	**Weighted Average**	**10.16**

Table A–61: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A5 – Project-alone Case

A5 – Project-alone Case – 1-h NO_2 Data			
Maximum Concentration 79.38 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	24,379	10	243,790
10–20	1,232	20	24,640
20–30	507	30	15,210
30–40	151	40	6,040
40–50	30	50	1,500
50–60	3	60	180
60–70	0	70	0
70–80	2	80	160
>80	0	90	0
Total	**26,304**	**Weighted Average**	**11.08**

Table A–62: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A5 – Base Case

A5 – Base Case – 1-h NO_2 Data			
Maximum Concentration 21.09 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,299	10	262,990
10–20	4	20	80
20–30	1	30	30
>30	0	40	0
Total	**26,304**	**Weighted Average**	**10.00**

Table A–63: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A5 – Application Case

A5 – Application Case – 1-h NO_2 Data			
Maximum Concentration 79.47 µg/m^3			
Concentration Range (µg/m^3)	Count	Upper Bin Limit	Weighted Sum
0–10	24,088	10	240,880
10–20	1,445	20	28,900
20–30	549	30	16,470
30–40	179	40	7,160
40–50	37	50	1,850
50–60	4	60	240
60–70	0	70	0
70–80	2	80	160
>80	0	90	0
Total	**26,304**	**Weighted Average**	**11.24**

Table A–64: 1-h Weighted-Average Concentrations of NO_2 for HHRA Areas – A5 – Cumulative Case

A5 – Cumulative Case – 1-h NO_2 Data			
Maximum Concentration 79.50 µg/m^3			
Concentration Range (µg/m^3)	Count	Upper Bin Limit	Weighted Sum
0–10	23,892	10	238,920
10–20	1,607	20	32,140
20–30	572	30	17,160
30–40	189	40	7,560
40–50	38	50	1,900
50–60	4	60	240
60–70	0	70	0
70–80	2	80	160
>80	0	90	0
Total	**26,304**	**Weighted Average**	**11.33**

5-min Weighted-Average SO_2 Concentrations for the HHRA Areas

Table A–65: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A1 – Project-alone Case

A1 – Project-alone Case – 5-min SO_2 Data							
Maximum Concentration: 49.06960 µg/m^3							
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**		**Expected Number of Occurrences (Count * Probability)**	
0–10	26,238	10	262,380	0.00020		5.170799112	
10–20	49	20	980	0.00060		0.029526245	
20–30	10	30	300	0.00116		0.011582593	
30–40	6	40	240	0.00184		0.011045524	
40–50	1	50	50	0.00264		0.00263636	
>50	0	60	0	0.00353		0	
Total	**26,304**	**Weighted Avg.**	**10.03**	**Weighted Sum**	**0.01**	**Weighted Sum**	**5.23**
Increase in Events							**0.0001986**

Table A–66: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A1 – Base Case

A1 – Base Case – 5-min SO_2 Data					
Maximum Concentration: 1,269.28794 µg/m^3					
Concentration Range (µg/m^3)	Count	Upper Bin Limit	Weighted Sum	Probability of Response at Upper Bin Limit	Expected Number of Occurrences (Count * Probability)
0–10	25,302	10	253,020	0.00020	4.986338865
10–20	390	20	7,800	0.00060	0.235004809
20–30	205	30	6,150	0.00116	0.237443159
30–40	107	40	4,280	0.00184	0.196978506
40–50	67	50	3,350	0.00264	0.176636107
50–60	55	60	3,300	0.00353	0.194399633
60–70	30	70	2,100	0.00453	0.135833245
70–80	32	80	2,560	0.00561	0.179516124
80–90	14	90	1,260	0.00678	0.094859555
90–100	8	100	800	0.00802	0.064166021
100–110	8	110	880	0.00934	0.074729662
110–120	8	120	960	0.01073	0.085868748
120–130	11	130	1,430	0.01219	0.134142735
130–140	8	140	1,120	0.01372	0.109775747
140–150	10	150	1,500	0.01531	0.15312502
150–160	1	160	160	0.01696	0.01696397
160–170	2	170	340	0.01867	0.037348219
170–180	1	180	180	0.02044	0.020440795
180–190	3	190	570	0.02226	0.066786061
190–200	5	200	1,000	0.02414	0.120679435

A1 – Base Case – 5-min SO_2 Data					
Maximum Concentration: 1,269.28794 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
200–210	4	210	840	0.02606	0.104242349
210–220	1	220	220	0.02803	0.028034397
220–230	1	230	230	0.03006	0.030055665
230–240	2	240	480	0.03212	0.064245619
240–250	0	250	0	0.03423	0
250–260	2	260	520	0.03639	0.072777382
260–270	5	270	1,350	0.03858	0.192922726
270–280	2	280	560	0.04082	0.081641001
280–290	1	290	290	0.04310	0.043095232
290–300	0	300	0	0.04541	0
300–310	3	310	930	0.04776	0.143267764
310–320	0	320	0	0.05014	0
320–330	0	330	0	0.05256	0
330–340	1	340	340	0.05501	0.055006839
340–350	1	350	350	0.05749	0.057488496
350–360	1	360	360	0.06000	0.060000659
360–370	1	370	370	0.06254	0.062542266
370–380	0	380	0	0.06511	0
380–390	1	390	390	0.06771	0.067709703
390–400	0	400	0	0.07033	0
400–410	1	410	410	0.07298	0.072982826

A1 – Base Case – 5-min SO_2 Data					
Maximum Concentration: 1,269.28794 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
410–420	0	420	0	0.07566	0
420–430	0	430	0	0.07835	0
430–440	0	440	0	0.08107	0
440–450	0	450	0	0.08382	0
450–460	2	460	920	0.08658	0.173157761
460–470	0	470	0	0.08936	0
470–480	0	480	0	0.09216	0
480–490	0	490	0	0.09498	0
490–500	1	500	500	0.09782	0.097823391
500–510	0	510	0	0.10068	0
510–520	0	520	0	0.10355	0
520–530	0	530	0	0.10644	0
530–540	0	540	0	0.10934	0
540–550	1	550	550	0.11226	0.112255021
550–560	0	560	0	0.11518	0
560–570	0	570	0	0.11813	0
570–580	0	580	0	0.12108	0
580–590	0	590	0	0.12404	0
590–600	1	600	600	0.12702	0.127020686
600–610	0	610	0	0.13001	0
610–620	1	620	620	0.13300	0.133002067

A1 – Base Case – 5-min SO_2 Data					
Maximum Concentration: 1,269.28794 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
620–630	0	630	0	0.13601	0
630–640	0	640	0	0.13902	0
640–650	0	650	0	0.14204	0
650–660	0	660	0	0.14507	0
660–670	0	670	0	0.14810	0
670–680	0	680	0	0.15114	0
680–690	0	690	0	0.15419	0
690–700	0	700	0	0.15724	0
700–710	0	710	0	0.16029	0
710–720	0	720	0	0.16335	0
720–730	0	730	0	0.16642	0
730–740	0	740	0	0.16948	0
740–750	1	750	750	0.17255	0.172554323
750–760	0	760	0	0.17563	0
760–770	0	770	0	0.17870	0
770–780	0	780	0	0.18177	0
780–790	1	790	790	0.18485	0.184851079
790–800	0	800	0	0.18793	0
800–810	0	810	0	0.19100	0
810–820	0	820	0	0.19408	0
820–830	0	830	0	0.19716	0

A1 – Base Case – 5-min SO_2 Data					
Maximum Concentration: 1,269.28794 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
830–840	0	840	0	0.20023	0
840–850	0	850	0	0.20331	0
850–860	0	860	0	0.20638	0
860–870	0	870	0	0.20945	0
870–880	0	880	0	0.21252	0
880–890	1	890	890	0.21559	0.215587322
890–900	0	900	0	0.21865	0
900–910	0	910	0	0.22171	0
910–920	0	920	0	0.22477	0
920–930	0	930	0	0.22782	0
930–940	0	940	0	0.23087	0
940–950	0	950	0	0.23391	0
950–960	0	960	0	0.23696	0
960–970	0	970	0	0.23999	0
970–980	0	980	0	0.24302	0
980–990	0	990	0	0.24605	0
990–1,000	0	1,000	0	0.24907	0
1,000–1,010	0	1,010	0	0.25208	0
1,010–1,020	0	1,020	0	0.25509	0
1,020–1,030	0	1,030	0	0.25809	0
1,030–1,040	0	1,040	0	0.26108	0

A1 – Base Case – 5-min SO_2 Data					
Maximum Concentration: 1,269.28794 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
1,040–1,050	0	1,050	0	0.26407	0
1,050–1,060	0	1,060	0	0.26706	0
1,060–1,070	0	1,070	0	0.27003	0
1,070–1,080	0	1,080	0	0.27300	0
1,080–1,090	0	1,090	0	0.27596	0
1,090–1,100	0	1,100	0	0.27891	0
1,100–1,110	0	1,110	0	0.28186	0
1,110–1,120	0	1,120	0	0.28479	0
1,120–1,130	0	1,130	0	0.28772	0
1,130–1,140	0	1,140	0	0.29065	0
1,140–1,150	0	1,150	0	0.29356	0
1,150–1,160	0	1,160	0	0.29646	0
1,160–1,170	0	1,170	0	0.29936	0
1,170–1,180	0	1,180	0	0.30225	0
1,180–1,190	0	1,190	0	0.30512	0
1,190–1,200	0	1,200	0	0.30799	0
1,200–1,210	0	1,210	0	0.31085	0
1,210–1,220	0	1,220	0	0.31371	0
1,220–1,230	0	1,230	0	0.31655	0
1,230–1,240	0	1,240	0	0.31938	0
1,240–1,250	0	1,250	0	0.32220	0

A1 – Base Case – 5-min SO_2 Data							
Maximum Concentration: 1,269.28794 µg/m^3							
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**		**Expected Number of Occurrences (Count * Probability)**	
1,250–1,260	0	1,260	0	0.32502		0	
1,260–1,270	1	1,270	1,270	0.32782		0.327819024	
>1,270	0	1,280	0	0.33061		0	
Total	**26,304**	**Weighted Avg.**	**11.68**	**Weighted Sum**	**18.88**	**Weighted Sum**	**10.00**
Increase in Events							**0.0003802**

Table A–67: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A1 – Application Case

A1 – Application Case – 5-min SO_2 Data					
Maximum Concentration: 1,271.15504 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
0–10	25,250	10	252,500	0.00020	4.976091073
10–20	413	20	8,260	0.00060	0.248864067
20–30	211	30	6,330	0.00116	0.244392715
30–40	108	40	4,320	0.00184	0.198819427
40–50	73	50	3,650	0.00264	0.192454266
50–60	60	60	3,600	0.00353	0.212072327
60–70	33	70	2,310	0.00453	0.149416569
70–80	27	80	2,160	0.00561	0.15146673

A1 – Application Case – 5-min SO_2 Data					
Maximum Concentration: 1,271.15504 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
80–90	22	90	1,980	0.00678	0.149065014
90–100	12	100	1,200	0.00802	0.096249031
100–110	4	110	440	0.00934	0.037364831
110–120	7	120	840	0.01073	0.075135155
120–130	13	130	1,690	0.01219	0.158532323
130–140	9	140	1,260	0.01372	0.123497716
140–150	8	150	1,200	0.01531	0.122500016
150–160	2	160	320	0.01696	0.03392794
160–170	3	170	510	0.01867	0.056022329
170–180	3	180	540	0.02044	0.061322384
180–190	4	190	760	0.02226	0.089048082
190–200	3	200	600	0.02414	0.072407661
200–210	3	210	630	0.02606	0.078181762
210–220	2	220	440	0.02803	0.056068793
220–230	2	230	460	0.03006	0.06011133
230–240	2	240	480	0.03212	0.064245619
240–250	1	250	250	0.03423	0.034234307
250–260	2	260	520	0.03639	0.072777382
260–270	4	270	1,080	0.03858	0.154338181
270–280	2	280	560	0.04082	0.081641001
280–290	0	290	0	0.04310	0

A1 – Application Case – 5-min SO_2 Data					
Maximum Concentration: 1,271.15504 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
290–300	2	300	600	0.04541	0.090814909
300–310	2	310	620	0.04776	0.095511842
310–320	1	320	320	0.05014	0.050139421
320–330	0	330	0	0.05256	0
330–340	1	340	340	0.05501	0.055006839
340–350	1	350	350	0.05749	0.057488496
350–360	1	360	360	0.06000	0.060000659
360–370	0	370	0	0.06254	0
370–380	0	380	0	0.06511	0
380–390	1	390	390	0.06771	0.067709703
390–400	1	400	400	0.07033	0.070333538
400–410	1	410	410	0.07298	0.072982826
410–420	0	420	0	0.07566	0
420–430	0	430	0	0.07835	0
430–440	0	440	0	0.08107	0
440–450	0	450	0	0.08382	0
450–460	0	460	0	0.08658	0
460–470	1	470	470	0.08936	0.089361863
470–480	0	480	0	0.09216	0
480–490	1	490	490	0.09498	0.094984913
490–500	1	500	500	0.09782	0.097823391

A1 – Application Case – 5-min SO_2 Data					
Maximum Concentration: 1,271.15504 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
500–510	0	510	0	0.10068	0
510–520	0	520	0	0.10355	0
520–530	0	530	0	0.10644	0
530–540	0	540	0	0.10934	0
540–550	0	550	0	0.11226	0
550–560	1	560	560	0.11518	0.115184148
560–570	0	570	0	0.11813	0
570–580	0	580	0	0.12108	0
580–590	0	590	0	0.12404	0
590–600	1	600	600	0.12702	0.127020686
600–610	0	610	0	0.13001	0
610–620	1	620	620	0.13300	0.133002067
620–630	0	630	0	0.13601	0
630–640	0	640	0	0.13902	0
640–650	0	650	0	0.14204	0
650–660	0	660	0	0.14507	0
660–670	0	670	0	0.14810	0
670–680	0	680	0	0.15114	0
680–690	0	690	0	0.15419	0
690–700	0	700	0	0.15724	0
700–710	0	710	0	0.16029	0

A1 – Application Case – 5-min SO_2 Data					
Maximum Concentration: 1,271.15504 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
710–720	0	720	0	0.16335	0
720–730	0	730	0	0.16642	0
730–740	0	740	0	0.16948	0
740–750	1	750	750	0.17255	0.172554323
750–760	0	760	0	0.17563	0
760–770	0	770	0	0.17870	0
770–780	0	780	0	0.18177	0
780–790	1	790	790	0.18485	0.184851079
790–800	0	800	0	0.18793	0
800–810	0	810	0	0.19100	0
810–820	0	820	0	0.19408	0
820–830	0	830	0	0.19716	0
830–840	0	840	0	0.20023	0
840–850	0	850	0	0.20331	0
850–860	0	860	0	0.20638	0
860–870	0	870	0	0.20945	0
870–880	0	880	0	0.21252	0
880–890	0	890	0	0.21559	0
890–900	1	900	900	0.21865	0.218650722
900–910	0	910	0	0.22171	0
910–920	0	920	0	0.22477	0

A1 – Application Case – 5-min SO_2 Data					
Maximum Concentration: 1,271.15504 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
920–930	0	930	0	0.22782	0
930–940	0	940	0	0.23087	0
940–950	0	950	0	0.23391	0
950–960	0	960	0	0.23696	0
960–970	0	970	0	0.23999	0
970–980	0	980	0	0.24302	0
980–990	0	990	0	0.24605	0
990–1,000	0	1,000	0	0.24907	0
1,000–1,010	0	1,010	0	0.25208	0
1,010–1,020	0	1,020	0	0.25509	0
1,020–1,030	0	1,030	0	0.25809	0
1,030–1,040	0	1,040	0	0.26108	0
1,040–1,050	0	1,050	0	0.26407	0
1,050–1,060	0	1,060	0	0.26706	0
1,060–1,070	0	1,070	0	0.27003	0
1,070–1,080	0	1,080	0	0.27300	0
1,080–1,090	0	1,090	0	0.27596	0
1,090–1,100	0	1,100	0	0.27891	0
1,100–1,110	0	1,110	0	0.28186	0
1,110–1,120	0	1,120	0	0.28479	0
1,120–1,130	0	1,130	0	0.28772	0

A1 – Application Case – 5-min SO_2 Data							
Maximum Concentration: 1,271.15504 µg/m^3							
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**		**Expected Number of Occurrences (Count * Probability)**	
1,130–1,140	0	1,140	0	0.29065		0	
1,140–1,150	0	1,150	0	0.29356		0	
1,150–1,160	0	1,160	0	0.29646		0	
1,160–1,170	0	1,170	0	0.29936		0	
1,170–1,180	0	1,180	0	0.30225		0	
1,180–1,190	0	1,190	0	0.30512		0	
1,190–1,200	0	1,200	0	0.30799		0	
1,200–1,210	0	1,210	0	0.31085		0	
1,210–1,220	0	1,220	0	0.31371		0	
1,220–1,230	0	1,230	0	0.31655		0	
1,230–1,240	0	1,240	0	0.31938		0	
1,240–1,250	0	1,250	0	0.32220		0	
1,250–1,260	0	1,260	0	0.32502		0	
1,260–1,270	0	1,270	0	0.32782		0	
1,270–1,280	1	1,280	1280	0.33061		0.330612777	
>1,280	0	1,290	0	0.33340		0	
Total	**26,304**	**Weighted Avg.**	**11.77**	**Weighted Sum**	**19.22**	**Weighted Sum**	**10.23**
Increase in Events							**0.0003807**

Table A–68: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A1 – Cumulative Case

A1 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration: 1,271.19922 µg/m^3					
Concentration Ranges (µg/m^3)	Count	Upper Bin Limit	Weighted Sum	Probability of Response at Upper Bin Limit	Expected Number of Occurrences (Count * Probability)
0–10	25,241	10	252,410	0.00020	4.974317417
10–20	419	20	8,380	0.00060	0.252479526
20–30	212	30	6,360	0.00116	0.245550974
30–40	107	40	4,280	0.00184	0.196978506
40–50	75	50	3,750	0.00264	0.197726986
50–60	59	60	3,540	0.00353	0.208537788
60–70	34	70	2,380	0.00453	0.153944344
70–80	28	80	2,240	0.00561	0.157076608
80–90	22	90	1,980	0.00678	0.149065014
90–100	12	100	1,200	0.00802	0.096249031
100–110	4	110	440	0.00934	0.037364831
110–120	7	120	840	0.01073	0.075135155
120–130	13	130	1,690	0.01219	0.158532323
130–140	8	140	1,120	0.01372	0.109775747
140–150	9	150	1,350	0.01531	0.137812518
150–160	2	160	320	0.01696	0.03392794
160–170	2	170	340	0.01867	0.037348219
170–180	4	180	720	0.02044	0.081763179
180–190	3	190	570	0.02226	0.066786061
190–200	4	200	800	0.02414	0.096543548

A1 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration: 1,271.19922 µg/m^3					
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
200–210	3	210	630	0.02606	0.078181762
210–220	2	220	440	0.02803	0.056068793
220–230	1	230	230	0.03006	0.030055665
230–240	3	240	720	0.03212	0.096368428
240–250	1	250	250	0.03423	0.034234307
250–260	2	260	520	0.03639	0.072777382
260–270	3	270	810	0.03858	0.115753635
270–280	3	280	840	0.04082	0.122461502
280–290	0	290	0	0.04310	0
290–300	2	300	600	0.04541	0.090814909
300–310	2	310	620	0.04776	0.095511842
310–320	1	320	320	0.05014	0.050139421
320–330	0	330	0	0.05256	0
330–340	1	340	340	0.05501	0.055006839
340–350	1	350	350	0.05749	0.057488496
350–360	1	360	360	0.06000	0.060000659
360–370	0	370	0	0.06254	0
370–380	0	380	0	0.06511	0
380–390	1	390	390	0.06771	0.067709703
390–400	1	400	400	0.07033	0.070333538
400–410	1	410	410	0.07298	0.072982826

A1 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration: 1,271.19922 µg/m^3					
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
410–420	0	420	0	0.07566	0
420–430	0	430	0	0.07835	0
430–440	0	440	0	0.08107	0
440–450	0	450	0	0.08382	0
450–460	0	460	0	0.08658	0
460–470	1	470	470	0.08936	0.089361863
470–480	0	480	0	0.09216	0
480–490	0	490	0	0.09498	0
490–500	2	500	1,000	0.09782	0.195646782
500–510	0	510	0	0.10068	0
510–520	0	520	0	0.10355	0
520–530	0	530	0	0.10644	0
530–540	0	540	0	0.10934	0
540–550	0	550	0	0.11226	0
550–560	1	560	560	0.11518	0.115184148
560–570	0	570	0	0.11813	0
570–580	0	580	0	0.12108	0
580–590	0	590	0	0.12404	0
590–600	1	600	600	0.12702	0.127020686
600–610	0	610	0	0.13001	0
610–620	1	620	620	0.13300	0.133002067

A1 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration: 1,271.19922 µg/m^3					
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
620–630	0	630	0	0.13601	0
630–640	0	640	0	0.13902	0
640–650	0	650	0	0.14204	0
650–660	0	660	0	0.14507	0
660–670	0	670	0	0.14810	0
670–680	0	680	0	0.15114	0
680–690	0	690	0	0.15419	0
690–700	0	700	0	0.15724	0
700–710	0	710	0	0.16029	0
710–720	0	720	0	0.16335	0
720–730	0	730	0	0.16642	0
730–740	0	740	0	0.16948	0
740–750	1	750	750	0.17255	0.172554323
750–760	0	760	0	0.17563	0
760–770	0	770	0	0.17870	0
770–780	0	780	0	0.18177	0
780–790	1	790	790	0.18485	0.184851079
790–800	0	800	0	0.18793	0
800–810	0	810	0	0.19100	0
810–820	0	820	0	0.19408	0
820–830	0	830	0	0.19716	0

A1 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration: 1,271.19922 µg/m^3					
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
830–840	0	840	0	0.20023	0
840–850	0	850	0	0.20331	0
850–860	0	860	0	0.20638	0
860–870	0	870	0	0.20945	0
870–880	0	880	0	0.21252	0
880–890	0	890	0	0.21559	0
890–900	1	900	900	0.21865	0.218650722
900–910	0	910	0	0.22171	0
910–920	0	920	0	0.22477	0
920–930	0	930	0	0.22782	0
930–940	0	940	0	0.23087	0
940–950	0	950	0	0.23391	0
950–960	0	960	0	0.23696	0
960–970	0	970	0	0.23999	0
970–980	0	980	0	0.24302	0
980–990	0	990	0	0.24605	0
990–1,000	0	1,000	0	0.24907	0
1,000–1,010	0	1,010	0	0.25208	0
1,010–1,020	0	1,020	0	0.25509	0
1,020–1,030	0	1,030	0	0.25809	0
1,030–1,040	0	1,040	0	0.26108	0

A1 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration: 1,271.19922 µg/m^3					
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
1,040–1,050	0	1,050	0	0.26407	0
1,050–1,060	0	1,060	0	0.26706	0
1,060–1,070	0	1,070	0	0.27003	0
1,070–1,080	0	1,080	0	0.27300	0
1,080–1,090	0	1,090	0	0.27596	0
1,090–1,100	0	1,100	0	0.27891	0
1,100–1,110	0	1,110	0	0.28186	0
1,110–1,120	0	1,120	0	0.28479	0
1,120–1,130	0	1,130	0	0.28772	0
1,130–1,140	0	1,140	0	0.29065	0
1,140–1,150	0	1,150	0	0.29356	0
1,150–1,160	0	1,160	0	0.29646	0
1,160–1,170	0	1,170	0	0.29936	0
1,170–1,180	0	1,180	0	0.30225	0
1,180–1,190	0	1,190	0	0.30512	0
1,190–1,200	0	1,200	0	0.30799	0
1,200–1,210	0	1,210	0	0.31085	0
1,210–1,220	0	1,220	0	0.31371	0
1,220–1,230	0	1,230	0	0.31655	0
1,230–1,240	0	1,240	0	0.31938	0
1,240–1,250	0	1,250	0	0.32220	0

A1 – Cumulative Case – 5-min SO_2 Data							
Maximum Concentration: 1,271.19922 µg/m^3							
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**		**Expected Number of Occurrences (Count * Probability)**	
1,250–1,260	0	1,260	0	0.32502		0	
1,260–1,270	0	1,270	0	0.32782		0	
1,270–1,280	1	1,280	1,280	0.33061		0.330612777	
>1,280	0	1,290	0	0.33340		0	
Total	**26,304**	**Weighted Avg.**	**11.78**	**Weighted Sum**	**19.22**	**Weighted Sum**	**10.26**
Increase in Events							**0.0003900**

Table A–69: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A2 – Project-alone Case

A2 – Project-alone Case – 5-min SO_2 Data							
Maximum Concentration: 151.58749 µg/m^3							
Concentration Range (µg/m^3)	Count	Upper Bin Limit	Weighted Sum	Probability of Response at Upper Bin Limit		Expected Number of Occurrences (Count * Probability)	
0–10	26,128	10	261,280	0.00020		5.149121092	
10–20	123	20	2,460	0.00060		0.074116901	
20–30	33	30	990	0.00116		0.038222557	
30–40	9	40	360	0.00184		0.016568286	
40–50	4	50	200	0.00264		0.010545439	
50–60	2	60	120	0.00353		0.007069078	
60–70	1	70	70	0.00453		0.004527775	
70–80	1	80	80	0.00561		0.005609879	
80–90	1	90	90	0.00678		0.006775682	
90–100	0	100	0	0.00802		0	
100–110	0	110	0	0.00934		0	
110–120	0	120	0	0.01073		0	
120–130	0	130	0	0.01219		0	
130–140	0	140	0	0.01372		0	
140–150	1	150	150	0.01531		0.015312502	
150–160	1	160	160	0.01696		0.01696397	
>160	0	170	0	0.01867		0	
Total	**26,304**	**Weighted Avg.**	**10.11**	**Weighted Sum**	**0.13**	**Weighted Sum**	**5.34**
Increase in Events							**0.0002031**

Table A–70: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A2 – Base Case

A2 – Base Case – 5-min SO_2 Data					
Maximum Concentration: 1,164.40356 µg/m^3					
Concentration Range (µg/m^3)	Count	Upper Bin Limit	Weighted Sum	Probability of Response at Upper Bin Limit	Expected Number of Occurrences (Count * Probability)
0–10	23,235	10	232,350	0.00020	4.578989152
10–20	1,132	20	22,640	0.00060	0.682116523
20–30	554	30	16,620	0.00116	0.641675659
30–40	384	40	15,360	0.00184	0.706913517
40–50	263	50	13,150	0.00264	0.69336263
50–60	148	60	8,880	0.00353	0.523111739
60–70	129	70	9,030	0.00453	0.584082951
70–80	78	80	6,240	0.00561	0.437570552
80–90	67	90	6,030	0.00678	0.453970726
90–100	59	100	5,900	0.00802	0.473224403
100–110	46	110	5,060	0.00934	0.429695559
110–120	29	120	3,480	0.01073	0.311274213
120–130	29	130	3,770	0.01219	0.353649029
130–140	21	140	2,940	0.01372	0.288161337
140–150	18	150	2,700	0.01531	0.275625036
150–160	13	160	2,080	0.01696	0.220531613
160–170	10	170	1,700	0.01867	0.186741095
170–180	14	180	2,520	0.02044	0.286171125
180–190	9	190	1,710	0.02226	0.200358184
190–200	6	200	1,200	0.02414	0.144815322

A2 – Base Case – 5-min SO_2 Data					
Maximum Concentration: 1,164.40356 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
200–210	7	210	1,470	0.02606	0.182424111
210–220	8	220	1,760	0.02803	0.224275173
220–230	3	230	690	0.03006	0.090166996
230–240	3	240	720	0.03212	0.096368428
240–250	6	250	1,500	0.03423	0.205405842
250–260	1	260	260	0.03639	0.036388691
260–270	2	270	540	0.03858	0.07716909
270–280	3	280	840	0.04082	0.122461502
280–290	1	290	290	0.04310	0.043095232
290–300	2	300	600	0.04541	0.090814909
300–310	0	310	0	0.04776	0
310–320	1	320	320	0.05014	0.050139421
320–330	2	330	660	0.05256	0.105113551
330–340	0	340	0	0.05501	0
340–350	1	350	350	0.05749	0.057488496
350–360	0	360	0	0.06000	0
360–370	1	370	370	0.06254	0.062542266
370–380	1	380	380	0.06511	0.065112284
380–390	1	390	390	0.06771	0.067709703
390–400	3	400	1,200	0.07033	0.211000614
400–410	0	410	0	0.07298	0

A2 – Base Case – 5-min SO_2 Data					
Maximum Concentration: 1,164.40356 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
410–420	0	420	0	0.07566	0
420–430	2	430	860	0.07835	0.156708041
430–440	0	440	0	0.08107	0
440–450	0	450	0	0.08382	0
450–460	1	460	460	0.08658	0.08657888
460–470	0	470	0	0.08936	0
470–480	2	480	960	0.09216	0.184328283
480–490	1	490	490	0.09498	0.094984913
490–500	1	500	500	0.09782	0.097823391
500–510	0	510	0	0.10068	0
510–520	0	520	0	0.10355	0
520–530	0	530	0	0.10644	0
530–540	0	540	0	0.10934	0
540–550	0	550	0	0.11226	0
550–560	0	560	0	0.11518	0
560–570	0	570	0	0.11813	0
570–580	1	580	580	0.12108	0.121079711
580–590	2	590	1,180	0.12404	0.24808968
590–600	0	600	0	0.12702	0
600–610	0	610	0	0.13001	0
610–620	0	620	0	0.13300	0

A2 – Base Case – 5-min SO_2 Data					
Maximum Concentration: 1,164.40356 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
620–630	0	630	0	0.13601	0
630–640	0	640	0	0.13902	0
640–650	1	650	650	0.14204	0.142039482
650–660	0	660	0	0.14507	0
660–670	0	670	0	0.14810	0
670–680	0	680	0	0.15114	0
680–690	0	690	0	0.15419	0
690–700	0	700	0	0.15724	0
700–710	0	710	0	0.16029	0
710–720	0	720	0	0.16335	0
720–730	0	730	0	0.16642	0
730–740	0	740	0	0.16948	0
740–750	0	750	0	0.17255	0
750–760	0	760	0	0.17563	0
760–770	0	770	0	0.17870	0
770–780	0	780	0	0.18177	0
780–790	0	790	0	0.18485	0
790–800	1	800	800	0.18793	0.187927904
800–810	0	810	0	0.19100	0
810–820	0	820	0	0.19408	0
820–830	0	830	0	0.19716	0

A2 – Base Case – 5-min SO_2 Data					
Maximum Concentration: 1,164.40356 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
830–840	1	840	840	0.20023	0.20023405
840–850	0	850	0	0.20331	0
850–860	0	860	0	0.20638	0
860–870	0	870	0	0.20945	0
870–880	0	880	0	0.21252	0
880–890	0	890	0	0.21559	0
890–900	0	900	0	0.21865	0
900–910	0	910	0	0.22171	0
910–920	0	920	0	0.22477	0
920–930	0	930	0	0.22782	0
930–940	0	940	0	0.23087	0
940–950	0	950	0	0.23391	0
950–960	0	960	0	0.23696	0
960–970	0	970	0	0.23999	0
970–980	0	980	0	0.24302	0
980–990	0	990	0	0.24605	0
990–1,000	0	1,000	0	0.24907	0
1,000–1,010	0	1,010	0	0.25208	0
1,010–1,020	0	1,020	0	0.25509	0
1,020–1,030	0	1,030	0	0.25809	0
1,030–1,040	0	1,040	0	0.26108	0

A2 – Base Case – 5-min SO_2 Data							
Maximum Concentration: 1,164.40356 µg/m^3							
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**		**Expected Number of Occurrences (Count * Probability)**	
1,040–1,050	0	1,050	0	0.26407		0	
1,050–1,060	0	1,060	0	0.26706		0	
1,060–1,070	0	1,070	0	0.27003		0	
1,070–1,080	0	1,080	0	0.27300		0	
1,080–1,090	0	1,090	0	0.27596		0	
1,090–1,100	0	1,100	0	0.27891		0	
1,100–1,110	0	1,110	0	0.28186		0	
1,110–1,120	0	1,120	0	0.28479		0	
1,120–1,130	0	1,130	0	0.28772		0	
1,130–1,140	0	1,140	0	0.29065		0	
1,140–1,150	0	1,150	0	0.29356		0	
1,150–1,160	0	1,160	0	0.29646		0	
1,160–1,170	1	1,170	1,170	0.29936		0.299358786	
>1,170	0	1,180	0	0.30225		0	
Total	**26,304**	**Weighted Avg.**	**14.61**	**Weighted Sum**	**15.70**	**Weighted Sum**	**16.08**
Increase in Events							**0.0006112**

Table A–71: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A2 – Application

A2 – Application Case – 5-min SO_2 Data					
Maximum Concentration: 1,245.20638 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
0–10	23,099	10	230,990	0.00020	4.552187236
10–20	1,156	20	23,120	0.00060	0.696578357
20–30	562	30	16,860	0.00116	0.650941734
30–40	418	40	16,720	0.00184	0.769504818
40–50	256	50	12,800	0.00264	0.674908112
50–60	182	60	10,920	0.00353	0.643286058
60–70	120	70	8,400	0.00453	0.543332978
70–80	99	80	7,920	0.00561	0.555378008
80–90	57	90	5,130	0.00678	0.386213901
90–100	71	100	7,100	0.00802	0.569473434
100–110	45	110	4,950	0.00934	0.420354351
110–120	40	120	4,800	0.01073	0.429343742
120–130	21	130	2,730	0.01219	0.256090676
130–140	29	140	4,060	0.01372	0.397937084
140–150	20	150	3,000	0.01531	0.30625004
150–160	17	160	2,720	0.01696	0.288387494
160–170	8	170	1,360	0.01867	0.149392876
170–180	17	180	3,060	0.02044	0.347493509
180–190	8	190	1,520	0.02226	0.178096164
190–200	13	200	2,600	0.02414	0.313766531

A2 – Application Case – 5-min SO_2 Data					
Maximum Concentration: 1,245.20638 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
200–210	10	210	2,100	0.02606	0.260605872
210–220	5	220	1,100	0.02803	0.140171983
220–230	4	230	920	0.03006	0.120222661
230–240	2	240	480	0.03212	0.064245619
240–250	4	250	1,000	0.03423	0.136937228
250–260	5	260	1,300	0.03639	0.181943455
260–270	2	270	540	0.03858	0.07716909
270–280	2	280	560	0.04082	0.081641001
280–290	1	290	290	0.04310	0.043095232
290–300	2	300	600	0.04541	0.090814909
300–310	0	310	0	0.04776	0
310–320	1	320	320	0.05014	0.050139421
320–330	3	330	990	0.05256	0.157670327
330–340	1	340	340	0.05501	0.055006839
340–350	1	350	350	0.05749	0.057488496
350–360	2	360	720	0.06000	0.120001317
360–370	0	370	0	0.06254	0
370–380	1	380	380	0.06511	0.065112284
380–390	1	390	390	0.06771	0.067709703
390–400	2	400	800	0.07033	0.140667076
400–410	0	410	0	0.07298	0

A2 – Application Case – 5-min SO_2 Data					
Maximum Concentration: 1,245.20638 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
410–420	2	420	840	0.07566	0.151313253
420–430	1	430	430	0.07835	0.07835402
430–440	1	440	440	0.08107	0.08107411
440–450	1	450	450	0.08382	0.083816016
450–460	0	460	0	0.08658	0
460–470	0	470	0	0.08936	0
470–480	0	480	0	0.09216	0
480–490	0	490	0	0.09498	0
490–500	2	500	1,000	0.09782	0.195646782
500–510	1	510	510	0.10068	0.100678806
510–520	1	520	520	0.10355	0.103550405
520–530	0	530	0	0.10644	0
530–540	0	540	0	0.10934	0
540–550	0	550	0	0.11226	0
550–560	0	560	0	0.11518	0
560–570	0	570	0	0.11813	0
570–580	0	580	0	0.12108	0
580–590	0	590	0	0.12404	0
590–600	3	600	1,800	0.12702	0.381062058
600–610	0	610	0	0.13001	0
610–620	0	620	0	0.13300	0

A2 – Application Case – 5-min SO_2 Data					
Maximum Concentration: 1,245.20638 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
620–630	0	630	0	0.13601	0
630–640	1	640	640	0.13902	0.139019066
640–650	0	650	0	0.14204	0
650–660	0	660	0	0.14507	0
660–670	0	670	0	0.14810	0
670–680	0	680	0	0.15114	0
680–690	0	690	0	0.15419	0
690–700	0	700	0	0.15724	0
700–710	1	710	710	0.16029	0.160294694
710–720	0	720	0	0.16335	0
720–730	0	730	0	0.16642	0
730–740	0	740	0	0.16948	0
740–750	0	750	0	0.17255	0
750–760	0	760	0	0.17563	0
760–770	0	770	0	0.17870	0
770–780	0	780	0	0.18177	0
780–790	0	790	0	0.18485	0
790–800	0	800	0	0.18793	0
800–810	0	810	0	0.19100	0
810–820	0	820	0	0.19408	0
820–830	0	830	0	0.19716	0

A2 – Application Case – 5-min SO_2 Data					
Maximum Concentration: 1,245.20638 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
830–840	0	840	0	0.20023	0
840–850	1	850	850	0.20331	0.203308466
850–860	0	860	0	0.20638	0
860–870	0	870	0	0.20945	0
870–880	1	880	880	0.21252	0.212521083
880–890	0	890	0	0.21559	0
890–900	0	900	0	0.21865	0
900–910	0	910	0	0.22171	0
910–920	0	920	0	0.22477	0
920–930	0	930	0	0.22782	0
930–940	0	940	0	0.23087	0
940–950	0	950	0	0.23391	0
950–960	0	960	0	0.23696	0
960–970	0	970	0	0.23999	0
970–980	0	980	0	0.24302	0
980–990	0	990	0	0.24605	0
990–1,000	0	1,000	0	0.24907	0
1,000–1,010	0	1,010	0	0.25208	0
1,010–1,020	0	1,020	0	0.25509	0
1,020–1,030	0	1,030	0	0.25809	0
1,030–1,040	0	1,040	0	0.26108	0

A2 – Application Case – 5-min SO_2 Data					
Maximum Concentration: 1,245.20638 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
1,040–1,050	0	1,050	0	0.26407	0
1,050–1,060	0	1,060	0	0.26706	0
1,060–1,070	0	1,070	0	0.27003	0
1,070–1,080	0	1,080	0	0.27300	0
1,080–1,090	0	1,090	0	0.27596	0
1,090–1,100	0	1,100	0	0.27891	0
1,100–1,110	0	1,110	0	0.28186	0
1,110–1,120	0	1,120	0	0.28479	0
1,120–1,130	0	1,130	0	0.28772	0
1,130–1,140	0	1,140	0	0.29065	0
1,140–1,150	0	1,150	0	0.29356	0
1,150–1,160	0	1,160	0	0.29646	0
1,160–1,170	0	1,170	0	0.29936	0
1,170–1,180	0	1,180	0	0.30225	0
1,180–1,190	0	1,190	0	0.30512	0
1,190–1,200	0	1,200	0	0.30799	0
1,200–1,210	0	1,210	0	0.31085	0
1,210–1,220	0	1,220	0	0.31371	0
1,220–1,230	0	1,230	0	0.31655	0
1,230–1,240	0	1,240	0	0.31938	0
1,240–1,250	1	1,250	1,250	0.32220	0.322202219

A2 – Application Case – 5-min SO_2 Data							
Maximum Concentration: 1,245.20638 µg/m^3							
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**		**Expected Number of Occurrences (Count * Probability)**	
>1,250	0	1,260	0	0.32502		0	
Total	**26,304**	**Weighted Avg.**	**14.99**	**Weighted Sum**	**18.22**	**Weighted Sum**	**17.25**
Increase in Events							**0.0006558**

Table A–72: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A2 – Cumulative Case

A2 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration: 1,245.40186 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
0–10	23,081	10	230,810	0.00020	4.548639923
10–20	1,166	20	23,320	0.00060	0.702604121
20–30	563	30	16,890	0.00116	0.652099993
30–40	423	40	16,920	0.00184	0.778709421
40–50	257	50	12,850	0.00264	0.677544471
50–60	182	60	10,920	0.00353	0.643286058
60–70	121	70	8,470	0.00453	0.547860753
70–80	96	80	7,680	0.00561	0.538548372
80–90	59	90	5,310	0.00678	0.399765266
90–100	72	100	7,200	0.00802	0.577494187

A2 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration: 1,245.40186 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
100–110	44	110	4,840	0.00934	0.411013143
110–120	41	120	4,920	0.01073	0.440077335
120–130	21	130	2,730	0.01219	0.256090676
130–140	29	140	4,060	0.01372	0.397937084
140–150	20	150	3,000	0.01531	0.30625004
150–160	17	160	2,720	0.01696	0.288387494
160–170	8	170	1,360	0.01867	0.149392876
170–180	16	180	2,880	0.02044	0.327052714
180–190	9	190	1,710	0.02226	0.200358184
190–200	13	200	2,600	0.02414	0.313766531
200–210	10	210	2,100	0.02606	0.260605872
210–220	5	220	1,100	0.02803	0.140171983
220–230	4	230	920	0.03006	0.120222661
230–240	2	240	480	0.03212	0.064245619
240–250	4	250	1,000	0.03423	0.136937228
250–260	5	260	1,300	0.03639	0.181943455
260–270	2	270	540	0.03858	0.07716909
270–280	2	280	560	0.04082	0.081641001
280–290	1	290	290	0.04310	0.043095232
290–300	2	300	600	0.04541	0.090814909
300–310	0	310	0	0.04776	0

A2 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration: 1,245.40186 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
310–320	1	320	320	0.05014	0.050139421
320–330	3	330	990	0.05256	0.157670327
330–340	1	340	340	0.05501	0.055006839
340–350	1	350	350	0.05749	0.057488496
350–360	2	360	720	0.06000	0.120001317
360–370	0	370	0	0.06254	0
370–380	1	380	380	0.06511	0.065112284
380–390	1	390	390	0.06771	0.067709703
390–400	2	400	800	0.07033	0.140667076
400–410	0	410	0	0.07298	0
410–420	2	420	840	0.07566	0.151313253
420–430	1	430	430	0.07835	0.07835402
430–440	1	440	440	0.08107	0.08107411
440–450	1	450	450	0.08382	0.083816016
450–460	0	460	0	0.08658	0
460–470	0	470	0	0.08936	0
470–480	0	480	0	0.09216	0
480–490	0	490	0	0.09498	0
490–500	2	500	1,000	0.09782	0.195646782
500–510	1	510	510	0.10068	0.100678806
510–520	1	520	520	0.10355	0.103550405

A2 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration: 1,245.40186 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
520–530	0	530	0	0.10644	0
530–540	0	540	0	0.10934	0
540–550	0	550	0	0.11226	0
550–560	0	560	0	0.11518	0
560–570	0	570	0	0.11813	0
570–580	0	580	0	0.12108	0
580–590	0	590	0	0.12404	0
590–600	3	600	1,800	0.12702	0.381062058
600–610	0	610	0	0.13001	0
610–620	0	620	0	0.13300	0
620–630	0	630	0	0.13601	0
630–640	1	640	640	0.13902	0.139019066
640–650	0	650	0	0.14204	0
650–660	0	660	0	0.14507	0
660–670	0	670	0	0.14810	0
670–680	0	680	0	0.15114	0
680–690	0	690	0	0.15419	0
690–700	0	700	0	0.15724	0
700–710	1	710	710	0.16029	0.160294694
710–720	0	720	0	0.16335	0
720–730	0	730	0	0.16642	0

A2 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration: 1,245.40186 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
730–740	0	740	0	0.16948	0
740–750	0	750	0	0.17255	0
750–760	0	760	0	0.17563	0
760–770	0	770	0	0.17870	0
770–780	0	780	0	0.18177	0
780–790	0	790	0	0.18485	0
790–800	0	800	0	0.18793	0
800–810	0	810	0	0.19100	0
810–820	0	820	0	0.19408	0
820–830	0	830	0	0.19716	0
830–840	0	840	0	0.20023	0
840–850	1	850	850	0.20331	0.203308466
850–860	0	860	0	0.20638	0
860–870	0	870	0	0.20945	0
870–880	1	880	880	0.21252	0.212521083
880–890	0	890	0	0.21559	0
890–900	0	900	0	0.21865	0
900–910	0	910	0	0.22171	0
910–920	0	920	0	0.22477	0
920–930	0	930	0	0.22782	0
930–940	0	940	0	0.23087	0

A2 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration: 1,245.40186 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
940–950	0	950	0	0.23391	0
950–960	0	960	0	0.23696	0
960–970	0	970	0	0.23999	0
970–980	0	980	0	0.24302	0
980–990	0	990	0	0.24605	0
990–1,000	0	1,000	0	0.24907	0
1,000–1,010	0	1,010	0	0.25208	0
1,010–1,020	0	1,020	0	0.25509	0
1,020–1,030	0	1,030	0	0.25809	0
1,030–1,040	0	1,040	0	0.26108	0
1,040–1,050	0	1,050	0	0.26407	0
1,050–1,060	0	1,060	0	0.26706	0
1,060–1,070	0	1,070	0	0.27003	0
1,070–1,080	0	1,080	0	0.27300	0
1,080–1,090	0	1,090	0	0.27596	0
1,090–1,100	0	1,100	0	0.27891	0
1,100–1,110	0	1,110	0	0.28186	0
1,110–1,120	0	1,120	0	0.28479	0
1,120–1,130	0	1,130	0	0.28772	0
1,130–1,140	0	1,140	0	0.29065	0
1,140–1,150	0	1,150	0	0.29356	0

A2 – Cumulative Case – 5-min SO_2 Data							
Maximum Concentration: 1,245.40186 µg/m^3							
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**		**Expected Number of Occurrences (Count * Probability)**	
1,150–1,160	0	1,160	0	0.29646		0	
1,160–1170	0	1,170	0	0.29936		0	
1,170–1180	0	1,180	0	0.30225		0	
1,180–1190	0	1,190	0	0.30512		0	
1,190–1200	0	1,200	0	0.30799		0	
1,200–1210	0	1,210	0	0.31085		0	
1,210–1220	0	1,220	0	0.31371		0	
1,220–1230	0	1,230	0	0.31655		0	
1,230–1240	0	1,240	0	0.31938		0	
1,240–1250	1	1,250	1,250	0.32220		0.322202219	
>1,250	0	1,260	0	0.32502		0	
Total	**26,304**	**Weighted Avg.**	**15.00**	**Weighted Sum**	**18.22**	**Weighted Sum**	**17.28**
Increase in Events							**0.000656**

Table A–73: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A3 – Project-alone Case

A3 – Project-alone Case – 5-min SO_2							
Maximum Concentration: 127.51 µg/m^3							
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**		**Expected Number of Occurrences (Count * Probability)**	
0–10	26,068	10	260,680	0.00020		5.137296717	
10–20	152	20	3,040	0.00060		0.091591618	
20–30	51	30	1,530	0.00116		0.059071225	
30–40	24	40	960	0.00184		0.044182095	
40–50	6	50	300	0.00264		0.015818159	
50–60	2	60	120	0.00353		0.007069078	
60–70	0	70	0	0.00453		0	
70–80	0	80	0	0.00561		0	
80–90	0	90	0	0.00678		0	
90–100	0	100	0	0.00802		0	
100–110	0	110	0	0.00934		0	
110–120	0	120	0	0.01073		0	
120–130	1	130	130	0.01219		0.012194794	
>130	0	140	0	0.01372		0	
Total	**26,304**	**Weighted Avg.**	**10.14**	**Weighted Sum**	**0.08**	**Weighted Sum**	**5.37**
Increase in Events							**0.000204**

Table A–74: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A3 – Base Case

A3 – Base Case – 5-min SO_2					
Maximum Concentration: 1,171.66 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
0–10	23,600	10	236,000	0.00020	4.650920766
10–20	1,044	20	20,880	0.00060	0.629089796
20–30	570	30	17,100	0.00116	0.660207808
30–40	331	40	13,240	0.00184	0.609344724
40–50	216	50	10,800	0.00264	0.569453719
50–60	146	60	8,760	0.00353	0.516042662
60–70	97	70	6,790	0.00453	0.439194157
70–80	56	80	4,480	0.00561	0.314153217
80–90	45	90	4,050	0.00678	0.304905711
90–100	43	100	4,300	0.00802	0.344892362
100–110	32	110	3,520	0.00934	0.29891865
110–120	17	120	2,040	0.01073	0.18247109
120–130	11	130	1,430	0.01219	0.134142735
130–140	15	140	2,100	0.01372	0.205829526
140–150	12	150	1,800	0.01531	0.183750024
150–160	10	160	1,600	0.01696	0.169639702
160–170	5	170	850	0.01867	0.093370548
170–180	11	180	1,980	0.02044	0.224848741
180–190	9	190	1,710	0.02226	0.200358184
190–200	5	200	1,000	0.02414	0.120679435

A3 – Base Case – 5-min SO_2					
Maximum Concentration: 1,171.66 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
200–210	3	210	630	0.02606	0.078181762
210–220	6	220	1,320	0.02803	0.16820638
220–230	4	230	920	0.03006	0.120222661
230–240	5	240	1,200	0.03212	0.160614047
240–250	3	250	750	0.03423	0.102702921
250–260	1	260	260	0.03639	0.036388691
260–270	2	270	540	0.03858	0.07716909
270–280	0	280	0	0.04082	0
280–290	0	290	0	0.04310	0
290–300	3	300	900	0.04541	0.136222363
300–310	0	310	0	0.04776	0
310–320	0	320	0	0.05014	0
320–330	0	330	0	0.05256	0
330–340	0	340	0	0.05501	0
340–350	0	350	0	0.05749	0
350–360	0	360	0	0.06000	0
360–370	1	370	370	0.06254	0.062542266
370–380	0	380	0	0.06511	0
380–390	0	390	0	0.06771	0
390–400	0	400	0	0.07033	0
400–410	0	410	0	0.07298	0

A3 – Base Case – 5-min SO_2					
Maximum Concentration: 1,171.66 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
410–420	0	420	0	0.07566	0
420–430	0	430	0	0.07835	0
430–440	0	440	0	0.08107	0
440–450	0	450	0	0.08382	0
450–460	0	460	0	0.08658	0
460–470	0	470	0	0.08936	0
470–480	0	480	0	0.09216	0
480–490	0	490	0	0.09498	0
490–500	0	500	0	0.09782	0
500–510	0	510	0	0.10068	0
510–520	0	520	0	0.10355	0
520–530	0	530	0	0.10644	0
530–540	0	540	0	0.10934	0
540–550	0	550	0	0.11226	0
550–560	0	560	0	0.11518	0
560–570	0	570	0	0.11813	0
570–580	0	580	0	0.12108	0
580–590	0	590	0	0.12404	0
590–600	0	600	0	0.12702	0
600–610	0	610	0	0.13001	0
610–620	0	620	0	0.13300	0

A3 – Base Case – 5-min SO_2					
Maximum Concentration: 1,171.66 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
620–630	0	630	0	0.13601	0
630–640	0	640	0	0.13902	0
640–650	0	650	0	0.14204	0
650–660	0	660	0	0.14507	0
660–670	0	670	0	0.14810	0
670–680	0	680	0	0.15114	0
680–690	0	690	0	0.15419	0
690–700	0	700	0	0.15724	0
700–710	0	710	0	0.16029	0
710–720	0	720	0	0.16335	0
720–730	0	730	0	0.16642	0
730–740	0	740	0	0.16948	0
740–750	0	750	0	0.17255	0
750–760	0	760	0	0.17563	0
760–770	0	770	0	0.17870	0
770–780	0	780	0	0.18177	0
780–790	0	790	0	0.18485	0
790–800	0	800	0	0.18793	0
800–810	0	810	0	0.19100	0
810–820	0	820	0	0.19408	0
820–830	0	830	0	0.19716	0

A3 – Base Case – 5-min SO_2					
Maximum Concentration: 1,171.66 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
830–840	0	840	0	0.20023	0
840–850	0	850	0	0.20331	0
850–860	0	860	0	0.20638	0
860–870	0	870	0	0.20945	0
870–880	0	880	0	0.21252	0
880–890	0	890	0	0.21559	0
890–900	0	900	0	0.21865	0
900–910	0	910	0	0.22171	0
910–920	0	920	0	0.22477	0
920–930	0	930	0	0.22782	0
930–940	0	940	0	0.23087	0
940–950	0	950	0	0.23391	0
950–960	0	960	0	0.23696	0
960–970	0	970	0	0.23999	0
970–980	0	980	0	0.24302	0
980–990	0	990	0	0.24605	0
990–1,000	0	1,000	0	0.24907	0
1,000–1,010	0	1,010	0	0.25208	0
1,010–1,020	0	1,020	0	0.25509	0
1,020–1,030	0	1,030	0	0.25809	0
1,030–1,040	0	1,040	0	0.26108	0

A3 – Base Case – 5-min SO_2							
Maximum Concentration: 1,171.66 µg/m^3							
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**		**Expected Number of Occurrences (Count * Probability)**	
1,040–1,050	0	1,050	0	0.26407		0	
1,050–1,060	0	1,060	0	0.26706		0	
1,060–1,070	0	1,070	0	0.27003		0	
1,070–1,080	0	1,080	0	0.27300		0	
1,080–1,090	0	1,090	0	0.27596		0	
1,090–1,100	0	1,100	0	0.27891		0	
1,100–1,110	0	1,110	0	0.28186		0	
1,110–1,120	0	1,120	0	0.28479		0	
1,120–1,130	0	1,130	0	0.28772		0	
1,130–1,140	0	1,140	0	0.29065		0	
1,140–1,150	0	1,150	0	0.29356		0	
1,150–1,160	0	1,160	0	0.29646		0	
1,160–1,170	0	1,170	0	0.29936		0	
1,170–1,180	1	1,180	1,180	0.30225		0.302245993	
>1,180	0	1,190	0	0.30512		0	
Total	**26,304**	**Weighted Avg.**	**13.40**	**Weighted Sum**	**16.01**	**Weighted Sum**	**12.10**
Increase in Events							**0.000459**

Table A–75: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A3 – Application Case

A3 – Application Case – 5-min SO_2 Data					
Maximum Concentration: 1,173.47 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
0–10	23,468	10	234,680	0.00020	4.624907141
10–20	1,092	20	21,840	0.00060	0.658013465
20–30	577	30	17,310	0.00116	0.668315623
30–40	348	40	13,920	0.00184	0.640640375
40–50	219	50	10,950	0.00264	0.577362799
50–60	169	60	10,140	0.00353	0.597337054
60–70	100	70	7,000	0.00453	0.452777482
70–80	66	80	5,280	0.00561	0.370252006
80–90	48	90	4,320	0.00678	0.325232759
90–100	38	100	3,800	0.00802	0.304788599
100–110	40	110	4,400	0.00934	0.373648312
110–120	21	120	2,520	0.01073	0.225405464
120–130	12	130	1,560	0.01219	0.146337529
130–140	14	140	1,960	0.01372	0.192107558
140–150	11	150	1,650	0.01531	0.168437522
150–160	13	160	2,080	0.01696	0.220531613
160–170	10	170	1,700	0.01867	0.186741095
170–180	4	180	720	0.02044	0.081763179
180–190	10	190	1,900	0.02226	0.222620205
190–200	9	200	1,800	0.02414	0.217222983

A3 – Application Case – 5-min SO_2 Data					
Maximum Concentration: 1,173.47 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
200–210	3	210	630	0.02606	0.078181762
210–220	7	220	1,540	0.02803	0.196240777
220–230	4	230	920	0.03006	0.120222661
230–240	5	240	1,200	0.03212	0.160614047
240–250	3	250	750	0.03423	0.102702921
250–260	4	260	1,040	0.03639	0.145554764
260–270	1	270	270	0.03858	0.038584545
270–280	2	280	560	0.04082	0.081641001
280–290	1	290	290	0.04310	0.043095232
290–300	0	300	0	0.04541	0
300–310	2	310	620	0.04776	0.095511842
310–320	1	320	320	0.05014	0.050139421
320–330	0	330	0	0.05256	0
330–340	0	340	0	0.05501	0
340–350	0	350	0	0.05749	0
350–360	0	360	0	0.06000	0
360–370	0	370	0	0.06254	0
370–380	0	380	0	0.06511	0
380–390	1	390	390	0.06771	0.067709703
390–400	0	400	0	0.07033	0
400–410	0	410	0	0.07298	0

A3 – Application Case – 5-min SO_2 Data					
Maximum Concentration: 1,173.47 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
410–420	0	420	0	0.07566	0
420–430	0	430	0	0.07835	0
430–440	0	440	0	0.08107	0
440–450	0	450	0	0.08382	0
450–460	0	460	0	0.08658	0
460–470	0	470	0	0.08936	0
470–480	0	480	0	0.09216	0
480–490	0	490	0	0.09498	0
490–500	0	500	0	0.09782	0
500–510	0	510	0	0.10068	0
510–520	0	520	0	0.10355	0
520–530	0	530	0	0.10644	0
530–540	0	540	0	0.10934	0
540–550	0	550	0	0.11226	0
550–560	0	560	0	0.11518	0
560–570	0	570	0	0.11813	0
570–580	0	580	0	0.12108	0
580–590	0	590	0	0.12404	0
590–600	0	600	0	0.12702	0
600–610	0	610	0	0.13001	0
610–620	0	620	0	0.13300	0

A3 – Application Case – 5-min SO_2 Data					
Maximum Concentration: 1,173.47 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
620–630	0	630	0	0.13601	0
630–640	0	640	0	0.13902	0
640–650	0	650	0	0.14204	0
650–660	0	660	0	0.14507	0
660–670	0	670	0	0.14810	0
670–680	0	680	0	0.15114	0
680–690	0	690	0	0.15419	0
690–700	0	700	0	0.15724	0
700–710	0	710	0	0.16029	0
710–720	0	720	0	0.16335	0
720–730	0	730	0	0.16642	0
730–740	0	740	0	0.16948	0
740–750	0	750	0	0.17255	0
750–760	0	760	0	0.17563	0
760–770	0	770	0	0.17870	0
770–780	0	780	0	0.18177	0
780–790	0	790	0	0.18485	0
790–800	0	800	0	0.18793	0
800–810	0	810	0	0.19100	0
810–820	0	820	0	0.19408	0
820–830	0	830	0	0.19716	0

A3 – Application Case – 5-min SO_2 Data					
Maximum Concentration: 1,173.47 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
830–840	0	840	0	0.20023	0
840–850	0	850	0	0.20331	0
850–860	0	860	0	0.20638	0
860–870	0	870	0	0.20945	0
870–880	0	880	0	0.21252	0
880–890	0	890	0	0.21559	0
890–900	0	900	0	0.21865	0
900–910	0	910	0	0.22171	0
910–920	0	920	0	0.22477	0
920–930	0	930	0	0.22782	0
930–940	0	940	0	0.23087	0
940–950	0	950	0	0.23391	0
950–960	0	960	0	0.23696	0
960–970	0	970	0	0.23999	0
970–980	0	980	0	0.24302	0
980–990	0	990	0	0.24605	0
990–1,000	0	1,000	0	0.24907	0
1,000–1,010	0	1,010	0	0.25208	0
1,010–1,020	0	1,020	0	0.25509	0
1,020–1,030	0	1,030	0	0.25809	0
1,030–1,040	0	1,040	0	0.26108	0

A3 – Application Case – 5-min SO_2 Data							
Maximum Concentration: 1,173.47 µg/m^3							
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**		**Expected Number of Occurrences (Count * Probability)**	
1,040–1,050	0	1,050	0	0.26407		0	
1,050–1,060	0	1,060	0	0.26706		0	
1,060–1,070	0	1,070	0	0.27003		0	
1,070–1,080	0	1,080	0	0.27300		0	
1,080–1,090	0	1,090	0	0.27596		0	
1,090–1,100	0	1,100	0	0.27891		0	
1,100–1,110	0	1,110	0	0.28186		0	
1,110–1,120	0	1,120	0	0.28479		0	
1,120–1,130	0	1,130	0	0.28772		0	
1,130–1,140	0	1,140	0	0.29065		0	
1,140–1,150	0	1,150	0	0.29356		0	
1,150–1,160	0	1,160	0	0.29646		0	
1,160–1,170	0	1,170	0	0.29936		0	
1,170–1,180	1	1,180	1,180	0.30225		0.302245993	
>1,180	0	1,190	0	0.30512		0	
Total	**26,304**	**Weighted Avg.**	**13.66**	**Weighted Sum**	**16.01**	**Weighted Sum**	**12.74**
Increase in Events							**0.0004842**

Table A–76: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A3 – Cumulative Case

A3 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration: 173.54 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
0–10	23,449	10	234,490	0.00020	4.621162756
10–20	1,100	20	22,000	0.00060	0.662834077
20–30	585	30	17,550	0.00116	0.677581698
30–40	349	40	13,960	0.00184	0.642481295
40–50	221	50	11,050	0.00264	0.582635518
50–60	168	60	10,080	0.00353	0.593802515
60–70	100	70	7,000	0.00453	0.452777482
70–80	66	80	5,280	0.00561	0.370252006
80–90	48	90	4,320	0.00678	0.325232759
90–100	39	100	3,900	0.00802	0.312809351
100–110	39	110	4,290	0.00934	0.364307104
110–120	21	120	2,520	0.01073	0.225405464
120–130	13	130	1,690	0.01219	0.158532323
130–140	14	140	1,960	0.01372	0.192107558
140–150	11	150	1,650	0.01531	0.168437522
150–160	12	160	1,920	0.01696	0.203567643
160–170	11	170	1,870	0.01867	0.205415205
170–180	4	180	720	0.02044	0.081763179
180–190	10	190	1,900	0.02226	0.222620205
190–200	9	200	1,800	0.02414	0.217222983

A3 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration: 173.54 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
200–210	3	210	630	0.02606	0.078181762
210–220	7	220	1,540	0.02803	0.196240777
220–230	4	230	920	0.03006	0.120222661
230–240	5	240	1,200	0.03212	0.160614047
240–250	3	250	750	0.03423	0.102702921
250–260	4	260	1,040	0.03639	0.145554764
260–270	1	270	270	0.03858	0.038584545
270–280	2	280	560	0.04082	0.081641001
280–290	1	290	290	0.04310	0.043095232
290–300	0	300	0	0.04541	0
300–310	2	310	620	0.04776	0.095511842
310–320	1	320	320	0.05014	0.050139421
320–330	0	330	0	0.05256	0
330–340	0	340	0	0.05501	0
340–350	0	350	0	0.05749	0
350–360	0	360	0	0.06000	0
360–370	0	370	0	0.06254	0
370–380	0	380	0	0.06511	0
380–390	1	390	390	0.06771	0.067709703
390–400	0	400	0	0.07033	0
400–410	0	410	0	0.07298	0

A3 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration: 173.54 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
410–420	0	420	0	0.07566	0
420–430	0	430	0	0.07835	0
430–440	0	440	0	0.08107	0
440–450	0	450	0	0.08382	0
450–460	0	460	0	0.08658	0
460–470	0	470	0	0.08936	0
470–480	0	480	0	0.09216	0
480–490	0	490	0	0.09498	0
490–500	0	500	0	0.09782	0
500–510	0	510	0	0.10068	0
510–520	0	520	0	0.10355	0
520–530	0	530	0	0.10644	0
530–540	0	540	0	0.10934	0
540–550	0	550	0	0.11226	0
550–560	0	560	0	0.11518	0
560–570	0	570	0	0.11813	0
570–580	0	580	0	0.12108	0
580–590	0	590	0	0.12404	0
590–600	0	600	0	0.12702	0
600–610	0	610	0	0.13001	0
610–620	0	620	0	0.13300	0

A3 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration: 173.54 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
620–630	0	630	0	0.13601	0
630–640	0	640	0	0.13902	0
640–650	0	650	0	0.14204	0
650–660	0	660	0	0.14507	0
660–670	0	670	0	0.14810	0
670–680	0	680	0	0.15114	0
680–690	0	690	0	0.15419	0
690–700	0	700	0	0.15724	0
700–710	0	710	0	0.16029	0
710–720	0	720	0	0.16335	0
720–730	0	730	0	0.16642	0
730–740	0	740	0	0.16948	0
740–750	0	750	0	0.17255	0
750–760	0	760	0	0.17563	0
760–770	0	770	0	0.17870	0
770–780	0	780	0	0.18177	0
780–790	0	790	0	0.18485	0
790–800	0	800	0	0.18793	0
800–810	0	810	0	0.19100	0
810–820	0	820	0	0.19408	0
820–830	0	830	0	0.19716	0

A3 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration: 173.54 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
830–840	0	840	0	0.20023	0
840–850	0	850	0	0.20331	0
850–860	0	860	0	0.20638	0
860–870	0	870	0	0.20945	0
870–880	0	880	0	0.21252	0
880–890	0	890	0	0.21559	0
890–900	0	900	0	0.21865	0
900–910	0	910	0	0.22171	0
910–920	0	920	0	0.22477	0
920–930	0	930	0	0.22782	0
930–940	0	940	0	0.23087	0
940–950	0	950	0	0.23391	0
950–960	0	960	0	0.23696	0
960–970	0	970	0	0.23999	0
970–980	0	980	0	0.24302	0
980–990	0	990	0	0.24605	0
990–1,000	0	1,000	0	0.24907	0
1,000–1,010	0	1,010	0	0.25208	0
1,010–1,020	0	1,020	0	0.25509	0
1,020–1,030	0	1,030	0	0.25809	0
1,030–1,040	0	1,040	0	0.26108	0

A3 – Cumulative Case – 5-min SO_2 Data							
Maximum Concentration: 173.54 µg/m^3							
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**		**Expected Number of Occurrences (Count * Probability)**	
1,040–1,050	0	1,050	0	0.26407		0	
1,050–1,060	0	1,060	0	0.26706		0	
1,060–1,070	0	1,070	0	0.27003		0	
1,070–1,080	0	1,080	0	0.27300		0	
1,080–1,090	0	1,090	0	0.27596		0	
1,090–1,100	0	1,100	0	0.27891		0	
1,100–1,110	0	1,110	0	0.28186		0	
1,110–1,120	0	1,120	0	0.28479		0	
1,120–1,130	0	1,130	0	0.28772		0	
1,130–1,140	0	1,140	0	0.29065		0	
1,140–1,150	0	1,150	0	0.29356		0	
1,150–1,160	0	1,160	0	0.29646		0	
1,160–1,170	0	1,170	0	0.29936		0	
1,170–1,180	1	1,180	1,180	0.30225		0.302245993	
>1,180	0	1,190	0	0.30512		0	
Total	**26,304**	**Weighted Avg.**	**13.67**	**Weighted Sum**	**16.01**	**Weighted Sum**	**12.76**
Increase in Events							**0.0004852**

Table A–77: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A4 – Project-alone Case

A4 – Project-alone Case – 5-min SO_2 Data							
Maximum Concentration: 18.05 µg/m^3							
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**		**Expected Number of Occurrences (Count * Probability)**	
0–10	26,224	10	262,240	0.00020		5.168040091	
10–20	80	20	1,600	0.00060		0.048206115	
>20	0	30	0	0.00116		0	
Total	**26,304**	**Weighted Avg.**	**10.03**	**Weighted Sum**	**0.002**	**Weighted Sum**	**5.22**
Increase in events							**0.0001983**

Table A–78: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A4 – Base Case

A4 – Base Case – 5-min SO_2 Data					
Maximum Concentration. 313.37 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
0–10	22,961	10	229,610	0.00020	4.524991174
10–20	1,263	20	25,260	0.00060	0.761054035
20–30	708	30	21,240	0.00116	0.820047593
30–40	448	40	17,920	0.00184	0.824732436
40–50	279	50	13,950	0.00264	0.735544387
50–60	186	60	11,160	0.00353	0.657424213
60–70	112	70	7,840	0.00453	0.50711078

A4 – Base Case – 5-min SO_2 Data					
Maximum Concentration. 313.37 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
70–80	96	80	7,680	0.00561	0.538548372
80–90	67	90	6,030	0.00678	0.453970726
90–100	45	100	4,500	0.00802	0.360933867
100–110	37	110	4,070	0.00934	0.345624689
110–120	25	120	3,000	0.01073	0.268339838
120–130	14	130	1,820	0.01219	0.170727117
130–140	13	140	1,820	0.01372	0.178385589
140–150	16	150	2,400	0.01531	0.245000032
150–160	5	160	800	0.01696	0.084819851
160–170	4	170	680	0.01867	0.074696438
170–180	6	180	1,080	0.02044	0.122644768
180–190	6	190	1,140	0.02226	0.133572123
190–200	3	200	600	0.02414	0.072407661
200–210	2	210	420	0.02606	0.052121174
210–220	1	220	220	0.02803	0.028034397
220–230	2	230	460	0.03006	0.06011133
230–240	1	240	240	0.03212	0.032122809
240–250	1	250	250	0.03423	0.034234307
250–260	2	260	520	0.03639	0.072777382
260–270	0	270	0	0.03858	0
270–280	0	280	0	0.04082	0

A4 – Base Case – 5-min SO_2 Data							
Maximum Concentration. 313.37 µg/m^3							
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**		**Expected Number of Occurrences (Count * Probability)**	
280–290	0	290	0	0.04310		0	
290–300	0	300	0	0.04541		0	
300–310	0	310	0	0.04776		0	
310–320	1	320	320	0.05014		0.050139421	
>320	0	330	0	0.05256		0	
Total	**26,304**	**Weighted Avg.**	**13.88**	**Weighted Sum**	**0.70**	**Weighted Sum**	**12.21**
Increase in Events							**0.0004641**

Table A–79: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A4 – Application Case

A4 – Application Case – 5-min SO_2 Data					
Maximum Concentration. 317.53 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
0–10	22,821	10	228,210	0.00020	4.497400966
10–20	1,287	20	25,740	0.00060	0.77551587
20–30	706	30	21,180	0.00116	0.817731075
30–40	456	40	18,240	0.00184	0.839459801
40–50	307	50	15,350	0.00264	0.809362462
50–60	207	60	12,420	0.00353	0.731649527

A4 – Application Case – 5-min SO_2 Data					
Maximum Concentration. 317.53 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
60–70	135	70	9,450	0.00453	0.6112496
70–80	85	80	6,800	0.00561	0.476839704
80–90	79	90	7,110	0.00678	0.535278916
90–100	56	100	5,600	0.00802	0.449162145
100–110	34	110	3,740	0.00934	0.317601065
110–120	34	120	4,080	0.01073	0.36494218
120–130	25	130	3,250	0.01219	0.304869852
130–140	13	140	1,820	0.01372	0.178385589
140–150	13	150	1,950	0.01531	0.199062526
150–160	10	160	1,600	0.01696	0.169639702
160–170	6	170	1,020	0.01867	0.112044657
170–180	8	180	1,440	0.02044	0.163526357
180–190	1	190	190	0.02226	0.02226202
190–200	9	200	1,800	0.02414	0.217222983
200–210	2	210	420	0.02606	0.052121174
210–220	3	220	660	0.02803	0.08410319
220–230	0	230	0	0.03006	0
230–240	2	240	480	0.03212	0.064245619
240–250	1	250	250	0.03423	0.034234307
250–260	2	260	520	0.03639	0.072777382
260–270	1	270	270	0.03858	0.038584545

A4 – Application Case – 5-min SO_2 Data							
Maximum Concentration. 317.53 µg/m^3							
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**		**Expected Number of Occurrences (Count * Probability)**	
270–280	0	280	0	0.04082		0	
280–290	0	290	0	0.04310		0	
290–300	0	300	0	0.04541		0	
300–310	0	310	0	0.04776		0	
310–320	1	320	320	0.05014		0.050139421	
>320	0	330	0	0.05256		0	
Total	**26,304**	**Weighted Avg.**	**14.21**	**Weighted Sum**	**0.70**	**Weighted Sum**	**12.99**
Increase in Events							**0.0004938**

Table A–80: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A4 – Cumulative Case

A4 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration. 317.90 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
0–10	22,796	10	227,960	0.00020	4.492474143
10–20	1,301	20	26,020	0.00060	0.78395194
20–30	714	30	21,420	0.00116	0.826997149
30–40	454	40	18,160	0.00184	0.83577796
40–50	308	50	15,400	0.00264	0.811998822

A4 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration. 317.90 µg/m^3					
Concentration Range (µg/m^3)	Count	Upper Bin Limit	Weighted Sum	Probability of Response at Upper Bin Limit	Expected Number of Occurrences (Count * Probability)
50–60	210	60	12,600	0.00353	0.742253144
60–70	136	70	9,520	0.00453	0.615777375
70–80	85	80	6,800	0.00561	0.476839704
80–90	79	90	7,110	0.00678	0.535278916
90–100	56	100	5,600	0.00802	0.449162145
100–110	34	110	3,740	0.00934	0.317601065
110–120	34	120	4,080	0.01073	0.36494218
120–130	25	130	3,250	0.01219	0.304869852
130–140	12	140	1,680	0.01372	0.164663621
140–150	14	150	2,100	0.01531	0.214375028
150–160	10	160	1,600	0.01696	0.169639702
160–170	6	170	1,020	0.01867	0.112044657
170–180	8	180	1,440	0.02044	0.163526357
180–190	1	190	190	0.02226	0.02226202
190–200	9	200	1,800	0.02414	0.217222983
200–210	2	210	420	0.02606	0.052121174
210–220	3	220	660	0.02803	0.08410319
220–230	0	230	0	0.03006	0
230–240	2	240	480	0.03212	0.064245619
240–250	1	250	250	0.03423	0.034234307
250–260	2	260	520	0.03639	0.072777382

A4 – Cumulative Case – 5-min SO_2 Data							
Maximum Concentration. 317.90 µg/m^3							
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**		**Expected Number of Occurrences (Count * Probability)**	
260–270	1	270	270	0.03858		0.038584545	
270–280	0	280	0	0.04082		0	
280–290	0	290	0	0.04310		0	
290–300	0	300	0	0.04541		0	
300–310	0	310	0	0.04776		0	
310–320	1	320	320	0.05014		0.050139421	
>320	0	330	0	0.05256		0	
Total	**26,304**	**Weighted Avg.**	**14.23**	**Weighted Sum**	**0.70**	**Weighted Sum**	**13.02**
Increase in Events							**0.0004949**

Table A–81: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A5 – Project-alone Case

A5 – Project-alone Case – 5-min SO_2 Data							
Maximum Concentration. 76.45 µg/m^3							
Concentration Range (µg/m^3)	Count	Upper Bin Limit	Weighted Sum	Probability of Response at Upper Bin Limit		Expected Number of Occurrences (Count * Probability)	
0–10	25,772	10	257,720	0.00020		5.078963134	
10–20	480	20	9,600	0.00060		0.289236688	
20–30	39	30	1,170	0.00116		0.045172113	
30–40	8	40	320	0.00184		0.014727365	
40–50	1	50	50	0.00264		0.00263636	
50–60	3	60	180	0.00353		0.010603616	
60–70	0	70	0	0.00453		0	
70–80	1	80	80	0.00561		0.005609879	
>80	0	90	0	0.00678		0	
Total	**26,304**	**Weighted Avg.**	**10.23**	**Weighted Sum**	**0.03**	**Weighted Sum**	**5.45**
Increase in Events							**0.0002070**

Table A–82: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A5 – Base Case

A5 – Base Case – 5-min SO_2 Data					
Maximum Concentration. 797.47 µg/m^3					
Concentration Range (µg/m^3)	Count	Upper Bin Limit	Weighted Sum	Probability of Response at Upper Bin Limit	Expected Number of Occurrences (Count * Probability)
0–10	20,619	10	206,190	0.00020	4.06344641
10–20	1,793	20	35,860	0.00060	1.080419545
20–30	1,080	30	32,400	0.00116	1.250920057
30–40	642	40	25,680	0.00184	1.181871036
40–50	400	50	20,000	0.00264	1.054543924
50–60	329	60	19,740	0.00353	1.162863258
60–70	235	70	16,450	0.00453	1.064027082
70–80	195	80	15,600	0.00561	1.09392638
80–90	178	90	16,020	0.00678	1.206071481
90–100	132	100	13,200	0.00802	1.058739343
100–110	142	110	15,620	0.00934	1.326451508
110–120	106	120	12,720	0.01073	1.137760915
120–130	87	130	11,310	0.01219	1.060947086
130–140	96	140	13,440	0.01372	1.317308968
140–150	66	150	9,900	0.01531	1.010625133
150–160	45	160	7,200	0.01696	0.76337866
160–170	43	170	7,310	0.01867	0.802986709
170–180	34	180	6,120	0.02044	0.694987018
180–190	16	190	3,040	0.02226	0.356192327
190–200	19	200	3,800	0.02414	0.458581853

A5 – Base Case – 5-min SO_2 Data					
Maximum Concentration. 797.47 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
200–210	10	210	2,100	0.02606	0.260605872
210–220	13	220	2,860	0.02803	0.364447157
220–230	4	230	920	0.03006	0.120222661
230–240	5	240	1,200	0.03212	0.160614047
240–250	2	250	500	0.03423	0.068468614
250–260	2	260	520	0.03639	0.072777382
260–270	3	270	810	0.03858	0.115753635
270–280	3	280	840	0.04082	0.122461502
280–290	0	290	0	0.04310	0
290–300	0	300	0	0.04541	0
300–310	1	310	310	0.04776	0.047755921
310–320	0	320	0	0.05014	0
320–330	0	330	0	0.05256	0
330–340	0	340	0	0.05501	0
340–350	0	350	0	0.05749	0
350–360	0	360	0	0.06000	0
360–370	0	370	0	0.06254	0
370–380	0	380	0	0.06511	0
380–390	0	390	0	0.06771	0
390–400	0	400	0	0.07033	0
400–410	0	410	0	0.07298	0

A5 – Base Case – 5-min SO_2 Data					
Maximum Concentration. 797.47 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
410–420	0	420	0	0.07566	0
420–430	0	430	0	0.07835	0
430–440	2	440	880	0.08107	0.16214822
440–450	0	450	0	0.08382	0
450–460	0	460	0	0.08658	0
460–470	0	470	0	0.08936	0
470–480	1	480	480	0.09216	0.092164142
480–490	0	490	0	0.09498	0
490–500	0	500	0	0.09782	0
500–510	0	510	0	0.10068	0
510–520	0	520	0	0.10355	0
520–530	0	530	0	0.10644	0
530–540	0	540	0	0.10934	0
540–550	0	550	0	0.11226	0
550–560	0	560	0	0.11518	0
560–570	0	570	0	0.11813	0
570–580	0	580	0	0.12108	0
580–590	0	590	0	0.12404	0
590–600	0	600	0	0.12702	0
600–610	0	610	0	0.13001	0
610–620	0	620	0	0.13300	0

A5 – Base Case – 5-min SO_2 Data							
Maximum Concentration. 797.47 µg/m^3							
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**		**Expected Number of Occurrences (Count * Probability)**	
620–630	0	630	0	0.13601		0	
630–640	0	640	0	0.13902		0	
640–650	0	650	0	0.14204		0	
650–660	0	660	0	0.14507		0	
660–670	0	670	0	0.14810		0	
670–680	0	680	0	0.15114		0	
680–690	0	690	0	0.15419		0	
690–700	0	700	0	0.15724		0	
700–710	0	710	0	0.16029		0	
710–720	0	720	0	0.16335		0	
720–730	0	730	0	0.16642		0	
730–740	0	740	0	0.16948		0	
740–750	0	750	0	0.17255		0	
750–760	0	760	0	0.17563		0	
760–770	0	770	0	0.17870		0	
770–780	0	780	0	0.18177		0	
780–790	0	790	0	0.18485		0	
790–800	1	800	800	0.18793		0.187927904	
>800	0	810	0	0.19100		0	
Total	**26,304**	**Weighted Avg.**	**19.15**	**Weighted Sum**	**6.50**	**Weighted Sum**	**24.92**
Increase in Events							**0.0009474**

Table A–83: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A5 – Application Case

A5 – Application Case – 5-min SO_2 Data					
Maximum Concentration. 820.35 µg/m^3					
Concentration Range (µg/m^3)	Count	Upper Bin Limit	Weighted Sum	Probability of Response at Upper Bin Limit	Expected Number of Occurrences (Count * Probability)
0–10	20,270	10	20,2700	0.00020	3.994667963
10–20	1,913	20	38,260	0.00060	1.152728717
20–30	1,120	30	33,600	0.00116	1.29725043
30–40	678	40	27,120	0.00184	1.248144178
40–50	437	50	21,850	0.00264	1.152089237
50–60	319	60	19,140	0.00353	1.127517871
60–70	267	70	18,690	0.00453	1.208915876
70–80	220	80	17,600	0.00561	1.234173352
80–90	166	90	14,940	0.00678	1.124763291
90–100	158	100	15,800	0.00802	1.26727891
100–110	132	110	14,520	0.00934	1.23303943
110–120	108	120	12,960	0.01073	1.159228102
120–130	103	130	13,390	0.01219	1.256063792
130–140	99	140	13,860	0.01372	1.358474873
140–150	81	150	12,150	0.01531	1.240312663
150–160	54	160	8,640	0.01696	0.916054392
160–170	35	170	5,950	0.01867	0.653593833
170–180	42	180	7,560	0.02044	0.858513375
180–190	21	190	3,990	0.02226	0.46750243
190–200	23	200	4,600	0.02414	0.555125401

A5 – Application Case – 5-min SO_2 Data					
Maximum Concentration. 820.35 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
200–210	15	210	3,150	0.02606	0.390908808
210–220	12	220	2,640	0.02803	0.33641276
220–230	8	230	1,840	0.03006	0.240445322
230–240	4	240	960	0.03212	0.128491238
240–250	3	250	750	0.03423	0.102702921
250–260	5	260	1,300	0.03639	0.181943455
260–270	1	270	270	0.03858	0.038584545
270–280	0	280	0	0.04082	0
280–290	5	290	1,450	0.04310	0.21547616
290–300	0	300	0	0.04541	0
300–310	1	310	310	0.04776	0.047755921
310–320	0	320	0	0.05014	0
320–330	0	330	0	0.05256	0
330–340	0	340	0	0.05501	0
340–350	0	350	0	0.05749	0
350–360	0	360	0	0.06000	0
360–370	0	370	0	0.06254	0
370–380	0	380	0	0.06511	0
380–390	0	390	0	0.06771	0
390–400	0	400	0	0.07033	0
400–410	0	410	0	0.07298	0

A5 – Application Case – 5-min SO_2 Data					
Maximum Concentration. 820.35 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
410–420	0	420	0	0.07566	0
420–430	0	430	0	0.07835	0
430–440	2	440	880	0.08107	0.16214822
440–450	0	450	0	0.08382	0
450–460	0	460	0	0.08658	0
460–470	0	470	0	0.08936	0
470–480	1	480	480	0.09216	0.092164142
480–490	0	490	0	0.09498	0
490–500	0	500	0	0.09782	0
500–510	0	510	0	0.10068	0
510–520	0	520	0	0.10355	0
520–530	0	530	0	0.10644	0
530–540	0	540	0	0.10934	0
540–550	0	550	0	0.11226	0
550–560	0	560	0	0.11518	0
560–570	0	570	0	0.11813	0
570–580	0	580	0	0.12108	0
580–590	0	590	0	0.12404	0
590–600	0	600	0	0.12702	0
600–610	0	610	0	0.13001	0
610–620	0	620	0	0.13300	0

A5 – Application Case – 5-min SO_2 Data					
Maximum Concentration. 820.35 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
620–630	0	630	0	0.13601	0
630–640	0	640	0	0.13902	0
640–650	0	650	0	0.14204	0
650–660	0	660	0	0.14507	0
660–670	0	670	0	0.14810	0
670–680	0	680	0	0.15114	0
680–690	0	690	0	0.15419	0
690–700	0	700	0	0.15724	0
700–710	0	710	0	0.16029	0
710–720	0	720	0	0.16335	0
720–730	0	730	0	0.16642	0
730–740	0	740	0	0.16948	0
740–750	0	750	0	0.17255	0
750–760	0	760	0	0.17563	0
760–770	0	770	0	0.17870	0
770–780	0	780	0	0.18177	0
780–790	0	790	0	0.18485	0
790–800	0	800	0	0.18793	0
800–810	0	810	0	0.19100	0
810–820	0	820	0	0.19408	0
820–830	1	830	830	0.19716	0.197158429

A5 – Application Case – 5-min SO_2 Data							
Maximum Concentration. 820.35 µg/m^3							
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**		**Expected Number of Occurrences (Count * Probability)**	
>830	0	840	0	0.20023		0	
Total	**26,304**	**Weighted Avg.**	**19.85**	**Weighted Sum**	**7.09**	**Weighted Sum**	**26.64**
Increase in Events							**0.001012**

Table A–84: 5-min SO_2 Weighted-Average and Increase in Events for HHRA Areas – A5 – Cumulative Case

A5 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration. 820.37 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
0–10	20,243	10	202,430	0.00020	3.989346994
10–20	1,930	20	38,600	0.00060	1.162972516
20–30	1,121	30	33,630	0.00116	1.298408689
30–40	682	40	27,280	0.00184	1.255507861
40–50	435	50	21,750	0.00264	1.146816518
50–60	325	60	19,500	0.00353	1.148725103
60–70	266	70	18,620	0.00453	1.204388102
70–80	222	80	17,760	0.00561	1.24539311
80–90	166	90	14,940	0.00678	1.124763291
90–100	157	100	15,700	0.00802	1.259258158

A5 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration. 820.37 µg/m^3					
Concentration Range (µg/m^3)	Count	Upper Bin Limit	Weighted Sum	Probability of Response at Upper Bin Limit	Expected Number of Occurrences (Count * Probability)
100–110	133	110	14,630	0.00934	1.242380638
110–120	108	120	12,960	0.01073	1.159228102
120–130	103	130	13,390	0.01219	1.256063792
130–140	99	140	13,860	0.01372	1.358474873
140–150	80	150	12,000	0.01531	1.225000161
150–160	52	160	8,320	0.01696	0.882126452
160–170	38	170	6,460	0.01867	0.709616161
170–180	41	180	7,380	0.02044	0.83807258
180–190	22	190	4,180	0.02226	0.48976445
190–200	23	200	4,600	0.02414	0.555125401
200–210	15	210	3,150	0.02606	0.390908808
210–220	12	220	2,640	0.02803	0.33641276
220–230	8	230	1,840	0.03006	0.240445322
230–240	4	240	960	0.03212	0.128491238
240–250	3	250	750	0.03423	0.102702921
250–260	5	260	1,300	0.03639	0.181943455
260–270	1	270	270	0.03858	0.038584545
270–280	0	280	0	0.04082	0
280–290	5	290	1,450	0.04310	0.21547616
290–300	0	300	0	0.04541	0
300–310	1	310	310	0.04776	0.047755921

A5 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration. 820.37 µg/m^3					
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**	**Expected Number of Occurrences (Count * Probability)**
310–320	0	320	0	0.05014	0
320–330	0	330	0	0.05256	0
330–340	0	340	0	0.05501	0
340–350	0	350	0	0.05749	0
350–360	0	360	0	0.06000	0
360–370	0	370	0	0.06254	0
370–380	0	380	0	0.06511	0
380–390	0	390	0	0.06771	0
390–400	0	400	0	0.07033	0
400–410	0	410	0	0.07298	0
410–420	0	420	0	0.07566	0
420–430	0	430	0	0.07835	0
430–440	2	440	880	0.08107	0.16214822
440–450	0	450	0	0.08382	0
450–460	0	460	0	0.08658	0
460–470	0	470	0	0.08936	0
470–480	1	480	480	0.09216	0.092164142
480–490	0	490	0	0.09498	0
490–500	0	500	0	0.09782	0
500–510	0	510	0	0.10068	0
510–520	0	520	0	0.10355	0

A5 – Cumulative Case – 5-min SO_2 Data					
Maximum Concentration. 820.37 µg/m^3					
Concentration Range (µg/m^3)	Count	Upper Bin Limit	Weighted Sum	Probability of Response at Upper Bin Limit	Expected Number of Occurrences (Count * Probability)
520–530	0	530	0	0.10644	0
530–540	0	540	0	0.10934	0
540–550	0	550	0	0.11226	0
550–560	0	560	0	0.11518	0
560–570	0	570	0	0.11813	0
570–580	0	580	0	0.12108	0
580–590	0	590	0	0.12404	0
590–600	0	600	0	0.12702	0
600–610	0	610	0	0.13001	0
610–620	0	620	0	0.13300	0
620–630	0	630	0	0.13601	0
630–640	0	640	0	0.13902	0
640–650	0	650	0	0.14204	0
650–660	0	660	0	0.14507	0
660–670	0	670	0	0.14810	0
670–680	0	680	0	0.15114	0
680–690	0	690	0	0.15419	0
690–700	0	700	0	0.15724	0
700–710	0	710	0	0.16029	0
710–720	0	720	0	0.16335	0
720–730	0	730	0	0.16642	0

A5 – Cumulative Case – 5-min SO_2 Data							
Maximum Concentration. 820.37 µg/m^3							
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**	**Probability of Response at Upper Bin Limit**		**Expected Number of Occurrences (Count * Probability)**	
730–740	0	740	0	0.16948		0	
740–750	0	750	0	0.17255		0	
750–760	0	760	0	0.17563		0	
760–770	0	770	0	0.17870		0	
770–780	0	780	0	0.18177		0	
780–790	0	790	0	0.18485		0	
790–800	0	800	0	0.18793		0	
800–810	0	810	0	0.19100		0	
810–820	0	820	0	0.19408		0	
820–830	1	830	830	0.19716		0.197158429	
>830	0	840	0	0.20023		0	
Total	**26,304**	**Weighted Avg.**	**19.88**	**Weighted Sum**	**7.09**	**Weighted Sum**	**26.69**
Increase in Events							**0.001014**

1-h Weighted-Average NO_2 and SO_2 Combined Concentrations for the HHRA Areas

Table A–85: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A1 – Project-alone Case

A1 – Project-alone Case – 1-h Combined NO_2 and SO_2.			
Maximum Concentration: 83.48565 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,068	10	260,680
10–20	172	20	3,440
20–30	41	30	1,230
30–40	15	40	600
40–50	5	50	250
50–60	2	60	120
60–70	0	70	0
70–80	0	80	0
80–90	1	90	90
>90	0	100	0
Total	**26,304**	**Weighted Average**	**10.13**

Table A–86: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A1 – Base Case

A1 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 734.86400 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,543	10	255,430
10–20	382	20	7,640
20–30	147	30	4,410
30–40	77	40	3,080
40–50	46	50	2,300
50–60	15	60	900
60–70	16	70	1,120
70–80	15	80	1,200
80–90	14	90	1,260
90–100	3	100	300

A1 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 734.86400 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
100–110	4	110	440
110–120	7	120	840
120–130	3	130	390
130–140	2	140	280
140–150	2	150	300
150–160	6	160	960
160–170	3	170	510
170–180	3	180	540
180–190	0	190	0
190–200	2	200	400
200–210	1	210	210
210–220	1	220	220
220–230	1	230	230
230–240	1	240	240
240–250	0	250	0
250–260	0	260	0
260–270	2	270	540
270–280	0	280	0
280–290	1	290	290
290–300	0	300	0
300–310	0	310	0
310–320	1	320	320
320–330	0	330	0
330–340	0	340	0
340–350	1	350	350
350–360	1	360	360
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0

A1 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 734.86400 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
430–440	1	440	440
440–450	0	450	0
450–460	1	460	460
460–470	0	470	0
470–480	0	480	0
480–490	0	490	0
490–500	0	500	0
500–510	0	510	0
510–520	1	520	520
520–530	0	530	0
530–540	0	540	0
540–550	0	550	0
550–560	0	560	0
560–570	0	570	0
570–580	0	580	0
580–590	0	590	0
590–600	0	600	0
600–610	0	610	0
610–620	0	620	0
620–630	0	630	0
630–640	0	640	0
640–650	0	650	0
650–660	0	660	0
660–670	0	670	0
670–680	0	680	0
680–690	0	690	0
690–700	0	700	0
700–710	0	710	0
710–720	0	720	0
720–730	0	730	0
730–740	1	740	740
>740	0	750	0
Total	**26,304**	**Weighted Average**	**10.92**

Table A–87: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A1 – Application Case

A1 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 738.87266 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,341	10	253,410
10–20	443	20	8,860
20–30	205	30	6,150
30–40	100	40	4,000
40–50	60	50	3,000
50–60	40	60	2,400
60–70	15	70	1,050
70–80	19	80	1,520
80–90	13	90	1,170
90–100	11	100	1,100
100–110	5	110	550
110–120	7	120	840
120–130	5	130	650
130–140	5	140	700
140–150	5	150	750
150–160	4	160	640
160–170	3	170	510
170–180	3	180	540
180–190	1	190	190
190–200	3	200	600
200–210	2	210	420
210–220	1	220	220
220–230	0	230	0
230–240	0	240	0
240–250	2	250	500
250–260	0	260	0
260–270	0	270	0
270–280	1	280	280
280–290	0	290	0
290–300	1	300	300
300–310	2	310	620
310–320	0	320	0

A1 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 738.87266 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
320–330	1	330	330
330–340	0	340	0
340–350	0	350	0
350–360	1	360	360
360–370	0	370	0
370–380	1	380	380
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	1	460	460
460–470	1	470	470
470–480	0	480	0
480–490	0	490	0
490–500	0	500	0
500–510	0	510	0
510–520	0	520	0
520–530	0	530	0
530–540	1	540	540
540–550	0	550	0
550–560	0	560	0
560–570	0	570	0
570–580	0	580	0
580–590	0	590	0
590–600	0	600	0
600–610	0	610	0
610–620	0	620	0
620–630	0	630	0
630–640	0	640	0
640–650	0	650	0

A1 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 738.87266 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
650–660	0	660	0
660–670	0	670	0
670–680	0	680	0
680–690	0	690	0
690–700	0	700	0
700–710	0	710	0
710–720	0	720	0
720–730	0	730	0
730–740	1	740	740
>740	0	750	0
Total	**26,304**	**Weighted Average**	**11.19**

Table A–88: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A1 – Cumulative Case

A1 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 739.55995 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,290	10	252,900
10–20	484	20	9,680
20–30	201	30	6,030
30–40	110	40	4,400
40–50	58	50	2,900
50–60	46	60	2,760
60–70	15	70	1,050
70–80	17	80	1,360
80–90	13	90	1,170
90–100	11	100	1,100
100–110	7	110	770
110–120	6	120	720
120–130	5	130	650
130–140	3	140	420

A1 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 739.55995 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
140–150	8	150	1,200
150–160	3	160	480
160–170	4	170	680
170–180	2	180	360
180–190	2	190	380
190–200	3	200	600
200–210	1	210	210
210–220	1	220	220
220–230	1	230	230
230–240	0	240	0
240–250	1	250	250
250–260	1	260	260
260–270	0	270	0
270–280	1	280	280
280–290	0	290	0
290–300	1	300	300
300–310	2	310	620
310–320	0	320	0
320–330	1	330	330
330–340	0	340	0
340–350	0	350	0
350–360	1	360	360
360–370	0	370	0
370–380	0	380	0
380–390	1	390	390
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	1	460	460
460–470	1	470	470

A1 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 739.55995 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
470–480	0	480	0
480–490	0	490	0
490–500	0	500	0
500–510	0	510	0
510–520	0	520	0
520–530	0	530	0
530–540	0	540	0
540–550	1	550	550
550–560	0	560	0
560–570	0	570	0
570–580	0	580	0
580–590	0	590	0
590–600	0	600	0
600–610	0	610	0
610–620	0	620	0
620–630	0	630	0
630–640	0	640	0
640–650	0	650	0
650–660	0	660	0
660–670	0	670	0
670–680	0	680	0
680–690	0	690	0
690–700	0	700	0
700–710	0	710	0
710–720	0	720	0
720–730	0	730	0
730–740	1	740	740
>740	0	750	0
Total	**26,304**	**Weighted Average**	**11.23**

Table A–89: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A2 – Project-alone Case

A2 – Project-alone Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 129.13217 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,347	10	253,470
10–20	746	20	14,920
20–30	140	30	4,200
30–40	48	40	1,920
40–50	7	50	350
50–60	7	60	420
60–70	1	70	70
70–80	1	80	80
80–90	4	90	360
90–100	1	100	100
100–110	0	110	0
110–120	0	120	0
120–130	2	130	260
>130	0	140	0
Total	**26,304**	**Weighted Average**	**10.50**

Table A–90: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A2 – Base Case

A2 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 678.10673 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	24,029	10	240,290
10–20	1,023	20	20,460
20–30	505	30	15,150
30–40	246	40	9,840
40–50	146	50	7,300
50–60	105	60	6,300
60–70	65	70	4,550
70–80	47	80	3,760
80–90	24	90	2,160

A2 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 678.10673 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
90–100	23	100	2,300
100–110	23	110	2,530
110–120	11	120	1,320
120–130	11	130	1,430
130–140	4	140	560
140–150	9	150	1,350
150–160	4	160	640
160–170	2	170	340
170–180	3	180	540
180–190	3	190	570
190–200	1	200	200
200–210	0	210	0
210–220	2	220	440
220–230	3	230	690
230–240	1	240	240
240–250	2	250	500
250–260	0	260	0
260–270	0	270	0
270–280	2	280	560
280–290	1	290	290
290–300	2	300	600
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0
330–340	2	340	680
340–350	1	350	350
350–360	0	360	0
360–370	0	370	0
370–380	1	380	380
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0

A2 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 678.10673 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	0	470	0
470–480	1	480	480
480–490	1	490	490
490–500	0	500	0
500–510	0	510	0
510–520	0	520	0
520–530	0	530	0
530–540	0	540	0
540–550	0	550	0
550–560	0	560	0
560–570	0	570	0
570–580	0	580	0
580–590	0	590	0
590–600	0	600	0
600–610	0	610	0
610–620	0	620	0
620–630	0	630	0
630–640	0	640	0
640–650	0	650	0
650–660	0	660	0
660–670	0	670	0
670–680	1	680	680
>680	0	690	0
Total	**26,304**	**Weighted Average**	**12.47**

Table A–91: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A2 – Application Case

A2 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 755.58365 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	22,913	10	229,130
10–20	1,621	20	32,420
20–30	661	30	19,830
30–40	379	40	15,160
40–50	192	50	9,600
50–60	154	60	9,240
60–70	90	70	6,300
70–80	70	80	5,600
80–90	42	90	3,780
90–100	41	100	4,100
100–110	27	110	2,970
110–120	20	120	2,400
120–130	19	130	2,470
130–140	15	140	2,100
140–150	7	150	1,050
150–160	13	160	2,080
160–170	3	170	510
170–180	4	180	720
180–190	2	190	380
190–200	3	200	600
200–210	3	210	630
210–220	2	220	440
220–230	2	230	460
230–240	1	240	240
240–250	0	250	0
250–260	1	260	260
260–270	4	270	1,080
270–280	1	280	280
280–290	2	290	580
290–300	0	300	0
300–310	2	310	620
310–320	1	320	320

A2 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 755.58365 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
320–330	0	330	0
330–340	1	340	340
340–350	0	350	0
350–360	0	360	0
360–370	1	370	370
370–380	0	380	0
380–390	1	390	390
390–400	1	400	400
400–410	0	410	0
410–420	2	420	840
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	0	470	0
470–480	0	480	0
480–490	0	490	0
490–500	0	500	0
500–510	0	510	0
510–520	0	520	0
520–530	1	530	530
530–540	0	540	0
540–550	0	550	0
550–560	1	560	560
560–570	0	570	0
570–580	0	580	0
580–590	0	590	0
590–600	0	600	0
600–610	0	610	0
610–620	0	620	0
620–630	0	630	0
630–640	0	640	0
640–650	0	650	0

A2 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 755.58365 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
650–660	0	660	0
660–670	0	670	0
670–680	0	680	0
680–690	0	690	0
690–700	0	700	0
700–710	0	710	0
710–720	0	720	0
720–730	0	730	0
730–740	0	740	0
740–750	0	750	0
750–760	1	760	760
>760	0	770	0
Total	**26,304**	**Weighted Average**	**13.67**

Table A–92: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A2 – Cumulative Case

A2 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 755.87504 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	22,694	10	226,940
10–20	1,777	20	35,540
20–30	698	30	20,940
30–40	394	40	15,760
40–50	198	50	9,900
50–60	153	60	9,180
60–70	91	70	6,370
70–80	72	80	5,760
80–90	45	90	4,050
90–100	38	100	3,800
100–110	28	110	3,080
110–120	21	120	2,520
120–130	20	130	2,600
130–140	14	140	1,960

A2 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 755.87504 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
140–150	7	150	1,050
150–160	14	160	2,240
160–170	3	170	510
170–180	3	180	540
180–190	3	190	570
190–200	3	200	600
200–210	3	210	630
210–220	2	220	440
220–230	2	230	460
230–240	1	240	240
240–250	0	250	0
250–260	1	260	260
260–270	3	270	810
270–280	2	280	560
280–290	2	290	580
290–300	0	300	0
300–310	1	310	310
310–320	2	320	640
320–330	0	330	0
330–340	1	340	340
340–350	0	350	0
350–360	0	360	0
360–370	1	370	370
370–380	0	380	0
380–390	1	390	390
390–400	1	400	400
400–410	0	410	0
410–420	2	420	840
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	0	470	0

A2 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 755.87504 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
470–480	0	480	0
480–490	0	490	0
490–500	0	500	0
500–510	0	510	0
510–520	0	520	0
520–530	1	530	530
530–540	0	540	0
540–550	0	550	0
550–560	1	560	560
560–570	0	570	0
570–580	0	580	0
580–590	0	590	0
590–600	0	600	0
600–610	0	610	0
610–620	0	620	0
620–630	0	630	0
630–640	0	640	0
640–650	0	650	0
650–660	0	660	0
660–670	0	670	0
670–680	0	680	0
680–690	0	690	0
690–700	0	700	0
700–710	0	710	0
710–720	0	720	0
720–730	0	730	0
730–740	0	740	0
740–750	0	750	0
750–760	1	760	760
>760	0	770	0
Total	**26,304**	**Weighted Average**	**13.80**

Table A–93: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A3 – Project-alone Case

A3 – Project-alone Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 108.08 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,299	10	252,990
10–20	776	20	15,520
20–30	152	30	4,560
30–40	39	40	1,560
40–50	20	50	1,000
50–60	9	60	540
60–70	5	70	350
70–80	2	80	160
80–90	1	90	90
90–100	0	100	0
100–110	1	110	110
>110	0	120	0
Total	**26,304**	**Weighted Average**	**10.53**

Table A–94: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A3 – Base Case

A3 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 679.09 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	24,286	10	242,860
10–20	1,015	20	20,300
20–30	435	30	13,050
30–40	224	40	8,960
40–50	99	50	4,950
50–60	76	60	4,560
60–70	46	70	3,220
70–80	31	80	2,480
80–90	24	90	2,160
90–100	11	100	1,100
100–110	14	110	1,540

A3 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 679.09 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
110–120	13	120	1,560
120–130	7	130	910
130–140	7	140	980
140–150	7	150	1,050
150–160	4	160	640
160–170	0	170	0
170–180	3	180	540
180–190	0	190	0
190–200	0	200	0
200–210	0	210	0
210–220	1	220	220
220–230	0	230	0
230–240	0	240	0
240–250	0	250	0
250–260	0	260	0
260–270	0	270	0
270–280	0	280	0
280–290	0	290	0
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0
330–340	0	340	0
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0

A3 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 679.09 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
440–450	0	450	0
450–460	0	460	0
460–470	0	470	0
470–480	0	480	0
480–490	0	490	0
490–500	0	500	0
500–510	0	510	0
510–520	0	520	0
520–530	0	530	0
530–540	0	540	0
540–550	0	550	0
550–560	0	560	0
560–570	0	570	0
570–580	0	580	0
580–590	0	590	0
590–600	0	600	0
600–610	0	610	0
610–620	0	620	0
620–630	0	630	0
630–640	0	640	0
640–650	0	650	0
650–660	0	660	0
660–670	0	670	0
670–680	1	680	680
>680	0	690	0
Total	**26,304**	**Weighted Average**	**11.85**

Table A–95: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A3 – Application Case

A3 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 717.8 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	23,212	10	232,120
10–20	1,641	20	32,820
20–30	595	30	17,850
30–40	327	40	13,080
40–50	175	50	8,750
50–60	108	60	6,480
60–70	63	70	4,410
70–80	42	80	3,360
80–90	36	90	3,240
90–100	21	100	2,100
100–110	21	110	2,310
110–120	11	120	1,320
120–130	8	130	1,040
130–140	11	140	1,540
140–150	5	150	750
150–160	9	160	1,440
160–170	8	170	1,360
170–180	3	180	540
180–190	1	190	190
190–200	2	200	400
200–210	2	210	420
210–220	1	220	220
220–230	1	230	230
230–240	0	240	0
240–250	0	250	0
250–260	0	260	0
260–270	0	270	0
270–280	0	280	0
280–290	0	290	0
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0

A3 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 717.8 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
320–330	0	330	0
330–340	0	340	0
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	0	470	0
470–480	0	480	0
480–490	0	490	0
490–500	0	500	0
500–510	0	510	0
510–520	0	520	0
520–530	0	530	0
530–540	0	540	0
540–550	0	550	0
550–560	0	560	0
560–570	0	570	0
570–580	0	580	0
580–590	0	590	0
590–600	0	600	0
600–610	0	610	0
610–620	0	620	0
620–630	0	630	0
630–640	0	640	0
640–650	0	650	0

A3 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 717.8 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
650–660	0	660	0
660–670	0	670	0
670–680	0	680	0
680–690	0	690	0
690–700	0	700	0
700–710	0	710	0
710–720	1	720	720
>720	0	730	0
Total	**26,304**	**Weighted Average**	**12.80**

Table A–96: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A3 – Cumulative Case

A3 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 718.43 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	23,235	10	232,350
10–20	1,132	20	22,640
20–30	554	30	16,620
30–40	384	40	15,360
40–50	263	50	13,150
50–60	148	60	8,880
60–70	129	70	9,030
70–80	78	80	6,240
80–90	67	90	6,030
90–100	59	100	5,900
100–110	46	110	5,060
110–120	29	120	3,480
120–130	29	130	3,770
130–140	21	140	2,940
140–150	18	150	2,700
150–160	13	160	2,080

A3 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 718.43 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
160–170	10	170	1,700
170–180	14	180	2,520
180–190	9	190	1,710
190–200	6	200	1,200
200–210	7	210	1,470
210–220	8	220	1,760
220–230	3	230	690
230–240	3	240	720
240–250	6	250	1,500
250–260	1	260	260
260–270	2	270	540
270–280	3	280	840
280–290	1	290	290
290–300	2	300	600
300–310	0	310	0
310–320	1	320	320
320–330	2	330	660
330–340	0	340	0
340–350	1	350	350
350–360	0	360	0
360–370	1	370	370
370–380	1	380	380
380–390	1	390	390
390–400	3	400	1,200
400–410	0	410	0
410–420	0	420	0
420–430	2	430	860
430–440	0	440	0
440–450	0	450	0
450–460	1	460	460
460–470	0	470	0
470–480	2	480	960
480–490	1	490	490

A3 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 718.43 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
490–500	1	500	500
500–510	0	510	0
510–520	0	520	0
520–530	0	530	0
530–540	0	540	0
540–550	0	550	0
550–560	0	560	0
560–570	0	570	0
570–580	1	580	580
580–590	2	590	1,180
590–600	0	600	0
600–610	0	610	0
610–620	0	620	0
620–630	0	630	0
630–640	0	640	0
640–650	1	650	650
650–660	0	660	0
660–670	0	670	0
670–680	0	680	0
680–690	0	690	0
690–700	0	700	0
700–710	0	710	0
710–720	0	720	0
>720	0	730	0
Total	**26,304**	**Weighted Average**	**12.93**

Table A–97: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A4 – Project-alone Case

A4 – Project-alone Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 40.82 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,823	10	258,230
10–20	440	20	8,800
20–30	39	30	1,170
30–40	1	40	40
40–50	1	50	50
>50	0	60	0
Total	**26,304**	**Weighted Average**	**10.20**

Table A–98: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A4 – Base Case

A4 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 182.60 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	23,893	10	238,930
10–20	1,214	20	24,280
20–30	575	30	17,250
30–40	260	40	10,400
40–50	150	50	7,500
50–60	79	60	4,740
60–70	54	70	3,780
70–80	26	80	2,080
80–90	22	90	1,980
90–100	7	100	700
100–110	10	110	1,100
110–120	6	120	720
120–130	2	130	260
130–140	2	140	280
140–150	2	150	300
150–160	1	160	160
160–170	0	170	0

A4 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 182.60 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
170–180	0	180	0
180–190	1	190	190
>190	0	200	0
Total	**26,304**	**Weighted Average**	**11.96**

Table A–99: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A4 – Application Case

A4 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration. 200.38 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	23,254	10	232,540
10–20	1,377	20	27,540
20–30	692	30	20,760
30–40	408	40	16,320
40–50	215	50	10,750
50–60	125	60	7,500
60–70	84	70	5,880
70–80	53	80	4,240
80–90	26	90	2,340
90–100	23	100	2,300
100–110	20	110	2,200
110–120	10	120	1,200
120–130	8	130	1,040
130–140	2	140	280
140–150	3	150	450
150–160	1	160	160
160–170	2	170	340
170–180	0	180	0
180–190	0	190	0
190–200	0	200	0
200–210	1	210	210

A4 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration. 200.38 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
>210	0	220	0
Total	**26,304**	**Weighted Average**	**12.78**

Table A–100: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A4 – Cumulative Case

A4 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration : 201.10 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	23,175	10	231,750
10–20	1,421	20	28,420
20–30	711	30	21,330
30–40	413	40	16,520
40–50	222	50	11,100
50–60	125	60	7,500
60–70	86	70	6,020
70–80	54	80	4,320
80–90	27	90	2,430
90–100	23	100	2,300
100–110	18	110	1,980
110–120	12	120	1,440
120–130	8	130	1,040
130–140	2	140	280
140–150	3	150	450
150–160	1	160	160
160–170	2	170	340
170–180	0	180	0
180–190	0	190	0
190–200	0	200	0
200–210	1	210	210
>210	0	220	0

Table A–101: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A5 – Project-alone Case

A5 – Project-alone Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 83.00 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	23,904	10	239,040
10–20	1,541	20	30,820
20–30	586	30	17,580
30–40	207	40	8,280
40–50	51	50	2,550
50–60	13	60	780
60–70	0	70	0
70–80	0	80	0
80–90	2	90	180
>90	0	100	0
Total	**26,304**	**Weighted Average**	**11.38**

Table A–102: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A5 – Base Case

A5 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 462.66 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	21,791	10	217,910
10–20	1,900	20	38,000
20–30	852	30	25,560
30–40	488	40	19,520
40–50	351	50	17,550
50–60	243	60	14,580
60–70	223	70	15,610
70–80	150	80	12,000
80–90	118	90	10,620
90–100	73	100	7,300
100–110	45	110	4,950
110–120	30	120	3,600
120–130	15	130	1,950

A5 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 462.66 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
130–140	10	140	1,400
140–150	4	150	600
150–160	4	160	640
160–170	2	170	340
170–180	1	180	180
180–190	0	190	0
190–200	0	200	0
200–210	0	210	0
210–220	0	220	0
220–230	0	230	0
230–240	0	240	0
240–250	1	250	250
250–260	1	260	260
260–270	0	270	0
270–280	1	280	280
280–290	0	290	0
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0
330–340	0	340	0
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0

A5 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 462.66 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
460–470	1	470	470
>470	0	480	0
Total	**26,304**	**Weighted Average**	**14.96**

Table A–103: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A5 – Application Case

A5 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 499.30 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	20,062	10	200,620
10–20	2,602	20	52,040
20–30	1,078	30	32,340
30–40	642	40	25,680
40–50	504	50	25,200
50–60	357	60	21,420
60–70	257	70	17,990
70–80	210	80	16,800
80–90	200	90	18,000
90–100	140	100	14,000
100–110	87	110	9,570
110–120	52	120	6,240
120–130	45	130	5,850
130–140	17	140	2,380
140–150	21	150	3,150
150–160	11	160	1,760
160–170	6	170	1,020
170–180	1	180	180
180–190	4	190	760
190–200	3	200	600
200–210	1	210	210
210–220	0	220	0
220–230	0	230	0
230–240	0	240	0

A5 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 499.30 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
240–250	0	250	0
250–260	1	260	260
260–270	1	270	270
270–280	1	280	280
280–290	0	290	0
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0
330–340	0	340	0
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	0	470	0
470–480	0	480	0
480–490	0	490	0
490–500	1	500	500
>500	0	510	0
Total	**26,304**	**Weighted Average**	**17.38**

Table A–104: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Human Health Area A5 – Cumulative Case

A5 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 499.31 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	19,721	10	19,7210
10–20	2,822	20	56,440
20–30	1,161	30	34,830
30–40	653	40	26,120
40–50	512	50	25,600
50–60	366	60	21,960
60–70	252	70	17,640
70–80	209	80	16,720
80–90	205	90	18,450
90–100	145	100	14,500
100–110	89	110	9,790
110–120	53	120	6,360
120–130	45	130	5,850
130–140	20	140	2,800
140–150	20	150	3,000
150–160	12	160	1,920
160–170	6	170	1,020
170–180	1	180	180
180–190	4	190	760
190–200	3	200	600
200–210	1	210	210
210–220	0	220	0
220–230	0	230	0
230–240	0	240	0
240–250	0	250	0
250–260	1	260	260
260–270	1	270	270
270–280	1	280	280
280–290	0	290	0
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0

A5 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration: 499.31 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
320–330	0	330	0
330–340	0	340	0
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	0	470	0
470–480	0	480	0
480–490	0	490	0
490–500	1	500	500
>500	0	510	0
Total	**26,304**	**Weighted Average**	**17.61**

1-h Weighted-Average NO_2 and SO_2 Combined Concentrations for the Special Receptor Locations

Table A–105: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 15 – Base Case

SR 15 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 259.36567 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,646	10	256,460
10–20	341	20	6,820
20–30	125	30	3,750
30–40	58	40	2,320
40–50	33	50	1,650
50–60	31	60	1,860
60–70	20	70	1,400
70–80	14	80	1,120
80–90	5	90	450
90–100	7	100	700
100–110	5	110	550
110–120	6	120	720
120–130	3	130	390
130–140	2	140	280
140–150	2	150	300
150–160	1	160	160
160–170	0	170	0
170–180	2	180	360
180–190	0	190	0
190–200	1	200	200
200–210	0	210	0
210–220	0	220	0
220–230	1	230	230
230–240	0	240	0
240–250	0	250	0
250–260	1	260	260
>260	0	270	0
Total	**26,304**	**Weighted Average**	**10.64400852**

Table A–106: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 15 – Application Case

SR 15 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 349.56531 µg/m^3			
Concentration Ranges (µg/m^3)	Count	Upper Bin Limit	Weighted Sum
0–10	25,262	10	252,620
10–20	582	20	11,640
20–30	176	30	5,280
30–40	90	40	3,600
40–50	51	50	2,550
50–60	35	60	2,100
60–70	22	70	1,540
70–80	27	80	2,160
80–90	11	90	990
90–100	12	100	1,200
100–110	5	110	550
110–120	5	120	600
120–130	3	130	390
130–140	5	140	700
140–150	4	150	600
150–160	3	160	480
160–170	2	170	340
170–180	2	180	360
180–190	1	190	190
190–200	1	200	200
200–210	1	210	210
210–220	2	220	440
220–230	0	230	0
230–240	0	240	0
240–250	0	250	0
250–260	1	260	260
260–270	0	270	0
270–280	0	280	0
280–290	0	290	0
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0

SR 15 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 349.56531 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
320–330	0	330	0
330–340	0	340	0
340–350	1	350	350
>350	0	360	0
Total	**26,304**	**Weighted Average**	**11.0002281**

Table A–107: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 15 – Cumulative Case

SR 15 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 349.63081 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,170	10	251,700
10–20	657	20	13,140
20–30	183	30	5,490
30–40	94	40	3,760
40–50	55	50	2,750
50–60	37	60	2,220
60–70	18	70	1,260
70–80	24	80	1,920
80–90	18	90	1,620
90–100	12	100	1,200
100–110	5	110	550
110–120	4	120	480
120–130	4	130	520
130–140	5	140	700
140–150	4	150	600
150–160	3	160	480
160–170	2	170	340
170–180	2	180	360
180–190	1	190	190
190–200	1	200	200

SR 15 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 349.63081 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
200–210	0	210	0
210–220	2	220	440
220–230	1	230	230
230–240	0	240	0
240–250	0	250	0
250–260	1	260	260
260–270	0	270	0
270–280	0	280	0
280–290	0	290	0
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0
330–340	0	340	0
340–350	1	350	350
>350	0	360	0
Total	**26,304**	**Weighted Average**	**11.053832**

Table A–108: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 22 – Base Case

SR 22 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 136.74203 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,070	10	260,700
10–20	148	20	2,960
20–30	46	30	1,380
30–40	18	40	720
40–50	15	50	750
50–60	4	60	240
60–70	1	70	70
70–80	1	80	80

SR 22 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 136.74203 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
80–90	0	90	0
90–100	0	100	0
100–110	0	110	0
110–120	0	120	0
120–130	0	130	0
130–140	1	140	140
>140	0	150	0
Grand Total	**26,304**	**Weighted Average**	**10.15206813**

Table A–109: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 22 – Application Case

SR 22 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 144.62188 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,974	10	259,740
10–20	198	20	3,960
20–30	72	30	2,160
30–40	25	40	1,000
40–50	22	50	1,100
50–60	6	60	360
60–70	3	70	210
70–80	3	80	240
80–90	0	90	0
90–100	0	100	0
100–110	0	110	0
110–120	0	120	0
120–130	0	130	0
130–140	0	140	0
140–150	1	150	150
>150	0	160	0
Grand Total	**26,304**	**Weighted Average**	**10.2235401**

Table A–110: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 22 – Cumulative Case

SR 22 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 144.62188 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,947	10	259,470
10–20	219	20	4,380
20–30	73	30	2,190
30–40	27	40	1,080
40–50	23	50	1,150
50–60	8	60	480
60–70	3	70	210
70–80	3	80	240
80–90	0	90	0
90–100	0	100	0
100–110	0	110	0
110–120	0	120	0
120–130	0	130	0
130–140	0	140	0
140–150	1	150	150
>150	0	160	0
Grand Total	**26,304**	**Weighted Average**	**10.2398875**

Table A–111: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 23 – Base Case

SR 23 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 415.61470 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	23,979	10	239,790
10–20	1,397	20	27,940
20–30	556	30	16,680
30–40	155	40	6,200
40–50	58	50	2,900
50–60	35	60	2,100
60–70	20	70	1,400

SR 23 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 415.61470 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
70–80	27	80	2,160
80–90	13	90	1,170
90–100	8	100	800
100–110	7	110	770
110–120	5	120	600
120–130	3	130	390
130–140	6	140	840
140–150	6	150	900
150–160	1	160	160
160–170	1	170	170
170–180	4	180	720
180–190	2	190	380
190–200	0	200	0
200–210	1	210	210
210–220	3	220	660
220–230	0	230	0
230–240	2	240	480
240–250	3	250	750
250–260	3	260	780
260–270	0	270	0
270–280	1	280	280
280–290	1	290	290
290–300	0	300	0
300–310	2	310	620
310–320	0	320	0
320–330	0	330	0
330–340	0	340	0
340–350	1	350	350
350–360	1	360	360
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	1	400	400

SR 23 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 415.61470 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
400–410	0	410	0
410–420	2	420	840
>420	0	430	0
Total	**26,304**	**Weighted Average**	**11.8647354**

Table A–112: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 23 – Application Case

SR 23 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 450.75344 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	22,954	10	229,540
10–20	1,970	20	39,400
20–30	759	30	22,770
30–40	261	40	10,440
40–50	111	50	5,550
50–60	68	60	4,080
60–70	42	70	2,940
70–80	28	80	2,240
80–90	17	90	1,530
90–100	19	100	1,900
100–110	13	110	1,430
110–120	4	120	480
120–130	12	130	1,560
130–140	4	140	560
140–150	2	150	300
150–160	4	160	640
160–170	6	170	1,020
170–180	2	180	360
180–190	2	190	380
190–200	2	200	400
200–210	1	210	210

SR 23 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 450.75344 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
210–220	2	220	440
220–230	1	230	230
230–240	1	240	240
240–250	1	250	250
250–260	4	260	1,040
260–270	3	270	810
270–280	2	280	560
280–290	0	290	0
290–300	1	300	300
300–310	1	310	310
310–320	0	320	0
320–330	1	330	330
330–340	0	340	0
340–350	1	350	350
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	1	390	390
390–400	0	400	0
400–410	1	410	410
410–420	0	420	0
420–430	1	430	430
430–440	0	440	0
440–450	1	450	450
450–460	1	460	460
>460	0	470	0
Grand Total	**26,304**	**Weighted Average**	**12.725441**

Table A–113: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 23 – Cumulative Case

SR 23 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 45.14396 µg/m^3			
Concentration Ranges (µg/m^3)	Count	Upper Bin Limit	Weighted Sum
0–10	22,786	10	227,860
10–20	2,082	20	41,640
20–30	785	30	23,550
30–40	274	40	10,960
40–50	122	50	6,100
50–60	62	60	3,720
60–70	49	70	3,430
70–80	32	80	2,560
80–90	18	90	1,620
90–100	18	100	1,800
100–110	13	110	1,430
110–120	5	120	600
120–130	11	130	1,430
130–140	5	140	700
140–150	1	150	150
150–160	5	160	800
160–170	6	170	1,020
170–180	2	180	360
180–190	2	190	380
190–200	2	200	400
200–210	1	210	210
210–220	2	220	440
220–230	1	230	230
230–240	1	240	240
240–250	1	250	250
250–260	4	260	1,040
260–270	3	270	810
270–280	2	280	560
280–290	0	290	0
290–300	1	300	300
300–310	1	310	310
310–320	0	320	0

SR 23 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 45.14396 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
320–330	1	330	330
330–340	0	340	0
340–350	1	350	350
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	1	390	390
390–400	0	400	0
400–410	1	410	410
410–420	0	420	0
420–430	1	430	430
430–440	0	440	0
440–450	1	450	450
450–460	1	460	460
>460	0	470	0
Total	**26,304**	**Weighted Average**	**12.839112**

Table A–114: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 24 – Base Case

SR 24 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 464.69840 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	24,580	10	245,800
10–20	1,171	20	23,420
20–30	273	30	8,190
30–40	98	40	3,920
40–50	50	50	2,500
50–60	34	60	2,040
60–70	26	70	1,820
70–80	12	80	960
80–90	6	90	540

SR 24 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 464.69840 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
90–100	7	100	700
100–110	8	110	880
110–120	7	120	840
120–130	4	130	520
130–140	1	140	140
140–150	4	150	600
150–160	1	160	160
160–170	4	170	680
170–180	0	180	0
180–190	3	190	570
190–200	3	200	600
200–210	0	210	0
210–220	4	220	880
220–230	0	230	0
230–240	1	240	240
240–250	0	250	0
250–260	0	260	0
260–270	2	270	540
270–280	1	280	280
280–290	1	290	290
290–300	0	300	0
300–310	1	310	310
310–320	1	320	320
320–330	0	330	0
330–340	0	340	0
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0

SR 24 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 464.69840 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	1	470	470
>470	0	480	0
Total	**26,304**	**Weighted Average**	**11.337059**

Table A–115: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 24 – Application Case

SR 24 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 496.54218 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	23,638	10	236,380
10–20	1,762	20	35,240
20–30	441	30	13,230
30–40	167	40	6,680
40–50	87	50	4,350
50–60	68	60	4,080
60–70	28	70	1,960
70–80	26	80	2,080
80–90	16	90	1,440
90–100	12	100	1,200
100–110	5	110	550
110–120	5	120	600
120–130	6	130	780
130–140	6	140	840
140–150	9	150	1,350
150–160	3	160	480
160–170	2	170	340
170–180	3	180	540
180–190	1	190	190
190–200	0	200	0

SR 24 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 496.54218 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
200–210	4	210	840
210–220	2	220	440
220–230	2	230	460
230–240	2	240	480
240–250	0	250	0
250–260	1	260	260
260–270	1	270	270
270–280	0	280	0
280–290	0	290	0
290–300	2	300	600
300–310	1	310	310
310–320	0	320	0
320–330	1	330	330
330–340	0	340	0
340–350	2	350	700
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	0	470	0
470–480	0	480	0
480–490	0	490	0
490–500	1	500	500
>500	0	510	0
Total	**26,304**	**Weighted Average**	**12.070408**

Table A–116: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 24 – Cumulative Case

SR 24 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 496.95779 µg/m^3			
Concentration Ranges (µg/m^3)	Count	Upper Bin Limit	Weighted Sum
0–10	23,351	10	233,510
10–20	1,989	20	39,780
20–30	471	30	14,130
30–40	183	40	7,320
40–50	84	50	4,200
50–60	77	60	4,620
60–70	33	70	2,310
70–80	27	80	2,160
80–90	15	90	1,350
90–100	13	100	1,300
100–110	7	110	770
110–120	5	120	600
120–130	6	130	780
130–140	5	140	700
140–150	10	150	1,500
150–160	3	160	480
160–170	1	170	170
170–180	4	180	720
180–190	1	190	190
190–200	0	200	0
200–210	4	210	840
210–220	2	220	440
220–230	2	230	460
230–240	1	240	240
240–250	1	250	250
250–260	1	260	260
260–270	1	270	270
270–280	0	280	0
280–290	0	290	0
290–300	2	300	600
300–310	1	310	310
310–320	0	320	0

SR 24 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 496.95779 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
320–330	1	330	330
330–340	0	340	0
340–350	1	350	350
350–360	1	360	360
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	0	400	0
400–410	0	410	0
410–420	0	420	0
420–430	0	430	0
430–440	0	440	0
440–450	0	450	0
450–460	0	460	0
460–470	0	470	0
470–480	0	480	0
480–490	0	490	0
490–500	1	500	500
>500	0	510	0
Total	**26,304**	**Weighted Average**	**12.2338808**

Table A–117: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 25 – Base Case

SR 25 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 345.92831 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,586	10	255,860
10–20	340	20	6,800
20–30	121	30	3,630
30–40	83	40	3,320
40–50	44	50	2,200

SR 25 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 345.92831 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
50–60	28	60	1,680
60–70	19	70	1,330
70–80	17	80	1,360
80–90	15	90	1,350
90–100	15	100	1,500
100–110	3	110	330
110–120	12	120	1,440
120–130	2	130	260
130–140	3	140	420
140–150	6	150	900
150–160	2	160	320
160–170	1	170	170
170–180	2	180	360
180–190	0	190	0
190–200	1	200	200
200–210	0	210	0
210–220	2	220	440
220–230	0	230	0
230–240	0	240	0
240–250	0	250	0
250–260	0	260	0
260–270	0	270	0
270–280	0	280	0
280–290	0	290	0
290–300	1	300	300
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0
330–340	0	340	0
340–350	1	350	350
>350	0	360	0
Total	**26,304**	**Weighted Average**	**10.81660584**

Table A–118: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 25 – Application Case

SR 25 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 398.77847 µg/m^3			
Concentration Ranges (µg/m^3)	Count	Upper Bin Limit	Weighted Sum
0–10	25,334	10	253,340
10–20	470	20	9,400
20–30	161	30	4,830
30–40	101	40	4,040
40–50	54	50	2,700
50–60	37	60	2,220
60–70	27	70	1,890
70–80	24	80	1,920
80–90	15	90	1,350
90–100	17	100	1,700
100–110	14	110	1,540
110–120	6	120	720
120–130	10	130	1,300
130–140	10	140	1,400
140–150	6	150	900
150–160	2	160	320
160–170	6	170	1,020
170–180	2	180	360
180–190	3	190	570
190–200	0	200	0
200–210	0	210	0
210–220	1	220	220
220–230	1	230	230
230–240	0	240	0
240–250	1	250	250
250–260	0	260	0
260–270	0	270	0
270–280	0	280	0
280–290	0	290	0
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0

SR 25 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 398.77847 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
320–330	0	330	0
330–340	1	340	340
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	1	400	400
>400	0	410	0
Total	**26,304**	**Weighted Average**	**11.13746959**

Table A–119: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 25 – Cumulative Case

SR 25 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 399.07174 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,313	10	253,130
10–20	467	20	9,340
20–30	180	30	5,400
30–40	100	40	4,000
40–50	56	50	2,800
50–60	37	60	2,220
60–70	31	70	2,170
70–80	21	80	1,680
80–90	16	90	1,440
90–100	19	100	1,900
100–110	13	110	1,430
110–120	7	120	840
120–130	10	130	1,300
130–140	9	140	1,260
140–150	6	150	900

SR 25 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 399.07174 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
150–160	3	160	480
160–170	6	170	1,020
170–180	2	180	360
180–190	3	190	570
190–200	0	200	0
200–210	0	210	0
210–220	1	220	220
220–230	1	230	230
230–240	0	240	0
240–250	0	250	0
250–260	1	260	260
260–270	0	270	0
270–280	0	280	0
280–290	0	290	0
290–300	0	300	0
300–310	0	310	0
310–320	0	320	0
320–330	0	330	0
330–340	1	340	340
340–350	0	350	0
350–360	0	360	0
360–370	0	370	0
370–380	0	380	0
380–390	0	390	0
390–400	1	400	400
>400	0	410	0
Total	**26,304**	**Weighted Average**	**11.165222**

Table A–120: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 26 – Base Case

SR 26 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 218.5047 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,559	10	255,590
10–20	374	20	7,480
20–30	148	30	4,440
30–40	71	40	2,840
40–50	59	50	2,950
50–60	26	60	1,560
60–70	18	70	1,260
70–80	9	80	720
80–90	10	90	900
90–100	12	100	1,200
100–110	5	110	550
110–120	3	120	360
120–130	2	130	260
130–140	2	140	280
140–150	1	150	150
150–160	2	160	320
160–170	0	170	0
170–180	0	180	0
180–190	0	190	0
190–200	0	200	0
200–210	2	210	420
210–220	1	220	220
>220	0	230	0
Total	**26,304**	**Weighted Average**	**10.701794**

Table A–121: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 26 – Application Case

SR 26 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 255.8788 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	25,026	10	250,260
10–20	734	20	14,680
20–30	218	30	6,540
30–40	108	40	4,320
40–50	67	50	3,350
50–60	49	60	2,940
60–70	21	70	1,470
70–80	18	80	1,440
80–90	11	90	990
90–100	14	100	1,400
100–110	8	110	880
110–120	6	120	720
120–130	8	130	1,040
130–140	5	140	700
140–150	1	150	150
150–160	3	160	480
160–170	2	170	340
170–180	1	180	180
180–190	0	190	0
190–200	1	200	200
200–210	0	210	0
210–220	0	220	0
220–230	1	230	230
230–240	1	240	240
240–250	0	250	0
250–260	1	260	260
>260	0	270	0
Total	**26,304**	**Weighted Average**	**11.131767**

Table A–122: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 26 – Cumulative Case

SR 26 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 257.4999 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	24,850	10	248,500
10–20	876	20	17,520
20–30	235	30	7,050
30–40	119	40	4,760
40–50	71	50	3,550
50–60	48	60	2,880
60–70	22	70	1,540
70–80	20	80	1,600
80–90	10	90	900
90–100	14	100	1,400
100–110	7	110	770
110–120	7	120	840
120–130	8	130	1,040
130–140	6	140	840
140–150	1	150	150
150–160	3	160	480
160–170	1	170	170
170–180	2	180	360
180–190	0	190	0
190–200	1	200	200
200–210	0	210	0
210–220	0	220	0
220–230	1	230	230
230–240	1	240	240
240–250	0	250	0
250–260	1	260	260
>260	0	270	0
Total	**26,304**	**Weighted Average**	**11.225669**

Table A–123: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 28 – Base Case

SR 28 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 179.7114 µg/m^3			
Concentration Ranges (µg/m^3)	Count	Upper Bin Limit	Weighted Sum
0–10	22,224	10	222,240
10–20	2,067	20	41,340
20–30	883	30	26,490
30–40	427	40	17,080
40–50	201	50	10,050
50–60	147	60	8,820
60–70	104	70	7,280
70–80	93	80	7,440
80–90	55	90	4,950
90–100	37	100	3,700
100–110	20	110	2,200
110–120	15	120	1,800
120–130	9	130	1,170
130–140	8	140	1,120
140–150	6	150	900
150–160	1	160	160
160–170	2	170	340
170–180	5	180	900
>180	0	190	0
Total	**26,304**	**Weighted Average**	**13.609337**

Table A–124: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 28 – Application Case

SR 28 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 217.9773 µg/m^3			
Concentration Ranges (µg/m^3)	Count	Upper Bin Limit	Weighted Sum
0–10	21,492	10	214,920
10–20	2,163	20	43,260
20–30	1,085	30	32,550
30–40	560	40	22,400

SR 28 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 217.9773 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
40–50	319	50	15,950
50–60	165	60	9,900
60–70	121	70	8,470
70–80	114	80	9,120
80–90	78	90	7,020
90–100	62	100	6,200
100–110	42	110	4,620
110–120	39	120	4,680
120–130	21	130	2,730
130–140	9	140	1,260
140–150	6	150	900
150–160	12	160	1,920
160–170	7	170	1,190
170–180	3	180	540
180–190	2	190	380
190–200	1	200	200
200–210	2	210	420
210–220	1	220	220
>220	0	230	0
Total	**26,304**	**Weighted Average**	**14.782923**

Table A–125: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 28 – Cumulative Case

SR 28 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 219.0744 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	21,375	10	213,750
10–20	2,241	20	44,820
20–30	1,095	30	32,850
30–40	575	40	23,000
40–50	327	50	16,350

SR 28 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 219.0744 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
50–60	162	60	9,720
60–70	130	70	9,100
70–80	112	80	8,960
80–90	79	90	7,110
90–100	62	100	6,200
100–110	40	110	4,400
110–120	40	120	4,800
120–130	23	130	2,990
130–140	9	140	1,260
140–150	6	150	900
150–160	11	160	1,760
160–170	7	170	1,190
170–180	4	180	720
180–190	2	190	380
190–200	1	200	200
200–210	2	210	420
210–220	1	220	220
>220	0	230	0
Total	**26,304**	**Weighted Average**	**14.86846107**

Table A–126: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 29 – Base Case

SR 29 – Base Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 31.0489 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,225	10	262,250
10–20	73	20	1,460
20–30	4	30	120
30–40	2	40	80
>40	0	50	0
Total	**26,304**	**Weighted Average**	**10.03307482**

Table A–127: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 29 – Application Case

SR 29 – Application Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 36.7046 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,200	10	262,000
10–20	88	20	1,760
20–30	14	30	420
30–40	2	40	80
>40	0	50	0
Total	**26,304**	**Weighted Average**	**10.04638078**

Table A–128: 1-h Weighted-Average Concentrations of Combined NO_2 and SO_2 for Special Receptor Location 29 – Cumulative Case

SR 29 – Cumulative Case – 1-h Combined NO_2 and SO_2			
Maximum Concentration 37.1572 µg/m^3			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	26,194	10	261,940
10–20	93	20	1,860
20–30	15	30	450
30–40	2	40	80
>40	0	50	0
Total	**26,304**	**Weighted Average**	**10.04904197**

24-h Weighted-Average SO_2 Concentrations for the HHRA Areas

Table A–129: 24-h Weighted-Average Concentrations of SO_2 for Human Health Area A1 – Base Case

A1 – Base Case – 24-h SO_2 Data			
Maximum Concentration: 69.744 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,066	10	10,660
10–20	22	20	440
20–30	4	30	120
30–40	2	40	80
40–50	1	50	50
50–60	0	60	0
60–70	1	70	70
>70	0	80	0
Total	**1,096**	**Weighted Average**	**10.41971**

Table A–130: 24-h Weighted-Average Concentrations of SO_2 for Human Health Area A1 – Application Case

A1 – Application Case – 24-h SO_2 Data			
Maximum Concentration: 70.076 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,065	10	10,650
10–20	22	20	440
20–30	5	30	150
30–40	2	40	80
40–50	1	50	50
50–60	0	60	0
60–70	0	70	0
70–80	1	80	80
>80	0	90	0
Total	**1,096**	**Weighted Average**	**10.44708**

Table A–131: 24-h Weighted-Average Concentrations of SO_2 for Human Health Area A1 – Cumulative Case

A1 – Cumulative Case – 24-h SO_2 Data			
Maximum Concentration: 70.137 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,065	10	10,650
10–20	22	20	440
20–30	5	30	150
30–40	2	40	80
40–50	1	50	50
50–60	0	60	0
60–70	0	70	0
70–80	1	80	80
>80	0	90	0
Total	**1,096**	**Weighted Average**	**10.44708**

Table A–132: 24-h Weighted-Average Concentrations of SO_2 for Human Health Area A2 – Base Case

A2 – Base Case – 24-h SO_2 Data			
Maximum Concentration: 40.496 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,009	10	10,090
10–20	66	20	1,320
20–30	17	30	510
30–40	3	40	120
40–50	1	50	50
>50	0	60	0
Total	**1,096**	**Weighted Average**	**11.03102**

Table A–133: 24-h Weighted-Average Concentrations of SO_2 for Human Health Area A2 – Application Case

A2 – Application Case – 24-h SO_2 Data			
Maximum Concentration: 42.0177 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	998	10	9,980
10–20	72	20	1,440
20–30	20	30	600
30–40	3	40	120
40–50	3	50	150
>50	0	60	0
Total	**1,096**	**Weighted Average**	**11.2135036**

Table A–134: 24-h Weighted-Average Concentrations of SO_2 for Human Health Area A2 – Cumulative Case

A2 – Cumulative Case – 24-h SO_2 Data			
Maximum Concentration: 42.0423 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	993	10	9,930
10–20	77	20	1,540
20–30	20	30	600
30–40	3	40	120
40–50	3	50	150
>50	0	60	0
Total	**1,096**	**Weighted Average**	**11.25912**

Table A–135: 24-h Weighted-Average Concentrations of SO_2 for Human Health Area A3 – Base Case

A3 – Base Case – 24-h SO_2 Data			
Maximum Concentration: 46.1634 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,042	10	10,420
10–20	45	20	900
20–30	8	30	240
30–40	0	40	0
40–50	1	50	50
>50	0	60	0
Total	**1,096**	**Weighted Average**	**10.5931**

Table A–136: 24-h Weighted-Average Concentrations of SO_2 for Human Health Area A3 – Application Case

A3 – Application Case – 24-h SO_2 Data			
Maximum Concentration: 46.6946 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,032	10	10,320
10–20	54	20	1,080
20–30	9	30	270
30–40	0	40	0
40–50	1	50	50
>50	0	60	0
Total	**1,096**	**Weighted Average**	**10.69343**

Table A–137: 24-h Weighted-Average Concentrations of SO_2 for Human Health Area A3 – Cumulative Case

A3 – Cumulative Case – 24-h SO_2 Data			
Maximum Concentration: 46.6991 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,032	10	10,320
10–20	54	20	1,080
20–30	9	30	270
30–40	0	40	0
40–50	1	50	50
>50	0	60	0
Total	**1,096**	**Weighted Average**	**10.69343066**

Table A–138: 24-h Weighted-Average Concentrations of SO_2 for Human Health Area A4 – Base Case

A4 – Base Case – 24-h SO_2 Data			
Maximum Concentration: 36.8923 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,020	10	10,200
10–20	69	20	1,380
20–30	6	30	180
30–40	1	40	40
>40	0	50	0
Total	**1,096**	**Weighted Average**	**10.76642**

Table A–139: 24-h Weighted-Average Concentrations of SO_2 for Human Health Area A4 – Application Case

A4 – Application Case – 24-h SO_2 Data			
Maximum Concentration: 38.7812 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,013	10	10,130
10–20	74	20	1,480
20–30	8	30	240
30–40	1	40	40
>40	0	50	0
Total	**1,096**	**Weighted Average**	**10.84854015**

Table A–140: 24-h Weighted-Average Concentrations of SO_2 for Human Health Area A4 – Cumulative Case

A4 – Cumulative Case – 24-h SO_2 Data			
Maximum Concentration: 38.9298 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,011	10	10,110
10–20	76	20	1,520
20–30	8	30	240
30–40	1	40	40
>40	0	50	0
Total	**1,096**	**Weighted Average**	**10.86678832**

Table A–141: 24-h Weighted-Average Concentrations of SO_2 for Human Health Area A5 – Base Case

A5 – Base Case – 24-h SO_2 Data			
Maximum Concentration: 35.2465 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	825	10	8,250
10–20	201	20	4,020
20–30	63	30	1,890
30–40	7	40	280
>40	0	50	0
Total	**1,096**	**Weighted Average**	**13.175182**

Table A–142: 24-h Weighted-Average Concentrations of SO_2 for Human Health Area A5 – Application Case

A5 – Application Case – 24-h SO_2 Data			
Maximum Concentration: 37.6902 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	799	10	7,990
10–20	219	20	4,380
20–30	66	30	1,980
30–40	12	40	480
>40	0	50	0
Total	**1,096**	**Weighted Average**	**13.5310219**

Table A–143: 24-h Weighted-Average Concentrations of SO_2 for Human Health Area A5 – Cumulative Case

A5 – Cumulative Case – 24-h SO_2 Data			
Maximum Concentration: 37.7179 µg/m^3			
Concentration Range (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	798	10	7,980
10–20	220	20	4,400
20–30	66	30	1,980
30–40	12	40	480
>40	0	50	0
Total	**1,096**	**Weighted Average**	**13.54014599**

24-h Weighted-Average Concentrations of SO_2 for Special Receptor Locations

Table A–144: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 15 – Base Case

SR 15 – Base Case – 24-h SO_2			
Maximum Concentration 40.13946 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,076	10	10,760
10–20	16	20	320
20–30	3	30	90
30–40	0	40	0
40–50	1	50	50
>50	0	60	0
Total	**1,096**	**Weighted Average**	**10.23722628**

Table A–145: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 15 – Application Case

SR 15 – Application Case – 24-h SO_2			
Maximum Concentration 42.35984 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,074	10	10,740
10–20	17	20	340
20–30	3	30	90
30–40	1	40	40
40–50	1	50	50
>50	0	60	0
Total	**1,096**	**Weighted Average**	**10.273723**

Table A–146: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 15 – Cumulative Case

SR 15 – Cumulative Case – 24-h SO_2			
Maximum Concentration 42.86841 (µg/m^3)			
Concentration Ranges (µg/m^3)	Count	Upper Bin Limit	Weighted Sum
0–10	1,074	10	10,740
10–20	17	20	340
20–30	3	30	90
30–40	1	40	40
40–50	1	50	50
>50	0	60	0
Total	**1,096**	**Weighted Average**	**10.27372**

Table A–147: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 22 – Base Case

SR 22 – Base Case – 24-h SO_2			
Maximum Concentration 11.38718 (µg/m^3)			
Concentration Ranges (µg/m^3)	Count	Upper Bin Limit	Weighted Sum
0–10	1,094	10	10,940
10–20	2	20	40
>20	0	30	0
Total	**1,096**	**Weighted Average**	**10.0182482**

Table A–148: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 22 – Application Case

SR 22 – Application Case – 24-h SO_2			
Maximum Concentration 11.89869 (µg/m^3)			
Concentration Ranges (µg/m^3)	Count	Upper Bin Limit	Weighted Sum
0–10	1,094	10	10,940
10–20	2	20	40
>20	0	30	0
Total	**1,096**	**Weighted Average**	**10.01825**

Table A–149: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 22 – Cumulative Case

SR 22 – Cumulative Case – 24-h SO_2			
Maximum Concentration 12.00428 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,094	10	10,940
10–20	2	20	40
>20	0	30	0
Total	**1,096**	**Weighted Average**	**10.018248**

Table A–150: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 23 – Base Case

SR 23 – Base Case – 24-h SO_2			
Maximum Concentration 67.59258 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,030	10	10,300
10–20	46	20	920
20–30	7	30	210
30–40	9	40	360
40–50	2	50	100
50–60	1	60	60
60–70	1	70	70
>70	0	80	0
Total	**1,096**	**Weighted Average**	**10.96715**

Table A–151: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 23 – Application Case

SR 23 – Application Case – 24-h SO_2			
Maximum Concentration 69.58105 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,026	10	10,260
10–20	50	20	1,000
20–30	7	30	210
30–40	9	40	360
40–50	2	50	100
50–60	1	60	60
60–70	1	70	70
>70	0	80	0
Total	**1,096**	**Weighted Average**	**11.00365**

Table A–152: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 23 – Cumulative Case

SR 23 – Cumulative Case – 24-h SO_2			
Maximum Concentration 69.86407 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,024	10	10,240
10–20	52	20	1,040
20–30	7	30	210
30–40	9	40	360
40–50	2	50	100
50–60	1	60	60
60–70	1	70	70
>70	0	80	0
Total	**1,096**	**Weighted Average**	**11.021898**

Table A–153: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 24 – Base Case

SR 24 – Base Case – 24-h SO_2			
Maximum Concentration 50.77970 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,053	10	10,530
10–20	29	20	580
20–30	8	30	240
30–40	2	40	80
40–50	3	50	150
50–60	1	60	60
>60	0	70	0
Total	**1,096**	**Weighted Average**	**10.620438**

Table A–154: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 24 – Application Case

SR 24 – Application Case – 24-h SO_2			
Maximum Concentration 52.54005 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,043	10	10,430
10–20	37	20	740
20–30	10	30	300
30–40	2	40	80
40–50	3	50	150
50–60	1	60	60
>60	0	70	0
Total	**1,096**	**Weighted Average**	**10.72993**

Table A–155: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 24 – Cumulative Case

SR 24 – Cumulative Case – 24-h SO_2			
Maximum Concentration 52.84241 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,042	10	10,420
10–20	38	20	760
20–30	10	30	300
30–40	2	40	80
40–50	3	50	150
50–60	1	60	60
>60	0	70	0
Total	**1,096**	**Weighted Average**	**10.73905**

Table A–156: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 25 – Base Case

SR 25 – Base Case – 24-h SO_2			
Maximum Concentration 32.13740 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,070	10	10,700
10–20	19	20	380
20–30	5	30	150
30–40	2	40	80
>40	0	50	0
Total	**1,096**	**Weighted Average**	**10.319343**

Table A–157: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 25 – Application Case

SR 25 – Application Case – 24-h SO_2			
Maximum Concentration 34.23374 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,063	10	10,630
10–20	24	20	480
20–30	6	30	180
30–40	3	40	120
>40	0	50	0
Total	**1,096**	**Weighted Average**	**10.410584**

Table A–158: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 25 – Cumulative Case

SR 25 – Cumulative Case – 24-h SO_2			
Maximum Concentration 34.71189 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,063	10	10,630
10–20	24	20	480
20–30	6	30	180
30–40	3	40	120
>40	0	50	0
Total	**1,096**	**Weighted Average**	**10.41058**

Table A–159: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 26 – Base Case

SR 26 – Base Case – 24-h SO_2			
Maximum Concentration 38.60604 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,075	10	10,750
10–20	19	20	380
20–30	1	30	30
30–40	1	40	40
>40	0	50	0
Total	**1,096**	**Weighted Average**	**10.21898**

Table A–160: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 26 – Application Case

SR 26 – Application Case – 24-h SO_2			
Maximum Concentration 41.04605 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,072	10	10,720
10–20	22	20	440
20–30	1	30	30
30–40	0	40	0
40–50	1	50	50
>50	0	60	0
Total	**1,096**	**Weighted Average**	**10.25547**

Table A–161: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 26 – Cumulative Case

SR 26 – Cumulative Case – 24-h SO_2			
Maximum Concentration 41.56963 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,072	10	10,720
10–20	22	20	440
20–30	1	30	30
30–40	0	40	0
40–50	1	50	50
>50	0	60	0
Total	**1,096**	**Weighted Average**	**10.25547**

Table A–162: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 28 – Base Case

SR 28 – Base Case – 24-h SO_2			
Maximum Concentration 51.80953 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	912	10	9,120
10–20	138	20	2,760
20–30	35	30	1,050
30–40	9	40	360
40–50	1	50	50
50–60	1	60	60
>60	0	70	0
Total	**1,096**	**Weighted Average**	**12.22627737**

Table A–163: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 28 – Application Case

SR 28 – Application Case – 24-h SO_2			
Maximum Concentration 54.93079 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	898	10	8,980
10–20	149	20	2,980
20–30	38	30	1,140
30–40	7	40	280
40–50	3	50	150
50–60	1	60	60
>60	0	70	0
Total	**1,096**	**Weighted Average**	**12.399635**

Table A–164: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 28 – Cumulative Case

SR 28 – Cumulative Case – 24-h SO_2			
Maximum Concentration 54.95686 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	896	10	8,960
10–20	151	20	3,020
20–30	38	30	1,140
30–40	7	40	280
40–50	3	50	150
50–60	1	60	60
>60	0	70	0
Total	**1,096**	**Weighted Average**	**12.417883**

Table A–165: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 29 – Base Case

SR 29 – Base Case – 24-h SO_2			
Maximum Concentration 3.91655 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,096	10	10,960
>10	0	20	0
Total	**1,096**	**Weighted Average**	**10**

Table A–166: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 29 – Application Case

SR 29 – Application Case – 24-h SO_2			
Maximum Concentration 4.26199 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,096	10	10,960
>10	0	20	0
Total	**1,096**	**Weighted Average**	**10**

Table A–167: 24-h Weighted-Average Concentrations of SO_2 for Special Receptor Location 29 – Cumulative Case

SR 29 – Cumulative Case – 24-h SO_2			
Maximum Concentration 4.32312 (µg/m^3)			
Concentration Ranges (µg/m^3)	**Count**	**Upper Bin Limit**	**Weighted Sum**
0–10	1,096	10	10,960
>10	0	20	0
Total	**1,096**	**Weighted Average**	**10**