APPENDIX O
PUBLIC HEALTH

Attachment 15A ALBERTA AMBIENT AIR QUALITY OBJECTIVES AND CANADIAN AMBIENT AIR QUALITY STANDARDS

The health-based guidelines used for the assessment of inhalation exposures rely heavily on the Alberta ambient air quality objectives (AAAQO) and the Canadian ambient air quality standards (CAAQS). Air quality objectives are generally established for one-hour, 24-hour, and annual averaging periods and are based on an evaluation of scientific, social, technical, and economic factors. As such, some air quality objectives are not used in the human health risk assessment because their protection goals are not based on human health. For example, although an AAAQO is provided for annual concentrations of nitrogen dioxide (NO_2), the annual guideline was derived based on the potential effects to plants and therefore are not appropriate to establish human health risk.

The health-based guidelines for each COPC (where they were available), as well as the key critical health outcomes and regulatory source are provided in Table 15A-1.

Table 15A-1 Health-based Screening Guidelines for Inhalation

Substance	Averaging Period	Health-based Guideline ($\mu g/m^3$)	Source	Health Endpoint
Criteria Air Contaminants				
Nitrogen dioxide (NO_2)	1-hour	300	AEP (2017)	Respiratory effects
Sulphur dioxide (SO_2)	1-hour	183	ECCC	Respiratory effects
Carbon monoxide (CO)	1-hour	15,000	AEP (2017)	Blood effects (oxygen-carrying capacity of blood)
Particulate matter ($PM_{2.5}$)	24-hour	28	ECCC	Cardiovascular and respiratory diseases [C]
	Annual	10	ECCC	cardiovascular and respiratory diseases [D]
Volatile Organic Compounds				
Acetaldehyde	1-hour	90	AEP (2017)	Irritation (eyes, skin, and respiratory tract)
Acrolein	1-hour	4.5	AEP (2017)	Irritation (eyes, nose, and throat)
	24-hour	0.40	AEP (2017)	Respiratory effects
Benzene	1-hour	30	AEP (2017)	Blood effects (reduced white and red blood cell counts or decreased bone marrow cells)
	Annual	3	AEP (2017)	Cancer effects (leukemia)
Ethylbenzene	1-hour	2,000	AEP (2017)	Irritation (respiratory tract and eye)
Formaldehyde	1-hour	65	AEP (2017)	Respiratory effects

Table 15A-1 Health-based Screening Guidelines for Inhalation

Substance	Averaging Period	Health-based Guideline (µg/m³)	Source	Health Endpoint
Toluene	1-hour	1,880	AEP (2017)	Neurobehavioural effects (headaches)
	24-hour	400	AEP (2017)	Neurobehavioural effects (headaches)
Xylenes	1-hour	2,300	AEP (2017)	Neurological and irritation effects
	24-hour	700	AEP (2017)	Neurological and irritation effects
Polycyclic Aromatic Hydrocarbons				
Benzo(a)pyrene	Annual	0.0003	AEP (2017)	Cancer and non-cancer effects (carcinogenicity, reproductive toxicity, and developmental toxicity)
Naphthalene	Annual	3	AEP (2017)	Nasal effects

NOTES:

[A] Alberta Environment and Parks (AEP). 2017. Ambient Air Quality Objectives and Guidelines.

[B] Environment and Climate Change Canada (ECCC). Canadian Ambient Air Quality Standards (CAAQS).

[C] The CAAQS for 24-hour $PM_{2.5}$ is referenced to the annual 98th percentile of daily 24-hour average concentrations, averaged over three years.

[D] The CAAQS for annual $PM_{2.5}$ is referenced to the three-year mean of annual average concentrations.

µg/m³ = micrograms per cubic metre.

SPRINGBANK OFF-STREAM RESERVOIR PROJECT
Environmental Impact Assessment

Volume 4: Appendices
Appendix O: Public Health

Human Health and Risk Assessment Technical Data Report

Prepared for:
Alberta Transportation

Prepared by:
Stantec Consulting Ltd.

March 2018

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Abbreviations

AAAQO	Alberta ambient air quality objectives
CAAQS	Canadian ambient air quality standards
CAC	criteria air contaminant
CO	carbon monoxide
COPC	chemical of potential concern
ER	exposure ratio
HHRA	human health risk assessment
ILCR	incremental lifetime cancer risk
MPOI	maximum point of impingement
NAAQO	national ambient air quality objectives
NOAEL	no observed adverse effects level
NO_2	nitrogen dioxide
PAH	polycyclic aromatic hydrocarbon
PDA	Project development area
$PM_{2.5}$	particulate matter less than 2.5 microns
PM_{10}	particulate matter less than 10 microns
SO_2	sulphur dioxide
The Project	Springbank Off-Stream Reservoir Project
TEF	toxic equivalency factor
TRV	toxicological reference value
US EPA	United States Environmental Protection Agency

VC	valued component
VOC	volatile organic compound

1.0 INTRODUCTION

1.1 OVERVIEW

This human health risk assessment (HHRA) evaluates the potential health risks to people from exposures to chemicals of potential concern (COPC) released from the Springbank Off-Stream Reservoir Project (the Project).

During the construction, dry operation, flood operation and post-flood operation phases of the Project, COPC may be released into the atmospheric, terrestrial and aquatic environments. The health risk to people is dependent on their exposure to these COPC, which could occur through food and water ingestion, air inhalation and/or dermal absorption from direct skin contact.

This report presents the background information for the Project in the context of human health, the methods used to assess human health risk, and the results of the HHRA in support of the assessment for public health (Volume 3A, Section 15 and Volume 3B, Section 15).

The HHRA follows the guidance framework prescribed by Health Canada (2010a) and Alberta Health and Wellness (2011), which is made up of five primary components.

- **Problem Formulation**: The problem formulation involves identifying Project-related COPC, exposure pathways, and human receptors. The objective of the problem formulation stage is to develop a conceptual site model that characterizes the COPCs released by the Project, identify receptors in the study area, whether there are exposure pathways by which these receptors are exposed to COPCs, and the exposure route (e.g., inhalation, ingestion, skin absorption). The conceptual site model is the foundation of the HHRA, which identifies the operable pathways to assess and the inoperable pathways that are considered but not assessed due to an absence of one or more elements of the exposure pathway (e.g., transport mechanism, exposure point, exposure route).
- **Toxicity Assessment**: The toxicity assessment characterizes the potential toxic effects of each COPC and establishes toxicological reference values (TRVs). Toxicological reference values are dose or exposure concentration benchmarks to which a human receptor can be exposed to without an appreciable risk of adverse health effects. The toxicological reference values applied in this HHRA are guidelines and objectives published by provincial, federal or international regulatory agencies.
- **Exposure Assessment**: The exposure assessment characterizes the COPC dose or exposure concentration for each operable pathway in the conceptual site model. The objective is to quantify the amount of COPC to which people could be exposed.

- **Risk Characterization**: The risk characterization stage characterizes the potential risk to human receptors from each operable pathway. The risk characterization compares the results of the exposure assessment to the TRVs to quantify potential health risk. The potential health risk is compared to the risk criteria established by the Government of Alberta (Alberta Government 2011) and Health Canada (Health Canada 2010a). If the risk criteria 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 in the risk estimates. Uncertainties associated with the data, predictive modelling and other factors that could affect the final risk estimate are described. When uncertainties exist, professional judgment is applied in a conservative manner to reduce the risk of underestimating the health risk.

1.2 PROJECT BACKGROUND

The purpose of the Project is to mitigate the effects of future extreme flood events on infrastructure, water courses and people in the City of Calgary and downstream communities. During a flood, the Project would divert and retain a portion of Elbow River flows, and release the water back to the Elbow River in a controlled manner after the flood has subsided. The Project is designed to mitigate a flood magnitude equivalent to the June 2013 flood in Calgary, referred herein as the design flood.

The Project consists of the construction, dry operations, flood operation and post-flood operation phases. A summary of each phase as it relates to human health is described in this report.

During the construction phase, physical activities include land clearing, channel excavation, and the construction of the dam, berm and water diversion structures. New roads and bridges would be constructed to address changes in road alignment. The duration of the construction phase is projected at 36 months, from April 2019 to November 2021. During the construction phase, the location of the construction activities varies according to the construction schedule illustrated in the project description (Volume 1, Table 3-7). For example, the construction of new roads and bridges along Highway 22 (Cowboy Trail) located along the west side of the Project would be completed by the end of 2020. The construction work for the diversion channel and dam embankment, located along the south of the Project, would continue to November 2021. Construction vehicles, machines and other equipment that uses gasoline or diesel fuel will produce emissions into the air, while particulate matter would also be produced from vehicles on the haul road, and earthworks.

Upon completion of the construction phase, the Project would transition into the dry operation phase. Physical activities during the dry operation phase are limited, and include infrastructure inspection, maintenance and repairs. No water from the Elbow River would be directed into the off-stream reservoir during this phase, and it would remain dry until the first diverted flood.

When a flood occurs, the Project would transition into the flood operation phase. Water would flow into the off-stream reservoir and be retained for a period of days to weeks. During this retention period, debris and suspended solids in the water would settle to the bottom of the reservoir. The gates of the diversion channel would be closed once the off-stream reservoir has reached capacity, or if the threat of flood has subsided. When the threat of flood has subsided, the Project would transition into the post-flood operation phase. The gates of the outlet structure would be opened to allow the retained water to drain back into the Elbow River. After draining the reservoir, physical activities include the partial removal of sediment (to maintain flows in and out of the reservoir for future floods) and debris deposited in the diversion channel and outlet structures.

Statements of concern were received following consultation and engagement with Indigenous groups, the public and regulators. Concerns related to health included the air quality during the construction and post-flood operation phases. During the construction phase, exhaust from vehicles and equipment, or dust particulates from the haul road may be inhaled by residents and other people near the Project. During the post-flood operation phase, when sediments have dried, winds can cause wind erosion and airborne dust. People may inhale these particulates, or they may consume sediments deposited onto backyard garden produce and traditional plants. Concerns were also made regarding the potential effect on water quality when releasing retained water back into the Elbow River, because the water enters the Glenmore Reservoir which supplies residents of Calgary with municipal tap water. These concerns are considered in the HHRA and the potential health risks are evaluated.

2.0 SITE CHARACTERIZATION

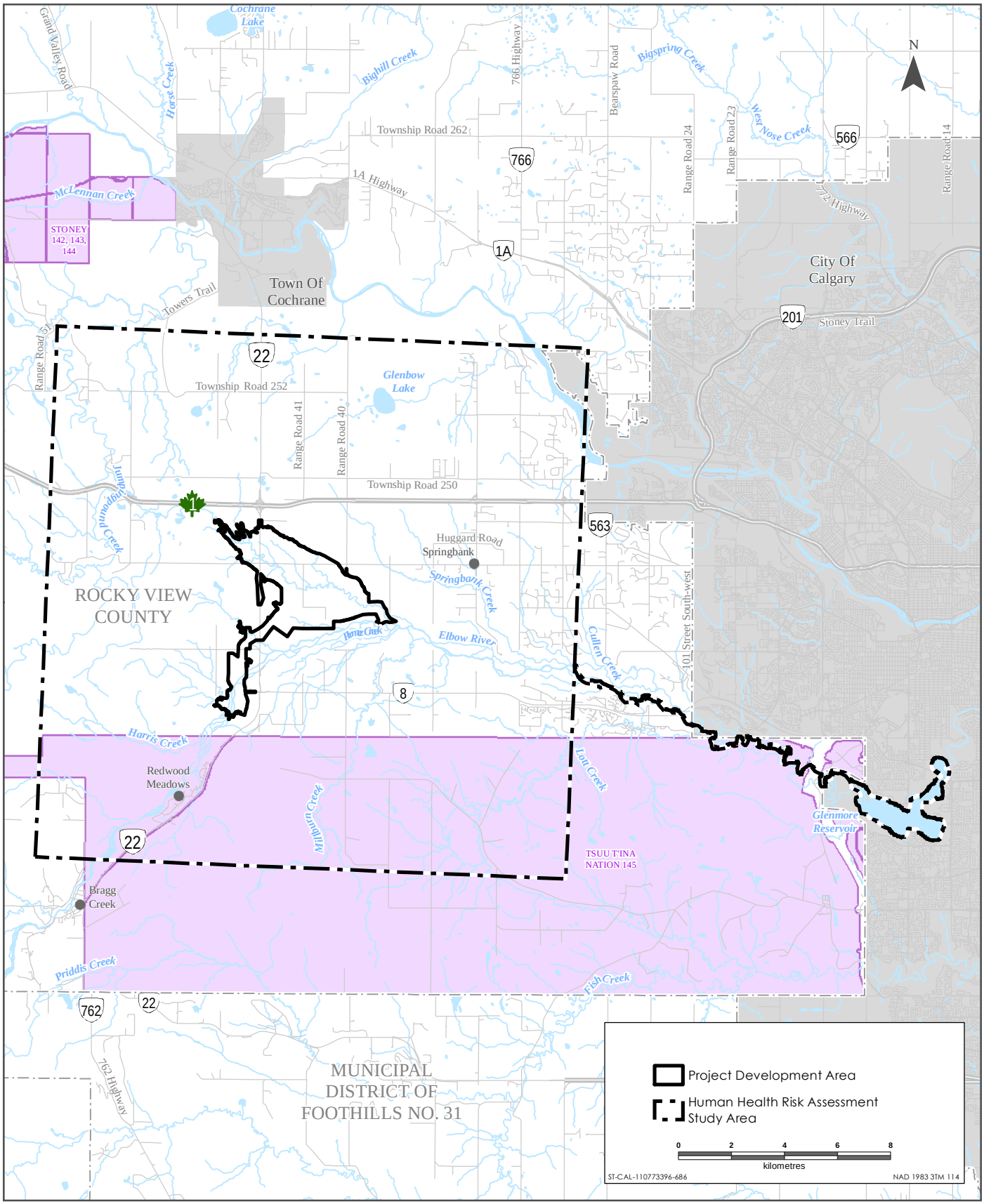
The site characterization provides a description of the study area applicable to the HHRA. This includes a description of the regional climate and meteorological conditions, current land uses and the applicable baseline quality of environmental media (e.g., air and water). The site characterization provides the context for how the Project could affect the environment in a manner that could influence human health risk.

2.1 STUDY BOUNDARIES

The project development area (PDA) is defined as the area where physical ground disturbance is planned for the Project and is 1,438 hectares in extent. The study area for the HHRA (referred to as the local (LAA) and regional assessment area in the Environmental Impact Statement) is shown in Figure 2-1: it is a 20 km by 20 km square centered on the PDA in addition to the waters of the Elbow River from the Project's diversion channel to the Glenmore Reservoir. The 20 km by 20 km area is the modelling domain used in the Air Quality and Climate VC (Section 3.0, Volume 3A and 3B) to predict air quality conditions.

A preliminary review of the predicted air quality results indicates that changes in air quality from the Project are modelled to occur close to the PDA. Therefore, the HHRA focuses on people located within a 5 km radius of the PDA because people located closer to the Project could have a higher degree of exposure to air emissions and therefore possibly a higher health risk than those located farther away. The waters of Elbow River to Glenmore Reservoir could have potential changes in water quality that potentially affect drinking water and fish quality.

For temporal boundaries, Project construction would take place over a 36-month period. Assuming regulatory approval by Q4 2018, construction would commence in Q1 2019. By Q4 2020, the Project would be able to accommodate a 1:100-year flood event. Construction would be complete by Q1 2022 at which time the Project would be able to accommodate water volumes equal to the 2013 flood, or design scenario equivalent to a 1:200-year flood event. Dry operations of the Project will occur indefinitely (i.e., permanent installation) after construction, with periods of dry operations alternating with flood and post-flood phases.



Sources: Base Data - ESRI, Government of Alberta, Government of Canada
Thematic Data - ERBC, Government of Alberta, Stantec Ltd

Human Health Risk Assessment Study Area

Stantec

2.2 ASSESSMENT SCENARIOS

To assess the potential effects of the Project on human health risk, the HHRA evaluated the potential health risks for the following scenarios:

- **Base Case**: For this scenario, the HHRA incorporated baseline environmental data to consider the potential environmental effects and associated health risks under current, pre-Project conditions, and the contribution of future projects or activities that have been approved
- **Project Case**: For this scenario, the HHRA considered the potential environmental effects and associated health risks of the Project in isolation (i.e., potential effects of the Project alone)
- **Application Case**: For this scenario, the HHRA considered the potential environmental effects and associated health risks of the Project in combination with the baseline conditions (i.e., Application Case = Base Case + Project Case)
- **Planned Development Case**: For this scenario, the HHRA considered the potential risks associated with the Project in combination with other existing and approved projects as well as planned or proposed projects and other reasonably foreseeable future activities (i.e., Planned Development Case = Application Case + future projects).

The Project, Application, and Planned Development cases considered all Project phases (i.e., construction, dry operation, flood operation and post-flood operation phases).

2.3 LAND USE

The characterization of land use is provided as part of the description of existing conditions in the Land Use and Management VC (Section 12.2, Volume 3A). A summary of that section is provided in this report.

There are 24 individuals, 4 businesses and the Kiwanis Club of Calgary that own land in the PDA. The majority of these private lands are used for ranching, while some businesses operate summer camps on their property. Agriculture encompasses approximately 632.8 hectares of the PDA, and includes annual crops, hayland and tame pastures related to the ranching activities. Most of these private lands are delineated by 1 m high wire fencing, and not accessible to the public. There are no urban or residential communities in the PDA, but there are several individual houses. Public land in the PDA and surrounding region include the ROWs for roads and road allowances and the bed and banks of the Elbow River and its tributaries.

Indigenous groups—Stoney Nakoda Nations, Métis Nation of Alberta – Region 3, Tsuut'ina Nation, Ktunaxa Nation, Métis Nation British Columbia, Samson Cree Nation, Ermineskin Cree Nation, and Kainai First Nation (Blood Tribe)—have stated the importance of harvesting in traditional territories as a historical and current-use activity for subsistence, treaty rights, and cultural practice. Harvesting may include hunting, trapping, fishing, and plant gathering throughout the region of southern Alberta, but there is limited information regarding these practices within the PDA, since most of these lands are privately owned.

Some Indigenous groups have indicated that they have informal agreements with landowners to access private lands in the PDA for traditional harvesting of plants and animals. Indigenous groups are assumed to have access to the PDA for traditional harvesting activities; however, the ability to conduct harvesting activities is substantially constrained compared to unoccupied Crown land. In addition, the vegetation in these private lands consist mostly of common grasses and shrubs for livestock grazing.

2.4 DRINKING AND RECREATIONAL WATER USE

The Elbow River is used by the public for recreational fishing, and by Indigenous groups for traditional fish harvesting. Survey records from Alberta Environment and Parks indicate there are various species of trout (e.g., Brook trout, cutthroat trout, rainbow trout), and mountain whitefish (AEP 2016) that are harvestable. Burbot, pike and suckers are also harvested from the Elbow River as indicated by local Indigenous groups.

Approximately 25 km downstream from the Project is the Glenmore Reservoir. The Glenmore Reservoir supplies southern Calgary with drinking water through the Glenmore Water Treatment Plant. Drinking water for northern Calgary comes from the Bow River through the Bearspaw Water Treatment Plant, which would not be affected by the Project.

2.5 CLIMATE AND METEOROLOGY

The climate and meteorological conditions are provided in the Air Quality and Climate VC (Section 3.2, Volume 3A). A summary of that section is provided in this report. Climate conditions are based on historical weather conditions over a 30-year period, while meteorological conditions are based on data recorded at the Springbank Airport, which is 7 km to the northeast of the study PDA.

The climate and meteorological conditions in the region are summarized as follows.

- Temperature—While the average monthly maximum temperature is 22.2°C, the extreme maximum is 33.8°C; both being observed in July. While the average monthly minimum temperature is -14.2°C, the extreme minimum is -42.8°C; both being observed in January. Freezing conditions (temperatures less than 0°C) can occur more than 75% of the days during the October to April period.
- Precipitation—Most precipitation tends to occur in the May to September period, with the high value occurring in June. The greatest recorded extreme daily rainfall event was 128.4 mm and occurred in June, this value was greater than the average rainfall amount of 106.7 mm for that month. The highest extreme daily snowfall event, 30.0 cm, occurred in March. Rainfall can occur more than 25% of the days during the May to August period.
- Snow depth—The ground is snow-covered in the November to March period with average depths of 4 to 8 cm. Extreme snow depths for this period have ranged from 22 to 60 cm. Eight or more days with 10 cm or more of snow depth occur in the December to March period.
- Winds—The maximum hourly wind speeds range from 61 km/h to 76 km/h, and these events occur most frequently from the west. The maximum recorded wind gust speed is 120 km/h (occurring January 1997).

Table 2-1 summarizes the meteorological observations (Canadian Climate Normals) from Springbank Airport (1981 to 2010).

Table 2-1 Canadian Climate Normals Based on Springbank Airport Observations (1981 to 2010)

Parameter	Month											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Temperature:												
Daily average (°C)	-8.2	-6.7	-2.7	3.4	8.1	12.1	14.8	13.7	9.5	3.9	-3.8	-7
Standard deviation	4.2	3.5	3.7	1.5	1.5	1.0	1.6	1.4	1.5	1.6	3.7	4
Daily maximum (°C)	-1.8	0	3.9	10.5	15.3	18.8	22.2	21.2	17	11	2.3	-0.6
Daily minimum (°C)	-14.5	-13.4	-9.2	-3.8	0.9	5.4	7.4	6.2	1.9	-3.3	-9.9	-13.3
Seasonal Average:												
Extreme maximum (°C)	16.5	22.1	23.8	26.5	33	31	33.8	32.1	30.6	27.1	20.4	17.9
Date (yyyy/dd of month)	2003/07	1992/27	2004/30	1987/28	1986/30	1986/01	2002/13	2003/01	1998/07	1991/11	1999/07	1988/01
Extreme minimum (°C)	-42.8	-41.6	-36.3	-21.7	-14.1	-6.1	-0.1	-5.9	-9.8	-29.1	-36.5	-41.6
Date (yyyy/dd of month)	1997/25	1989/03	1989/01	2002/02	2002/08	2000/19	2002/02	1992/25	2000/23	1991/28	1996/21	1996/29
Precipitation:												
Rainfall (mm)	0.2	0	0.4	9.3	49.5	106.7	66.9	78	45.5	7	2.4	0.3
Snowfall (cm)	12.7	14.7	21.7	19	12.4	0	0.1	0	5.3	11.6	17.4	12.4
Precipitation (mm)	9.9	11.5	17.6	25.4	61.1	106.7	66.9	78	50.3	16.3	16.3	9.8
Average snow depth (cm)	8	7	6	1	0	0	0	0	0	0	4	6
Median snow depth (cm)	7	7	4	0	0	0	0	0	0	0	3	6
Snow depth at month-end (cm)	7	7	2	1	0	0	0	0	0	2	7	7
SOURCE: ECCC 2016.												

2.6 EXISTING CONDITIONS

Existing environmental data can be used to characterize current environmental conditions in the study area. This is important since the HHRA includes a characterization of health risk under the Base Case, and the incremental change in health risk from the Project (Application Case). Data used to characterize existing conditions come from multiple sources including the field, publicly available literature, research and databases and site-specific modelling of the environment.

Existing conditions also includes a discussion of the current health status in the region. For the HHRA, the description of the current health status relies on publicly available data, and range from the large geographic area (i.e., Calgary Zone) to the local geographic area (i.e., Cochrane-Springbank).

2.6.1 Air Quality

The air quality for baseline conditions (and applicable Project phases) are based on the results of the air quality dispersion modelling, which was conducted as part of the assessment of air quality and climate. Technical details about the modelling methods (e.g., model software, model inputs and assumptions) and the modelling results are described in Section 3.0, Volume 3A and 3B.

The air dispersion model included predictions of ground-level concentrations of criteria air contaminants (CAC), volatile organic compounds (VOC), polycyclic aromatic hydrocarbons (PAH), and metals in the study area. These COPC were modelled because the combustion of fuel by vehicles and equipment releases these substances into the air. Particulate matter was also modelled to address dust concerns in the post-flood operations phase, where high winds during dry periods can cause wind erosion and dust storms.

The COPC from air emissions considered in the HHRA are those associated with gasoline and diesel combustion exhaust during the construction phase (i.e., CACs, VOCs, PAHs and trace metals), and particulate matter in the air resulting from dust storms during the post-flood operation phase.

CACs include sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), and particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$). VOCs are organic compounds with a high vapour pressure at ambient temperatures that allow these substances to volatilize or evaporate into the air relatively quickly. The VOCs considered in the HHRA are those associated with emissions from fuel combustion: specifically, 1,3-butadiene, 2,2,4-trimethylpentane, acetaldehyde, acrolein, benzene, ethylbenzene, formaldehyde, propionaldehyde, toluene and xylenes.

PAHs are also byproducts of fuel combustion, but they have low vapour pressures and remain in a solid or liquid state. PAHs from fuel combustion are typically bound to particulates in the air, and do not readily exist in a gas phase at ambient temperatures. The PAHs considered in the HHRA are acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, and pyrene. The metals associated with vehicle exhaust emissions are arsenic, chromium, manganese, mercury and nickel.

2.6.2 Water Quality

Baseline environmental data for water quality is based on water samples collected at the Glenmore Water Treatment Plant, which supplies residents of the City of Calgary with municipal tap water. Samples of treated drinking water at the plant and in the distribution system are routinely tested for quality and the results are compared to the Canadian drinking water quality guidelines (Health Canada 2017a). Table 2-2 includes a list of drinking water quality parameters, guidelines, and the range of measured results from water samples taken from the Glenmore Water Treatment Plant in 2015 and 2016 (City of Calgary 2017).

The water treatment process at the Glenmore Water Treatment Plant includes water filtration and disinfection before entering the municipal water distribution system (City of Calgary 2016). First, silt, debris, and microorganisms are removed from the raw water supply using aluminum sulphate, sand, and polymer to create floc, which settles to the bottom of the tank. Next, the clarified water is treated with chlorine as sodium hypochlorite to kill microorganisms and viruses. Finally, the water is filtered through crushed coal and sand. The drinking water treatment is not designed to remove dissolved metals.

Drinking water quality from the Glenmore Water Treatment Plant is considered very good, and met the applicable health-related guidelines for the parameters tested. The water was in compliance with health-based, aesthetic and operational water quality guidelines with the exception of water temperature. The natural range of water temperature was occasionally higher than the aesthetic guideline. Higher temperatures can indirectly influence water disinfection processes and promote biofilm formation under certain conditions. However, no information was found to suggest that these potential effects occurred at the Glenmore Water Treatment Plant at the time when the water temperature were higher than the guideline.

Table 2-2 Drinking Water Quality for the Glenmore Water Treatment Plant, 2015 and 2016

Parameter	Water Quality Guideline	Measured Water Quality Range	
		2015	2016
Treated Water in from Glenmore Water Treatment Plant			
Temperature (°C)	≤15 b	0.8 to 20.0	5.0 to 20.2
pH	7.0 to 10.5 c	7.3 to 8.1	7.3 to 7.9
Turbidity (nephelometric turbidity unit)	<0.15 c	<0.05 to 0.14	<0.05 to 0.08
Total dissolved solids (mg/L)	≤500 b	152 to 300	254 to 297
Colour (True Color)	≤15 c	<2	<2
Nitrate as Nitrogen (mg/L as N)	10a	0.0023 to 0.231	<0.005 to 0.248
Nitrite as Nitrogen (mg/L as N)	1a	<0.003	<0.003
Sulphate (mg/L)	≤500b	37 to 81	70.8 to 90.2
Fluoride (mg/L)	1.5b	0.09 to 0.28	0.19 to 0.27
E. coli (per 100mL)	0 a	<1	<1
Total coliform (per 100 mL)	0 a	<1	<1
Aluminum (mg/L)	0.1cd	0.091 to 0.1	0.0528
Arsenic (mg/L)	0.01a	<0.0005	<0.0005
Barium (mg/L)	1a	0.027 to 0.079	0.0639 to 0.0877
Cadmium (mg/L)	0.005 a	<0.0005	<0.0005
Chromium (mg/L)	0.05 a	<0.0005 to 0.0023	<0.0005 to 0.0020
Copper (mg/L)	≤1.0 b	<0.0005 to 0.0007	<0.0005 to 0.0008
Iron (mg/L)	≤0.3 b	<0.05	<0.05 to 0.015
Lead (mg/L)	0.01a	<0.0005	<0.0005
Manganese (mg/L)	≤0.05 b	<0.0005 to 0.0007	<0.0005 to 0.0012
Mercury (mg/L)	0.001a	<0.000002	<0.000002
Sodium (mg/L)	≤200 b	2.5 to 10.1	5.79 to 9.30
Zinc (mg/L)	≤5.0 b	<0.003	<0.003
Treated Water in Municipal Distribution System			
E. coli (present/absent)	0 a	Absent	Absent
Total coliform (present/absent)	0 a	Absent	Absent

NOTES:
[a] Health guideline
[b] Aesthetic guideline
[c] Operational guideline
[d] Added to the water supply as part of the water treatment process

2.6.3 Country Foods

Baseline information for country foods includes the types of country food harvested in the region by local Indigenous groups, a description of the area of land within the PDA that is currently available for country food harvesting, and the potential for country foods to be present within the PDA. Country foods are animals, plants, and fungi used by Indigenous groups for nutritional, medicinal, spiritual or cultural purposes that are harvested through hunting, fishing and gathering. For example, elk and moose may provide food, clothing and tools. Plants and plant parts (e.g., roots, leaves, bark, twigs) are used in traditional medicine and spiritual ceremonies. A list of the country foods harvested by local Indigenous groups was identified through a review of publicly available information, traditional use studies, and the Indigenous engagement program. Indigenous groups engaged for the Project are:

- Blood Tribe
- Ermineskin Cree Nation
- Foothills Ojibway First Nation
- Ktunaxa Nation
- Louis Bull Tribe
- Métis Nation of Alberta (Region 3)
- Métis Nation of British Columbia
- Montana First Nation
- Piikani Nation
- Samson Cree Nation
- Siksika Nation
- Stoney Nakoda Nation (Bearspaw First Nation, Chiniki First Nation and Wesley First Nation)
- Tsuut'ina Nation

Table 2-3 summarizes the traditional country foods as reported by each Indigenous group, which is described in more detail in the assessment of traditional land use (Section 14, Volume 3A and 3B). The list includes country foods that are harvested in the region of southern Alberta; but not necessarily within the PDA. The information is not intended to be an exhaustive list of the traditional country food that are used, nor does the absence of information imply that an Indigenous group does not use of the resource.

The PDA consists primarily private land that is used for ranching, while some businesses operate summer camps on their property. Most of these private lands are delineated by 1 m high wire fencing, and not accessible to the public. Some Indigenous groups have indicated that they have informal agreements with landowners to access private lands in the PDA for traditional harvesting of plants and animals, however, the ability to conduct harvesting activities is substantially constrained compared to unoccupied Crown land.

Table 2-3 List of Traditional Country Foods

Type of Country Food	Traditional Country Food Species	Kainai First Nation	Ermineskin Cree Nation	Foothills Ojibway First Nation	Ktunaxa First Nation	Louis Bull Tribe	Métis Nation of Alberta	Métis Nation British Columbia	Montana First Nation	Piikani First Nation	Samson Cree Nation	Siksika Nation	Stoney Nakoda Nations	Tsuut'ina Nation
Wildlife	badger									✓				
	bear (black, grizzly)		✓	✓	✓		✓	✓	✓	✓	✓		✓	
	beaver	✓	✓		✓		✓		✓	✓	✓		✓	
	bobcat, bobtail		✓				✓							
	cougar		✓				✓				✓			
	coyote	✓		✓			✓			✓				✓
	deer (mule, white-tailed)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	duck (American coot)	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓
	eagle (golden, bald)	✓								✓				✓
	elk	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
	fox (red)	✓					✓			✓				✓
	fisher								✓					
	goose (Canada, white, dark)	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓
	gopher									✓				
	grebe						✓							
	grouse (including prairie[1], mountain[2])		✓					✓		✓	✓	✓		
	hare, rabbit	✓	✓			✓	✓	✓		✓	✓		✓	✓
	lynx		✓				✓		✓		✓			
	marten				✓				✓					
	moose	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
	mountain goat	✓	✓					✓		✓				✓

[1] Assumed to be sharp-tailed grouse
[2] Assumed to be spruce and ruffed grouse

Table 2-3 List of Traditional Country Foods

Type of Country Food	Traditional Country Food Species	Kainai First Nation	Ermineskin Cree Nation	Foothills Ojibway First Nation	Ktunaxa First Nation	Louis Bull Tribe	Métis Nation of Alberta	Métis Nation British Columbia	Montana First Nation	Piikani First Nation	Samson Cree Nation	Siksika Nation	Stoney Nakoda Nations	Tsuut'ina Nation
Wildlife (cont'd)	Mink	✓							✓		✓			
	muskrat	✓	✓		✓	✓	✓		✓		✓		✓	
	owl									✓				
	partridge (chukar)	✓						✓		✓				
	pheasant						✓	✓						
	porcupine	✓								✓				✓
	ptarmigan							✓						
	sheep (mountain, bighorn, stone, ram)	✓	✓	✓	✓			✓	✓	✓	✓	✓		✓
	skunk										✓			
	Sprague's pipit										✓			
	squirrel	✓	✓						✓	✓	✓			✓
	swan	✓								✓	✓	✓		✓
	weasel		✓		✓						✓			
	wolverine			✓	✓		✓				✓			
	wolf	✓	✓	✓						✓	✓			✓
Fish	burbot		✓		✓			✓					✓	
	minnow				✓									
	pike (northern), jackfish		✓		✓	✓	✓	✓	✓		✓		✓	
	trout (bull, cutthroat, rainbow)	✓	✓		✓	✓		✓	✓		✓		✓	
	sucker		✓		✓	✓		✓	✓		✓		✓	
	whitefish (mountain)		✓		✓	✓		✓	✓		✓		✓	
Vegetation and Fungus	alsike clover		✓											
	aspen		✓											
	bearberry, *kinnikinnick*	✓	✓		✓	✓		✓	✓	✓				✓

Table 2-3 List of Traditional Country Foods

Type of Country Food	Traditional Country Food Species	Kainai First Nation	Ermineskin Cree Nation	Foothills Ojibway First Nation	Ktunaxa First Nation	Louis Bull Tribe	Métis Nation of Alberta	Métis Nation British Columbia	Montana First Nation	Piikani First Nation	Samson Cree Nation	Siksika Nation	Stoney Nakoda Nations	Tsuut'ina Nation
Vegetation and Fungus (cont'd)	bear root					✓								✓
	bitter berry										✓			
	black root					✓					✓			
	blueberry (high-bush, low-bush, dwarf)		✓			✓	✓	✓	✓		✓			
	bunchberry		✓											
	camas	✓								✓				
	caribou weed							✓						
	cattail						✓	✓						
	cedar (including western red)		✓		✓	✓		✓			✓		✓	
	chokecherry	✓	✓		✓	✓	✓	✓	✓	✓	✓			
	cloudberry, dewberry						✓				✓			
	cohosh, honeysuckle						✓							
	cottonwood (black), poplar				✓			✓		✓			✓	✓
	cow parsnip				✓									
	cranberry (low-bush), eye berry, mooseberry		✓		✓	✓	✓	✓	✓		✓			
	currant				✓									
	dandelion							✓						
	diamond willow fungus							✓	✓		✓			
	fireweed	✓						✓						
	frog plant								✓					
	fungus (tree, wood, green wood-cup)		✓				✓							✓
	goldenrod							✓						

Table 2-3 List of Traditional Country Foods

Type of Country Food	Traditional Country Food Species	Kainai First Nation	Ermineskin Cree Nation	Foothills Ojibway First Nation	Ktunaxa First Nation	Louis Bull Tribe	Métis Nation of Alberta	Métis Nation British Columbia	Montana First Nation	Piikani First Nation	Samson Cree Nation	Siksika Nation	Stoney Nakoda Nations	Tsuut'ina Nation
Vegetation and Fungus (cont'd)	gooseberry (northern)		✓		✓	✓	✓		✓		✓			
	green alder		✓				✓							
	horse grass										✓			
	huckleberry		✓		✓	✓		✓			✓			
	juniper (ground, berry)	✓	✓					✓		✓	✓			✓
	king root										✓			
	Labrador tea, muskeg tea, muskeg leaves		✓			✓			✓		✓			✓
	lichen (tree)									✓				✓
	mint, peppermint, wild mint		✓			✓	✓	✓	✓		✓			
	moss (spike, sponge)	✓									✓			
	mushrooms (chanterelle, morel, pine, puff balls)						✓	✓						
	northern bedstraw						✓	✓						
	old-man's beard							✓						
	old-man's whiskers	✓												
	onion (wild, prairie)		✓		✓		✓	✓			✓			
	pigweed (lamb's quarter, red)						✓							
	pine (lodgepole, sweet)	✓	✓						✓	✓	✓			✓
	pineapple weed						✓							
	pin cherry					✓	✓		✓					
	plantain (common, whiteman's foot)		✓				✓	✓						
	prairie clover						✓							

Table 2-3 List of Traditional Country Foods

Type of Country Food	Traditional Country Food Species	Kainai First Nation	Ermineskin Cree Nation	Foothills Ojibway First Nation	Ktunaxa First Nation	Louis Bull Tribe	Métis Nation of Alberta	Métis Nation British Columbia	Montana First Nation	Piikani First Nation	Samson Cree Nation	Siksika Nation	Stoney Nakoda Nations	Tsuut'ina Nation
Vegetation and Fungus (cont'd)	prairie coneflower						✓							
	rabbit root										✓			
	raspberry (wild)		✓				✓	✓	✓		✓			✓
	red clover							✓						
	red osier dogwood, *nipiswasiskwatew*		✓		✓									
	rosehip							✓						
	sage (bush, prairie)	✓	✓			✓	✓	✓			✓			
	saskatoon berry	✓	✓			✓	✓	✓	✓	✓	✓			
	saw-grass							✓						
	silverberry, wolf willow, white sage berry	✓					✓							
	smelly root										✓			
	soapberry, hoshum							✓						
	spruce		✓					✓	✓		✓		✓	
	stinging nettle						✓	✓						
	strawberry		✓			✓	✓	✓			✓			
	sweetgrass	✓	✓			✓					✓		✓	✓
	tiger lily								✓					
	tumbleweed										✓			
	twinberry						✓							
	western dock						✓							
	wheat		✓											
	white birch				✓			✓		✓	✓			
	wild asparagus							✓						
	wild carrot		✓											

Table 2-3 List of Traditional Country Foods

Type of Country Food	Traditional Country Food Species	Kainai First Nation	Ermineskin Cree Nation	Foothills Ojibway First Nation	Ktunaxa First Nation	Louis Bull Tribe	Métis Nation of Alberta	Métis Nation British Columbia	Montana First Nation	Piikani First Nation	Samson Cree Nation	Siksika Nation	Stoney Nakoda Nations	Tsuut'ina Nation
Vegetation and Fungus (cont'd)	wild chives		✓											
	wild potato		✓		✓			✓						
	wild rice										✓			
	wild rose	✓	✓							✓				
	wild tobacco				✓					✓				
	wild turnip	✓								✓				
	willow (red)		✓			✓	✓	✓	✓	✓				✓
	Yarrow	✓						✓		✓				

2.6.4 Current Health Status

There are no specific publicly available health data for the LAA, and therefore the information presented relies on publicly available data for the Calgary Zone the local geographic area of Cochrane-Springbank. The information should not be interpreted as a definitive baseline for residents of the LAA; however, it may be useful for identifying critical receptors as well as in interpreting the HHRA in the context of population baseline, project and cumulative risks" (Alberta Government 2011).

Health Indicators

In addition to the quality of a person's natural environment (e.g., quality of air, water, food), many other factors play a role in determining a person's overall health. These determinants of health include such things as income and social status, education, employment and working conditions, physical environment (such as housing), social support networks, employment and working conditions, biology and genetics, social support networks, personal health practices, healthy child development, and access to health services (Health Canada 2004).

Site Characterization
March 2018

Alberta Health has developed a series of reports to provide a broad range of demographic, socio-economic, and population health statistics for various local geographic areas. The Project is located within the Cochrane-Springbank local geographic area, within the Calgary health services zones. Some of the key findings of the community profile for Cochrane-Springbank (Government of Alberta 2017) were:

- The percentage of obese adults in the Calgary Zone was lower than the provincial percentage in 2014 (19.8% Calgary Zone versus 22.8% Alberta)
- The Calgary Zone reported a lower proportion of inactive people compare to the provincial proportion during the same year (39.4% Calgary Zone versus 43.1% Alberta)
- Cochrane-Springbank's population increased by 295.8% between 1996 and 2016 (compared to 62.2% increase for Alberta) and currently stands at 44,090 people
- The largest age group in Cochrane-Springbank in 2016 was 35-64 year olds, who accounted for 43.2% of the population compared to 40.4% for Alberta
- Cochrane-Sprinbank had a similar proportion of First Nations and Inuit people compared to Alberta (0.5% versus 2.8% Alberta)
- The percentage of female lone-parent families was lower than the provincial percentage (6.5% versus 11.1% Alberta)
- A lower proportion of families with an after-tax low-income level were reported in Cochrane-Springbank compared to Alberta (7.6% versus 10.7% Alberta)
- Cochrane-Springbank reported a higher proportion of people with university certificates, diplomas or degrees compared to Alberta (43.6% versus 30.3% Alberta)
- The mortality rate (per 100,000 population) due to all causes was lower in Cochrane-Springbank in 2013-2015, compared to the province (471.4 versus 634.7 for the Alberta) and the most frequent cause of death reported between 2006 and 2015 was neoplasms
- Acute upper respiratory infections were the most common reason for emergency visits (among select conditions) in 2014, and had a higher rate (per 100,000 population) compared to the provincial rate (4,885.9 versus 3,601.8 Alberta); emergency room visit rates for asthma (per 100,000 population) were similar to the provincial rate (501.5 versus 496.8 Alberta) but emergency room visit rates for emphysema and chronic bronchitis were higher than the provincial rate (564.2 versus 331.1 Alberta)

Cancer and Respiratory Disease

Mortality data for the most common cancers and respiratory diseases are available for the Government of Alberta's Interactive Health Data Application (IHDA) (Government of Alberta 2018). The mortality rates (per 100,000 population) for lung, colorectal, breast, and prostate cancer for both women and men in the Calgary Zone from 2003 to 2012 are presented in Table 2-4. Mortality rates for lung, colorectal breast, and prostate cancer in women and men in the Calgary Zone are similar to or less than the provincial averages.

The Alberta IHDA also provides mortality data are also available for asthma and chronic obstructive pulmonary disease (COPD) (Government of Alberta 2018). The mortality rates (per 100,000 population) for asthma and COPD in the Calgary Zone are presented as from 2000 to 2015 (see Table 2-5). Mortality rates for COPD and asthma in women and men in the Calgary Zone are similar to or less than the provincial averages.

Table 2-4 Mortality Cancer Rates per 100,000 Population in the Calgary Zone from 2003 to 2014 (Provincial Averages are in Parentheses)

Year	Lung		Colorectal		Breast	Prostate
	Female	Male	Female	Male	Female	Male
2003	30.4 (34.0) ↓	50.9 (53.9) ↔	14.4 (15.2) ↔	20.0 (22.0) ↔	22 (24.4) ↓	24.8 (26.8) ↔
2004	34.3 (35.3) ↔	49.8 (52.4) ↔	15.3 (16.2) ↔	25.0 (26.1) ↔	19.2 (19.4) ↔	19.3 (24.0) ↓↓
2005	32.5 (34.9) ↔	45.0 (52.1) ↓↓	12.9 (13.9) ↔	23.3 (23.7) ↔	22.7 (21.6) ↔	17.8 (23.5) ↓↓
2006	31.8 (35.0) ↓	44.4 (47.8) ↓	12.8 (14.7) ↓	19.7 (21.0) ↔	20.8 (20.1) ↔	22.3 (23.4) ↔
2007	31.9 (33.7) ↔	38.5 (49.5) ↓↓	13.0 (15.3) ↓	19.0 (22.1) ↓	18.6 (21.3) ↓	16.6 (21.8) ↓↓
2008	35.9 (35.8) ↔	39.9 (45.4) ↓	12.5 (12.6) ↔	20.5 (21.3) ↔	17.2 (18.9) ↓	18.0 (22.8) ↓↓
2009	28.4 (34.4) ↓↓	40.6 (48.4) ↓↓	11.2 (12.6) ↓	21.9 (22.8) ↔	17.6 (19.9) ↓	19.4 (23.1) ↓
2010	26.9 (33.0) ↓↓	37.3 (45.6) ↓↓	15.0 (14.8) ↔	19.7 (20.3) ↔	16.8 (18.6) ↓	22.6 (21.9) ↔
2011	30.7 (34.8) ↓	35.9 (41.5) ↓↓	9.48 (12.0) ↓↓	19.6 (21.5) ↓	16.3 (17.8) ↓	16.7 (20.1) ↓
2012	24.6 (32.3) ↓↓	33.8 (39.5) ↓↓	11.2 (12.7) ↓	18.4 (20.0) ↔	16.2 (16.6) ↔	15.8 (19.3) ↓↓

NOTES:

Statistical significance of differences between Calgary Zone and Provincial rates (based on IHDA):

↑↑ significantly higher than provincial average
↑ slightly higher than provincial average
↔ similar to provincial average
↓ slightly lower than provincial average
↓↓ significantly lower than provincial average

Table 2-5 Mortality Rates per 100,000 Population for COPD and Asthma in the Calgary Zone from 2000 to 2015 (Provincial Averages are in Parentheses)

Year	COPD		Asthma	
	Female	Male	Female	Male
2000	28.3 (27.8) ↔	56.2 (57.3) ↔	0.845 (1.5) ↓	0.126 (0.44) ↓↓
2001	28.5 (27.4) ↔	47.1 (56.4) ↓	0.18 (0.76) ↓↓	0.804 (1.31) ↓
2002	27.3 (28.5) ↔	46.3 (56.6) ↓↓	0.677 (0.70) ↔	0 (0.72) ↓↓
2003	21.5 (28.5) ↓↓	45.7 (52.3) ↓	0.599 (1.28) ↓	0.294 (0.94) ↓↓
2004	27.6 (29.3) ↔	41.0 (46.4) ↓	0.696 (1.01) ↔	0.489 (1.05) ↓
2005	23.2 (28.3) ↓↓	38.5 (51.1) ↓↓	0.667 (0.87) ↔	0.615 (0.37) ↔
2006	29.5 (28.2) ↔	40.7 (52.1) ↓↓	1.039 (1.04) ↔	0.453 (0.51) ↔
2007	26.0 (29.9) ↓	41.8 (49.0) ↓	0.577 (0.71) ↔	0.388 (0.95) ↓↓
2008	30.4 (30.9) ↔	52.5 (54.5) ↔	0.761 (0.99) ↔	0.445 (0.81) ↓
2009	22.7 (28.5) ↓↓	43.0 (47.7) ↓	0.568 (0.84) ↔	0 (0.62) ↓↓
2010	25.2 (27.1) ↔	36.7 (45.3) ↓↓	0 (0.26) ↔	0.388 (0.93) ↓
2011	28.3 (31.0) ↓	41.1 (48.2) ↓	1.021 (0.79) ↔	0.138 (0.27) ↔
2012	27.0 (30.7) ↓	30.0 (43.5) ↓↓	0 (0.35) ↓	0.303 (0.59) ↔
2013	26.1 (32.5) ↓↓	39.3 (42.6) ↓	0 (0.06) ↓↓	0.793 (0.71) ↔
2014	26.7 (28.8) ↓	27.2 (41.2) ↓↓	0.589 (0.69) ↔	0.446 (0.66) ↔
2015	28.3 (29.4) ↔	37.4 (45.1) ↓↓	0.637 (0.55) ↔	0.82 (0.67) ↔

Table 2-5 Mortality Rates per 100,000 Population for COPD and Asthma in the Calgary Zone from 2000 to 2015 (Provincial Averages are in Parentheses)

NOTES:
Statistical significance of differences between Calgary Zone and Provincial rates (based on IHDA):
↑↑ significantly higher than provincial average
↑ slightly higher than provincial average
↔ similar to provincial average
↓ slightly lower than provincial average
↓↓ significantly lower than provincial average

3.0 PROBLEM FORMULATION

The purpose of the problem formulation stage is to characterize the pathways for which the Project could influence human health risk during the construction, dry operation, flood operation and post-flood operation phases of the Project. For a health risk to exist, three components need to be present during a Project phase: hazards, human receptors and exposure. That is:

1. A chemical must be released or produced to the environment
2. A human receptor (e.g., residents, Indigenous people, or subgroups such as children, adults, or elderly people) must be present
3. A pathway must exist for the human receptor to be exposed to the identified chemical hazard

These three components of the problem formulation are integrated to develop a conceptual site model. The conceptual site model identifies the plausible exposure pathways where human receptors could be exposed to COPCs during each phase of the Project. Exposure pathways that are identified as plausible contributors to human health risk for the Project are deemed as "*operable pathways*". Exposure pathways that are identified as not plausible contributors to human health risk for the Project are deemed as "*inoperable pathways*".

3.1 CHEMICALS OF POTENTIAL CONCERN

Chemicals of potential concern (COPCs) are identified as those chemicals that may be released by Project activities that have the potential to affect human health. COPCs may exist currently in the environment as a result of natural or anthropogenic activities. The following subsections identify the COPCs that were selected from each environmental media, and the rationale for their selection.

3.1.1 Selection of COPCs in Air

The selection of airborne COPCs is based upon modelled Project emissions identified as part of the Air Quality and Climate VC (Section 3.0, Volume 3A and 3B, and Appendix E, Attachment 3A).

Construction Phase

Atmospheric emissions during the construction phase result from construction vehicle exhausts and from fugitive dust associated with the construction activities. Specific air emissions associated with these activities are:

- Criteria air contaminants: sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), particulate matter less than 2.5 micrometres in diameter ($PM_{2.5}$), and diesel exhaust particulate (DEP)
- Volatile organic compounds: 1,3-butadiene, 2,2,4-trimethylpentane, acetaldehyde, acrolein, benzene, ethylbenzene, formaldehyde, propionaldehyde, toluene and xylenes
- Polycyclic aromatic hydrocarbons: acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, and pyrene
- Metals (from vehicle exhaust): arsenic, chromium, mercury, manganese, nickel

The main exposure route for airborne COPCs is inhalation. Each of the above-identified air emissions are considered COPC for inhalation exposures.

To identify COPC for indirect exposure pathways related to deposition (e.g., deposition of contaminant onto soil and uptake into plants), the fate and persistence of chemicals was assessed. The characterization of persistence and bioaccumulation is provided in detail within Environment Canada's Existing Substances Program and the Health Canada and Environment Canada's Domestic Substances List Categorization, under the Canadian Environmental Protection Act.

Persistence refers to the length of time a chemical resides in the environment and is measured by its half-life. This is the time required for the quantity of a chemical to diminish or degrade to half of its original amount within a particular environment or medium. For the purposes of this HHRA, a chemical was considered persistent if its half-life in soil was greater than or equal to (≥) six months (182 days).

Bioaccumulation is a general term used to describe the process by which chemicals are accumulated in an organism directly from exposure to water, soil, or through consumption of food containing the substances. A chemical's potential to bioaccumulate is related to its octanol-water partition coefficient (K_{ow}). The K_{ow} refers to the ratio of distribution of a substance in octanol compared to that in water. For the purposes of this HHERA, a chemical is considered bioaccumulative if its Log K_{ow} was is greater than or equal to 5.

Therefore, exposure of COPC via secondary pathways was considered if the COPC had a:

- half-life in soil greater than or equal to six months or
- log Kow greater than or equal to 5.

The screening completed on the COPC to evaluate persistence and bioaccumulation is provided in Attachment B.

Dry Operation, Flood Operation, and Post Flood Operation Phases

Although the dry operation, flood operation and post-flood operation phases will utilize vehicles that produce airborne COPCs, the number of vehicles required to perform inspection, maintenance and repair activities is insubstantial. For example, only six employees are required during the dry operation phase to perform maintenance and repair duties, likely requiring less than six light trucks for transportation. The short-term, transient nature of these vehicle emissions and the small number of vehicles and equipment required to perform maintenance and repair activities do not produce emissions to a level that could reasonably change the local air quality in a manner that could affect the health of the population.

Concerns were raised by the public regarding fugitive dust that may be generated by high winds during the post-flood operation phase. Fugitive dust may be generated from wind erosion of sediments deposited in the off-stream reservoir after draining. $PM_{2.5}$ was modelled for the post-flood operation phase and included as a COPC for the post-flood operation phase to address these public concerns. $PM_{2.5}$ is was assessed for short-term exposure durations (1-hour and 24-hour), since high wind periods do not apply to long-term durations.

Coarse grained dust from wind erosion is not selected as a COPC. Coarse grained dust may refer to PM_{10} (particulate matter ranging in diameter from 2.5 to 10 micrometres) or larger. The composition of this dust would be soil and silt, which is inert crustal material. When inhaled, coarse dust such as PM_{10} is trapped in the upper respiratory passages (e.g., mouth, nasal cavity, pharynx) which are subsequently swallowed, while $PM_{2.5}$ can penetrate deep into the lungs, bronchioles and alveoli. Federal and international health regulatory agencies (e.g., Health Canada, World Health Organization) recognize that health risk from dust inhalation is primarily associated with $PM_{2.5}$, rather than coarse particulate matter. For example, Health Canada reviewed studies that indicated, "…only limited evidence that crustal coarse particulate matter from Asian dust storm events has an effect on mortality, in spite of the extremely high levels of PM_{10} from dust storms". In contrast, traffic-related $PM_{2.5}$ had a stronger demonstrable relationship with adverse health effects (Health Canada 2016a). The World Health Organization notes that, "the effects of long-term particulate matter exposure on mortality seem to be attributable to $PM_{2.5}$ rather than coarse particles" (WHO 2006). Consequently, coarse dust and dustfall from

wind erosion is discussed in the assessment of air quality and climate (Section 3.0, Volume 3B), but it is not a factor related to public health.

3.1.2 Selection of COPCs in Water

There are no naturally occurring COPCs identified in the waters of the Elbow River. Routine testing of water samples from the Glenmore Reservoir from 2015 and 2016 found that all chemical parameters were within the Canadian drinking water quality guidelines, as noted in Section 2.7.2.

No COPCs are identified in the waters of the Elbow River during the construction and dry operation phases. The PDA does not overlap any confirmed or suspected contaminated site. Therefore, construction and dry operation activities would not mobilize or introduce hazardous chemicals into the Elbow River or downstream at the Glenmore Reservoir.

During the flood operation and post-flood operation phases, the retention of water in the off-stream reservoir may promote the conversion of inorganic mercury into methylmercury. Inorganic mercury is ubiquitous in the environment, and it exists in trace concentrations in the water and soil. Inorganic mercury can be converted into methylmercury by anaerobic microbes in anoxic (i.e., low oxygen) aquatic environments. Such conditions are commonly found at hydro-electric reservoirs. Deep lakes formed by a reservoir often have low dissolved oxygen concentrations in the water due to a low surface area-to-volume ratio. The rate of oxygen consumption by aquatic life and other processes (e.g., decomposition of organic matter) is greater than the rate that oxygen in the atmosphere can diffuse into the water body. In these anoxic conditions, anaerobic microbes can convert inorganic mercury in the sediment or submerged soil to methylmercury. Methylmercury is an organometallic compound, which has a higher potential to accumulate in the food chain relative to inorganic mercury. People who consume aquatic foods from affected areas may be exposed to methylmercury through their diet.

Concerns were raised by the public regarding sediments in the off-stream reservoir resuspending in the water column and flowing back into the Elbow River as total suspended solids during the post-flood operation phase. Total suspended solids in drinking water does not directly affect health, and there are no Canadian drinking water quality guidelines for this parameter.

The Project is a mitigation measure to reduce the potential impacts from a future flood event. During the post-flood operation phase, total suspended solids in the water that is released back into the Elbow River is a small proportion of the total suspended solids that would normally flow into the Elbow River and Glenmore Reservoir during an unmitigated flood. Approximately 97.6% of the total suspended solids that enter the off-stream reservoir will remain as sediment when the reservoir is drained, as predicted in the assessment of surface water quality (Section 7.0,

Volume 3B). The Glenmore Water Treatment Plant can manage high concentrations of total suspended solids to produce safe drinking water. During the 2013 flood in Calgary, boil-water advisories were avoided for municipal waters from the Glenmore Reservoir due to earlier investments in water treatment infrastructure (Alberta Water Portal 2013). The Glenmore Water Treatment Plant will have the capacity to remove the substantially lower concentrations of total suspended solids that are expected during the post-flood operation phase. Consequently, total suspended solids is not selected as a COPC.

3.1.3 Summary List of COPCs

In summary, the COPCs selected for assessment are as follows:

- Construction Phase
  - Criteria air contaminants - SO_2, NO_2, CO, $PM_{2.5}$, DEP
  - Volatile organic compounds - 1,3-butadiene, 2,2,4-trimethylpentane, acetaldehyde, acrolein, benzene, ethylbenzene, formaldehyde, propionaldehyde, toluene and xylenes
  - Polycyclic aromatic hydrocarbons - acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, and pyrene
  - Metals - arsenic, chromium, manganese, mercury, nickel
- Dry Operation and Flood Operation Phases: No COPCs identified
- Post-Flood Operation Phase
  - $PM_{2.5}$, methylmercury

3.2 IDENTIFICATION OF HUMAN RECEPTORS AND RECEPTOR LOCATIONS

Human receptors are people within the study area that could be exposed to COPCs, while human receptor locations are the places where they are likely to be present. The characterization of human receptors is important because distinct groups of people (e.g., infants, elderly, people with existing health conditions, and Indigenous people) may have varying degrees of sensitivity to a COPC, or their behaviours may cause them to be exposed to COPCs in different ways. For many air contaminants, children with asthma, people with COPD, and the elderly are considered the sensitive sub-groups. Members of these sensitive sub-groups may be present at any residential location; however, their presence is more likely at institutional facilities such as schools, hospitals, retirement complexes, and assisted care homes.

Human receptor locations are important if the exposure to a COPC is dependent on the location of the person. For example, exposure to airborne COPCs is dependent on the location of the person, since the concentration in the air will vary between locations. In total, 58 receptor locations within a 5 km radius of the PDA are considered in the HHRA. Locations in the study area that are farther than 5 km from the PDA would experience less change in air quality, and there would be a lower degree of change in the health risk. The receptor locations represent the range of current and anticipated future land use in the LAA, including residential, recreational, educational, commercial, and industrial uses. Table 3-1 lists 58 human receptor locations along with their coordinates and a description of the location. The human receptor locations are also illustrated in Figure 3-1.

Human receptors are hypothetical people of all age group (e.g., infant, toddler, child, adolescent, or adult) who could potentially be exposed to the COPC. Two types of receptors were considered for the evaluation of risks to human health: a residential receptor and an Indigenous receptor. Both residential and Indigenous receptors are assumed to have the opportunity to gather, harvest and consume local foods from the study area including garden produce, wild plants, berries, and fish from the Elbow River. Human receptors also include visitors, tourists, and recreational users. However, these people would only be in the area temporarily and they are expected to have a lower exposure to Project-related COPCs compared to residential and Indigenous receptors who also participate in recreational and traditional activities in the area.

Workers for the Project are not included as human receptors in the HHRA. Worker health and safety is addressed through compliance with applicable provincial (Work Safe Alberta) and federal legislation. Non work-related exposures of these persons (e.g., recreational activities within the study area during non-work hours) would be the same as the other human receptors already identified.

Table 3-1 Human Receptor Locations

Receptor ID	Zone 11 UTM Coordinates		Receptor Location Description
	Easting	Northing	
SR1	676781	5661332	Rural residence 1,000 m from intersection of Highway 1 and Highway 22
SR2	678048	5662120	Rural residence 750 m from intersection of Highway 1 and Highway 22
SR3	678552	5662111	Rural residence 450 m south of Highway
SR4	679819	5660801	Rural residence adjacent to Springbank Road
SR5	680547	5660634	Rural residence 255 m from Springbank Road and Range Road 40
SR6	681210	5661082	Rural residence adjacent to Range Road 40
SR7	682145	5661010	Rural residence adjacent to Range Road 35
SR8	683263	5660233	Rural residence adjacent to Springbank Road
SR9	677002	5660074	Rural residence 520 m from Springbank Road and Highway 22
SR10	676827	5659179	Rural residence adjacent to Highway 22
SR11	677449	5658688	Rural residence adjacent to Highway 22
SR12	680518	5660339	Rural residence 260 m from Springbank Road and Range Road 40
SR13	680670	5660343	Rural residence 110 m from Springbank Road and Range Road 40
SR14	680684	5660190	Rural residence 245 m from Springbank Road and Range Road 40
SR15	681089	5660001	Rural residence 545 m from Springbank Road and Range Road 40
SR16	682288	5658906	Rural residence adjacent to Range Road 35
SR17	683867	5659435	Rural residence adjacent to Range Road 34
SR18	677183	5658120	Rural residence adjacent to Highway 22
SR19	677141	5657024	Rural residence adjacent to Township Road 242
SR20	677303	5656696	Rural residence adjacent to Township Road 242
SR21	679639	5656961	Rural residence adjacent to Elbow River
SR22	680364	5657431	Rural residence in wooded area adjacent to Elbow River
SR23	681065	5657451	Rural residence in wooded area adjacent to Elbow River
SR24	682806	5658065	Rural residence in wooded area adjacent to Elbow River
SR25	677400	5657051	Commercial premises adjacent to intersection of Township Road 242 and Highway 22
SR26	676700	5654151	Rural residence in wooded area adjacent to Elbow River

Table 3-1 Human Receptor Locations

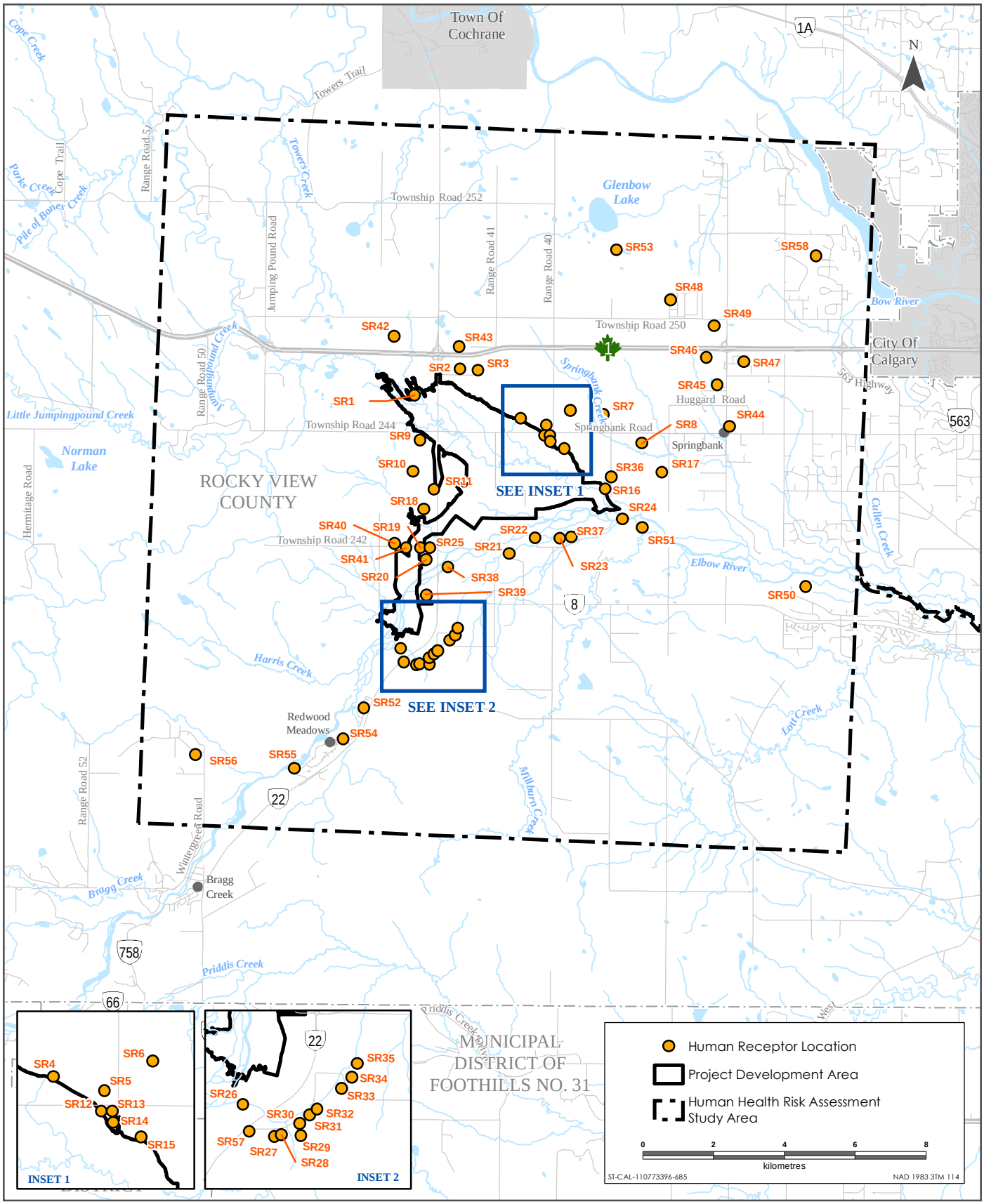
Receptor ID	Zone 11 UTM Coordinates		Receptor Location Description
	Easting	Northing	
SR27*	677250	5653751	Rural residence in wooded area
SR28*	677250	5653751	Entheos Conference and Retreat Centre
SR29*	677500	5653751	Rural residence in wooded area
SR30	677500	5654001	Rural residence in wooded area
SR31	677500	5654001	Rural residence in wooded area
SR32	677750	5654251	Rural residence in wooded area
SR33	678000	5654501	Rural residence in wooded area
SR34	678250	5654751	Rural residence in wooded area
SR35	678250	5654751	Rural residence in wooded area
SR36	682450	5659251	Rural residence adjacent to Range Road 35
SR37	681250	5657501	Rural residence in wooded area adjacent to Elbow River
SR38	677800	5656551	Camp Gardner
SR39	677350	5655701	Kamp Kiwanis
SR40	676400	5657101	Rural residence adjacent to Township Road 242
SR41	676750	5657001	Rural residence adjacent to Township Road 242
SR42	676250	5663001	Rural residence 1,250 m from intersection of Highway 1 and Highway 22
SR43	678000	5662751	Rural residence 600 m from intersection of Highway 1 and Highway 22
SR44	685500	5660501	Springbank Community High School and Springbank Park for All Seasons
SR45	685000	5662001	Springbank Middle School and Elbow Valley Elementary School
SR46	685000	5662501	Calaway Park
SR47	685500	5662501	Commercial area adjacent to Highway 1
SR48	683500	5664001	Springbank Airport
SR49	684500	5663501	The Edge School
SR50	687500	5657001	Glenco Golf and Country Club
SR51	683250	5658001	River Spirit Golf Club
SR52*	675750	5652751	Redwood Meadows community

Table 3-1 Human Receptor Locations

Receptor ID	Zone 11 UTM Coordinates		Receptor Location Description
	Easting	Northing	
SR53	682000	5665001	Harmony community
SR54*	675000	5651501	Curtis Field Park
SR55*	674000	5650501	Redwood Meadows Golf and Country Club
SR56	671500	5651001	Wintergreen Golf and Country Club
SR57*	676750	5653751	Bragg Creek Paintball
SR58	688500	5666001	Springbank Links Golf Course

NOTE:

* indicates receptor location corresponds to the Tsuut'ina Nation reserve and therefore presence of Indigenous receptor is assumed.



Sources: Base Data - ESRI, Government of Alberta, Government of Canada
Thematic Data - ERBC, Government of Alberta, Stantec Ltd

Human Receptor Locations

Stantec

3.3 EXPOSURE PATHWAY IDENTIFICATION AND SCREENING

Exposure pathways are the means by which human receptors may be exposed to COPCs from the Project in the environment. The exposure pathway screening examines the potential exposure pathways for each type of COPC that applies to the HHRA. Typical exposure pathways include:

- inhalation of volatile substances or particulate matter
- ingestion of water, soil, agricultural produce, vegetation, fish and game
- dermal contact with soil or water

The main exposure route for airborne COPCs is inhalation. Because people within the LAA could be exposed to airborne COPC, each of the identified COPC in air are assessed for inhalation exposures.

As noted in Section 3.2.1, metals and some PAHs were identified as meeting the criteria for persistence and bioaccumulation, and therefore further consideration for secondary exposures related to deposition were considered (i.e., deposition and accumulation in soil, plant uptake from soil, uptake to birds and mammals via ingestion of plants, soil invertebrates and incidental ingestion of soil). The deposition rates for these COPCs in diesel exhaust are low, and the construction period is limited to 3 years. Therefore, to evaluate whether these secondary pathways represent a potential risk to human health, a review of the maximum potential Project-related effects to soil chemistry were evaluated. Soil concentrations for each of the COPC were predicted based on maximum deposition rates, as described in Attachment B. Project-related changes in soil chemistry are considered negligible since:

- Maximum changes in soil chemistry are negligible (less than 5%) and/or
- Predicted concentrations are less than health-based screening levels.

The location of maximum deposition is located close to the PDA. Deposition rates (and hence potential changes in soil chemistry) at the receptor locations are lower. Based on these results, secondary pathways related to the airborne COPC (such direct contact with soil, ingestion of country foods and garden produce) are not considered farther in the HHRA.

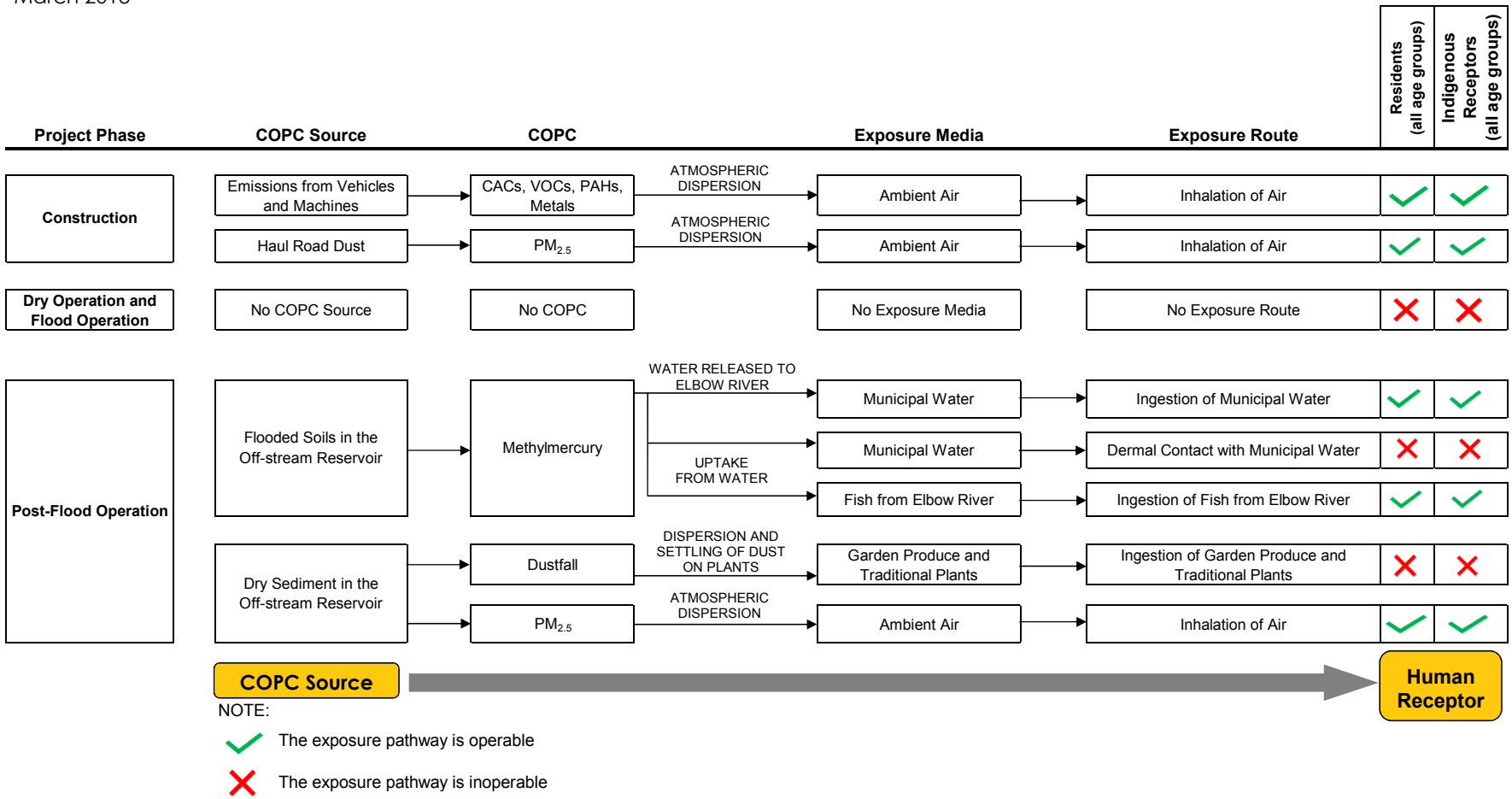
The main exposure route for methylmercury in the water is from ingestion. Specifically, people that consume municipal tap water that has been treated in the Glenmore Water Treatment Plant. Exposure to methylmercury may also occur from the ingestion of fish that have taken up methylmercury from the Elbow River. Dermal absorption through contact with water is a negligible exposure route. Studies indicate that inorganic and organic mercury reacts with skin proteins and are absorbed at similar rates through the skin (Guy et al. 1999).

3.4 CONCEPTUAL SITE MODEL

The conceptual site model is a core component of the HHRA. The conceptual site model illustrates the plausible pathways by which human receptors could be exposed to COPCs from project activities. The conceptual site model combines key information regarding COPC sources, human receptors or human receptor locations, and exposure routes for COPCs.

An exposure pathway is characterized as "operable" if there is a reasonable expectation that human receptors could be exposed to COPCs from the Project in a manner that influence the health risk. Operable exposure pathways are characterized further in the HHRA. An exposure pathway is characterized as "inoperable" if one of the three components of health risk is not present (i.e., there is no chemical hazard, there are no human receptors, or there is no exposure to the chemical hazard by human receptors). Further screening may be undertaken to exclude pathways whose contribution to exposure for a specific chemical is expected to be not significant (Alberta Health and Wellness 2011). Inoperable exposure pathways are not carried forward in the HHRA.

The conceptual site model is presented in Figure 3-2, which indicates the operable pathways with a green check icon (√), and the inoperable pathways with a red cross icon (**X**).



Conceptual Site Model

Figure 3-2

4.0 TOXICITY ASSESSMENT

The toxicity assessment characterizes the potential health effects of each COPC through the applicable exposure routes, and establishes toxicological reference values (TRVs). TRVs are dose or exposure concentration limits that are derived using a conservative approach intended to protect human health, including sensitive members of the population such as infants, children, the elderly and women of child-bearing age.

4.1 THRESHOLD AND NON-THRESHOLD EFFECTS

Two basic categories of contaminants are commonly recognized by regulatory agencies (depending on the contaminant's mode of toxic action) and applied when estimating TRVs for human health (US EPA 1989): "threshold" (typically used to evaluate non-carcinogens) and "non-threshold" contaminants (typically used for carcinogenic compounds).

In the case of threshold contaminants, a threshold level must be exceeded for toxicity to occur. A no observable adverse effect level (NOAEL) can be identified for threshold contaminants, which is the dose or amount of the contaminant that results in no obvious response in the most sensitive test species and test endpoint. The application of uncertainty or safety factors to the NOAEL provides an added level of protection, allowing for derivation of a TRV that is expected to be safe to the general public following exposure for a prescribed period of time. TRVs for threshold contaminants are typically provided in terms of an acceptable concentration (e.g., µg/m^3) or an acceptable dose, most commonly expressed in terms of the total intake of the contaminant per unit of body weight per day (mg/kg-day).

Carcinogenic contaminants are capable of producing cancer by altering genetic material. Regulatory agencies such as Health Canada and the US EPA assume that any level of long-term exposure to carcinogenic chemicals contaminants is associated with some "hypothetical cancer risk". As a result, regulatory agencies have typically employed acceptable Incremental Lifetime Cancer Risk levels (ILCR) (i.e., levels over and above those that one would expect to be exposed to from background sources other than related to the Project). Generic nomenclature for TRVs for non-threshold contaminants includes Unit Risk, defined as the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a unit concentration of 1 µg/L in water, or 1 µg/m^3 in air (US EPA 1989), and cancer Slope Factor, which is generally defined as the upper-bound increased cancer risk from a lifetime exposure to an agent usually expressed in units of proportion (of a population) affected per mg/kg-day (US EPA 1989). It is also appropriate to express TRVs for carcinogens in terms of a risk-specific dose or concentration. For this assessment, inhalation unit risk factors were also expressed as risk-specific concentrations associated with the ILCR level that regulatory agencies in Alberta and Health Canada consider to be "essentially negligible" of 1 in 100,000 (Alberta Government 2011). Because these risk-specific concentrations are based on targets over and above the risks

experienced by the general population due to background exposure levels, their use is limited to Project Case concentrations.

The toxicity of a chemical has been observed to vary between acute (short-term) and chronic (long-term) exposure. Thus, it is important to differentiate TRVs based on duration of exposure. The two TRV durations used in the current HHRA can be described as follows.

- Acute: The amount or dose of a chemical that can be tolerated without evidence of adverse health outcomes on a short-term basis. These limits are routinely applied to conditions in which exposures extend from minutes through several hours or several days only (ATSDR 2006). For the HHRA, risks are evaluated based upon 1- to 24-hour exposure periods, where a relevant acute TRV for that time period is available.
- Chronic: The amount of a chemical that is expected to be without health outcomes, even when exposure occurs continuously or regularly over extended periods, possibly lasting for periods of at least a year, and possibly extending over an entire lifetime (ATSDR 2006).

The TRVs applied in this HHRA are guidelines and objectives published by provincial, federal or international regulatory agencies that are protective of health. When TRVs for a particular COPC are available from multiple regulatory agencies, preference was given to those provided by Alberta Environment and Parks; and Health Canada.

For airborne COPCs, when regulatory agencies did not publish toxicological limits, health-based ambient air quality objectives were sometimes selected as TRVs. These include the Alberta ambient air quality objectives (AAAQO), National Ambient Air Quality Objectives (NAAQO) and the Canadian Ambient Air Quality Standards (CAAQS). If more than one guideline or objective is available, the more conservative value was selected as the TRV.

4.2 TOXICOLOGICAL REFERENCE VALUES

Comprehensive toxicity evaluations for many of the COPC have been prepared by agencies such as Health Canada, US EPA, California EPA, Texas Commission on Environmental Quality (TCEQ), and the World Health Organization (WHO). The following profile represents a short summary of the relevant background information related to the selected TRVs.

4.2.1 Criteria Air Contaminants

Criteria air contaminants (CACs) are generally defined as a group of air pollutants that cause smog, acid rain, and other health hazards, commonly associated with the burning of fossil fuels. These typically include nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO), and particulate matter ($PM_{2.5}$).

Nitrogen Dioxide (NO2)

Nitrogen oxides are a mixture of gases composed of nitrogen and oxygen with one of the most toxicologically significant being nitrogen dioxide. Nitrogen oxides are emitted primarily from the exhaust of motor vehicles, the burning of coal, oil or natural gas and during processes such as arc welding, engraving and dynamite blasting (ATSDR 2002).

Inhalation exposure to NO_2 increases the likelihood of respiratory problems as NO_2 inflames the lining of the lungs and can reduce immunity to lung infections. Health Canada classifies NO_2 as having non-threshold effects, meaning that there is no clear evidence of a threshold concentration that results in a health effect (Health Canada 2017b). The relationship between exposure concentration and health response is approximately linear for short-term exposures, indicating that incremental increases in NO_2 exposure presents an increased risk at all concentration ranges.

Human receptors that are sensitive to NO_2 include asthmatics and people with chronic obstructive pulmonary disease. For these individuals, exposure to low concentrations can irritate the eyes, nose, throat and lung as well as causing shortness of breath, fluid build-up in the lungs, tiredness and nausea (ATSDR 2002, Health Canada 2017b). Inhalation of high doses can cause burning, spasms and swelling of the throat and upper respiratory tract, reduced oxygenation of body tissues and in extreme cases, death (ATSDR 2002). Exercise can exacerbate symptoms due to the increased rate of ventilation.

As NO_2 has been classified as having non-threshold effects, the acute and chronic TRVs for NO_2 are based upon the CAAQS, as they are more conservative than the AAAQO and NAAQO:

- Acute, 1-hour NO_2: 114 µg/m^3, based on the 3-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations
- Chronic, Annual NO_2: 32 µg/m^3, based on the average over a single calendar year of all 1-hour average concentrations

Sulphur Dioxide (SO2)

SO_2 is a colorless gas with a pungent odor. The combustion of fossil fuel is the dominant source of SO_2 emissions in the world, primarily emitted at power plants and other industrial facilities, as well as fuel combustion in automobiles, locomotives, ships, and other types of machines and equipment. Natural sources of SO_2 include volcanoes and forest fires.

SO_2 has been linked to a number of adverse effects on the respiratory system (ATSDR 1999a). The immediate effect of SO_2 on the respiratory system is irritation of the mucous membranes resulting from the reaction with water that forms an acid. Bronchoconstriction, reduced lung function and other respiratory symptoms that follow include rapid shallow breathing. Asthmatics and people with chronic obstructive pulmonary disease are therefore likely more sensitive to the respiratory effects of SO_2 due to pre-existing inflammation associated with the disease.

A human study investigating eye and respiratory irritation from acute exposure (minutes to hours) found irritant effects exposure concentrations of 1 part per million (1 ppm = approximately 2,600 µg/m^3). Decreased lung function was also observed when these exposures were combined with exercise (Arts et al. 2006). However, the US Environmental Protection Agency reported that the epidemiological evidence for respiratory effects of long-term SO_2 exposure was inadequate to infer a causal relationship (Health Canada 2017c, US EPA 2008a).

The CAAQS for SO_2 were developed in recognition of the respiratory health effects associated with acute inhalation exposures, and represent the most recent (and most conservative) of the AAAQO, NAAQO and CAAQS. There is inadequate toxicological information to infer a causal relationship with long-term SO_2 exposure. Consequently, the chronic, annual SO_2 TRV applies the lowest annual objective among the AAAQO, NAAQO and CAAQS, which is an ecosystem-based objective to protect vegetation. These acute and chronic values are based on a statistical comparison, as shown below:

- Acute, 1-hour SO_2: 183 µg/m^3, based on the 3-year average of the annual 99th percentile of the SO_2 daily maximum 1-hour average concentrations
- Chronic, Annual SO_2 = 13 µg/m^3, based on the average over a single calendar year of all the 1-hour average SO_2 concentrations

Carbon Monoxide (CO)

CO is a colorless, non-irritating, odorless and tasteless gas that can be found in both indoor and outdoor air. The main source of CO comes from incomplete combustion of carbon-containing fuels such as natural gas, oil, wood, propane and kerosene (Kampa and Castanas 2008) as well as from photochemical reactions in the atmosphere (US EPA 2011). In Canada, on-road gasoline emissions contribute to approximately 1 part per billion (1 ppb = 1.15 µg/m^3) of CO to the annual average daily maximum concentration. Around larger urban centres, on-road gasoline emissions may contribute 100 to 500 ppb (115 to 576 µg/m^3) of CO.

Inhaled CO can bind to a number of heme-containing molecules, mainly hemoglobin in red blood cells, resulting in decreased oxygen availability to critical tissues and organs specifically the heart. Exposure to low CO concentrations might induce fatigue while exposure to high levels of CO might lead to impaired vision, impaired coordination, headaches, dizziness, confusion, nausea and flu-like symptoms. At extremely high levels, CO can cause death (US EPA 2011).

Several controlled studies on human test subjects have been conducted and the best data describing the effects of exposure to low CO concentration are those for individuals diagnosed with coronary disease. Following CO exposure, myocardial ischemia (for COHb level of 2.4%), a reduction in the duration of the exercise caused by chest pains (for COHb level of over 3%) and an increase in the number and complexity of arrhythmia (for COHb level of 6%) were observed (US EPA 2011). Based on these studies, Health Canada suggests that, in order to protect the entire population, COHb levels should not exceed 2% to 2.5% (Health Canada 2010b). Almost all cases of CO poisoning are associated with indoor or enclosed environments. An enclosed space with an active source of CO can displace oxygen and result in high CO concentrations if the space also has poor ventilation. High concentrations of CO in outdoor environments are rare, and typically associated with industrial accidents and releases of stored CO in a pure form.

For the purposes of this HHRA, the AAAQO and NAAQO for 1-hour and 8-hour exposures were used to characterize the health risk from acute exposure to CO. These values were derived by Health Canada (1994) based on the carbon monoxide concentration that will result in a COHb level of less than 1%. The 1-hour averaging period is intended to be protective for effects that might occur following short exposures to high concentrations of carbon monoxide, while the 8-hour averaging period reflects that most individuals approach equilibrium levels of COHb in the blood after about 8–12 hours of exposure to CO (Health Canada 1994).

These acute TRVs for CO are:

- 1-hour CO = 15,000 µg/m^3
- 8-hour CO = 6,000 µg/m^3

These TRVs are based upon the AAAQO and NAAQO. These objectives are based on clinical evidence relating to reduced oxygen carrying capacity of hemoglobin in the blood (Health Canada 1994, AEP 2017).

Particulate Matter (PM2.5)

$PM_{2.5}$ represents particles smaller than 2.5 microns and are defined as fine particles. PM consist of a complex mixture of solid and liquid particles of organic and inorganic substances suspended in the air. The major components of PM are sulfate, nitrates, ammonia, sodium chloride, black carbon, mineral dust and water. On-road gasoline emissions are a minor contributor to the annual average $PM_{2.5}$ concentrations across Canada. Gasoline emissions contribute less than 0.01 µg/m^3 of $PM_{2.5}$ in rural areas, and approximately 0.5 to 2.0 µg/m^3 in urban centres (Health Canada 2017d).

Particles are defined based on their size, rather than chemical composition because particle size is the parameter that is directly linked to their potential for causing health problems. When inhaled, larger particles are trapped in the upper respiratory system such as nasal hairs, and the mucousa of the nose, pharynx, and bronchioles, while smaller particle sizes (<$PM_{2.5}$) can penetrate deeper into the respiratory system and into the alveoli of the lungs, which result in a greater health effects.

Several studies have linked particle pollution with various health effects such as premature death in people with heart or lung disease, nonfatal heart attack, irregular heartbeat, aggravated asthma, decreased lung function and increased respiratory symptoms (irritation of the airways, coughing or difficulty breathing). People with heart or lung diseases, children and older adults are the most likely to be affected by particle pollution exposure (US EPA 2003). There is no recognized threshold of health effects for $PM_{2.5}$ and there is evidence that adverse health effects occur at current levels of exposure. For the purposes of this HHRA, the AAAQO and NAAQO for acute and chronic exposures were used to characterize the health risk from $PM_{2.5}$:

- 1-hour $PM_{2.5}$ = 80 µg/m^3
- 24- hour $PM_{2.5}$ = 28 µg/m^3, based on the 3-year average of the annual 98th percentile of the daily 24-hour average concentrations
- Annual $PM_{2.5}$ = 10 µg/m^3, based on the 3-year average of the annual average concentrations.

Diesel Exhaust

Health Canada reviewed a number of studies on the health effects of exposure to diesel exhaust ranging from rural farm, urban city, and occupational exposures (Health Canada 2016b). Inhalation of diesel exhaust may result in a variety of health effects, in part due to the mixture of chemical hazards, where each chemical hazard may have different types of health effects and at different concentrations. Sensitive groups of people generally include children, asthmatics, and people with chronic obstructive pulmonary disease (COPD).

Acute inhalation of diesel exhaust shows a causal relationship with respiratory effects, and a likely relationship with cardiovascular and immunological effects. There is some evidence to suggest a relationship between exposure to diesel exhaust and reproductive, developmental, and central nervous system effects. However, long-term relationships are more difficult to distinguish due to the co-exposure to other airborne hazards in the air.

For non-cancer health effects, diesel exhaust particulate (DEP) was chosen by Health Canada (2016b) as the basis for development of acute and chronic exposure guidance values as:

- toxicological studies have demonstrated DEP to be the main causative agent of many of the health effects associated with diesel exhaust exposure
- removal of the particulate component of diesel exhaust resulted in fewer or less severe health effects
- the DEP component of exhaust contains compounds known to be hazardous to human health, and DEP contributes to ambient PM, which is also known to be harmful to human health
- DEP is typically the parameter used to set experimental exposure levels

Health Canada (2016b) acknowledges that it would be preferable to use epidemiological data for large populations for characterization of the exposure–response relationship between short-term and long-term diesel exhaust exposure and non-cancer health effects; however, the current data are not deemed adequate for this purpose.

Health Canada (2016b) reviewed controlled human exposure studies to determine the critical effect associated with short-term exposure to diesel exhaust, and concluded that respiratory endpoints are the most sensitive, with effects demonstrated at lower concentrations than for other types of endpoints (such as cardiovascular health). Based on multiple studies conducted with healthy and/or mildly asthmatic participants, increased measures of airway resistance and/or respiratory inflammation were observed at 100 µg/m^3 diesel exhaust particulate for a 2 hour exposure period (Mudway et al. 2004; Riedl et al. 2012; Stenfors et al. 2004; Behndig et al. 2006, 2011). Based on this lowest-observed adverse effect level of 100 µg/m^3, Health Canada (2016b) derived a short-term exposure (2 hour) guidance value for diesel exhaust particulate of 10 µg/m^3. This Health Canada value was selected as the TRV for short-term exposures, and was conservatively applied to 1-hour concentrations.

For chronic exposure to diesel exhaust, a consistent exposure–response relationship for respiratory effects were observed in studies with animal test species, and epidemiological studies also indicate that respiratory health effects are associated with human exposures (Health Canada 2016b). Health Canada (2016b) derived a chronic exposure limit using the no-observed-adverse-effect level of 0.46 mg/m^3 DEP from the inhalation study on rats by Ishinishi et al. (1986, 1988) by performing dosimetric modelling to derive a human equivalent concentration of 0.12 mg/m^3 DEP. Based on the human equivalent concentration of 0.12 mg/m^3 DEP and applying a composite uncertainty factor of 25, Health Canada derived a chronic exposure guidance value of 5 µg/m^3 DEP. This value is consistent with values previously developed by the World Health Organization, the US EPA and the California EPA, and was selected for use in this HHRA.

The International Agency for Research on Cancer classifies diesel exhaust as a Group 1 human carcinogen. The Group 1 classification indicates that there is sufficient evidence to conclude carcinogenicity in humans. Specifically, diesel exhaust has exhibited a causal relationship with lung cancer, and a suggested relationship with bladder cancer (Health Canada 2016b, IARC 2013). However, within their most recent document, Health Canada (2016b) has not evaluated studies for use in a quantitative exposure–response analysis of lung cancer risk with diesel exhaust particulate exposure. Given the limited exposure period (i.e., 3 years of construction over a typical 80 year receptor lifetime), the chronic TRV for diesel exhaust particulate that is considered protective of non-cancer effects is expected to be protective of chronic exposures associated with exposures throughout the construction period.

4.2.2 Volatile Organic Compounds

VOCs are organic compounds with a high vapour pressure at ambient temperatures that allow these substances to volatilize or evaporate into the air relatively quickly. Fuel-based VOCs associated with Project-related activities include acetaldehyde, acrolein, benzene, ethylbenzene, formaldehyde, toluene and xylenes.

1,3-Butadiene

1,3-Butadiene is a flammable, colourless gas with a mild aromatic odour. It is ubiquitous in the environment, and is produced from the combustion of organic matter (Environment Canada 2000a). Emission sources include chemical products industries such as plastics, refined petroleum and coal, automobile exhaust (gasoline- and diesel- motor vehicles) and cigarette smoke. In air, 1,3-butadiene is rapidly degraded by photochemical reactions to form acrolein and formaldehyde (US EPA IRIS 2002).

There is a paucity of data on acute human exposure to butadiene. The OEHHA (2013) developed an acute (1-hour) exposure limit of 660 µg/m^3 for 1,3-butadiene based on an inhalation study using pregnant mice and offspring, as it addressed the most sensitive non-cancer endpoint associated with butadiene – developmental effects (lowered male fetal weight). As no acute toxicity-based criterion for 1,3-butadiene has been established by regulatory agencies in Canada, nor by the US EPA, the OEHHA value was selected for this HHRA.

The US EPA IRIS (2002) established a chronic inhalation TRV of 2.0 µg/m^3 for 1,3-butadiene. This value was derived based on a human equivalent benchmark response of 1,980 µg/m^3 from a two-year mouse inhalation study (NTP 1993) and an uncertainty factor of 1,000 (composed of 3 for interspecies variation, 10 for intraspecies variability, 10 for extrapolation to a level below the 10% effect level, and an additional 3-fold for an incomplete database). The critical effect was ovarian atrophy. This value was selected as the chronic (annual) ambient air exposure limit by both the Ontario MOECC (2016) and the OEHHA (2013), and was considered appropriate to evaluate long-term non-carcinogenic exposure risks to 1,3-butadiene within the current assessment.

The US EPA IRIS (2002) also derived an inhalation unit risk of 3.0×10^{-6} $(\mu g/m^3)^{-1}$, which equates to a risk-specific concentration of 0.3 $\mu g/m^3$ at the 1-in-100,000 risk level. This value was derived from a retrospective cohort study (Delzell et al. 1995) of more than 15,000 male styrene-butadiene rubber production workers to provide high-quality epidemiologic data on leukemia risk from 1,3-butadiene exposure. The risk-specific concentration of 0.3 $\mu g/m^3$ was selected to conservatively screen for potential long-term cancer health risks associated with 1,3-butadiene.

2,2,4-Trimethylpentane

2,2,4-Trimethylpentane (isooctane) is an isomers of octane. Octanes are natural constituents in crude oil, natural gas, and gasoline, and the combustion of gasoline is a major mechanism for the release of octanes into the atmosphere (TCEQ 2016). Isooctane has a low order of acute toxicity, and information from human studies regarding the acute toxicity of octanes is limited. Therefore, the TCEQ (2016) relied on animal studies to develop an acute (1-hour) and chronic TRVs.

Short-term inhalation of high concentrations (≥ 1,000 ppm) of octane causes depression of the central nervous system, respiratory arrest, and mucous membrane, sensory and motor irritation in mice and rats (TCEQ 2016). The key study used by the TCEQ in their development of the acute (1-hour) TRV of 19,000 $\mu g/m^3$ was Boyes et al. (2010), which evaluated the potential neurological impairment from inhalation exposures to 2,2,4-trimethylpentane in adult male rats and established a no-observed adverse effect level.

A subchronic inhalation toxicity study based on exposing male and female rats to a product that was 85% 2,2,4-trimethylpentane for 12 weeks (Exxon 1987) was the key study used for the chronic assessment. No statistically significant differences in clinical signs or hematological/microscopic parameters were observed. The high-dose used in the study was considered an appropriate no observed adverse effect level and conservatively used by TCEQ (2016) to derive a chronic inhalation TRV of 1,800 $\mu g/m^3$.

Acetaldehyde

Acetaldehyde is a colorless liquid with a pungent fruity odour, and is highly volatile. Anthropogenic sources include combustion from motor vehicles, furnaces, power plants, waste incinerators, cigarettes, and cooking of certain types of food. Emissions also result from industrial manufacturing of products with residual acetaldehyde. The secondary formation of acetaldehyde from photochemical reactions with organic compounds and pollutants in the atmosphere is a major source that often exceeds primary emissions (Environment Canada 2000b). Humans are exposed to acetaldehyde primarily through the inhalation of ambient and indoor (Environment Canada 2000b). General effects documented from acute occupational exposure to acetaldehyde vapours include irritation of the throat, eyes, skin, and mucous membranes, pulmonary edema, and headaches while prolonged occupational exposure in

humans has resulted in a decline in red and white blood cells, and a rise in blood pressure (WHO 1995).

The AAAQO for 1-hour exposures to acetaldehyde was adapted from Texas (AEP 2017); however, the basis of the short-term guideline developed for Texas is odour, not health (TCEQ 2016). The OEHHA (2008) reviewed a number of studies, and selected a study by Prieto et al. (2000) investigated human asthmatic volunteers for bronchoconstriction following short-term exposure to aerosolized acetaldehyde solutions to derive an acute (1-hour) exposure limit of 470 µg/m^3. This value was selected for use in this HHRA.

A chronic exposure limit of 9.0 µg/m^3 was derived by US EPA IRIS (1991a) using a no observed adverse effect level for the degeneration of olfactory epithelium in short-term inhalation studies on rats. A more recent review by OEHHRA (2008) relied on the same rat inhalation studies, but derived a chronic exposure limit of 140 µg/m^3.

The US EPA IRIS (1991a) also derived an inhalation unit risk of 2.2 x 10^{-6} (µg/m^3)$^{-1}$, which equates to a risk-specific concentration of 4.5 µg/m^3 at the 1-in-100,000 risk level. This value was derived from based in the incidence of nasal squamous cell carcinoma in rats following inhalation exposure study. The risk-specific concentration of 4.5 µg/m^3 was selected to conservatively screen for potential health risks associated with long-term exposure to acetaldehyde via inhalation, as it is lower than the non-cancer chronic exposure limits.

Acrolein

Acrolein is a clear to yellowish liquid with an acrid odour and vaporizes readily due to its high vapour pressure. Acrolein degrades easily and hence it is not persistent in the environment. The primary use of acrolein is in the synthesis of acrylates, a family of vinyl polymers. Acrolein is released into the environment primarily through combustion processes. which include motor vehicles, waste incinerators, furnaces, coal-based electric power generation plants, and cigarette smoking (ATSDR 2007a).

Both the OEHHRA (2008) and the Ontario Ministry of Environment (2009) derived acute (1-hour) hour exposure limits for acrolein based on a key study by Darley et al. (1960), which evaluated subjective reports of eye irritation in human volunteers exposed to acrolein for five minutes. The lowest observed adverse effect level in the study was 140 µg/m^3. However, the agencies applied different uncertainty factors to arrive at different exposure levels: 4.5 µg/m^3 (Ontario Ministry of Environment) and 2.3 µg/m^3 (OEHHA). Since the AAAQO for acrolein is based on the Ontario value of 4.5 µg/m^3, this value was considered appropriate for use in this HHRA.

A chronic RfC for acrolein of 0.02 µg/m^3 was derived by the US EPA IRIS (2003a) based upon nasal lesions observed in a subchronic inhalation study on rats by Feron et al. (1978). More recently, the OEHHA (2008), the Ontario Ministry of Environment (2009) and the TCEQ (2015a) assessed the potential chronic effects from inhalation of acrolein and relied on a more recent

chronic inhalation study on rats by Dorman et al. (2008). The Ontario Ministry of Environment (2009) derived a 24-hour average exposure limit of 0.4 µg/m^3 to be protective of chronic exposures, while the OEHHA (2008) derived a chronic (annual average) exposure limit 0.35 µg/m^3 and the TCEQ (2015a) derived a chronic (annual average) exposure limit of 2.7 µg/m^3 (derivation differences were related to dosimetric adjustments and selection of uncertainty factors). The chronic value of 0.35 µg/m^3 (OEHHA 2008) was selected for use in the HHRA to characterize health risk from chronic exposure to acrolein since it was based on the newer (Dorman et al. 2008) study, the newer study is recognized by multiple agencies as being the appropriate key study, and is the lower value of the three more recent assessments.

Benzene

Benzene is a colourless liquid with a high vapour pressure and a sweet odour at room temperature, which is produced by natural (e.g., volcanoes and forest fires) and anthropogenic activities (ATSDR 2007b). Incomplete combustion of gasoline, coal, oil and other petroleum-based fuels are the most significant sources of benzene released into the environment (ATSDR 2007b). Inhalation is the general public's primary route of exposure to benzene (ATSDR 2007b). Acute exposure to benzene may cause in dizziness, headaches, and drowsiness while chronic inhalation exposure to benzene affects the bone marrow, and the immune and central nervous systems (ATSDR 2007b).

In both human and animal non-carcinogenic studies, data suggest the most sensitive endpoint for short-term inhalation exposure to benzene is hematotoxicity (TCEQ 2015b, ATSDR 2007b). A lowest-observed-adverse-effect-level of approximately 10 ppm for hematotoxic effects of benzene in mice was indicated in a key study by Rozen et al. (1984), which was selected as the key study by both the TCEQ (2015b) in their derivation of an acute exposure limit (1 hour) of 580 µg/m^3, and by ATSDR (2007b) in their derivation of an acute (1 to 14 day) exposure limit of 30 µg/m^3 (0.009 ppmv). This same value (30 µg/m^3) is used as the AAAQO for acute (1-hour) exposure to benzene. For this HHRA, the ATSDR and AAAQO exposure limit of 30 µg/m^3 was used to assess acute (1-hour) concentrations of benzene.

The Health Canada (2010c) and Alberta Government (2016) provides an inhalation unit risk for benzene of 3.3 x 10^{-6} (µg/m^3)$^{-1}$, which equates to a risk-specific concentration of 3.0 µg/m^3 at the 1-in-100,000 risk level. This value was derived based on the incidence of leukemia observed in human occupational studies (Rinsky et al. 1987). The risk-specific concentration of 3.0 µg/m^3, which is also the AAAQO annual exposure for benzene, was selected to conservatively screen for potential carcinogenic health risks associated with long-term exposure to benzene via inhalation.

The US EPA IRIS (2003b) derived a chronic inhalation exposure limit of 30 µg/m^3 for benzene based on a decreased lymphocyte count observed during a human occupational inhalation study (Rothman et al. 1996). This value (30 µg/m^3) was selected as the chronic inhalation exposure limit in the current assessment.

Ethylbenzene

Ethylbenzene is a naturally occurring volatile, colourless, flammable liquid found in coal tar and petroleum crude oil (ATSDR 2010). Ethylbenzene is present as a gas in both gasoline and diesel exhaust and evaporative emissions from gasoline powered vehicles (ATSDR 2010).

Acute exposure to ethylbenzene in humans is reportedly similar to other low molecular weight aromatics (i.e., toluene, xylenes), with the central nervous system as the primary target organ (TCEQ 2015c). The reported central nervous system effects in humans include vertigo, dizziness, and hearing loss (TCEQ 2015c; ATSDR 2010). Based on a review of the extensive database of human and animal ethylbenzene inhalation studies, both the TCEQ (2015c) and ATSDR (2010) identified the auditory system as the critical endpoint for ethylbenzene acute toxicity, and selected Cappaert et al. (2000) as the key study. In the Cappaert et al. (2000) study, rats were exposed to ethylbenzene for 8 hours per day for 5 consecutive days in an inhalation chamber. The TCEQ (2015c) derived an acute 1-hour exposure level of 86,000 µg/m^3, which was selected as the TRV for acute (1-hour) concentrations of ethylbenzene.

A chronic inhalation exposure limit of 1,000 µg/m^3 was derived by the US EPA IRIS (1991b) for ethylbenzene for developmental toxicity observed during rat and rabbit developmental inhalation studies (Andrew et al. 1981; Hardin et al. 1981). This value, which is recommended as the chronic inhalation TRV by Health Canada (2010c) and Alberta Government (2016), was selected as the chronic inhalation exposure limit for ethylbenzene within this assessment.

Formaldehyde

Formaldehyde is a gaseous pollutant which is a natural product of biogenic and catabolic biological processes including the natural breakdown of vegetable matter in the environment. Outdoors, combustion emissions, including motor vehicle and other exhausts can be a significant source of the exposure for the general public (WHO 1989). The critical target for toxicity to airborne formaldehyde is the respiratory tract, especially the upper respiratory tract (ATSDR 1999b).

The TCEQ (2008) developed an acute (1-hour) exposure limit of 50 µg/m^3 for formaldehyde based on key inhalation studies on human volunteers by Pazdrak et al. (1993), which included 20 human volunteers (9 with skin hypersensitivity to formaldehyde) and Krakowiak et al. (1998), which also included 20 volunteers (10 with bronchial asthma and suspected respiratory formaldehyde sensitization). The critical health effect in these studies was eye and nose irritation. This value is slightly lower than 1-hour exposure limits established by Ontario Ministry of Environment (1998) and OEHHA (2008), of 65 µg/m^3 and 55 µg/m^3, respectively. The TCEQ (2008) exposure limit was selected for use in this HHRA.

Health Canada did not assign a cancer classification to formaldehyde, but derived a unit risk of 5.3×10^{-6} $(\mu g/m^3)^{-1}$ (which equates to a risk-specific concentration of 2 $\mu g/m^3$ at the 1-in-100,000 risk level) based upon the incidence of nasal squamous tumours and the exposure-response observed during a rat inhalation study (Monticello et al. 1996; Health Canada 2001). This risk-specific concentration was used to conservatively screen for the potential carcinogenic effects of formaldehyde.

To derive a chronic exposure limit protective of non-carcinogenic health effects, the TCEQ (2008) relied on a key study by Wilhelmsson and Holmstrom (1992), who identified the specific critical effects of formaldehyde exposure in the key study as increased rates of symptoms such as eye, nasal, and lower airway discomfort (e.g., cough, wheezing) in a study of exposed workers. The TCEQ chronic exposure limit of 11 $\mu g/m^3$ was used to assess the potential non-cancer health risks of chronic exposure to formaldehyde.

Propionaldehyde

Propionaldehyde is used in the manufacture of plastics, in the synthesis of rubber chemicals, and is a disinfectant and preservative. Exposure to propionaldehyde may occur from ambient air, where it is released from manufacturing facilities, from municipal waste incinerators, and from the combustion of wood, gasoline, diesel fuel, and polyethylenes (USDHHS 1993). Limited information is available on the health effects of propionaldehyde.

The US EPA IRIS (2008b) derived a chronic inhalation exposure limit of 8 $\mu g/m^3$ based on a subchronic inhalation study in rats by Union Carbide (1993) where the critical effect was atrophy of olfactory epithelium (i.e., nervous, respiratory system effects). The US EPA (2008b) indicated that confidence in the principle was low; however, the critical effect identified is consistent with irritant effects identified for other aldehydes. The US EPA IRIS (2008b) exposure limit was used in the HHRA.

Toluene

Toluene is a clear to amber colourless liquid at room temperatures or in the ambient environment (ATSDR 2015). Anthropogenic sources of toluene include processes such as the refinement of gasoline and other fuels from crude oil, coke production, and the manufacture of styrene (ATSDR 2015). Toluene released to the environment does not persist; rather it is readily volatilized or degraded by micro-organisms (ATSDR 2015).

The most sensitive endpoints following acute inhalation of toluene are neurological, and are supported by numerous toxicity studies conducted on both animals and humans (TCEQ 2015b, ATSDR 2015). The key study used by TCEQ (2015b) is Andersen et al. (1983), who reported impaired reaction time and symptoms of headache, dizziness, a feeling of intoxication and slight eye and nose irritation in human volunteers following 6-hour exposures to toluene at 100 ppm (on day four of 4 consecutive days of increasing exposure ranging from 0, 10, 40 and 100 ppm).

The study was used to identify a non-observed-adverse-effect-level (NOAEL) of 40 ppm, from which TCEQ (2015b) derived an acute 1-hour exposure limit of 15,000 µg/m^3. ATSDR (2015) has derived an acute (1 to 14 day) exposure limit of 7,600 µg/m^3 based on a study by Little et al. (1999) in which human volunteers were subjected to neuropsychological tests prior to and after 20 minute exposures to toluene. The TCEQ acute exposure limit of 15,000 µg/m^3 was used to screen maximum 1-hour concentrations of toluene, while the ATSDR acute exposure limit of 7,600 µg/m^3 was used to screen maximum 24-hour concentrations of toluene.

Health Canada (2010c) used the Andersen et al. (1983) study to derive a chronic inhalation exposure limit of 3,750 µg/m^3 for toluene. This is the same chronic inhalation TRV recommended by Alberta Government (2016), and was therefore used in this HHRA.

Xylenes

Xylenes are a group of three isomers of dimethyl benzene: o-, m-, and p- xylene, which evaporate easily into air from other environmental media. Xylenes are released into the environment from fugitive industrial emissions (e.g., petroleum refineries, chemical plants), car exhaust, and from its use as a solvent in commercial and industrial products. It can also be released from the use and storage of petroleum products.

Neurological and respiratory effects have been identified as critical endpoints following acute inhalation exposure to xylenes, and have been observed in humans after xylene inhalation. Both TCEQ (2015d) and ATSDR (2007) identified as the key study for their derivations of acute exposure limits. In this study, human volunteers were exposed to m-xylene and clean air (controls) for 2 hours in an inhalation chamber (TCEQ 2015d). Subjects exposed to xylene reported mild respiratory effects and subjective symptoms of neurotoxicity (headaches, dizziness, and a feeling of intoxication). Using these findings, the TCEQ (2015d) derived an acute 1-hour exposure limit of 7,400 µg/m^3 and the ATSDR (2007) derived an acute (1 to 14 day) exposure limit of 8,700 µg/m^3. For this HHRA, the 1-hour exposure limit of 7,400 µg/m^3 was used to assess acute exposures.

A chronic inhalation exposure limit of 180 µg/m^3 was derived by Health Canada (2010c) for xylenes for developmental effects (maternal effects, fetal retardation, increased proportion of fetal mortality and resorbed fetuses) observed during a subchronic inhalation study of rats (Ungvary and Tantrai, 1985). This value, which is recommended as the chronic inhalation TRV by Alberta Government (2016), was selected as the chronic inhalation exposure limit for xylenes within this assessment.

4.2.3 Polycyclic Aromatic Hydrocarbons

PAHs are a class of organic compounds containing only carbon and hydrogen, where the carbon atoms form multiple aromatic rings. PAHs are ubiquitous in the environment, and are formed by incomplete combustion of organic matter. Natural processes that produce PAHs include volcanic activity, forest fires, and lightning strikes. PAHs are also found naturally in fossil fuels such as oil and coal. Human activities including the combustion of fossil fuels, barbequing, flame cooking or smoking food, and tobacco smoking can also produce PAHs and release it into the air through the formation of smoke and soot. Among the PAHs, naphthalene is the predominant PAH found in gasoline and diesel exhaust (Marr et al. 1999).

Some polycyclic aromatic hydrocarbons are associated with non-carcinogenic effects (e.g., anthracene) while others are associated with carcinogenic effects (e.g., benzo(a)pyrene).

Non-carcinogenic PAHs

Non-carcinogenic PAHs potentially emitted by Project-related activities and assessed as individual compounds include: acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and pyrene.

Toxicologically relevant values associated with inhalation exposure to individual PAHs is limited to naphthalene. The OMOE (2012) provides an acute (24-hour) ambient air quality criteria of 22.5 µg/m^3 for naphthalene for human health effects; however, the rationale for the derivation (the scientific study, observed health effect, and the uncertainty factor) was not provided. The TCEQ likewise has published environmental screening levels for a number of non-carcinogenic PAHs; however, the toxicological basis was not provided, and in some instances (e.g., naphthalene), the basis of the screening level was odour.

A chronic exposure limit of 3.0 µg/m^3 was derived for naphthalene by the US EPA IRIS (1998a) for nasal effects (hyperplasia and metaplasia in respiratory and olfactory epithelium, respectively) observed during a chronic inhalation study on mice (NTP 1992). The same exposure limit (3.0 µg/m^3) was derived by ATSDR (2005) using more recent scientific studies (NTP 2000; Abdo et al. 2001). The chronic exposure limit developed by the US EPA IRIS (1998a) matches the AAAQO for naphthalene, and was selected as the chronic TRV for the HHRA.

Carcinogenic PAHs

Although there is strong evidence of carcinogenicity for several PAH compounds, benzo(a)pyrene is the compound that has been most reliably studied for carcinogenicity. The International Agency for Research on Cancer classifies benzo(a)pyrene as a Group 1 human carcinogen. The Group 1 classification indicates that there is sufficient evidence to conclude carcinogenicity in humans. Studies on the carcinogenic potential of other PAHs in humans is less certain, and many other PAHs that are suspected carcinogens such as benz(a)anthracene, are

classified as Group 2B human carcinogens. Group 2B carcinogens are those that are considered possible human carcinogens based on limited evidence in human studies, or inadequate evidence in human studies but strong evidence in animal studies.

The mechanism of carcinogenicity among PAHs is believed to be similar. However, the carcinogenic potential differs between PAHs. Health Canada recommends assessing exposures to mixtures of carcinogenic PAHs according to the potency equivalency factor (PEF) approach, in which carcinogenic PAHs are adjusted for their carcinogenic potency relative to benzo(a)pyrene (B(a)P). Concentrations of each compound are multiplied by their PEF and summed to give a B(a)P total potency equivalents (TPE), which represents the carcinogenic potency of the entire mixture. Health Canada provides PEF values for the following PAH compounds identified as COPC for this Project:

- Benz(a)anthracene = 0.1
- Benzo(a)pyrene = 1.0
- Benzo(b)fluoranthene = 0.1
- Benzo(g,h,i)perylene = 0.01
- Benzo(k)fluoranthene = 0.1
- Chrysene = 0.01
- Dibenz(a,h)anthracene = 1.0
- Fluoranthene = 0.001
- Indeno (1,2,3-c,d)pyrene = 0.1

For acenaphthylene, a PEF value of 0.01was selected, based on RIVM (2001). The final B(a)P TPE is then compared to the chronic carcinogenic exposure limit for B(a)P.

In the development of an inhalation TRV for benzo(a)pyrene, many agencies rely on a key study by Thyssen et al. (1981), in which squamous cell neoplasia in the larynx, pharynx, trachea, nasal cavity, esophagus, and forestomach were observed in male Syrian golden hamsters exposed to benzo(a)pyrene via inhalation for up to 130 weeks. This study forms the basis for Health Canada's (2010c) inhalation unit risk value of 0.000031 $(\mu g/m^3)^{-1}$ (which equates to a risk-specific concentration of 0.3 $\mu g/m^3$ at the 1-in-100,000 risk level), OEHHRA's inhalation unit risk of 0.0011 $(\mu g/m^3)^{-1}$ (which equates to a risk-specific concentration of 0.009 $\mu g/m^3$ at the 1-in-100,000 risk level), and the US EPA IRIS (2017) inhalation unit risk of 0.0006 $(\mu g/m^3)^{-1}$ (which equates to a risk-specific concentration of 0.02 $\mu g/m^3$ at the 1-in-100,000 risk level). The OEHHA risk-specific concentration of 0.009 $\mu g/m^3$ was selected for this HHRA, as it represents the lowest of the three exposure limits derived from the Thyssen et al. (1981) study.

4.2.4 Metals in Air Emissions

Several metals are present in gasoline and diesel fuels and could be emitted to the atmosphere.

Arsenic

Arsenic is a well-known toxic metal and is present in the environment from natural and anthropogenic sources. Trace concentrations of arsenic are present in gasoline and diesel, and usually associate with airborne particulate matter. Major anthropogenic sources of arsenic include glass furnaces, metallurgical industries, and automobile engines that combust gasoline or diesel (Talebi and Abedi 2005).

Short-term exposures to arsenic have been reported to result in severe irritation to both the upper and lower parts of the respiratory system (TCEQ 2012, Alberta Environment 2011). The TCEQ (2012) did not develop short-term toxicity factors using the reports of respiratory and/or gastrointestinal effects to develop short-term toxicity factors because they concluded the exposure concentrations and exposure durations were not adequately reported in these studies. Both the TCEQ (2012) and the OEHHA (2008) developed acute (1-hour) inhalation exposure limits of 9.9 µg/m^3 and 0.2 µg/m^3, respectively, based on developmental effects, Alberta Government (2013) developed a 1-hour exposure limit (i.e., AAAQO) of 0.1 µg/m^3 for arsenic based on protection of respiratory effects, but did not provide the toxicological details such as key studies or uncertainty factors. However, since the guidelines produced by other agencies may not be protective of this health endpoint, the AAAQO of 0.1 µg/m^3 was selected as the acute (1-hour) TRV.

Chronic inhalation exposures to inorganic arsenic is associated with irritation of the skin and mucous membranes and effects in the brain and nervous system (US EPA 2016a). Chronic inhalation exposure to inorganic arsenic is strongly associated with lung cancer, while ingestion of inorganic arsenic has been linked to cancers of the skin, bladder, liver, and lung. The International Agency for Research on Cancer classifies inorganic arsenic as a Group 1 carcinogen (i.e., carcinogenic to humans).

US EPA IRIS (1998b) derived an inhalation unit risk of 0.0043 (µg/m^3)$^{-1}$, which equates to a risk-specific concentration of 0.002 µg/m^3 at the 1-in-100,000 risk level, based on excess lung cancer mortality in workers at two smelters - the Asarco smelter in Tacoma, Washington and the Anaconda smelter in Montana. More recently, the TCEQ (2012) derived an inhalation unit risk of 0.00015 (µg/m^3)$^{-1}$, which equates to a risk-specific concentration of 0.067 µg/m^3 at the 1-in-100,000 risk level, based on based on more recent epidemiological studies from three smelters - updated estimates from Tacoma smelter and the Montana smelter, as well as estimates from the Ronnskar Copper Smelter cohort study in Sweden. Alberta Government (2013) reviewed the risk-specific concentrations provided by US EPA IRIS and TCEQ (as provided in Alberta Environment 2011) and determined that the appropriate chronic (annual) exposure limit that is protective of cancer is 0.01 µg/m^3. This value (0.01 µg/m^3) was selected as the appropriate TRV for this HHRA.

Chromium

Chromium is a naturally occurring toxic metal. Chromium in the environment exists primarily in two valence states, trivalent (Cr III) and hexavalent (Cr VI). The general public is exposed to trivalent chromium from eating food, drinking water, and inhaling air that contains the chemical. Trace concentrations of chromium are present in diesel and gasoline, and usually associated with particulate matter in fuel combustion exhaust. Trivalent chromium is an essential element in the human body, required for the metabolism of glucose, protein and fat. At higher doses, trivalent chromium is toxic. However, trivalent chromium is much less toxic than hexavalent chromium (US EPA 2016b). Chromium emissions from the Project were modelled as hexavalent chromium. The International Agency for Research on Cancer classifies trivalent chromium as a Group 3 substance (i.e., not classifiable as to its carcinogenicity to humans); and hexavalent chromium as a Group 1 substance (i.e., carcinogenic to humans). All chromium emissions are conservatively assumed to be in the hexavalent form.

The respiratory tract is a major target organ for acute chromium toxicity. Symptoms include shortness of breath, coughing, and wheezing. Gastrointestinal and neurological effects have also been observed at very high acute inhalation exposures associated with industrial accidental exposures (US EPA 2016b). The TCEQ derived an acute (24-hour) exposure limit of 1.3 µg/m^3 based on the increase in relative lung weight in rats following a 30-day (subacute) exposure to hexavalent chromium particulate (Glaser et al. 1990). This value was selected as the acute TRV for the HHRA.

Epidemiological studies on workers clearly establish that inhaled hexavalent chromium is a human carcinogen, resulting in an increased risk of lung cancer. However, trivalent chromium is not considered carcinogenic. Mancuso (1975) followed new employees of a chromate production plant in Painesville, Ohio, hired between 1931 and 1937. Data from an industrial hygiene study of the plant performed in 1949 was used to derive chromium exposure concentrations. Increased lung cancer rates were associated with increased exposure to chromium. Mancuso (1975) is the key study used by Health Canada (2010c) and US EPA IRIS (1998c) to derive inhalation unit risk factors of 0.076 (µg/m^3)$^{-1}$ and 0.012 (µg/m^3)$^{-1}$, respectively. Neither Health Canada nor US EPA IRIS updated their assessments to incorporate more recent studies of the Painesville, Ohio cohort, or studies of other chromate production workers, such as those related to a Baltimore, Maryland chromate production plant. TCEQ (2014) re-calculated an inhalation unit risk factor for inhalation of particulate hexavalent chromium based on more recent studies of the Painesville, Ohio cohort (Crump et al. 2003) and the Baltimore, Maryland cohort (Gibb et al. 2000). The TCEQ inhalation unit risk value of 0.0023 (µg/m^3)$^{-1}$, which equates to a risk-specific concentration of 0.0043 µg/m^3 at the 1-in-100,000 risk level, was selected for this HHRA.

Manganese

Manganese is a naturally occurring element that constitutes approximately 0.1% of the Earth's crust. It does not naturally occur in pure metal form, but as a component of many minerals, silicates, sulphides, oxides, phosphates, and borates. Manganese has many applications, including use as a fertilizer (manganese sulphate), and as a precursor in the manufacturing of batteries, fireworks, and explosives (US EPA 2014). Manganese is present in gasoline and diesel as an additive in the form of methylcyclopentadienyl manganese tricarbonyl. This additive increases the octane rating of the fuel. During fuel combustion, manganese is emitted into the air and bound to particulate matter.

Manganese is an essential element that is required for normal metabolic function in humans. At high doses by inhalation, manganese is toxic, as demonstrated by occupational exposures in miners. The primary target of manganese toxicity is the nervous system. Symptoms include ataxia, dementia and anxiety, similar to symptoms of Parkinson's disease. These symptoms are typically observed at very high acute inhalation doses, and not observed at low inhalation exposures that the general public is exposed to. Manganese is not considered a carcinogen, and classified as a Group D (not classifiable as a human carcinogen) substance by the US EPA (US EPA 2014). The International Agency for Research on Cancer does not provide a classification for manganese.

The TCEQ (2017) derived an acute (1-hour) exposure limit of 9.1 µg/m^3 based on respiratory effects (mild inflammatory airway changes) observed in Rhesus monkeys following inhalation exposure over a 3-week period (Dorman et al. 2005), and a chronic (annual) exposure limit of 0.84 µg/m^3 based on neurological effects (abnormal eye-hand coordination scores) in battery factory workers (Roels et al. 1992). The TCEQ (2017) exposure limits were selected as the acute (1-hour) and chronic (24-hour) TRVs for the HHRA.

Mercury

Mercury occurs naturally in the environment and exists is several forms. It is most commonly found in rocks and soil as mercuric sulphide (ATSDR 1999c; RIVM 2001). Mercury is released into the atmosphere from mining and smelting, fossil fuel combustion, and waste incineration (ATSDR 1999c).

Acute exposures to mercury vapours have resulted in central nervous system effects such as cognitive, sensory, personality, and motor disturbances (ATSDR 1999c). In the absence of acute inhalation studies in humans, Cal EPA (OEHHA 2008) derived an acute inhalation exposure limit of 0.6 µg/m^3 for a 1-hour exposure time based on behavioural deficits in rats exposed to metallic mercury vapour *in utero* (Danielsson et al. 1993). This exposure limit was developed for metallic mercury vapour, but is considered protective for inhalation of inorganic mercury (OEHHA 2008), and was adopted as the 1-hour acute exposure limit for the current assessment.

Health Canada has not derived an inhalation exposure limit for mercury. US EPA IRIS (1995) derived a chronic inhalation limit of 0.3 µg/m^3 for elemental mercury vapour based on neurobehavioral effects (hand tremors, increases in memory disturbance, and slight subjective and objective evidence of autonomic dysfunction) in occupationally-exposed subjects (Fawer et al. 1983; Piikivi and Tolonen 1989; Piikivi and Hanninen 1989; Piikivi 1989; Ngim et al. 1992; Liang et al. 1993). The studies used by the US EPA IRIS (1995) were also employed for the derivation of the chronic exposure limit of 0.03 µg/m^3 derived by OEHHA (2008). As the OEHHA derivation is more recent, it was selected as the chronic exposure limit for this HHRA.

Nickel

Nickel is a naturally occurring element in the environment. Anthropogenic sources of nickel include the combustion of coal, oil and diesel fuel. It is also used in nickel containing jewelry, stainless steel cookware, and eating utensils (US EPA 2016c).

Inhalation exposure to nickel has been associated with respiratory effects, including a type of asthma specific to nickel, decreased lung function, and bronchitis. TCEQ (2017) derived an acute (1-hour) exposure limit of 1.1 µg/m^3 that is based on respiratory effects (bronchoconstriction) in nickel workers, a significant portion of whom were occupational asthmatics, following exposure to aerosolized nickel sulfate.

Studies on the carcinogenic potential of nickel are inconclusive. Inhalation of nickel sulphate and ingestion of nickel acetate did not demonstrate carcinogenic effects in animal studies. Workers in nickel mines and nickel refineries show an increased risk of lung and nasal cancers, but the risk cannot be attributed to a particular form of nickel due to the number of different nickel salts present in those occupational settings. In general, carcinogenicity has mostly been attributed to nickel sulphides. The International Agency for Research on Cancer classifies nickel as a Group 2B substance (possibly carcinogenic to humans). TCEQ (2017) derived an inhalation unit risk of 0.00017(µg/m^3)$^{-1}$ (which equates to a risk-specific concentration of 0.059 µg/m^3 at the 1-in-100,000 risk level) using a meta-analysis approach that combines unit risk factors obtained from preferred individual epidemiological studies of lung cancer occurrence in industrial workers.

4.2.5 Methylmercury

Mercury occurs naturally in the environment and exists in several forms. These forms can be classified as inorganic mercury and organic mercury. The most common organic form of mercury is methylmercury. Methylmercury is of particular concern because it can bioconcentrate in certain edible freshwater and saltwater fish and marine mammals to levels that are many times greater than levels in the surrounding water. Methylmercury is primarily the product of microbes converting inorganic mercury through biological processes (ATSDR 1999a).

Exposure to all forms of mercury can cause adverse effects to the central nervous system. Symptoms of mercury exposure include irritability, tremors, changes in hearing and vision, and memory problems. Mercury is also harmful to developing fetuses, with most research focused on methylmercury because it is more bioavailable and able to cross the placental barrier to the developing fetus, whereas inorganic mercury cannot cross to the fetus.

The Canadian drinking water guidelines apply to total mercury and does not distinguish between inorganic and organic mercury forms. The Canadian drinking water guideline of 1 µg/L. Daily consumption rate of 1.5 L of water containing 1 µg/L, would contribute appropriately 5 percent of the tolerable daily intake of 0.03 mg of mercury as methyl mercury for a 70-kg adult (Health Canada 1979).

For mercury in fish, seafood, and marine mammals, Health Canada (2007, 2010c) provides a TRV of 0.20 µg/kg bw/day that is protective of women of child-bearing age and children under 12, and was derived from epidemiological prospective studies of neurodevelopmental effects. In addition, Health Canada (2007) has provided a guideline of 0.5 mg/kg total mercury in fish tissues.

4.2.6 Summary List of Toxicological Reference Values

Table 4-1 shows the TRVs that are applied in the HHRA. For airborne COPCs, if the AAAQO, NAAQO, or CAAQS is derived using a statistical metric (e.g., annual average, 99th percentile, or 98th percentile), the same statistical metric is applied to the TRV and to the air dispersion modelling results. For example, the 1-hour SO_2 objective from the CAAQS is 183 µg/m^3, based on the 99th percentile of the daily maximum 1-hour average concentration over a 3-year modelling period. The TRV and the air dispersion modelling results apply the same statistical metric in order to be comparable.

Table 4-1 Toxicological Reference Values

Chemical of Potential Concern	Exposure Period	Toxicological Reference Value	Critical Effect	Reference
Criteria Air Contaminants				
Nitrogen Dioxide	Acute (1-hour) [a]	114 µg/m^3	Respiratory effects	CAAQS 2017
	Chronic (Annual)	32 µg/m^3	Respiratory effects	CAAQS 2017
Sulphur Dioxide	Acute (1-hour)[a]	183 µg/m^3	Respiratory effects	CAAQS 2017
	Chronic (Annual)	13 µg/m^3	Respiratory effects	CAAQS 2017

Table 4-1 Toxicological Reference Values

Chemical of Potential Concern	Exposure Period	Toxicological Reference Value	Critical Effect	Reference
Carbon Monoxide	Acute (1-hour)	15,000 µg/m^3	Oxygen carrying capacity of blood	Health Canada (1994)
	Acute (8-hour)	6,000 µg/m^3	Oxygen carrying capacity of blood	Health Canada (1994)
$PM_{2.5}$	Acute (1-hour)	80 µg/m^3	Health (not specified)	AAAQO
	Acute (24-hour) [a]	28 µg/m^3	Health (not specified)	CAAQS
	Chronic (Annual) [a]	10 µg/m^3	Health (not specified)	CAAQS
DEP	Acute (2-hour) [b]	10 µg/m^3	Respiratory effects	Health Canada (2016b)
	Chronic (Annual)	5 µg/m^3	Respiratory effects	Health Canada (2016b)
Volatile Organic Compounds				
1,3-butadiene	Acute (1-hour)	660 µg/m^3	Developmental Effects	OEHHA (2013)
	Chronic (Annual)	2 µg/m^3	Ovarian atrophy	US EPA IRIS (2002)
	Chronic (Annual)	0.3 µg/m^3	Leukemia	US EPA IRIS (2002)
2,2,4-trimethylpentane	Acute (1-hour)	19,000 µg/m^3	Neurological function effects	TCEQ (2016)
	Chronic (Annual)	1,800 µg/m^3	Free-standing (systemic effects)	TCEQ (2016)
Acetaldehyde	Acute (1-hour)	470 µg/m^3	Respiratory effects	AAAQO
	Chronic (annual)	4.5 µg/m^3	Cancer (nasal)	US EPA IRIS (1991)
Acrolein	Acute (1-hour)	4.5 µg/m^3	Eye irritation	Ontario Ministry of Environment (2009)
	Chronic (Annual)	0.35 µg/m^3	Nasal lesions	AAAQO

Table 4-1 Toxicological Reference Values

Chemical of Potential Concern	Exposure Period	Toxicological Reference Value	Critical Effect	Reference
Benzene	Acute (1-hour)	30 µg/m^3	Blood toxicity (bone marrow depression)	ATSDR (2007b)
	Chronic (Annual)	30 µg/m^3	decreased lymphocyte count	US EPA IRIS (2003)
	Chronic (Annual)	3 µg/m^3	Leukemia	Health Canada (2010c), AAAQO
Ethylbenzene	Acute (1-hour)	86,000 µg/m^3	Ototoxicity (hearing loss)	TCEQ (2015c)
	Chronic (Annual)	1,000 µg/m^3	Developmental toxicity	US EPA IRIS (1991b)
Formaldehyde	Acute (1-hour)	50 µg/m^3	Eye and nose irritation	TCEQ (2008)
	Chronic (Annual)	11 µg/m^3	Eye, nose, and lower airway discomfort	TCEQ (2008)
	Chronic (Annual)	2 µg/m^3	Nasal squamous tumours	Health Canada (2001)
Propionaldehyde	Chronic (Annual)	8 µg/m^3	Atrophy of olfactory epithelium	US EPA (2008b)
Toluene	Acute (1-hour)	15,000 µg/m^3	Neurological	TCEQ (2015)
	Acute (24-hour)	7,600 µg/m^3	Neurological	ATSDR (2015)
	Chronic (Annual)	3,800 µg/m^3	Neurological	Health Canada (2010c), Alberta Government (2016)

Table 4-1 Toxicological Reference Values

Chemical of Potential Concern	Exposure Period	Toxicological Reference Value	Critical Effect	Reference
Xylenes	Acute (1-hour)	7,400 µg/m^3	Neurological and mild respiratory effects	TCEQ(2015d)
	Chronic (Annual)	180 µg/m^3	Developmental effects	Health Canada (2010c), Alberta Government (2016)
Polycyclic Aromatic Hydrocarbons				
Benzo(a)pyrene	Annual	0.0009µg/m^3	Cancer (respiratory system)	OEHHA (2011)
Naphthalene	Chronic (Annual)	3 µg/m^3	Nasal effects (hyperplasia and metaplasia in respiratory and olfactory epithelium, respectively)	US EPA IRIS (1998), ATSDR (2005), AAAQO
Metals in Air Emissions				
Arsenic	Acute (1-hour)	0.1 µg/m^3	Respiratory effects	AAAQO
	Chronic (Annual)	0.01 µg/m^3	Lung cancer	AAAQO
Chromium (VI)	Acute (1-hour)	1.3 µg/m^3	Respiratory effects	TCEQ (2014)
	Chronic (Annual)	0.0043 µg/m^3	Lung cancer	TCEQ (2014)
Manganese	Acute (1-hour)	9.1 µg/m^3	Respiratory effects	TCEQ (2017a)
	Chronic (Annual)	0.84 µg/m^3	Neurological effects	TCEQ (2017a)
Mercury	Acute (1-hour)	0.6 µg/m^3	Neurological effects	OEHHA (2008)
	Chronic (Annual)	0.03 µg/m^3	Neurobehavioral effects	OEHHA (2008)
Nickel	Acute (1-hour)	6.0 µg/m^3	Respiratory effects	AAAQO
	Chronic (Annual)	0.05 µg/m^3	Lung cancer	AAAQO

Table 4-1 Toxicological Reference Values

Chemical of Potential Concern	Exposure Period	Toxicological Reference Value	Critical Effect	Reference
Methylmercury				
Methylmercury (in water)	Chronic	1 µg/L	Neurodevelopmental effects	Health Canada (1979)
Methylmercury (in fish)	Chronic	0.20 µg/kg bw/day	Neurodevelopmental effects	Health Canada (2010c)

NOTES:

[a] value is based on a statistical comparison. Please refer to details in individual contaminant write-up

[b] although guideline is applicable to 2-hour exposure time, in the HHRA, 1-hour exposures were conservatively compared to this value

5.0 EXPOSURE ASSESSMENT

The objective of the exposure assessment is to estimate the intake of each COPC by the identified human receptors. For airborne COPCs, the exposure assessment includes the predicted exposure concentrations at the 58 human receptor locations in the study area. For COPCs in the water and food, the predicted concentrations in the respective media are representative of the study area.

5.1 INHALATION EXPOSURE TO AIRBORNE COPCS

The ground-level concentrations of airborne COPCs in the study area are based on air dispersion modelling simulations conducted over a 20 km x 20 km modelling domain using the CALMET/CALPUFF modelling system. The air dispersion modelling was conducted as part of the Air Quality and Climate VC (Section 3.0, Volume 3A and 3B). For the purposes of the exposure assessment, only the model predictions are discussed in the HHRA. Technical details on the CALMET/CALPUFF model implementation are provided in Volume 4, Appendix E, Attachment 3B and Attachment 3C.

For CACs, VOCs, and PAHs, Project-related air concentrations are limited to diesel exhaust emissions; however, for metals, the air concentrations also include fugitive dust emissions. The modeled air concentrations are based on an assumption that that total suspended particulate would have the same concentrations of metals as the maximum measured concentrations in the soil samples collected from the PDA. Because the total suspended particulate includes fractions that are outside the respirable range, not all of the metals in air would be inhaled into the lungs. Also, the chromium in soil is typically trivalent chromium and not the hexavalent chromium associated with diesel emissions. Trivalent chromium (chromium III) is not a carcinogen, and is considered less toxic than hexavalent chromium (chromium VI).

Attatchment A provides tables that summarize the modelled concentrations of each airborne COPC at the 58 human receptor locations and the location of the maximum point of impingement (MPOI) for the Base, Project, and Application Cases. The MPOI is the location with the maximum predicted exposure concentration in the study area. For the Base Case, the MPOI location corresponds to an existing emission source (e.g., industrial facility or major roadway). For the Project and Application Cases, the MPOI location corresponds to a location along the boundary of the PDA of the Project. The predicted exposure concentrations at the MPOI do not correspond to human receptor locations, and as such receptor exposure would be limited to short-term (acute) durations.

Concentrations of SO_2, NO_2, CO and $PM_{2.5}$ were calculated using the same averaging periods and statistical metrics as the TRVs in order to be comparable to each other. For VOCs, PAHs and airborne metals, the predicted concentrations are based on Alberta air quality guidelines for data interpretation. Predicted concentrations of VOCs, PAHs and airborne metals for 1-hour averaging periods are based on the 99th percentile concentration that is predicted to occur in a year (i.e., the 9th highest 1-hour maximum concentration, out of 8,760 hours). The predicted concentrations for 24-hour averaging periods are based on the maximum concentration that is predicted to occur in a year (i.e., the day with the highest concentration, out of 365 days). The predicted annual concentrations are the annual average.

With respect to the Planned Development Case for construction, the expected Project construction period of 275 days could be spread over a two to three calendar year period, with most of the construction is expected to occur during non-winter periods when the ground is not frozen or covered with snow. Several future projects were identified that could potentially overlap with the Project-related emissions during construction:

- The Community of Harmony - Stage 2 and 3: Development on approximately 700 ha includes residential, commercial, recreational, infrastructure and institutions. Stage 2 construction starts 2019. By 2020, the Harmony anticipated population is 1,200 in over 500 homes. Development will continue beyond 2020 in the same approved development area; however, no specific details are available.
- Bingham Crossing: A pedestrian oriented shopping and lifestyle with a seniors housing complex development in approximately 60 acres. Development is scheduled to be complete in 2019; however, minimal construction has so far occurred. and no further details are available.
- Realignment of existing pipelines and utilities: Oil and gas pipelines within the PDA would either be relocated within the PDA or retrofitted. One power line crosses the diversion channel and some power pole locations would be adjusted to permit a clear span over the channel. Alterations to infrastructure would occur in 2019-2020.
- NGTL West Path Rocky View Section pipeline: A 21.5 km, 42-inch diameter, natural gas pipeline paralleling and adjacent to existing pipeline right-of-way extending between Cochrane and an existing valve station just north of the Elbow River. The right-of-way crosses underneath the Springbank Off-stream Reservoir Project diversion channel. Construction is anticipated from 2019 to 2020.
- City of Calgary: Developments within City of Calgary. Several residential, commercial/retail, infrastructure, and institutional projects within the City of Calgary are planned for development.

Ambient concentrations downwind from each emission source are the greatest near the emission source and decrease with increasing distance from the source due to atmospheric dispersion processes. For short-term air quality changes, emission plumes from different sources will only align under limited wind direction conditions.

The Community of Harmony is 5 km northeast of the PDA. Emissions will result from construction activities that will be spread over a 15-year phased development period and from residential and local traffic emissions associated with each phase as it is completed and occupied. During the initial clearing, grading, and road construction phase, the emission profile is expected to be similar to that associated with the Project (i.e., diesel fueled construction equipment and fugitive dust emissions). Because the Community of Harmony will be developed and occupied in phases over an extended 15-year period, it is expected that the developer will manage construction emissions to reduce air quality changes in adjacent developed (i.e., occupied) phases. The Harmony earthworks contractor has implemented a 5-minute idling policy on large earth moving equipment; i.e., if a piece of equipment is sitting longer than 5 minutes, they turn the engine off (http://liveinharmony.ca/vision-team/a-sustainable-vision/http://liveinharmony.ca/vision-team/a-sustainable-vision/).

The Bingham Crossing development is 6 km northeast of the PDA. As with the Community of Harmony, the emission profile during the initial construction phase is expected to be similar to that associated with the Project. Once development is complete, the emissions will result from residential/commercial heating and local traffic. Bingham Crossing proposes to adopt LEED (Leadership in Energy and Environmental Design) certified building to increase energy efficiencies and reduce emissions (https://www.rockyview.ca/Portals/0/Files/.../Planning/CS/.../CS-Bingham-Crossing.pdf).

An examination of Springbank Airport wind measurements (Volume 3A, Section 3.2.2, Figure 3-3) indicates the least frequent wind directions are from the northeast and southwest quadrants. This suggests limited potential for emissions from the Project to overlap with those from the Community of Harmony and Bingham Crossing. Therefore, the emissions from the Community of Harmony and the emissions associated with the construction and development of Bingham Crossing are not expected to materially change the predicted Project-related exposures.

The NGTL West Path Rocky View Section construction occurs during approximately a year, with intermittent equipment use along the right-of-way for the installation of a buried pipeline. The emissions from the NGTL West Path Rocky View Section pipeline will be minor and intermittent, limited to some equipment as construction moves along the right-of-way. Therefore, the emissions from the NGTL West Path Rocky View Section construction are not expected to materially change the predicted Project-related exposures.

The realignment activities associated with existing pipelines and utilities will primarily occur within the PDA. The emission profile associated with these activities is also expected to be similar to that associated with the Project (i.e., diesel fueled construction equipment and fugitive dust emissions). These activities are expected to occur during the Project construction period. It is expected that realignment activities associated with existing pipelines and utilities will follow emission management practices similar to those adopted by the Project. Because realignment activities occur primarily within the PDA and are relatively small and short term, emissions are not expected to materially change the predicted Project-related exposures.

5.2 INGESTION EXPOSURE TO METHYLMERCURY

The estimation of methylmercury formation during the flood phase of the Project was included as part of the assessment of surface water quality. The estimation of methylmercury was based on literature for experimentally filled reservoirs in Ontario for upland forest environments. Methylmercury formation in this prediction is a function of flooded surface area, duration of flooding, and the organic carbon content of the flooded soils. Technical details regarding the methylmercury predictions are described in Section 7.0 (Volume 3B).

Assuming the current concentration (i.e., Base Case) of methylmercury in the water is essentially zero, methylmercury concentration in the water is predicted to reach a maximum of 0.00044 µg/L (low estimate) to 0.002 µg/L (high estimate) for the duration of the flood phase (i.e., Application Case), which is the more conservative (higher) estimate of methylmercury concentrations. In comparison, the Canadian drinking water quality guideline for total mercury is 1 µg/L, which applies to all forms of mercury. Given that the existing drinking water quality from the Glenmore Water Treatment Plant is below 1 µg/L, the influx of water from the reservoir containing 0.002 µg/L mercury is not expected to substantially increase mercury concentrations in the drinking water supply, or have a long-term effect on the mercury concentrations. The influx of water from the off-stream reservoir into the Elbow River would occur for approximately 38 to 39 days, and would be further diluted by Elbow River flows. Human receptors consuming municipal water sourced from the Glenmore Reservoir would therefore be exposed to methylmercury concentrations that are less than 0.002 µg/L.

With regards to methylmercury bioaccumulation and biomagnification in fish, the short-term influx of water with a high-estimate methylmercury concentration of 0.002 µg/L is unlikely to affect methylmercury concentrations in fish. Released water from the off-stream reservoir would be further diluted upon entering the Elbow River. Furthermore, the duration of the water release is expected to be only a month. The current understanding of methylmercury formation and accumulation in fish tissue is that the process is time-dependent. This is due to the amount of time required for inorganic mercury to convert to methylmercury, followed by the uptake of methylmercury by aquatic organisms, and subsequent consumed by predators to accumulate up the food chain.

Considering that there are no current fish consumption advisories for the Elbow River related to mercury content, there is a low probability that a single month-long release of water from the off-stream reservoir could substantially change the long-term concentrations of methylmercury in the aquatic ecosystem to the extent that fish consumers would be at risk. Methylmercury concentrations in Elbow River fish are not predicted to change given the duration of the event, the amount of methylmercury that could form during the flood operation phase, and the short period for which stored water is released into the Elbow River.

With respect to the Planned Development Case, there are currently no other reasonably foreseeable future projects in the study area that are expected to affect methylmercury concentrations of fish in the Elbow River.

6.0 RISK CHARACTERIZATION

The risk characterization stage involves comparing the results of the exposure assessment to the outcomes of the toxicity assessment to quantify the potential health risk. The potential health risk is compared to the risk thresholds established by Alberta Government (2011) and Health Canada (Health Canada 2010a). If the risk thresholds are exceeded, the risk is further characterized by magnitude and risk type.

6.1 METHODS

A change to human health may occur from exposure to COPCs produced from Project activities. In the HHRA, risk is normally expressed as a ratio of estimated exposure concentration (or dose) to the exposure limit for threshold chemicals (non-carcinogens), or as an ILCR for non-threshold chemicals (carcinogens). In an environmental assessment, it is common to use the concept of exposure ratio (ER) to facilitate comparison of risks associated with both classes of chemicals (Alberta Government 2011). For threshold COPC, the ER is the ratio of the estimated receptor exposure to the exposure limit; for carcinogens, the ratio is equal to the estimated exposure concentration or dose to the risk-specific concentration or dose, respectively, where the latter are expressed in relation to the accepted target ILCR (i.e., 1 in 100,000) (Alberta Government 2011). The potential risk expressed as an ER is calculated as follows (see Attachment C for examples):

$$\text{Exposure Ratio (unitless)} = \frac{\text{Exposure Estimate}}{\text{Exposure Limit (or TRV)}}$$

For inhalation exposures to airborne COPCs, an ER threshold of 1.0 is applied because there is only one exposure route applicable. When multiple exposure routes exist for a COPC (e.g., ingestion and dermal exposure), an ER threshold of 0.2 is applied. An ER threshold of 0.2 would apply to methylmercury in drinking water and fish. This implies that a single exposure pathway for a COPC should not account for more than 20% of the applicable guideline or objective. The other exposure pathways (e.g., exposure via consumer products) account for the remaining exposure or dose.

When the ER is less than the threshold of 1.0 for inhalation or 0.2 for ingestion pathways, it indicates a low or negligible health risk. An ER that is above the threshold does not necessarily indicate that an adverse health risk would be present because the TRVs are derived using a conservative approach and applying safety factors. However, an ER that is above the applied threshold suggests that a potential risk could occur, which may require a more detailed evaluation of the significance of the estimated risks, a need for locally validated data, or potentially risk management (Alberta Government 2011, Health Canada 2010a).

For the assessment of carcinogenic effects, the risk-specific concentrations (and the ER) are only applicable to the Project Case scenario as they were developed to address cancer risks that are above existing conditions (i.e., the ILCR). There are no regulatory benchmarks of acceptable or tolerable cancer risk for existing incidences of cancers (Alberta Government 2011). Exposure ratios for carcinogens for Base and Application Cases are provided for context, but are not compared to the target of 1.0.

The first step in characterizing the health risk is to review the exposure estimate concentration at the MPOI. If the ER is less than 1.0 at the MPOI location, it means that the ER is also less than 1.0 throughout the entire study area. In this scenario, there would be no unacceptable risk to human health, and the COPC is not assessed further.

If the ER is greater than 1.0 at the MPOI location, the second step is to apply the exposure estimate at the 58 human receptor locations to determine whether there may be an unacceptable risk in locations where people are regularly present. If the ER is greater than 1.0 at a human receptor location, a more detailed evaluation of the significance of the estimated risk is provided. The predicted exposure concentrations and exposure ratios for the MPOI and the 58 receptor locations are in Attachment A.

6.2 HEALTH RISK DURING CONSTRUCTION PHASE

6.2.1 Health Risk from Exposure to Criteria Air Contaminants – Base, Project, and Application Cases

Exposure Ratios at the Maximum Point of Impingement

Table 6-1 shows the ERs at the MPOI for each CAC. The ERs for SO_2 and CO are less than 1.0, indicating that there are no unacceptable risks to human health from these COPCs. The ERs for NO_2 (1-hour and annual), $PM_{2.5}$ (1-hour, 24-hours, and annual) and DEP (1-hour) are greater than 1.0 at the MPOI location. The ERs at the 58 human receptor locations are examined in greater detail for NO_2, $PM_{2.5}$, and DEP.

Table 6-1 Exposure Ratios at the Maximum Point of Impingement for Criteria Air Contaminants

Criteria Air Contaminant	Averaging Period	Exposure Ratio at the Maximum Point of Impingement		
		Base	Project	Application
Nitrogen Dioxide	1-hour	9.0E-01	3.1E+00	3.3E+00
	Annual	1.3E+00	6.8E-01	1.3E+00
Sulphur Dioxide	1-hour	3.5E-02	4.5E-02	7.5E-02
	Annual	2.1E-01	1.2E-02	2.1E-01
Carbon Monoxide	1-hour	6.9E-02	2.0E-01	2.3E-01
	8-hour	1.4E-01	3.4E-01	4.1E-01
Particulate Matter ($PM_{2.5}$)	1-hour	3.4E-01	3.7E+00	3.9E+00
	24-hour	6.6E-01	2.1E+00	2.6E+00
	Annual	7.2E-01	1.2E+00	1.6E+00
Diesel Emission Particulate (DEP)	1-hour	1.1E+00	1.8E+01	1.8E+01
	Annual	5.1E-01	7.2E-01	7.7E-01

NOTE:
Shaded cell indicates a ER greater than 1.0

Exposure Ratios for NO_2, $PM_{2.5}$, and DEP at the Human Receptor Locations

The ERs for NO_2, $PM_{2.5}$, and DEP at the human receptor locations are shown in Table 6-2 to Table 6-4.

The ERs for annual NO_2 are less than 1.0, and indicate that there are no unacceptable health risks from chronic exposure to NO_2. The ERs for 1-hour NO_2 are greater than 1.0 at four residential receptor locations (SR01, SR 09, SR19, and SR41), which are within 100 m of the PDA. This indicates that there are potentially unacceptable acute risks from exposure to NO_2. However, given that the ERs at these locations range from 1.0 to 1.1, the overall conservative nature of the air quality model, and the uncertainty factors applied in the derivation of the TRVs, it is improbable that there would be an unacceptable risk from acute NO_2 exposure. Further mitigations can also be implemented to reduce emissions of NO_2, including operational adjustments that reduce the number of vehicles and equipment that operate in an area.

For $PM_{2.5}$, the short-term (1-hour or 24-hour) and long-term (annual) ERs are greater than 1.0 at 18 residential receptor locations (SR04, SR05, SR09, SR10, SR11, SR12, SR13, SR14, SR15, SR16, SR18, SR19, SR20, SR25, SR36, SR38, SR40 and SR41). These 18 residential receptor locations are located near Project activities associated with the construction of the diversion structure and diversion channel along Highway 22 (Cowboy Trail), and the borrow material area at the intersection of Springbank Road and Range Road 40. Fourteen of the 18 receptor locations are located within 100 m of the PDA, while receptor locations 10 and 38 are located 600 m from the PDA. These receptor locations do not include Indigenous receptor locations, or institutional facilities such as schools. The ERs are less than 1.0 at receptor locations farther than 600 m from the PDA.

The results indicate that with partial mitigations to reduce $PM_{2.5}$ along the haul road and borrow material area, there could still be an unacceptable short-term risk to human health for residents and people adjacent to the PDA.

Concentrations of $PM_{2.5}$ are expected to be lower than the modelled predictions. More intensive dust mitigation measures can be applied during the construction phase. These mitigations include dust suppressants or water on haul roads on an as-needed basis during dry periods with high wind conditions. Real-time $PM_{2.5}$ monitors can be deployed in the areas of concern to indicate when more intensive dust mitigation measures may be needed. The construction schedule may also be adjusted to reduce the number of dust generating vehicles operating in an area during dry periods with high wind conditions.

These more intensive mitigation measures are intended to reduce the potential change in air quality, which effectively reduces the potential risk to human health. The mitigation measures are expected to be effective in reducing concentrations of $PM_{2.5}$ below the applicable TRV at human receptor locations near the PDA. Consequently, $PM_{2.5}$ can be managed to levels that do not result in an unacceptable risk to human health.

Short-term exposures to DEP were assessed by comparing 1-hour concentrations to the acute (2-hour) DEP exposure limit. The ERs at multiple residential receptor locations were higher than the benchmark of 1.0; the ERs at Indigenous receptor locations and schools were less than 1.0. Also provided in Table 6-4 are the frequency of exceedances for each of the receptor locations. As indicated, maximum frequency of exceedances is less than 5%. Based on multiple studies on test subjects, Health Canada (2016b) concluded that at concentrations above the DEP exposure limit, healthy and/or mildly asthmatic participants may experience increased measures of airway resistance and/or respiratory inflammation. Large-scale epidemiological studies examining the acute effects of diesel exhaust in the general population would likely provide a better understanding of the exposure–response relationships and characterization of population health risks associated with short-term diesel exposure (Health Canada 2016b).

Table 6-2 Exposure Ratios for NO2 at Human Receptor Locations (Construction)

Human Receptor Location	Exposure Ratio (unitless)					
	1-hour NO_2			Annual NO_2		
	Base	Project	Application	Base	Project	Application
SR01	3.1E-01	9.6E-01	1.1E+00	2.0E-01	2.0E-01	3.8E-01
SR02	4.9E-01	7.6E-01	8.6E-01	2.6E-01	7.9E-02	3.4E-01
SR03	4.1E-01	7.2E-01	8.1E-01	2.4E-01	8.2E-02	3.2E-01
SR04	2.1E-01	7.4E-01	8.3E-01	1.7E-01	1.6E-01	3.3E-01
SR05	2.3E-01	7.7E-01	8.6E-01	1.9E-01	1.5E-01	3.3E-01
SR06	2.2E-01	6.7E-01	7.6E-01	2.0E-01	8.2E-02	2.8E-01
SR07	2.1E-01	6.0E-01	7.2E-01	1.9E-01	6.1E-02	2.5E-01
SR08	1.9E-01	6.2E-01	7.1E-01	1.8E-01	7.2E-02	2.5E-01
SR09	3.4E-01	1.0E+00	1.1E+00	1.9E-01	1.5E-01	3.4E-01
SR10	2.8E-01	7.8E-01	8.7E-01	1.8E-01	1.3E-01	3.0E-01
SR11	6.6E-01	8.6E-01	9.7E-01	3.7E-01	1.8E-01	5.1E-01
SR12	2.1E-01	8.3E-01	9.2E-01	1.7E-01	2.1E-01	3.8E-01
SR13	2.2E-01	8.1E-01	9.0E-01	1.8E-01	2.0E-01	3.7E-01
SR14	2.1E-01	8.7E-01	9.6E-01	1.7E-01	2.5E-01	4.2E-01
SR15	2.1E-01	8.3E-01	9.2E-01	1.7E-01	2.6E-01	4.2E-01
SR16	1.5E-01	7.6E-01	8.5E-01	1.5E-01	2.1E-01	3.5E-01
SR17	1.7E-01	6.0E-01	6.9E-01	1.5E-01	9.1E-02	2.4E-01
SR18	3.9E-01	8.9E-01	9.8E-01	2.0E-01	2.2E-01	4.0E-01
SR19	3.0E-01	9.1E-01	1.0E+00	1.8E-01	5.3E-01	7.0E-01
SR20	3.7E-01	8.3E-01	9.2E-01	2.0E-01	2.8E-01	4.6E-01
SR21	1.6E-01	6.1E-01	7.1E-01	1.5E-01	1.2E-01	2.7E-01
SR22	1.4E-01	6.3E-01	7.2E-01	1.4E-01	1.2E-01	2.6E-01
SR23	1.4E-01	5.9E-01	6.8E-01	1.4E-01	1.1E-01	2.5E-01
SR24	1.4E-01	5.1E-01	6.0E-01	1.4E-01	1.1E-01	2.5E-01
SR25	4.2E-01	8.8E-01	9.8E-01	2.3E-01	3.3E-01	5.4E-01
SR26	3.1E-01	7.1E-01	8.4E-01	1.8E-01	3.4E-02	2.1E-01
SR27	4.1E-01	6.2E-01	8.2E-01	2.1E-01	3.2E-02	2.3E-01
SR28	4.1E-01	6.2E-01	8.2E-01	2.1E-01	3.2E-02	2.3E-01
SR29	4.5E-01	6.2E-01	8.3E-01	2.0E-01	3.4E-02	2.3E-01
SR30	5.8E-01	6.2E-01	8.5E-01	4.3E-01	3.8E-02	4.6E-01

Table 6-2 Exposure Ratios for NO2 at Human Receptor Locations (Construction)

Human Receptor Location	Exposure Ratio (unitless)					
	1-hour NO_2			Annual NO_2		
	Base	Project	Application	Base	Project	Application
SR31	5.8E-01	6.2E-01	8.5E-01	4.3E-01	3.8E-02	4.6E-01
SR32	4.6E-01	6.0E-01	8.4E-01	2.9E-01	4.3E-02	3.2E-01
SR33	3.1E-01	5.9E-01	7.7E-01	2.0E-01	4.9E-02	2.4E-01
SR34	2.8E-01	6.0E-01	7.8E-01	1.8E-01	5.7E-02	2.3E-01
SR35	2.8E-01	6.0E-01	7.8E-01	1.8E-01	5.7E-02	2.3E-01
SR36	1.7E-01	7.7E-01	8.6E-01	1.5E-01	1.6E-01	3.1E-01
SR37	1.4E-01	5.8E-01	7.0E-01	1.4E-01	1.1E-01	2.5E-01
SR38	3.6E-01	7.5E-01	8.5E-01	2.4E-01	1.6E-01	3.8E-01
SR39	3.9E-01	7.4E-01	8.4E-01	2.0E-01	9.4E-02	2.8E-01
SR40	2.3E-01	8.8E-01	9.7E-01	1.5E-01	1.5E-01	3.0E-01
SR41	2.6E-01	1.0E+00	1.1E+00	1.6E-01	3.0E-01	4.5E-01
SR42	5.6E-01	6.6E-01	7.9E-01	3.1E-01	7.0E-02	3.6E-01
SR43	8.1E-01	6.4E-01	8.5E-01	6.4E-01	5.7E-02	6.6E-01
SR44	1.9E-01	3.5E-01	4.7E-01	2.0E-01	3.8E-02	2.4E-01
SR45	2.2E-01	2.6E-01	3.6E-01	1.8E-01	1.8E-02	2.0E-01
SR46	3.1E-01	2.2E-01	3.6E-01	2.2E-01	1.4E-02	2.3E-01
SR47	3.4E-01	2.4E-01	3.9E-01	2.2E-01	1.4E-02	2.4E-01
SR48	3.0E-01	1.8E-01	3.7E-01	1.9E-01	8.8E-03	2.0E-01
SR49	4.5E-01	1.6E-01	5.0E-01	2.6E-01	9.4E-03	2.7E-01
SR50	1.2E-01	1.5E-01	2.5E-01	1.3E-01	2.5E-02	1.6E-01
SR51	1.3E-01	4.2E-01	5.1E-01	1.4E-01	8.3E-02	2.2E-01
SR52	3.5E-01	4.5E-01	5.7E-01	1.6E-01	1.4E-02	1.7E-01
SR53	2.1E-01	1.7E-01	3.0E-01	1.6E-01	7.9E-03	1.6E-01
SR54	3.2E-01	2.4E-01	4.0E-01	1.5E-01	6.9E-03	1.5E-01
SR55	3.5E-01	1.6E-01	3.9E-01	1.8E-01	4.4E-03	1.9E-01
SR56	1.4E-01	1.4E-01	2.4E-01	1.2E-01	3.1E-03	1.3E-01
SR57	4.5E-01	6.8E-01	8.5E-01	2.8E-01	2.9E-02	3.0E-01
SR58	1.3E-01	7.5E-02	1.8E-01	1.3E-01	4.1E-03	1.3E-01

NOTE:
Shaded cell indicates a ER greater than 1.0

Table 6-3 Exposure Ratios for PM2.5 at Human Receptor Locations (Construction)

Human Receptor Location	Exposure Ratio (unitless)								
	1-hour $PM_{2.5}$			24-hour $PM_{2.5}$			Annual $PM_{2.5}$		
	Base	Project	Application	Base	Project	Application	Base	Project	Application
SR01	1.7E-01	7.9E-01	9.6E-01	4.2E-01	4.4E-01	8.5E-01	3.7E-01	1.8E-01	5.5E-01
SR02	1.8E-01	5.0E-01	6.6E-01	4.3E-01	2.3E-01	6.4E-01	3.9E-01	9.2E-02	4.8E-01
SR03	1.8E-01	4.3E-01	5.7E-01	4.3E-01	2.2E-01	6.3E-01	3.8E-01	9.1E-02	4.7E-01
SR04	1.5E-01	8.6E-01	1.0E+00	4.1E-01	4.8E-01	8.7E-01	3.7E-01	2.1E-01	5.7E-01
SR05	1.6E-01	9.5E-01	1.1E+00	4.2E-01	4.8E-01	8.7E-01	3.7E-01	2.1E-01	5.8E-01
SR06	1.6E-01	5.5E-01	7.0E-01	4.2E-01	2.6E-01	6.6E-01	3.7E-01	1.0E-01	4.7E-01
SR07	1.6E-01	4.4E-01	5.8E-01	4.2E-01	2.1E-01	6.1E-01	3.7E-01	7.3E-02	4.5E-01
SR08	1.6E-01	5.0E-01	6.4E-01	4.2E-01	2.1E-01	6.2E-01	3.7E-01	9.1E-02	4.6E-01
SR09	1.7E-01	8.8E-01	1.0E+00	4.2E-01	4.5E-01	8.6E-01	3.7E-01	1.9E-01	5.6E-01
SR10	1.6E-01	1.1E+00	1.2E+00	4.2E-01	4.9E-01	9.0E-01	3.7E-01	2.0E-01	5.7E-01
SR11	2.1E-01	1.6E+00	1.8E+00	4.8E-01	8.1E-01	1.3E+00	4.1E-01	3.5E-01	7.6E-01
SR12	1.6E-01	1.2E+00	1.3E+00	4.1E-01	6.6E-01	1.1E+00	3.7E-01	3.2E-01	6.9E-01
SR13	1.6E-01	1.1E+00	1.3E+00	4.2E-01	6.1E-01	1.0E+00	3.7E-01	2.9E-01	6.6E-01
SR14	1.6E-01	1.3E+00	1.5E+00	4.1E-01	7.5E-01	1.1E+00	3.7E-01	3.9E-01	7.5E-01
SR15	1.6E-01	1.3E+00	1.4E+00	4.2E-01	7.8E-01	1.2E+00	3.7E-01	4.0E-01	7.6E-01
SR16	1.5E-01	1.3E+00	1.5E+00	4.1E-01	7.0E-01	1.1E+00	3.6E-01	3.8E-01	7.5E-01
SR17	1.5E-01	5.5E-01	6.9E-01	4.1E-01	2.7E-01	6.7E-01	3.6E-01	1.3E-01	4.9E-01
SR18	1.8E-01	1.9E+00	2.0E+00	4.3E-01	1.0E+00	1.4E+00	3.7E-01	4.4E-01	8.1E-01
SR19	1.7E-01	2.4E+00	2.6E+00	4.2E-01	1.3E+00	1.7E+00	3.7E-01	9.3E-01	1.3E+00
SR20	1.8E-01	1.7E+00	1.8E+00	4.3E-01	8.1E-01	1.2E+00	3.7E-01	5.1E-01	8.9E-01
SR21	1.6E-01	7.1E-01	8.5E-01	4.1E-01	3.2E-01	7.2E-01	3.6E-01	1.8E-01	5.5E-01

Table 6-3 Exposure Ratios for PM2.5 at Human Receptor Locations (Construction)

Human Receptor Location	Exposure Ratio (unitless)								
	1-hour $PM_{2.5}$			24-hour $PM_{2.5}$			Annual $PM_{2.5}$		
	Base	Project	Application	Base	Project	Application	Base	Project	Application
SR22	1.5E-01	7.1E-01	8.5E-01	4.1E-01	3.6E-01	7.5E-01	3.6E-01	1.9E-01	5.5E-01
SR23	1.5E-01	6.0E-01	7.5E-01	4.1E-01	3.1E-01	7.1E-01	3.6E-01	1.7E-01	5.3E-01
SR24	1.5E-01	4.9E-01	6.4E-01	4.1E-01	2.7E-01	6.6E-01	3.6E-01	1.8E-01	5.4E-01
SR25	1.9E-01	2.1E+00	2.2E+00	4.4E-01	9.8E-01	1.4E+00	3.8E-01	6.1E-01	9.9E-01
SR26	1.7E-01	7.0E-01	8.5E-01	4.2E-01	2.0E-01	6.1E-01	3.7E-01	5.2E-02	4.2E-01
SR27	1.8E-01	5.7E-01	7.4E-01	4.3E-01	2.0E-01	6.1E-01	3.7E-01	4.9E-02	4.2E-01
SR28	1.8E-01	5.7E-01	7.4E-01	4.3E-01	2.0E-01	6.1E-01	3.7E-01	4.9E-02	4.2E-01
SR29	1.8E-01	5.5E-01	7.2E-01	4.2E-01	2.0E-01	6.1E-01	3.7E-01	5.1E-02	4.2E-01
SR30	2.1E-01	5.9E-01	7.7E-01	4.6E-01	2.2E-01	6.5E-01	4.3E-01	5.7E-02	4.8E-01
SR31	2.1E-01	5.9E-01	7.7E-01	4.6E-01	2.2E-01	6.5E-01	4.3E-01	5.7E-02	4.8E-01
SR32	1.9E-01	5.8E-01	7.6E-01	4.4E-01	2.3E-01	6.5E-01	3.9E-01	6.4E-02	4.6E-01
SR33	1.7E-01	5.8E-01	7.4E-01	4.2E-01	2.4E-01	6.5E-01	3.7E-01	7.2E-02	4.5E-01
SR34	1.7E-01	5.9E-01	7.6E-01	4.2E-01	2.5E-01	6.6E-01	3.7E-01	8.3E-02	4.5E-01
SR35	1.7E-01	5.9E-01	7.6E-01	4.2E-01	2.5E-01	6.6E-01	3.7E-01	8.3E-02	4.5E-01
SR36	1.5E-01	1.4E+00	1.6E+00	4.1E-01	6.6E-01	1.1E+00	3.6E-01	2.9E-01	6.5E-01
SR37	1.5E-01	6.0E-01	7.5E-01	4.1E-01	3.0E-01	7.0E-01	3.6E-01	1.7E-01	5.3E-01
SR38	1.8E-01	8.7E-01	1.0E+00	4.3E-01	4.5E-01	8.6E-01	3.8E-01	2.6E-01	6.4E-01
SR39	1.9E-01	7.8E-01	9.3E-01	4.3E-01	3.8E-01	7.9E-01	3.7E-01	1.4E-01	5.2E-01
SR40	1.6E-01	1.7E+00	1.8E+00	4.1E-01	8.9E-01	1.3E+00	3.6E-01	2.9E-01	6.5E-01
SR41	1.6E-01	2.9E+00	3.1E+00	4.1E-01	1.5E+00	1.9E+00	3.6E-01	6.3E-01	9.9E-01
SR42	2.0E-01	3.4E-01	5.1E-01	4.5E-01	1.6E-01	6.1E-01	4.0E-01	6.4E-02	4.6E-01

Table 6-3 Exposure Ratios for PM2.5 at Human Receptor Locations (Construction)

Human Receptor Location	Exposure Ratio (unitless)								
	1-hour $PM_{2.5}$			24-hour $PM_{2.5}$			Annual $PM_{2.5}$		
	Base	Project	Application	Base	Project	Application	Base	Project	Application
SR43	2.6E-01	3.4E-01	5.6E-01	5.4E-01	1.7E-01	6.8E-01	4.9E-01	6.5E-02	5.6E-01
SR44	1.7E-01	2.3E-01	3.7E-01	4.3E-01	1.2E-01	5.2E-01	3.9E-01	5.0E-02	4.4E-01
SR45	1.6E-01	1.5E-01	3.0E-01	4.1E-01	6.7E-02	4.7E-01	3.7E-01	2.3E-02	3.9E-01
SR46	1.7E-01	1.3E-01	2.8E-01	4.2E-01	5.2E-02	4.6E-01	3.8E-01	1.9E-02	4.0E-01
SR47	1.8E-01	1.4E-01	2.8E-01	4.3E-01	5.6E-02	4.6E-01	3.8E-01	2.0E-02	4.0E-01
SR48	1.7E-01	9.5E-02	2.5E-01	4.2E-01	3.8E-02	4.5E-01	3.7E-01	1.2E-02	3.8E-01
SR49	1.9E-01	9.5E-02	2.7E-01	4.4E-01	3.8E-02	4.6E-01	3.9E-01	1.3E-02	4.0E-01
SR50	1.5E-01	1.1E-01	2.5E-01	4.0E-01	5.9E-02	4.5E-01	3.6E-01	3.7E-02	3.9E-01
SR51	1.5E-01	3.2E-01	4.6E-01	4.0E-01	1.9E-01	5.8E-01	3.6E-01	1.2E-01	4.8E-01
SR52	1.7E-01	3.3E-01	4.8E-01	4.1E-01	1.0E-01	5.0E-01	3.6E-01	2.1E-02	3.8E-01
SR53	1.6E-01	9.3E-02	2.4E-01	4.1E-01	3.3E-02	4.4E-01	3.6E-01	1.1E-02	3.7E-01
SR54	1.7E-01	2.0E-01	3.4E-01	4.1E-01	5.4E-02	4.5E-01	3.6E-01	1.2E-02	3.7E-01
SR55	1.7E-01	1.3E-01	2.9E-01	4.2E-01	3.5E-02	4.4E-01	3.7E-01	7.7E-03	3.7E-01
SR56	1.5E-01	9.5E-02	2.4E-01	4.0E-01	2.5E-02	4.2E-01	3.5E-01	5.5E-03	3.6E-01
SR57	1.9E-01	6.2E-01	7.8E-01	4.4E-01	1.7E-01	5.9E-01	3.9E-01	4.4E-02	4.3E-01
SR58	1.5E-01	5.0E-02	1.9E-01	4.0E-01	1.8E-02	4.1E-01	3.5E-01	5.9E-03	3.6E-01

NOTE:
Shaded cell indicates a ER greater than 1.0

Table 6-4 Exposure Ratios and Frequency of Exceedance for DEP at Human Receptor Locations

Human Receptor Location	Exposure Ratios			Frequency of Exceedances (%)		
	1-hour DEP			1-hour DEP		
	Base	Project	Application	Base	Project	Application
SR01	1.4E-01	3.3E+00	3.4E+00	0.0%	2.6%	2.7%
SR02	2.5E-01	2.0E+00	2.1E+00	0.0%	0.5%	0.6%
SR03	2.0E-01	1.4E+00	1.5E+00	0.0%	0.2%	0.2%
SR04	8.2E-02	1.0E+00	1.1E+00	0.0%	0.0%	0.1%
SR05	1.0E-01	1.3E+00	1.3E+00	0.0%	0.3%	0.4%
SR06	9.2E-02	6.9E-01	7.4E-01	0.0%	0.0%	0.0%
SR07	9.0E-02	5.7E-01	6.0E-01	0.0%	0.0%	0.0%
SR08	8.8E-02	5.5E-01	5.9E-01	0.0%	0.0%	0.0%
SR09	1.7E-01	3.6E+00	3.7E+00	0.0%	0.7%	0.8%
SR10	1.3E-01	1.6E+00	1.7E+00	0.0%	0.3%	0.4%
SR11	3.8E-01	1.9E+00	2.1E+00	0.0%	1.4%	2.1%
SR12	8.4E-02	1.9E+00	1.9E+00	0.0%	1.4%	1.5%
SR13	1.0E-01	1.8E+00	1.8E+00	0.0%	1.0%	1.1%
SR14	9.2E-02	2.5E+00	2.5E+00	0.0%	1.8%	1.8%
SR15	8.9E-02	1.9E+00	2.0E+00	0.0%	1.8%	1.8%
SR16	5.0E-02	1.5E+00	1.5E+00	0.0%	0.5%	0.5%
SR17	6.4E-02	5.8E-01	5.8E-01	0.0%	0.0%	0.0%
SR18	2.0E-01	2.1E+00	2.2E+00	0.0%	1.9%	2.2%
SR19	1.5E-01	2.6E+00	2.7E+00	0.0%	3.7%	3.8%
SR20	1.9E-01	1.8E+00	1.9E+00	0.0%	1.0%	1.2%
SR21	5.5E-02	7.2E-01	7.4E-01	0.0%	0.0%	0.0%
SR22	4.1E-02	7.5E-01	7.7E-01	0.0%	0.0%	0.0%
SR23	3.8E-02	6.3E-01	6.6E-01	0.0%	0.0%	0.0%
SR24	3.7E-02	5.0E-01	5.1E-01	0.0%	0.0%	0.0%
SR25	2.3E-01	2.3E+00	2.5E+00	0.0%	1.9%	2.1%
SR26	1.7E-01	8.7E-01	9.0E-01	0.0%	0.0%	0.0%
SR27	2.2E-01	7.0E-01	8.1E-01	0.0%	0.0%	0.0%
SR28	2.2E-01	7.0E-01	8.1E-01	0.0%	0.0%	0.0%
SR29	2.3E-01	7.5E-01	9.5E-01	0.0%	0.0%	0.0%
SR30	3.7E-01	7.9E-01	1.1E+00	0.0%	0.0%	0.0%

Table 6-4 Exposure Ratios and Frequency of Exceedance for DEP at Human Receptor Locations

Human Receptor Location	Exposure Ratios			Frequency of Exceedances (%)		
	1-hour DEP			1-hour DEP		
	Base	Project	Application	Base	Project	Application
SR31	3.7E-01	7.9E-01	1.1E+00	0.0%	0.0%	0.0%
SR32	2.4E-01	7.2E-01	9.0E-01	0.0%	0.0%	0.0%
SR33	1.6E-01	7.0E-01	7.9E-01	0.0%	0.0%	0.0%
SR34	1.3E-01	6.8E-01	7.8E-01	0.0%	0.0%	0.0%
SR35	1.3E-01	6.8E-01	7.8E-01	0.0%	0.0%	0.0%
SR36	6.0E-02	1.5E+00	1.5E+00	0.0%	0.5%	0.6%
SR37	3.8E-02	6.4E-01	6.6E-01	0.0%	0.0%	0.0%
SR38	1.9E-01	1.0E+00	1.1E+00	0.0%	0.0%	0.1%
SR39	2.1E-01	9.0E-01	1.0E+00	0.0%	0.0%	0.0%
SR40	9.6E-02	2.0E+00	2.0E+00	0.0%	1.0%	1.1%
SR41	1.1E-01	3.3E+00	3.4E+00	0.0%	3.1%	3.2%
SR42	3.2E-01	1.1E+00	1.2E+00	0.0%	0.0%	0.2%
SR43	6.4E-01	1.3E+00	1.8E+00	0.0%	0.1%	0.5%
SR44	1.0E-01	2.7E-01	3.2E-01	0.0%	0.0%	0.0%
SR45	1.1E-01	1.9E-01	2.1E-01	0.0%	0.0%	0.0%
SR46	1.6E-01	1.7E-01	2.3E-01	0.0%	0.0%	0.0%
SR47	1.9E-01	1.7E-01	2.3E-01	0.0%	0.0%	0.0%
SR48	1.5E-01	1.3E-01	2.1E-01	0.0%	0.0%	0.0%
SR49	2.6E-01	1.3E-01	3.1E-01	0.0%	0.0%	0.0%
SR50	2.9E-02	1.1E-01	1.2E-01	0.0%	0.0%	0.0%
SR51	3.5E-02	3.2E-01	3.4E-01	0.0%	0.0%	0.0%
SR52	1.9E-01	3.7E-01	4.4E-01	0.0%	0.0%	0.0%
SR53	9.1E-02	1.3E-01	1.7E-01	0.0%	0.0%	0.0%
SR54	1.5E-01	2.2E-01	2.7E-01	0.0%	0.0%	0.0%
SR55	1.7E-01	1.4E-01	2.4E-01	0.0%	0.0%	0.0%
SR56	3.9E-02	1.2E-01	1.3E-01	0.0%	0.0%	0.0%
SR57	2.4E-01	7.7E-01	9.1E-01	0.0%	0.0%	0.0%
SR58	3.6E-02	6.6E-02	8.3E-02	0.0%	0.0%	0.0%

NOTE:
Shaded cell indicates a ER greater than 1.0

6.2.2 Health Risk from Exposure to Volatile Organic Compounds – Base, Project, and Application Cases

Exposure Ratios at the Maximum Point of Impingement

Table 6-5 shows the ERs at the MPOI for each VOC. The ERs for 1,3-butadiene, 2,2,4-trimethylpentane, acetaldehyde, acrolein (annual), benzene, ethylbenzene, propionaldehyde, toluene, and xylenes are less than 1.0, indicating that there are no unacceptable risks to human health from these COPCs. The ERs for acrolein (1-hour) and formaldehyde (1-hour) are greater than 1.0 at the MPOI location.

The Base and Application ERs for formaldehyde (annual) are provided for context, and are not compared to the threshold target of 1.0 since formaldehyde is a carcinogen. Annual concentrations of formaldehyde for Base Case of 2.77 µg/m^3, and the Application Case of 3.87 µg/m^3 at the MPOI are lower than those observed in urban areas, which are reported to range from 13 to 25 µg/m^3 (11 to 20 ppb) (US EPA 2000).

The ERs at the 58 human receptor locations are examined in greater detail for acrolein and formaldehyde.

Table 6-5 Exposure Ratios at the Maximum Point of Impingement for Volatile Organic Compounds (Construction)

Volatile Organic Compound	Averaging Period	Exposure Ratio at the MPOI		
		Base	Project	Application
1,3-butadiene	1-hour	1.2E-03	6.7E-04	1.8E-03
	Annual	1.5E-02	4.6E-03	1.5E-02
	Annual*	9.9E-02	3.0E-02	1.0E-01
2,2,4-trimethylpentane	1-hour	1.0E-03	1.0E-04	1.1E-03
	Annual	1.8E-04	2.2E-05	1.8E-04
Acetaldehyde	1-hour	7.8E-03	4.6E-02	5.3E-02
	Annual*	7.6E-02	9.8E-02	1.6E-01
Acrolein	1-hour	7.6E-02	1.2E+00	1.2E+00
	Annual	1.1E-01	3.0E-01	3.8E-01
Benzene	1-hour	5.1E-02	2.8E-01	3.1E-01
	Annual	1.6E-02	5.7E-03	1.7E-02
	Annual*	1.6E-01	5.7E-02	1.7E-01
Ethylbenzene	1-hour	7.7E-06	1.7E-05	2.1E-05
	Annual	1.8E-04	3.0E-05	1.8E-04

Table 6-5 Exposure Ratios at the Maximum Point of Impingement for Volatile Organic Compounds (Construction)

Volatile Organic Compound	Averaging Period	Exposure Ratio at the MPOI		
		Base	Project	Application
Formaldehyde	1-hour	2.1E-01	1.2E+00	1.4E+00
	Annual*	1.4E+00	6.3E-01	1.9E+00
	Annual	2.5E-01	1.1E-01	3.5E-01
Propionaldehyde	Annual	2.9E-02	1.4E-02	4.2E-02
Toluene	1-hour	2.7E-04	4.3E-04	5.4E-04
	24-hour	4.1E-04	2.9E-04	4.6E-04
	Annual	3.1E-04	3.5E-05	3.1E-04
Xylenes	1-hour	2.7E-04	6.0E-04	6.9E-04
	Annual	2.7E-03	5.1E-04	2.7E-03

NOTES:

* ERs are based on non-threshold effects (i.e., cancer risk) and therefore only Project case values are compared to a threshold target of 1.0

Shaded cell indicates a ER greater than 1.0

Exposure Ratios for Acrolein and Formaldehyde at the Human Receptor Locations

The ERs for acrolein and formaldehyde at the human receptor locations are shown in Table 6-6. The ERs for acrolein (1-hour) and formaldehyde (1-hour) are less than 1.0, and indicate that there are no unacceptable health risks from acute exposure to these COPCs.

Table 6-6 Exposure Ratios for Acrolein and Formaldehyde at Human Receptor Locations (Construction)

Human Receptor Location	Exposure Ratio (unitless)					
	1-hour Acrolein			1-hour Formaldehyde		
	Base	Project	Application	Base	Project	Application
SR01	6.6E-02	2.2E-01	2.8E-01	2.0E-01	2.3E-01	4.3E-01
SR02	6.7E-02	1.3E-01	2.0E-01	2.0E-01	1.4E-01	3.4E-01
SR03	6.7E-02	9.4E-02	1.6E-01	2.0E-01	9.9E-02	3.0E-01
SR04	6.5E-02	7.1E-02	1.4E-01	2.0E-01	7.5E-02	2.7E-01
SR05	6.6E-02	8.7E-02	1.5E-01	2.0E-01	9.2E-02	2.9E-01
SR06	6.6E-02	4.7E-02	1.1E-01	2.0E-01	5.0E-02	2.5E-01

Table 6-6 Exposure Ratios for Acrolein and Formaldehyde at Human Receptor Locations (Construction)

Human Receptor Location	Exposure Ratio (unitless)					
	1-hour Acrolein			1-hour Formaldehyde		
	Base	Project	Application	Base	Project	Application
SR07	6.6E-02	3.9E-02	1.0E-01	2.0E-01	4.1E-02	2.4E-01
SR08	6.6E-02	3.7E-02	1.0E-01	2.0E-01	3.9E-02	2.4E-01
SR09	6.6E-02	2.4E-01	3.0E-01	2.0E-01	2.5E-01	4.5E-01
SR10	6.6E-02	1.1E-01	1.7E-01	2.0E-01	1.1E-01	3.1E-01
SR11	6.9E-02	1.3E-01	2.0E-01	2.0E-01	1.4E-01	3.4E-01
SR12	6.5E-02	1.3E-01	2.0E-01	2.0E-01	1.4E-01	3.4E-01
SR13	6.6E-02	1.2E-01	1.9E-01	2.0E-01	1.3E-01	3.3E-01
SR14	6.6E-02	1.7E-01	2.3E-01	2.0E-01	1.7E-01	3.7E-01
SR15	6.6E-02	1.3E-01	2.0E-01	2.0E-01	1.4E-01	3.4E-01
SR16	6.5E-02	9.8E-02	1.6E-01	2.0E-01	1.0E-01	3.0E-01
SR17	6.5E-02	3.9E-02	1.0E-01	2.0E-01	4.1E-02	2.4E-01
SR18	6.7E-02	1.5E-01	2.2E-01	2.0E-01	1.6E-01	3.6E-01
SR19	6.6E-02	1.8E-01	2.5E-01	2.0E-01	1.9E-01	3.9E-01
SR20	6.7E-02	1.3E-01	2.0E-01	2.0E-01	1.4E-01	3.4E-01
SR21	6.5E-02	4.9E-02	1.1E-01	2.0E-01	5.2E-02	2.5E-01
SR22	6.5E-02	5.1E-02	1.2E-01	2.0E-01	5.4E-02	2.5E-01
SR23	6.5E-02	4.4E-02	1.1E-01	2.0E-01	4.6E-02	2.4E-01
SR24	6.5E-02	3.4E-02	9.8E-02	2.0E-01	3.6E-02	2.3E-01
SR25	6.7E-02	1.7E-01	2.4E-01	2.0E-01	1.8E-01	3.8E-01
SR26	6.6E-02	6.0E-02	1.3E-01	2.0E-01	6.4E-02	2.6E-01
SR27	6.7E-02	4.9E-02	1.1E-01	2.0E-01	5.1E-02	2.5E-01
SR28	6.7E-02	4.9E-02	1.1E-01	2.0E-01	5.1E-02	2.5E-01
SR29	6.7E-02	5.1E-02	1.2E-01	2.0E-01	5.4E-02	2.5E-01
SR30	6.9E-02	5.6E-02	1.2E-01	2.0E-01	5.9E-02	2.6E-01
SR31	6.9E-02	5.6E-02	1.2E-01	2.0E-01	5.9E-02	2.6E-01
SR32	6.7E-02	5.2E-02	1.2E-01	2.0E-01	5.5E-02	2.6E-01
SR33	6.6E-02	5.0E-02	1.1E-01	2.0E-01	5.3E-02	2.5E-01
SR34	6.6E-02	5.0E-02	1.2E-01	2.0E-01	5.3E-02	2.5E-01
SR35	6.6E-02	5.0E-02	1.2E-01	2.0E-01	5.3E-02	2.5E-01

Table 6-6 Exposure Ratios for Acrolein and Formaldehyde at Human Receptor Locations (Construction)

Human Receptor Location	Exposure Ratio (unitless)					
	1-hour Acrolein			1-hour Formaldehyde		
	Base	Project	Application	Base	Project	Application
SR36	6.5E-02	9.8E-02	1.6E-01	2.0E-01	1.0E-01	3.0E-01
SR37	6.5E-02	4.4E-02	1.1E-01	2.0E-01	4.7E-02	2.5E-01
SR38	6.7E-02	7.0E-02	1.4E-01	2.0E-01	7.4E-02	2.7E-01
SR39	6.7E-02	6.8E-02	1.3E-01	2.0E-01	7.2E-02	2.7E-01
SR40	6.6E-02	1.4E-01	2.0E-01	2.0E-01	1.5E-01	3.4E-01
SR41	6.6E-02	2.3E-01	3.0E-01	2.0E-01	2.5E-01	4.4E-01
SR42	6.8E-02	7.1E-02	1.4E-01	2.0E-01	7.5E-02	2.7E-01
SR43	7.1E-02	8.5E-02	1.5E-01	2.1E-01	9.0E-02	2.9E-01
SR44	6.6E-02	1.8E-02	8.3E-02	2.0E-01	1.9E-02	2.2E-01
SR45	6.6E-02	1.3E-02	7.7E-02	2.0E-01	1.4E-02	2.1E-01
SR46	6.7E-02	1.1E-02	7.6E-02	2.0E-01	1.2E-02	2.1E-01
SR47	6.7E-02	1.2E-02	7.7E-02	2.0E-01	1.3E-02	2.1E-01
SR48	6.6E-02	8.7E-03	7.4E-02	2.0E-01	9.2E-03	2.1E-01
SR49	6.8E-02	8.5E-03	7.4E-02	2.0E-01	9.0E-03	2.1E-01
SR50	6.5E-02	7.8E-03	7.2E-02	2.0E-01	8.2E-03	2.1E-01
SR51	6.5E-02	2.2E-02	8.7E-02	2.0E-01	2.3E-02	2.2E-01
SR52	6.7E-02	2.7E-02	9.3E-02	2.0E-01	2.9E-02	2.3E-01
SR53	6.6E-02	8.8E-03	7.4E-02	2.0E-01	9.3E-03	2.1E-01
SR54	6.6E-02	1.6E-02	8.1E-02	2.0E-01	1.7E-02	2.2E-01
SR55	6.6E-02	1.1E-02	7.6E-02	2.0E-01	1.2E-02	2.1E-01
SR56	6.5E-02	8.7E-03	7.3E-02	2.0E-01	9.2E-03	2.1E-01
SR57	6.7E-02	5.3E-02	1.2E-01	2.0E-01	5.6E-02	2.6E-01
SR58	6.5E-02	4.4E-03	6.9E-02	2.0E-01	4.7E-03	2.0E-01

NOTE:
Shaded cell indicates an ER > 1.0

6.2.3 Health Risk from Exposure to Polycyclic Aromatic Hydrocarbons – Base, Project, and Application Cases

Exposure Ratios at the Maximum Point of Impingement

Table 6-7 shows the ERs at the MPOI for benzo(a)pyrene and naphthalene. The chronic ERs for benzo(a)pyrene and naphthalene are less than 1.0 at the MPOI, indicating that the ER must be less than 1.0 throughout the entire study area. The difference between the Base Case and Application Case ERs are negligible, indicating that the Project is not a substantial contributor to the risk associated with these substances in the study area. Based on this information, there are no unacceptable risks to human health from benzo(a)pyrene and naphthalene, and these substances are not assessed further.

Table 6-7 Exposure Ratios at the Maximum Point of Impingement for Polycyclic Aromatic Hydrocarbons (Construction)

Polycyclic Aromatic Hydrocarbon	Averaging Period	Exposure Ratio at the MPOI		
		Base	Project	Application
Benzo(a)pyrene TPE	Annual*	6.9E-01	3.1E-02	6.9E-01
Naphthalene	Annual	2.4E-02	7.8E-03	2.6E-02

NOTE:
* ERs are based on non-threshold effects (i.e., cancer risk) and therefore only Project case values are compared to a threshold target of 1.0

6.2.4 Health Risk from Exposure to Metals – Base, Project, and Application Cases

Exposure Ratios at the Maximum Point of Impingement

Table 6-8 shows the ERs at the MPOI for metals in the air. The ERs for arsenic, manganese, mercury and nickel are less than 1.0, indicating that there are no unacceptable risks to human health from these COPCs. The ER for chromium VI (1-hour) are also less than 1.0; however, the ER for chromium VI (annual) at the MPOI is greater than 1.0.

The Base and Application ER values for chromium(VI) (annual) are provided for context, and are not compared to the threshold target of 1.0 since chromium VI is a carcinogen. Annual concentrations of chromium VI for Base Case of 0.001 µg/m^3, and the Application Case of 0.008 µg/m$_3$ at the MPOI similar to those observed in urban areas of Canada. Mean airborne concentrations of chromium in 12 Canadian cities from 1987 to 1990 ranged from 0.003 to 0.009 µg/m^3, while levels in nonurban areas were usually <0.001 µg/m^3 (Environment Canada 1994). As noted in Section 5.2, the modeled chromium concentrations in air included included

particle sizes that are beyond the respirable range). As such, comparing the total chromium concentration in air to the chromium VI TRV is very conservative.

Table 6-8 Exposure Ratios at the Maximum Point of Impingement for Metals in the Air (Construction)

Metals in Air Emissions	Averaging Period	Exposure Ratio at the MPOI		
		Base	Project	Application
Arsenic	1-hour	2.2E-02	4.0E-01	4.0E-01
	Annual*	5.6E-02	2.2E-01	2.3E-01
Chromium (VI)	1-hour	3.9E-03	1.2E-01	1.2E-01
	Annual*	3.2E-01	1.9E+00	2.0E+00
Manganese	1-hour	5.3E-04	9.5E-05	6.0E-04
	Annual	2.5E-03	2.1E-05	2.5E-03
Mercury	1-hour	4.6E-05	2.9E-04	2.9E-04
	Annual	2.2E-04	3.1E-04	3.3E-04
Nickel	1-hour	8.2E-04	2.3E-02	2.4E-02
	Annual	2.6E-02	1.5E-01	1.6E-01

NOTES:
* ERs are based on non-threshold effects (i.e., cancer risk) and therefore only Project case values are compared to a threshold target of 1.0
Shaded cell indicates a ER greater than 1.0

Exposure Ratios for Chromium at the Human Receptor Locations

The ERs for annual chromium at the human receptor locations are shown in Table 6-9.

The ERs for annual chromium are less than 1.0 for the Project Case, with the exception of receptor location SR19 (rural residence adjacent to Township Road 242). This indicates that there may be an unacceptable risk to human health for long-term cancer risk.

To characterize the risk more accurately, the conservative assumptions applied in the HHRA are examined, and the ILCR for this specific location determined. Firstly, the air quality model was generally conservative. For example, the air quality was modelled over three years, and the year with the poorest air quality was applied as the Project Case. Another assumption in the air quality model was that all chromium emissions were hexavalent chromium. However, the US EPA reports that an analysis of emissions from on-road vehicles show that only 18% of the total chromium is composed of hexavalent chromium (US EPA 2016d). The remaining 82% of chromium is composed of the less toxic forms of chromium (e.g., Cr^{-2}, Cr^{0}, and Cr^{+3}), that are also

not carcinogenic (US EPA 2016d). If this was factored into the air quality model, the Project Case ER at receptor location SR19 would be reduced from 1.3 to 0.23.

The air quality model also only applied partial mitigations to reduce vehicle emissions, since the construction schedule and use of vehicles is flexible. During the construction phase, further operational mitigations can be applied that reduce the number of vehicles and equipment operating in an area with nearby human receptors. This would effectively reduce vehicle emissions, but the degree of effect on chromium emissions cannot be quantified without a more detailed construction schedule.

Another factor affecting the characterization of cancer risk is the duration of the construction phase. The Project's contribution to chromium in the air only lasts for 36 months during construction. As per Health Canada (2010a), the ILCR may be estimated as:

ILCR = Air concentration ($\mu g/m^3$) x Fraction of Time Exposed x inhalation unit risk $(\mu g/m^3)^{-1}$

At SR19, the predicted annual air concentration is 0.0056 $\mu g/m^3$, the fraction of time exposed for all receptors is 0.0375 (i.e., 3 years/80 years), and the inhalation unit risk for hexavalent chromium is of 0.0023 $(\mu g/m^3)^{-1}$(see Section 4.2.4). This results in a predicted ILCR of 4.8E-07 (or 0.048 in 100,000), which is less than the benchmark ILCR of 1E-05 (or 1 in 100,000) determined by regulatory agencies such as Alberta Environment and Health Canada to be "essentially negligible".

Based on these factors, there is no unacceptable cancer risk to human receptors from hexavalent chromium during the construction phase.

Table 6-9 Exposure Ratios for Chromium at Human Receptor Locations (Construction)

Human Receptor Location	Exposure Ratio (unitless)		
	Annual Chromium (VI)*		
	Base	Project	Application
SR01	8.4E-02	9.6E-02	1.8E-01
SR02	9.5E-02	5.9E-02	1.5E-01
SR03	9.1E-02	6.5E-02	1.6E-01
SR04	8.1E-02	2.2E-01	3.0E-01
SR05	8.6E-02	2.4E-01	3.3E-01
SR06	8.9E-02	1.0E-01	1.9E-01
SR07	8.6E-02	6.7E-02	1.5E-01
SR08	9.1E-02	1.0E-01	1.9E-01

Table 6-9 Exposure Ratios for Chromium at Human Receptor Locations (Construction)

Human Receptor Location	Exposure Ratio (unitless)		
	Annual Chromium (VI)*		
	Base	Project	Application
SR09	8.2E-02	1.4E-01	2.2E-01
SR10	7.9E-02	1.7E-01	2.5E-01
SR11	1.1E-01	3.6E-01	4.7E-01
SR12	8.2E-02	4.1E-01	4.9E-01
SR13	8.3E-02	3.6E-01	4.5E-01
SR14	8.1E-02	5.2E-01	6.0E-01
SR15	8.1E-02	5.4E-01	6.2E-01
SR16	7.8E-02	5.4E-01	6.2E-01
SR17	8.0E-02	1.4E-01	2.2E-01
SR18	8.1E-02	4.7E-01	5.5E-01
SR19	7.9E-02	1.3E+00	1.4E+00
SR20	8.1E-02	7.0E-01	7.8E-01
SR21	7.8E-02	2.1E-01	2.9E-01
SR22	7.7E-02	2.6E-01	3.4E-01
SR23	7.7E-02	2.2E-01	3.0E-01
SR24	7.7E-02	2.3E-01	3.1E-01
SR25	8.4E-02	7.6E-01	8.4E-01
SR26	7.9E-02	3.3E-02	1.1E-01
SR27	8.2E-02	2.9E-02	1.1E-01
SR28	8.2E-02	2.9E-02	1.1E-01
SR29	8.1E-02	3.1E-02	1.1E-01
SR30	1.1E-01	3.6E-02	1.5E-01
SR31	1.1E-01	3.6E-02	1.5E-01
SR32	9.4E-02	4.3E-02	1.4E-01
SR33	8.1E-02	5.1E-02	1.3E-01
SR34	7.9E-02	6.0E-02	1.4E-01
SR35	7.9E-02	6.0E-02	1.4E-01
SR36	7.9E-02	3.7E-01	4.5E-01
SR37	7.7E-02	2.1E-01	2.9E-01

Table 6-9 Exposure Ratios for Chromium at Human Receptor Locations (Construction)

Human Receptor Location	Exposure Ratio (unitless)		
	Annual Chromium (VI)*		
	Base	Project	Application
SR38	8.6E-02	3.1E-01	4.0E-01
SR39	8.2E-02	1.5E-01	2.4E-01
SR40	7.7E-02	2.9E-01	3.7E-01
SR41	7.7E-02	8.3E-01	9.0E-01
SR42	1.0E-01	3.6E-02	1.4E-01
SR43	1.7E-01	4.4E-02	2.1E-01
SR44	1.0E-01	4.8E-02	1.5E-01
SR45	8.0E-02	1.7E-02	9.6E-02
SR46	8.2E-02	1.2E-02	9.4E-02
SR47	8.1E-02	1.3E-02	9.4E-02
SR48	7.9E-02	6.7E-03	8.5E-02
SR49	8.5E-02	7.4E-03	9.2E-02
SR50	7.7E-02	4.0E-02	1.2E-01
SR51	7.7E-02	1.7E-01	2.5E-01
SR52	7.8E-02	1.0E-02	8.9E-02
SR53	7.7E-02	6.5E-03	8.3E-02
SR54	7.7E-02	4.8E-03	8.2E-02
SR55	8.3E-02	2.9E-03	8.6E-02
SR56	7.5E-02	2.0E-03	7.7E-02
SR57	9.3E-02	2.6E-02	1.2E-01
SR58	7.5E-02	3.7E-03	7.9E-02

NOTES:

* ERs are based on non-threshold effects (i.e., cancer risk) and therefore only Project case values are compared to a threshold target of 1.0

Shaded cell indicates a ER greater than 1.0

6.2.5 Health Risk from Chemical Mixtures

Concurrent exposures to more than one chemical may result in interactions among toxicological health effects. This may result in a combined toxicity which is:

- equal to the sum of toxicities of the individual chemicals (additivity or independence)
- greater than the sum (synergism or potentiation), or
- less than the sum (antagonism)

In general, toxicological interactions depend on the chemicals present, the levels of exposure to each, their mode of action and their concentrations. Most non-additive interactions can only be demonstrated at relatively high exposures, where clear adverse health outcomes are observed. Such interactions have not been observed or quantified at the relatively low rates of exposure typical of those associated with most environmental situations (NAS 1983; Krewski and Thomas 1992).

Additive interactions only apply to chemicals that are structurally similar, act toxicologically through similar mechanisms or affect the same target tissue in the body (i.e., share common health effect), such as the additivity of carcinogenic PAH compounds. Although the interaction between chemicals can take many forms, Health Canada (2010a) requests that additive interactions be assumed for any chemicals that affect the same target tissue in the body for the HHRA (Health Canada 2010a).

Potential additive interactions were identified for specific COPC that may cause:

- irritation of the eyes, nose or respiratory tract;
- neurotoxicity;
- developmental and reproductive toxicity; or
- cancer (e.g., lung, leukemia).

The health endpoint of the TRVs used in the HHRA, as identified in Table 4-1, provided the basis for an individual chemical's inclusion in a chemical mixture. The various evaluated mixture groups, as well as the COPC considered in each group, are listed in Table 6-10.

Table 6-10 Potential Additive Interactions of the Chemicals of Potential Concern

Exposure Period	Potential Health Endpoint of Mixture	Chemical of Potential Concern
Inhalation – Acute Exposure	Eye Irritants	Acrolein, formaldehyde
	Respiratory Irritants	Acetaldehyde, arsenic, chromium VI, manganese, nickel, xylenes
	Neurological effects	2,2,4-trimethylpentane, toluene, mercury, xylenes
Inhalation – Chronic Exposure	Nasal Irritants	Acrolein, formaldehyde, naphthalene
	Neurological effects	Toluene, manganese, mercury
	Developmental effects	Ethylbenzene, xylenes
	Lung cancer	Benzo(a)pyrene, arsenic, chromium VI, nickel
	Nasal cancer	Acetaldehyde, formaldehyde
	Leukemia	1,3-butadiene, benzene

The predicted cumulative acute ERs for Base Case, Project Alone Case, and Application Case exposures to the COPC are provided in Table 6-11.

Table 6-11 Summary of Acute Inhalation ER Values for each Mixture Group at the MPOI

Mixture Group	Acute ER Values (based on concentrations at MPOI)		
	Base	Project Alone	Application
Eye Irritants	0.29	2.4	2.6
Respiratory Irritants	0.035	0.58	0.60
Neurological effects	0.0016	0.0014	0.0026

NOTE:
Shaded cell indicates a ER greater than 1.0

The results of the acute inhalation assessment of the mixtures group indicate the following.

- None of the measured 1-hour air concentrations for COPC leading to potential long-term neurological effects, were above the ER benchmark of 1.0 for any of the assessment cases

- None of the measured 1-hour air concentrations for COPC leading to potential respiratory effects, were above the ER benchmark of 1.0 for any of the assessment cases
- Predicted risks related to eye irritation exceeded the ER benchmark of 1.0 for both Project Alone and the Application Cases. These health risks at the MPOI are related to elevated concentrations of acrolein and formaldehyde

Although there is a low probability of a receptor being present at the MPOI at the same time as the elevated1-hour exposure concentrations of acrolein and formaldehyde, it does suggest that further assessment is warranted to assess the potential for cumulative effects of eye irritants at the 58 receptor locations, where there is a higher likelihood of exposure. A summary of the cumulative acute ER values for Base Case, Project Alone Case, and Application Case exposures to eye irritants is provided in Table 6-12.

Table 6-12 Summary Acute Inhalation ERs for Eye Irritants at each of the Receptor Locations

Receptor Location	Acute ER Values for Eye Irritants		
	Base	Project Alone	Application
SR01	0.27	0.45	0.71
SR02	0.27	0.27	0.54
SR03	0.27	0.19	0.46
SR04	0.26	0.15	0.41
SR05	0.27	0.18	0.44
SR06	0.26	0.10	0.36
SR07	0.26	0.08	0.34
SR08	0.26	0.08	0.34
SR09	0.27	0.49	0.76
SR10	0.27	0.22	0.48
SR11	0.27	0.27	0.53
SR12	0.26	0.27	0.54
SR13	0.27	0.25	0.52
SR14	0.26	0.34	0.60
SR15	0.26	0.27	0.54
SR16	0.26	0.20	0.47
SR17	0.26	0.08	0.34
SR18	0.27	0.31	0.57
SR19	0.27	0.37	0.64
SR20	0.27	0.27	0.54

Table 6-12 Summary Acute Inhalation ERs for Eye Irritants at each of the Receptor Locations

Receptor Location	Acute ER Values for Eye Irritants		
	Base	Project Alone	Application
SR21	0.26	0.10	0.36
SR22	0.26	0.10	0.37
SR23	0.26	0.09	0.35
SR24	0.26	0.07	0.33
SR25	0.27	0.35	0.61
SR26	0.27	0.12	0.39
SR27	0.27	0.10	0.36
SR28	0.27	0.10	0.36
SR29	0.27	0.10	0.37
SR30	0.27	0.11	0.39
SR31	0.27	0.11	0.39
SR32	0.27	0.11	0.37
SR33	0.27	0.10	0.37
SR34	0.27	0.10	0.37
SR35	0.27	0.10	0.37
SR36	0.26	0.20	0.47
SR37	0.26	0.09	0.35
SR38	0.27	0.14	0.41
SR39	0.27	0.14	0.41
SR40	0.26	0.28	0.55
SR41	0.27	0.48	0.74
SR42	0.27	0.15	0.41
SR43	0.28	0.18	0.44
SR44	0.27	0.04	0.30
SR45	0.27	0.03	0.29
SR46	0.27	0.02	0.29
SR47	0.27	0.02	0.29
SR48	0.27	0.02	0.28
SR49	0.27	0.02	0.28
SR50	0.26	0.02	0.28
SR51	0.26	0.05	0.31

Table 6-12 Summary Acute Inhalation ERs for Eye Irritants at each of the Receptor Locations

Receptor Location	Acute ER Values for Eye Irritants		
	Base	Project Alone	Application
SR52	0.27	0.06	0.32
SR53	0.27	0.02	0.28
SR54	0.27	0.03	0.30
SR55	0.27	0.02	0.29
SR56	0.26	0.02	0.28
SR57	0.27	0.11	0.38
SR58	0.26	0.01	0.27

The ERs for acute (1-hour) exposure to eye irritants are less than 1.0 at each of the receptor locations, and indicate that the risk of cumulative effects from exposure to eye irritants at the receptor locations is negligible.

Predicted cumulative chronic ERs for Base Case, Project Alone Case, and Application Case exposures to the COPC at the MPOI are provided in Table 6-13. The MPOI are not located at receptor locations; therefore, no one would be exposed to chronic levels of COPC. As such, the ER values in Table 6-13 are considered very conservative, and suitable primarily for screening purposes.

Table 6-13 Summary of Chronic Inhalation ER Values for each Mixture Group at the MPOI

Mixture Group	Chronic ER Values (based on concentrations at MPOI)		
	Base	Project Alone	Application
Nasal Irritants	0.38	0.43	0.76
Neurological effects	0.0028	0.00035	0.0031
Developmental effects	0.0029	0.00054	0.0029
Lung cancer*	1.1	2.3	3.1
Nasal cancer*	1.5	0.72	2.1
Leukemia *	0.26	0.087	0.27

NOTE:

* ERs are based on non-threshold effects (i.e., cancer risk) and therefore only Project case values are compared to a threshold target of 1.0

Shaded cell indicates a ER greater than 1.0

The results of the chronic inhalation assessment of the mixtures group indicate the following:

- The predicted annual average air concentrations for COPC leading to potential health concerns such as nasal irritation, neurological effects, and development effects were not above the ER benchmark of 1.0 for any of the assessment cases, indicating that the risk of cumulative effects from exposure for these effects is negligible
- The predicted annual average air concentrations for COPC leading to potential health concerns such as nasal cancer and leukemia were below the ER benchmark of 1.0 for the Project Alone Case, indicating that the risk of cumulative effects from exposure for these effects is negligible
- The predicted annual average air concentrations for COPC leading to lung cancer is above the ER benchmark of 1.0 for the Project Alone Case at the MPOI

The ERs for lung cancer at each of the receptor locations are provided in Table 6-14.

Table 6-14 Summary of Chronic Inhalation ER Values for Lung Cancer at the Receptor Locations

Receptor Location	Chronic ER Values for Lung Cancer		
	Base	Project Alone	Application
SR01	0.26	0.12	0.38
SR02	0.29	0.07	0.37
SR03	0.28	0.08	0.36
SR04	0.25	0.27	0.51
SR05	0.26	0.29	0.55
SR06	0.27	0.12	0.39
SR07	0.26	0.08	0.34
SR08	0.27	0.12	0.39
SR09	0.25	0.17	0.42
SR10	0.24	0.20	0.45
SR11	0.36	0.44	0.79
SR12	0.25	0.50	0.74
SR13	0.25	0.44	0.69
SR14	0.25	0.63	0.88
SR15	0.24	0.65	0.89
SR16	0.23	0.65	0.88
SR17	0.24	0.17	0.41

Table 6-14 Summary of Chronic Inhalation ER Values for Lung Cancer at the Receptor Locations

Receptor Location	Chronic ER Values for Lung Cancer		
	Base	Project Alone	Application
SR18	0.25	0.57	0.82
SR19	0.24	1.56	1.81
SR20	0.25	0.84	1.09
SR21	0.23	0.26	0.49
SR22	0.23	0.32	0.54
SR23	0.23	0.26	0.49
SR24	0.23	0.28	0.51
SR25	0.27	0.91	1.18
SR26	0.24	0.04	0.28
SR27	0.26	0.04	0.29
SR28	0.26	0.04	0.29
SR29	0.25	0.04	0.29
SR30	0.38	0.04	0.43
SR31	0.38	0.04	0.43
SR32	0.30	0.05	0.35
SR33	0.26	0.06	0.32
SR34	0.25	0.07	0.32
SR35	0.25	0.07	0.32
SR36	0.23	0.44	0.68
SR37	0.23	0.26	0.49
SR38	0.28	0.37	0.65
SR39	0.25	0.19	0.44
SR40	0.23	0.35	0.58
SR41	0.24	1.00	1.23
SR42	0.32	0.04	0.36
SR43	0.55	0.05	0.60
SR44	0.30	0.06	0.35
SR45	0.25	0.02	0.27
SR46	0.26	0.01	0.28
SR47	0.27	0.02	0.28

Table 6-14 Summary of Chronic Inhalation ER Values for Lung Cancer at the Receptor Locations

Receptor Location	Chronic ER Values for Lung Cancer		
	Base	Project Alone	Application
SR48	0.25	0.01	0.26
SR49	0.28	0.01	0.29
SR50	0.22	0.05	0.27
SR51	0.23	0.21	0.44
SR52	0.24	0.01	0.25
SR53	0.23	0.01	0.24
SR54	0.23	0.01	0.24
SR55	0.25	0.00	0.25
SR56	0.22	0.00	0.22
SR57	0.30	0.03	0.33
SR58	0.22	0.00	0.22

NOTES:

* ERs are based on non-threshold effects (i.e., cancer risk) and therefore only Project case values are compared to a threshold target of 1.0

Shaded cell indicates a ER greater than 1.0

The ERs for lung cancer do not exceed the benchmark of 1.0 for the Project Case, with the exception of receptor location SR19 (rural residence adjacent to Township Road 242). This indicates that there may be an unacceptable risk to human health for long-term cancer risk. The lung cancer risk at this location is driven primarily by predicted exposure to annual chromium VI. As discussed in Section 6.3.4, the lung cancer risk associated with the construction phase is considered negligible because of the following conservative assumptions:

- All chromium emissions were evaluated as hexavalent chromium; however, contributions from soil are unlikely to contain hexavalent chromium
- Although all chromium emissions were modelled as hexavalent chromium, the US EPA (2016d) reports that an analysis of emissions from on-road vehicles show that only 18% of the total chromium is composed of hexavalent chromium
- The ER values are based on continuous, lifetime exposure; however, actual exposures will be limited to 3 years over a lifetime

6.2.6 Health Risk from Exposure to Air COPCs – Planned Development Case

Based on air model predictions, the HHRA results for the Base, Project Alone, and Application Case indicate that with only partial mitigations, there could still be an unacceptable short-term risk to human health for residents and people adjacent to the PDA. To address these concerns, an ambient air monitoring program is planned during construction (i.e., an adaptive management plan). In addition, more intensive mitigation measures have been planned to reduce the potential change in air quality, which effectively reduces the potential risk to human health.

With respect to the Planned Development Case for construction, several future projects were identified that could potentially overlap with the Project-related emissions during construction, as discussed in Section 5.2. As noted in Section 5.2, emissions from these other projects are not expected to materially change the predicted Project-related exposures, or affect the need for an air quality monitoring program and adaptive management plan.

6.3 HEALTH RISK DURING POST-FLOOD OPERATION PHASE

6.3.1 Health Risk from Exposure to $PM_{2.5}$

The ERs for $PM_{2.5}$ inhalation for Base, Project Alone, and Application Cases are shown in Table 6-15. Overall, the Application Case ERs are less than 1.0 at the human receptor locations. This indicates that there are no unacceptable risks to human receptors from inhalation exposures to $PM_{2.5}$ during a period of dry weather and high winds in the post-flood operation phase.

Table 6-15 Exposure Ratios for PM2.5 at Human Receptor Locations (Post-Flood Operation)

Human Receptor Location	Exposure Ratio (unitless)					
	1-hour $PM_{2.5}$			24-hour $PM_{2.5}$		
	Base	Project	Application	Base	Project	Application
SR01	1.7E-01	4.9E-04	1.7E-01	4.2E-01	1.0E-05	4.2E-01
SR02	1.8E-01	2.1E-03	1.9E-01	4.3E-01	1.3E-04	4.3E-01
SR03	1.8E-01	2.4E-03	1.8E-01	4.3E-01	2.7E-04	4.3E-01
SR04	1.5E-01	1.2E-02	1.7E-01	4.1E-01	8.6E-04	4.1E-01
SR05	1.6E-01	5.5E-02	2.2E-01	4.2E-01	3.9E-03	4.2E-01
SR06	1.6E-01	3.5E-03	1.6E-01	4.2E-01	1.4E-04	4.2E-01
SR07	1.6E-01	6.7E-03	1.6E-01	4.2E-01	3.2E-04	4.2E-01
SR08	1.6E-01	1.4E-02	1.8E-01	4.2E-01	2.5E-03	4.2E-01
SR09	1.7E-01	5.9E-04	1.7E-01	4.2E-01	5.6E-07	4.2E-01

Table 6-15 Exposure Ratios for PM2.5 at Human Receptor Locations (Post-Flood Operation)

Human Receptor Location	Exposure Ratio (unitless)					
	1-hour $PM_{2.5}$			24-hour $PM_{2.5}$		
	Base	Project	Application	Base	Project	Application
SR10	1.6E-01	1.1E-04	1.6E-01	4.2E-01	6.3E-07	4.2E-01
SR11	2.1E-01	4.5E-05	2.1E-01	4.8E-01	5.8E-07	4.8E-01
SR12	1.6E-01	1.2E-01	2.8E-01	4.1E-01	3.0E-02	4.4E-01
SR13	1.6E-01	1.1E-01	2.7E-01	4.2E-01	2.2E-02	4.4E-01
SR14	1.6E-01	1.6E-01	3.2E-01	4.1E-01	4.4E-02	4.6E-01
SR15	1.6E-01	1.2E-01	2.8E-01	4.2E-01	3.4E-02	4.5E-01
SR16	1.5E-01	3.6E-02	1.9E-01	4.1E-01	2.0E-02	4.2E-01
SR17	1.5E-01	1.7E-02	1.7E-01	4.1E-01	6.6E-03	4.2E-01
SR18	1.8E-01	3.2E-05	1.8E-01	4.3E-01	1.1E-07	4.3E-01
SR19	1.7E-01	5.2E-04	1.7E-01	4.2E-01	9.1E-08	4.2E-01
SR20	1.8E-01	9.6E-04	1.8E-01	4.3E-01	9.0E-08	4.3E-01
SR21	1.6E-01	8.5E-03	1.6E-01	4.1E-01	5.7E-04	4.1E-01
SR22	1.5E-01	1.1E-02	1.6E-01	4.1E-01	1.3E-03	4.1E-01
SR23	1.5E-01	1.1E-02	1.6E-01	4.1E-01	1.6E-03	4.1E-01
SR24	1.5E-01	2.3E-02	1.7E-01	4.1E-01	5.2E-03	4.1E-01
SR25	1.9E-01	7.9E-04	1.9E-01	4.4E-01	8.9E-08	4.4E-01
SR26	1.7E-01	6.7E-04	1.7E-01	4.2E-01	9.4E-08	4.2E-01
SR27	1.8E-01	7.9E-04	1.8E-01	4.3E-01	7.8E-07	4.3E-01
SR28	1.8E-01	7.9E-04	1.8E-01	4.3E-01	7.8E-07	4.3E-01
SR29	1.8E-01	8.5E-04	1.8E-01	4.2E-01	2.8E-06	4.2E-01
SR30	2.1E-01	9.3E-04	2.1E-01	4.6E-01	2.0E-06	4.6E-01
SR31	2.1E-01	9.3E-04	2.1E-01	4.6E-01	2.0E-06	4.6E-01
SR32	1.9E-01	1.1E-03	1.9E-01	4.4E-01	6.1E-06	4.4E-01
SR33	1.7E-01	1.2E-03	1.7E-01	4.2E-01	1.1E-05	4.2E-01
SR34	1.7E-01	1.3E-03	1.7E-01	4.2E-01	2.0E-05	4.2E-01
SR35	1.7E-01	1.3E-03	1.7E-01	4.2E-01	2.0E-05	4.2E-01
SR36	1.5E-01	3.2E-02	1.8E-01	4.1E-01	1.7E-02	4.2E-01
SR37	1.5E-01	1.1E-02	1.6E-01	4.1E-01	1.7E-03	4.1E-01
SR38	1.8E-01	1.4E-03	1.8E-01	4.3E-01	3.5E-07	4.3E-01

Table 6-15 Exposure Ratios for PM2.5 at Human Receptor Locations (Post-Flood Operation)

Human Receptor Location	Exposure Ratio (unitless)					
	1-hour $PM_{2.5}$			24-hour $PM_{2.5}$		
	Base	Project	Application	Base	Project	Application
SR39	1.9E-01	9.7E-04	1.9E-01	4.3E-01	1.0E-07	4.3E-01
SR40	1.6E-01	1.3E-05	1.6E-01	4.1E-01	6.0E-09	4.1E-01
SR41	1.6E-01	8.6E-05	1.6E-01	4.1E-01	9.3E-08	4.1E-01
SR42	2.0E-01	6.7E-04	2.0E-01	4.5E-01	9.1E-06	4.5E-01
SR43	2.6E-01	1.8E-03	2.6E-01	5.4E-01	1.2E-04	5.4E-01
SR44	1.7E-01	8.7E-03	1.7E-01	4.3E-01	1.1E-03	4.3E-01
SR45	1.6E-01	2.8E-03	1.6E-01	4.1E-01	1.1E-04	4.1E-01
SR46	1.7E-01	1.4E-03	1.7E-01	4.2E-01	2.9E-05	4.2E-01
SR47	1.8E-01	1.5E-03	1.8E-01	4.3E-01	4.4E-05	4.3E-01
SR48	1.7E-01	4.6E-04	1.7E-01	4.2E-01	5.2E-06	4.2E-01
SR49	1.9E-01	4.6E-04	1.9E-01	4.4E-01	4.3E-06	4.4E-01
SR50	1.5E-01	9.5E-03	1.6E-01	4.0E-01	2.4E-03	4.0E-01
SR51	1.5E-01	1.7E-02	1.6E-01	4.0E-01	5.0E-03	4.1E-01
SR52	1.7E-01	2.5E-04	1.7E-01	4.1E-01	9.6E-08	4.1E-01
SR53	1.6E-01	8.5E-05	1.6E-01	4.1E-01	3.9E-06	4.1E-01
SR54	1.7E-01	1.8E-04	1.7E-01	4.1E-01	6.5E-08	4.1E-01
SR55	1.7E-01	1.5E-04	1.7E-01	4.2E-01	8.6E-09	4.2E-01
SR56	1.5E-01	7.4E-06	1.5E-01	4.0E-01	1.9E-10	4.0E-01
SR57	1.9E-01	6.2E-04	1.9E-01	4.4E-01	1.3E-07	4.4E-01
SR58	1.5E-01	8.3E-05	1.5E-01	4.0E-01	6.6E-07	4.0E-01

NOTE:
Shaded cell indicates a ER greater than 1.0

With respect to the Planned Development Case during post-flood operations, two other future planned projects were identified that could also result in fugitive dust emissions.

- The Community of Harmony - Stage 2 and 3: Development on approximately 700 ha includes residential, commercial, recreational, infrastructure and institutions. Stage 2 construction starts 2019. By 2020 Harmony anticipated population of 1,200 in over 500 homes. Development will continue beyond 2020 in the same approved development area; however, no specific details are available.
- Upgrades to Highways 1, 8 and 22: Upgrading of Highway 1 and 22 interchange, Highway 8 and 22 interchange, and Highway 22 to four lanes and ultimately six lanes. These future road developments are not listed in the Provincial Construction Program for 2017-2020, and therefore it is assumed that construction would start after 2020. No specific footprint details are available.

Project-related fugitive dust emissions from wind erosion of the deposited sediment are expected to be limited to a maximum of a five-month summer period (June to October) after the occurrence of 1:100 to design floods. The highest probability of a flood occurring is during May to September. Windblown emissions are not expected to occur during winter periods when the ground is frozen or covered with snow. In the long term (more than one year), fugitive dust emissions will be effectively mitigated by revegetation of the sediment surface after a flood.

The Project is scheduled to accommodate a 1:100 year flood in the spring of 2021 and be fully constructed to accommodate a design flood in the spring of 2022. Fugitive dust emissions during the post-flood phase are assumed to occur at the earliest in 2021 for the 1:100 year flood and in 2022 for the design flood. Given this timing, there will be limited overlap of Project fugitive dust emissions and emissions with these other future projects. As the Project-related effects are not predicted to result in unacceptable risks, and there is limited opportunity for overlap with future projects, no unacceptable risks are predicted for the Planned Development Case.

6.3.2 Health Risk from Exposure to Methylmercury

The current understanding of methylmercury formation in the environment is that inorganic mercury is converted to methylmercury by anaerobic microbial activity under anoxic (i.e., low oxygen) aquatic conditions. Therefore, most studies regarding methylmercury formation focus on water and hydro-electric reservoirs (St. Louis et al. 2004; Montgomery et al. 2000; Risch and Frederickson 2015). The conditions at a reservoir that promote mercury methylation include newly flooded soils that serve as a source of inorganic mercury; and the formation of a deep lake that has a low water surface area and a high-water volume. The resulting low ratio of surface area to water volume results in anoxic conditions at the bottom of a hydro-electric reservoir because the surface area at the water surface is insufficient for oxygen to diffuse into the large volume of water. This allows anaerobic microbes at the bottom of a hydro-electric reservoir to convert the inorganic mercury from the flooded soil to methylmercury. Such

reservoirs are permanently filled, although they are subject to periodic partial draw down and refill. The degree of mercury methylation is a function of time and may continue for many years.

The conditions of the proposed Project during the flood phase bears some similarities to the conditions present at a hydro-electric dam. These conditions include newly flooded soils during the flood phase, the formation of a deep reservoir (i.e., 25 m maximum depth), and a large volume of retained water (i.e., 77,771,000 m^3 at design capacity). The water surface area at the design capacity is 789 ha. However, the duration of these conditions during the flood phase is expected to last between 20 to 43 days only. During this period, water flowing into the off-stream reservoir would contain high concentrations of dissolved oxygen resulting from the strong water turbulence and mixing as the off-stream reservoir is filling. The flood phase of 20 to 43 days may be insufficient time for the dissolved oxygen to be consumed and create the anoxic conditions necessary to allow anaerobic microbes to proliferate and convert inorganic mercury to methylmercury.

Assuming the anoxic aquatic conditions were to occur immediately, the duration of 20 to 43 days is also not expected to be long enough to generate methylmercury concentrations in the drinking water to a degree that would substantially affect public health. While methylmercury concentrations may increase marginally in the water stored in the off-stream reservoir, the predicted concentration would remain less than the Canadian drinking water quality guideline for total mercury. When the water is released back into the Elbow River, the total mercury would be further diluted from Elbow River flows before reaching the Glenmore Water Treatment Plant.

Considering that there have been no fish consumption advisories for methylmercury in the Elbow River recently, there is a low probability that a single water release from the off-stream reservoir after a flood event could substantially change the viability of fish. Longer reservoir retention time appears to be associated with increased methylmercury concentrations in fish, but this process is typically observed over years (Risch and Frederickson 2015). Specifically, the process of methylmercury uptake by lower trophic level aquatic organisms, followed by predators consuming these organisms in the food chain and accumulating methylmercury in its tissues is a time-dependent process. This is the reason why permanently flooded reservoirs are studied for methylmercury accumulation in the environment and aquatic life. In contrast, methylmercury in the released water would be further diluted by Elbow River flows, and would last approximately one month. There may be insufficient time for the bioaccumulation and biomagnification process to occur within the period of one month, assuming the concentration of methylmercury is sufficient for these processes to occur at an increased rate. Based on these factors, it is unlikely that the long-term viability of fish from the Elbow River would be changed with respect to methylmercury content. Consequently, there are no unacceptable risks to human health from exposure to methylmercury in fish harvested from the Elbow River in the post-flood operation phase. The overall health risk to people who harvest and consume fish from the Elbow River would remain the same as the current conditions.

With respect to the Planned Development Case, there are currently no other reasonably foreseeable future projects in the study area that are expected to affect methylmercury concentrations of fish in the Elbow River.

7.0 UNCERTAINTY ANALYSIS

The process of evaluating human health risks involves multiple steps. Inherent to 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.

7.1 UNCERTAINTY IN THE TOXICOLOGICAL REFERENCE VALUES

There is a very limited amount of toxicological information on the effects associated with human exposures to low levels of chemicals in the environment. The information based on human exposures that is available is typically based on epidemiological studies of occupationally exposed workers. These studies are generally limited in scope and provide results that may not be applicable to chronic or continuous exposures to low levels of chemicals. Because human toxicological information is limited, TRVs for many compounds are based on the results of dose-response assessment studies using animals.

The use of experimental animal data to estimate potential biological effects in humans introduces uncertainties into the evaluation of potential human health effects. These estimations require that the following number of assumptions be made:

- The toxicological effect reported in animals is relevant and could occur in humans.
- The assumption that extrapolation from high-dose studies to low-dose environmental exposures adequately represents the shape of the dose-response curve in the low-dose exposure range.
- Short-term exposures used in animal studies can be extrapolated to chronic or long-term exposures in humans.
- The pharmacokinetic processes that occur in the test animals also occur in humans.

There are a number of uncertainties associated with extrapolating from experimental animal data to humans. In order to address these weaknesses, regulatory agencies incorporate a large number of conservative assumptions to account for the uncertainties associated with this process. The uncertainties are accounted for by the use of Uncertainty Factors that are used to lower the reference dose or TRV well-below the level at which adverse health effects have been reported in the test species. Uncertainty factors are generally applied as factors of 10 and are used to account for the following types of uncertainties:

- Variation within the population (protection of sensitive members of the population)

- Differences between humans and the test species
- Differences in using short or medium-term studies to estimate the health effects associated with long-term or chronic exposures
- Limitations in the available toxicological information.

The magnitude of the uncertainty factors applied provides an indication of the level of confidence that should be placed in the reference value. Uncertainty factors typically range between 100 and 10,000, although some can be lower than 10. The latter values are found for a few chemicals, such as benzene, where sound and substantial human toxicological information is available to enable the setting of a TRV solely on the basis of human epidemiological information.

The application of uncertainty factors is intended to introduce a high degree of conservatism into the risk assessment process and to ensure, to the extent feasible, that limited exposures that exceed the TRV will not result in adverse human health effects. Because risk assessments that use these regulatory limits incorporate the conservatism used in the development of the toxicological information, the results can generally be viewed as being conservative.

7.2 UNCERTAINTIES WITH MODELLED AIR QUALITY

The air quality model introduces several uncertainties with regard to the accuracy of the predicted air quality outputs. Emission rates employed in the modelling are based on a combination of available baseline air quality data from provincial databases or regional monitoring stations, meteorological data, emission factors from the project inventory of equipment, vehicles and machines.

The CALPUFF modelling program and its limitations will also influence the output. CALPUFF modelling is typically used for long distance dispersion of plumes. Generally, CALPUFF modelling results are less accurate for locations that are close to the emission source because a sufficient amount of modelled time and air space is needed to properly predict the plume dispersion. While such models employ assumptions to simplify the random behavior of the atmosphere into short periods of average behavior, they are designed to have a bias towards overestimation of contaminant concentrations (i.e., to be conservative under most conditions). Consequently, model predictions along the fenceline of the Project are likely to be more conservative (i.e., overpredicted) compared to locations farther from the Project.

Another uncertainty with air quality modelling is for VOC emissions. For most types of vehicles, machines and equipment, emission specification for VOCs are measured as “total VOCs”. This means that air dispersion modelling also models VOCs as “total VOCs”. Individual chemical components that comprise VOCs are not individually modelled, as is the case for SO_2, NO_2, CO and $PM_{2.5}$. The predicted total VOC concentrations are subsequently fractioned into individual VOCs afterward, based on literature on the composition of VOCs in combustion engine exhaust.

Further, the details of the construction equipment to be used, including the frequency and timing of vehicles and emission standards of the equipment, are not currently known. Conservative estimates of these emissions were made to ensure that the resulting predicted air concentrations would tend to overstate, rather than understate, potential exposures.

7.3 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, or occupation exposures involving a single compound. However, the human population is exposed to complex mixtures of contaminants generally at much lower concentrations than those routinely examined in animal toxicity studies. The effects of any chemical interactions between multiple 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. An uncertainty factor is usually used to develop guidelines and objectives and it assumes that the degree of any synergistic increase in toxicity will not exceed the safety factors applied.

Substances in a mixture may interact in the following 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
- 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 amongst substances in a mixture and their potential effects to human health risk. For example, criteria air contaminants such as SO_2 and NO_2 are typically produced simultaneously in combustion products, and they are both respiratory irritants that act on the lungs. Although scientific literature recognizes that SO_2 and NO_2 are likely to act on the lungs in an additive or synergistic manner, Health Canada recently released two reports that assess the health effects of SO_2 and NO_2 independently (Health Canada 2017b, 2017c).

There are exceptions for chemical groups such as PAHs, polychlorinated biphenyls, dioxins and furan, 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 carcinogenic PAHs. In these instances, each chemical in the group is assigned a toxic equivalence that is relative to the most studied substance in the group (and typically amongst the highest toxicity) with a relative toxicity of 1.0. For example, benzo(a)pyrene is the most studied carcinogenic PAH with a toxic equivalence of 1.0, while chrysene has a toxic equivalence of 0.01 (i.e., chrysene has 1% of the toxic potential relative to benzo(a)pyrene).

An assessment of potential effects of exposure to mixtures was completed based on an assumed additive effect for COPC with the same health endpoint, consistent with Health Canada guidance.

7.4 HEALTH BENEFITS OF THE PROJECT

The objective of the Project is to mitigate the potential for a flooding event in the City of Calgary. While the environmental changes associated with the Project described in this report can adversely influence some aspects of human health, there are also numerous health benefits to the Project as well. These benefits are not considered in the HHRA, since they are not associated with chemical exposures.

For example, preventing a flood event to the City of Calgary, would reduce the number of injuries and fatalities that would be directly attributable to a. By preventing or reducing the severity of a potential flood, the Project would also prevent or reduce the severity of the following public health and public safety issues in the period during and immediately after a flood event:

- scarcity of food, clean drinking water, and medical supplies
- decline in sanitation (due to garbage, industrial waste, sewage)
- water-borne communicable diseases and infections
- increase in disease transmission (e.g., cold, flu) between people due to reduced sanitation and sheltering of large groups of people in close quarters
- high numbers of pests such as rodents and insects (especially mosquitoes due to stagnant pools of water that provide breeding habitat)
- vector-borne diseases (e.g., diseases transmitted by mosquitoes)
- health risk from direct exposure to chemical contaminants in the water and food (e.g., chemical burns, rashes, food poisoning)
- looting and theft

- loss of electricity and communication services
- loss of access and availability of transportation infrastructure and health-related infrastructure
- contamination of agricultural land used for food production
- contamination of buildings due to mold growth, which may trigger asthma or other respiratory issues
- anxiety, depression and post-traumatic stress disorder, or exacerbation of existing mental health problems

Although these issues are not considered, diverting flood waters to a reservoir would benefits multiple other determinants of health that extend beyond to the narrow definition used in the HHRA.

7.5 DEFINITION OF HEALTH

As per recommendation by Health Canada, this HHRA used a science based approach. While the HHRA is aimed at protecting human receptors from adverse health effects associated with the exposure to COPCs, it is important to notice that other factors such as social, cultural, nutritional and economic parameters also play an important role in a person overall health status. The HHRA is not designed to evaluate non-COPC factors of health. The influence of these factors on the health risk for the Project is beyond the scope of an HHRA.

8.0 CONCLUSION

The HHRA evaluated the potential risks to human health from COPCs associated with the Project. In the construction phase, the HHRA evaluated the potential risks from the inhalation of CACs, VOCs, PAHs, and metals. In the post-flood operation phase, the HHRA evaluated the potential risks from the inhalation of PM2.5 during a dust storm, and the ingestion of methylmercury from municipal water and fish harvested from the Elbow River.

During the construction phase of the Project, the ERs for inhalation exposure to CACs, VOCs, PAHs, and metals are predicted to be less than 1.0 for most airborne COPCs among the 58 human receptor locations. The exceptions were:

- Acute concentrations (1-hour) for NO_2, which are greater than 1.0 at four human receptor locations that are within 100 m of the PDA. This indicates that there are potentially unacceptable acute risks from exposure to NO_2. However, given that the ERs at these locations range from 1.0 to 1.1, the overall conservative nature of the air quality model, and the uncertainty factors applied in the derivation of the TRVs, it is improbable that there would be an unacceptable risk from acute NO_2 exposure.
- Acute concentrations of $PM_{2.5}$, for which both short-term (1-hour or 24-hour) and long-term (annual) ERs are greater than 1.0 at up to 18 of the 58 human receptor locations. Even with partial mitigations, model results indicate there could still be an unacceptable short-term risk to human health for residents and people adjacent to the PDA. Although concentrations of $PM_{2.5}$ are expected to be lower than the modelled predictions, more intensive dust mitigation measures may be considered during the construction phase, including dust suppressants or water on haul roads on an as-needed basis during dry periods with high wind conditions.
- 1-hour concentrations of DEP at some receptor locations may exceed the acute (2-hour) DEP exposure limit (maximum frequency of exceedances is less than 5%). Based on multiple studies on test subjects, Health Canada (2016b) concluded that at concentrations above the DEP exposure limit, healthy and/or mildly asthmatic participants may experience increased measures of airway resistance and/or respiratory inflammation. Additional mitigation that may be used to reduce $PM_{2.5}$ exposures (such as adjusting the construction schedule to reduce the number of vehicles operating in an area during dry periods with high wind conditions) would also mitigate acute DEP exposures.
- chronic concentrations of chromium, for which there was a Project Case ER of 1.3 for non-threshold, carcinogenic risk. However, conservative assumptions applied in the HHRA (assumption that 100% of chromium emissions are hexavalent, when studies show it is approximately 18% from vehicle exhaust and negligible in soil), and that the exposure duration is 36 months and not a lifetime exposure, would reduce the ER to less than 0.23.

Given the conservative assumptions applied in the HHRA and air quality modelling, and with more intensive mitigation measures applied (e.g., dust suppressants and adjustments to the number of vehicles operating during periods of high winds), the potential health risk is expected to be negligible for airborne COPCs.

During the dry operation and flood operation phases of the Project, no operable exposure pathways were identified.

During the post-flood operation phase of the Project, periods of dry weather and high winds within 6 months of a flood event could cause wind erosion of deposited sediments in the off-stream reservoir. With the application of more intensive mitigation measures to reduce particulates in the air, there are no unacceptable health risks from inhalation.

Methylmercury ingestion from municipal water and fish from the Elbow River was also considered for potential health risks. Overall, the Project does not emit mercury into the environment. Conversion of existing inorganic mercury in the environment to methylmercury is unlikely to affect health risk via ingestion of drinking water, since the predicted concentration of total mercury in water is below the Canadian drinking water quality guideline for total mercury. Given the short duration that methylmercury forming conditions could occur (approximately 1 month), there is a low likelihood that methylmercury could migrate throughout the aquatic food web to change the quality of fish harvested from the Elbow River because this process typically occurs over a period of years. Consequently, there are no unacceptable health risks to people drinking municipal tap water from the Glenmore Reservoir, or consuming fish harvested from the Elbow River.

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Attachment A PREDICTED CONCENTRATIONS OF AIRBORNE COPCS AND EXPOSURE RATIOS

Table A-1 Exposure Concentrations and Exposure Ratios for 1-hour NO_2 (Construction)

Human Receptor Location	1-hour NO_2 (TRV = 114 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	1.0E+02	3.6E+02	3.7E+02	9.0E-01	3.1E+00	3.3E+00
SR01	3.5E+01	1.1E+02	1.2E+02	3.1E-01	9.6E-01	1.1E+00
SR02	5.6E+01	8.7E+01	9.8E+01	4.9E-01	7.6E-01	8.6E-01
SR03	4.7E+01	8.2E+01	9.2E+01	4.1E-01	7.2E-01	8.1E-01
SR04	2.4E+01	8.4E+01	9.5E+01	2.1E-01	7.4E-01	8.3E-01
SR05	2.6E+01	8.8E+01	9.8E+01	2.3E-01	7.7E-01	8.6E-01
SR06	2.5E+01	7.7E+01	8.7E+01	2.2E-01	6.7E-01	7.6E-01
SR07	2.4E+01	6.8E+01	8.2E+01	2.1E-01	6.0E-01	7.2E-01
SR08	2.1E+01	7.0E+01	8.1E+01	1.9E-01	6.2E-01	7.1E-01
SR09	3.9E+01	1.2E+02	1.3E+02	3.4E-01	1.0E+00	1.1E+00
SR10	3.2E+01	8.9E+01	9.9E+01	2.8E-01	7.8E-01	8.7E-01
SR11	7.5E+01	9.8E+01	1.1E+02	6.6E-01	8.6E-01	9.7E-01
SR12	2.3E+01	9.5E+01	1.0E+02	2.1E-01	8.3E-01	9.2E-01
SR13	2.6E+01	9.3E+01	1.0E+02	2.2E-01	8.1E-01	9.0E-01
SR14	2.4E+01	9.9E+01	1.1E+02	2.1E-01	8.7E-01	9.6E-01
SR15	2.4E+01	9.4E+01	1.0E+02	2.1E-01	8.3E-01	9.2E-01
SR16	1.7E+01	8.7E+01	9.7E+01	1.5E-01	7.6E-01	8.5E-01
SR17	1.9E+01	6.8E+01	7.8E+01	1.7E-01	6.0E-01	6.9E-01
SR18	4.4E+01	1.0E+02	1.1E+02	3.9E-01	8.9E-01	9.8E-01
SR19	3.4E+01	1.0E+02	1.1E+02	3.0E-01	9.1E-01	1.0E+00
SR20	4.2E+01	9.5E+01	1.0E+02	3.7E-01	8.3E-01	9.2E-01
SR21	1.8E+01	7.0E+01	8.1E+01	1.6E-01	6.1E-01	7.1E-01
SR22	1.6E+01	7.2E+01	8.2E+01	1.4E-01	6.3E-01	7.2E-01
SR23	1.6E+01	6.7E+01	7.8E+01	1.4E-01	5.9E-01	6.8E-01
SR24	1.5E+01	5.8E+01	6.8E+01	1.4E-01	5.1E-01	6.0E-01
SR25	4.8E+01	1.0E+02	1.1E+02	4.2E-01	8.8E-01	9.8E-01
SR26	3.6E+01	8.1E+01	9.5E+01	3.1E-01	7.1E-01	8.4E-01
SR27	4.7E+01	7.1E+01	9.3E+01	4.1E-01	6.2E-01	8.2E-01
SR28	4.7E+01	7.1E+01	9.3E+01	4.1E-01	6.2E-01	8.2E-01
SR29	5.1E+01	7.0E+01	9.5E+01	4.5E-01	6.2E-01	8.3E-01
SR30	6.7E+01	7.1E+01	9.7E+01	5.8E-01	6.2E-01	8.5E-01
SR31	6.7E+01	7.1E+01	9.7E+01	5.8E-01	6.2E-01	8.5E-01
SR32	5.3E+01	6.9E+01	9.6E+01	4.6E-01	6.0E-01	8.4E-01
SR33	3.6E+01	6.8E+01	8.8E+01	3.1E-01	5.9E-01	7.7E-01
SR34	3.2E+01	6.8E+01	8.9E+01	2.8E-01	6.0E-01	7.8E-01
SR35	3.2E+01	6.8E+01	8.9E+01	2.8E-01	6.0E-01	7.8E-01
SR36	1.9E+01	8.8E+01	9.8E+01	1.7E-01	7.7E-01	8.6E-01
SR37	1.5E+01	6.6E+01	7.9E+01	1.4E-01	5.8E-01	7.0E-01
SR38	4.1E+01	8.5E+01	9.7E+01	3.6E-01	7.5E-01	8.5E-01
SR39	4.5E+01	8.4E+01	9.5E+01	3.9E-01	7.4E-01	8.4E-01
SR40	2.6E+01	1.0E+02	1.1E+02	2.3E-01	8.8E-01	9.7E-01
SR41	2.9E+01	1.2E+02	1.3E+02	2.6E-01	1.0E+00	1.1E+00
SR42	6.4E+01	7.6E+01	9.0E+01	5.6E-01	6.6E-01	7.9E-01
SR43	9.2E+01	7.2E+01	9.6E+01	8.1E-01	6.4E-01	8.5E-01
SR44	2.2E+01	3.9E+01	5.4E+01	1.9E-01	3.5E-01	4.7E-01
SR45	2.5E+01	3.0E+01	4.2E+01	2.2E-01	2.6E-01	3.6E-01
SR46	3.5E+01	2.5E+01	4.2E+01	3.1E-01	2.2E-01	3.6E-01
SR47	3.8E+01	2.7E+01	4.5E+01	3.4E-01	2.4E-01	3.9E-01
SR48	3.4E+01	2.0E+01	4.2E+01	3.0E-01	1.8E-01	3.7E-01
SR49	5.1E+01	1.9E+01	5.7E+01	4.5E-01	1.6E-01	5.0E-01
SR50	1.4E+01	1.7E+01	2.8E+01	1.2E-01	1.5E-01	2.5E-01
SR51	1.5E+01	4.8E+01	5.9E+01	1.3E-01	4.2E-01	5.1E-01
SR52	4.0E+01	5.1E+01	6.5E+01	3.5E-01	4.5E-01	5.7E-01
SR53	2.4E+01	1.9E+01	3.4E+01	2.1E-01	1.7E-01	3.0E-01
SR54	3.7E+01	2.7E+01	4.6E+01	3.2E-01	2.4E-01	4.0E-01
SR55	4.0E+01	1.8E+01	4.4E+01	3.5E-01	1.6E-01	3.9E-01
SR56	1.6E+01	1.5E+01	2.7E+01	1.4E-01	1.4E-01	2.4E-01
SR57	5.1E+01	7.8E+01	9.6E+01	4.5E-01	6.8E-01	8.5E-01
SR58	1.5E+01	8.5E+00	2.1E+01	1.3E-01	7.5E-02	1.8E-01

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-2 Exposure Concentrations and Exposure Ratios for Annual NO2 (Construction)

Human Receptor Location	Annual NO_2 (TRV = 32 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	4.2E+01	2.2E+01	4.3E+01	1.3E+00	6.8E-01	1.3E+00
SR01	6.3E+00	6.4E+00	1.2E+01	2.0E-01	2.0E-01	3.8E-01
SR02	8.4E+00	2.5E+00	1.1E+01	2.6E-01	7.9E-02	3.4E-01
SR03	7.7E+00	2.6E+00	1.0E+01	2.4E-01	8.2E-02	3.2E-01
SR04	5.5E+00	5.2E+00	1.1E+01	1.7E-01	1.6E-01	3.3E-01
SR05	5.9E+00	4.9E+00	1.1E+01	1.9E-01	1.5E-01	3.3E-01
SR06	6.3E+00	2.6E+00	8.8E+00	2.0E-01	8.2E-02	2.8E-01
SR07	6.1E+00	2.0E+00	8.1E+00	1.9E-01	6.1E-02	2.5E-01
SR08	5.7E+00	2.3E+00	8.0E+00	1.8E-01	7.2E-02	2.5E-01
SR09	6.2E+00	4.9E+00	1.1E+01	1.9E-01	1.5E-01	3.4E-01
SR10	5.7E+00	4.1E+00	9.5E+00	1.8E-01	1.3E-01	3.0E-01
SR11	1.2E+01	5.9E+00	1.6E+01	3.7E-01	1.8E-01	5.1E-01
SR12	5.5E+00	6.9E+00	1.2E+01	1.7E-01	2.1E-01	3.8E-01
SR13	5.6E+00	6.3E+00	1.2E+01	1.8E-01	2.0E-01	3.7E-01
SR14	5.5E+00	8.0E+00	1.3E+01	1.7E-01	2.5E-01	4.2E-01
SR15	5.4E+00	8.2E+00	1.3E+01	1.7E-01	2.6E-01	4.2E-01
SR16	4.7E+00	6.6E+00	1.1E+01	1.5E-01	2.1E-01	3.5E-01
SR17	4.9E+00	2.9E+00	7.7E+00	1.5E-01	9.1E-02	2.4E-01
SR18	6.3E+00	7.0E+00	1.3E+01	2.0E-01	2.2E-01	4.0E-01
SR19	5.8E+00	1.7E+01	2.2E+01	1.8E-01	5.3E-01	7.0E-01
SR20	6.3E+00	8.9E+00	1.5E+01	2.0E-01	2.8E-01	4.6E-01
SR21	4.9E+00	3.8E+00	8.6E+00	1.5E-01	1.2E-01	2.7E-01
SR22	4.6E+00	3.8E+00	8.4E+00	1.4E-01	1.2E-01	2.6E-01
SR23	4.6E+00	3.5E+00	8.0E+00	1.4E-01	1.1E-01	2.5E-01
SR24	4.5E+00	3.6E+00	8.2E+00	1.4E-01	1.1E-01	2.5E-01
SR25	7.3E+00	1.1E+01	1.7E+01	2.3E-01	3.3E-01	5.4E-01
SR26	5.7E+00	1.1E+00	6.7E+00	1.8E-01	3.4E-02	2.1E-01
SR27	6.6E+00	1.0E+00	7.5E+00	2.1E-01	3.2E-02	2.3E-01
SR28	6.6E+00	1.0E+00	7.5E+00	2.1E-01	3.2E-02	2.3E-01
SR29	6.4E+00	1.1E+00	7.3E+00	2.0E-01	3.4E-02	2.3E-01
SR30	1.4E+01	1.2E+00	1.5E+01	4.3E-01	3.8E-02	4.6E-01
SR31	1.4E+01	1.2E+00	1.5E+01	4.3E-01	3.8E-02	4.6E-01
SR32	9.2E+00	1.4E+00	1.0E+01	2.9E-01	4.3E-02	3.2E-01
SR33	6.4E+00	1.6E+00	7.8E+00	2.0E-01	4.9E-02	2.4E-01
SR34	5.8E+00	1.8E+00	7.5E+00	1.8E-01	5.7E-02	2.3E-01
SR35	5.8E+00	1.8E+00	7.5E+00	1.8E-01	5.7E-02	2.3E-01
SR36	4.9E+00	5.2E+00	9.9E+00	1.5E-01	1.6E-01	3.1E-01
SR37	4.5E+00	3.5E+00	8.0E+00	1.4E-01	1.1E-01	2.5E-01
SR38	7.6E+00	5.2E+00	1.2E+01	2.4E-01	1.6E-01	3.8E-01
SR39	6.3E+00	3.0E+00	9.1E+00	2.0E-01	9.4E-02	2.8E-01
SR40	4.9E+00	4.9E+00	9.6E+00	1.5E-01	1.5E-01	3.0E-01
SR41	5.2E+00	9.5E+00	1.4E+01	1.6E-01	3.0E-01	4.5E-01
SR42	9.8E+00	2.3E+00	1.2E+01	3.1E-01	7.0E-02	3.6E-01
SR43	2.0E+01	1.8E+00	2.1E+01	6.4E-01	5.7E-02	6.6E-01
SR44	6.3E+00	1.2E+00	7.6E+00	2.0E-01	3.8E-02	2.4E-01
SR45	5.8E+00	5.6E-01	6.3E+00	1.8E-01	1.8E-02	2.0E-01
SR46	6.9E+00	4.4E-01	7.3E+00	2.2E-01	1.4E-02	2.3E-01
SR47	7.2E+00	4.6E-01	7.6E+00	2.2E-01	1.4E-02	2.4E-01
SR48	6.1E+00	2.8E-01	6.3E+00	1.9E-01	8.8E-03	2.0E-01
SR49	8.2E+00	3.0E-01	8.5E+00	2.6E-01	9.4E-03	2.7E-01
SR50	4.3E+00	8.1E-01	5.1E+00	1.3E-01	2.5E-02	1.6E-01
SR51	4.5E+00	2.7E+00	7.1E+00	1.4E-01	8.3E-02	2.2E-01
SR52	5.1E+00	4.4E-01	5.5E+00	1.6E-01	1.4E-02	1.7E-01
SR53	5.0E+00	2.5E-01	5.3E+00	1.6E-01	7.9E-03	1.6E-01
SR54	4.7E+00	2.2E-01	4.9E+00	1.5E-01	6.9E-03	1.5E-01
SR55	5.9E+00	1.4E-01	6.0E+00	1.8E-01	4.4E-03	1.9E-01
SR56	4.0E+00	9.8E-02	4.1E+00	1.2E-01	3.1E-03	1.3E-01
SR57	9.0E+00	9.3E-01	9.7E+00	2.8E-01	2.9E-02	3.0E-01
SR58	4.1E+00	1.3E-01	4.3E+00	1.3E-01	4.1E-03	1.3E-01

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-3 Exposure Concentrations and Exposure Ratios for 1-hour SO2 (Construction)

Human Receptor Location	1-hour SO_2 (TRV = 183 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	6.5E+00	8.2E+00	1.4E+01	3.5E-02	4.5E-02	7.5E-02
SR01	5.4E+00	1.5E+00	6.9E+00	2.9E-02	8.2E-03	3.8E-02
SR02	5.5E+00	9.3E-01	6.3E+00	3.0E-02	5.1E-03	3.4E-02
SR03	5.5E+00	6.6E-01	6.0E+00	3.0E-02	3.6E-03	3.3E-02
SR04	5.3E+00	4.2E-01	5.7E+00	2.9E-02	2.3E-03	3.1E-02
SR05	5.3E+00	4.9E-01	5.8E+00	2.9E-02	2.7E-03	3.2E-02
SR06	5.3E+00	2.7E-01	5.6E+00	2.9E-02	1.5E-03	3.0E-02
SR07	5.3E+00	2.3E-01	5.5E+00	2.9E-02	1.3E-03	3.0E-02
SR08	5.3E+00	2.2E-01	5.5E+00	2.9E-02	1.2E-03	3.0E-02
SR09	5.4E+00	1.7E+00	7.1E+00	3.0E-02	9.0E-03	3.9E-02
SR10	5.4E+00	7.0E-01	6.1E+00	2.9E-02	3.8E-03	3.4E-02
SR11	5.7E+00	8.2E-01	6.4E+00	3.1E-02	4.5E-03	3.5E-02
SR12	5.3E+00	7.2E-01	6.0E+00	2.9E-02	4.0E-03	3.3E-02
SR13	5.3E+00	6.9E-01	6.0E+00	2.9E-02	3.8E-03	3.3E-02
SR14	5.3E+00	9.2E-01	6.2E+00	2.9E-02	5.0E-03	3.4E-02
SR15	5.3E+00	7.5E-01	6.0E+00	2.9E-02	4.1E-03	3.3E-02
SR16	5.3E+00	6.6E-01	5.9E+00	2.9E-02	3.6E-03	3.2E-02
SR17	5.3E+00	2.3E-01	5.5E+00	2.9E-02	1.3E-03	3.0E-02
SR18	5.4E+00	8.2E-01	6.2E+00	3.0E-02	4.5E-03	3.4E-02
SR19	5.4E+00	1.2E+00	6.5E+00	2.9E-02	6.4E-03	3.6E-02
SR20	5.4E+00	6.9E-01	6.0E+00	3.0E-02	3.8E-03	3.3E-02
SR21	5.3E+00	2.7E-01	5.5E+00	2.9E-02	1.5E-03	3.0E-02
SR22	5.3E+00	2.7E-01	5.5E+00	2.9E-02	1.5E-03	3.0E-02
SR23	5.3E+00	2.4E-01	5.5E+00	2.9E-02	1.3E-03	3.0E-02
SR24	5.3E+00	2.0E-01	5.5E+00	2.9E-02	1.1E-03	3.0E-02
SR25	5.5E+00	9.2E-01	6.3E+00	3.0E-02	5.0E-03	3.4E-02
SR26	5.4E+00	3.3E-01	5.6E+00	2.9E-02	1.8E-03	3.1E-02
SR27	5.5E+00	2.8E-01	5.6E+00	3.0E-02	1.5E-03	3.1E-02
SR28	5.5E+00	2.8E-01	5.6E+00	3.0E-02	1.5E-03	3.1E-02
SR29	5.5E+00	2.7E-01	5.7E+00	3.0E-02	1.5E-03	3.1E-02
SR30	5.6E+00	3.0E-01	5.8E+00	3.1E-02	1.7E-03	3.2E-02
SR31	5.6E+00	3.0E-01	5.8E+00	3.1E-02	1.7E-03	3.2E-02
SR32	5.5E+00	2.7E-01	5.7E+00	3.0E-02	1.5E-03	3.1E-02
SR33	5.4E+00	2.8E-01	5.6E+00	2.9E-02	1.5E-03	3.1E-02
SR34	5.4E+00	2.8E-01	5.6E+00	2.9E-02	1.5E-03	3.1E-02
SR35	5.4E+00	2.8E-01	5.6E+00	2.9E-02	1.5E-03	3.1E-02
SR36	5.3E+00	6.2E-01	6.0E+00	2.9E-02	3.4E-03	3.3E-02
SR37	5.3E+00	2.4E-01	5.5E+00	2.9E-02	1.3E-03	3.0E-02
SR38	5.4E+00	4.3E-01	5.8E+00	3.0E-02	2.3E-03	3.2E-02
SR39	5.4E+00	3.5E-01	5.7E+00	3.0E-02	1.9E-03	3.1E-02
SR40	5.3E+00	8.0E-01	6.1E+00	2.9E-02	4.4E-03	3.4E-02
SR41	5.4E+00	1.5E+00	7.0E+00	2.9E-02	8.0E-03	3.8E-02
SR42	5.6E+00	5.0E-01	5.9E+00	3.1E-02	2.7E-03	3.2E-02
SR43	6.0E+00	5.7E-01	6.4E+00	3.3E-02	3.1E-03	3.5E-02
SR44	5.3E+00	1.1E-01	5.4E+00	2.9E-02	5.9E-04	3.0E-02
SR45	5.3E+00	7.7E-02	5.4E+00	2.9E-02	4.2E-04	2.9E-02
SR46	5.4E+00	6.3E-02	5.4E+00	2.9E-02	3.5E-04	2.9E-02
SR47	5.4E+00	6.8E-02	5.4E+00	3.0E-02	3.7E-04	3.0E-02
SR48	5.4E+00	5.0E-02	5.4E+00	2.9E-02	2.7E-04	2.9E-02
SR49	5.5E+00	4.7E-02	5.5E+00	3.0E-02	2.6E-04	3.0E-02
SR50	5.3E+00	4.2E-02	5.3E+00	2.9E-02	2.3E-04	2.9E-02
SR51	5.3E+00	1.3E-01	5.4E+00	2.9E-02	7.2E-04	2.9E-02
SR52	5.4E+00	1.4E-01	5.4E+00	3.0E-02	7.6E-04	3.0E-02
SR53	5.3E+00	4.9E-02	5.3E+00	2.9E-02	2.7E-04	2.9E-02
SR54	5.4E+00	7.1E-02	5.4E+00	3.0E-02	3.9E-04	3.0E-02
SR55	5.4E+00	4.6E-02	5.4E+00	3.0E-02	2.5E-04	3.0E-02
SR56	5.3E+00	4.1E-02	5.3E+00	2.9E-02	2.2E-04	2.9E-02
SR57	5.5E+00	2.9E-01	5.7E+00	3.0E-02	1.6E-03	3.1E-02
SR58	5.3E+00	2.2E-02	5.3E+00	2.9E-02	1.2E-04	2.9E-02

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-4 Exposure Concentrations and Exposure Ratios for Annual SO2 (Construction)

Human Receptor Location	Annual SO_2 (TRV = 13 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	2.7E+00	1.6E-01	2.7E+00	2.1E-01	1.2E-02	2.1E-01
SR01	1.9E-01	2.0E-03	1.9E-01	1.5E-02	1.5E-04	1.5E-02
SR02	1.9E-01	6.5E-04	1.9E-01	1.5E-02	5.0E-05	1.5E-02
SR03	1.9E-01	5.8E-04	1.9E-01	1.5E-02	4.5E-05	1.5E-02
SR04	1.9E-01	1.2E-03	1.9E-01	1.5E-02	9.0E-05	1.5E-02
SR05	1.9E-01	1.2E-03	1.9E-01	1.5E-02	8.9E-05	1.5E-02
SR06	1.9E-01	5.4E-04	1.9E-01	1.5E-02	4.2E-05	1.5E-02
SR07	1.9E-01	3.9E-04	1.9E-01	1.5E-02	3.0E-05	1.5E-02
SR08	1.9E-01	4.6E-04	1.9E-01	1.5E-02	3.5E-05	1.5E-02
SR09	1.9E-01	1.3E-03	1.9E-01	1.5E-02	9.7E-05	1.5E-02
SR10	1.9E-01	9.2E-04	1.9E-01	1.5E-02	7.1E-05	1.5E-02
SR11	1.9E-01	1.5E-03	2.0E-01	1.5E-02	1.2E-04	1.5E-02
SR12	1.9E-01	1.8E-03	1.9E-01	1.5E-02	1.4E-04	1.5E-02
SR13	1.9E-01	1.6E-03	1.9E-01	1.5E-02	1.2E-04	1.5E-02
SR14	1.9E-01	2.1E-03	1.9E-01	1.5E-02	1.6E-04	1.5E-02
SR15	1.9E-01	2.2E-03	1.9E-01	1.5E-02	1.7E-04	1.5E-02
SR16	1.9E-01	1.6E-03	1.9E-01	1.5E-02	1.2E-04	1.5E-02
SR17	1.9E-01	5.8E-04	1.9E-01	1.5E-02	4.4E-05	1.5E-02
SR18	1.9E-01	1.9E-03	1.9E-01	1.5E-02	1.5E-04	1.5E-02
SR19	1.9E-01	4.6E-03	2.0E-01	1.5E-02	3.5E-04	1.5E-02
SR20	1.9E-01	2.1E-03	1.9E-01	1.5E-02	1.6E-04	1.5E-02
SR21	1.9E-01	7.4E-04	1.9E-01	1.5E-02	5.7E-05	1.5E-02
SR22	1.9E-01	7.6E-04	1.9E-01	1.5E-02	5.8E-05	1.5E-02
SR23	1.9E-01	6.8E-04	1.9E-01	1.5E-02	5.2E-05	1.5E-02
SR24	1.9E-01	6.8E-04	1.9E-01	1.5E-02	5.2E-05	1.5E-02
SR25	1.9E-01	2.7E-03	2.0E-01	1.5E-02	2.0E-04	1.5E-02
SR26	1.9E-01	2.2E-04	1.9E-01	1.5E-02	1.7E-05	1.5E-02
SR27	1.9E-01	2.0E-04	1.9E-01	1.5E-02	1.6E-05	1.5E-02
SR28	1.9E-01	2.0E-04	1.9E-01	1.5E-02	1.6E-05	1.5E-02
SR29	1.9E-01	2.2E-04	1.9E-01	1.5E-02	1.7E-05	1.5E-02
SR30	2.0E-01	2.4E-04	2.0E-01	1.5E-02	1.9E-05	1.5E-02
SR31	2.0E-01	2.4E-04	2.0E-01	1.5E-02	1.9E-05	1.5E-02
SR32	1.9E-01	2.8E-04	1.9E-01	1.5E-02	2.1E-05	1.5E-02
SR33	1.9E-01	3.1E-04	1.9E-01	1.5E-02	2.4E-05	1.5E-02
SR34	1.9E-01	3.6E-04	1.9E-01	1.5E-02	2.8E-05	1.5E-02
SR35	1.9E-01	3.6E-04	1.9E-01	1.5E-02	2.8E-05	1.5E-02
SR36	1.9E-01	1.3E-03	1.9E-01	1.5E-02	1.0E-04	1.5E-02
SR37	1.9E-01	6.7E-04	1.9E-01	1.5E-02	5.2E-05	1.5E-02
SR38	1.9E-01	1.1E-03	1.9E-01	1.5E-02	8.1E-05	1.5E-02
SR39	1.9E-01	6.1E-04	1.9E-01	1.5E-02	4.7E-05	1.5E-02
SR40	1.9E-01	1.2E-03	1.9E-01	1.5E-02	9.4E-05	1.5E-02
SR41	1.9E-01	2.8E-03	2.0E-01	1.5E-02	2.1E-04	1.5E-02
SR42	1.9E-01	4.9E-04	1.9E-01	1.5E-02	3.8E-05	1.5E-02
SR43	2.0E-01	3.9E-04	2.0E-01	1.5E-02	3.0E-05	1.5E-02
SR44	1.9E-01	2.3E-04	1.9E-01	1.5E-02	1.8E-05	1.5E-02
SR45	1.9E-01	1.1E-04	1.9E-01	1.5E-02	8.2E-06	1.5E-02
SR46	1.9E-01	8.3E-05	1.9E-01	1.5E-02	6.4E-06	1.5E-02
SR47	1.9E-01	8.6E-05	1.9E-01	1.5E-02	6.6E-06	1.5E-02
SR48	1.9E-01	5.3E-05	1.9E-01	1.5E-02	4.1E-06	1.5E-02
SR49	1.9E-01	5.7E-05	1.9E-01	1.5E-02	4.4E-06	1.5E-02
SR50	1.9E-01	1.5E-04	1.9E-01	1.5E-02	1.2E-05	1.5E-02
SR51	1.9E-01	4.9E-04	1.9E-01	1.5E-02	3.8E-05	1.5E-02
SR52	1.9E-01	8.3E-05	1.9E-01	1.5E-02	6.4E-06	1.5E-02
SR53	1.9E-01	4.8E-05	1.9E-01	1.5E-02	3.7E-06	1.5E-02
SR54	1.9E-01	4.2E-05	1.9E-01	1.5E-02	3.3E-06	1.5E-02
SR55	1.9E-01	2.7E-05	1.9E-01	1.5E-02	2.1E-06	1.5E-02
SR56	1.9E-01	1.9E-05	1.9E-01	1.5E-02	1.4E-06	1.5E-02
SR57	1.9E-01	1.8E-04	1.9E-01	1.5E-02	1.4E-05	1.5E-02
SR58	1.9E-01	2.5E-05	1.9E-01	1.5E-02	1.9E-06	1.5E-02

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-5 Exposure Concentrations and Exposure Ratios for 1-hour CO (Construction)

Human Receptor Location	1-hour CO (TRV = 15,000 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	1.0E+03	3.0E+03	3.5E+03	6.9E-02	2.0E-01	2.3E-01
SR01	4.3E+02	5.7E+02	9.5E+02	2.9E-02	3.8E-02	6.4E-02
SR02	5.0E+02	3.5E+02	7.5E+02	3.4E-02	2.3E-02	5.0E-02
SR03	4.7E+02	2.5E+02	6.2E+02	3.1E-02	1.6E-02	4.1E-02
SR04	4.0E+02	1.7E+02	5.4E+02	2.7E-02	1.1E-02	3.6E-02
SR05	4.1E+02	1.9E+02	5.6E+02	2.7E-02	1.3E-02	3.7E-02
SR06	4.1E+02	1.1E+02	4.9E+02	2.7E-02	7.2E-03	3.3E-02
SR07	4.1E+02	8.9E+01	4.7E+02	2.7E-02	6.0E-03	3.1E-02
SR08	4.0E+02	8.8E+01	4.6E+02	2.7E-02	5.9E-03	3.1E-02
SR09	4.4E+02	6.3E+02	1.0E+03	2.9E-02	4.2E-02	6.8E-02
SR10	4.2E+02	2.8E+02	6.6E+02	2.8E-02	1.9E-02	4.4E-02
SR11	5.7E+02	3.2E+02	8.4E+02	3.8E-02	2.1E-02	5.6E-02
SR12	4.0E+02	2.7E+02	6.4E+02	2.7E-02	1.8E-02	4.3E-02
SR13	4.1E+02	2.5E+02	6.2E+02	2.7E-02	1.6E-02	4.1E-02
SR14	4.0E+02	3.2E+02	6.9E+02	2.7E-02	2.2E-02	4.6E-02
SR15	4.0E+02	2.7E+02	6.5E+02	2.7E-02	1.8E-02	4.3E-02
SR16	3.8E+02	2.5E+02	6.0E+02	2.5E-02	1.7E-02	4.0E-02
SR17	3.9E+02	9.4E+01	4.5E+02	2.6E-02	6.3E-03	3.0E-02
SR18	4.6E+02	3.6E+02	7.9E+02	3.1E-02	2.4E-02	5.3E-02
SR19	4.4E+02	4.4E+02	8.5E+02	2.9E-02	2.9E-02	5.7E-02
SR20	4.7E+02	3.2E+02	7.1E+02	3.1E-02	2.1E-02	4.8E-02
SR21	3.8E+02	1.2E+02	4.8E+02	2.5E-02	7.9E-03	3.2E-02
SR22	3.7E+02	1.2E+02	4.8E+02	2.5E-02	8.0E-03	3.2E-02
SR23	3.7E+02	1.0E+02	4.7E+02	2.5E-02	7.0E-03	3.1E-02
SR24	3.7E+02	8.3E+01	4.4E+02	2.5E-02	5.5E-03	2.9E-02
SR25	4.9E+02	4.0E+02	8.2E+02	3.3E-02	2.7E-02	5.5E-02
SR26	4.5E+02	1.5E+02	5.3E+02	3.0E-02	1.0E-02	3.5E-02
SR27	4.7E+02	1.2E+02	5.7E+02	3.2E-02	7.9E-03	3.8E-02
SR28	4.7E+02	1.2E+02	5.7E+02	3.2E-02	7.9E-03	3.8E-02
SR29	4.8E+02	1.3E+02	5.8E+02	3.2E-02	8.6E-03	3.9E-02
SR30	5.6E+02	1.4E+02	6.5E+02	3.7E-02	9.0E-03	4.3E-02
SR31	5.6E+02	1.4E+02	6.5E+02	3.7E-02	9.0E-03	4.3E-02
SR32	5.0E+02	1.3E+02	6.1E+02	3.3E-02	8.7E-03	4.1E-02
SR33	4.5E+02	1.2E+02	5.5E+02	3.0E-02	8.0E-03	3.7E-02
SR34	4.3E+02	1.2E+02	5.4E+02	2.9E-02	8.3E-03	3.6E-02
SR35	4.3E+02	1.2E+02	5.4E+02	2.9E-02	8.3E-03	3.6E-02
SR36	3.8E+02	2.4E+02	6.2E+02	2.6E-02	1.6E-02	4.1E-02
SR37	3.7E+02	1.1E+02	4.7E+02	2.5E-02	7.3E-03	3.1E-02
SR38	4.7E+02	1.8E+02	6.1E+02	3.1E-02	1.2E-02	4.1E-02
SR39	4.8E+02	1.7E+02	5.8E+02	3.2E-02	1.1E-02	3.9E-02
SR40	4.0E+02	3.4E+02	7.1E+02	2.7E-02	2.2E-02	4.7E-02
SR41	4.1E+02	5.6E+02	9.5E+02	2.7E-02	3.8E-02	6.3E-02
SR42	5.4E+02	1.9E+02	6.3E+02	3.6E-02	1.2E-02	4.2E-02
SR43	7.7E+02	2.2E+02	8.4E+02	5.1E-02	1.5E-02	5.6E-02
SR44	4.1E+02	4.4E+01	4.3E+02	2.7E-02	3.0E-03	2.9E-02
SR45	4.2E+02	3.1E+01	4.3E+02	2.8E-02	2.1E-03	2.9E-02
SR46	4.6E+02	2.7E+01	4.7E+02	3.1E-02	1.8E-03	3.1E-02
SR47	4.8E+02	2.8E+01	4.9E+02	3.2E-02	1.9E-03	3.3E-02
SR48	4.6E+02	2.2E+01	4.7E+02	3.1E-02	1.4E-03	3.1E-02
SR49	5.5E+02	2.2E+01	5.5E+02	3.6E-02	1.4E-03	3.7E-02
SR50	3.6E+02	1.9E+01	3.8E+02	2.4E-02	1.2E-03	2.5E-02
SR51	3.7E+02	5.4E+01	4.1E+02	2.5E-02	3.6E-03	2.8E-02
SR52	4.6E+02	6.5E+01	4.8E+02	3.1E-02	4.4E-03	3.2E-02
SR53	4.1E+02	2.3E+01	4.2E+02	2.7E-02	1.5E-03	2.8E-02
SR54	4.3E+02	3.9E+01	4.4E+02	2.9E-02	2.6E-03	3.0E-02
SR55	4.5E+02	2.7E+01	4.5E+02	3.0E-02	1.8E-03	3.0E-02
SR56	3.7E+02	2.1E+01	3.8E+02	2.4E-02	1.4E-03	2.5E-02
SR57	4.9E+02	1.3E+02	5.7E+02	3.2E-02	9.0E-03	3.8E-02
SR58	3.7E+02	1.1E+01	3.7E+02	2.5E-02	7.4E-04	2.5E-02

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-6 Exposure Concentrations and Exposure Ratios for 8-hour CO (Construction)

Human Receptor Location	8-hour CO (TRV = 6,000 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	8.5E+02	2.1E+03	2.5E+03	1.4E-01	3.4E-01	4.1E-01
SR01	4.2E+02	4.0E+02	7.9E+02	6.9E-02	6.7E-02	1.3E-01
SR02	4.7E+02	3.5E+02	7.4E+02	7.8E-02	5.8E-02	1.2E-01
SR03	4.4E+02	2.4E+02	6.2E+02	7.3E-02	4.0E-02	1.0E-01
SR04	3.9E+02	1.3E+02	5.0E+02	6.5E-02	2.1E-02	8.4E-02
SR05	4.0E+02	1.6E+02	5.4E+02	6.6E-02	2.6E-02	9.0E-02
SR06	4.0E+02	7.6E+01	4.6E+02	6.6E-02	1.3E-02	7.7E-02
SR07	3.9E+02	6.3E+01	4.5E+02	6.6E-02	1.0E-02	7.5E-02
SR08	3.9E+02	7.4E+01	4.5E+02	6.5E-02	1.2E-02	7.4E-02
SR09	4.3E+02	3.0E+02	6.8E+02	7.2E-02	5.0E-02	1.1E-01
SR10	4.0E+02	1.5E+02	5.4E+02	6.7E-02	2.5E-02	9.0E-02
SR11	5.4E+02	2.5E+02	7.4E+02	9.0E-02	4.2E-02	1.2E-01
SR12	3.9E+02	2.5E+02	6.3E+02	6.5E-02	4.2E-02	1.0E-01
SR13	4.0E+02	2.3E+02	6.1E+02	6.6E-02	3.8E-02	1.0E-01
SR14	3.9E+02	3.1E+02	6.8E+02	6.5E-02	5.1E-02	1.1E-01
SR15	3.9E+02	2.7E+02	6.3E+02	6.5E-02	4.5E-02	1.1E-01
SR16	3.7E+02	1.9E+02	5.4E+02	6.2E-02	3.1E-02	9.1E-02
SR17	3.8E+02	7.1E+01	4.2E+02	6.4E-02	1.2E-02	7.0E-02
SR18	4.3E+02	3.1E+02	7.4E+02	7.1E-02	5.2E-02	1.2E-01
SR19	4.2E+02	3.1E+02	7.3E+02	7.0E-02	5.2E-02	1.2E-01
SR20	4.4E+02	2.2E+02	6.3E+02	7.4E-02	3.7E-02	1.0E-01
SR21	3.8E+02	8.8E+01	4.4E+02	6.3E-02	1.5E-02	7.4E-02
SR22	3.7E+02	8.8E+01	4.4E+02	6.2E-02	1.5E-02	7.4E-02
SR23	3.7E+02	8.3E+01	4.4E+02	6.1E-02	1.4E-02	7.3E-02
SR24	3.7E+02	7.5E+01	4.3E+02	6.1E-02	1.3E-02	7.2E-02
SR25	4.6E+02	2.9E+02	7.0E+02	7.6E-02	4.8E-02	1.2E-01
SR26	4.3E+02	1.1E+02	4.9E+02	7.1E-02	1.8E-02	8.2E-02
SR27	4.5E+02	1.1E+02	5.3E+02	7.5E-02	1.9E-02	8.8E-02
SR28	4.5E+02	1.1E+02	5.3E+02	7.5E-02	1.9E-02	8.8E-02
SR29	4.4E+02	1.1E+02	5.4E+02	7.4E-02	1.8E-02	9.0E-02
SR30	5.2E+02	1.2E+02	5.9E+02	8.6E-02	2.0E-02	9.8E-02
SR31	5.2E+02	1.2E+02	5.9E+02	8.6E-02	2.0E-02	9.8E-02
SR32	4.6E+02	1.1E+02	5.6E+02	7.7E-02	1.8E-02	9.3E-02
SR33	4.2E+02	1.1E+02	5.2E+02	7.0E-02	1.8E-02	8.7E-02
SR34	4.0E+02	1.1E+02	5.1E+02	6.7E-02	1.9E-02	8.6E-02
SR35	4.0E+02	1.1E+02	5.1E+02	6.7E-02	1.9E-02	8.6E-02
SR36	3.8E+02	1.7E+02	5.3E+02	6.3E-02	2.8E-02	8.9E-02
SR37	3.7E+02	7.7E+01	4.3E+02	6.1E-02	1.3E-02	7.2E-02
SR38	4.5E+02	1.3E+02	5.4E+02	7.5E-02	2.2E-02	9.0E-02
SR39	4.4E+02	1.2E+02	5.2E+02	7.3E-02	2.0E-02	8.6E-02
SR40	3.9E+02	2.4E+02	6.2E+02	6.4E-02	4.0E-02	1.0E-01
SR41	3.9E+02	4.5E+02	8.4E+02	6.6E-02	7.6E-02	1.4E-01
SR42	5.2E+02	9.1E+01	5.4E+02	8.7E-02	1.5E-02	9.1E-02
SR43	6.9E+02	1.3E+02	7.8E+02	1.1E-01	2.1E-02	1.3E-01
SR44	4.1E+02	2.8E+01	4.2E+02	6.8E-02	4.7E-03	7.1E-02
SR45	4.0E+02	2.8E+01	4.2E+02	6.7E-02	4.7E-03	7.0E-02
SR46	4.4E+02	2.4E+01	4.4E+02	7.3E-02	3.9E-03	7.4E-02
SR47	4.5E+02	2.7E+01	4.5E+02	7.4E-02	4.4E-03	7.6E-02
SR48	4.3E+02	1.4E+01	4.4E+02	7.2E-02	2.3E-03	7.4E-02
SR49	5.4E+02	1.3E+01	5.5E+02	9.0E-02	2.2E-03	9.1E-02
SR50	3.6E+02	1.5E+01	3.7E+02	6.0E-02	2.6E-03	6.2E-02
SR51	3.7E+02	4.4E+01	4.0E+02	6.1E-02	7.3E-03	6.7E-02
SR52	4.3E+02	4.2E+01	4.4E+02	7.2E-02	7.0E-03	7.3E-02
SR53	3.9E+02	1.2E+01	4.0E+02	6.5E-02	2.0E-03	6.7E-02
SR54	4.2E+02	2.5E+01	4.2E+02	6.9E-02	4.2E-03	7.0E-02
SR55	4.2E+02	1.9E+01	4.3E+02	7.0E-02	3.2E-03	7.1E-02
SR56	3.6E+02	1.5E+01	3.7E+02	6.1E-02	2.5E-03	6.1E-02
SR57	4.5E+02	9.8E+01	5.2E+02	7.5E-02	1.6E-02	8.7E-02
SR58	3.6E+02	7.6E+00	3.7E+02	6.0E-02	1.3E-03	6.1E-02

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-7 Exposure Concentrations and Exposure Ratios for 1-hour PM2.5 (Construction)

Human Receptor Location	1-hour $PM_{2.5}$ (TRV = 80 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	2.7E+01	3.0E+02	3.1E+02	3.4E-01	3.7E+00	3.9E+00
SR01	1.3E+01	6.4E+01	7.7E+01	1.7E-01	7.9E-01	9.6E-01
SR02	1.5E+01	4.0E+01	5.3E+01	1.8E-01	5.0E-01	6.6E-01
SR03	1.4E+01	3.4E+01	4.6E+01	1.8E-01	4.3E-01	5.7E-01
SR04	1.2E+01	6.9E+01	8.0E+01	1.5E-01	8.6E-01	1.0E+00
SR05	1.3E+01	7.6E+01	8.8E+01	1.6E-01	9.5E-01	1.1E+00
SR06	1.3E+01	4.4E+01	5.6E+01	1.6E-01	5.5E-01	7.0E-01
SR07	1.3E+01	3.5E+01	4.7E+01	1.6E-01	4.4E-01	5.8E-01
SR08	1.3E+01	4.0E+01	5.1E+01	1.6E-01	5.0E-01	6.4E-01
SR09	1.4E+01	7.1E+01	8.4E+01	1.7E-01	8.8E-01	1.0E+00
SR10	1.3E+01	8.5E+01	9.8E+01	1.6E-01	1.1E+00	1.2E+00
SR11	1.7E+01	1.3E+02	1.4E+02	2.1E-01	1.6E+00	1.8E+00
SR12	1.3E+01	9.5E+01	1.1E+02	1.6E-01	1.2E+00	1.3E+00
SR13	1.3E+01	9.0E+01	1.0E+02	1.6E-01	1.1E+00	1.3E+00
SR14	1.3E+01	1.1E+02	1.2E+02	1.6E-01	1.3E+00	1.5E+00
SR15	1.3E+01	1.0E+02	1.1E+02	1.6E-01	1.3E+00	1.4E+00
SR16	1.2E+01	1.0E+02	1.2E+02	1.5E-01	1.3E+00	1.5E+00
SR17	1.2E+01	4.4E+01	5.5E+01	1.5E-01	5.5E-01	6.9E-01
SR18	1.4E+01	1.5E+02	1.6E+02	1.8E-01	1.9E+00	2.0E+00
SR19	1.4E+01	1.9E+02	2.1E+02	1.7E-01	2.4E+00	2.6E+00
SR20	1.4E+01	1.4E+02	1.5E+02	1.8E-01	1.7E+00	1.8E+00
SR21	1.2E+01	5.7E+01	6.8E+01	1.6E-01	7.1E-01	8.5E-01
SR22	1.2E+01	5.7E+01	6.8E+01	1.5E-01	7.1E-01	8.5E-01
SR23	1.2E+01	4.8E+01	6.0E+01	1.5E-01	6.0E-01	7.5E-01
SR24	1.2E+01	3.9E+01	5.1E+01	1.5E-01	4.9E-01	6.4E-01
SR25	1.5E+01	1.7E+02	1.8E+02	1.9E-01	2.1E+00	2.2E+00
SR26	1.4E+01	5.6E+01	6.8E+01	1.7E-01	7.0E-01	8.5E-01
SR27	1.5E+01	4.6E+01	6.0E+01	1.8E-01	5.7E-01	7.4E-01
SR28	1.5E+01	4.6E+01	6.0E+01	1.8E-01	5.7E-01	7.4E-01
SR29	1.5E+01	4.4E+01	5.7E+01	1.8E-01	5.5E-01	7.2E-01
SR30	1.7E+01	4.7E+01	6.2E+01	2.1E-01	5.9E-01	7.7E-01
SR31	1.7E+01	4.7E+01	6.2E+01	2.1E-01	5.9E-01	7.7E-01
SR32	1.5E+01	4.6E+01	6.1E+01	1.9E-01	5.8E-01	7.6E-01
SR33	1.4E+01	4.7E+01	6.0E+01	1.7E-01	5.8E-01	7.4E-01
SR34	1.3E+01	4.8E+01	6.1E+01	1.7E-01	5.9E-01	7.6E-01
SR35	1.3E+01	4.8E+01	6.1E+01	1.7E-01	5.9E-01	7.6E-01
SR36	1.2E+01	1.1E+02	1.2E+02	1.5E-01	1.4E+00	1.6E+00
SR37	1.2E+01	4.8E+01	6.0E+01	1.5E-01	6.0E-01	7.5E-01
SR38	1.4E+01	7.0E+01	8.3E+01	1.8E-01	8.7E-01	1.0E+00
SR39	1.5E+01	6.3E+01	7.5E+01	1.9E-01	7.8E-01	9.3E-01
SR40	1.3E+01	1.3E+02	1.5E+02	1.6E-01	1.7E+00	1.8E+00
SR41	1.3E+01	2.3E+02	2.5E+02	1.6E-01	2.9E+00	3.1E+00
SR42	1.6E+01	2.7E+01	4.1E+01	2.0E-01	3.4E-01	5.1E-01
SR43	2.0E+01	2.7E+01	4.5E+01	2.6E-01	3.4E-01	5.6E-01
SR44	1.3E+01	1.8E+01	3.0E+01	1.7E-01	2.3E-01	3.7E-01
SR45	1.3E+01	1.2E+01	2.4E+01	1.6E-01	1.5E-01	3.0E-01
SR46	1.4E+01	1.0E+01	2.2E+01	1.7E-01	1.3E-01	2.8E-01
SR47	1.4E+01	1.1E+01	2.3E+01	1.8E-01	1.4E-01	2.8E-01
SR48	1.4E+01	7.6E+00	2.0E+01	1.7E-01	9.5E-02	2.5E-01
SR49	1.6E+01	7.6E+00	2.2E+01	1.9E-01	9.5E-02	2.7E-01
SR50	1.2E+01	8.7E+00	2.0E+01	1.5E-01	1.1E-01	2.5E-01
SR51	1.2E+01	2.6E+01	3.7E+01	1.5E-01	3.2E-01	4.6E-01
SR52	1.4E+01	2.7E+01	3.8E+01	1.7E-01	3.3E-01	4.8E-01
SR53	1.3E+01	7.4E+00	1.9E+01	1.6E-01	9.3E-02	2.4E-01
SR54	1.3E+01	1.6E+01	2.7E+01	1.7E-01	2.0E-01	3.4E-01
SR55	1.4E+01	1.0E+01	2.3E+01	1.7E-01	1.3E-01	2.9E-01
SR56	1.2E+01	7.6E+00	1.9E+01	1.5E-01	9.5E-02	2.4E-01
SR57	1.5E+01	4.9E+01	6.3E+01	1.9E-01	6.2E-01	7.8E-01
SR58	1.2E+01	4.0E+00	1.5E+01	1.5E-01	5.0E-02	1.9E-01

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-8 Exposure Concentrations and Exposure Ratios for 24-hour PM2.5 (Construction)

Human Receptor Location	24-hour $PM_{2.5}$ (TRV = 28 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	1.8E+01	6.0E+01	7.2E+01	6.6E-01	2.1E+00	2.6E+00
SR01	1.2E+01	1.2E+01	2.4E+01	4.2E-01	4.4E-01	8.5E-01
SR02	1.2E+01	6.3E+00	1.8E+01	4.3E-01	2.3E-01	6.4E-01
SR03	1.2E+01	6.3E+00	1.8E+01	4.3E-01	2.2E-01	6.3E-01
SR04	1.2E+01	1.3E+01	2.4E+01	4.1E-01	4.8E-01	8.7E-01
SR05	1.2E+01	1.3E+01	2.4E+01	4.2E-01	4.8E-01	8.7E-01
SR06	1.2E+01	7.3E+00	1.9E+01	4.2E-01	2.6E-01	6.6E-01
SR07	1.2E+01	6.0E+00	1.7E+01	4.2E-01	2.1E-01	6.1E-01
SR08	1.2E+01	6.0E+00	1.7E+01	4.2E-01	2.1E-01	6.2E-01
SR09	1.2E+01	1.2E+01	2.4E+01	4.2E-01	4.5E-01	8.6E-01
SR10	1.2E+01	1.4E+01	2.5E+01	4.2E-01	4.9E-01	9.0E-01
SR11	1.3E+01	2.3E+01	3.5E+01	4.8E-01	8.1E-01	1.3E+00
SR12	1.2E+01	1.8E+01	2.9E+01	4.1E-01	6.6E-01	1.1E+00
SR13	1.2E+01	1.7E+01	2.8E+01	4.2E-01	6.1E-01	1.0E+00
SR14	1.2E+01	2.1E+01	3.2E+01	4.1E-01	7.5E-01	1.1E+00
SR15	1.2E+01	2.2E+01	3.3E+01	4.2E-01	7.8E-01	1.2E+00
SR16	1.1E+01	2.0E+01	3.1E+01	4.1E-01	7.0E-01	1.1E+00
SR17	1.1E+01	7.5E+00	1.9E+01	4.1E-01	2.7E-01	6.7E-01
SR18	1.2E+01	2.8E+01	4.0E+01	4.3E-01	1.0E+00	1.4E+00
SR19	1.2E+01	3.6E+01	4.7E+01	4.2E-01	1.3E+00	1.7E+00
SR20	1.2E+01	2.3E+01	3.4E+01	4.3E-01	8.1E-01	1.2E+00
SR21	1.1E+01	9.0E+00	2.0E+01	4.1E-01	3.2E-01	7.2E-01
SR22	1.1E+01	1.0E+01	2.1E+01	4.1E-01	3.6E-01	7.5E-01
SR23	1.1E+01	8.7E+00	2.0E+01	4.1E-01	3.1E-01	7.1E-01
SR24	1.1E+01	7.4E+00	1.8E+01	4.1E-01	2.7E-01	6.6E-01
SR25	1.2E+01	2.8E+01	3.9E+01	4.4E-01	9.8E-01	1.4E+00
SR26	1.2E+01	5.7E+00	1.7E+01	4.2E-01	2.0E-01	6.1E-01
SR27	1.2E+01	5.5E+00	1.7E+01	4.3E-01	2.0E-01	6.1E-01
SR28	1.2E+01	5.5E+00	1.7E+01	4.3E-01	2.0E-01	6.1E-01
SR29	1.2E+01	5.7E+00	1.7E+01	4.2E-01	2.0E-01	6.1E-01
SR30	1.3E+01	6.1E+00	1.8E+01	4.6E-01	2.2E-01	6.5E-01
SR31	1.3E+01	6.1E+00	1.8E+01	4.6E-01	2.2E-01	6.5E-01
SR32	1.2E+01	6.4E+00	1.8E+01	4.4E-01	2.3E-01	6.5E-01
SR33	1.2E+01	6.7E+00	1.8E+01	4.2E-01	2.4E-01	6.5E-01
SR34	1.2E+01	7.1E+00	1.8E+01	4.2E-01	2.5E-01	6.6E-01
SR35	1.2E+01	7.1E+00	1.8E+01	4.2E-01	2.5E-01	6.6E-01
SR36	1.1E+01	1.9E+01	3.0E+01	4.1E-01	6.6E-01	1.1E+00
SR37	1.1E+01	8.5E+00	2.0E+01	4.1E-01	3.0E-01	7.0E-01
SR38	1.2E+01	1.3E+01	2.4E+01	4.3E-01	4.5E-01	8.6E-01
SR39	1.2E+01	1.1E+01	2.2E+01	4.3E-01	3.8E-01	7.9E-01
SR40	1.2E+01	2.5E+01	3.6E+01	4.1E-01	8.9E-01	1.3E+00
SR41	1.2E+01	4.2E+01	5.4E+01	4.1E-01	1.5E+00	1.9E+00
SR42	1.3E+01	4.5E+00	1.7E+01	4.5E-01	1.6E-01	6.1E-01
SR43	1.5E+01	4.6E+00	1.9E+01	5.4E-01	1.7E-01	6.8E-01
SR44	1.2E+01	3.2E+00	1.5E+01	4.3E-01	1.2E-01	5.2E-01
SR45	1.2E+01	1.9E+00	1.3E+01	4.1E-01	6.7E-02	4.7E-01
SR46	1.2E+01	1.5E+00	1.3E+01	4.2E-01	5.2E-02	4.6E-01
SR47	1.2E+01	1.6E+00	1.3E+01	4.3E-01	5.6E-02	4.6E-01
SR48	1.2E+01	1.1E+00	1.3E+01	4.2E-01	3.8E-02	4.5E-01
SR49	1.2E+01	1.1E+00	1.3E+01	4.4E-01	3.8E-02	4.6E-01
SR50	1.1E+01	1.7E+00	1.3E+01	4.0E-01	5.9E-02	4.5E-01
SR51	1.1E+01	5.2E+00	1.6E+01	4.0E-01	1.9E-01	5.8E-01
SR52	1.2E+01	2.8E+00	1.4E+01	4.1E-01	1.0E-01	5.0E-01
SR53	1.2E+01	9.1E-01	1.2E+01	4.1E-01	3.3E-02	4.4E-01
SR54	1.1E+01	1.5E+00	1.3E+01	4.1E-01	5.4E-02	4.5E-01
SR55	1.2E+01	9.8E-01	1.2E+01	4.2E-01	3.5E-02	4.4E-01
SR56	1.1E+01	7.0E-01	1.2E+01	4.0E-01	2.5E-02	4.2E-01
SR57	1.2E+01	4.9E+00	1.6E+01	4.4E-01	1.7E-01	5.9E-01
SR58	1.1E+01	5.1E-01	1.2E+01	4.0E-01	1.8E-02	4.1E-01

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-9 Exposure Concentrations and Exposure Ratios for Annual PM2.5 (Construction)

Human Receptor Location	Annual $PM_{2.5}$ (TRV = 10 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	7.2E+00	1.2E+01	1.6E+01	7.2E-01	1.2E+00	1.6E+00
SR01	3.7E+00	1.8E+00	5.5E+00	3.7E-01	1.8E-01	5.5E-01
SR02	3.9E+00	9.2E-01	4.8E+00	3.9E-01	9.2E-02	4.8E-01
SR03	3.8E+00	9.1E-01	4.7E+00	3.8E-01	9.1E-02	4.7E-01
SR04	3.7E+00	2.1E+00	5.7E+00	3.7E-01	2.1E-01	5.7E-01
SR05	3.7E+00	2.1E+00	5.8E+00	3.7E-01	2.1E-01	5.8E-01
SR06	3.7E+00	1.0E+00	4.7E+00	3.7E-01	1.0E-01	4.7E-01
SR07	3.7E+00	7.3E-01	4.5E+00	3.7E-01	7.3E-02	4.5E-01
SR08	3.7E+00	9.1E-01	4.6E+00	3.7E-01	9.1E-02	4.6E-01
SR09	3.7E+00	1.9E+00	5.6E+00	3.7E-01	1.9E-01	5.6E-01
SR10	3.7E+00	2.0E+00	5.7E+00	3.7E-01	2.0E-01	5.7E-01
SR11	4.1E+00	3.5E+00	7.6E+00	4.1E-01	3.5E-01	7.6E-01
SR12	3.7E+00	3.2E+00	6.9E+00	3.7E-01	3.2E-01	6.9E-01
SR13	3.7E+00	2.9E+00	6.6E+00	3.7E-01	2.9E-01	6.6E-01
SR14	3.7E+00	3.9E+00	7.5E+00	3.7E-01	3.9E-01	7.5E-01
SR15	3.7E+00	4.0E+00	7.6E+00	3.7E-01	4.0E-01	7.6E-01
SR16	3.6E+00	3.8E+00	7.5E+00	3.6E-01	3.8E-01	7.5E-01
SR17	3.6E+00	1.3E+00	4.9E+00	3.6E-01	1.3E-01	4.9E-01
SR18	3.7E+00	4.4E+00	8.1E+00	3.7E-01	4.4E-01	8.1E-01
SR19	3.7E+00	9.3E+00	1.3E+01	3.7E-01	9.3E-01	1.3E+00
SR20	3.7E+00	5.1E+00	8.9E+00	3.7E-01	5.1E-01	8.9E-01
SR21	3.6E+00	1.8E+00	5.5E+00	3.6E-01	1.8E-01	5.5E-01
SR22	3.6E+00	1.9E+00	5.5E+00	3.6E-01	1.9E-01	5.5E-01
SR23	3.6E+00	1.7E+00	5.3E+00	3.6E-01	1.7E-01	5.3E-01
SR24	3.6E+00	1.8E+00	5.4E+00	3.6E-01	1.8E-01	5.4E-01
SR25	3.8E+00	6.1E+00	9.9E+00	3.8E-01	6.1E-01	9.9E-01
SR26	3.7E+00	5.2E-01	4.2E+00	3.7E-01	5.2E-02	4.2E-01
SR27	3.7E+00	4.9E-01	4.2E+00	3.7E-01	4.9E-02	4.2E-01
SR28	3.7E+00	4.9E-01	4.2E+00	3.7E-01	4.9E-02	4.2E-01
SR29	3.7E+00	5.1E-01	4.2E+00	3.7E-01	5.1E-02	4.2E-01
SR30	4.3E+00	5.7E-01	4.8E+00	4.3E-01	5.7E-02	4.8E-01
SR31	4.3E+00	5.7E-01	4.8E+00	4.3E-01	5.7E-02	4.8E-01
SR32	3.9E+00	6.4E-01	4.6E+00	3.9E-01	6.4E-02	4.6E-01
SR33	3.7E+00	7.2E-01	4.5E+00	3.7E-01	7.2E-02	4.5E-01
SR34	3.7E+00	8.3E-01	4.5E+00	3.7E-01	8.3E-02	4.5E-01
SR35	3.7E+00	8.3E-01	4.5E+00	3.7E-01	8.3E-02	4.5E-01
SR36	3.6E+00	2.9E+00	6.5E+00	3.6E-01	2.9E-01	6.5E-01
SR37	3.6E+00	1.7E+00	5.3E+00	3.6E-01	1.7E-01	5.3E-01
SR38	3.8E+00	2.6E+00	6.4E+00	3.8E-01	2.6E-01	6.4E-01
SR39	3.7E+00	1.4E+00	5.2E+00	3.7E-01	1.4E-01	5.2E-01
SR40	3.6E+00	2.9E+00	6.5E+00	3.6E-01	2.9E-01	6.5E-01
SR41	3.6E+00	6.3E+00	9.9E+00	3.6E-01	6.3E-01	9.9E-01
SR42	4.0E+00	6.4E-01	4.6E+00	4.0E-01	6.4E-02	4.6E-01
SR43	4.9E+00	6.5E-01	5.6E+00	4.9E-01	6.5E-02	5.6E-01
SR44	3.9E+00	5.0E-01	4.4E+00	3.9E-01	5.0E-02	4.4E-01
SR45	3.7E+00	2.3E-01	3.9E+00	3.7E-01	2.3E-02	3.9E-01
SR46	3.8E+00	1.9E-01	4.0E+00	3.8E-01	1.9E-02	4.0E-01
SR47	3.8E+00	2.0E-01	4.0E+00	3.8E-01	2.0E-02	4.0E-01
SR48	3.7E+00	1.2E-01	3.8E+00	3.7E-01	1.2E-02	3.8E-01
SR49	3.9E+00	1.3E-01	4.0E+00	3.9E-01	1.3E-02	4.0E-01
SR50	3.6E+00	3.7E-01	3.9E+00	3.6E-01	3.7E-02	3.9E-01
SR51	3.6E+00	1.2E+00	4.8E+00	3.6E-01	1.2E-01	4.8E-01
SR52	3.6E+00	2.1E-01	3.8E+00	3.6E-01	2.1E-02	3.8E-01
SR53	3.6E+00	1.1E-01	3.7E+00	3.6E-01	1.1E-02	3.7E-01
SR54	3.6E+00	1.2E-01	3.7E+00	3.6E-01	1.2E-02	3.7E-01
SR55	3.7E+00	7.7E-02	3.7E+00	3.7E-01	7.7E-03	3.7E-01
SR56	3.5E+00	5.5E-02	3.6E+00	3.5E-01	5.5E-03	3.6E-01
SR57	3.9E+00	4.4E-01	4.3E+00	3.9E-01	4.4E-02	4.3E-01
SR58	3.5E+00	5.9E-02	3.6E+00	3.5E-01	5.9E-03	3.6E-01

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-10 Exposure Concentrations and Exposure Ratios for 1-hour DEP (Construction)

Human Receptor Location	1-hour DEP (TRV = 10 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	1.1E+01	1.8E+02	1.8E+02	1.1E+00	1.8E+01	1.8E+01
SR01	1.4E+00	3.3E+01	3.4E+01	1.4E-01	3.3E+00	3.4E+00
SR02	2.5E+00	2.0E+01	2.1E+01	2.5E-01	2.0E+00	2.1E+00
SR03	2.0E+00	1.4E+01	1.5E+01	2.0E-01	1.4E+00	1.5E+00
SR04	8.2E-01	1.0E+01	1.1E+01	8.2E-02	1.0E+00	1.1E+00
SR05	1.0E+00	1.3E+01	1.3E+01	1.0E-01	1.3E+00	1.3E+00
SR06	9.2E-01	6.9E+00	7.4E+00	9.2E-02	6.9E-01	7.4E-01
SR07	9.0E-01	5.7E+00	6.0E+00	9.0E-02	5.7E-01	6.0E-01
SR08	8.8E-01	5.5E+00	5.9E+00	8.8E-02	5.5E-01	5.9E-01
SR09	1.7E+00	3.6E+01	3.7E+01	1.7E-01	3.6E+00	3.7E+00
SR10	1.3E+00	1.6E+01	1.7E+01	1.3E-01	1.6E+00	1.7E+00
SR11	3.8E+00	1.9E+01	2.1E+01	3.8E-01	1.9E+00	2.1E+00
SR12	8.4E-01	1.9E+01	1.9E+01	8.4E-02	1.9E+00	1.9E+00
SR13	1.0E+00	1.8E+01	1.8E+01	1.0E-01	1.8E+00	1.8E+00
SR14	9.2E-01	2.5E+01	2.5E+01	9.2E-02	2.5E+00	2.5E+00
SR15	8.9E-01	1.9E+01	2.0E+01	8.9E-02	1.9E+00	2.0E+00
SR16	5.0E-01	1.5E+01	1.5E+01	5.0E-02	1.5E+00	1.5E+00
SR17	6.4E-01	5.8E+00	5.8E+00	6.4E-02	5.8E-01	5.8E-01
SR18	2.0E+00	2.1E+01	2.2E+01	2.0E-01	2.1E+00	2.2E+00
SR19	1.5E+00	2.6E+01	2.7E+01	1.5E-01	2.6E+00	2.7E+00
SR20	1.9E+00	1.8E+01	1.9E+01	1.9E-01	1.8E+00	1.9E+00
SR21	5.5E-01	7.2E+00	7.4E+00	5.5E-02	7.2E-01	7.4E-01
SR22	4.1E-01	7.5E+00	7.7E+00	4.1E-02	7.5E-01	7.7E-01
SR23	3.8E-01	6.3E+00	6.6E+00	3.8E-02	6.3E-01	6.6E-01
SR24	3.7E-01	5.0E+00	5.1E+00	3.7E-02	5.0E-01	5.1E-01
SR25	2.3E+00	2.3E+01	2.5E+01	2.3E-01	2.3E+00	2.5E+00
SR26	1.7E+00	8.7E+00	9.0E+00	1.7E-01	8.7E-01	9.0E-01
SR27	2.2E+00	7.0E+00	8.1E+00	2.2E-01	7.0E-01	8.1E-01
SR28	2.2E+00	7.0E+00	8.1E+00	2.2E-01	7.0E-01	8.1E-01
SR29	2.3E+00	7.5E+00	9.5E+00	2.3E-01	7.5E-01	9.5E-01
SR30	3.7E+00	7.9E+00	1.1E+01	3.7E-01	7.9E-01	1.1E+00
SR31	3.7E+00	7.9E+00	1.1E+01	3.7E-01	7.9E-01	1.1E+00
SR32	2.4E+00	7.2E+00	9.0E+00	2.4E-01	7.2E-01	9.0E-01
SR33	1.6E+00	7.0E+00	7.9E+00	1.6E-01	7.0E-01	7.9E-01
SR34	1.3E+00	6.8E+00	7.8E+00	1.3E-01	6.8E-01	7.8E-01
SR35	1.3E+00	6.8E+00	7.8E+00	1.3E-01	6.8E-01	7.8E-01
SR36	6.0E-01	1.5E+01	1.5E+01	6.0E-02	1.5E+00	1.5E+00
SR37	3.8E-01	6.4E+00	6.6E+00	3.8E-02	6.4E-01	6.6E-01
SR38	1.9E+00	1.0E+01	1.1E+01	1.9E-01	1.0E+00	1.1E+00
SR39	2.1E+00	9.0E+00	1.0E+01	2.1E-01	9.0E-01	1.0E+00
SR40	9.6E-01	2.0E+01	2.0E+01	9.6E-02	2.0E+00	2.0E+00
SR41	1.1E+00	3.3E+01	3.4E+01	1.1E-01	3.3E+00	3.4E+00
SR42	3.2E+00	1.1E+01	1.2E+01	3.2E-01	1.1E+00	1.2E+00
SR43	6.4E+00	1.3E+01	1.8E+01	6.4E-01	1.3E+00	1.8E+00
SR44	1.0E+00	2.7E+00	3.2E+00	1.0E-01	2.7E-01	3.2E-01
SR45	1.1E+00	1.9E+00	2.1E+00	1.1E-01	1.9E-01	2.1E-01
SR46	1.6E+00	1.7E+00	2.3E+00	1.6E-01	1.7E-01	2.3E-01
SR47	1.9E+00	1.7E+00	2.3E+00	1.9E-01	1.7E-01	2.3E-01
SR48	1.5E+00	1.3E+00	2.1E+00	1.5E-01	1.3E-01	2.1E-01
SR49	2.6E+00	1.3E+00	3.1E+00	2.6E-01	1.3E-01	3.1E-01
SR50	2.9E-01	1.1E+00	1.2E+00	2.9E-02	1.1E-01	1.2E-01
SR51	3.5E-01	3.2E+00	3.4E+00	3.5E-02	3.2E-01	3.4E-01
SR52	1.9E+00	3.7E+00	4.4E+00	1.9E-01	3.7E-01	4.4E-01
SR53	9.1E-01	1.3E+00	1.7E+00	9.1E-02	1.3E-01	1.7E-01
SR54	1.5E+00	2.2E+00	2.7E+00	1.5E-01	2.2E-01	2.7E-01
SR55	1.7E+00	1.4E+00	2.4E+00	1.7E-01	1.4E-01	2.4E-01
SR56	3.9E-01	1.2E+00	1.3E+00	3.9E-02	1.2E-01	1.3E-01
SR57	2.4E+00	7.7E+00	9.1E+00	2.4E-01	7.7E-01	9.1E-01
SR58	3.6E-01	6.6E-01	8.3E-01	3.6E-02	6.6E-02	8.3E-02

NOTE:
Shaded cell indicates a ER greater than 1.0

Table A-11 Exposure Concentrations and Exposure Ratios for Annual DEP (Construction)

Human Receptor Location	Annual DEP (TRV = 5 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	2.5E+00	3.6E+00	3.9E+00	5.1E-01	7.2E-01	7.7E-01
SR01	1.3E-01	6.0E-01	7.3E-01	2.6E-02	1.2E-01	1.5E-01
SR02	2.4E-01	2.0E-01	4.4E-01	4.8E-02	4.0E-02	8.9E-02
SR03	2.0E-01	1.8E-01	3.9E-01	4.1E-02	3.7E-02	7.7E-02
SR04	9.8E-02	3.6E-01	4.6E-01	2.0E-02	7.3E-02	9.3E-02
SR05	1.3E-01	3.6E-01	4.9E-01	2.6E-02	7.2E-02	9.8E-02
SR06	1.5E-01	1.7E-01	3.2E-01	2.9E-02	3.4E-02	6.4E-02
SR07	1.4E-01	1.2E-01	2.6E-01	2.7E-02	2.5E-02	5.2E-02
SR08	1.3E-01	1.5E-01	2.8E-01	2.6E-02	2.9E-02	5.6E-02
SR09	1.3E-01	4.0E-01	5.2E-01	2.5E-02	7.9E-02	1.0E-01
SR10	1.0E-01	3.0E-01	4.0E-01	2.0E-02	6.0E-02	8.0E-02
SR11	4.3E-01	4.9E-01	9.2E-01	8.5E-02	9.8E-02	1.8E-01
SR12	9.7E-02	5.6E-01	6.4E-01	1.9E-02	1.1E-01	1.3E-01
SR13	1.1E-01	4.9E-01	6.0E-01	2.2E-02	9.8E-02	1.2E-01
SR14	9.8E-02	6.6E-01	7.6E-01	2.0E-02	1.3E-01	1.5E-01
SR15	9.5E-02	6.8E-01	7.7E-01	1.9E-02	1.4E-01	1.5E-01
SR16	5.5E-02	5.2E-01	5.7E-01	1.1E-02	1.0E-01	1.1E-01
SR17	6.9E-02	1.9E-01	2.5E-01	1.4E-02	3.7E-02	5.0E-02
SR18	1.3E-01	6.1E-01	7.4E-01	2.6E-02	1.2E-01	1.5E-01
SR19	1.1E-01	1.4E+00	1.5E+00	2.1E-02	2.7E-01	2.9E-01
SR20	1.3E-01	6.6E-01	8.0E-01	2.7E-02	1.3E-01	1.6E-01
SR21	6.3E-02	2.4E-01	3.0E-01	1.3E-02	4.8E-02	6.1E-02
SR22	4.8E-02	2.5E-01	3.0E-01	9.6E-03	5.0E-02	5.9E-02
SR23	4.4E-02	2.3E-01	2.7E-01	8.9E-03	4.5E-02	5.4E-02
SR24	4.5E-02	2.3E-01	2.7E-01	8.9E-03	4.5E-02	5.4E-02
SR25	1.8E-01	8.3E-01	1.0E+00	3.7E-02	1.7E-01	2.0E-01
SR26	1.1E-01	7.8E-02	1.8E-01	2.1E-02	1.6E-02	3.7E-02
SR27	1.5E-01	7.3E-02	2.3E-01	3.0E-02	1.5E-02	4.5E-02
SR28	1.5E-01	7.3E-02	2.3E-01	3.0E-02	1.5E-02	4.5E-02
SR29	1.4E-01	7.8E-02	2.2E-01	2.8E-02	1.6E-02	4.4E-02
SR30	5.3E-01	8.6E-02	6.0E-01	1.1E-01	1.7E-02	1.2E-01
SR31	5.3E-01	8.6E-02	6.0E-01	1.1E-01	1.7E-02	1.2E-01
SR32	2.9E-01	9.7E-02	3.7E-01	5.7E-02	1.9E-02	7.5E-02
SR33	1.5E-01	1.1E-01	2.5E-01	2.9E-02	2.2E-02	5.0E-02
SR34	1.1E-01	1.2E-01	2.3E-01	2.2E-02	2.5E-02	4.7E-02
SR35	1.1E-01	1.2E-01	2.3E-01	2.2E-02	2.5E-02	4.7E-02
SR36	6.6E-02	4.2E-01	4.8E-01	1.3E-02	8.3E-02	9.5E-02
SR37	4.3E-02	2.2E-01	2.7E-01	8.7E-03	4.5E-02	5.3E-02
SR38	2.1E-01	3.4E-01	5.4E-01	4.1E-02	6.9E-02	1.1E-01
SR39	1.3E-01	2.0E-01	3.4E-01	2.7E-02	4.1E-02	6.8E-02
SR40	6.2E-02	4.0E-01	4.6E-01	1.2E-02	8.0E-02	9.2E-02
SR41	7.5E-02	8.7E-01	9.4E-01	1.5E-02	1.7E-01	1.9E-01
SR42	3.1E-01	1.5E-01	4.7E-01	6.3E-02	3.1E-02	9.3E-02
SR43	9.7E-01	1.3E-01	1.1E+00	1.9E-01	2.5E-02	2.2E-01
SR44	2.0E-01	7.7E-02	2.7E-01	3.9E-02	1.5E-02	5.5E-02
SR45	1.2E-01	3.7E-02	1.5E-01	2.3E-02	7.3E-03	3.1E-02
SR46	1.8E-01	2.9E-02	2.1E-01	3.6E-02	5.8E-03	4.1E-02
SR47	1.9E-01	3.0E-02	2.3E-01	3.9E-02	6.1E-03	4.5E-02
SR48	1.3E-01	1.9E-02	1.5E-01	2.6E-02	3.9E-03	3.0E-02
SR49	2.5E-01	2.1E-02	2.7E-01	5.0E-02	4.1E-03	5.4E-02
SR50	3.0E-02	5.1E-02	8.0E-02	6.0E-03	1.0E-02	1.6E-02
SR51	4.0E-02	1.6E-01	2.0E-01	8.0E-03	3.2E-02	4.0E-02
SR52	7.2E-02	3.2E-02	1.0E-01	1.4E-02	6.3E-03	2.1E-02
SR53	7.2E-02	1.8E-02	8.9E-02	1.4E-02	3.5E-03	1.8E-02
SR54	5.1E-02	1.7E-02	6.6E-02	1.0E-02	3.4E-03	1.3E-02
SR55	1.1E-01	1.1E-02	1.2E-01	2.2E-02	2.2E-03	2.4E-02
SR56	1.1E-02	7.5E-03	1.8E-02	2.1E-03	1.5E-03	3.7E-03
SR57	2.7E-01	6.6E-02	3.3E-01	5.5E-02	1.3E-02	6.7E-02
SR58	2.2E-02	9.3E-03	3.1E-02	4.4E-03	1.9E-03	6.3E-03

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-12 Exposure Concentrations and Exposure Ratios for 1-hour 1,3-butadiene (Construction)

Human Receptor Location	1-hour 1,3-butadiene (TRV = 660 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	7.8E-01	4.4E-01	1.2E+00	1.2E-03	6.7E-04	1.8E-03
SR01	7.3E-01	8.3E-02	8.1E-01	1.1E-03	1.3E-04	1.2E-03
SR02	7.4E-01	5.1E-02	7.8E-01	1.1E-03	7.7E-05	1.2E-03
SR03	7.3E-01	3.6E-02	7.6E-01	1.1E-03	5.5E-05	1.2E-03
SR04	7.3E-01	2.7E-02	7.5E-01	1.1E-03	4.1E-05	1.1E-03
SR05	7.3E-01	3.4E-02	7.6E-01	1.1E-03	5.1E-05	1.2E-03
SR06	7.3E-01	1.8E-02	7.5E-01	1.1E-03	2.7E-05	1.1E-03
SR07	7.3E-01	1.5E-02	7.4E-01	1.1E-03	2.3E-05	1.1E-03
SR08	7.3E-01	1.4E-02	7.4E-01	1.1E-03	2.2E-05	1.1E-03
SR09	7.3E-01	9.2E-02	8.2E-01	1.1E-03	1.4E-04	1.2E-03
SR10	7.3E-01	4.1E-02	7.7E-01	1.1E-03	6.2E-05	1.2E-03
SR11	7.4E-01	5.0E-02	7.9E-01	1.1E-03	7.6E-05	1.2E-03
SR12	7.3E-01	5.1E-02	7.8E-01	1.1E-03	7.7E-05	1.2E-03
SR13	7.3E-01	4.8E-02	7.7E-01	1.1E-03	7.2E-05	1.2E-03
SR14	7.3E-01	6.4E-02	7.9E-01	1.1E-03	9.6E-05	1.2E-03
SR15	7.3E-01	5.1E-02	7.8E-01	1.1E-03	7.7E-05	1.2E-03
SR16	7.3E-01	3.8E-02	7.6E-01	1.1E-03	5.7E-05	1.2E-03
SR17	7.3E-01	1.5E-02	7.4E-01	1.1E-03	2.3E-05	1.1E-03
SR18	7.3E-01	5.8E-02	7.9E-01	1.1E-03	8.7E-05	1.2E-03
SR19	7.3E-01	7.0E-02	8.0E-01	1.1E-03	1.1E-04	1.2E-03
SR20	7.3E-01	5.1E-02	7.8E-01	1.1E-03	7.7E-05	1.2E-03
SR21	7.3E-01	1.9E-02	7.5E-01	1.1E-03	2.9E-05	1.1E-03
SR22	7.3E-01	2.0E-02	7.5E-01	1.1E-03	3.0E-05	1.1E-03
SR23	7.3E-01	1.7E-02	7.4E-01	1.1E-03	2.5E-05	1.1E-03
SR24	7.3E-01	1.3E-02	7.4E-01	1.1E-03	2.0E-05	1.1E-03
SR25	7.4E-01	6.5E-02	7.9E-01	1.1E-03	9.9E-05	1.2E-03
SR26	7.3E-01	2.3E-02	7.5E-01	1.1E-03	3.5E-05	1.1E-03
SR27	7.4E-01	1.9E-02	7.5E-01	1.1E-03	2.8E-05	1.1E-03
SR28	7.4E-01	1.9E-02	7.5E-01	1.1E-03	2.8E-05	1.1E-03
SR29	7.4E-01	2.0E-02	7.5E-01	1.1E-03	3.0E-05	1.1E-03
SR30	7.4E-01	2.1E-02	7.6E-01	1.1E-03	3.2E-05	1.2E-03
SR31	7.4E-01	2.1E-02	7.6E-01	1.1E-03	3.2E-05	1.2E-03
SR32	7.4E-01	2.0E-02	7.5E-01	1.1E-03	3.0E-05	1.1E-03
SR33	7.3E-01	1.9E-02	7.5E-01	1.1E-03	2.9E-05	1.1E-03
SR34	7.3E-01	1.9E-02	7.5E-01	1.1E-03	2.9E-05	1.1E-03
SR35	7.3E-01	1.9E-02	7.5E-01	1.1E-03	2.9E-05	1.1E-03
SR36	7.3E-01	3.8E-02	7.6E-01	1.1E-03	5.7E-05	1.2E-03
SR37	7.3E-01	1.7E-02	7.4E-01	1.1E-03	2.6E-05	1.1E-03
SR38	7.4E-01	2.7E-02	7.6E-01	1.1E-03	4.1E-05	1.1E-03
SR39	7.4E-01	2.6E-02	7.6E-01	1.1E-03	4.0E-05	1.1E-03
SR40	7.3E-01	5.3E-02	7.8E-01	1.1E-03	8.0E-05	1.2E-03
SR41	7.3E-01	8.9E-02	8.2E-01	1.1E-03	1.4E-04	1.2E-03
SR42	7.4E-01	2.7E-02	7.6E-01	1.1E-03	4.1E-05	1.2E-03
SR43	7.5E-01	3.3E-02	7.8E-01	1.1E-03	5.0E-05	1.2E-03
SR44	7.3E-01	6.9E-03	7.3E-01	1.1E-03	1.1E-05	1.1E-03
SR45	7.3E-01	4.9E-03	7.3E-01	1.1E-03	7.5E-06	1.1E-03
SR46	7.3E-01	4.2E-03	7.3E-01	1.1E-03	6.3E-06	1.1E-03
SR47	7.3E-01	4.7E-03	7.4E-01	1.1E-03	7.0E-06	1.1E-03
SR48	7.3E-01	3.3E-03	7.3E-01	1.1E-03	5.1E-06	1.1E-03
SR49	7.4E-01	3.3E-03	7.4E-01	1.1E-03	5.0E-06	1.1E-03
SR50	7.3E-01	3.0E-03	7.3E-01	1.1E-03	4.5E-06	1.1E-03
SR51	7.3E-01	8.5E-03	7.3E-01	1.1E-03	1.3E-05	1.1E-03
SR52	7.3E-01	1.1E-02	7.4E-01	1.1E-03	1.6E-05	1.1E-03
SR53	7.3E-01	3.4E-03	7.3E-01	1.1E-03	5.1E-06	1.1E-03
SR54	7.3E-01	6.2E-03	7.3E-01	1.1E-03	9.4E-06	1.1E-03
SR55	7.3E-01	4.3E-03	7.3E-01	1.1E-03	6.5E-06	1.1E-03
SR56	7.3E-01	3.3E-03	7.3E-01	1.1E-03	5.0E-06	1.1E-03
SR57	7.4E-01	2.0E-02	7.5E-01	1.1E-03	3.1E-05	1.1E-03
SR58	7.3E-01	1.7E-03	7.3E-01	1.1E-03	2.6E-06	1.1E-03

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-13 Exposure Concentrations and Exposure Ratios for Annual 1,3-butadiene (Construction)

Human Receptor Location	Annual 1,3-butadiene (TRV = 2 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	3.0E-02	9.1E-03	3.0E-02	1.5E-02	4.6E-03	1.5E-02
SR01	1.9E-02	1.5E-03	2.0E-02	9.3E-03	7.7E-04	1.0E-02
SR02	1.9E-02	5.2E-04	2.0E-02	9.6E-03	2.6E-04	9.8E-03
SR03	1.9E-02	4.7E-04	1.9E-02	9.5E-03	2.4E-04	9.7E-03
SR04	1.8E-02	9.4E-04	1.9E-02	9.2E-03	4.7E-04	9.7E-03
SR05	1.9E-02	9.3E-04	2.0E-02	9.3E-03	4.7E-04	9.8E-03
SR06	1.9E-02	4.5E-04	1.9E-02	9.4E-03	2.2E-04	9.6E-03
SR07	1.9E-02	3.2E-04	1.9E-02	9.3E-03	1.6E-04	9.5E-03
SR08	1.9E-02	3.8E-04	1.9E-02	9.3E-03	1.9E-04	9.5E-03
SR09	1.9E-02	1.0E-03	2.0E-02	9.3E-03	5.1E-04	9.8E-03
SR10	1.8E-02	7.9E-04	1.9E-02	9.2E-03	4.0E-04	9.6E-03
SR11	2.0E-02	1.3E-03	2.1E-02	1.0E-02	6.4E-04	1.1E-02
SR12	1.8E-02	1.4E-03	2.0E-02	9.2E-03	7.2E-04	9.9E-03
SR13	1.9E-02	1.3E-03	2.0E-02	9.3E-03	6.3E-04	9.9E-03
SR14	1.8E-02	1.7E-03	2.0E-02	9.2E-03	8.6E-04	1.0E-02
SR15	1.8E-02	1.8E-03	2.0E-02	9.2E-03	8.9E-04	1.0E-02
SR16	1.8E-02	1.3E-03	2.0E-02	9.1E-03	6.7E-04	9.8E-03
SR17	1.8E-02	4.9E-04	1.9E-02	9.2E-03	2.4E-04	9.4E-03
SR18	1.9E-02	1.6E-03	2.0E-02	9.3E-03	7.9E-04	1.0E-02
SR19	1.9E-02	3.4E-03	2.2E-02	9.3E-03	1.7E-03	1.1E-02
SR20	1.9E-02	1.8E-03	2.0E-02	9.3E-03	8.8E-04	1.0E-02
SR21	1.8E-02	6.4E-04	1.9E-02	9.2E-03	3.2E-04	9.5E-03
SR22	1.8E-02	6.5E-04	1.9E-02	9.1E-03	3.3E-04	9.4E-03
SR23	1.8E-02	5.9E-04	1.9E-02	9.1E-03	3.0E-04	9.4E-03
SR24	1.8E-02	5.9E-04	1.9E-02	9.1E-03	2.9E-04	9.4E-03
SR25	1.9E-02	2.2E-03	2.1E-02	9.4E-03	1.1E-03	1.1E-02
SR26	1.9E-02	2.1E-04	1.9E-02	9.3E-03	1.1E-04	9.4E-03
SR27	1.9E-02	2.0E-04	1.9E-02	9.4E-03	1.0E-04	9.5E-03
SR28	1.9E-02	2.0E-04	1.9E-02	9.4E-03	1.0E-04	9.5E-03
SR29	1.9E-02	2.2E-04	1.9E-02	9.3E-03	1.1E-04	9.5E-03
SR30	2.0E-02	2.4E-04	2.1E-02	1.0E-02	1.2E-04	1.0E-02
SR31	2.0E-02	2.4E-04	2.1E-02	1.0E-02	1.2E-04	1.0E-02
SR32	1.9E-02	2.7E-04	2.0E-02	9.7E-03	1.3E-04	9.8E-03
SR33	1.9E-02	3.0E-04	1.9E-02	9.4E-03	1.5E-04	9.5E-03
SR34	1.9E-02	3.4E-04	1.9E-02	9.3E-03	1.7E-04	9.4E-03
SR35	1.9E-02	3.4E-04	1.9E-02	9.3E-03	1.7E-04	9.4E-03
SR36	1.8E-02	1.1E-03	1.9E-02	9.2E-03	5.4E-04	9.7E-03
SR37	1.8E-02	5.9E-04	1.9E-02	9.1E-03	2.9E-04	9.4E-03
SR38	1.9E-02	9.1E-04	2.0E-02	9.5E-03	4.6E-04	9.9E-03
SR39	1.9E-02	5.5E-04	1.9E-02	9.3E-03	2.7E-04	9.6E-03
SR40	1.8E-02	1.0E-03	1.9E-02	9.2E-03	5.2E-04	9.7E-03
SR41	1.8E-02	2.3E-03	2.1E-02	9.2E-03	1.1E-03	1.0E-02
SR42	1.9E-02	4.0E-04	2.0E-02	9.7E-03	2.0E-04	9.9E-03
SR43	2.3E-02	3.3E-04	2.3E-02	1.1E-02	1.6E-04	1.1E-02
SR44	1.9E-02	2.0E-04	1.9E-02	9.5E-03	1.0E-04	9.6E-03
SR45	1.9E-02	9.7E-05	1.9E-02	9.3E-03	4.9E-05	9.3E-03
SR46	1.9E-02	7.8E-05	1.9E-02	9.4E-03	3.9E-05	9.5E-03
SR47	1.9E-02	8.0E-05	1.9E-02	9.5E-03	4.0E-05	9.5E-03
SR48	1.9E-02	5.2E-05	1.9E-02	9.3E-03	2.6E-05	9.4E-03
SR49	1.9E-02	5.5E-05	1.9E-02	9.6E-03	2.8E-05	9.6E-03
SR50	1.8E-02	1.3E-04	1.8E-02	9.1E-03	6.7E-05	9.1E-03
SR51	1.8E-02	4.2E-04	1.9E-02	9.1E-03	2.1E-04	9.3E-03
SR52	1.8E-02	8.8E-05	1.8E-02	9.2E-03	4.4E-05	9.2E-03
SR53	1.8E-02	4.8E-05	1.8E-02	9.2E-03	2.4E-05	9.2E-03
SR54	1.8E-02	4.8E-05	1.8E-02	9.1E-03	2.4E-05	9.1E-03
SR55	1.9E-02	3.2E-05	1.9E-02	9.3E-03	1.6E-05	9.3E-03
SR56	1.8E-02	2.2E-05	1.8E-02	9.0E-03	1.1E-05	9.0E-03
SR57	1.9E-02	1.8E-04	1.9E-02	9.7E-03	9.1E-05	9.7E-03
SR58	1.8E-02	2.5E-05	1.8E-02	9.1E-03	1.3E-05	9.1E-03

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-14 Exposure Concentrations and Exposure Ratios for Annual 1,3-butadiene (Construction)

Human Receptor Location	Annual 1,3-butadiene (non-threshold TRV = 0.3 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	3.0E-02	9.1E-03	3.0E-02	9.9E-02	3.0E-02	1.0E-01
SR01	1.9E-02	1.5E-03	2.0E-02	6.2E-02	5.1E-03	6.7E-02
SR02	1.9E-02	5.2E-04	2.0E-02	6.4E-02	1.7E-03	6.6E-02
SR03	1.9E-02	4.7E-04	1.9E-02	6.3E-02	1.6E-03	6.5E-02
SR04	1.8E-02	9.4E-04	1.9E-02	6.2E-02	3.1E-03	6.5E-02
SR05	1.9E-02	9.3E-04	2.0E-02	6.2E-02	3.1E-03	6.5E-02
SR06	1.9E-02	4.5E-04	1.9E-02	6.2E-02	1.5E-03	6.4E-02
SR07	1.9E-02	3.2E-04	1.9E-02	6.2E-02	1.1E-03	6.3E-02
SR08	1.9E-02	3.8E-04	1.9E-02	6.2E-02	1.3E-03	6.3E-02
SR09	1.9E-02	1.0E-03	2.0E-02	6.2E-02	3.4E-03	6.6E-02
SR10	1.8E-02	7.9E-04	1.9E-02	6.2E-02	2.6E-03	6.4E-02
SR11	2.0E-02	1.3E-03	2.1E-02	6.7E-02	4.3E-03	7.1E-02
SR12	1.8E-02	1.4E-03	2.0E-02	6.2E-02	4.8E-03	6.6E-02
SR13	1.9E-02	1.3E-03	2.0E-02	6.2E-02	4.2E-03	6.6E-02
SR14	1.8E-02	1.7E-03	2.0E-02	6.2E-02	5.7E-03	6.7E-02
SR15	1.8E-02	1.8E-03	2.0E-02	6.2E-02	5.9E-03	6.7E-02
SR16	1.8E-02	1.3E-03	2.0E-02	6.1E-02	4.4E-03	6.5E-02
SR17	1.8E-02	4.9E-04	1.9E-02	6.1E-02	1.6E-03	6.3E-02
SR18	1.9E-02	1.6E-03	2.0E-02	6.2E-02	5.3E-03	6.7E-02
SR19	1.9E-02	3.4E-03	2.2E-02	6.2E-02	1.1E-02	7.3E-02
SR20	1.9E-02	1.8E-03	2.0E-02	6.2E-02	5.8E-03	6.8E-02
SR21	1.8E-02	6.4E-04	1.9E-02	6.1E-02	2.1E-03	6.3E-02
SR22	1.8E-02	6.5E-04	1.9E-02	6.1E-02	2.2E-03	6.3E-02
SR23	1.8E-02	5.9E-04	1.9E-02	6.1E-02	2.0E-03	6.3E-02
SR24	1.8E-02	5.9E-04	1.9E-02	6.1E-02	2.0E-03	6.3E-02
SR25	1.9E-02	2.2E-03	2.1E-02	6.3E-02	7.2E-03	7.0E-02
SR26	1.9E-02	2.1E-04	1.9E-02	6.2E-02	7.1E-04	6.2E-02
SR27	1.9E-02	2.0E-04	1.9E-02	6.2E-02	6.8E-04	6.3E-02
SR28	1.9E-02	2.0E-04	1.9E-02	6.2E-02	6.8E-04	6.3E-02
SR29	1.9E-02	2.2E-04	1.9E-02	6.2E-02	7.2E-04	6.3E-02
SR30	2.0E-02	2.4E-04	2.1E-02	6.8E-02	7.9E-04	6.9E-02
SR31	2.0E-02	2.4E-04	2.1E-02	6.8E-02	7.9E-04	6.9E-02
SR32	1.9E-02	2.7E-04	2.0E-02	6.5E-02	8.9E-04	6.5E-02
SR33	1.9E-02	3.0E-04	1.9E-02	6.2E-02	1.0E-03	6.3E-02
SR34	1.9E-02	3.4E-04	1.9E-02	6.2E-02	1.1E-03	6.3E-02
SR35	1.9E-02	3.4E-04	1.9E-02	6.2E-02	1.1E-03	6.3E-02
SR36	1.8E-02	1.1E-03	1.9E-02	6.1E-02	3.6E-03	6.5E-02
SR37	1.8E-02	5.9E-04	1.9E-02	6.1E-02	2.0E-03	6.3E-02
SR38	1.9E-02	9.1E-04	2.0E-02	6.3E-02	3.0E-03	6.6E-02
SR39	1.9E-02	5.5E-04	1.9E-02	6.2E-02	1.8E-03	6.4E-02
SR40	1.8E-02	1.0E-03	1.9E-02	6.1E-02	3.5E-03	6.5E-02
SR41	1.8E-02	2.3E-03	2.1E-02	6.1E-02	7.5E-03	6.9E-02
SR42	1.9E-02	4.0E-04	2.0E-02	6.5E-02	1.3E-03	6.6E-02
SR43	2.3E-02	3.3E-04	2.3E-02	7.5E-02	1.1E-03	7.6E-02
SR44	1.9E-02	2.0E-04	1.9E-02	6.3E-02	6.7E-04	6.4E-02
SR45	1.9E-02	9.7E-05	1.9E-02	6.2E-02	3.2E-04	6.2E-02
SR46	1.9E-02	7.8E-05	1.9E-02	6.3E-02	2.6E-04	6.3E-02
SR47	1.9E-02	8.0E-05	1.9E-02	6.3E-02	2.7E-04	6.4E-02
SR48	1.9E-02	5.2E-05	1.9E-02	6.2E-02	1.7E-04	6.2E-02
SR49	1.9E-02	5.5E-05	1.9E-02	6.4E-02	1.8E-04	6.4E-02
SR50	1.8E-02	1.3E-04	1.8E-02	6.0E-02	4.5E-04	6.1E-02
SR51	1.8E-02	4.2E-04	1.9E-02	6.1E-02	1.4E-03	6.2E-02
SR52	1.8E-02	8.8E-05	1.8E-02	6.1E-02	2.9E-04	6.1E-02
SR53	1.8E-02	4.8E-05	1.8E-02	6.1E-02	1.6E-04	6.1E-02
SR54	1.8E-02	4.8E-05	1.8E-02	6.1E-02	1.6E-04	6.1E-02
SR55	1.9E-02	3.2E-05	1.9E-02	6.2E-02	1.1E-04	6.2E-02
SR56	1.8E-02	2.2E-05	1.8E-02	6.0E-02	7.2E-05	6.0E-02
SR57	1.9E-02	1.8E-04	1.9E-02	6.4E-02	6.1E-04	6.5E-02
SR58	1.8E-02	2.5E-05	1.8E-02	6.0E-02	8.4E-05	6.0E-02

NOTE:

Shaded cell indicates a ER greater than 1.0

* ERs are based on non-threshold effects (i.e., cancer risk) and therefore only Project case values are compared to a threshold target of 1.0

Table A-15 Exposure Concentrations and Exposure Ratios for 1-hour 2,2,4-trimethylpentane (Construction)

Human Receptor Location	1-hour 2,2,4-trimethylpentane (TRV = 19,000 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	1.9E+01	1.9E+00	2.1E+01	1.0E-03	1.0E-04	1.1E-03
SR01	1.9E+01	3.6E-01	1.9E+01	9.9E-04	1.9E-05	1.0E-03
SR02	1.9E+01	2.2E-01	1.9E+01	9.9E-04	1.2E-05	1.0E-03
SR03	1.9E+01	1.6E-01	1.9E+01	9.9E-04	8.2E-06	1.0E-03
SR04	1.9E+01	1.2E-01	1.9E+01	9.9E-04	6.2E-06	9.9E-04
SR05	1.9E+01	1.5E-01	1.9E+01	9.9E-04	7.7E-06	9.9E-04
SR06	1.9E+01	7.9E-02	1.9E+01	9.9E-04	4.1E-06	9.9E-04
SR07	1.9E+01	6.5E-02	1.9E+01	9.9E-04	3.4E-06	9.9E-04
SR08	1.9E+01	6.2E-02	1.9E+01	9.9E-04	3.2E-06	9.9E-04
SR09	1.9E+01	4.0E-01	1.9E+01	9.9E-04	2.1E-05	1.0E-03
SR10	1.9E+01	1.8E-01	1.9E+01	9.9E-04	9.4E-06	1.0E-03
SR11	1.9E+01	2.2E-01	1.9E+01	1.0E-03	1.1E-05	1.0E-03
SR12	1.9E+01	2.2E-01	1.9E+01	9.9E-04	1.2E-05	1.0E-03
SR13	1.9E+01	2.1E-01	1.9E+01	9.9E-04	1.1E-05	1.0E-03
SR14	1.9E+01	2.8E-01	1.9E+01	9.9E-04	1.5E-05	1.0E-03
SR15	1.9E+01	2.2E-01	1.9E+01	9.9E-04	1.2E-05	1.0E-03
SR16	1.9E+01	1.6E-01	1.9E+01	9.9E-04	8.6E-06	9.9E-04
SR17	1.9E+01	6.5E-02	1.9E+01	9.9E-04	3.4E-06	9.9E-04
SR18	1.9E+01	2.5E-01	1.9E+01	9.9E-04	1.3E-05	1.0E-03
SR19	1.9E+01	3.0E-01	1.9E+01	9.9E-04	1.6E-05	1.0E-03
SR20	1.9E+01	2.2E-01	1.9E+01	9.9E-04	1.2E-05	1.0E-03
SR21	1.9E+01	8.2E-02	1.9E+01	9.9E-04	4.3E-06	9.9E-04
SR22	1.9E+01	8.5E-02	1.9E+01	9.9E-04	4.5E-06	9.9E-04
SR23	1.9E+01	7.3E-02	1.9E+01	9.9E-04	3.8E-06	9.9E-04
SR24	1.9E+01	5.6E-02	1.9E+01	9.9E-04	3.0E-06	9.9E-04
SR25	1.9E+01	2.8E-01	1.9E+01	9.9E-04	1.5E-05	1.0E-03
SR26	1.9E+01	1.0E-01	1.9E+01	9.9E-04	5.3E-06	9.9E-04
SR27	1.9E+01	8.1E-02	1.9E+01	9.9E-04	4.3E-06	9.9E-04
SR28	1.9E+01	8.1E-02	1.9E+01	9.9E-04	4.3E-06	9.9E-04
SR29	1.9E+01	8.5E-02	1.9E+01	9.9E-04	4.5E-06	1.0E-03
SR30	1.9E+01	9.3E-02	1.9E+01	1.0E-03	4.9E-06	1.0E-03
SR31	1.9E+01	9.3E-02	1.9E+01	1.0E-03	4.9E-06	1.0E-03
SR32	1.9E+01	8.6E-02	1.9E+01	9.9E-04	4.5E-06	1.0E-03
SR33	1.9E+01	8.3E-02	1.9E+01	9.9E-04	4.4E-06	9.9E-04
SR34	1.9E+01	8.3E-02	1.9E+01	9.9E-04	4.4E-06	9.9E-04
SR35	1.9E+01	8.3E-02	1.9E+01	9.9E-04	4.4E-06	9.9E-04
SR36	1.9E+01	1.6E-01	1.9E+01	9.9E-04	8.6E-06	9.9E-04
SR37	1.9E+01	7.4E-02	1.9E+01	9.9E-04	3.9E-06	9.9E-04
SR38	1.9E+01	1.2E-01	1.9E+01	9.9E-04	6.2E-06	1.0E-03
SR39	1.9E+01	1.1E-01	1.9E+01	9.9E-04	6.0E-06	9.9E-04
SR40	1.9E+01	2.3E-01	1.9E+01	9.9E-04	1.2E-05	1.0E-03
SR41	1.9E+01	3.9E-01	1.9E+01	9.9E-04	2.0E-05	1.0E-03
SR42	1.9E+01	1.2E-01	1.9E+01	1.0E-03	6.3E-06	1.0E-03
SR43	1.9E+01	1.4E-01	1.9E+01	1.0E-03	7.5E-06	1.0E-03
SR44	1.9E+01	3.0E-02	1.9E+01	9.9E-04	1.6E-06	9.9E-04
SR45	1.9E+01	2.1E-02	1.9E+01	9.9E-04	1.1E-06	9.9E-04
SR46	1.9E+01	1.8E-02	1.9E+01	9.9E-04	9.6E-07	9.9E-04
SR47	1.9E+01	2.0E-02	1.9E+01	9.9E-04	1.1E-06	9.9E-04
SR48	1.9E+01	1.5E-02	1.9E+01	9.9E-04	7.6E-07	9.9E-04
SR49	1.9E+01	1.4E-02	1.9E+01	9.9E-04	7.5E-07	9.9E-04
SR50	1.9E+01	1.3E-02	1.9E+01	9.9E-04	6.8E-07	9.9E-04
SR51	1.9E+01	3.7E-02	1.9E+01	9.9E-04	1.9E-06	9.9E-04
SR52	1.9E+01	4.6E-02	1.9E+01	9.9E-04	2.4E-06	9.9E-04
SR53	1.9E+01	1.5E-02	1.9E+01	9.9E-04	7.7E-07	9.9E-04
SR54	1.9E+01	2.7E-02	1.9E+01	9.9E-04	1.4E-06	9.9E-04
SR55	1.9E+01	1.9E-02	1.9E+01	9.9E-04	9.9E-07	9.9E-04
SR56	1.9E+01	1.4E-02	1.9E+01	9.9E-04	7.6E-07	9.9E-04
SR57	1.9E+01	8.9E-02	1.9E+01	9.9E-04	4.7E-06	1.0E-03
SR58	1.9E+01	7.4E-03	1.9E+01	9.9E-04	3.9E-07	9.9E-04

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-16 Exposure Concentrations and Exposure Ratios for Annual 2,2,4-trimethylpentane (Construction)

Human Receptor Location	Annual 2,2,4-trimethylpentane (TRV =1,800 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	3.3E-01	4.0E-02	3.3E-01	1.8E-04	2.2E-05	1.8E-04
SR01	1.7E-01	6.7E-03	1.8E-01	9.7E-05	3.7E-06	1.0E-04
SR02	1.8E-01	2.3E-03	1.8E-01	1.0E-04	1.3E-06	1.0E-04
SR03	1.8E-01	2.1E-03	1.8E-01	1.0E-04	1.1E-06	1.0E-04
SR04	1.7E-01	4.1E-03	1.8E-01	9.6E-05	2.3E-06	9.8E-05
SR05	1.7E-01	4.1E-03	1.8E-01	9.7E-05	2.3E-06	9.9E-05
SR06	1.8E-01	1.9E-03	1.8E-01	9.8E-05	1.1E-06	9.9E-05
SR07	1.8E-01	1.4E-03	1.8E-01	9.7E-05	7.8E-07	9.8E-05
SR08	1.7E-01	1.6E-03	1.8E-01	9.7E-05	9.2E-07	9.8E-05
SR09	1.7E-01	4.5E-03	1.8E-01	9.7E-05	2.5E-06	9.9E-05
SR10	1.7E-01	3.4E-03	1.8E-01	9.6E-05	1.9E-06	9.8E-05
SR11	1.9E-01	5.6E-03	2.0E-01	1.1E-04	3.1E-06	1.1E-04
SR12	1.7E-01	6.3E-03	1.8E-01	9.6E-05	3.5E-06	9.9E-05
SR13	1.7E-01	5.5E-03	1.8E-01	9.6E-05	3.1E-06	9.9E-05
SR14	1.7E-01	7.5E-03	1.8E-01	9.6E-05	4.1E-06	1.0E-04
SR15	1.7E-01	7.7E-03	1.8E-01	9.6E-05	4.3E-06	1.0E-04
SR16	1.7E-01	5.8E-03	1.8E-01	9.4E-05	3.2E-06	9.7E-05
SR17	1.7E-01	2.1E-03	1.7E-01	9.5E-05	1.2E-06	9.6E-05
SR18	1.7E-01	6.8E-03	1.8E-01	9.7E-05	3.8E-06	1.0E-04
SR19	1.7E-01	1.5E-02	1.9E-01	9.6E-05	8.3E-06	1.0E-04
SR20	1.8E-01	7.6E-03	1.8E-01	9.7E-05	4.2E-06	1.0E-04
SR21	1.7E-01	2.8E-03	1.7E-01	9.5E-05	1.5E-06	9.6E-05
SR22	1.7E-01	2.8E-03	1.7E-01	9.4E-05	1.6E-06	9.6E-05
SR23	1.7E-01	2.6E-03	1.7E-01	9.4E-05	1.4E-06	9.5E-05
SR24	1.7E-01	2.5E-03	1.7E-01	9.4E-05	1.4E-06	9.5E-05
SR25	1.8E-01	9.4E-03	1.9E-01	9.9E-05	5.2E-06	1.0E-04
SR26	1.7E-01	9.3E-04	1.7E-01	9.6E-05	5.2E-07	9.7E-05
SR27	1.8E-01	8.8E-04	1.8E-01	9.8E-05	4.9E-07	9.8E-05
SR28	1.8E-01	8.8E-04	1.8E-01	9.8E-05	4.9E-07	9.8E-05
SR29	1.8E-01	9.4E-04	1.8E-01	9.7E-05	5.2E-07	9.8E-05
SR30	2.0E-01	1.0E-03	2.0E-01	1.1E-04	5.7E-07	1.1E-04
SR31	2.0E-01	1.0E-03	2.0E-01	1.1E-04	5.7E-07	1.1E-04
SR32	1.8E-01	1.2E-03	1.9E-01	1.0E-04	6.4E-07	1.0E-04
SR33	1.8E-01	1.3E-03	1.8E-01	9.8E-05	7.2E-07	9.8E-05
SR34	1.7E-01	1.5E-03	1.7E-01	9.6E-05	8.2E-07	9.7E-05
SR35	1.7E-01	1.5E-03	1.7E-01	9.6E-05	8.2E-07	9.7E-05
SR36	1.7E-01	4.7E-03	1.7E-01	9.5E-05	2.6E-06	9.7E-05
SR37	1.7E-01	2.6E-03	1.7E-01	9.4E-05	1.4E-06	9.5E-05
SR38	1.8E-01	4.0E-03	1.8E-01	1.0E-04	2.2E-06	1.0E-04
SR39	1.7E-01	2.4E-03	1.8E-01	9.7E-05	1.3E-06	9.8E-05
SR40	1.7E-01	4.6E-03	1.7E-01	9.5E-05	2.5E-06	9.7E-05
SR41	1.7E-01	9.8E-03	1.8E-01	9.5E-05	5.4E-06	1.0E-04
SR42	1.9E-01	1.7E-03	1.9E-01	1.0E-04	9.5E-07	1.0E-04
SR43	2.3E-01	1.4E-03	2.3E-01	1.3E-04	7.9E-07	1.3E-04
SR44	1.8E-01	8.7E-04	1.8E-01	9.9E-05	4.9E-07	1.0E-04
SR45	1.7E-01	4.2E-04	1.7E-01	9.7E-05	2.3E-07	9.7E-05
SR46	1.8E-01	3.4E-04	1.8E-01	9.9E-05	1.9E-07	9.9E-05
SR47	1.8E-01	3.5E-04	1.8E-01	1.0E-04	1.9E-07	1.0E-04
SR48	1.7E-01	2.3E-04	1.8E-01	9.7E-05	1.3E-07	9.7E-05
SR49	1.8E-01	2.4E-04	1.8E-01	1.0E-04	1.3E-07	1.0E-04
SR50	1.7E-01	5.8E-04	1.7E-01	9.3E-05	3.2E-07	9.4E-05
SR51	1.7E-01	1.8E-03	1.7E-01	9.4E-05	1.0E-06	9.5E-05
SR52	1.7E-01	3.8E-04	1.7E-01	9.5E-05	2.1E-07	9.5E-05
SR53	1.7E-01	2.1E-04	1.7E-01	9.5E-05	1.2E-07	9.5E-05
SR54	1.7E-01	2.1E-04	1.7E-01	9.4E-05	1.2E-07	9.4E-05
SR55	1.7E-01	1.4E-04	1.7E-01	9.6E-05	7.6E-08	9.6E-05
SR56	1.7E-01	9.4E-05	1.7E-01	9.3E-05	5.2E-08	9.3E-05
SR57	1.8E-01	7.9E-04	1.8E-01	1.0E-04	4.4E-07	1.0E-04
SR58	1.7E-01	1.1E-04	1.7E-01	9.3E-05	6.1E-08	9.3E-05

NOTE:
Shaded cell indicates a ER greater than 1.0

Table A-17 Exposure Concentrations and Exposure Ratios for 1-hour Acetaldehyde (Construction)

Human Receptor Location	1-hour Acetaldehyde (TRV = 470 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	3.7E+00	2.2E+01	2.5E+01	7.8E-03	4.6E-02	5.3E-02
SR01	3.4E+00	4.1E+00	7.4E+00	7.3E-03	8.6E-03	1.6E-02
SR02	3.4E+00	2.5E+00	5.9E+00	7.3E-03	5.3E-03	1.3E-02
SR03	3.4E+00	1.8E+00	5.1E+00	7.3E-03	3.7E-03	1.1E-02
SR04	3.4E+00	1.3E+00	4.7E+00	7.2E-03	2.8E-03	1.0E-02
SR05	3.4E+00	1.6E+00	5.0E+00	7.2E-03	3.5E-03	1.1E-02
SR06	3.4E+00	8.8E-01	4.3E+00	7.2E-03	1.9E-03	9.1E-03
SR07	3.4E+00	7.3E-01	4.1E+00	7.2E-03	1.5E-03	8.7E-03
SR08	3.4E+00	6.9E-01	4.1E+00	7.2E-03	1.5E-03	8.7E-03
SR09	3.4E+00	4.5E+00	7.9E+00	7.3E-03	9.5E-03	1.7E-02
SR10	3.4E+00	2.0E+00	5.4E+00	7.3E-03	4.3E-03	1.1E-02
SR11	3.5E+00	2.4E+00	5.9E+00	7.4E-03	5.2E-03	1.2E-02
SR12	3.4E+00	2.5E+00	5.9E+00	7.2E-03	5.3E-03	1.2E-02
SR13	3.4E+00	2.3E+00	5.7E+00	7.2E-03	4.9E-03	1.2E-02
SR14	3.4E+00	3.1E+00	6.5E+00	7.2E-03	6.6E-03	1.4E-02
SR15	3.4E+00	2.5E+00	5.9E+00	7.2E-03	5.3E-03	1.2E-02
SR16	3.4E+00	1.8E+00	5.2E+00	7.2E-03	3.9E-03	1.1E-02
SR17	3.4E+00	7.3E-01	4.1E+00	7.2E-03	1.5E-03	8.7E-03
SR18	3.4E+00	2.8E+00	6.2E+00	7.3E-03	6.0E-03	1.3E-02
SR19	3.4E+00	3.4E+00	6.8E+00	7.3E-03	7.2E-03	1.4E-02
SR20	3.4E+00	2.5E+00	5.9E+00	7.3E-03	5.3E-03	1.2E-02
SR21	3.4E+00	9.2E-01	4.3E+00	7.2E-03	2.0E-03	9.2E-03
SR22	3.4E+00	9.5E-01	4.3E+00	7.2E-03	2.0E-03	9.2E-03
SR23	3.4E+00	8.2E-01	4.2E+00	7.2E-03	1.7E-03	8.9E-03
SR24	3.4E+00	6.3E-01	4.0E+00	7.2E-03	1.3E-03	8.5E-03
SR25	3.4E+00	3.2E+00	6.6E+00	7.3E-03	6.8E-03	1.4E-02
SR26	3.4E+00	1.1E+00	4.5E+00	7.3E-03	2.4E-03	9.6E-03
SR27	3.4E+00	9.1E-01	4.3E+00	7.3E-03	1.9E-03	9.2E-03
SR28	3.4E+00	9.1E-01	4.3E+00	7.3E-03	1.9E-03	9.2E-03
SR29	3.4E+00	9.5E-01	4.4E+00	7.3E-03	2.0E-03	9.3E-03
SR30	3.5E+00	1.0E+00	4.5E+00	7.4E-03	2.2E-03	9.6E-03
SR31	3.5E+00	1.0E+00	4.5E+00	7.4E-03	2.2E-03	9.6E-03
SR32	3.4E+00	9.7E-01	4.4E+00	7.3E-03	2.1E-03	9.4E-03
SR33	3.4E+00	9.3E-01	4.3E+00	7.3E-03	2.0E-03	9.2E-03
SR34	3.4E+00	9.3E-01	4.3E+00	7.3E-03	2.0E-03	9.2E-03
SR35	3.4E+00	9.3E-01	4.3E+00	7.3E-03	2.0E-03	9.2E-03
SR36	3.4E+00	1.8E+00	5.2E+00	7.2E-03	3.9E-03	1.1E-02
SR37	3.4E+00	8.3E-01	4.2E+00	7.2E-03	1.8E-03	9.0E-03
SR38	3.4E+00	1.3E+00	4.7E+00	7.3E-03	2.8E-03	1.0E-02
SR39	3.4E+00	1.3E+00	4.7E+00	7.3E-03	2.7E-03	1.0E-02
SR40	3.4E+00	2.6E+00	6.0E+00	7.2E-03	5.5E-03	1.3E-02
SR41	3.4E+00	4.3E+00	7.7E+00	7.3E-03	9.2E-03	1.6E-02
SR42	3.5E+00	1.3E+00	4.7E+00	7.4E-03	2.8E-03	1.0E-02
SR43	3.6E+00	1.6E+00	5.0E+00	7.6E-03	3.4E-03	1.1E-02
SR44	3.4E+00	3.4E-01	3.7E+00	7.2E-03	7.2E-04	7.9E-03
SR45	3.4E+00	2.4E-01	3.6E+00	7.3E-03	5.1E-04	7.7E-03
SR46	3.4E+00	2.0E-01	3.6E+00	7.3E-03	4.3E-04	7.7E-03
SR47	3.4E+00	2.3E-01	3.6E+00	7.3E-03	4.8E-04	7.7E-03
SR48	3.4E+00	1.6E-01	3.6E+00	7.3E-03	3.5E-04	7.6E-03
SR49	3.5E+00	1.6E-01	3.6E+00	7.4E-03	3.4E-04	7.6E-03
SR50	3.4E+00	1.5E-01	3.5E+00	7.2E-03	3.1E-04	7.5E-03
SR51	3.4E+00	4.1E-01	3.8E+00	7.2E-03	8.8E-04	8.1E-03
SR52	3.4E+00	5.1E-01	3.9E+00	7.3E-03	1.1E-03	8.3E-03
SR53	3.4E+00	1.6E-01	3.6E+00	7.2E-03	3.5E-04	7.6E-03
SR54	3.4E+00	3.0E-01	3.7E+00	7.3E-03	6.4E-04	7.8E-03
SR55	3.4E+00	2.1E-01	3.6E+00	7.3E-03	4.5E-04	7.7E-03
SR56	3.4E+00	1.6E-01	3.5E+00	7.2E-03	3.4E-04	7.5E-03
SR57	3.4E+00	9.9E-01	4.4E+00	7.3E-03	2.1E-03	9.4E-03
SR58	3.4E+00	8.3E-02	3.5E+00	7.2E-03	1.8E-04	7.4E-03

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-18 Exposure Concentrations and Exposure Ratios for Annual Acetaldehyde (Construction)

Human Receptor Location	Annual Acetaldehyde (TRV = 4.5 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	3.4E-01	4.4E-01	7.2E-01	7.6E-02	9.8E-02	1.6E-01
SR01	2.7E-01	7.5E-02	3.5E-01	6.1E-02	1.7E-02	7.7E-02
SR02	2.8E-01	2.5E-02	3.0E-01	6.2E-02	5.7E-03	6.7E-02
SR03	2.8E-01	2.3E-02	3.0E-01	6.1E-02	5.1E-03	6.6E-02
SR04	2.7E-01	4.6E-02	3.2E-01	6.1E-02	1.0E-02	7.1E-02
SR05	2.7E-01	4.5E-02	3.2E-01	6.1E-02	1.0E-02	7.1E-02
SR06	2.7E-01	2.2E-02	3.0E-01	6.1E-02	4.8E-03	6.6E-02
SR07	2.7E-01	1.6E-02	2.9E-01	6.1E-02	3.5E-03	6.4E-02
SR08	2.7E-01	1.8E-02	2.9E-01	6.1E-02	4.1E-03	6.5E-02
SR09	2.7E-01	5.0E-02	3.2E-01	6.1E-02	1.1E-02	7.2E-02
SR10	2.7E-01	3.9E-02	3.1E-01	6.1E-02	8.6E-03	6.9E-02
SR11	2.8E-01	6.2E-02	3.4E-01	6.3E-02	1.4E-02	7.7E-02
SR12	2.7E-01	7.0E-02	3.4E-01	6.1E-02	1.6E-02	7.6E-02
SR13	2.7E-01	6.2E-02	3.3E-01	6.1E-02	1.4E-02	7.4E-02
SR14	2.7E-01	8.4E-02	3.6E-01	6.1E-02	1.9E-02	7.9E-02
SR15	2.7E-01	8.6E-02	3.6E-01	6.1E-02	1.9E-02	8.0E-02
SR16	2.7E-01	6.5E-02	3.4E-01	6.0E-02	1.4E-02	7.5E-02
SR17	2.7E-01	2.4E-02	3.0E-01	6.0E-02	5.3E-03	6.6E-02
SR18	2.7E-01	7.7E-02	3.5E-01	6.1E-02	1.7E-02	7.8E-02
SR19	2.7E-01	1.7E-01	4.4E-01	6.1E-02	3.7E-02	9.8E-02
SR20	2.7E-01	8.5E-02	3.6E-01	6.1E-02	1.9E-02	8.0E-02
SR21	2.7E-01	3.1E-02	3.0E-01	6.0E-02	6.9E-03	6.7E-02
SR22	2.7E-01	3.2E-02	3.0E-01	6.0E-02	7.1E-03	6.7E-02
SR23	2.7E-01	2.9E-02	3.0E-01	6.0E-02	6.4E-03	6.7E-02
SR24	2.7E-01	2.9E-02	3.0E-01	6.0E-02	6.3E-03	6.7E-02
SR25	2.8E-01	1.1E-01	3.8E-01	6.1E-02	2.3E-02	8.5E-02
SR26	2.7E-01	1.0E-02	2.8E-01	6.1E-02	2.3E-03	6.3E-02
SR27	2.7E-01	9.9E-03	2.8E-01	6.1E-02	2.2E-03	6.3E-02
SR28	2.7E-01	9.9E-03	2.8E-01	6.1E-02	2.2E-03	6.3E-02
SR29	2.7E-01	1.0E-02	2.8E-01	6.1E-02	2.3E-03	6.3E-02
SR30	2.9E-01	1.2E-02	3.0E-01	6.3E-02	2.6E-03	6.6E-02
SR31	2.9E-01	1.2E-02	3.0E-01	6.3E-02	2.6E-03	6.6E-02
SR32	2.8E-01	1.3E-02	2.9E-01	6.2E-02	2.9E-03	6.5E-02
SR33	2.7E-01	1.5E-02	2.9E-01	6.1E-02	3.2E-03	6.4E-02
SR34	2.7E-01	1.6E-02	2.9E-01	6.1E-02	3.7E-03	6.4E-02
SR35	2.7E-01	1.6E-02	2.9E-01	6.1E-02	3.7E-03	6.4E-02
SR36	2.7E-01	5.3E-02	3.2E-01	6.0E-02	1.2E-02	7.2E-02
SR37	2.7E-01	2.9E-02	3.0E-01	6.0E-02	6.4E-03	6.7E-02
SR38	2.8E-01	4.4E-02	3.2E-01	6.1E-02	9.9E-03	7.1E-02
SR39	2.7E-01	2.7E-02	3.0E-01	6.1E-02	5.9E-03	6.7E-02
SR40	2.7E-01	5.1E-02	3.2E-01	6.0E-02	1.1E-02	7.2E-02
SR41	2.7E-01	1.1E-01	3.8E-01	6.1E-02	2.4E-02	8.5E-02
SR42	2.8E-01	1.9E-02	3.0E-01	6.2E-02	4.3E-03	6.6E-02
SR43	3.0E-01	1.6E-02	3.1E-01	6.6E-02	3.5E-03	7.0E-02
SR44	2.8E-01	9.8E-03	2.9E-01	6.1E-02	2.2E-03	6.3E-02
SR45	2.7E-01	4.7E-03	2.8E-01	6.1E-02	1.1E-03	6.2E-02
SR46	2.8E-01	3.8E-03	2.8E-01	6.1E-02	8.4E-04	6.2E-02
SR47	2.8E-01	3.9E-03	2.8E-01	6.1E-02	8.7E-04	6.2E-02
SR48	2.7E-01	2.5E-03	2.8E-01	6.1E-02	5.6E-04	6.1E-02
SR49	2.8E-01	2.7E-03	2.8E-01	6.2E-02	6.0E-04	6.2E-02
SR50	2.7E-01	6.5E-03	2.8E-01	6.0E-02	1.5E-03	6.2E-02
SR51	2.7E-01	2.0E-02	2.9E-01	6.0E-02	4.5E-03	6.5E-02
SR52	2.7E-01	4.3E-03	2.8E-01	6.0E-02	9.5E-04	6.1E-02
SR53	2.7E-01	2.3E-03	2.7E-01	6.1E-02	5.2E-04	6.1E-02
SR54	2.7E-01	2.3E-03	2.7E-01	6.0E-02	5.2E-04	6.1E-02
SR55	2.7E-01	1.5E-03	2.7E-01	6.1E-02	3.4E-04	6.1E-02
SR56	2.7E-01	1.1E-03	2.7E-01	6.0E-02	2.3E-04	6.0E-02
SR57	2.8E-01	8.8E-03	2.9E-01	6.2E-02	2.0E-03	6.4E-02
SR58	2.7E-01	1.2E-03	2.7E-01	6.0E-02	2.7E-04	6.0E-02

NOTE:
Shaded cell indicates a ER greater than 1.0

Table A-19 Exposure Concentrations and Exposure Ratios for 1-hour Acrolein (Construction)

Human Receptor Location	1-hour Acrolein (TRV = 4.5 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	3.4E-01	5.2E+00	5.5E+00	7.6E-02	1.2E+00	1.2E+00
SR01	3.0E-01	9.8E-01	1.3E+00	6.6E-02	2.2E-01	2.8E-01
SR02	3.0E-01	6.0E-01	8.9E-01	6.7E-02	1.3E-01	2.0E-01
SR03	3.0E-01	4.2E-01	7.1E-01	6.7E-02	9.4E-02	1.6E-01
SR04	2.9E-01	3.2E-01	6.1E-01	6.5E-02	7.1E-02	1.4E-01
SR05	3.0E-01	3.9E-01	6.8E-01	6.6E-02	8.7E-02	1.5E-01
SR06	2.9E-01	2.1E-01	5.1E-01	6.6E-02	4.7E-02	1.1E-01
SR07	2.9E-01	1.8E-01	4.7E-01	6.6E-02	3.9E-02	1.0E-01
SR08	2.9E-01	1.7E-01	4.6E-01	6.6E-02	3.7E-02	1.0E-01
SR09	3.0E-01	1.1E+00	1.4E+00	6.6E-02	2.4E-01	3.0E-01
SR10	3.0E-01	4.8E-01	7.8E-01	6.6E-02	1.1E-01	1.7E-01
SR11	3.1E-01	5.8E-01	8.8E-01	6.9E-02	1.3E-01	2.0E-01
SR12	2.9E-01	6.0E-01	8.9E-01	6.5E-02	1.3E-01	2.0E-01
SR13	3.0E-01	5.6E-01	8.5E-01	6.6E-02	1.2E-01	1.9E-01
SR14	2.9E-01	7.4E-01	1.0E+00	6.6E-02	1.7E-01	2.3E-01
SR15	2.9E-01	6.0E-01	8.9E-01	6.6E-02	1.3E-01	2.0E-01
SR16	2.9E-01	4.4E-01	7.3E-01	6.5E-02	9.8E-02	1.6E-01
SR17	2.9E-01	1.7E-01	4.7E-01	6.5E-02	3.9E-02	1.0E-01
SR18	3.0E-01	6.7E-01	9.7E-01	6.7E-02	1.5E-01	2.2E-01
SR19	3.0E-01	8.2E-01	1.1E+00	6.6E-02	1.8E-01	2.5E-01
SR20	3.0E-01	6.0E-01	8.9E-01	6.7E-02	1.3E-01	2.0E-01
SR21	2.9E-01	2.2E-01	5.1E-01	6.5E-02	4.9E-02	1.1E-01
SR22	2.9E-01	2.3E-01	5.2E-01	6.5E-02	5.1E-02	1.2E-01
SR23	2.9E-01	2.0E-01	4.9E-01	6.5E-02	4.4E-02	1.1E-01
SR24	2.9E-01	1.5E-01	4.4E-01	6.5E-02	3.4E-02	9.8E-02
SR25	3.0E-01	7.6E-01	1.1E+00	6.7E-02	1.7E-01	2.4E-01
SR26	3.0E-01	2.7E-01	5.6E-01	6.6E-02	6.0E-02	1.3E-01
SR27	3.0E-01	2.2E-01	5.1E-01	6.7E-02	4.9E-02	1.1E-01
SR28	3.0E-01	2.2E-01	5.1E-01	6.7E-02	4.9E-02	1.1E-01
SR29	3.0E-01	2.3E-01	5.3E-01	6.7E-02	5.1E-02	1.2E-01
SR30	3.1E-01	2.5E-01	5.6E-01	6.9E-02	5.6E-02	1.2E-01
SR31	3.1E-01	2.5E-01	5.6E-01	6.9E-02	5.6E-02	1.2E-01
SR32	3.0E-01	2.3E-01	5.3E-01	6.7E-02	5.2E-02	1.2E-01
SR33	3.0E-01	2.2E-01	5.2E-01	6.6E-02	5.0E-02	1.1E-01
SR34	3.0E-01	2.2E-01	5.2E-01	6.6E-02	5.0E-02	1.2E-01
SR35	3.0E-01	2.2E-01	5.2E-01	6.6E-02	5.0E-02	1.2E-01
SR36	2.9E-01	4.4E-01	7.3E-01	6.5E-02	9.8E-02	1.6E-01
SR37	2.9E-01	2.0E-01	4.9E-01	6.5E-02	4.4E-02	1.1E-01
SR38	3.0E-01	3.2E-01	6.2E-01	6.7E-02	7.0E-02	1.4E-01
SR39	3.0E-01	3.1E-01	6.0E-01	6.7E-02	6.8E-02	1.3E-01
SR40	3.0E-01	6.2E-01	9.1E-01	6.6E-02	1.4E-01	2.0E-01
SR41	3.0E-01	1.0E+00	1.3E+00	6.6E-02	2.3E-01	3.0E-01
SR42	3.1E-01	3.2E-01	6.2E-01	6.8E-02	7.1E-02	1.4E-01
SR43	3.2E-01	3.8E-01	6.8E-01	7.1E-02	8.5E-02	1.5E-01
SR44	3.0E-01	8.1E-02	3.7E-01	6.6E-02	1.8E-02	8.3E-02
SR45	3.0E-01	5.8E-02	3.5E-01	6.6E-02	1.3E-02	7.7E-02
SR46	3.0E-01	4.9E-02	3.4E-01	6.7E-02	1.1E-02	7.6E-02
SR47	3.0E-01	5.4E-02	3.5E-01	6.7E-02	1.2E-02	7.7E-02
SR48	3.0E-01	3.9E-02	3.3E-01	6.6E-02	8.7E-03	7.4E-02
SR49	3.0E-01	3.8E-02	3.4E-01	6.8E-02	8.5E-03	7.4E-02
SR50	2.9E-01	3.5E-02	3.3E-01	6.5E-02	7.8E-03	7.2E-02
SR51	2.9E-01	9.9E-02	3.9E-01	6.5E-02	2.2E-02	8.7E-02
SR52	3.0E-01	1.2E-01	4.2E-01	6.7E-02	2.7E-02	9.3E-02
SR53	3.0E-01	4.0E-02	3.3E-01	6.6E-02	8.8E-03	7.4E-02
SR54	3.0E-01	7.3E-02	3.6E-01	6.6E-02	1.6E-02	8.1E-02
SR55	3.0E-01	5.0E-02	3.4E-01	6.6E-02	1.1E-02	7.6E-02
SR56	2.9E-01	3.9E-02	3.3E-01	6.5E-02	8.7E-03	7.3E-02
SR57	3.0E-01	2.4E-01	5.4E-01	6.7E-02	5.3E-02	1.2E-01
SR58	2.9E-01	2.0E-02	3.1E-01	6.5E-02	4.4E-03	6.9E-02

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-20 Exposure Concentrations and Exposure Ratios for Annual Acrolein (Construction)

Human Receptor Location	Annual Acrolein (TRV = 0.35 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	3.7E-02	1.1E-01	1.3E-01	1.1E-01	3.0E-01	3.8E-01
SR01	2.6E-02	1.8E-02	4.4E-02	7.3E-02	5.1E-02	1.2E-01
SR02	2.6E-02	6.1E-03	3.2E-02	7.5E-02	1.8E-02	9.2E-02
SR03	2.6E-02	5.5E-03	3.2E-02	7.4E-02	1.6E-02	9.0E-02
SR04	2.5E-02	1.1E-02	3.7E-02	7.3E-02	3.2E-02	1.0E-01
SR05	2.6E-02	1.1E-02	3.7E-02	7.3E-02	3.1E-02	1.0E-01
SR06	2.6E-02	5.2E-03	3.1E-02	7.4E-02	1.5E-02	8.8E-02
SR07	2.6E-02	3.8E-03	2.9E-02	7.3E-02	1.1E-02	8.4E-02
SR08	2.6E-02	4.4E-03	3.0E-02	7.3E-02	1.3E-02	8.6E-02
SR09	2.6E-02	1.2E-02	3.8E-02	7.3E-02	3.4E-02	1.1E-01
SR10	2.6E-02	9.3E-03	3.5E-02	7.3E-02	2.6E-02	9.9E-02
SR11	2.7E-02	1.5E-02	4.2E-02	7.7E-02	4.3E-02	1.2E-01
SR12	2.5E-02	1.7E-02	4.2E-02	7.3E-02	4.8E-02	1.2E-01
SR13	2.6E-02	1.5E-02	4.0E-02	7.3E-02	4.2E-02	1.2E-01
SR14	2.6E-02	2.0E-02	4.6E-02	7.3E-02	5.7E-02	1.3E-01
SR15	2.5E-02	2.1E-02	4.6E-02	7.3E-02	5.9E-02	1.3E-01
SR16	2.5E-02	1.6E-02	4.1E-02	7.2E-02	4.5E-02	1.2E-01
SR17	2.5E-02	5.7E-03	3.1E-02	7.2E-02	1.6E-02	8.9E-02
SR18	2.6E-02	1.8E-02	4.4E-02	7.3E-02	5.3E-02	1.3E-01
SR19	2.6E-02	4.0E-02	6.6E-02	7.3E-02	1.1E-01	1.9E-01
SR20	2.6E-02	2.0E-02	4.6E-02	7.3E-02	5.9E-02	1.3E-01
SR21	2.5E-02	7.5E-03	3.3E-02	7.2E-02	2.1E-02	9.4E-02
SR22	2.5E-02	7.7E-03	3.3E-02	7.2E-02	2.2E-02	9.4E-02
SR23	2.5E-02	7.0E-03	3.2E-02	7.2E-02	2.0E-02	9.2E-02
SR24	2.5E-02	6.9E-03	3.2E-02	7.2E-02	2.0E-02	9.2E-02
SR25	2.6E-02	2.5E-02	5.1E-02	7.4E-02	7.2E-02	1.5E-01
SR26	2.6E-02	2.5E-03	2.8E-02	7.3E-02	7.1E-03	8.0E-02
SR27	2.6E-02	2.4E-03	2.8E-02	7.4E-02	6.8E-03	8.0E-02
SR28	2.6E-02	2.4E-03	2.8E-02	7.4E-02	6.8E-03	8.0E-02
SR29	2.6E-02	2.5E-03	2.8E-02	7.3E-02	7.2E-03	8.1E-02
SR30	2.8E-02	2.8E-03	3.0E-02	7.9E-02	7.9E-03	8.6E-02
SR31	2.8E-02	2.8E-03	3.0E-02	7.9E-02	7.9E-03	8.6E-02
SR32	2.6E-02	3.1E-03	2.9E-02	7.5E-02	8.9E-03	8.4E-02
SR33	2.6E-02	3.5E-03	2.9E-02	7.4E-02	1.0E-02	8.3E-02
SR34	2.6E-02	4.0E-03	3.0E-02	7.3E-02	1.1E-02	8.4E-02
SR35	2.6E-02	4.0E-03	3.0E-02	7.3E-02	1.1E-02	8.4E-02
SR36	2.5E-02	1.3E-02	3.8E-02	7.2E-02	3.6E-02	1.1E-01
SR37	2.5E-02	6.9E-03	3.2E-02	7.2E-02	2.0E-02	9.2E-02
SR38	2.6E-02	1.1E-02	3.7E-02	7.4E-02	3.1E-02	1.0E-01
SR39	2.6E-02	6.4E-03	3.2E-02	7.3E-02	1.8E-02	9.2E-02
SR40	2.5E-02	1.2E-02	3.8E-02	7.2E-02	3.5E-02	1.1E-01
SR41	2.5E-02	2.6E-02	5.2E-02	7.3E-02	7.5E-02	1.5E-01
SR42	2.7E-02	4.6E-03	3.1E-02	7.6E-02	1.3E-02	8.9E-02
SR43	3.0E-02	3.8E-03	3.4E-02	8.5E-02	1.1E-02	9.6E-02
SR44	2.6E-02	2.4E-03	2.8E-02	7.4E-02	6.7E-03	8.1E-02
SR45	2.6E-02	1.1E-03	2.7E-02	7.3E-02	3.3E-03	7.6E-02
SR46	2.6E-02	9.1E-04	2.7E-02	7.4E-02	2.6E-03	7.7E-02
SR47	2.6E-02	9.4E-04	2.7E-02	7.4E-02	2.7E-03	7.7E-02
SR48	2.6E-02	6.1E-04	2.6E-02	7.3E-02	1.7E-03	7.5E-02
SR49	2.6E-02	6.5E-04	2.7E-02	7.5E-02	1.8E-03	7.7E-02
SR50	2.5E-02	1.6E-03	2.7E-02	7.2E-02	4.5E-03	7.6E-02
SR51	2.5E-02	4.9E-03	3.0E-02	7.2E-02	1.4E-02	8.6E-02
SR52	2.5E-02	1.0E-03	2.6E-02	7.2E-02	3.0E-03	7.5E-02
SR53	2.5E-02	5.6E-04	2.6E-02	7.3E-02	1.6E-03	7.4E-02
SR54	2.5E-02	5.6E-04	2.6E-02	7.2E-02	1.6E-03	7.4E-02
SR55	2.6E-02	3.7E-04	2.6E-02	7.3E-02	1.1E-03	7.4E-02
SR56	2.5E-02	2.5E-04	2.5E-02	7.2E-02	7.2E-04	7.2E-02
SR57	2.6E-02	2.1E-03	2.8E-02	7.5E-02	6.1E-03	8.1E-02
SR58	2.5E-02	3.0E-04	2.5E-02	7.2E-02	8.5E-04	7.3E-02

NOTE:
Shaded cell indicates a ER greater than 1.0

Table A-21 Exposure Concentrations and Exposure Ratios for 1-hour Benzene (Construction)

Human Receptor Location	1-hour Benzene (TRV = 30 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	1.5E+00	8.3E+00	9.3E+00	5.1E-02	2.8E-01	3.1E-01
SR01	9.1E-01	1.6E+00	2.4E+00	3.0E-02	5.2E-02	8.1E-02
SR02	9.8E-01	9.5E-01	1.8E+00	3.3E-02	3.2E-02	6.1E-02
SR03	9.4E-01	6.7E-01	1.5E+00	3.1E-02	2.2E-02	5.1E-02
SR04	8.7E-01	5.1E-01	1.3E+00	2.9E-02	1.7E-02	4.5E-02
SR05	8.9E-01	6.3E-01	1.5E+00	3.0E-02	2.1E-02	4.9E-02
SR06	8.8E-01	3.4E-01	1.2E+00	2.9E-02	1.1E-02	3.9E-02
SR07	8.8E-01	2.8E-01	1.1E+00	2.9E-02	9.3E-03	3.7E-02
SR08	8.8E-01	2.7E-01	1.1E+00	2.9E-02	8.8E-03	3.7E-02
SR09	9.2E-01	1.7E+00	2.6E+00	3.1E-02	5.7E-02	8.6E-02
SR10	9.0E-01	7.7E-01	1.6E+00	3.0E-02	2.6E-02	5.4E-02
SR11	1.1E+00	9.3E-01	1.9E+00	3.5E-02	3.1E-02	6.4E-02
SR12	8.7E-01	9.5E-01	1.8E+00	2.9E-02	3.2E-02	5.9E-02
SR13	8.8E-01	8.9E-01	1.7E+00	2.9E-02	3.0E-02	5.7E-02
SR14	8.8E-01	1.2E+00	2.0E+00	2.9E-02	4.0E-02	6.8E-02
SR15	8.8E-01	9.5E-01	1.8E+00	2.9E-02	3.2E-02	6.0E-02
SR16	8.5E-01	7.1E-01	1.5E+00	2.8E-02	2.4E-02	5.1E-02
SR17	8.6E-01	2.8E-01	1.1E+00	2.9E-02	9.3E-03	3.7E-02
SR18	9.5E-01	1.1E+00	2.0E+00	3.2E-02	3.6E-02	6.6E-02
SR19	9.2E-01	1.3E+00	2.2E+00	3.1E-02	4.4E-02	7.2E-02
SR20	9.5E-01	9.5E-01	1.8E+00	3.2E-02	3.2E-02	6.0E-02
SR21	8.5E-01	3.5E-01	1.2E+00	2.8E-02	1.2E-02	3.9E-02
SR22	8.4E-01	3.7E-01	1.2E+00	2.8E-02	1.2E-02	4.0E-02
SR23	8.4E-01	3.1E-01	1.1E+00	2.8E-02	1.0E-02	3.8E-02
SR24	8.4E-01	2.4E-01	1.1E+00	2.8E-02	8.1E-03	3.6E-02
SR25	9.8E-01	1.2E+00	2.1E+00	3.3E-02	4.1E-02	7.0E-02
SR26	9.3E-01	4.3E-01	1.3E+00	3.1E-02	1.4E-02	4.3E-02
SR27	9.7E-01	3.5E-01	1.3E+00	3.2E-02	1.2E-02	4.2E-02
SR28	9.7E-01	3.5E-01	1.3E+00	3.2E-02	1.2E-02	4.2E-02
SR29	9.7E-01	3.7E-01	1.3E+00	3.2E-02	1.2E-02	4.4E-02
SR30	1.1E+00	4.0E-01	1.4E+00	3.5E-02	1.3E-02	4.7E-02
SR31	1.1E+00	4.0E-01	1.4E+00	3.5E-02	1.3E-02	4.7E-02
SR32	9.8E-01	3.7E-01	1.3E+00	3.3E-02	1.2E-02	4.4E-02
SR33	9.3E-01	3.6E-01	1.2E+00	3.1E-02	1.2E-02	4.2E-02
SR34	9.0E-01	3.6E-01	1.2E+00	3.0E-02	1.2E-02	4.1E-02
SR35	9.0E-01	3.6E-01	1.2E+00	3.0E-02	1.2E-02	4.1E-02
SR36	8.6E-01	7.1E-01	1.5E+00	2.9E-02	2.4E-02	5.2E-02
SR37	8.4E-01	3.2E-01	1.1E+00	2.8E-02	1.1E-02	3.8E-02
SR38	9.5E-01	5.1E-01	1.4E+00	3.2E-02	1.7E-02	4.7E-02
SR39	9.6E-01	4.9E-01	1.4E+00	3.2E-02	1.6E-02	4.6E-02
SR40	8.8E-01	9.9E-01	1.8E+00	2.9E-02	3.3E-02	6.1E-02
SR41	8.9E-01	1.7E+00	2.5E+00	3.0E-02	5.6E-02	8.4E-02
SR42	1.0E+00	5.1E-01	1.4E+00	3.4E-02	1.7E-02	4.7E-02
SR43	1.2E+00	6.1E-01	1.8E+00	4.1E-02	2.0E-02	6.0E-02
SR44	8.8E-01	1.3E-01	9.8E-01	2.9E-02	4.3E-03	3.3E-02
SR45	8.9E-01	9.2E-02	9.3E-01	3.0E-02	3.1E-03	3.1E-02
SR46	9.4E-01	7.8E-02	9.6E-01	3.1E-02	2.6E-03	3.2E-02
SR47	9.5E-01	8.7E-02	9.8E-01	3.2E-02	2.9E-03	3.3E-02
SR48	9.3E-01	6.2E-02	9.6E-01	3.1E-02	2.1E-03	3.2E-02
SR49	1.0E+00	6.1E-02	1.0E+00	3.4E-02	2.0E-03	3.5E-02
SR50	8.3E-01	5.6E-02	8.8E-01	2.8E-02	1.9E-03	2.9E-02
SR51	8.4E-01	1.6E-01	9.8E-01	2.8E-02	5.3E-03	3.3E-02
SR52	9.4E-01	2.0E-01	1.1E+00	3.1E-02	6.6E-03	3.6E-02
SR53	8.8E-01	6.3E-02	9.1E-01	2.9E-02	2.1E-03	3.0E-02
SR54	9.1E-01	1.2E-01	9.6E-01	3.0E-02	3.9E-03	3.2E-02
SR55	9.3E-01	8.1E-02	9.5E-01	3.1E-02	2.7E-03	3.2E-02
SR56	8.4E-01	6.2E-02	8.9E-01	2.8E-02	2.1E-03	3.0E-02
SR57	9.8E-01	3.8E-01	1.3E+00	3.3E-02	1.3E-02	4.2E-02
SR58	8.4E-01	3.2E-02	8.6E-01	2.8E-02	1.1E-03	2.9E-02

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-22 Exposure Concentrations and Exposure Ratios for Annual Benzene (Construction)

Human Receptor Location	Annual Benzene (TRV = 30 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	4.9E-01	1.7E-01	5.1E-01	1.6E-02	5.7E-03	1.7E-02
SR01	3.3E-01	2.9E-02	3.6E-01	1.1E-02	9.6E-04	1.2E-02
SR02	3.4E-01	9.8E-03	3.5E-01	1.1E-02	3.3E-04	1.2E-02
SR03	3.3E-01	8.9E-03	3.4E-01	1.1E-02	3.0E-04	1.1E-02
SR04	3.3E-01	1.8E-02	3.4E-01	1.1E-02	5.9E-04	1.1E-02
SR05	3.3E-01	1.7E-02	3.5E-01	1.1E-02	5.8E-04	1.2E-02
SR06	3.3E-01	8.3E-03	3.4E-01	1.1E-02	2.8E-04	1.1E-02
SR07	3.3E-01	6.1E-03	3.4E-01	1.1E-02	2.0E-04	1.1E-02
SR08	3.3E-01	7.1E-03	3.4E-01	1.1E-02	2.4E-04	1.1E-02
SR09	3.3E-01	1.9E-02	3.5E-01	1.1E-02	6.4E-04	1.2E-02
SR10	3.3E-01	1.5E-02	3.4E-01	1.1E-02	4.9E-04	1.1E-02
SR11	3.5E-01	2.4E-02	3.7E-01	1.2E-02	8.0E-04	1.2E-02
SR12	3.3E-01	2.7E-02	3.5E-01	1.1E-02	9.0E-04	1.2E-02
SR13	3.3E-01	2.4E-02	3.5E-01	1.1E-02	7.9E-04	1.2E-02
SR14	3.3E-01	3.2E-02	3.6E-01	1.1E-02	1.1E-03	1.2E-02
SR15	3.3E-01	3.3E-02	3.6E-01	1.1E-02	1.1E-03	1.2E-02
SR16	3.2E-01	2.5E-02	3.5E-01	1.1E-02	8.3E-04	1.2E-02
SR17	3.2E-01	9.1E-03	3.3E-01	1.1E-02	3.0E-04	1.1E-02
SR18	3.3E-01	2.9E-02	3.6E-01	1.1E-02	9.8E-04	1.2E-02
SR19	3.3E-01	6.4E-02	3.9E-01	1.1E-02	2.1E-03	1.3E-02
SR20	3.3E-01	3.3E-02	3.6E-01	1.1E-02	1.1E-03	1.2E-02
SR21	3.2E-01	1.2E-02	3.4E-01	1.1E-02	4.0E-04	1.1E-02
SR22	3.2E-01	1.2E-02	3.4E-01	1.1E-02	4.1E-04	1.1E-02
SR23	3.2E-01	1.1E-02	3.3E-01	1.1E-02	3.7E-04	1.1E-02
SR24	3.2E-01	1.1E-02	3.3E-01	1.1E-02	3.7E-04	1.1E-02
SR25	3.3E-01	4.0E-02	3.7E-01	1.1E-02	1.3E-03	1.2E-02
SR26	3.3E-01	4.0E-03	3.3E-01	1.1E-02	1.3E-04	1.1E-02
SR27	3.3E-01	3.8E-03	3.3E-01	1.1E-02	1.3E-04	1.1E-02
SR28	3.3E-01	3.8E-03	3.3E-01	1.1E-02	1.3E-04	1.1E-02
SR29	3.3E-01	4.0E-03	3.3E-01	1.1E-02	1.3E-04	1.1E-02
SR30	3.6E-01	4.4E-03	3.6E-01	1.2E-02	1.5E-04	1.2E-02
SR31	3.6E-01	4.4E-03	3.6E-01	1.2E-02	1.5E-04	1.2E-02
SR32	3.4E-01	5.0E-03	3.4E-01	1.1E-02	1.7E-04	1.1E-02
SR33	3.3E-01	5.6E-03	3.4E-01	1.1E-02	1.9E-04	1.1E-02
SR34	3.3E-01	6.3E-03	3.3E-01	1.1E-02	2.1E-04	1.1E-02
SR35	3.3E-01	6.3E-03	3.3E-01	1.1E-02	2.1E-04	1.1E-02
SR36	3.2E-01	2.0E-02	3.4E-01	1.1E-02	6.7E-04	1.1E-02
SR37	3.2E-01	1.1E-02	3.3E-01	1.1E-02	3.7E-04	1.1E-02
SR38	3.3E-01	1.7E-02	3.5E-01	1.1E-02	5.7E-04	1.2E-02
SR39	3.3E-01	1.0E-02	3.4E-01	1.1E-02	3.4E-04	1.1E-02
SR40	3.2E-01	2.0E-02	3.4E-01	1.1E-02	6.5E-04	1.1E-02
SR41	3.3E-01	4.2E-02	3.7E-01	1.1E-02	1.4E-03	1.2E-02
SR42	3.4E-01	7.4E-03	3.5E-01	1.1E-02	2.5E-04	1.2E-02
SR43	3.9E-01	6.1E-03	3.9E-01	1.3E-02	2.0E-04	1.3E-02
SR44	3.3E-01	3.8E-03	3.4E-01	1.1E-02	1.3E-04	1.1E-02
SR45	3.3E-01	1.8E-03	3.3E-01	1.1E-02	6.1E-05	1.1E-02
SR46	3.3E-01	1.5E-03	3.3E-01	1.1E-02	4.8E-05	1.1E-02
SR47	3.3E-01	1.5E-03	3.4E-01	1.1E-02	5.0E-05	1.1E-02
SR48	3.3E-01	9.7E-04	3.3E-01	1.1E-02	3.2E-05	1.1E-02
SR49	3.4E-01	1.0E-03	3.4E-01	1.1E-02	3.4E-05	1.1E-02
SR50	3.2E-01	2.5E-03	3.2E-01	1.1E-02	8.4E-05	1.1E-02
SR51	3.2E-01	7.9E-03	3.3E-01	1.1E-02	2.6E-04	1.1E-02
SR52	3.3E-01	1.7E-03	3.3E-01	1.1E-02	5.5E-05	1.1E-02
SR53	3.3E-01	8.9E-04	3.3E-01	1.1E-02	3.0E-05	1.1E-02
SR54	3.2E-01	8.9E-04	3.2E-01	1.1E-02	3.0E-05	1.1E-02
SR55	3.3E-01	5.9E-04	3.3E-01	1.1E-02	2.0E-05	1.1E-02
SR56	3.2E-01	4.0E-04	3.2E-01	1.1E-02	1.3E-05	1.1E-02
SR57	3.4E-01	3.4E-03	3.4E-01	1.1E-02	1.1E-04	1.1E-02
SR58	3.2E-01	4.7E-04	3.2E-01	1.1E-02	1.6E-05	1.1E-02

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-23 Exposure Concentrations and Exposure Ratios for Annual Benzene (Construction)

Human Receptor Location	Annual Benzene (non-threshold TRV = 3 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	4.9E-01	1.7E-01	5.1E-01	1.6E-01	5.7E-02	1.7E-01
SR01	3.3E-01	2.9E-02	3.6E-01	1.1E-01	9.6E-03	1.2E-01
SR02	3.4E-01	9.8E-03	3.5E-01	1.1E-01	3.3E-03	1.2E-01
SR03	3.3E-01	8.9E-03	3.4E-01	1.1E-01	3.0E-03	1.1E-01
SR04	3.3E-01	1.8E-02	3.4E-01	1.1E-01	5.9E-03	1.1E-01
SR05	3.3E-01	1.7E-02	3.5E-01	1.1E-01	5.8E-03	1.2E-01
SR06	3.3E-01	8.3E-03	3.4E-01	1.1E-01	2.8E-03	1.1E-01
SR07	3.3E-01	6.1E-03	3.4E-01	1.1E-01	2.0E-03	1.1E-01
SR08	3.3E-01	7.1E-03	3.4E-01	1.1E-01	2.4E-03	1.1E-01
SR09	3.3E-01	1.9E-02	3.5E-01	1.1E-01	6.4E-03	1.2E-01
SR10	3.3E-01	1.5E-02	3.4E-01	1.1E-01	4.9E-03	1.1E-01
SR11	3.5E-01	2.4E-02	3.7E-01	1.2E-01	8.0E-03	1.2E-01
SR12	3.3E-01	2.7E-02	3.5E-01	1.1E-01	9.0E-03	1.2E-01
SR13	3.3E-01	2.4E-02	3.5E-01	1.1E-01	7.9E-03	1.2E-01
SR14	3.3E-01	3.2E-02	3.6E-01	1.1E-01	1.1E-02	1.2E-01
SR15	3.3E-01	3.3E-02	3.6E-01	1.1E-01	1.1E-02	1.2E-01
SR16	3.2E-01	2.5E-02	3.5E-01	1.1E-01	8.3E-03	1.2E-01
SR17	3.2E-01	9.1E-03	3.3E-01	1.1E-01	3.0E-03	1.1E-01
SR18	3.3E-01	2.9E-02	3.6E-01	1.1E-01	9.8E-03	1.2E-01
SR19	3.3E-01	6.4E-02	3.9E-01	1.1E-01	2.1E-02	1.3E-01
SR20	3.3E-01	3.3E-02	3.6E-01	1.1E-01	1.1E-02	1.2E-01
SR21	3.2E-01	1.2E-02	3.4E-01	1.1E-01	4.0E-03	1.1E-01
SR22	3.2E-01	1.2E-02	3.4E-01	1.1E-01	4.1E-03	1.1E-01
SR23	3.2E-01	1.1E-02	3.3E-01	1.1E-01	3.7E-03	1.1E-01
SR24	3.2E-01	1.1E-02	3.3E-01	1.1E-01	3.7E-03	1.1E-01
SR25	3.3E-01	4.0E-02	3.7E-01	1.1E-01	1.3E-02	1.2E-01
SR26	3.3E-01	4.0E-03	3.3E-01	1.1E-01	1.3E-03	1.1E-01
SR27	3.3E-01	3.8E-03	3.3E-01	1.1E-01	1.3E-03	1.1E-01
SR28	3.3E-01	3.8E-03	3.3E-01	1.1E-01	1.3E-03	1.1E-01
SR29	3.3E-01	4.0E-03	3.3E-01	1.1E-01	1.3E-03	1.1E-01
SR30	3.6E-01	4.4E-03	3.6E-01	1.2E-01	1.5E-03	1.2E-01
SR31	3.6E-01	4.4E-03	3.6E-01	1.2E-01	1.5E-03	1.2E-01
SR32	3.4E-01	5.0E-03	3.4E-01	1.1E-01	1.7E-03	1.1E-01
SR33	3.3E-01	5.6E-03	3.4E-01	1.1E-01	1.9E-03	1.1E-01
SR34	3.3E-01	6.3E-03	3.3E-01	1.1E-01	2.1E-03	1.1E-01
SR35	3.3E-01	6.3E-03	3.3E-01	1.1E-01	2.1E-03	1.1E-01
SR36	3.2E-01	2.0E-02	3.4E-01	1.1E-01	6.7E-03	1.1E-01
SR37	3.2E-01	1.1E-02	3.3E-01	1.1E-01	3.7E-03	1.1E-01
SR38	3.3E-01	1.7E-02	3.5E-01	1.1E-01	5.7E-03	1.2E-01
SR39	3.3E-01	1.0E-02	3.4E-01	1.1E-01	3.4E-03	1.1E-01
SR40	3.2E-01	2.0E-02	3.4E-01	1.1E-01	6.5E-03	1.1E-01
SR41	3.3E-01	4.2E-02	3.7E-01	1.1E-01	1.4E-02	1.2E-01
SR42	3.4E-01	7.4E-03	3.5E-01	1.1E-01	2.5E-03	1.2E-01
SR43	3.9E-01	6.1E-03	3.9E-01	1.3E-01	2.0E-03	1.3E-01
SR44	3.3E-01	3.8E-03	3.4E-01	1.1E-01	1.3E-03	1.1E-01
SR45	3.3E-01	1.8E-03	3.3E-01	1.1E-01	6.1E-04	1.1E-01
SR46	3.3E-01	1.5E-03	3.3E-01	1.1E-01	4.8E-04	1.1E-01
SR47	3.3E-01	1.5E-03	3.4E-01	1.1E-01	5.0E-04	1.1E-01
SR48	3.3E-01	9.7E-04	3.3E-01	1.1E-01	3.2E-04	1.1E-01
SR49	3.4E-01	1.0E-03	3.4E-01	1.1E-01	3.4E-04	1.1E-01
SR50	3.2E-01	2.5E-03	3.2E-01	1.1E-01	8.4E-04	1.1E-01
SR51	3.2E-01	7.9E-03	3.3E-01	1.1E-01	2.6E-03	1.1E-01
SR52	3.3E-01	1.7E-03	3.3E-01	1.1E-01	5.5E-04	1.1E-01
SR53	3.3E-01	8.9E-04	3.3E-01	1.1E-01	3.0E-04	1.1E-01
SR54	3.2E-01	8.9E-04	3.2E-01	1.1E-01	3.0E-04	1.1E-01
SR55	3.3E-01	5.9E-04	3.3E-01	1.1E-01	2.0E-04	1.1E-01
SR56	3.2E-01	4.0E-04	3.2E-01	1.1E-01	1.3E-04	1.1E-01
SR57	3.4E-01	3.4E-03	3.4E-01	1.1E-01	1.1E-03	1.1E-01
SR58	3.2E-01	4.7E-04	3.2E-01	1.1E-01	1.6E-04	1.1E-01

NOTE:

Shaded cell indicates a ER greater than 1.0

* ERs are based on non-threshold effects (i.e., cancer risk) and therefore only Project case values are compared to a threshold target of 1.0

Table A-24 Exposure Concentrations and Exposure Ratios for 1-hour Ethylbenzene (Construction)

Human Receptor Location	1-hour Ethylbenzene (TRV = 86,000 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	6.6E-01	1.5E+00	1.8E+00	7.7E-06	1.7E-05	2.1E-05
SR01	2.5E-01	2.8E-01	5.0E-01	3.0E-06	3.2E-06	5.8E-06
SR02	3.0E-01	1.7E-01	4.1E-01	3.5E-06	2.0E-06	4.8E-06
SR03	2.8E-01	1.2E-01	3.4E-01	3.2E-06	1.4E-06	4.0E-06
SR04	2.3E-01	9.0E-02	3.0E-01	2.7E-06	1.0E-06	3.5E-06
SR05	2.4E-01	1.1E-01	3.2E-01	2.8E-06	1.3E-06	3.7E-06
SR06	2.3E-01	6.0E-02	2.8E-01	2.7E-06	7.0E-07	3.2E-06
SR07	2.3E-01	4.9E-02	2.6E-01	2.7E-06	5.7E-07	3.1E-06
SR08	2.3E-01	4.7E-02	2.6E-01	2.7E-06	5.5E-07	3.0E-06
SR09	2.6E-01	3.0E-01	5.3E-01	3.1E-06	3.5E-06	6.2E-06
SR10	2.5E-01	1.4E-01	3.6E-01	2.9E-06	1.6E-06	4.1E-06
SR11	3.6E-01	1.6E-01	4.9E-01	4.1E-06	1.9E-06	5.7E-06
SR12	2.3E-01	1.7E-01	3.7E-01	2.7E-06	2.0E-06	4.4E-06
SR13	2.4E-01	1.6E-01	3.6E-01	2.8E-06	1.8E-06	4.2E-06
SR14	2.3E-01	2.1E-01	4.2E-01	2.7E-06	2.4E-06	4.9E-06
SR15	2.3E-01	1.7E-01	3.8E-01	2.7E-06	2.0E-06	4.4E-06
SR16	2.2E-01	1.3E-01	3.3E-01	2.5E-06	1.5E-06	3.9E-06
SR17	2.2E-01	4.9E-02	2.5E-01	2.6E-06	5.7E-07	2.9E-06
SR18	2.8E-01	1.9E-01	4.4E-01	3.3E-06	2.2E-06	5.1E-06
SR19	2.6E-01	2.3E-01	4.7E-01	3.1E-06	2.7E-06	5.5E-06
SR20	2.8E-01	1.7E-01	4.0E-01	3.3E-06	2.0E-06	4.7E-06
SR21	2.2E-01	6.3E-02	2.7E-01	2.5E-06	7.3E-07	3.1E-06
SR22	2.1E-01	6.5E-02	2.6E-01	2.4E-06	7.5E-07	3.1E-06
SR23	2.1E-01	5.6E-02	2.6E-01	2.4E-06	6.5E-07	3.0E-06
SR24	2.1E-01	4.3E-02	2.4E-01	2.4E-06	5.0E-07	2.8E-06
SR25	3.0E-01	2.2E-01	4.7E-01	3.5E-06	2.5E-06	5.4E-06
SR26	2.7E-01	7.7E-02	2.9E-01	3.2E-06	8.9E-07	3.4E-06
SR27	2.9E-01	6.2E-02	3.3E-01	3.4E-06	7.2E-07	3.8E-06
SR28	2.9E-01	6.2E-02	3.3E-01	3.4E-06	7.2E-07	3.8E-06
SR29	3.0E-01	6.5E-02	3.4E-01	3.4E-06	7.5E-07	3.9E-06
SR30	3.6E-01	7.1E-02	3.9E-01	4.1E-06	8.2E-07	4.5E-06
SR31	3.6E-01	7.1E-02	3.9E-01	4.1E-06	8.2E-07	4.5E-06
SR32	3.0E-01	6.6E-02	3.5E-01	3.5E-06	7.6E-07	4.1E-06
SR33	2.7E-01	6.3E-02	3.1E-01	3.1E-06	7.3E-07	3.6E-06
SR34	2.5E-01	6.3E-02	3.0E-01	2.9E-06	7.4E-07	3.5E-06
SR35	2.5E-01	6.3E-02	3.0E-01	2.9E-06	7.4E-07	3.5E-06
SR36	2.2E-01	1.2E-01	3.4E-01	2.6E-06	1.5E-06	3.9E-06
SR37	2.1E-01	5.6E-02	2.6E-01	2.4E-06	6.6E-07	3.0E-06
SR38	2.8E-01	8.9E-02	3.4E-01	3.3E-06	1.0E-06	4.0E-06
SR39	2.9E-01	8.7E-02	3.3E-01	3.4E-06	1.0E-06	3.8E-06
SR40	2.4E-01	1.8E-01	3.9E-01	2.7E-06	2.0E-06	4.5E-06
SR41	2.4E-01	3.0E-01	5.2E-01	2.8E-06	3.4E-06	6.0E-06
SR42	3.3E-01	9.0E-02	3.7E-01	3.9E-06	1.1E-06	4.3E-06
SR43	4.7E-01	1.1E-01	5.2E-01	5.4E-06	1.3E-06	6.1E-06
SR44	2.4E-01	2.3E-02	2.5E-01	2.8E-06	2.7E-07	2.9E-06
SR45	2.4E-01	1.6E-02	2.4E-01	2.8E-06	1.9E-07	2.8E-06
SR46	2.7E-01	1.4E-02	2.8E-01	3.2E-06	1.6E-07	3.2E-06
SR47	2.8E-01	1.5E-02	2.8E-01	3.3E-06	1.8E-07	3.3E-06
SR48	2.6E-01	1.1E-02	2.7E-01	3.1E-06	1.3E-07	3.1E-06
SR49	3.2E-01	1.1E-02	3.2E-01	3.7E-06	1.3E-07	3.7E-06
SR50	2.0E-01	9.9E-03	2.1E-01	2.4E-06	1.1E-07	2.5E-06
SR51	2.1E-01	2.8E-02	2.3E-01	2.4E-06	3.3E-07	2.7E-06
SR52	2.8E-01	3.5E-02	2.8E-01	3.2E-06	4.0E-07	3.3E-06
SR53	2.4E-01	1.1E-02	2.4E-01	2.7E-06	1.3E-07	2.8E-06
SR54	2.6E-01	2.1E-02	2.6E-01	3.0E-06	2.4E-07	3.0E-06
SR55	2.7E-01	1.4E-02	2.7E-01	3.1E-06	1.7E-07	3.1E-06
SR56	2.1E-01	1.1E-02	2.1E-01	2.4E-06	1.3E-07	2.5E-06
SR57	3.0E-01	6.7E-02	3.3E-01	3.5E-06	7.8E-07	3.9E-06
SR58	2.1E-01	5.6E-03	2.1E-01	2.4E-06	6.5E-08	2.5E-06

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-25 Exposure Concentrations and Exposure Ratios for Annual Ethylbenzene (Construction)

Human Receptor Location	Annual Ethylbenzene (TRV = 1,000 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	1.8E-01	3.0E-02	1.8E-01	1.8E-04	3.0E-05	1.8E-04
SR01	7.9E-02	5.1E-03	8.4E-02	7.9E-05	5.1E-06	8.4E-05
SR02	8.4E-02	1.7E-03	8.5E-02	8.4E-05	1.7E-06	8.5E-05
SR03	8.2E-02	1.6E-03	8.4E-02	8.2E-05	1.6E-06	8.4E-05
SR04	7.7E-02	3.1E-03	8.1E-02	7.7E-05	3.1E-06	8.1E-05
SR05	7.9E-02	3.1E-03	8.2E-02	7.9E-05	3.1E-06	8.2E-05
SR06	8.0E-02	1.5E-03	8.1E-02	8.0E-05	1.5E-06	8.1E-05
SR07	7.9E-02	1.1E-03	8.0E-02	7.9E-05	1.1E-06	8.0E-05
SR08	7.9E-02	1.3E-03	8.0E-02	7.9E-05	1.3E-06	8.0E-05
SR09	7.9E-02	3.4E-03	8.2E-02	7.9E-05	3.4E-06	8.2E-05
SR10	7.8E-02	2.6E-03	8.0E-02	7.8E-05	2.6E-06	8.0E-05
SR11	9.2E-02	4.2E-03	9.6E-02	9.2E-05	4.2E-06	9.6E-05
SR12	7.7E-02	4.8E-03	8.2E-02	7.7E-05	4.8E-06	8.2E-05
SR13	7.8E-02	4.2E-03	8.2E-02	7.8E-05	4.2E-06	8.2E-05
SR14	7.8E-02	5.7E-03	8.3E-02	7.8E-05	5.7E-06	8.3E-05
SR15	7.7E-02	5.9E-03	8.3E-02	7.7E-05	5.9E-06	8.3E-05
SR16	7.6E-02	4.4E-03	8.0E-02	7.6E-05	4.4E-06	8.0E-05
SR17	7.6E-02	1.6E-03	7.8E-02	7.6E-05	1.6E-06	7.8E-05
SR18	7.9E-02	5.2E-03	8.4E-02	7.9E-05	5.2E-06	8.4E-05
SR19	7.8E-02	1.1E-02	8.9E-02	7.8E-05	1.1E-05	8.9E-05
SR20	7.9E-02	5.8E-03	8.5E-02	7.9E-05	5.8E-06	8.5E-05
SR21	7.6E-02	2.1E-03	7.8E-02	7.6E-05	2.1E-06	7.8E-05
SR22	7.5E-02	2.2E-03	7.7E-02	7.5E-05	2.2E-06	7.7E-05
SR23	7.5E-02	2.0E-03	7.7E-02	7.5E-05	2.0E-06	7.7E-05
SR24	7.5E-02	1.9E-03	7.7E-02	7.5E-05	1.9E-06	7.7E-05
SR25	8.1E-02	7.1E-03	8.9E-02	8.1E-05	7.1E-06	8.9E-05
SR26	7.8E-02	7.1E-04	7.9E-02	7.8E-05	7.1E-07	7.9E-05
SR27	8.0E-02	6.7E-04	8.1E-02	8.0E-05	6.7E-07	8.1E-05
SR28	8.0E-02	6.7E-04	8.1E-02	8.0E-05	6.7E-07	8.1E-05
SR29	8.0E-02	7.1E-04	8.0E-02	8.0E-05	7.1E-07	8.0E-05
SR30	9.6E-02	7.8E-04	9.7E-02	9.6E-05	7.8E-07	9.7E-05
SR31	9.6E-02	7.8E-04	9.7E-02	9.6E-05	7.8E-07	9.7E-05
SR32	8.6E-02	8.8E-04	8.6E-02	8.6E-05	8.8E-07	8.6E-05
SR33	8.0E-02	9.9E-04	8.0E-02	8.0E-05	9.9E-07	8.0E-05
SR34	7.8E-02	1.1E-03	7.9E-02	7.8E-05	1.1E-06	7.9E-05
SR35	7.8E-02	1.1E-03	7.9E-02	7.8E-05	1.1E-06	7.9E-05
SR36	7.6E-02	3.6E-03	7.9E-02	7.6E-05	3.6E-06	7.9E-05
SR37	7.5E-02	1.9E-03	7.7E-02	7.5E-05	1.9E-06	7.7E-05
SR38	8.2E-02	3.0E-03	8.5E-02	8.2E-05	3.0E-06	8.5E-05
SR39	7.9E-02	1.8E-03	8.1E-02	7.9E-05	1.8E-06	8.1E-05
SR40	7.6E-02	3.5E-03	7.9E-02	7.6E-05	3.5E-06	7.9E-05
SR41	7.7E-02	7.4E-03	8.4E-02	7.7E-05	7.4E-06	8.4E-05
SR42	8.7E-02	1.3E-03	8.8E-02	8.7E-05	1.3E-06	8.8E-05
SR43	1.2E-01	1.1E-03	1.2E-01	1.2E-04	1.1E-06	1.2E-04
SR44	8.2E-02	6.6E-04	8.3E-02	8.2E-05	6.6E-07	8.3E-05
SR45	7.8E-02	3.2E-04	7.9E-02	7.8E-05	3.2E-07	7.9E-05
SR46	8.1E-02	2.6E-04	8.2E-02	8.1E-05	2.6E-07	8.2E-05
SR47	8.2E-02	2.7E-04	8.2E-02	8.2E-05	2.7E-07	8.2E-05
SR48	7.9E-02	1.7E-04	7.9E-02	7.9E-05	1.7E-07	7.9E-05
SR49	8.5E-02	1.8E-04	8.5E-02	8.5E-05	1.8E-07	8.5E-05
SR50	7.4E-02	4.4E-04	7.5E-02	7.4E-05	4.4E-07	7.5E-05
SR51	7.5E-02	1.4E-03	7.6E-02	7.5E-05	1.4E-06	7.6E-05
SR52	7.6E-02	2.9E-04	7.7E-02	7.6E-05	2.9E-07	7.7E-05
SR53	7.7E-02	1.6E-04	7.7E-02	7.7E-05	1.6E-07	7.7E-05
SR54	7.5E-02	1.6E-04	7.5E-02	7.5E-05	1.6E-07	7.5E-05
SR55	7.8E-02	1.0E-04	7.8E-02	7.8E-05	1.0E-07	7.8E-05
SR56	7.4E-02	7.1E-05	7.4E-02	7.4E-05	7.1E-08	7.4E-05
SR57	8.5E-02	6.0E-04	8.6E-02	8.5E-05	6.0E-07	8.6E-05
SR58	7.4E-02	8.4E-05	7.4E-02	7.4E-05	8.4E-08	7.4E-05

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-26 Exposure Concentrations and Exposure Ratios for 1-hour Formaldehyde (Construction)

Human Receptor Location	1-hour Formaldehyde (TRV = 50 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	1.1E+01	6.1E+01	7.1E+01	2.1E-01	1.2E+00	1.4E+00
SR01	1.0E+01	1.1E+01	2.1E+01	2.0E-01	2.3E-01	4.3E-01
SR02	1.0E+01	7.0E+00	1.7E+01	2.0E-01	1.4E-01	3.4E-01
SR03	1.0E+01	4.9E+00	1.5E+01	2.0E-01	9.9E-02	3.0E-01
SR04	1.0E+01	3.7E+00	1.4E+01	2.0E-01	7.5E-02	2.7E-01
SR05	1.0E+01	4.6E+00	1.5E+01	2.0E-01	9.2E-02	2.9E-01
SR06	1.0E+01	2.5E+00	1.2E+01	2.0E-01	5.0E-02	2.5E-01
SR07	1.0E+01	2.1E+00	1.2E+01	2.0E-01	4.1E-02	2.4E-01
SR08	1.0E+01	2.0E+00	1.2E+01	2.0E-01	3.9E-02	2.4E-01
SR09	1.0E+01	1.3E+01	2.3E+01	2.0E-01	2.5E-01	4.5E-01
SR10	1.0E+01	5.7E+00	1.6E+01	2.0E-01	1.1E-01	3.1E-01
SR11	1.0E+01	6.9E+00	1.7E+01	2.0E-01	1.4E-01	3.4E-01
SR12	1.0E+01	7.0E+00	1.7E+01	2.0E-01	1.4E-01	3.4E-01
SR13	1.0E+01	6.5E+00	1.6E+01	2.0E-01	1.3E-01	3.3E-01
SR14	1.0E+01	8.7E+00	1.9E+01	2.0E-01	1.7E-01	3.7E-01
SR15	1.0E+01	7.0E+00	1.7E+01	2.0E-01	1.4E-01	3.4E-01
SR16	9.9E+00	5.2E+00	1.5E+01	2.0E-01	1.0E-01	3.0E-01
SR17	9.9E+00	2.1E+00	1.2E+01	2.0E-01	4.1E-02	2.4E-01
SR18	1.0E+01	7.9E+00	1.8E+01	2.0E-01	1.6E-01	3.6E-01
SR19	1.0E+01	9.6E+00	2.0E+01	2.0E-01	1.9E-01	3.9E-01
SR20	1.0E+01	7.0E+00	1.7E+01	2.0E-01	1.4E-01	3.4E-01
SR21	9.9E+00	2.6E+00	1.3E+01	2.0E-01	5.2E-02	2.5E-01
SR22	9.9E+00	2.7E+00	1.3E+01	2.0E-01	5.4E-02	2.5E-01
SR23	9.9E+00	2.3E+00	1.2E+01	2.0E-01	4.6E-02	2.4E-01
SR24	9.9E+00	1.8E+00	1.2E+01	2.0E-01	3.6E-02	2.3E-01
SR25	1.0E+01	9.0E+00	1.9E+01	2.0E-01	1.8E-01	3.8E-01
SR26	1.0E+01	3.2E+00	1.3E+01	2.0E-01	6.4E-02	2.6E-01
SR27	1.0E+01	2.6E+00	1.3E+01	2.0E-01	5.1E-02	2.5E-01
SR28	1.0E+01	2.6E+00	1.3E+01	2.0E-01	5.1E-02	2.5E-01
SR29	1.0E+01	2.7E+00	1.3E+01	2.0E-01	5.4E-02	2.5E-01
SR30	1.0E+01	2.9E+00	1.3E+01	2.0E-01	5.9E-02	2.6E-01
SR31	1.0E+01	2.9E+00	1.3E+01	2.0E-01	5.9E-02	2.6E-01
SR32	1.0E+01	2.7E+00	1.3E+01	2.0E-01	5.5E-02	2.6E-01
SR33	1.0E+01	2.6E+00	1.3E+01	2.0E-01	5.3E-02	2.5E-01
SR34	1.0E+01	2.6E+00	1.3E+01	2.0E-01	5.3E-02	2.5E-01
SR35	1.0E+01	2.6E+00	1.3E+01	2.0E-01	5.3E-02	2.5E-01
SR36	9.9E+00	5.2E+00	1.5E+01	2.0E-01	1.0E-01	3.0E-01
SR37	9.9E+00	2.4E+00	1.2E+01	2.0E-01	4.7E-02	2.5E-01
SR38	1.0E+01	3.7E+00	1.4E+01	2.0E-01	7.4E-02	2.7E-01
SR39	1.0E+01	3.6E+00	1.4E+01	2.0E-01	7.2E-02	2.7E-01
SR40	1.0E+01	7.3E+00	1.7E+01	2.0E-01	1.5E-01	3.4E-01
SR41	1.0E+01	1.2E+01	2.2E+01	2.0E-01	2.5E-01	4.4E-01
SR42	1.0E+01	3.8E+00	1.4E+01	2.0E-01	7.5E-02	2.7E-01
SR43	1.0E+01	4.5E+00	1.5E+01	2.1E-01	9.0E-02	2.9E-01
SR44	1.0E+01	9.6E-01	1.1E+01	2.0E-01	1.9E-02	2.2E-01
SR45	1.0E+01	6.8E-01	1.1E+01	2.0E-01	1.4E-02	2.1E-01
SR46	1.0E+01	5.8E-01	1.1E+01	2.0E-01	1.2E-02	2.1E-01
SR47	1.0E+01	6.4E-01	1.1E+01	2.0E-01	1.3E-02	2.1E-01
SR48	1.0E+01	4.6E-01	1.0E+01	2.0E-01	9.2E-03	2.1E-01
SR49	1.0E+01	4.5E-01	1.0E+01	2.0E-01	9.0E-03	2.1E-01
SR50	9.9E+00	4.1E-01	1.0E+01	2.0E-01	8.2E-03	2.1E-01
SR51	9.9E+00	1.2E+00	1.1E+01	2.0E-01	2.3E-02	2.2E-01
SR52	1.0E+01	1.4E+00	1.1E+01	2.0E-01	2.9E-02	2.3E-01
SR53	1.0E+01	4.6E-01	1.0E+01	2.0E-01	9.3E-03	2.1E-01
SR54	1.0E+01	8.6E-01	1.1E+01	2.0E-01	1.7E-02	2.2E-01
SR55	1.0E+01	5.9E-01	1.1E+01	2.0E-01	1.2E-02	2.1E-01
SR56	9.9E+00	4.6E-01	1.0E+01	2.0E-01	9.2E-03	2.1E-01
SR57	1.0E+01	2.8E+00	1.3E+01	2.0E-01	5.6E-02	2.6E-01
SR58	9.9E+00	2.3E-01	1.0E+01	2.0E-01	4.7E-03	2.0E-01

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-27 Exposure Concentrations and Exposure Ratios for Annual Formaldehyde (Construction)

Human Receptor Location	Annual Formaldehyde (TRV = 11 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	2.8E+00	1.3E+00	3.9E+00	2.5E-01	1.1E-01	3.5E-01
SR01	2.6E+00	2.1E-01	2.8E+00	2.4E-01	1.9E-02	2.6E-01
SR02	2.6E+00	7.2E-02	2.7E+00	2.4E-01	6.5E-03	2.4E-01
SR03	2.6E+00	6.5E-02	2.7E+00	2.4E-01	5.9E-03	2.4E-01
SR04	2.6E+00	1.3E-01	2.7E+00	2.4E-01	1.2E-02	2.5E-01
SR05	2.6E+00	1.3E-01	2.7E+00	2.4E-01	1.2E-02	2.5E-01
SR06	2.6E+00	6.1E-02	2.7E+00	2.4E-01	5.6E-03	2.4E-01
SR07	2.6E+00	4.5E-02	2.7E+00	2.4E-01	4.1E-03	2.4E-01
SR08	2.6E+00	5.2E-02	2.7E+00	2.4E-01	4.7E-03	2.4E-01
SR09	2.6E+00	1.4E-01	2.8E+00	2.4E-01	1.3E-02	2.5E-01
SR10	2.6E+00	1.1E-01	2.7E+00	2.4E-01	9.9E-03	2.5E-01
SR11	2.6E+00	1.8E-01	2.8E+00	2.4E-01	1.6E-02	2.6E-01
SR12	2.6E+00	2.0E-01	2.8E+00	2.4E-01	1.8E-02	2.5E-01
SR13	2.6E+00	1.7E-01	2.8E+00	2.4E-01	1.6E-02	2.5E-01
SR14	2.6E+00	2.4E-01	2.8E+00	2.4E-01	2.1E-02	2.6E-01
SR15	2.6E+00	2.4E-01	2.8E+00	2.4E-01	2.2E-02	2.6E-01
SR16	2.6E+00	1.8E-01	2.8E+00	2.4E-01	1.7E-02	2.5E-01
SR17	2.6E+00	6.7E-02	2.7E+00	2.4E-01	6.1E-03	2.4E-01
SR18	2.6E+00	2.2E-01	2.8E+00	2.4E-01	2.0E-02	2.6E-01
SR19	2.6E+00	4.7E-01	3.1E+00	2.4E-01	4.3E-02	2.8E-01
SR20	2.6E+00	2.4E-01	2.9E+00	2.4E-01	2.2E-02	2.6E-01
SR21	2.6E+00	8.8E-02	2.7E+00	2.4E-01	8.0E-03	2.4E-01
SR22	2.6E+00	9.0E-02	2.7E+00	2.4E-01	8.2E-03	2.4E-01
SR23	2.6E+00	8.2E-02	2.7E+00	2.4E-01	7.4E-03	2.4E-01
SR24	2.6E+00	8.1E-02	2.7E+00	2.4E-01	7.3E-03	2.4E-01
SR25	2.6E+00	3.0E-01	2.9E+00	2.4E-01	2.7E-02	2.6E-01
SR26	2.6E+00	2.9E-02	2.6E+00	2.4E-01	2.7E-03	2.4E-01
SR27	2.6E+00	2.8E-02	2.6E+00	2.4E-01	2.5E-03	2.4E-01
SR28	2.6E+00	2.8E-02	2.6E+00	2.4E-01	2.5E-03	2.4E-01
SR29	2.6E+00	3.0E-02	2.6E+00	2.4E-01	2.7E-03	2.4E-01
SR30	2.6E+00	3.3E-02	2.7E+00	2.4E-01	3.0E-03	2.4E-01
SR31	2.6E+00	3.3E-02	2.7E+00	2.4E-01	3.0E-03	2.4E-01
SR32	2.6E+00	3.7E-02	2.7E+00	2.4E-01	3.3E-03	2.4E-01
SR33	2.6E+00	4.1E-02	2.7E+00	2.4E-01	3.7E-03	2.4E-01
SR34	2.6E+00	4.7E-02	2.7E+00	2.4E-01	4.2E-03	2.4E-01
SR35	2.6E+00	4.7E-02	2.7E+00	2.4E-01	4.2E-03	2.4E-01
SR36	2.6E+00	1.5E-01	2.8E+00	2.4E-01	1.4E-02	2.5E-01
SR37	2.6E+00	8.1E-02	2.7E+00	2.4E-01	7.4E-03	2.4E-01
SR38	2.6E+00	1.3E-01	2.7E+00	2.4E-01	1.1E-02	2.5E-01
SR39	2.6E+00	7.5E-02	2.7E+00	2.4E-01	6.8E-03	2.4E-01
SR40	2.6E+00	1.4E-01	2.7E+00	2.4E-01	1.3E-02	2.5E-01
SR41	2.6E+00	3.1E-01	2.9E+00	2.4E-01	2.8E-02	2.7E-01
SR42	2.6E+00	5.4E-02	2.7E+00	2.4E-01	4.9E-03	2.4E-01
SR43	2.7E+00	4.5E-02	2.7E+00	2.4E-01	4.1E-03	2.5E-01
SR44	2.6E+00	2.8E-02	2.6E+00	2.4E-01	2.5E-03	2.4E-01
SR45	2.6E+00	1.3E-02	2.6E+00	2.4E-01	1.2E-03	2.4E-01
SR46	2.6E+00	1.1E-02	2.6E+00	2.4E-01	9.7E-04	2.4E-01
SR47	2.6E+00	1.1E-02	2.6E+00	2.4E-01	1.0E-03	2.4E-01
SR48	2.6E+00	7.2E-03	2.6E+00	2.4E-01	6.5E-04	2.4E-01
SR49	2.6E+00	7.6E-03	2.6E+00	2.4E-01	6.9E-04	2.4E-01
SR50	2.6E+00	1.8E-02	2.6E+00	2.4E-01	1.7E-03	2.4E-01
SR51	2.6E+00	5.8E-02	2.7E+00	2.4E-01	5.3E-03	2.4E-01
SR52	2.6E+00	1.2E-02	2.6E+00	2.4E-01	1.1E-03	2.4E-01
SR53	2.6E+00	6.6E-03	2.6E+00	2.4E-01	6.0E-04	2.4E-01
SR54	2.6E+00	6.6E-03	2.6E+00	2.4E-01	6.0E-04	2.4E-01
SR55	2.6E+00	4.3E-03	2.6E+00	2.4E-01	3.9E-04	2.4E-01
SR56	2.6E+00	3.0E-03	2.6E+00	2.4E-01	2.7E-04	2.4E-01
SR57	2.6E+00	2.5E-02	2.6E+00	2.4E-01	2.3E-03	2.4E-01
SR58	2.6E+00	3.5E-03	2.6E+00	2.4E-01	3.2E-04	2.4E-01

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-28 Exposure Concentrations and Exposure Ratios for Annual Formaldehyde (Construction)

Human Receptor Location	Annual Formaldehyde (non-threshold TRV = 2 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	2.8E+00	1.3E+00	3.9E+00	1.4E+00	6.3E-01	1.9E+00
SR01	2.6E+00	2.1E-01	2.8E+00	1.3E+00	1.1E-01	1.4E+00
SR02	2.6E+00	7.2E-02	2.7E+00	1.3E+00	3.6E-02	1.3E+00
SR03	2.6E+00	6.5E-02	2.7E+00	1.3E+00	3.3E-02	1.3E+00
SR04	2.6E+00	1.3E-01	2.7E+00	1.3E+00	6.5E-02	1.4E+00
SR05	2.6E+00	1.3E-01	2.7E+00	1.3E+00	6.4E-02	1.4E+00
SR06	2.6E+00	6.1E-02	2.7E+00	1.3E+00	3.1E-02	1.3E+00
SR07	2.6E+00	4.5E-02	2.7E+00	1.3E+00	2.2E-02	1.3E+00
SR08	2.6E+00	5.2E-02	2.7E+00	1.3E+00	2.6E-02	1.3E+00
SR09	2.6E+00	1.4E-01	2.8E+00	1.3E+00	7.1E-02	1.4E+00
SR10	2.6E+00	1.1E-01	2.7E+00	1.3E+00	5.4E-02	1.4E+00
SR11	2.6E+00	1.8E-01	2.8E+00	1.3E+00	8.8E-02	1.4E+00
SR12	2.6E+00	2.0E-01	2.8E+00	1.3E+00	9.9E-02	1.4E+00
SR13	2.6E+00	1.7E-01	2.8E+00	1.3E+00	8.7E-02	1.4E+00
SR14	2.6E+00	2.4E-01	2.8E+00	1.3E+00	1.2E-01	1.4E+00
SR15	2.6E+00	2.4E-01	2.8E+00	1.3E+00	1.2E-01	1.4E+00
SR16	2.6E+00	1.8E-01	2.8E+00	1.3E+00	9.2E-02	1.4E+00
SR17	2.6E+00	6.7E-02	2.7E+00	1.3E+00	3.3E-02	1.3E+00
SR18	2.6E+00	2.2E-01	2.8E+00	1.3E+00	1.1E-01	1.4E+00
SR19	2.6E+00	4.7E-01	3.1E+00	1.3E+00	2.4E-01	1.5E+00
SR20	2.6E+00	2.4E-01	2.9E+00	1.3E+00	1.2E-01	1.4E+00
SR21	2.6E+00	8.8E-02	2.7E+00	1.3E+00	4.4E-02	1.3E+00
SR22	2.6E+00	9.0E-02	2.7E+00	1.3E+00	4.5E-02	1.3E+00
SR23	2.6E+00	8.2E-02	2.7E+00	1.3E+00	4.1E-02	1.3E+00
SR24	2.6E+00	8.1E-02	2.7E+00	1.3E+00	4.0E-02	1.3E+00
SR25	2.6E+00	3.0E-01	2.9E+00	1.3E+00	1.5E-01	1.5E+00
SR26	2.6E+00	2.9E-02	2.6E+00	1.3E+00	1.5E-02	1.3E+00
SR27	2.6E+00	2.8E-02	2.6E+00	1.3E+00	1.4E-02	1.3E+00
SR28	2.6E+00	2.8E-02	2.6E+00	1.3E+00	1.4E-02	1.3E+00
SR29	2.6E+00	3.0E-02	2.6E+00	1.3E+00	1.5E-02	1.3E+00
SR30	2.6E+00	3.3E-02	2.7E+00	1.3E+00	1.6E-02	1.3E+00
SR31	2.6E+00	3.3E-02	2.7E+00	1.3E+00	1.6E-02	1.3E+00
SR32	2.6E+00	3.7E-02	2.7E+00	1.3E+00	1.8E-02	1.3E+00
SR33	2.6E+00	4.1E-02	2.7E+00	1.3E+00	2.1E-02	1.3E+00
SR34	2.6E+00	4.7E-02	2.7E+00	1.3E+00	2.3E-02	1.3E+00
SR35	2.6E+00	4.7E-02	2.7E+00	1.3E+00	2.3E-02	1.3E+00
SR36	2.6E+00	1.5E-01	2.8E+00	1.3E+00	7.4E-02	1.4E+00
SR37	2.6E+00	8.1E-02	2.7E+00	1.3E+00	4.0E-02	1.3E+00
SR38	2.6E+00	1.3E-01	2.7E+00	1.3E+00	6.3E-02	1.4E+00
SR39	2.6E+00	7.5E-02	2.7E+00	1.3E+00	3.8E-02	1.3E+00
SR40	2.6E+00	1.4E-01	2.7E+00	1.3E+00	7.2E-02	1.4E+00
SR41	2.6E+00	3.1E-01	2.9E+00	1.3E+00	1.5E-01	1.5E+00
SR42	2.6E+00	5.4E-02	2.7E+00	1.3E+00	2.7E-02	1.3E+00
SR43	2.7E+00	4.5E-02	2.7E+00	1.3E+00	2.2E-02	1.4E+00
SR44	2.6E+00	2.8E-02	2.6E+00	1.3E+00	1.4E-02	1.3E+00
SR45	2.6E+00	1.3E-02	2.6E+00	1.3E+00	6.7E-03	1.3E+00
SR46	2.6E+00	1.1E-02	2.6E+00	1.3E+00	5.3E-03	1.3E+00
SR47	2.6E+00	1.1E-02	2.6E+00	1.3E+00	5.5E-03	1.3E+00
SR48	2.6E+00	7.2E-03	2.6E+00	1.3E+00	3.6E-03	1.3E+00
SR49	2.6E+00	7.6E-03	2.6E+00	1.3E+00	3.8E-03	1.3E+00
SR50	2.6E+00	1.8E-02	2.6E+00	1.3E+00	9.2E-03	1.3E+00
SR51	2.6E+00	5.8E-02	2.7E+00	1.3E+00	2.9E-02	1.3E+00
SR52	2.6E+00	1.2E-02	2.6E+00	1.3E+00	6.1E-03	1.3E+00
SR53	2.6E+00	6.6E-03	2.6E+00	1.3E+00	3.3E-03	1.3E+00
SR54	2.6E+00	6.6E-03	2.6E+00	1.3E+00	3.3E-03	1.3E+00
SR55	2.6E+00	4.3E-03	2.6E+00	1.3E+00	2.2E-03	1.3E+00
SR56	2.6E+00	3.0E-03	2.6E+00	1.3E+00	1.5E-03	1.3E+00
SR57	2.6E+00	2.5E-02	2.6E+00	1.3E+00	1.3E-02	1.3E+00
SR58	2.6E+00	3.5E-03	2.6E+00	1.3E+00	1.7E-03	1.3E+00

NOTE:

Shaded cell indicates a ER greater than 1.0

* ERs are based on non-threshold effects (i.e., cancer risk) and therefore only Project case values are compared to a threshold target of 1.0

Table A-29 Exposure Concentrations and Exposure Ratios for Annual Propionaldehyde (Construction)

Human Receptor Location	Annual Propionaldehyde (TRV = 8 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	2.3E-01	1.1E-01	3.4E-01	2.9E-02	1.4E-02	4.2E-02
SR01	2.2E-01	1.9E-02	2.4E-01	2.8E-02	2.4E-03	3.0E-02
SR02	2.2E-01	6.6E-03	2.3E-01	2.8E-02	8.2E-04	2.9E-02
SR03	2.2E-01	5.9E-03	2.3E-01	2.8E-02	7.4E-04	2.9E-02
SR04	2.2E-01	1.2E-02	2.4E-01	2.8E-02	1.5E-03	3.0E-02
SR05	2.2E-01	1.2E-02	2.4E-01	2.8E-02	1.5E-03	3.0E-02
SR06	2.2E-01	5.6E-03	2.3E-01	2.8E-02	7.0E-04	2.9E-02
SR07	2.2E-01	4.1E-03	2.3E-01	2.8E-02	5.1E-04	2.9E-02
SR08	2.2E-01	4.8E-03	2.3E-01	2.8E-02	6.0E-04	2.9E-02
SR09	2.2E-01	1.3E-02	2.4E-01	2.8E-02	1.6E-03	3.0E-02
SR10	2.2E-01	9.9E-03	2.3E-01	2.8E-02	1.2E-03	2.9E-02
SR11	2.3E-01	1.6E-02	2.4E-01	2.8E-02	2.0E-03	3.0E-02
SR12	2.2E-01	1.8E-02	2.4E-01	2.8E-02	2.3E-03	3.0E-02
SR13	2.2E-01	1.6E-02	2.4E-01	2.8E-02	2.0E-03	3.0E-02
SR14	2.2E-01	2.2E-02	2.5E-01	2.8E-02	2.7E-03	3.1E-02
SR15	2.2E-01	2.2E-02	2.5E-01	2.8E-02	2.8E-03	3.1E-02
SR16	2.2E-01	1.7E-02	2.4E-01	2.8E-02	2.1E-03	3.0E-02
SR17	2.2E-01	6.1E-03	2.3E-01	2.8E-02	7.6E-04	2.9E-02
SR18	2.2E-01	2.0E-02	2.4E-01	2.8E-02	2.5E-03	3.1E-02
SR19	2.2E-01	4.3E-02	2.7E-01	2.8E-02	5.4E-03	3.3E-02
SR20	2.2E-01	2.2E-02	2.5E-01	2.8E-02	2.7E-03	3.1E-02
SR21	2.2E-01	8.0E-03	2.3E-01	2.8E-02	1.0E-03	2.9E-02
SR22	2.2E-01	8.2E-03	2.3E-01	2.8E-02	1.0E-03	2.9E-02
SR23	2.2E-01	7.5E-03	2.3E-01	2.8E-02	9.3E-04	2.9E-02
SR24	2.2E-01	7.4E-03	2.3E-01	2.8E-02	9.2E-04	2.9E-02
SR25	2.2E-01	2.7E-02	2.5E-01	2.8E-02	3.4E-03	3.1E-02
SR26	2.2E-01	2.7E-03	2.3E-01	2.8E-02	3.4E-04	2.8E-02
SR27	2.2E-01	2.5E-03	2.3E-01	2.8E-02	3.2E-04	2.8E-02
SR28	2.2E-01	2.5E-03	2.3E-01	2.8E-02	3.2E-04	2.8E-02
SR29	2.2E-01	2.7E-03	2.3E-01	2.8E-02	3.4E-04	2.8E-02
SR30	2.3E-01	3.0E-03	2.3E-01	2.8E-02	3.7E-04	2.9E-02
SR31	2.3E-01	3.0E-03	2.3E-01	2.8E-02	3.7E-04	2.9E-02
SR32	2.3E-01	3.3E-03	2.3E-01	2.8E-02	4.2E-04	2.9E-02
SR33	2.2E-01	3.8E-03	2.3E-01	2.8E-02	4.7E-04	2.9E-02
SR34	2.2E-01	4.3E-03	2.3E-01	2.8E-02	5.3E-04	2.9E-02
SR35	2.2E-01	4.3E-03	2.3E-01	2.8E-02	5.3E-04	2.9E-02
SR36	2.2E-01	1.4E-02	2.4E-01	2.8E-02	1.7E-03	3.0E-02
SR37	2.2E-01	7.4E-03	2.3E-01	2.8E-02	9.2E-04	2.9E-02
SR38	2.2E-01	1.1E-02	2.4E-01	2.8E-02	1.4E-03	3.0E-02
SR39	2.2E-01	6.9E-03	2.3E-01	2.8E-02	8.6E-04	2.9E-02
SR40	2.2E-01	1.3E-02	2.4E-01	2.8E-02	1.6E-03	3.0E-02
SR41	2.2E-01	2.8E-02	2.5E-01	2.8E-02	3.5E-03	3.2E-02
SR42	2.3E-01	5.0E-03	2.3E-01	2.8E-02	6.2E-04	2.9E-02
SR43	2.3E-01	4.1E-03	2.3E-01	2.8E-02	5.1E-04	2.9E-02
SR44	2.2E-01	2.5E-03	2.3E-01	2.8E-02	3.2E-04	2.8E-02
SR45	2.2E-01	1.2E-03	2.3E-01	2.8E-02	1.5E-04	2.8E-02
SR46	2.2E-01	9.7E-04	2.3E-01	2.8E-02	1.2E-04	2.8E-02
SR47	2.2E-01	1.0E-03	2.3E-01	2.8E-02	1.3E-04	2.8E-02
SR48	2.2E-01	6.5E-04	2.3E-01	2.8E-02	8.2E-05	2.8E-02
SR49	2.3E-01	6.9E-04	2.3E-01	2.8E-02	8.7E-05	2.8E-02
SR50	2.2E-01	1.7E-03	2.3E-01	2.8E-02	2.1E-04	2.8E-02
SR51	2.2E-01	5.3E-03	2.3E-01	2.8E-02	6.6E-04	2.9E-02
SR52	2.2E-01	1.1E-03	2.3E-01	2.8E-02	1.4E-04	2.8E-02
SR53	2.2E-01	6.0E-04	2.2E-01	2.8E-02	7.5E-05	2.8E-02
SR54	2.2E-01	6.0E-04	2.2E-01	2.8E-02	7.5E-05	2.8E-02
SR55	2.2E-01	4.0E-04	2.2E-01	2.8E-02	5.0E-05	2.8E-02
SR56	2.2E-01	2.7E-04	2.2E-01	2.8E-02	3.4E-05	2.8E-02
SR57	2.3E-01	2.3E-03	2.3E-01	2.8E-02	2.9E-04	2.8E-02
SR58	2.2E-01	3.2E-04	2.2E-01	2.8E-02	4.0E-05	2.8E-02

NOTE:
Shaded cell indicates a ER greater than 1.0

Table A-30 Exposure Concentrations and Exposure Ratios for 1-hour Toluene (Construction)

Human Receptor Location	1-hour Toluene (TRV = 15,000 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	4.1E+00	6.4E+00	8.1E+00	2.7E-04	4.3E-04	5.4E-04
SR01	1.4E+00	1.2E+00	2.5E+00	9.4E-05	8.0E-05	1.6E-04
SR02	1.7E+00	7.4E-01	2.0E+00	1.1E-04	4.9E-05	1.4E-04
SR03	1.6E+00	5.2E-01	1.8E+00	1.0E-04	3.5E-05	1.2E-04
SR04	1.3E+00	3.9E-01	1.5E+00	8.4E-05	2.6E-05	1.0E-04
SR05	1.3E+00	4.8E-01	1.6E+00	8.8E-05	3.2E-05	1.1E-04
SR06	1.3E+00	2.6E-01	1.4E+00	8.6E-05	1.7E-05	9.6E-05
SR07	1.3E+00	2.2E-01	1.4E+00	8.6E-05	1.4E-05	9.3E-05
SR08	1.3E+00	2.0E-01	1.4E+00	8.6E-05	1.4E-05	9.1E-05
SR09	1.5E+00	1.3E+00	2.6E+00	9.9E-05	8.8E-05	1.7E-04
SR10	1.4E+00	5.9E-01	1.8E+00	9.2E-05	4.0E-05	1.2E-04
SR11	2.1E+00	7.2E-01	2.6E+00	1.4E-04	4.8E-05	1.7E-04
SR12	1.3E+00	7.3E-01	1.8E+00	8.5E-05	4.9E-05	1.2E-04
SR13	1.3E+00	6.9E-01	1.8E+00	8.8E-05	4.6E-05	1.2E-04
SR14	1.3E+00	9.2E-01	2.0E+00	8.6E-05	6.1E-05	1.4E-04
SR15	1.3E+00	7.3E-01	1.9E+00	8.6E-05	4.9E-05	1.3E-04
SR16	1.2E+00	5.5E-01	1.6E+00	7.8E-05	3.6E-05	1.1E-04
SR17	1.2E+00	2.2E-01	1.3E+00	8.0E-05	1.4E-05	8.7E-05
SR18	1.6E+00	8.3E-01	2.2E+00	1.1E-04	5.5E-05	1.5E-04
SR19	1.5E+00	1.0E+00	2.3E+00	9.8E-05	6.7E-05	1.6E-04
SR20	1.6E+00	7.3E-01	2.0E+00	1.1E-04	4.9E-05	1.4E-04
SR21	1.2E+00	2.7E-01	1.4E+00	7.9E-05	1.8E-05	9.0E-05
SR22	1.1E+00	2.8E-01	1.3E+00	7.6E-05	1.9E-05	9.0E-05
SR23	1.1E+00	2.4E-01	1.3E+00	7.5E-05	1.6E-05	8.8E-05
SR24	1.1E+00	1.9E-01	1.3E+00	7.5E-05	1.3E-05	8.4E-05
SR25	1.7E+00	9.4E-01	2.4E+00	1.1E-04	6.3E-05	1.6E-04
SR26	1.5E+00	3.4E-01	1.6E+00	1.0E-04	2.2E-05	1.1E-04
SR27	1.7E+00	2.7E-01	1.8E+00	1.1E-04	1.8E-05	1.2E-04
SR28	1.7E+00	2.7E-01	1.8E+00	1.1E-04	1.8E-05	1.2E-04
SR29	1.7E+00	2.8E-01	1.9E+00	1.1E-04	1.9E-05	1.3E-04
SR30	2.1E+00	3.1E-01	2.3E+00	1.4E-04	2.1E-05	1.5E-04
SR31	2.1E+00	3.1E-01	2.3E+00	1.4E-04	2.1E-05	1.5E-04
SR32	1.7E+00	2.9E-01	1.9E+00	1.2E-04	1.9E-05	1.3E-04
SR33	1.5E+00	2.8E-01	1.7E+00	1.0E-04	1.8E-05	1.1E-04
SR34	1.4E+00	2.8E-01	1.6E+00	9.3E-05	1.8E-05	1.1E-04
SR35	1.4E+00	2.8E-01	1.6E+00	9.3E-05	1.8E-05	1.1E-04
SR36	1.2E+00	5.5E-01	1.7E+00	8.0E-05	3.6E-05	1.1E-04
SR37	1.1E+00	2.5E-01	1.3E+00	7.5E-05	1.6E-05	8.8E-05
SR38	1.6E+00	3.9E-01	1.8E+00	1.1E-04	2.6E-05	1.2E-04
SR39	1.6E+00	3.8E-01	1.8E+00	1.1E-04	2.5E-05	1.2E-04
SR40	1.3E+00	7.7E-01	1.9E+00	8.6E-05	5.1E-05	1.3E-04
SR41	1.3E+00	1.3E+00	2.5E+00	8.9E-05	8.6E-05	1.7E-04
SR42	1.9E+00	4.0E-01	2.0E+00	1.3E-04	2.6E-05	1.4E-04
SR43	2.8E+00	4.7E-01	3.0E+00	1.9E-04	3.1E-05	2.0E-04
SR44	1.3E+00	1.0E-01	1.4E+00	8.7E-05	6.7E-06	9.0E-05
SR45	1.3E+00	7.1E-02	1.3E+00	8.9E-05	4.8E-06	8.9E-05
SR46	1.5E+00	6.0E-02	1.6E+00	1.0E-04	4.0E-06	1.0E-04
SR47	1.6E+00	6.7E-02	1.6E+00	1.1E-04	4.5E-06	1.1E-04
SR48	1.5E+00	4.8E-02	1.5E+00	9.9E-05	3.2E-06	1.0E-04
SR49	1.9E+00	4.7E-02	1.9E+00	1.2E-04	3.1E-06	1.2E-04
SR50	1.1E+00	4.3E-02	1.1E+00	7.3E-05	2.9E-06	7.5E-05
SR51	1.1E+00	1.2E-01	1.2E+00	7.4E-05	8.1E-06	8.0E-05
SR52	1.6E+00	1.5E-01	1.6E+00	1.0E-04	1.0E-05	1.1E-04
SR53	1.3E+00	4.9E-02	1.3E+00	8.7E-05	3.3E-06	8.7E-05
SR54	1.4E+00	9.0E-02	1.4E+00	9.6E-05	6.0E-06	9.6E-05
SR55	1.5E+00	6.2E-02	1.5E+00	9.9E-05	4.2E-06	1.0E-04
SR56	1.1E+00	4.8E-02	1.1E+00	7.5E-05	3.2E-06	7.6E-05
SR57	1.7E+00	2.9E-01	1.8E+00	1.1E-04	2.0E-05	1.2E-04
SR58	1.1E+00	2.5E-02	1.1E+00	7.5E-05	1.6E-06	7.5E-05

NOTE:
Shaded cell indicates a ER greater than 1.0

Table A-31 Exposure Concentrations and Exposure Ratios for 24-hour Toluene (Construction)

Human Receptor Location	24-hour Toluene (TRV = 7,600 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	3.1E+00	2.2E+00	3.5E+00	4.1E-04	2.9E-04	4.6E-04
SR01	1.2E+00	4.2E-01	1.6E+00	1.6E-04	5.5E-05	2.1E-04
SR02	1.5E+00	2.5E-01	1.5E+00	2.0E-04	3.3E-05	2.0E-04
SR03	1.4E+00	1.7E-01	1.4E+00	1.9E-04	2.3E-05	1.9E-04
SR04	1.2E+00	1.4E-01	1.2E+00	1.5E-04	1.8E-05	1.6E-04
SR05	1.2E+00	1.5E-01	1.3E+00	1.6E-04	2.0E-05	1.6E-04
SR06	1.2E+00	7.8E-02	1.2E+00	1.6E-04	1.0E-05	1.6E-04
SR07	1.2E+00	6.6E-02	1.2E+00	1.6E-04	8.7E-06	1.6E-04
SR08	1.2E+00	7.6E-02	1.2E+00	1.6E-04	1.0E-05	1.6E-04
SR09	1.2E+00	3.7E-01	1.6E+00	1.6E-04	4.9E-05	2.1E-04
SR10	1.2E+00	1.4E-01	1.3E+00	1.6E-04	1.9E-05	1.7E-04
SR11	1.6E+00	2.2E-01	1.7E+00	2.1E-04	3.0E-05	2.2E-04
SR12	1.2E+00	2.5E-01	1.3E+00	1.5E-04	3.3E-05	1.7E-04
SR13	1.2E+00	2.4E-01	1.3E+00	1.6E-04	3.1E-05	1.7E-04
SR14	1.2E+00	3.2E-01	1.4E+00	1.5E-04	4.2E-05	1.8E-04
SR15	1.2E+00	3.4E-01	1.4E+00	1.5E-04	4.5E-05	1.9E-04
SR16	1.1E+00	2.6E-01	1.3E+00	1.4E-04	3.4E-05	1.7E-04
SR17	1.1E+00	1.0E-01	1.2E+00	1.5E-04	1.3E-05	1.5E-04
SR18	1.2E+00	3.3E-01	1.5E+00	1.6E-04	4.3E-05	2.0E-04
SR19	1.2E+00	3.8E-01	1.5E+00	1.6E-04	5.1E-05	2.0E-04
SR20	1.2E+00	2.9E-01	1.5E+00	1.6E-04	3.8E-05	1.9E-04
SR21	1.1E+00	1.2E-01	1.2E+00	1.5E-04	1.5E-05	1.5E-04
SR22	1.1E+00	1.2E-01	1.2E+00	1.4E-04	1.6E-05	1.5E-04
SR23	1.1E+00	9.1E-02	1.1E+00	1.4E-04	1.2E-05	1.5E-04
SR24	1.1E+00	6.9E-02	1.1E+00	1.4E-04	9.0E-06	1.5E-04
SR25	1.3E+00	3.8E-01	1.6E+00	1.7E-04	5.0E-05	2.1E-04
SR26	1.2E+00	1.3E-01	1.3E+00	1.6E-04	1.7E-05	1.7E-04
SR27	1.3E+00	8.8E-02	1.4E+00	1.7E-04	1.2E-05	1.8E-04
SR28	1.3E+00	8.8E-02	1.4E+00	1.7E-04	1.2E-05	1.8E-04
SR29	1.4E+00	8.9E-02	1.4E+00	1.8E-04	1.2E-05	1.9E-04
SR30	1.6E+00	9.1E-02	1.7E+00	2.2E-04	1.2E-05	2.2E-04
SR31	1.6E+00	9.1E-02	1.7E+00	2.2E-04	1.2E-05	2.2E-04
SR32	1.4E+00	9.1E-02	1.4E+00	1.8E-04	1.2E-05	1.9E-04
SR33	1.2E+00	9.1E-02	1.3E+00	1.6E-04	1.2E-05	1.7E-04
SR34	1.2E+00	9.3E-02	1.2E+00	1.6E-04	1.2E-05	1.6E-04
SR35	1.2E+00	9.3E-02	1.2E+00	1.6E-04	1.2E-05	1.6E-04
SR36	1.1E+00	2.3E-01	1.3E+00	1.5E-04	3.1E-05	1.7E-04
SR37	1.1E+00	8.2E-02	1.1E+00	1.4E-04	1.1E-05	1.5E-04
SR38	1.3E+00	1.6E-01	1.4E+00	1.7E-04	2.1E-05	1.8E-04
SR39	1.3E+00	1.5E-01	1.3E+00	1.7E-04	1.9E-05	1.7E-04
SR40	1.2E+00	2.4E-01	1.3E+00	1.5E-04	3.2E-05	1.7E-04
SR41	1.2E+00	4.4E-01	1.5E+00	1.5E-04	5.8E-05	2.0E-04
SR42	1.6E+00	1.0E-01	1.6E+00	2.1E-04	1.3E-05	2.2E-04
SR43	2.5E+00	1.6E-01	2.7E+00	3.3E-04	2.2E-05	3.5E-04
SR44	1.2E+00	4.2E-02	1.3E+00	1.6E-04	5.6E-06	1.7E-04
SR45	1.2E+00	2.9E-02	1.2E+00	1.6E-04	3.8E-06	1.6E-04
SR46	1.3E+00	2.2E-02	1.4E+00	1.8E-04	2.8E-06	1.8E-04
SR47	1.4E+00	2.6E-02	1.4E+00	1.8E-04	3.4E-06	1.8E-04
SR48	1.3E+00	1.3E-02	1.3E+00	1.8E-04	1.7E-06	1.8E-04
SR49	1.7E+00	1.5E-02	1.7E+00	2.3E-04	1.9E-06	2.3E-04
SR50	1.1E+00	1.9E-02	1.1E+00	1.4E-04	2.4E-06	1.4E-04
SR51	1.1E+00	3.8E-02	1.1E+00	1.4E-04	5.0E-06	1.5E-04
SR52	1.2E+00	5.6E-02	1.2E+00	1.6E-04	7.4E-06	1.6E-04
SR53	1.2E+00	1.2E-02	1.2E+00	1.6E-04	1.5E-06	1.6E-04
SR54	1.2E+00	3.1E-02	1.2E+00	1.5E-04	4.1E-06	1.5E-04
SR55	1.2E+00	2.5E-02	1.2E+00	1.6E-04	3.2E-06	1.6E-04
SR56	1.0E+00	1.6E-02	1.1E+00	1.4E-04	2.1E-06	1.4E-04
SR57	1.4E+00	1.0E-01	1.4E+00	1.8E-04	1.3E-05	1.9E-04
SR58	1.1E+00	7.5E-03	1.1E+00	1.4E-04	9.8E-07	1.4E-04

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-32 Exposure Concentrations and Exposure Ratios for Annual Toluene (Construction)

Human Receptor Location	Annual Toluene (TRV = 3,800 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	1.2E+00	1.3E-01	1.2E+00	3.1E-04	3.5E-05	3.1E-04
SR01	4.9E-01	2.2E-02	5.1E-01	1.3E-04	5.8E-06	1.3E-04
SR02	5.2E-01	7.6E-03	5.3E-01	1.4E-04	2.0E-06	1.4E-04
SR03	5.1E-01	6.8E-03	5.2E-01	1.3E-04	1.8E-06	1.4E-04
SR04	4.8E-01	1.4E-02	4.9E-01	1.3E-04	3.6E-06	1.3E-04
SR05	4.9E-01	1.3E-02	5.0E-01	1.3E-04	3.6E-06	1.3E-04
SR06	4.9E-01	6.4E-03	5.0E-01	1.3E-04	1.7E-06	1.3E-04
SR07	4.9E-01	4.7E-03	5.0E-01	1.3E-04	1.2E-06	1.3E-04
SR08	4.9E-01	5.5E-03	4.9E-01	1.3E-04	1.4E-06	1.3E-04
SR09	4.9E-01	1.5E-02	5.0E-01	1.3E-04	3.9E-06	1.3E-04
SR10	4.8E-01	1.1E-02	4.9E-01	1.3E-04	3.0E-06	1.3E-04
SR11	5.7E-01	1.9E-02	5.9E-01	1.5E-04	4.9E-06	1.6E-04
SR12	4.8E-01	2.1E-02	5.0E-01	1.3E-04	5.5E-06	1.3E-04
SR13	4.8E-01	1.8E-02	5.0E-01	1.3E-04	4.8E-06	1.3E-04
SR14	4.8E-01	2.5E-02	5.0E-01	1.3E-04	6.5E-06	1.3E-04
SR15	4.8E-01	2.6E-02	5.0E-01	1.3E-04	6.7E-06	1.3E-04
SR16	4.7E-01	1.9E-02	4.9E-01	1.2E-04	5.1E-06	1.3E-04
SR17	4.7E-01	7.0E-03	4.8E-01	1.2E-04	1.8E-06	1.3E-04
SR18	4.9E-01	2.3E-02	5.1E-01	1.3E-04	6.0E-06	1.3E-04
SR19	4.8E-01	5.0E-02	5.3E-01	1.3E-04	1.3E-05	1.4E-04
SR20	4.9E-01	2.5E-02	5.2E-01	1.3E-04	6.7E-06	1.4E-04
SR21	4.7E-01	9.3E-03	4.8E-01	1.2E-04	2.4E-06	1.3E-04
SR22	4.6E-01	9.4E-03	4.7E-01	1.2E-04	2.5E-06	1.2E-04
SR23	4.6E-01	8.6E-03	4.7E-01	1.2E-04	2.3E-06	1.2E-04
SR24	4.6E-01	8.5E-03	4.7E-01	1.2E-04	2.2E-06	1.2E-04
SR25	5.0E-01	3.1E-02	5.4E-01	1.3E-04	8.2E-06	1.4E-04
SR26	4.8E-01	3.1E-03	4.8E-01	1.3E-04	8.1E-07	1.3E-04
SR27	5.0E-01	2.9E-03	5.0E-01	1.3E-04	7.7E-07	1.3E-04
SR28	5.0E-01	2.9E-03	5.0E-01	1.3E-04	7.7E-07	1.3E-04
SR29	4.9E-01	3.1E-03	5.0E-01	1.3E-04	8.2E-07	1.3E-04
SR30	6.0E-01	3.4E-03	6.0E-01	1.6E-04	9.0E-07	1.6E-04
SR31	6.0E-01	3.4E-03	6.0E-01	1.6E-04	9.0E-07	1.6E-04
SR32	5.3E-01	3.8E-03	5.4E-01	1.4E-04	1.0E-06	1.4E-04
SR33	4.9E-01	4.3E-03	5.0E-01	1.3E-04	1.1E-06	1.3E-04
SR34	4.8E-01	4.9E-03	4.9E-01	1.3E-04	1.3E-06	1.3E-04
SR35	4.8E-01	4.9E-03	4.9E-01	1.3E-04	1.3E-06	1.3E-04
SR36	4.7E-01	1.6E-02	4.8E-01	1.2E-04	4.1E-06	1.3E-04
SR37	4.6E-01	8.5E-03	4.7E-01	1.2E-04	2.2E-06	1.2E-04
SR38	5.1E-01	1.3E-02	5.2E-01	1.3E-04	3.5E-06	1.4E-04
SR39	4.9E-01	7.9E-03	5.0E-01	1.3E-04	2.1E-06	1.3E-04
SR40	4.7E-01	1.5E-02	4.8E-01	1.2E-04	4.0E-06	1.3E-04
SR41	4.7E-01	3.3E-02	5.1E-01	1.2E-04	8.6E-06	1.3E-04
SR42	5.4E-01	5.7E-03	5.5E-01	1.4E-04	1.5E-06	1.4E-04
SR43	7.3E-01	4.7E-03	7.3E-01	1.9E-04	1.2E-06	1.9E-04
SR44	5.1E-01	2.9E-03	5.1E-01	1.3E-04	7.6E-07	1.3E-04
SR45	4.9E-01	1.4E-03	4.9E-01	1.3E-04	3.7E-07	1.3E-04
SR46	5.0E-01	1.1E-03	5.1E-01	1.3E-04	3.0E-07	1.3E-04
SR47	5.1E-01	1.2E-03	5.1E-01	1.3E-04	3.1E-07	1.3E-04
SR48	4.9E-01	7.5E-04	4.9E-01	1.3E-04	2.0E-07	1.3E-04
SR49	5.3E-01	8.0E-04	5.3E-01	1.4E-04	2.1E-07	1.4E-04
SR50	4.6E-01	1.9E-03	4.6E-01	1.2E-04	5.1E-07	1.2E-04
SR51	4.6E-01	6.1E-03	4.7E-01	1.2E-04	1.6E-06	1.2E-04
SR52	4.7E-01	1.3E-03	4.7E-01	1.2E-04	3.4E-07	1.2E-04
SR53	4.7E-01	6.9E-04	4.7E-01	1.2E-04	1.8E-07	1.2E-04
SR54	4.6E-01	6.9E-04	4.7E-01	1.2E-04	1.8E-07	1.2E-04
SR55	4.8E-01	4.6E-04	4.8E-01	1.3E-04	1.2E-07	1.3E-04
SR56	4.5E-01	3.1E-04	4.5E-01	1.2E-04	8.2E-08	1.2E-04
SR57	5.3E-01	2.6E-03	5.3E-01	1.4E-04	6.9E-07	1.4E-04
SR58	4.6E-01	3.7E-04	4.6E-01	1.2E-04	9.6E-08	1.2E-04

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-33 Exposure Concentrations and Exposure Ratios for 1-hour Xylenes (Construction)

Human Receptor Location	1-hour Xylenes (TRV = 7,400 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	2.0E+00	4.5E+00	5.1E+00	2.7E-04	6.0E-04	6.9E-04
SR01	4.6E-01	8.4E-01	1.2E+00	6.2E-05	1.1E-04	1.6E-04
SR02	6.2E-01	5.1E-01	9.1E-01	8.4E-05	6.9E-05	1.2E-04
SR03	5.4E-01	3.6E-01	7.0E-01	7.3E-05	4.9E-05	9.4E-05
SR04	3.7E-01	2.7E-01	5.7E-01	4.9E-05	3.7E-05	7.7E-05
SR05	4.0E-01	3.4E-01	6.3E-01	5.4E-05	4.6E-05	8.6E-05
SR06	3.8E-01	1.8E-01	5.0E-01	5.2E-05	2.5E-05	6.8E-05
SR07	3.8E-01	1.5E-01	4.6E-01	5.1E-05	2.0E-05	6.3E-05
SR08	3.8E-01	1.4E-01	4.5E-01	5.1E-05	1.9E-05	6.1E-05
SR09	5.0E-01	9.2E-01	1.3E+00	6.7E-05	1.2E-04	1.7E-04
SR10	4.4E-01	4.1E-01	7.4E-01	5.9E-05	5.6E-05	1.0E-04
SR11	8.3E-01	5.0E-01	1.2E+00	1.1E-04	6.8E-05	1.6E-04
SR12	3.7E-01	5.1E-01	7.9E-01	5.0E-05	6.9E-05	1.1E-04
SR13	4.0E-01	4.8E-01	7.6E-01	5.4E-05	6.5E-05	1.0E-04
SR14	3.8E-01	6.4E-01	9.3E-01	5.1E-05	8.6E-05	1.3E-04
SR15	3.8E-01	5.1E-01	8.1E-01	5.1E-05	6.9E-05	1.1E-04
SR16	3.1E-01	3.8E-01	6.5E-01	4.2E-05	5.1E-05	8.8E-05
SR17	3.3E-01	1.5E-01	4.1E-01	4.5E-05	2.0E-05	5.6E-05
SR18	5.5E-01	5.8E-01	1.0E+00	7.5E-05	7.8E-05	1.4E-04
SR19	4.9E-01	7.0E-01	1.1E+00	6.6E-05	9.5E-05	1.5E-04
SR20	5.6E-01	5.1E-01	9.0E-01	7.5E-05	6.9E-05	1.2E-04
SR21	3.2E-01	1.9E-01	4.6E-01	4.4E-05	2.6E-05	6.2E-05
SR22	3.0E-01	2.0E-01	4.5E-01	4.0E-05	2.7E-05	6.1E-05
SR23	2.9E-01	1.7E-01	4.3E-01	4.0E-05	2.3E-05	5.9E-05
SR24	2.9E-01	1.3E-01	3.9E-01	3.9E-05	1.8E-05	5.3E-05
SR25	6.2E-01	6.6E-01	1.1E+00	8.4E-05	8.9E-05	1.5E-04
SR26	5.2E-01	2.3E-01	5.7E-01	7.0E-05	3.2E-05	7.7E-05
SR27	6.0E-01	1.9E-01	6.9E-01	8.1E-05	2.5E-05	9.3E-05
SR28	6.0E-01	1.9E-01	6.9E-01	8.1E-05	2.5E-05	9.3E-05
SR29	6.1E-01	2.0E-01	7.4E-01	8.3E-05	2.7E-05	1.0E-04
SR30	8.3E-01	2.2E-01	9.4E-01	1.1E-04	2.9E-05	1.3E-04
SR31	8.3E-01	2.2E-01	9.4E-01	1.1E-04	2.9E-05	1.3E-04
SR32	6.3E-01	2.0E-01	7.6E-01	8.5E-05	2.7E-05	1.0E-04
SR33	5.0E-01	1.9E-01	6.3E-01	6.8E-05	2.6E-05	8.5E-05
SR34	4.4E-01	1.9E-01	6.0E-01	6.0E-05	2.6E-05	8.1E-05
SR35	4.4E-01	1.9E-01	6.0E-01	6.0E-05	2.6E-05	8.1E-05
SR36	3.3E-01	3.8E-01	6.7E-01	4.5E-05	5.1E-05	9.1E-05
SR37	2.9E-01	1.7E-01	4.3E-01	3.9E-05	2.3E-05	5.9E-05
SR38	5.7E-01	2.7E-01	7.3E-01	7.7E-05	3.7E-05	9.9E-05
SR39	5.9E-01	2.6E-01	6.9E-01	7.9E-05	3.6E-05	9.3E-05
SR40	3.9E-01	5.3E-01	8.5E-01	5.2E-05	7.2E-05	1.1E-04
SR41	4.1E-01	9.0E-01	1.2E+00	5.6E-05	1.2E-04	1.7E-04
SR42	7.5E-01	2.8E-01	8.4E-01	1.0E-04	3.7E-05	1.1E-04
SR43	1.2E+00	3.3E-01	1.4E+00	1.7E-04	4.4E-05	1.9E-04
SR44	4.0E-01	7.0E-02	4.3E-01	5.3E-05	9.4E-06	5.8E-05
SR45	4.1E-01	5.0E-02	4.1E-01	5.6E-05	6.7E-06	5.6E-05
SR46	5.3E-01	4.2E-02	5.3E-01	7.1E-05	5.7E-06	7.2E-05
SR47	5.6E-01	4.7E-02	5.7E-01	7.6E-05	6.3E-06	7.7E-05
SR48	5.0E-01	3.4E-02	5.1E-01	6.7E-05	4.5E-06	6.9E-05
SR49	7.0E-01	3.3E-02	7.1E-01	9.5E-05	4.4E-06	9.6E-05
SR50	2.7E-01	3.0E-02	2.9E-01	3.7E-05	4.1E-06	4.0E-05
SR51	2.9E-01	8.5E-02	3.5E-01	3.9E-05	1.2E-05	4.7E-05
SR52	5.4E-01	1.1E-01	5.6E-01	7.3E-05	1.4E-05	7.5E-05
SR53	3.9E-01	3.4E-02	3.9E-01	5.3E-05	4.6E-06	5.3E-05
SR54	4.7E-01	6.3E-02	4.7E-01	6.4E-05	8.5E-06	6.4E-05
SR55	5.0E-01	4.3E-02	5.0E-01	6.7E-05	5.9E-06	6.8E-05
SR56	2.9E-01	3.4E-02	3.0E-01	3.9E-05	4.5E-06	4.1E-05
SR57	6.2E-01	2.1E-01	7.2E-01	8.4E-05	2.8E-05	9.8E-05
SR58	2.9E-01	1.7E-02	3.0E-01	3.9E-05	2.3E-06	4.0E-05

NOTE:
Shaded cell indicates a ER greater than 1.0

Table A-34 Exposure Concentrations and Exposure Ratios for Annual Xylenes (Construction)

Human Receptor Location	Annual Xylenes (TRV = 180 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	4.9E-01	9.2E-02	4.9E-01	2.7E-03	5.1E-04	2.7E-03
SR01	1.0E-01	1.5E-02	1.2E-01	5.8E-04	8.6E-05	6.7E-04
SR02	1.2E-01	5.3E-03	1.3E-01	6.8E-04	2.9E-05	7.1E-04
SR03	1.2E-01	4.8E-03	1.2E-01	6.5E-04	2.6E-05	6.7E-04
SR04	1.0E-01	9.5E-03	1.1E-01	5.5E-04	5.3E-05	6.1E-04
SR05	1.0E-01	9.4E-03	1.1E-01	5.8E-04	5.2E-05	6.3E-04
SR06	1.1E-01	4.5E-03	1.1E-01	6.0E-04	2.5E-05	6.2E-04
SR07	1.1E-01	3.3E-03	1.1E-01	5.9E-04	1.8E-05	6.1E-04
SR08	1.1E-01	3.8E-03	1.1E-01	5.8E-04	2.1E-05	6.1E-04
SR09	1.0E-01	1.0E-02	1.1E-01	5.8E-04	5.8E-05	6.4E-04
SR10	1.0E-01	8.0E-03	1.1E-01	5.6E-04	4.4E-05	6.0E-04
SR11	1.5E-01	1.3E-02	1.7E-01	8.5E-04	7.2E-05	9.2E-04
SR12	9.9E-02	1.5E-02	1.1E-01	5.5E-04	8.1E-05	6.3E-04
SR13	1.0E-01	1.3E-02	1.1E-01	5.6E-04	7.1E-05	6.3E-04
SR14	1.0E-01	1.7E-02	1.2E-01	5.5E-04	9.6E-05	6.5E-04
SR15	9.9E-02	1.8E-02	1.2E-01	5.5E-04	9.9E-05	6.5E-04
SR16	9.2E-02	1.3E-02	1.1E-01	5.1E-04	7.4E-05	5.8E-04
SR17	9.5E-02	4.9E-03	1.0E-01	5.3E-04	2.7E-05	5.5E-04
SR18	1.1E-01	1.6E-02	1.2E-01	5.8E-04	8.8E-05	6.7E-04
SR19	1.0E-01	3.5E-02	1.4E-01	5.6E-04	1.9E-04	7.6E-04
SR20	1.1E-01	1.8E-02	1.2E-01	5.9E-04	9.8E-05	6.9E-04
SR21	9.4E-02	6.4E-03	1.0E-01	5.2E-04	3.6E-05	5.5E-04
SR22	9.1E-02	6.6E-03	9.7E-02	5.1E-04	3.7E-05	5.4E-04
SR23	9.0E-02	6.0E-03	9.6E-02	5.0E-04	3.3E-05	5.3E-04
SR24	9.1E-02	5.9E-03	9.6E-02	5.0E-04	3.3E-05	5.3E-04
SR25	1.1E-01	2.2E-02	1.4E-01	6.3E-04	1.2E-04	7.5E-04
SR26	1.0E-01	2.1E-03	1.0E-01	5.6E-04	1.2E-05	5.7E-04
SR27	1.1E-01	2.0E-03	1.1E-01	6.0E-04	1.1E-05	6.2E-04
SR28	1.1E-01	2.0E-03	1.1E-01	6.0E-04	1.1E-05	6.2E-04
SR29	1.1E-01	2.2E-03	1.1E-01	6.0E-04	1.2E-05	6.1E-04
SR30	1.7E-01	2.4E-03	1.7E-01	9.4E-04	1.3E-05	9.5E-04
SR31	1.7E-01	2.4E-03	1.7E-01	9.4E-04	1.3E-05	9.5E-04
SR32	1.3E-01	2.7E-03	1.3E-01	7.2E-04	1.5E-05	7.3E-04
SR33	1.1E-01	3.0E-03	1.1E-01	6.0E-04	1.7E-05	6.1E-04
SR34	1.0E-01	3.4E-03	1.1E-01	5.7E-04	1.9E-05	5.8E-04
SR35	1.0E-01	3.4E-03	1.1E-01	5.7E-04	1.9E-05	5.8E-04
SR36	9.4E-02	1.1E-02	1.0E-01	5.2E-04	6.0E-05	5.8E-04
SR37	9.0E-02	5.9E-03	9.6E-02	5.0E-04	3.3E-05	5.3E-04
SR38	1.2E-01	9.2E-03	1.3E-01	6.5E-04	5.1E-05	7.0E-04
SR39	1.1E-01	5.5E-03	1.1E-01	5.9E-04	3.1E-05	6.2E-04
SR40	9.4E-02	1.1E-02	1.0E-01	5.2E-04	5.9E-05	5.8E-04
SR41	9.6E-02	2.3E-02	1.2E-01	5.3E-04	1.3E-04	6.6E-04
SR42	1.3E-01	4.0E-03	1.4E-01	7.4E-04	2.2E-05	7.7E-04
SR43	2.4E-01	3.3E-03	2.4E-01	1.3E-03	1.8E-05	1.4E-03
SR44	1.2E-01	2.0E-03	1.2E-01	6.4E-04	1.1E-05	6.6E-04
SR45	1.0E-01	9.8E-04	1.0E-01	5.7E-04	5.4E-06	5.8E-04
SR46	1.1E-01	7.8E-04	1.1E-01	6.3E-04	4.3E-06	6.4E-04
SR47	1.2E-01	8.1E-04	1.2E-01	6.5E-04	4.5E-06	6.5E-04
SR48	1.1E-01	5.2E-04	1.1E-01	5.9E-04	2.9E-06	5.9E-04
SR49	1.3E-01	5.5E-04	1.3E-01	7.0E-04	3.1E-06	7.0E-04
SR50	8.8E-02	1.4E-03	8.9E-02	4.9E-04	7.5E-06	5.0E-04
SR51	9.0E-02	4.2E-03	9.4E-02	5.0E-04	2.4E-05	5.2E-04
SR52	9.5E-02	8.9E-04	9.6E-02	5.3E-04	4.9E-06	5.3E-04
SR53	9.6E-02	4.8E-04	9.6E-02	5.3E-04	2.7E-06	5.4E-04
SR54	9.1E-02	4.8E-04	9.2E-02	5.1E-04	2.7E-06	5.1E-04
SR55	1.0E-01	3.2E-04	1.0E-01	5.6E-04	1.8E-06	5.6E-04
SR56	8.5E-02	2.2E-04	8.5E-02	4.7E-04	1.2E-06	4.7E-04
SR57	1.3E-01	1.8E-03	1.3E-01	7.1E-04	1.0E-05	7.2E-04
SR58	8.7E-02	2.5E-04	8.7E-02	4.8E-04	1.4E-06	4.8E-04

NOTE:
Shaded cell indicates a ER greater than 1.0

Table A-35 Exposure Concentrations and Exposure Ratios for Annual Benzo(a)pyrene (Construction)

Human Receptor Location	Annual Benzo(a)pyrene (non-threshold TRV = 0.0009 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	6.2E-04	2.8E-05	6.2E-04	6.9E-01	3.1E-02	6.9E-01
SR01	1.4E-04	4.6E-06	1.4E-04	1.5E-01	5.2E-03	1.6E-01
SR02	1.6E-04	1.6E-06	1.6E-04	1.7E-01	1.7E-03	1.8E-01
SR03	1.5E-04	1.4E-06	1.5E-04	1.7E-01	1.6E-03	1.7E-01
SR04	1.3E-04	2.8E-06	1.3E-04	1.4E-01	3.1E-03	1.5E-01
SR05	1.3E-04	2.8E-06	1.4E-04	1.5E-01	3.1E-03	1.5E-01
SR06	1.4E-04	1.3E-06	1.4E-04	1.5E-01	1.5E-03	1.5E-01
SR07	1.4E-04	9.7E-07	1.4E-04	1.5E-01	1.1E-03	1.5E-01
SR08	1.4E-04	1.1E-06	1.4E-04	1.5E-01	1.3E-03	1.5E-01
SR09	1.3E-04	3.1E-06	1.4E-04	1.5E-01	3.4E-03	1.5E-01
SR10	1.3E-04	2.3E-06	1.3E-04	1.4E-01	2.6E-03	1.5E-01
SR11	2.0E-04	3.8E-06	2.0E-04	2.2E-01	4.2E-03	2.2E-01
SR12	1.3E-04	4.3E-06	1.3E-04	1.4E-01	4.8E-03	1.5E-01
SR13	1.3E-04	3.8E-06	1.3E-04	1.5E-01	4.2E-03	1.5E-01
SR14	1.3E-04	5.1E-06	1.3E-04	1.4E-01	5.7E-03	1.5E-01
SR15	1.3E-04	5.3E-06	1.3E-04	1.4E-01	5.9E-03	1.5E-01
SR16	1.2E-04	4.0E-06	1.2E-04	1.3E-01	4.5E-03	1.4E-01
SR17	1.2E-04	1.5E-06	1.2E-04	1.4E-01	1.6E-03	1.4E-01
SR18	1.4E-04	4.7E-06	1.4E-04	1.5E-01	5.2E-03	1.6E-01
SR19	1.3E-04	1.1E-05	1.4E-04	1.4E-01	1.2E-02	1.6E-01
SR20	1.4E-04	5.2E-06	1.4E-04	1.5E-01	5.7E-03	1.6E-01
SR21	1.2E-04	1.9E-06	1.2E-04	1.3E-01	2.1E-03	1.4E-01
SR22	1.2E-04	1.9E-06	1.2E-04	1.3E-01	2.1E-03	1.3E-01
SR23	1.2E-04	1.8E-06	1.2E-04	1.3E-01	2.0E-03	1.3E-01
SR24	1.2E-04	1.8E-06	1.2E-04	1.3E-01	1.9E-03	1.3E-01
SR25	1.5E-04	6.5E-06	1.5E-04	1.6E-01	7.2E-03	1.7E-01
SR26	1.3E-04	6.1E-07	1.3E-04	1.4E-01	6.7E-04	1.5E-01
SR27	1.4E-04	5.7E-07	1.4E-04	1.6E-01	6.4E-04	1.6E-01
SR28	1.4E-04	5.7E-07	1.4E-04	1.6E-01	6.4E-04	1.6E-01
SR29	1.4E-04	6.1E-07	1.4E-04	1.5E-01	6.8E-04	1.5E-01
SR30	2.2E-04	6.7E-07	2.2E-04	2.4E-01	7.5E-04	2.4E-01
SR31	2.2E-04	6.7E-07	2.2E-04	2.4E-01	7.5E-04	2.4E-01
SR32	1.7E-04	7.6E-07	1.7E-04	1.9E-01	8.4E-04	1.9E-01
SR33	1.4E-04	8.5E-07	1.4E-04	1.5E-01	9.5E-04	1.5E-01
SR34	1.3E-04	9.7E-07	1.3E-04	1.5E-01	1.1E-03	1.5E-01
SR35	1.3E-04	9.7E-07	1.3E-04	1.5E-01	1.1E-03	1.5E-01
SR36	1.2E-04	3.2E-06	1.2E-04	1.4E-01	3.6E-03	1.4E-01
SR37	1.2E-04	1.7E-06	1.2E-04	1.3E-01	1.9E-03	1.3E-01
SR38	1.5E-04	2.7E-06	1.5E-04	1.7E-01	3.0E-03	1.7E-01
SR39	1.4E-04	1.6E-06	1.4E-04	1.5E-01	1.8E-03	1.5E-01
SR40	1.2E-04	3.1E-06	1.2E-04	1.3E-01	3.4E-03	1.4E-01
SR41	1.2E-04	6.7E-06	1.3E-04	1.4E-01	7.5E-03	1.5E-01
SR42	1.7E-04	1.2E-06	1.7E-04	1.9E-01	1.3E-03	1.9E-01
SR43	3.1E-04	9.7E-07	3.1E-04	3.4E-01	1.1E-03	3.4E-01
SR44	1.5E-04	6.0E-07	1.5E-04	1.6E-01	6.7E-04	1.7E-01
SR45	1.3E-04	2.9E-07	1.3E-04	1.5E-01	3.2E-04	1.5E-01
SR46	1.4E-04	2.3E-07	1.4E-04	1.6E-01	2.5E-04	1.6E-01
SR47	1.5E-04	2.4E-07	1.5E-04	1.6E-01	2.6E-04	1.6E-01
SR48	1.3E-04	1.5E-07	1.3E-04	1.5E-01	1.7E-04	1.5E-01
SR49	1.6E-04	1.6E-07	1.6E-04	1.8E-01	1.8E-04	1.8E-01
SR50	1.1E-04	4.0E-07	1.1E-04	1.3E-01	4.4E-04	1.3E-01
SR51	1.2E-04	1.3E-06	1.2E-04	1.3E-01	1.4E-03	1.3E-01
SR52	1.2E-04	2.5E-07	1.2E-04	1.4E-01	2.7E-04	1.4E-01
SR53	1.2E-04	1.4E-07	1.2E-04	1.4E-01	1.5E-04	1.4E-01
SR54	1.2E-04	1.3E-07	1.2E-04	1.3E-01	1.5E-04	1.3E-01
SR55	1.3E-04	8.7E-08	1.3E-04	1.5E-01	9.6E-05	1.5E-01
SR56	1.1E-04	5.9E-08	1.1E-04	1.2E-01	6.6E-05	1.2E-01
SR57	1.6E-04	5.1E-07	1.6E-04	1.8E-01	5.7E-04	1.8E-01
SR58	1.1E-04	7.3E-08	1.1E-04	1.3E-01	8.1E-05	1.3E-01

NOTE:

Shaded cell indicates a ER greater than 1.0

* ERs are based on non-threshold effects (i.e., cancer risk) and therefore only Project case values are compared to a threshold target of 1.0

Table A-36 Exposure Concentrations and Exposure Ratios for Annual Naphthalane (Construction)

Human Receptor Location	Annual Naphthalene (TRV = 3 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	7.2E-02	2.3E-02	7.8E-02	2.4E-02	7.8E-03	2.6E-02
SR01	5.3E-02	3.9E-03	5.7E-02	1.8E-02	1.3E-03	1.9E-02
SR02	5.4E-02	1.3E-03	5.5E-02	1.8E-02	4.5E-04	1.8E-02
SR03	5.4E-02	1.2E-03	5.5E-02	1.8E-02	4.1E-04	1.8E-02
SR04	5.3E-02	2.4E-03	5.5E-02	1.8E-02	8.1E-04	1.8E-02
SR05	5.3E-02	2.4E-03	5.5E-02	1.8E-02	8.0E-04	1.8E-02
SR06	5.3E-02	1.1E-03	5.4E-02	1.8E-02	3.8E-04	1.8E-02
SR07	5.3E-02	8.3E-04	5.4E-02	1.8E-02	2.8E-04	1.8E-02
SR08	5.3E-02	9.8E-04	5.4E-02	1.8E-02	3.3E-04	1.8E-02
SR09	5.3E-02	2.6E-03	5.6E-02	1.8E-02	8.8E-04	1.9E-02
SR10	5.3E-02	2.0E-03	5.5E-02	1.8E-02	6.8E-04	1.8E-02
SR11	5.5E-02	3.3E-03	5.9E-02	1.8E-02	1.1E-03	2.0E-02
SR12	5.3E-02	3.7E-03	5.6E-02	1.8E-02	1.2E-03	1.9E-02
SR13	5.3E-02	3.2E-03	5.6E-02	1.8E-02	1.1E-03	1.9E-02
SR14	5.3E-02	4.4E-03	5.7E-02	1.8E-02	1.5E-03	1.9E-02
SR15	5.3E-02	4.6E-03	5.7E-02	1.8E-02	1.5E-03	1.9E-02
SR16	5.2E-02	3.4E-03	5.6E-02	1.7E-02	1.1E-03	1.9E-02
SR17	5.3E-02	1.2E-03	5.4E-02	1.8E-02	4.2E-04	1.8E-02
SR18	5.3E-02	4.0E-03	5.7E-02	1.8E-02	1.3E-03	1.9E-02
SR19	5.3E-02	8.8E-03	6.2E-02	1.8E-02	2.9E-03	2.1E-02
SR20	5.3E-02	4.5E-03	5.8E-02	1.8E-02	1.5E-03	1.9E-02
SR21	5.3E-02	1.6E-03	5.4E-02	1.8E-02	5.5E-04	1.8E-02
SR22	5.2E-02	1.7E-03	5.4E-02	1.7E-02	5.6E-04	1.8E-02
SR23	5.2E-02	1.5E-03	5.4E-02	1.7E-02	5.1E-04	1.8E-02
SR24	5.2E-02	1.5E-03	5.4E-02	1.7E-02	5.0E-04	1.8E-02
SR25	5.4E-02	5.6E-03	5.9E-02	1.8E-02	1.9E-03	2.0E-02
SR26	5.3E-02	5.5E-04	5.3E-02	1.8E-02	1.8E-04	1.8E-02
SR27	5.3E-02	5.2E-04	5.4E-02	1.8E-02	1.7E-04	1.8E-02
SR28	5.3E-02	5.2E-04	5.4E-02	1.8E-02	1.7E-04	1.8E-02
SR29	5.3E-02	5.5E-04	5.4E-02	1.8E-02	1.8E-04	1.8E-02
SR30	5.6E-02	6.1E-04	5.7E-02	1.9E-02	2.0E-04	1.9E-02
SR31	5.6E-02	6.1E-04	5.7E-02	1.9E-02	2.0E-04	1.9E-02
SR32	5.4E-02	6.8E-04	5.5E-02	1.8E-02	2.3E-04	1.8E-02
SR33	5.3E-02	7.7E-04	5.4E-02	1.8E-02	2.6E-04	1.8E-02
SR34	5.3E-02	8.7E-04	5.4E-02	1.8E-02	2.9E-04	1.8E-02
SR35	5.3E-02	8.7E-04	5.4E-02	1.8E-02	2.9E-04	1.8E-02
SR36	5.3E-02	2.8E-03	5.5E-02	1.8E-02	9.3E-04	1.8E-02
SR37	5.2E-02	1.5E-03	5.4E-02	1.7E-02	5.0E-04	1.8E-02
SR38	5.4E-02	2.3E-03	5.6E-02	1.8E-02	7.8E-04	1.9E-02
SR39	5.3E-02	1.4E-03	5.5E-02	1.8E-02	4.7E-04	1.8E-02
SR40	5.3E-02	2.7E-03	5.5E-02	1.8E-02	9.0E-04	1.8E-02
SR41	5.3E-02	5.8E-03	5.8E-02	1.8E-02	1.9E-03	1.9E-02
SR42	5.5E-02	1.0E-03	5.6E-02	1.8E-02	3.4E-04	1.9E-02
SR43	6.0E-02	8.4E-04	6.1E-02	2.0E-02	2.8E-04	2.0E-02
SR44	5.4E-02	5.2E-04	5.4E-02	1.8E-02	1.7E-04	1.8E-02
SR45	5.3E-02	2.5E-04	5.3E-02	1.8E-02	8.3E-05	1.8E-02
SR46	5.4E-02	2.0E-04	5.4E-02	1.8E-02	6.6E-05	1.8E-02
SR47	5.4E-02	2.1E-04	5.4E-02	1.8E-02	6.9E-05	1.8E-02
SR48	5.3E-02	1.3E-04	5.3E-02	1.8E-02	4.5E-05	1.8E-02
SR49	5.4E-02	1.4E-04	5.4E-02	1.8E-02	4.7E-05	1.8E-02
SR50	5.2E-02	3.5E-04	5.3E-02	1.7E-02	1.2E-04	1.8E-02
SR51	5.2E-02	1.1E-03	5.3E-02	1.7E-02	3.6E-04	1.8E-02
SR52	5.3E-02	2.3E-04	5.3E-02	1.8E-02	7.6E-05	1.8E-02
SR53	5.3E-02	1.2E-04	5.3E-02	1.8E-02	4.1E-05	1.8E-02
SR54	5.2E-02	1.2E-04	5.3E-02	1.7E-02	4.1E-05	1.8E-02
SR55	5.3E-02	8.1E-05	5.3E-02	1.8E-02	2.7E-05	1.8E-02
SR56	5.2E-02	5.6E-05	5.2E-02	1.7E-02	1.9E-05	1.7E-02
SR57	5.4E-02	4.7E-04	5.5E-02	1.8E-02	1.6E-04	1.8E-02
SR58	5.2E-02	6.5E-05	5.2E-02	1.7E-02	2.2E-05	1.7E-02

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-37 Exposure Concentrations and Exposure Ratios for 1-hour Arsenic (Construction)

Human Receptor Location	1-hour Arsenic (TRV = 0.1 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	2.2E-03	4.0E-02	4.0E-02	2.2E-02	4.0E-01	4.0E-01
SR01	6.6E-04	3.0E-03	3.5E-03	6.6E-03	3.0E-02	3.5E-02
SR02	8.7E-04	1.9E-03	2.5E-03	8.7E-03	1.9E-02	2.5E-02
SR03	7.9E-04	2.1E-03	2.6E-03	7.9E-03	2.1E-02	2.6E-02
SR04	6.1E-04	7.0E-03	7.5E-03	6.1E-03	7.0E-02	7.5E-02
SR05	7.2E-04	7.7E-03	8.2E-03	7.2E-03	7.7E-02	8.2E-02
SR06	6.3E-04	4.9E-03	5.4E-03	6.3E-03	4.9E-02	5.4E-02
SR07	6.0E-04	4.2E-03	4.8E-03	6.0E-03	4.2E-02	4.8E-02
SR08	6.7E-04	5.1E-03	5.6E-03	6.7E-03	5.1E-02	5.6E-02
SR09	6.5E-04	4.2E-03	4.8E-03	6.5E-03	4.2E-02	4.8E-02
SR10	6.1E-04	5.7E-03	6.3E-03	6.1E-03	5.7E-02	6.3E-02
SR11	9.4E-04	1.2E-02	1.2E-02	9.4E-03	1.2E-01	1.2E-01
SR12	6.6E-04	9.9E-03	1.0E-02	6.6E-03	9.9E-02	1.0E-01
SR13	6.9E-04	9.1E-03	9.6E-03	6.9E-03	9.1E-02	9.6E-02
SR14	6.5E-04	1.1E-02	1.1E-02	6.5E-03	1.1E-01	1.1E-01
SR15	6.3E-04	1.1E-02	1.2E-02	6.3E-03	1.1E-01	1.2E-01
SR16	5.6E-04	1.3E-02	1.3E-02	5.6E-03	1.3E-01	1.3E-01
SR17	5.9E-04	5.6E-03	6.1E-03	5.9E-03	5.6E-02	6.1E-02
SR18	6.8E-04	1.4E-02	1.4E-02	6.8E-03	1.4E-01	1.4E-01
SR19	6.2E-04	2.3E-02	2.4E-02	6.2E-03	2.3E-01	2.4E-01
SR20	6.6E-04	1.6E-02	1.6E-02	6.6E-03	1.6E-01	1.6E-01
SR21	5.5E-04	4.6E-03	5.1E-03	5.5E-03	4.6E-02	5.1E-02
SR22	5.4E-04	5.5E-03	6.0E-03	5.4E-03	5.5E-02	6.0E-02
SR23	5.4E-04	4.8E-03	5.3E-03	5.4E-03	4.8E-02	5.3E-02
SR24	5.4E-04	4.4E-03	4.9E-03	5.4E-03	4.4E-02	4.9E-02
SR25	7.1E-04	1.7E-02	1.7E-02	7.1E-03	1.7E-01	1.7E-01
SR26	6.4E-04	3.3E-03	3.8E-03	6.4E-03	3.3E-02	3.8E-02
SR27	6.8E-04	2.3E-03	3.0E-03	6.8E-03	2.3E-02	3.0E-02
SR28	6.8E-04	2.3E-03	3.0E-03	6.8E-03	2.3E-02	3.0E-02
SR29	6.9E-04	2.3E-03	2.9E-03	6.9E-03	2.3E-02	2.9E-02
SR30	8.9E-04	2.5E-03	3.2E-03	8.9E-03	2.5E-02	3.2E-02
SR31	8.9E-04	2.5E-03	3.2E-03	8.9E-03	2.5E-02	3.2E-02
SR32	7.3E-04	2.4E-03	3.1E-03	7.3E-03	2.4E-02	3.1E-02
SR33	6.3E-04	2.5E-03	3.0E-03	6.3E-03	2.5E-02	3.0E-02
SR34	6.0E-04	2.4E-03	3.0E-03	6.0E-03	2.4E-02	3.0E-02
SR35	6.0E-04	2.4E-03	3.0E-03	6.0E-03	2.4E-02	3.0E-02
SR36	5.8E-04	1.4E-02	1.4E-02	5.8E-03	1.4E-01	1.4E-01
SR37	5.3E-04	4.8E-03	5.3E-03	5.3E-03	4.8E-02	5.3E-02
SR38	6.7E-04	4.8E-03	5.4E-03	6.7E-03	4.8E-02	5.4E-02
SR39	7.3E-04	4.7E-03	5.3E-03	7.3E-03	4.7E-02	5.3E-02
SR40	5.7E-04	1.1E-02	1.2E-02	5.7E-03	1.1E-01	1.2E-01
SR41	5.8E-04	2.4E-02	2.5E-02	5.8E-03	2.4E-01	2.5E-01
SR42	9.7E-04	1.3E-03	1.9E-03	9.7E-03	1.3E-02	1.9E-02
SR43	1.5E-03	1.4E-03	2.5E-03	1.5E-02	1.4E-02	2.5E-02
SR44	7.2E-04	2.1E-03	2.6E-03	7.2E-03	2.1E-02	2.6E-02
SR45	5.7E-04	1.4E-03	1.9E-03	5.7E-03	1.4E-02	1.9E-02
SR46	6.3E-04	1.1E-03	1.6E-03	6.3E-03	1.1E-02	1.6E-02
SR47	6.3E-04	1.1E-03	1.6E-03	6.3E-03	1.1E-02	1.6E-02
SR48	6.0E-04	6.4E-04	1.2E-03	6.0E-03	6.4E-03	1.2E-02
SR49	7.3E-04	7.1E-04	1.3E-03	7.3E-03	7.1E-03	1.3E-02
SR50	5.3E-04	9.6E-04	1.5E-03	5.3E-03	9.6E-03	1.5E-02
SR51	5.4E-04	3.2E-03	3.7E-03	5.4E-03	3.2E-02	3.7E-02
SR52	6.9E-04	1.2E-03	1.8E-03	6.9E-03	1.2E-02	1.8E-02
SR53	5.6E-04	5.5E-04	1.1E-03	5.6E-03	5.5E-03	1.1E-02
SR54	6.6E-04	5.8E-04	1.1E-03	6.6E-03	5.8E-03	1.1E-02
SR55	6.8E-04	3.7E-04	9.0E-04	6.8E-03	3.7E-03	9.0E-03
SR56	5.3E-04	2.6E-04	7.7E-04	5.3E-03	2.6E-03	7.7E-03
SR57	7.2E-04	2.6E-03	3.3E-03	7.2E-03	2.6E-02	3.3E-02
SR58	5.3E-04	4.0E-04	9.1E-04	5.3E-03	4.0E-03	9.1E-03

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-38 Exposure Concentrations and Exposure Ratios for Annual Arsenic (Construction)

Human Receptor Location	Annual Arsenic (non-threshold TRV = 0.01 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	5.6E-04	2.2E-03	2.3E-03	5.6E-02	2.2E-01	2.3E-01
SR01	1.8E-04	1.1E-04	2.9E-04	1.8E-02	1.1E-02	2.9E-02
SR02	1.9E-04	6.8E-05	2.6E-04	1.9E-02	6.8E-03	2.6E-02
SR03	1.9E-04	7.4E-05	2.6E-04	1.9E-02	7.4E-03	2.6E-02
SR04	1.7E-04	2.5E-04	4.2E-04	1.7E-02	2.5E-02	4.2E-02
SR05	1.8E-04	2.7E-04	4.5E-04	1.8E-02	2.7E-02	4.5E-02
SR06	1.8E-04	1.1E-04	3.0E-04	1.8E-02	1.1E-02	3.0E-02
SR07	1.8E-04	7.7E-05	2.6E-04	1.8E-02	7.7E-03	2.6E-02
SR08	1.9E-04	1.1E-04	3.0E-04	1.9E-02	1.1E-02	3.0E-02
SR09	1.7E-04	1.6E-04	3.3E-04	1.7E-02	1.6E-02	3.3E-02
SR10	1.7E-04	1.9E-04	3.6E-04	1.7E-02	1.9E-02	3.6E-02
SR11	2.2E-04	4.1E-04	6.3E-04	2.2E-02	4.1E-02	6.3E-02
SR12	1.7E-04	4.7E-04	6.4E-04	1.7E-02	4.7E-02	6.4E-02
SR13	1.7E-04	4.2E-04	5.9E-04	1.7E-02	4.2E-02	5.9E-02
SR14	1.7E-04	6.0E-04	7.7E-04	1.7E-02	6.0E-02	7.7E-02
SR15	1.7E-04	6.2E-04	7.9E-04	1.7E-02	6.2E-02	7.9E-02
SR16	1.7E-04	6.2E-04	7.8E-04	1.7E-02	6.2E-02	7.8E-02
SR17	1.7E-04	1.6E-04	3.3E-04	1.7E-02	1.6E-02	3.3E-02
SR18	1.7E-04	5.4E-04	7.1E-04	1.7E-02	5.4E-02	7.1E-02
SR19	1.7E-04	1.5E-03	1.7E-03	1.7E-02	1.5E-01	1.7E-01
SR20	1.7E-04	8.0E-04	9.7E-04	1.7E-02	8.0E-02	9.7E-02
SR21	1.7E-04	2.4E-04	4.1E-04	1.7E-02	2.4E-02	4.1E-02
SR22	1.7E-04	3.0E-04	4.7E-04	1.7E-02	3.0E-02	4.7E-02
SR23	1.6E-04	2.5E-04	4.2E-04	1.6E-02	2.5E-02	4.2E-02
SR24	1.7E-04	2.7E-04	4.3E-04	1.7E-02	2.7E-02	4.3E-02
SR25	1.8E-04	8.6E-04	1.0E-03	1.8E-02	8.6E-02	1.0E-01
SR26	1.7E-04	3.8E-05	2.1E-04	1.7E-02	3.8E-03	2.1E-02
SR27	1.8E-04	3.3E-05	2.1E-04	1.8E-02	3.3E-03	2.1E-02
SR28	1.8E-04	3.3E-05	2.1E-04	1.8E-02	3.3E-03	2.1E-02
SR29	1.7E-04	3.5E-05	2.1E-04	1.7E-02	3.5E-03	2.1E-02
SR30	2.3E-04	4.1E-05	2.7E-04	2.3E-02	4.1E-03	2.7E-02
SR31	2.3E-04	4.1E-05	2.7E-04	2.3E-02	4.1E-03	2.7E-02
SR32	1.9E-04	4.9E-05	2.4E-04	1.9E-02	4.9E-03	2.4E-02
SR33	1.7E-04	5.8E-05	2.3E-04	1.7E-02	5.8E-03	2.3E-02
SR34	1.7E-04	6.9E-05	2.4E-04	1.7E-02	6.9E-03	2.4E-02
SR35	1.7E-04	6.9E-05	2.4E-04	1.7E-02	6.9E-03	2.4E-02
SR36	1.7E-04	4.2E-04	5.9E-04	1.7E-02	4.2E-02	5.9E-02
SR37	1.6E-04	2.5E-04	4.1E-04	1.6E-02	2.5E-02	4.1E-02
SR38	1.8E-04	3.6E-04	5.4E-04	1.8E-02	3.6E-02	5.4E-02
SR39	1.8E-04	1.8E-04	3.5E-04	1.8E-02	1.8E-02	3.5E-02
SR40	1.7E-04	3.3E-04	5.0E-04	1.7E-02	3.3E-02	5.0E-02
SR41	1.7E-04	9.5E-04	1.1E-03	1.7E-02	9.5E-02	1.1E-01
SR42	2.1E-04	4.1E-05	2.5E-04	2.1E-02	4.1E-03	2.5E-02
SR43	3.1E-04	5.0E-05	3.6E-04	3.1E-02	5.0E-03	3.6E-02
SR44	2.0E-04	5.5E-05	2.6E-04	2.0E-02	5.5E-03	2.6E-02
SR45	1.7E-04	1.9E-05	1.9E-04	1.7E-02	1.9E-03	1.9E-02
SR46	1.8E-04	1.4E-05	1.9E-04	1.8E-02	1.4E-03	1.9E-02
SR47	1.8E-04	1.5E-05	1.9E-04	1.8E-02	1.5E-03	1.9E-02
SR48	1.7E-04	7.7E-06	1.8E-04	1.7E-02	7.7E-04	1.8E-02
SR49	1.8E-04	8.4E-06	1.9E-04	1.8E-02	8.4E-04	1.9E-02
SR50	1.6E-04	4.6E-05	2.1E-04	1.6E-02	4.6E-03	2.1E-02
SR51	1.6E-04	2.0E-04	3.6E-04	1.6E-02	2.0E-02	3.6E-02
SR52	1.7E-04	1.2E-05	1.8E-04	1.7E-02	1.2E-03	1.8E-02
SR53	1.7E-04	7.5E-06	1.7E-04	1.7E-02	7.5E-04	1.7E-02
SR54	1.7E-04	5.5E-06	1.7E-04	1.7E-02	5.5E-04	1.7E-02
SR55	1.8E-04	3.3E-06	1.8E-04	1.8E-02	3.3E-04	1.8E-02
SR56	1.6E-04	2.3E-06	1.6E-04	1.6E-02	2.3E-04	1.6E-02
SR57	1.9E-04	2.9E-05	2.2E-04	1.9E-02	2.9E-03	2.2E-02
SR58	1.6E-04	4.2E-06	1.7E-04	1.6E-02	4.2E-04	1.7E-02

NOTE:

Shaded cell indicates a ER greater than 1.0

* ERs are based on non-threshold effects (i.e., cancer risk) and therefore only Project case values are compared to a threshold target of 1.0

Table A-39 Exposure Concentrations and Exposure Ratios for 1-hour Chromium VI (Construction)

Human Receptor Location	1-hour Chromium VI (TRV = 1.3 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	5.1E-03	1.5E-01	1.5E-01	3.9E-03	1.2E-01	1.2E-01
SR01	1.1E-03	1.1E-02	1.2E-02	8.1E-04	8.5E-03	9.0E-03
SR02	1.6E-03	7.3E-03	7.9E-03	1.2E-03	5.6E-03	6.1E-03
SR03	1.4E-03	7.8E-03	8.4E-03	1.0E-03	6.0E-03	6.5E-03
SR04	9.0E-04	2.6E-02	2.7E-02	6.9E-04	2.0E-02	2.1E-02
SR05	1.3E-03	2.9E-02	2.9E-02	9.9E-04	2.2E-02	2.3E-02
SR06	9.7E-04	1.8E-02	1.9E-02	7.5E-04	1.4E-02	1.5E-02
SR07	8.8E-04	1.6E-02	1.7E-02	6.7E-04	1.2E-02	1.3E-02
SR08	1.1E-03	1.9E-02	2.0E-02	8.4E-04	1.5E-02	1.5E-02
SR09	9.1E-04	1.6E-02	1.7E-02	7.0E-04	1.2E-02	1.3E-02
SR10	8.1E-04	2.1E-02	2.2E-02	6.2E-04	1.6E-02	1.7E-02
SR11	1.6E-03	4.3E-02	4.5E-02	1.2E-03	3.3E-02	3.4E-02
SR12	1.1E-03	3.7E-02	3.8E-02	8.1E-04	2.9E-02	2.9E-02
SR13	1.1E-03	3.4E-02	3.5E-02	8.8E-04	2.6E-02	2.7E-02
SR14	1.0E-03	4.1E-02	4.2E-02	7.9E-04	3.2E-02	3.2E-02
SR15	9.7E-04	4.2E-02	4.3E-02	7.5E-04	3.2E-02	3.3E-02
SR16	7.5E-04	4.7E-02	4.8E-02	5.8E-04	3.6E-02	3.7E-02
SR17	8.4E-04	2.1E-02	2.2E-02	6.5E-04	1.6E-02	1.7E-02
SR18	9.6E-04	5.2E-02	5.2E-02	7.4E-04	4.0E-02	4.0E-02
SR19	8.1E-04	8.7E-02	8.8E-02	6.2E-04	6.7E-02	6.8E-02
SR20	9.0E-04	5.9E-02	5.9E-02	6.9E-04	4.5E-02	4.6E-02
SR21	7.2E-04	1.7E-02	1.8E-02	5.6E-04	1.3E-02	1.4E-02
SR22	6.9E-04	2.1E-02	2.1E-02	5.3E-04	1.6E-02	1.6E-02
SR23	6.8E-04	1.8E-02	1.9E-02	5.2E-04	1.4E-02	1.4E-02
SR24	6.9E-04	1.6E-02	1.7E-02	5.3E-04	1.3E-02	1.3E-02
SR25	1.0E-03	6.3E-02	6.4E-02	7.7E-04	4.9E-02	4.9E-02
SR26	8.7E-04	1.2E-02	1.3E-02	6.7E-04	9.3E-03	9.8E-03
SR27	9.2E-04	8.8E-03	9.6E-03	7.1E-04	6.7E-03	7.4E-03
SR28	9.2E-04	8.8E-03	9.6E-03	7.1E-04	6.7E-03	7.4E-03
SR29	9.2E-04	8.5E-03	9.4E-03	7.1E-04	6.5E-03	7.2E-03
SR30	1.4E-03	9.3E-03	1.1E-02	1.1E-03	7.1E-03	8.1E-03
SR31	1.4E-03	9.3E-03	1.1E-02	1.1E-03	7.1E-03	8.1E-03
SR32	1.1E-03	9.0E-03	9.9E-03	8.4E-04	6.9E-03	7.6E-03
SR33	8.4E-04	9.2E-03	1.0E-02	6.5E-04	7.1E-03	7.7E-03
SR34	7.8E-04	9.0E-03	9.7E-03	6.0E-04	6.9E-03	7.5E-03
SR35	7.8E-04	9.0E-03	9.7E-03	6.0E-04	6.9E-03	7.5E-03
SR36	8.2E-04	5.1E-02	5.2E-02	6.3E-04	3.9E-02	4.0E-02
SR37	6.7E-04	1.8E-02	1.8E-02	5.2E-04	1.4E-02	1.4E-02
SR38	9.3E-04	1.8E-02	1.9E-02	7.2E-04	1.4E-02	1.4E-02
SR39	1.1E-03	1.8E-02	1.8E-02	8.6E-04	1.4E-02	1.4E-02
SR40	7.1E-04	4.2E-02	4.3E-02	5.5E-04	3.3E-02	3.3E-02
SR41	7.3E-04	9.1E-02	9.2E-02	5.6E-04	7.0E-02	7.1E-02
SR42	1.8E-03	4.7E-03	5.8E-03	1.4E-03	3.6E-03	4.5E-03
SR43	3.2E-03	5.4E-03	7.5E-03	2.5E-03	4.1E-03	5.8E-03
SR44	1.3E-03	7.8E-03	8.5E-03	9.8E-04	6.0E-03	6.5E-03
SR45	7.2E-04	5.2E-03	5.8E-03	5.5E-04	4.0E-03	4.5E-03
SR46	8.4E-04	4.1E-03	4.7E-03	6.5E-04	3.2E-03	3.6E-03
SR47	8.4E-04	4.1E-03	4.7E-03	6.4E-04	3.1E-03	3.6E-03
SR48	7.5E-04	2.4E-03	3.0E-03	5.7E-04	1.9E-03	2.3E-03
SR49	1.0E-03	2.7E-03	3.4E-03	8.0E-04	2.0E-03	2.6E-03
SR50	6.7E-04	3.6E-03	4.2E-03	5.2E-04	2.8E-03	3.2E-03
SR51	6.9E-04	1.2E-02	1.3E-02	5.3E-04	9.3E-03	9.8E-03
SR52	9.9E-04	4.5E-03	5.1E-03	7.6E-04	3.5E-03	3.9E-03
SR53	6.8E-04	2.1E-03	2.7E-03	5.2E-04	1.6E-03	2.1E-03
SR54	9.4E-04	2.2E-03	2.8E-03	7.2E-04	1.7E-03	2.2E-03
SR55	1.0E-03	1.4E-03	2.0E-03	7.7E-04	1.1E-03	1.6E-03
SR56	6.4E-04	9.5E-04	1.6E-03	4.9E-04	7.3E-04	1.2E-03
SR57	1.1E-03	9.9E-03	1.1E-02	8.2E-04	7.6E-03	8.4E-03
SR58	6.5E-04	1.5E-03	2.1E-03	5.0E-04	1.2E-03	1.6E-03

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-40 Exposure Concentrations and Exposure Ratios for Annual Chromium VI (Construction)

Human Receptor Location	Annual Chromium VI (non-threshold TRV = 0.0043 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	1.4E-03	8.1E-03	8.5E-03	3.2E-01	1.9E+00	2.0E+00
SR01	3.6E-04	4.1E-04	7.7E-04	8.4E-02	9.6E-02	1.8E-01
SR02	4.1E-04	2.5E-04	6.6E-04	9.5E-02	5.9E-02	1.5E-01
SR03	3.9E-04	2.8E-04	6.7E-04	9.1E-02	6.5E-02	1.6E-01
SR04	3.5E-04	9.5E-04	1.3E-03	8.1E-02	2.2E-01	3.0E-01
SR05	3.7E-04	1.0E-03	1.4E-03	8.6E-02	2.4E-01	3.3E-01
SR06	3.8E-04	4.3E-04	8.1E-04	8.9E-02	1.0E-01	1.9E-01
SR07	3.7E-04	2.9E-04	6.6E-04	8.6E-02	6.7E-02	1.5E-01
SR08	3.9E-04	4.3E-04	8.2E-04	9.1E-02	1.0E-01	1.9E-01
SR09	3.5E-04	5.8E-04	9.4E-04	8.2E-02	1.4E-01	2.2E-01
SR10	3.4E-04	7.2E-04	1.1E-03	7.9E-02	1.7E-01	2.5E-01
SR11	4.7E-04	1.6E-03	2.0E-03	1.1E-01	3.6E-01	4.7E-01
SR12	3.5E-04	1.8E-03	2.1E-03	8.2E-02	4.1E-01	4.9E-01
SR13	3.6E-04	1.6E-03	1.9E-03	8.3E-02	3.6E-01	4.5E-01
SR14	3.5E-04	2.3E-03	2.6E-03	8.1E-02	5.2E-01	6.0E-01
SR15	3.5E-04	2.3E-03	2.7E-03	8.1E-02	5.4E-01	6.2E-01
SR16	3.3E-04	2.3E-03	2.6E-03	7.8E-02	5.4E-01	6.2E-01
SR17	3.4E-04	6.2E-04	9.6E-04	8.0E-02	1.4E-01	2.2E-01
SR18	3.5E-04	2.0E-03	2.4E-03	8.1E-02	4.7E-01	5.5E-01
SR19	3.4E-04	5.6E-03	5.9E-03	7.9E-02	1.3E+00	1.4E+00
SR20	3.5E-04	3.0E-03	3.3E-03	8.1E-02	7.0E-01	7.8E-01
SR21	3.4E-04	9.1E-04	1.2E-03	7.8E-02	2.1E-01	2.9E-01
SR22	3.3E-04	1.1E-03	1.5E-03	7.7E-02	2.6E-01	3.4E-01
SR23	3.3E-04	9.4E-04	1.3E-03	7.7E-02	2.2E-01	3.0E-01
SR24	3.3E-04	1.0E-03	1.3E-03	7.7E-02	2.3E-01	3.1E-01
SR25	3.6E-04	3.2E-03	3.6E-03	8.4E-02	7.6E-01	8.4E-01
SR26	3.4E-04	1.4E-04	4.8E-04	7.9E-02	3.3E-02	1.1E-01
SR27	3.5E-04	1.2E-04	4.7E-04	8.2E-02	2.9E-02	1.1E-01
SR28	3.5E-04	1.2E-04	4.7E-04	8.2E-02	2.9E-02	1.1E-01
SR29	3.5E-04	1.3E-04	4.8E-04	8.1E-02	3.1E-02	1.1E-01
SR30	4.9E-04	1.5E-04	6.4E-04	1.1E-01	3.6E-02	1.5E-01
SR31	4.9E-04	1.5E-04	6.4E-04	1.1E-01	3.6E-02	1.5E-01
SR32	4.0E-04	1.8E-04	5.8E-04	9.4E-02	4.3E-02	1.4E-01
SR33	3.5E-04	2.2E-04	5.7E-04	8.1E-02	5.1E-02	1.3E-01
SR34	3.4E-04	2.6E-04	6.0E-04	7.9E-02	6.0E-02	1.4E-01
SR35	3.4E-04	2.6E-04	6.0E-04	7.9E-02	6.0E-02	1.4E-01
SR36	3.4E-04	1.6E-03	1.9E-03	7.9E-02	3.7E-01	4.5E-01
SR37	3.3E-04	9.2E-04	1.3E-03	7.7E-02	2.1E-01	2.9E-01
SR38	3.7E-04	1.3E-03	1.7E-03	8.6E-02	3.1E-01	4.0E-01
SR39	3.5E-04	6.6E-04	1.0E-03	8.2E-02	1.5E-01	2.4E-01
SR40	3.3E-04	1.3E-03	1.6E-03	7.7E-02	2.9E-01	3.7E-01
SR41	3.3E-04	3.6E-03	3.9E-03	7.7E-02	8.3E-01	9.0E-01
SR42	4.4E-04	1.5E-04	5.9E-04	1.0E-01	3.6E-02	1.4E-01
SR43	7.2E-04	1.9E-04	9.1E-04	1.7E-01	4.4E-02	2.1E-01
SR44	4.5E-04	2.1E-04	6.5E-04	1.0E-01	4.8E-02	1.5E-01
SR45	3.4E-04	7.2E-05	4.1E-04	8.0E-02	1.7E-02	9.6E-02
SR46	3.5E-04	5.3E-05	4.0E-04	8.2E-02	1.2E-02	9.4E-02
SR47	3.5E-04	5.4E-05	4.0E-04	8.1E-02	1.3E-02	9.4E-02
SR48	3.4E-04	2.9E-05	3.7E-04	7.9E-02	6.7E-03	8.5E-02
SR49	3.7E-04	3.2E-05	4.0E-04	8.5E-02	7.4E-03	9.2E-02
SR50	3.3E-04	1.7E-04	5.0E-04	7.7E-02	4.0E-02	1.2E-01
SR51	3.3E-04	7.5E-04	1.1E-03	7.7E-02	1.7E-01	2.5E-01
SR52	3.4E-04	4.5E-05	3.8E-04	7.8E-02	1.0E-02	8.9E-02
SR53	3.3E-04	2.8E-05	3.6E-04	7.7E-02	6.5E-03	8.3E-02
SR54	3.3E-04	2.0E-05	3.5E-04	7.7E-02	4.8E-03	8.2E-02
SR55	3.6E-04	1.2E-05	3.7E-04	8.3E-02	2.9E-03	8.6E-02
SR56	3.2E-04	8.4E-06	3.3E-04	7.5E-02	2.0E-03	7.7E-02
SR57	4.0E-04	1.1E-04	5.1E-04	9.3E-02	2.6E-02	1.2E-01
SR58	3.2E-04	1.6E-05	3.4E-04	7.5E-02	3.7E-03	7.9E-02

NOTE:

Shaded cell indicates a ER greater than 1.0

* ERs are based on non-threshold effects (i.e., cancer risk) and therefore only Project case values are compared to a threshold target of 1.0

Table A-41 Exposure Concentrations and Exposure Ratios for 1-hour Manganese (Construction)

Human Receptor Location	1-hour Manganese (TRV = 9.1 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	4.8E-03	8.6E-04	5.4E-03	5.3E-04	9.5E-05	6.0E-04
SR01	4.5E-03	1.6E-04	4.7E-03	5.0E-04	1.8E-05	5.1E-04
SR02	4.6E-03	9.9E-05	4.6E-03	5.0E-04	1.1E-05	5.1E-04
SR03	4.6E-03	7.0E-05	4.6E-03	5.0E-04	7.7E-06	5.0E-04
SR04	4.5E-03	5.1E-05	4.6E-03	5.0E-04	5.6E-06	5.0E-04
SR05	4.5E-03	6.3E-05	4.6E-03	5.0E-04	7.0E-06	5.0E-04
SR06	4.5E-03	3.4E-05	4.6E-03	5.0E-04	3.7E-06	5.0E-04
SR07	4.5E-03	2.8E-05	4.5E-03	5.0E-04	3.1E-06	5.0E-04
SR08	4.5E-03	2.7E-05	4.5E-03	5.0E-04	2.9E-06	5.0E-04
SR09	4.6E-03	1.8E-04	4.7E-03	5.0E-04	1.9E-05	5.2E-04
SR10	4.5E-03	7.8E-05	4.6E-03	5.0E-04	8.6E-06	5.1E-04
SR11	4.6E-03	9.4E-05	4.7E-03	5.1E-04	1.0E-05	5.1E-04
SR12	4.5E-03	9.4E-05	4.6E-03	5.0E-04	1.0E-05	5.1E-04
SR13	4.5E-03	8.9E-05	4.6E-03	5.0E-04	9.7E-06	5.1E-04
SR14	4.5E-03	1.2E-04	4.6E-03	5.0E-04	1.3E-05	5.1E-04
SR15	4.5E-03	9.5E-05	4.6E-03	5.0E-04	1.0E-05	5.1E-04
SR16	4.5E-03	7.4E-05	4.6E-03	5.0E-04	8.1E-06	5.0E-04
SR17	4.5E-03	2.8E-05	4.5E-03	5.0E-04	3.1E-06	5.0E-04
SR18	4.6E-03	1.0E-04	4.6E-03	5.0E-04	1.1E-05	5.1E-04
SR19	4.5E-03	1.3E-04	4.7E-03	5.0E-04	1.4E-05	5.1E-04
SR20	4.6E-03	8.9E-05	4.6E-03	5.0E-04	9.8E-06	5.1E-04
SR21	4.5E-03	3.5E-05	4.5E-03	5.0E-04	3.9E-06	5.0E-04
SR22	4.5E-03	3.7E-05	4.5E-03	5.0E-04	4.0E-06	5.0E-04
SR23	4.5E-03	3.1E-05	4.5E-03	5.0E-04	3.4E-06	5.0E-04
SR24	4.5E-03	2.4E-05	4.5E-03	5.0E-04	2.7E-06	5.0E-04
SR25	4.6E-03	1.1E-04	4.7E-03	5.0E-04	1.3E-05	5.1E-04
SR26	4.6E-03	4.3E-05	4.6E-03	5.0E-04	4.7E-06	5.0E-04
SR27	4.6E-03	3.4E-05	4.6E-03	5.0E-04	3.8E-06	5.0E-04
SR28	4.6E-03	3.4E-05	4.6E-03	5.0E-04	3.8E-06	5.0E-04
SR29	4.6E-03	3.7E-05	4.6E-03	5.0E-04	4.0E-06	5.1E-04
SR30	4.6E-03	3.9E-05	4.6E-03	5.1E-04	4.3E-06	5.1E-04
SR31	4.6E-03	3.9E-05	4.6E-03	5.1E-04	4.3E-06	5.1E-04
SR32	4.6E-03	3.5E-05	4.6E-03	5.0E-04	3.9E-06	5.1E-04
SR33	4.5E-03	3.4E-05	4.6E-03	5.0E-04	3.8E-06	5.0E-04
SR34	4.5E-03	3.3E-05	4.6E-03	5.0E-04	3.6E-06	5.0E-04
SR35	4.5E-03	3.3E-05	4.6E-03	5.0E-04	3.6E-06	5.0E-04
SR36	4.5E-03	7.2E-05	4.6E-03	5.0E-04	7.9E-06	5.0E-04
SR37	4.5E-03	3.1E-05	4.5E-03	5.0E-04	3.5E-06	5.0E-04
SR38	4.6E-03	5.1E-05	4.6E-03	5.0E-04	5.6E-06	5.0E-04
SR39	4.6E-03	4.4E-05	4.6E-03	5.0E-04	4.9E-06	5.0E-04
SR40	4.5E-03	9.7E-05	4.6E-03	5.0E-04	1.1E-05	5.1E-04
SR41	4.5E-03	1.6E-04	4.7E-03	5.0E-04	1.8E-05	5.1E-04
SR42	4.6E-03	5.3E-05	4.6E-03	5.1E-04	5.8E-06	5.1E-04
SR43	4.7E-03	6.3E-05	4.7E-03	5.2E-04	7.0E-06	5.2E-04
SR44	4.5E-03	1.3E-05	4.5E-03	5.0E-04	1.5E-06	5.0E-04
SR45	4.5E-03	9.4E-06	4.5E-03	5.0E-04	1.0E-06	5.0E-04
SR46	4.6E-03	8.1E-06	4.6E-03	5.0E-04	8.9E-07	5.0E-04
SR47	4.6E-03	8.2E-06	4.6E-03	5.0E-04	9.0E-07	5.0E-04
SR48	4.5E-03	6.2E-06	4.5E-03	5.0E-04	6.8E-07	5.0E-04
SR49	4.6E-03	6.3E-06	4.6E-03	5.0E-04	6.9E-07	5.0E-04
SR50	4.5E-03	5.5E-06	4.5E-03	5.0E-04	6.0E-07	5.0E-04
SR51	4.5E-03	1.6E-05	4.5E-03	5.0E-04	1.7E-06	5.0E-04
SR52	4.6E-03	1.8E-05	4.6E-03	5.0E-04	2.0E-06	5.0E-04
SR53	4.5E-03	6.4E-06	4.5E-03	5.0E-04	7.0E-07	5.0E-04
SR54	4.5E-03	1.1E-05	4.5E-03	5.0E-04	1.2E-06	5.0E-04
SR55	4.6E-03	7.0E-06	4.6E-03	5.0E-04	7.7E-07	5.0E-04
SR56	4.5E-03	6.0E-06	4.5E-03	5.0E-04	6.6E-07	5.0E-04
SR57	4.6E-03	3.8E-05	4.6E-03	5.0E-04	4.2E-06	5.0E-04
SR58	4.5E-03	3.2E-06	4.5E-03	5.0E-04	3.6E-07	5.0E-04

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-42 Exposure Concentrations and Exposure Ratios for Annual Manganese (Construction)

Human Receptor Location	Annual Manganese (TRV = 0.84 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	2.1E-03	1.8E-05	2.1E-03	2.5E-03	2.1E-05	2.5E-03
SR01	2.0E-03	2.9E-06	2.0E-03	2.4E-03	3.5E-06	2.4E-03
SR02	2.0E-03	9.9E-07	2.0E-03	2.4E-03	1.2E-06	2.4E-03
SR03	2.0E-03	9.0E-07	2.0E-03	2.4E-03	1.1E-06	2.4E-03
SR04	2.0E-03	1.8E-06	2.0E-03	2.4E-03	2.1E-06	2.4E-03
SR05	2.0E-03	1.8E-06	2.0E-03	2.4E-03	2.1E-06	2.4E-03
SR06	2.0E-03	8.4E-07	2.0E-03	2.4E-03	1.0E-06	2.4E-03
SR07	2.0E-03	6.1E-07	2.0E-03	2.4E-03	7.3E-07	2.4E-03
SR08	2.0E-03	7.2E-07	2.0E-03	2.4E-03	8.6E-07	2.4E-03
SR09	2.0E-03	1.9E-06	2.0E-03	2.4E-03	2.3E-06	2.4E-03
SR10	2.0E-03	1.5E-06	2.0E-03	2.4E-03	1.8E-06	2.4E-03
SR11	2.0E-03	2.4E-06	2.0E-03	2.4E-03	2.8E-06	2.4E-03
SR12	2.0E-03	2.7E-06	2.0E-03	2.4E-03	3.2E-06	2.4E-03
SR13	2.0E-03	2.4E-06	2.0E-03	2.4E-03	2.9E-06	2.4E-03
SR14	2.0E-03	3.2E-06	2.0E-03	2.4E-03	3.9E-06	2.4E-03
SR15	2.0E-03	3.4E-06	2.0E-03	2.4E-03	4.0E-06	2.4E-03
SR16	2.0E-03	2.5E-06	2.0E-03	2.4E-03	3.0E-06	2.4E-03
SR17	2.0E-03	9.2E-07	2.0E-03	2.4E-03	1.1E-06	2.4E-03
SR18	2.0E-03	3.0E-06	2.0E-03	2.4E-03	3.5E-06	2.4E-03
SR19	2.0E-03	6.7E-06	2.0E-03	2.4E-03	7.9E-06	2.4E-03
SR20	2.0E-03	3.3E-06	2.0E-03	2.4E-03	3.9E-06	2.4E-03
SR21	2.0E-03	1.2E-06	2.0E-03	2.4E-03	1.4E-06	2.4E-03
SR22	2.0E-03	1.2E-06	2.0E-03	2.4E-03	1.4E-06	2.4E-03
SR23	2.0E-03	1.1E-06	2.0E-03	2.4E-03	1.3E-06	2.4E-03
SR24	2.0E-03	1.1E-06	2.0E-03	2.4E-03	1.3E-06	2.4E-03
SR25	2.0E-03	4.1E-06	2.0E-03	2.4E-03	4.9E-06	2.4E-03
SR26	2.0E-03	3.8E-07	2.0E-03	2.4E-03	4.5E-07	2.4E-03
SR27	2.0E-03	3.6E-07	2.0E-03	2.4E-03	4.3E-07	2.4E-03
SR28	2.0E-03	3.6E-07	2.0E-03	2.4E-03	4.3E-07	2.4E-03
SR29	2.0E-03	3.8E-07	2.0E-03	2.4E-03	4.5E-07	2.4E-03
SR30	2.0E-03	4.2E-07	2.0E-03	2.4E-03	5.0E-07	2.4E-03
SR31	2.0E-03	4.2E-07	2.0E-03	2.4E-03	5.0E-07	2.4E-03
SR32	2.0E-03	4.8E-07	2.0E-03	2.4E-03	5.7E-07	2.4E-03
SR33	2.0E-03	5.4E-07	2.0E-03	2.4E-03	6.4E-07	2.4E-03
SR34	2.0E-03	6.1E-07	2.0E-03	2.4E-03	7.3E-07	2.4E-03
SR35	2.0E-03	6.1E-07	2.0E-03	2.4E-03	7.3E-07	2.4E-03
SR36	2.0E-03	2.0E-06	2.0E-03	2.4E-03	2.4E-06	2.4E-03
SR37	2.0E-03	1.1E-06	2.0E-03	2.4E-03	1.3E-06	2.4E-03
SR38	2.0E-03	1.7E-06	2.0E-03	2.4E-03	2.0E-06	2.4E-03
SR39	2.0E-03	1.0E-06	2.0E-03	2.4E-03	1.2E-06	2.4E-03
SR40	2.0E-03	2.0E-06	2.0E-03	2.4E-03	2.3E-06	2.4E-03
SR41	2.0E-03	4.2E-06	2.0E-03	2.4E-03	5.1E-06	2.4E-03
SR42	2.0E-03	7.5E-07	2.0E-03	2.4E-03	8.9E-07	2.4E-03
SR43	2.0E-03	6.1E-07	2.0E-03	2.4E-03	7.3E-07	2.4E-03
SR44	2.0E-03	3.8E-07	2.0E-03	2.4E-03	4.5E-07	2.4E-03
SR45	2.0E-03	1.8E-07	2.0E-03	2.4E-03	2.1E-07	2.4E-03
SR46	2.0E-03	1.4E-07	2.0E-03	2.4E-03	1.7E-07	2.4E-03
SR47	2.0E-03	1.5E-07	2.0E-03	2.4E-03	1.8E-07	2.4E-03
SR48	2.0E-03	9.5E-08	2.0E-03	2.4E-03	1.1E-07	2.4E-03
SR49	2.0E-03	1.0E-07	2.0E-03	2.4E-03	1.2E-07	2.4E-03
SR50	2.0E-03	2.5E-07	2.0E-03	2.4E-03	3.0E-07	2.4E-03
SR51	2.0E-03	7.9E-07	2.0E-03	2.4E-03	9.4E-07	2.4E-03
SR52	2.0E-03	1.5E-07	2.0E-03	2.4E-03	1.8E-07	2.4E-03
SR53	2.0E-03	8.7E-08	2.0E-03	2.4E-03	1.0E-07	2.4E-03
SR54	2.0E-03	8.3E-08	2.0E-03	2.4E-03	9.8E-08	2.4E-03
SR55	2.0E-03	5.4E-08	2.0E-03	2.4E-03	6.4E-08	2.4E-03
SR56	2.0E-03	3.7E-08	2.0E-03	2.4E-03	4.4E-08	2.4E-03
SR57	2.0E-03	3.2E-07	2.0E-03	2.4E-03	3.8E-07	2.4E-03
SR58	2.0E-03	4.6E-08	2.0E-03	2.4E-03	5.4E-08	2.4E-03

NOTE:
Shaded cell indicates a ER greater than 1.0

Table A-43 Exposure Concentrations and Exposure Ratios for 1-hour Nickel (Construction)

Human Receptor Location	1-hour Nickel (TRV = 6 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	4.9E-03	1.4E-01	1.4E-01	8.2E-04	2.3E-02	2.4E-02
SR01	8.3E-04	1.0E-02	1.1E-02	1.4E-04	1.7E-03	1.8E-03
SR02	1.4E-03	6.9E-03	7.3E-03	2.3E-04	1.1E-03	1.2E-03
SR03	1.1E-03	7.4E-03	7.8E-03	1.9E-04	1.2E-03	1.3E-03
SR04	6.6E-04	2.5E-02	2.5E-02	1.1E-04	4.1E-03	4.2E-03
SR05	1.0E-03	2.7E-02	2.8E-02	1.7E-04	4.5E-03	4.6E-03
SR06	7.3E-04	1.7E-02	1.8E-02	1.2E-04	2.9E-03	3.0E-03
SR07	6.4E-04	1.5E-02	1.5E-02	1.1E-04	2.5E-03	2.6E-03
SR08	8.6E-04	1.8E-02	1.9E-02	1.4E-04	3.0E-03	3.1E-03
SR09	7.1E-04	1.5E-02	1.5E-02	1.2E-04	2.5E-03	2.6E-03
SR10	6.0E-04	2.0E-02	2.1E-02	1.0E-04	3.4E-03	3.4E-03
SR11	1.5E-03	4.1E-02	4.2E-02	2.4E-04	6.8E-03	7.0E-03
SR12	8.1E-04	3.5E-02	3.6E-02	1.4E-04	5.9E-03	5.9E-03
SR13	9.0E-04	3.2E-02	3.2E-02	1.5E-04	5.3E-03	5.4E-03
SR14	7.9E-04	3.9E-02	3.9E-02	1.3E-04	6.4E-03	6.5E-03
SR15	7.4E-04	4.0E-02	4.0E-02	1.2E-04	6.6E-03	6.7E-03
SR16	5.1E-04	4.4E-02	4.5E-02	8.6E-05	7.4E-03	7.5E-03
SR17	6.1E-04	2.0E-02	2.0E-02	1.0E-04	3.3E-03	3.3E-03
SR18	7.7E-04	4.9E-02	4.9E-02	1.3E-04	8.1E-03	8.2E-03
SR19	6.1E-04	8.2E-02	8.3E-02	1.0E-04	1.4E-02	1.4E-02
SR20	7.1E-04	5.5E-02	5.6E-02	1.2E-04	9.2E-03	9.3E-03
SR21	4.9E-04	1.6E-02	1.7E-02	8.2E-05	2.7E-03	2.8E-03
SR22	4.5E-04	1.9E-02	2.0E-02	7.5E-05	3.2E-03	3.3E-03
SR23	4.5E-04	1.7E-02	1.7E-02	7.4E-05	2.8E-03	2.9E-03
SR24	4.5E-04	1.5E-02	1.6E-02	7.5E-05	2.6E-03	2.6E-03
SR25	8.1E-04	6.0E-02	6.0E-02	1.4E-04	9.9E-03	1.0E-02
SR26	6.7E-04	1.1E-02	1.2E-02	1.1E-04	1.9E-03	2.0E-03
SR27	7.5E-04	8.3E-03	8.9E-03	1.2E-04	1.4E-03	1.5E-03
SR28	7.5E-04	8.3E-03	8.9E-03	1.2E-04	1.4E-03	1.5E-03
SR29	7.5E-04	8.0E-03	8.7E-03	1.2E-04	1.3E-03	1.4E-03
SR30	1.3E-03	8.8E-03	9.8E-03	2.1E-04	1.5E-03	1.6E-03
SR31	1.3E-03	8.8E-03	9.8E-03	2.1E-04	1.5E-03	1.6E-03
SR32	9.0E-04	8.5E-03	9.2E-03	1.5E-04	1.4E-03	1.5E-03
SR33	6.4E-04	8.7E-03	9.2E-03	1.1E-04	1.5E-03	1.5E-03
SR34	5.7E-04	8.5E-03	9.0E-03	9.6E-05	1.4E-03	1.5E-03
SR35	5.7E-04	8.5E-03	9.0E-03	9.6E-05	1.4E-03	1.5E-03
SR36	5.8E-04	4.8E-02	4.8E-02	9.7E-05	8.0E-03	8.1E-03
SR37	4.4E-04	1.7E-02	1.7E-02	7.4E-05	2.8E-03	2.9E-03
SR38	7.4E-04	1.7E-02	1.7E-02	1.2E-04	2.8E-03	2.9E-03
SR39	9.2E-04	1.7E-02	1.7E-02	1.5E-04	2.8E-03	2.9E-03
SR40	4.9E-04	4.0E-02	4.0E-02	8.2E-05	6.7E-03	6.7E-03
SR41	5.1E-04	8.6E-02	8.6E-02	8.6E-05	1.4E-02	1.4E-02
SR42	1.6E-03	4.5E-03	5.3E-03	2.7E-04	7.5E-04	8.9E-04
SR43	3.0E-03	5.1E-03	7.1E-03	5.1E-04	8.5E-04	1.2E-03
SR44	1.0E-03	7.3E-03	7.8E-03	1.7E-04	1.2E-03	1.3E-03
SR45	4.9E-04	4.9E-03	5.3E-03	8.1E-05	8.2E-04	8.9E-04
SR46	6.3E-04	3.9E-03	4.2E-03	1.1E-04	6.4E-04	7.1E-04
SR47	6.3E-04	3.9E-03	4.2E-03	1.1E-04	6.4E-04	7.1E-04
SR48	5.4E-04	2.3E-03	2.7E-03	9.0E-05	3.8E-04	4.5E-04
SR49	8.6E-04	2.5E-03	3.0E-03	1.4E-04	4.2E-04	5.0E-04
SR50	4.3E-04	3.4E-03	3.8E-03	7.2E-05	5.7E-04	6.3E-04
SR51	4.5E-04	1.1E-02	1.2E-02	7.5E-05	1.9E-03	2.0E-03
SR52	7.9E-04	4.2E-03	4.7E-03	1.3E-04	7.1E-04	7.8E-04
SR53	4.6E-04	1.9E-03	2.4E-03	7.7E-05	3.2E-04	3.9E-04
SR54	7.4E-04	2.1E-03	2.5E-03	1.2E-04	3.4E-04	4.1E-04
SR55	8.0E-04	1.3E-03	1.7E-03	1.3E-04	2.2E-04	2.8E-04
SR56	4.1E-04	9.0E-04	1.3E-03	6.8E-05	1.5E-04	2.1E-04
SR57	8.7E-04	9.4E-03	1.0E-02	1.4E-04	1.6E-03	1.7E-03
SR58	4.1E-04	1.4E-03	1.8E-03	6.9E-05	2.4E-04	3.0E-04

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-44 Exposure Concentrations and Exposure Ratios for Annual Nickel (Construction)

Human Receptor Location	Annual Nickel (TRV = 0.05 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	1.3E-03	7.6E-03	7.8E-03	2.6E-02	1.5E-01	1.6E-01
SR01	2.1E-04	3.9E-04	6.1E-04	4.3E-03	7.9E-03	1.2E-02
SR02	2.6E-04	2.4E-04	5.0E-04	5.2E-03	4.8E-03	1.0E-02
SR03	2.5E-04	2.6E-04	5.1E-04	4.9E-03	5.2E-03	1.0E-02
SR04	2.0E-04	8.9E-04	1.1E-03	4.0E-03	1.8E-02	2.2E-02
SR05	2.2E-04	9.7E-04	1.2E-03	4.5E-03	1.9E-02	2.4E-02
SR06	2.3E-04	4.1E-04	6.4E-04	4.7E-03	8.1E-03	1.3E-02
SR07	2.2E-04	2.7E-04	4.9E-04	4.4E-03	5.4E-03	9.9E-03
SR08	2.4E-04	4.0E-04	6.5E-04	4.9E-03	8.1E-03	1.3E-02
SR09	2.1E-04	5.5E-04	7.6E-04	4.1E-03	1.1E-02	1.5E-02
SR10	1.9E-04	6.8E-04	8.7E-04	3.9E-03	1.4E-02	1.7E-02
SR11	3.3E-04	1.5E-03	1.8E-03	6.5E-03	2.9E-02	3.6E-02
SR12	2.0E-04	1.7E-03	1.9E-03	4.0E-03	3.3E-02	3.7E-02
SR13	2.1E-04	1.5E-03	1.7E-03	4.2E-03	3.0E-02	3.4E-02
SR14	2.0E-04	2.1E-03	2.3E-03	4.0E-03	4.2E-02	4.6E-02
SR15	2.0E-04	2.2E-03	2.4E-03	4.0E-03	4.4E-02	4.8E-02
SR16	1.9E-04	2.2E-03	2.4E-03	3.7E-03	4.4E-02	4.7E-02
SR17	1.9E-04	5.8E-04	7.7E-04	3.9E-03	1.2E-02	1.5E-02
SR18	2.0E-04	1.9E-03	2.1E-03	4.0E-03	3.8E-02	4.2E-02
SR19	1.9E-04	5.2E-03	5.4E-03	3.8E-03	1.0E-01	1.1E-01
SR20	2.0E-04	2.8E-03	3.0E-03	4.0E-03	5.6E-02	6.1E-02
SR21	1.9E-04	8.6E-04	1.0E-03	3.7E-03	1.7E-02	2.1E-02
SR22	1.8E-04	1.1E-03	1.2E-03	3.7E-03	2.1E-02	2.5E-02
SR23	1.8E-04	8.9E-04	1.1E-03	3.6E-03	1.8E-02	2.1E-02
SR24	1.8E-04	9.5E-04	1.1E-03	3.6E-03	1.9E-02	2.3E-02
SR25	2.2E-04	3.1E-03	3.3E-03	4.4E-03	6.1E-02	6.5E-02
SR26	1.9E-04	1.3E-04	3.3E-04	3.9E-03	2.7E-03	6.5E-03
SR27	2.0E-04	1.2E-04	3.2E-04	4.1E-03	2.3E-03	6.4E-03
SR28	2.0E-04	1.2E-04	3.2E-04	4.1E-03	2.3E-03	6.4E-03
SR29	2.0E-04	1.2E-04	3.3E-04	4.0E-03	2.5E-03	6.5E-03
SR30	3.5E-04	1.5E-04	4.9E-04	7.1E-03	2.9E-03	9.9E-03
SR31	3.5E-04	1.5E-04	4.9E-04	7.1E-03	2.9E-03	9.9E-03
SR32	2.6E-04	1.7E-04	4.3E-04	5.2E-03	3.5E-03	8.6E-03
SR33	2.0E-04	2.1E-04	4.1E-04	4.1E-03	4.1E-03	8.1E-03
SR34	1.9E-04	2.4E-04	4.4E-04	3.9E-03	4.9E-03	8.7E-03
SR35	1.9E-04	2.4E-04	4.4E-04	3.9E-03	4.9E-03	8.7E-03
SR36	1.9E-04	1.5E-03	1.7E-03	3.8E-03	3.0E-02	3.3E-02
SR37	1.8E-04	8.7E-04	1.0E-03	3.6E-03	1.7E-02	2.1E-02
SR38	2.3E-04	1.3E-03	1.5E-03	4.5E-03	2.5E-02	3.0E-02
SR39	2.1E-04	6.3E-04	8.3E-04	4.1E-03	1.3E-02	1.7E-02
SR40	1.8E-04	1.2E-03	1.4E-03	3.6E-03	2.4E-02	2.7E-02
SR41	1.8E-04	3.3E-03	3.5E-03	3.7E-03	6.7E-02	7.1E-02
SR42	2.9E-04	1.5E-04	4.4E-04	5.8E-03	2.9E-03	8.8E-03
SR43	5.8E-04	1.8E-04	7.6E-04	1.2E-02	3.5E-03	1.5E-02
SR44	3.0E-04	2.0E-04	4.9E-04	6.0E-03	3.9E-03	9.8E-03
SR45	2.0E-04	6.8E-05	2.6E-04	3.9E-03	1.4E-03	5.3E-03
SR46	2.1E-04	5.0E-05	2.6E-04	4.1E-03	9.9E-04	5.1E-03
SR47	2.1E-04	5.1E-05	2.6E-04	4.1E-03	1.0E-03	5.1E-03
SR48	1.9E-04	2.7E-05	2.2E-04	3.8E-03	5.4E-04	4.4E-03
SR49	2.2E-04	3.0E-05	2.5E-04	4.5E-03	6.0E-04	5.1E-03
SR50	1.8E-04	1.6E-04	3.4E-04	3.6E-03	3.2E-03	6.8E-03
SR51	1.8E-04	7.0E-04	8.8E-04	3.6E-03	1.4E-02	1.8E-02
SR52	1.9E-04	4.2E-05	2.3E-04	3.8E-03	8.4E-04	4.6E-03
SR53	1.8E-04	2.7E-05	2.1E-04	3.6E-03	5.3E-04	4.2E-03
SR54	1.8E-04	1.9E-05	2.0E-04	3.7E-03	3.9E-04	4.1E-03
SR55	2.1E-04	1.2E-05	2.2E-04	4.2E-03	2.4E-04	4.4E-03
SR56	1.7E-04	8.0E-06	1.8E-04	3.4E-03	1.6E-04	3.6E-03
SR57	2.6E-04	1.0E-04	3.6E-04	5.1E-03	2.1E-03	7.1E-03
SR58	1.7E-04	1.5E-05	1.9E-04	3.5E-03	3.0E-04	3.8E-03

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-45 Exposure Concentrations and Exposure Ratios for 1-hour Mercury (Construction)

Human Receptor Location	1-hour Mercury (TRV = 0.6 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	2.8E-05	1.7E-04	1.7E-04	4.6E-05	2.9E-04	2.9E-04
SR01	3.4E-06	1.3E-05	1.5E-05	5.7E-06	2.2E-05	2.4E-05
SR02	6.4E-06	8.6E-06	9.6E-06	1.1E-05	1.4E-05	1.6E-05
SR03	5.1E-06	9.2E-06	9.7E-06	8.5E-06	1.5E-05	1.6E-05
SR04	2.1E-06	3.1E-05	3.2E-05	3.4E-06	5.1E-05	5.3E-05
SR05	2.9E-06	3.4E-05	3.5E-05	4.9E-06	5.6E-05	5.8E-05
SR06	2.3E-06	2.1E-05	2.2E-05	3.9E-06	3.6E-05	3.7E-05
SR07	2.3E-06	1.9E-05	1.9E-05	3.8E-06	3.1E-05	3.2E-05
SR08	2.5E-06	2.2E-05	2.3E-05	4.2E-06	3.7E-05	3.8E-05
SR09	3.9E-06	1.8E-05	2.1E-05	6.6E-06	3.1E-05	3.4E-05
SR10	3.1E-06	2.5E-05	2.6E-05	5.2E-06	4.2E-05	4.4E-05
SR11	9.2E-06	5.1E-05	5.5E-05	1.5E-05	8.4E-05	9.1E-05
SR12	2.4E-06	4.4E-05	4.4E-05	3.9E-06	7.3E-05	7.4E-05
SR13	2.9E-06	4.0E-05	4.1E-05	4.8E-06	6.6E-05	6.8E-05
SR14	2.5E-06	4.8E-05	4.9E-05	4.2E-06	8.0E-05	8.2E-05
SR15	2.4E-06	4.9E-05	5.0E-05	4.0E-06	8.2E-05	8.4E-05
SR16	1.3E-06	5.5E-05	5.5E-05	2.1E-06	9.1E-05	9.1E-05
SR17	1.7E-06	2.4E-05	2.5E-05	2.8E-06	4.1E-05	4.1E-05
SR18	4.8E-06	6.0E-05	6.4E-05	8.0E-06	1.0E-04	1.1E-04
SR19	3.7E-06	1.0E-04	1.0E-04	6.2E-06	1.7E-04	1.7E-04
SR20	4.8E-06	6.8E-05	7.0E-05	8.0E-06	1.1E-04	1.2E-04
SR21	1.4E-06	2.0E-05	2.1E-05	2.4E-06	3.3E-05	3.4E-05
SR22	1.0E-06	2.4E-05	2.4E-05	1.7E-06	4.0E-05	4.1E-05
SR23	1.0E-06	2.1E-05	2.2E-05	1.7E-06	3.5E-05	3.6E-05
SR24	9.9E-07	1.9E-05	1.9E-05	1.7E-06	3.2E-05	3.2E-05
SR25	5.7E-06	7.4E-05	7.7E-05	9.5E-06	1.2E-04	1.3E-04
SR26	4.3E-06	1.4E-05	1.6E-05	7.1E-06	2.4E-05	2.6E-05
SR27	5.3E-06	1.0E-05	1.4E-05	8.9E-06	1.7E-05	2.3E-05
SR28	5.3E-06	1.0E-05	1.4E-05	8.9E-06	1.7E-05	2.3E-05
SR29	5.5E-06	1.0E-05	1.4E-05	9.2E-06	1.7E-05	2.3E-05
SR30	9.0E-06	1.1E-05	1.7E-05	1.5E-05	1.8E-05	2.9E-05
SR31	9.0E-06	1.1E-05	1.7E-05	1.5E-05	1.8E-05	2.9E-05
SR32	6.0E-06	1.1E-05	1.6E-05	9.9E-06	1.8E-05	2.6E-05
SR33	4.0E-06	1.1E-05	1.3E-05	6.6E-06	1.8E-05	2.2E-05
SR34	3.2E-06	1.1E-05	1.3E-05	5.3E-06	1.8E-05	2.2E-05
SR35	3.2E-06	1.1E-05	1.3E-05	5.3E-06	1.8E-05	2.2E-05
SR36	1.6E-06	5.9E-05	5.9E-05	2.7E-06	9.9E-05	9.9E-05
SR37	1.0E-06	2.1E-05	2.1E-05	1.7E-06	3.5E-05	3.6E-05
SR38	4.9E-06	2.1E-05	2.4E-05	8.2E-06	3.5E-05	4.0E-05
SR39	5.4E-06	2.1E-05	2.2E-05	9.0E-06	3.4E-05	3.7E-05
SR40	2.3E-06	5.0E-05	5.0E-05	3.8E-06	8.3E-05	8.4E-05
SR41	2.7E-06	1.1E-04	1.1E-04	4.4E-06	1.8E-04	1.8E-04
SR42	8.3E-06	5.7E-06	1.1E-05	1.4E-05	9.5E-06	1.8E-05
SR43	1.6E-05	6.4E-06	1.8E-05	2.7E-05	1.1E-05	3.1E-05
SR44	3.0E-06	9.1E-06	9.7E-06	5.0E-06	1.5E-05	1.6E-05
SR45	2.6E-06	6.1E-06	6.2E-06	4.4E-06	1.0E-05	1.0E-05
SR46	4.3E-06	4.8E-06	5.1E-06	7.1E-06	8.0E-06	8.5E-06
SR47	4.7E-06	4.8E-06	5.5E-06	7.8E-06	8.0E-06	9.1E-06
SR48	3.8E-06	2.8E-06	4.6E-06	6.3E-06	4.7E-06	7.6E-06
SR49	6.8E-06	3.1E-06	7.4E-06	1.1E-05	5.2E-06	1.2E-05
SR50	7.5E-07	4.2E-06	4.2E-06	1.3E-06	7.0E-06	7.0E-06
SR51	9.4E-07	1.4E-05	1.4E-05	1.6E-06	2.4E-05	2.4E-05
SR52	4.6E-06	5.3E-06	6.3E-06	7.7E-06	8.8E-06	1.1E-05
SR53	2.3E-06	2.4E-06	3.2E-06	3.9E-06	4.0E-06	5.3E-06
SR54	3.7E-06	2.6E-06	4.2E-06	6.2E-06	4.3E-06	6.9E-06
SR55	4.0E-06	1.6E-06	4.2E-06	6.7E-06	2.7E-06	7.1E-06
SR56	9.6E-07	1.1E-06	1.6E-06	1.6E-06	1.9E-06	2.7E-06
SR57	5.8E-06	1.2E-05	1.5E-05	9.6E-06	2.0E-05	2.5E-05
SR58	9.2E-07	1.8E-06	2.1E-06	1.5E-06	2.9E-06	3.5E-06

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-46 Exposure Concentrations and Exposure Ratios for Annual Mercury (Construction)

Human Receptor Location	Annual Mercury (TRV = 0.03 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	6.6E-06	9.4E-06	9.8E-06	2.2E-04	3.1E-04	3.3E-04
SR01	3.3E-07	5.0E-07	8.4E-07	1.1E-05	1.7E-05	2.8E-05
SR02	6.2E-07	3.0E-07	9.2E-07	2.1E-05	1.0E-05	3.1E-05
SR03	5.3E-07	3.3E-07	8.5E-07	1.8E-05	1.1E-05	2.8E-05
SR04	2.5E-07	1.1E-06	1.3E-06	8.4E-06	3.7E-05	4.5E-05
SR05	3.4E-07	1.2E-06	1.5E-06	1.1E-05	4.0E-05	5.2E-05
SR06	3.9E-07	5.0E-07	9.0E-07	1.3E-05	1.7E-05	3.0E-05
SR07	3.6E-07	3.4E-07	7.0E-07	1.2E-05	1.1E-05	2.3E-05
SR08	3.8E-07	5.0E-07	8.8E-07	1.3E-05	1.7E-05	2.9E-05
SR09	3.2E-07	6.9E-07	1.0E-06	1.1E-05	2.3E-05	3.4E-05
SR10	2.5E-07	8.4E-07	1.1E-06	8.4E-06	2.8E-05	3.6E-05
SR11	1.1E-06	1.8E-06	2.9E-06	3.6E-05	6.0E-05	9.7E-05
SR12	2.5E-07	2.1E-06	2.3E-06	8.4E-06	6.9E-05	7.6E-05
SR13	2.9E-07	1.8E-06	2.1E-06	9.6E-06	6.1E-05	6.9E-05
SR14	2.5E-07	2.6E-06	2.8E-06	8.5E-06	8.7E-05	9.5E-05
SR15	2.4E-07	2.7E-06	2.9E-06	8.1E-06	9.0E-05	9.7E-05
SR16	1.4E-07	2.7E-06	2.8E-06	4.7E-06	9.0E-05	9.4E-05
SR17	1.8E-07	7.2E-07	8.9E-07	6.1E-06	2.4E-05	3.0E-05
SR18	3.3E-07	2.4E-06	2.7E-06	1.1E-05	7.9E-05	9.0E-05
SR19	2.6E-07	6.5E-06	6.7E-06	8.8E-06	2.2E-04	2.2E-04
SR20	3.4E-07	3.5E-06	3.8E-06	1.1E-05	1.2E-04	1.3E-04
SR21	1.6E-07	1.1E-06	1.2E-06	5.2E-06	3.5E-05	4.1E-05
SR22	1.2E-07	1.3E-06	1.4E-06	4.0E-06	4.4E-05	4.8E-05
SR23	1.1E-07	1.1E-06	1.2E-06	3.7E-06	3.6E-05	4.0E-05
SR24	1.1E-07	1.2E-06	1.3E-06	3.8E-06	3.9E-05	4.3E-05
SR25	4.6E-07	3.8E-06	4.2E-06	1.5E-05	1.3E-04	1.4E-04
SR26	2.6E-07	1.7E-07	4.3E-07	8.7E-06	5.5E-06	1.4E-05
SR27	3.8E-07	1.5E-07	5.2E-07	1.3E-05	4.9E-06	1.7E-05
SR28	3.8E-07	1.5E-07	5.2E-07	1.3E-05	4.9E-06	1.7E-05
SR29	3.5E-07	1.6E-07	5.0E-07	1.2E-05	5.2E-06	1.7E-05
SR30	1.3E-06	1.8E-07	1.5E-06	4.4E-05	6.0E-06	5.0E-05
SR31	1.3E-06	1.8E-07	1.5E-06	4.4E-05	6.0E-06	5.0E-05
SR32	7.1E-07	2.2E-07	9.1E-07	2.4E-05	7.2E-06	3.0E-05
SR33	3.5E-07	2.6E-07	6.0E-07	1.2E-05	8.5E-06	2.0E-05
SR34	2.7E-07	3.0E-07	5.7E-07	9.1E-06	1.0E-05	1.9E-05
SR35	2.7E-07	3.0E-07	5.7E-07	9.1E-06	1.0E-05	1.9E-05
SR36	1.7E-07	1.8E-06	2.0E-06	5.7E-06	6.1E-05	6.6E-05
SR37	1.1E-07	1.1E-06	1.2E-06	3.6E-06	3.6E-05	3.9E-05
SR38	5.1E-07	1.6E-06	2.1E-06	1.7E-05	5.2E-05	6.8E-05
SR39	3.4E-07	7.7E-07	1.1E-06	1.1E-05	2.6E-05	3.7E-05
SR40	1.6E-07	1.5E-06	1.6E-06	5.2E-06	4.9E-05	5.4E-05
SR41	1.9E-07	4.1E-06	4.3E-06	6.3E-06	1.4E-04	1.4E-04
SR42	8.1E-07	1.8E-07	9.9E-07	2.7E-05	6.1E-06	3.3E-05
SR43	2.5E-06	2.2E-07	2.8E-06	8.5E-05	7.4E-06	9.2E-05
SR44	5.8E-07	2.4E-07	8.1E-07	1.9E-05	8.1E-06	2.7E-05
SR45	2.9E-07	8.5E-08	3.8E-07	9.8E-06	2.8E-06	1.3E-05
SR46	4.5E-07	6.2E-08	5.1E-07	1.5E-05	2.1E-06	1.7E-05
SR47	4.8E-07	6.4E-08	5.5E-07	1.6E-05	2.1E-06	1.8E-05
SR48	3.2E-07	3.4E-08	3.6E-07	1.1E-05	1.1E-06	1.2E-05
SR49	6.2E-07	3.7E-08	6.6E-07	2.1E-05	1.2E-06	2.2E-05
SR50	7.9E-08	2.0E-07	2.7E-07	2.6E-06	6.6E-06	9.2E-06
SR51	1.0E-07	8.7E-07	9.7E-07	3.4E-06	2.9E-05	3.2E-05
SR52	1.8E-07	5.3E-08	2.3E-07	6.0E-06	1.8E-06	7.7E-06
SR53	1.8E-07	3.3E-08	2.1E-07	6.1E-06	1.1E-06	7.1E-06
SR54	1.3E-07	2.4E-08	1.5E-07	4.2E-06	8.1E-07	5.0E-06
SR55	2.8E-07	1.5E-08	2.9E-07	9.3E-06	4.9E-07	9.8E-06
SR56	2.8E-08	1.0E-08	3.8E-08	9.4E-07	3.3E-07	1.3E-06
SR57	6.9E-07	1.3E-07	8.1E-07	2.3E-05	4.3E-06	2.7E-05
SR58	5.7E-08	1.9E-08	7.5E-08	1.9E-06	6.2E-07	2.5E-06

NOTE:
Shaded cell indicates a ER greater than 1.0

Table A-47 Exposure Concentrations and Exposure Ratios for 1-hour PM2.5 (Post-Flood Operation)

Human Receptor Location	1-hour $PM_{2.5}$ (TRV = 80 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	2.7E+01	6.9E+00	2.7E+01	3.4E-01	8.6E-02	3.4E-01
SR01	1.3E+01	2.5E-02	1.3E+01	1.7E-01	3.1E-04	1.7E-01
SR02	1.5E+01	8.6E-02	1.5E+01	1.8E-01	1.1E-03	1.9E-01
SR03	1.4E+01	1.1E-01	1.4E+01	1.8E-01	1.3E-03	1.8E-01
SR04	1.2E+01	4.8E-01	1.3E+01	1.5E-01	6.0E-03	1.6E-01
SR05	1.3E+01	3.5E-01	1.3E+01	1.6E-01	4.4E-03	1.7E-01
SR06	1.3E+01	9.1E-02	1.3E+01	1.6E-01	1.1E-03	1.6E-01
SR07	1.3E+01	8.8E-02	1.3E+01	1.6E-01	1.1E-03	1.6E-01
SR08	1.3E+01	6.3E-01	1.3E+01	1.6E-01	7.9E-03	1.7E-01
SR09	1.4E+01	2.5E-02	1.4E+01	1.7E-01	3.1E-04	1.7E-01
SR10	1.3E+01	4.0E-03	1.3E+01	1.6E-01	5.0E-05	1.6E-01
SR11	1.7E+01	2.0E-03	1.7E+01	2.1E-01	2.5E-05	2.1E-01
SR12	1.3E+01	6.7E-01	1.3E+01	1.6E-01	8.3E-03	1.6E-01
SR13	1.3E+01	5.5E-01	1.3E+01	1.6E-01	6.9E-03	1.7E-01
SR14	1.3E+01	4.2E+00	1.7E+01	1.6E-01	5.3E-02	2.1E-01
SR15	1.3E+01	4.2E+00	1.7E+01	1.6E-01	5.2E-02	2.1E-01
SR16	1.2E+01	2.1E+00	1.4E+01	1.5E-01	2.6E-02	1.8E-01
SR17	1.2E+01	8.5E-01	1.3E+01	1.5E-01	1.1E-02	1.6E-01
SR18	1.4E+01	6.2E-04	1.4E+01	1.8E-01	7.8E-06	1.8E-01
SR19	1.4E+01	5.6E-04	1.4E+01	1.7E-01	7.1E-06	1.7E-01
SR20	1.4E+01	2.9E-03	1.4E+01	1.8E-01	3.6E-05	1.8E-01
SR21	1.2E+01	2.8E-01	1.3E+01	1.6E-01	3.5E-03	1.6E-01
SR22	1.2E+01	6.3E-01	1.3E+01	1.5E-01	7.9E-03	1.6E-01
SR23	1.2E+01	6.6E-01	1.3E+01	1.5E-01	8.3E-03	1.6E-01
SR24	1.2E+01	1.2E+00	1.3E+01	1.5E-01	1.5E-02	1.6E-01
SR25	1.5E+01	1.1E-03	1.5E+01	1.9E-01	1.4E-05	1.9E-01
SR26	1.4E+01	2.0E-02	1.4E+01	1.7E-01	2.5E-04	1.7E-01
SR27	1.5E+01	3.6E-02	1.5E+01	1.8E-01	4.5E-04	1.8E-01
SR28	1.5E+01	3.6E-02	1.5E+01	1.8E-01	4.5E-04	1.8E-01
SR29	1.5E+01	4.4E-02	1.5E+01	1.8E-01	5.5E-04	1.8E-01
SR30	1.7E+01	4.4E-02	1.7E+01	2.1E-01	5.5E-04	2.1E-01
SR31	1.7E+01	4.4E-02	1.7E+01	2.1E-01	5.5E-04	2.1E-01
SR32	1.5E+01	5.6E-02	1.5E+01	1.9E-01	7.1E-04	1.9E-01
SR33	1.4E+01	6.7E-02	1.4E+01	1.7E-01	8.4E-04	1.7E-01
SR34	1.3E+01	7.6E-02	1.3E+01	1.7E-01	9.5E-04	1.7E-01
SR35	1.3E+01	7.6E-02	1.3E+01	1.7E-01	9.5E-04	1.7E-01
SR36	1.2E+01	1.6E+00	1.4E+01	1.5E-01	2.0E-02	1.7E-01
SR37	1.2E+01	7.2E-01	1.3E+01	1.5E-01	9.0E-03	1.6E-01
SR38	1.4E+01	2.7E-02	1.4E+01	1.8E-01	3.3E-04	1.8E-01
SR39	1.5E+01	2.6E-02	1.5E+01	1.9E-01	3.3E-04	1.9E-01
SR40	1.3E+01	3.2E-04	1.3E+01	1.6E-01	4.0E-06	1.6E-01
SR41	1.3E+01	3.6E-04	1.3E+01	1.6E-01	4.6E-06	1.6E-01
SR42	1.6E+01	2.2E-02	1.6E+01	2.0E-01	2.8E-04	2.0E-01
SR43	2.0E+01	7.6E-02	2.1E+01	2.6E-01	9.5E-04	2.6E-01
SR44	1.3E+01	3.7E-01	1.4E+01	1.7E-01	4.6E-03	1.7E-01
SR45	1.3E+01	7.1E-02	1.3E+01	1.6E-01	8.9E-04	1.6E-01
SR46	1.4E+01	1.6E-02	1.4E+01	1.7E-01	2.0E-04	1.7E-01
SR47	1.4E+01	2.6E-02	1.4E+01	1.8E-01	3.2E-04	1.8E-01
SR48	1.4E+01	6.8E-03	1.4E+01	1.7E-01	8.5E-05	1.7E-01
SR49	1.6E+01	1.2E-02	1.6E+01	1.9E-01	1.5E-04	1.9E-01
SR50	1.2E+01	4.8E-01	1.2E+01	1.5E-01	6.0E-03	1.5E-01
SR51	1.2E+01	9.1E-01	1.3E+01	1.5E-01	1.1E-02	1.6E-01
SR52	1.4E+01	8.1E-03	1.4E+01	1.7E-01	1.0E-04	1.7E-01
SR53	1.3E+01	1.3E-03	1.3E+01	1.6E-01	1.6E-05	1.6E-01
SR54	1.3E+01	6.8E-03	1.3E+01	1.7E-01	8.5E-05	1.7E-01
SR55	1.4E+01	3.6E-03	1.4E+01	1.7E-01	4.5E-05	1.7E-01
SR56	1.2E+01	3.6E-04	1.2E+01	1.5E-01	4.5E-06	1.5E-01
SR57	1.5E+01	2.2E-02	1.5E+01	1.9E-01	2.7E-04	1.9E-01
SR58	1.2E+01	2.3E-03	1.2E+01	1.5E-01	2.9E-05	1.5E-01

NOTE:

Shaded cell indicates a ER greater than 1.0

Table A-48 Exposure Concentrations and Exposure Ratios for 24-hour PM2.5 (Post-Flood Operation)

Human Receptor Location	24-hour $PM_{2.5}$ (TRV = 28 µg/m^3)					
	Exposure Concentration (µg/m^3)			Exposure Ratio (unitless)		
	Base	Project	Application	Base	Project	Application
MPOI	1.8E+01	6.4E-01	1.8E+01	6.6E-01	2.3E-02	6.6E-01
SR01	1.2E+01	9.3E-05	1.2E+01	4.2E-01	3.3E-06	4.2E-01
SR02	1.2E+01	7.2E-04	1.2E+01	4.3E-01	2.6E-05	4.3E-01
SR03	1.2E+01	2.1E-03	1.2E+01	4.3E-01	7.7E-05	4.3E-01
SR04	1.2E+01	1.4E-02	1.2E+01	4.1E-01	4.9E-04	4.1E-01
SR05	1.2E+01	3.8E-03	1.2E+01	4.2E-01	1.3E-04	4.2E-01
SR06	1.2E+01	1.4E-03	1.2E+01	4.2E-01	4.9E-05	4.2E-01
SR07	1.2E+01	8.2E-04	1.2E+01	4.2E-01	2.9E-05	4.2E-01
SR08	1.2E+01	2.5E-02	1.2E+01	4.2E-01	9.0E-04	4.2E-01
SR09	1.2E+01	8.1E-06	1.2E+01	4.2E-01	2.9E-07	4.2E-01
SR10	1.2E+01	9.1E-06	1.2E+01	4.2E-01	3.2E-07	4.2E-01
SR11	1.3E+01	8.5E-06	1.3E+01	4.8E-01	3.0E-07	4.8E-01
SR12	1.2E+01	1.2E-02	1.2E+01	4.1E-01	4.3E-04	4.1E-01
SR13	1.2E+01	1.2E-02	1.2E+01	4.2E-01	4.3E-04	4.2E-01
SR14	1.2E+01	5.6E-02	1.2E+01	4.1E-01	2.0E-03	4.2E-01
SR15	1.2E+01	1.7E-01	1.2E+01	4.2E-01	5.9E-03	4.2E-01
SR16	1.1E+01	4.1E-01	1.2E+01	4.1E-01	1.5E-02	4.2E-01
SR17	1.1E+01	8.1E-02	1.2E+01	4.1E-01	2.9E-03	4.1E-01
SR18	1.2E+01	1.2E-06	1.2E+01	4.3E-01	4.3E-08	4.3E-01
SR19	1.2E+01	3.9E-08	1.2E+01	4.2E-01	1.4E-09	4.2E-01
SR20	1.2E+01	6.3E-07	1.2E+01	4.3E-01	2.3E-08	4.3E-01
SR21	1.1E+01	2.6E-03	1.1E+01	4.1E-01	9.4E-05	4.1E-01
SR22	1.1E+01	2.0E-02	1.1E+01	4.1E-01	7.2E-04	4.1E-01
SR23	1.1E+01	2.9E-02	1.1E+01	4.1E-01	1.0E-03	4.1E-01
SR24	1.1E+01	9.0E-02	1.1E+01	4.1E-01	3.2E-03	4.1E-01
SR25	1.2E+01	1.7E-07	1.2E+01	4.4E-01	6.0E-09	4.4E-01
SR26	1.2E+01	1.3E-06	1.2E+01	4.2E-01	4.6E-08	4.2E-01
SR27	1.2E+01	1.3E-06	1.2E+01	4.3E-01	4.5E-08	4.3E-01
SR28	1.2E+01	1.3E-06	1.2E+01	4.3E-01	4.5E-08	4.3E-01
SR29	1.2E+01	1.9E-06	1.2E+01	4.2E-01	6.7E-08	4.2E-01
SR30	1.3E+01	1.3E-06	1.3E+01	4.6E-01	4.6E-08	4.6E-01
SR31	1.3E+01	1.3E-06	1.3E+01	4.6E-01	4.6E-08	4.6E-01
SR32	1.2E+01	2.9E-06	1.2E+01	4.4E-01	1.0E-07	4.4E-01
SR33	1.2E+01	7.5E-06	1.2E+01	4.2E-01	2.7E-07	4.2E-01
SR34	1.2E+01	2.0E-05	1.2E+01	4.2E-01	7.0E-07	4.2E-01
SR35	1.2E+01	2.0E-05	1.2E+01	4.2E-01	7.0E-07	4.2E-01
SR36	1.1E+01	2.6E-01	1.2E+01	4.1E-01	9.4E-03	4.2E-01
SR37	1.1E+01	3.3E-02	1.1E+01	4.1E-01	1.2E-03	4.1E-01
SR38	1.2E+01	1.2E-06	1.2E+01	4.3E-01	4.3E-08	4.3E-01
SR39	1.2E+01	1.2E-06	1.2E+01	4.3E-01	4.5E-08	4.3E-01
SR40	1.2E+01	5.5E-10	1.2E+01	4.1E-01	2.0E-11	4.1E-01
SR41	1.2E+01	6.0E-09	1.2E+01	4.1E-01	2.2E-10	4.1E-01
SR42	1.3E+01	6.6E-05	1.3E+01	4.5E-01	2.3E-06	4.5E-01
SR43	1.5E+01	1.1E-03	1.5E+01	5.4E-01	3.8E-05	5.4E-01
SR44	1.2E+01	1.5E-02	1.2E+01	4.3E-01	5.2E-04	4.3E-01
SR45	1.2E+01	5.7E-04	1.2E+01	4.1E-01	2.0E-05	4.1E-01
SR46	1.2E+01	1.0E-04	1.2E+01	4.2E-01	3.7E-06	4.2E-01
SR47	1.2E+01	2.1E-04	1.2E+01	4.3E-01	7.6E-06	4.3E-01
SR48	1.2E+01	5.6E-05	1.2E+01	4.2E-01	2.0E-06	4.2E-01
SR49	1.2E+01	5.2E-05	1.2E+01	4.4E-01	1.9E-06	4.4E-01
SR50	1.1E+01	4.3E-02	1.1E+01	4.0E-01	1.5E-03	4.0E-01
SR51	1.1E+01	8.8E-02	1.1E+01	4.0E-01	3.1E-03	4.1E-01
SR52	1.2E+01	4.3E-07	1.2E+01	4.1E-01	1.5E-08	4.1E-01
SR53	1.2E+01	1.9E-05	1.2E+01	4.1E-01	6.8E-07	4.1E-01
SR54	1.1E+01	8.5E-10	1.1E+01	4.1E-01	3.0E-11	4.1E-01
SR55	1.2E+01	3.9E-10	1.2E+01	4.2E-01	1.4E-11	4.2E-01
SR56	1.1E+01	3.6E-10	1.1E+01	4.0E-01	1.3E-11	4.0E-01
SR57	1.2E+01	1.3E-06	1.2E+01	4.4E-01	4.6E-08	4.4E-01
SR58	1.1E+01	4.4E-07	1.1E+01	4.0E-01	1.6E-08	4.0E-01

NOTE:

Shaded cell indicates a ER greater than 1.0

Attachment B COPC SCREENING

Table B-1 Screening of COPC in Air for Secondary Pathways

Chemicals of Potential Concern	Bioaccumulation		Persistence		Carried Forward Based on Kow/Half Life?
	Log Kow	Reference	Half Life (days)	Reference	
Carcinogenic PAH					
Acenaphthene	3.9	a	58	b	No
Acenaphthylene	4.0	b	**229**	b	**Yes**
Benz(a)anthracene	**5.7**	a	**708**	b	**Yes**
Benzo(a)pyrene	**6.0**	a	**708**	b	**Yes**
Benzo(b)fluoranthene	**6.1**	a	**330**	b	**Yes**
Benzo(g,h,i)perylene	**6.5**	b	**620**	b	**Yes**
Benzo(j)fluoranthene	**6.4**	b	**570**	c	**Yes**
Benzo(k)fluoranthene	**6.1**	a	**708**	b	**Yes**
Chrysene	**5.7**	a	**708**	b	**Yes**
Fluoranthene	**5.0**	a	**708**	b	**Yes**
Indeno(1,2,3-cd)pyrene	**6.6**	a	**570**	c	**Yes**
Non-carcinogenic PAH					
Anthracene	4.5	a	**229**	b	**Yes**
Fluorene	4.2	a	**229**	b	**Yes**
Naphthalene	3.3	a	71	b	No
Phenanthrene	4.5	a	**229**	b	**Yes**
Pyrene	4.9	a	**708**	b	**Yes**
Metals					
Arsenic	0.68	a	**100000000**	c	**Yes**
Total chromium	0.23	a	**100000000**	c	**Yes**
Chromium VI	0	a	**100000000**	c	**Yes**
Manganese	0.23	d	**100000000**	c	**Yes**
Mercury	0.62	a	**100000000**	c	**Yes**
Nickel	-0.57	a	**100000000**	c	**Yes**

Table B-1 Screening of COPC in Air for Secondary Pathways

Chemicals of Potential Concern	Bioaccumulation		Persistence		Carried Forward Based on Kow/Half Life?
	Log Kow	Reference	Half Life (days)	Reference	
Volatile Organic Compounds					
1,3,-Butadiene	1.99	b	23	b	No
2,2,4-trimethylpentane	4.1	e	2.3	e	No
Acetaldehyde	-0.22	a	2.3	b	No
Acrolein	-0.01	a	2.3	b	No
Benzene	2.1	a	23	b	No
Ethylbenzene	3.1	a	71	b	No
Formaldehyde	0.35	a	2.3	b	No
Proprionaldehyde	0.59	f	0.8	f	No
Toluene	2.7	a	71	b	No
Xylenes	3.2	b	71	b	No

NOTES:

Blue shading indicates potentially bioaccumulative (Log K_{ow} > 5)

Green shading indicates potentially persistent (half-life greater than 182 days)

References:

a. US EPA. 2005. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (HHRAP), Final. EPA520-R-05-006 Environmental Protection Agency.
b. Mackay, D., Shiu, W.Y., Ma, K.C. 2000. Illustrated handbook of physical-chemical properties and environmental fate for organic chemicals.
c. Cal EPA. 2000. Technical Support Document for Exposure Assessment and Stochastic Analysis. Appendix G: Chemical Specific Soil Half-Lives.
d. ChemID. TOXNET database.
e. Organisation for Economic Co-operation and Development (OECD). 2010. SIDS Initial Assessment Profile. Category: C7-C9 Aliphatic Hydrocarbon Solvents.
f. US EPA. 2008. Toxicological Profile for Propionaldehyde.

Table B-2 **Maximum Predicted Annual Deposition for Project Case (Construction Phase)**

Receptor Location	Acenaphthylene	Benz(a)anthracene	Benzo(a)pyrene
	Deposition Rate, Q (mg/100 cm²/yr)		
MPOI	6.02E-03	6.78E-05	2.30E-05
SR1	1.02E-03	1.14E-05	3.85E-06
SR2	3.46E-04	3.87E-06	1.30E-06
SR3	3.14E-04	3.50E-06	1.18E-06
SR4	6.24E-04	6.96E-06	2.34E-06
SR5	6.18E-04	6.91E-06	2.33E-06
SR6	2.95E-04	3.29E-06	1.11E-06
SR7	2.15E-04	2.39E-06	8.02E-07
SR8	2.51E-04	2.80E-06	9.43E-07
SR9	6.81E-04	7.58E-06	2.54E-06
SR10	5.24E-04	5.81E-06	1.94E-06
SR11	8.49E-04	9.40E-06	3.14E-06
SR12	9.56E-04	1.07E-05	3.58E-06
SR13	8.38E-04	9.35E-06	3.15E-06
SR14	1.14E-03	1.27E-05	4.25E-06
SR15	1.17E-03	1.31E-05	4.40E-06
SR16	8.82E-04	9.88E-06	3.34E-06
SR17	3.22E-04	3.58E-06	1.20E-06
SR18	1.04E-03	1.16E-05	3.90E-06
SR19	2.27E-03	2.57E-05	8.76E-06
SR20	1.16E-03	1.28E-05	4.27E-06
SR21	4.24E-04	4.69E-06	1.56E-06
SR22	4.32E-04	4.79E-06	1.60E-06
SR23	3.93E-04	4.36E-06	1.45E-06
SR24	3.88E-04	4.32E-06	1.45E-06
SR25	1.43E-03	1.60E-05	5.36E-06
SR26	1.41E-04	1.54E-06	4.99E-07
SR27	1.34E-04	1.46E-06	4.72E-07
SR28	1.34E-04	1.46E-06	4.72E-07
SR29	1.43E-04	1.55E-06	5.01E-07
SR30	1.57E-04	1.70E-06	5.52E-07
SR31	1.57E-04	1.70E-06	5.52E-07
SR32	1.76E-04	1.92E-06	6.24E-07
SR33	1.98E-04	2.16E-06	7.03E-07
SR34	2.24E-04	2.45E-06	8.00E-07
SR35	2.24E-04	2.45E-06	8.00E-07
SR36	7.15E-04	7.98E-06	2.69E-06
SR37	3.89E-04	4.31E-06	1.44E-06
SR38	6.04E-04	6.67E-06	2.22E-06
SR39	3.62E-04	3.97E-06	1.31E-06
SR40	6.94E-04	7.69E-06	2.56E-06
SR41	1.49E-03	1.66E-05	5.57E-06
SR42	2.62E-04	2.92E-06	9.83E-07
SR43	2.15E-04	2.40E-06	8.05E-07
SR44	1.33E-04	1.48E-06	4.95E-07

Table B-2 **Maximum Predicted Annual Deposition for Project Case (Construction Phase)**

Receptor Location	Acenaphthylene	Benz(a)anthracene	Benzo(a)pyrene
	Deposition Rate, Q (mg/100 cm²/yr)		
SR45	6.43E-05	7.11E-07	2.36E-07
SR46	5.14E-05	5.67E-07	1.88E-07
SR47	5.33E-05	5.87E-07	1.95E-07
SR48	3.45E-05	3.78E-07	1.25E-07
SR49	3.65E-05	4.01E-07	1.32E-07
SR50	8.90E-05	9.85E-07	3.28E-07
SR51	2.78E-04	3.10E-06	1.04E-06
SR52	5.85E-05	6.30E-07	2.03E-07
SR53	3.16E-05	3.46E-07	1.14E-07
SR54	3.17E-05	3.40E-07	1.08E-07
SR55	2.09E-05	2.23E-07	7.09E-08
SR56	1.43E-05	1.53E-07	4.85E-08
SR57	1.20E-04	1.30E-06	4.23E-07
SR58	1.67E-05	1.83E-07	6.01E-08

Table B-2

Maximum Predicted Annual Deposition for Project Case (Construction Phase)

Receptor Location	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene
	Deposition Rate, Q (mg/100 cm²/yr)		
MPOI	3.41E-05	4.57E-05	2.62E-05
SR1	5.68E-06	7.66E-06	4.37E-06
SR2	1.92E-06	2.60E-06	1.48E-06
SR3	1.74E-06	2.35E-06	1.34E-06
SR4	3.47E-06	4.68E-06	2.67E-06
SR5	3.44E-06	4.65E-06	2.65E-06
SR6	1.63E-06	2.21E-06	1.26E-06
SR7	1.19E-06	1.61E-06	9.13E-07
SR8	1.39E-06	1.89E-06	1.07E-06
SR9	3.76E-06	5.10E-06	2.89E-06
SR10	2.86E-06	3.90E-06	2.20E-06
SR11	4.64E-06	6.32E-06	3.57E-06
SR12	5.29E-06	7.17E-06	4.07E-06
SR13	4.65E-06	6.29E-06	3.58E-06
SR14	6.29E-06	8.52E-06	4.84E-06
SR15	6.50E-06	8.80E-06	5.00E-06
SR16	4.93E-06	6.65E-06	3.80E-06
SR17	1.78E-06	2.41E-06	1.37E-06
SR18	5.76E-06	7.81E-06	4.43E-06
SR19	1.29E-05	1.73E-05	9.96E-06
SR20	6.32E-06	8.62E-06	4.86E-06
SR21	2.30E-06	3.15E-06	1.77E-06
SR22	2.36E-06	3.22E-06	1.82E-06
SR23	2.15E-06	2.93E-06	1.65E-06
SR24	2.14E-06	2.91E-06	1.65E-06
SR25	7.92E-06	1.07E-05	6.10E-06
SR26	7.38E-07	1.03E-06	5.68E-07
SR27	6.97E-07	9.75E-07	5.37E-07
SR28	6.97E-07	9.75E-07	5.37E-07
SR29	7.41E-07	1.04E-06	5.70E-07
SR30	8.16E-07	1.14E-06	6.28E-07
SR31	8.16E-07	1.14E-06	6.28E-07
SR32	9.22E-07	1.28E-06	7.09E-07
SR33	1.04E-06	1.45E-06	8.00E-07
SR34	1.18E-06	1.64E-06	9.10E-07
SR35	1.18E-06	1.64E-06	9.10E-07
SR36	3.97E-06	5.37E-06	3.05E-06
SR37	2.13E-06	2.90E-06	1.64E-06
SR38	3.27E-06	4.48E-06	2.52E-06
SR39	1.94E-06	2.66E-06	1.49E-06
SR40	3.79E-06	5.17E-06	2.92E-06
SR41	8.24E-06	1.12E-05	6.34E-06
SR42	1.45E-06	1.96E-06	1.12E-06
SR43	1.19E-06	1.61E-06	9.16E-07
SR44	7.32E-07	9.95E-07	5.63E-07

Table B-2

Maximum Predicted Annual Deposition for Project Case (Construction Phase)

Receptor Location	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene
	Deposition Rate, Q (mg/100 cm²/yr)		
SR45	3.49E-07	4.77E-07	2.68E-07
SR46	2.78E-07	3.80E-07	2.14E-07
SR47	2.88E-07	3.94E-07	2.21E-07
SR48	1.84E-07	2.54E-07	1.42E-07
SR49	1.95E-07	2.69E-07	1.50E-07
SR50	4.85E-07	6.62E-07	3.73E-07
SR51	1.54E-06	2.09E-06	1.18E-06
SR52	3.00E-07	4.22E-07	2.31E-07
SR53	1.68E-07	2.32E-07	1.30E-07
SR54	1.60E-07	2.27E-07	1.23E-07
SR55	1.05E-07	1.49E-07	8.06E-08
SR56	7.18E-08	1.02E-07	5.52E-08
SR57	6.25E-07	8.73E-07	4.81E-07
SR58	8.88E-08	1.23E-07	6.83E-08

Table B-2 **Maximum Predicted Annual Deposition for Project Case (Construction Phase)**

Receptor Location	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene
	Deposition Rate, Q (mg/100 cm²/yr)		
MPOI	9.00E-05	6.61E-06	8.37E-04
SR1	1.51E-05	1.10E-06	1.41E-04
SR2	5.12E-06	3.73E-07	4.79E-05
SR3	4.63E-06	3.38E-07	4.34E-05
SR4	9.22E-06	6.72E-07	8.63E-05
SR5	9.15E-06	6.67E-07	8.56E-05
SR6	4.36E-06	3.17E-07	4.08E-05
SR7	3.16E-06	2.30E-07	2.97E-05
SR8	3.71E-06	2.70E-07	3.48E-05
SR9	1.00E-05	7.29E-07	9.41E-05
SR10	7.67E-06	5.55E-07	7.22E-05
SR11	1.24E-05	8.99E-07	1.17E-04
SR12	1.41E-05	1.03E-06	1.32E-04
SR13	1.24E-05	9.03E-07	1.16E-04
SR14	1.68E-05	1.22E-06	1.57E-04
SR15	1.73E-05	1.26E-06	1.62E-04
SR16	1.31E-05	9.57E-07	1.22E-04
SR17	4.74E-06	3.45E-07	4.45E-05
SR18	1.54E-05	1.12E-06	1.44E-04
SR19	3.41E-05	2.51E-06	3.16E-04
SR20	1.69E-05	1.23E-06	1.60E-04
SR21	6.18E-06	4.47E-07	5.83E-05
SR22	6.33E-06	4.58E-07	5.96E-05
SR23	5.75E-06	4.17E-07	5.42E-05
SR24	5.72E-06	4.16E-07	5.36E-05
SR25	2.11E-05	1.54E-06	1.98E-04
SR26	2.02E-06	1.43E-07	1.93E-05
SR27	1.91E-06	1.35E-07	1.83E-05
SR28	1.91E-06	1.35E-07	1.83E-05
SR29	2.03E-06	1.44E-07	1.94E-05
SR30	2.23E-06	1.58E-07	2.14E-05
SR31	2.23E-06	1.58E-07	2.14E-05
SR32	2.52E-06	1.79E-07	2.41E-05
SR33	2.83E-06	2.02E-07	2.71E-05
SR34	3.22E-06	2.29E-07	3.07E-05
SR35	3.22E-06	2.29E-07	3.07E-05
SR36	1.06E-05	7.70E-07	9.90E-05
SR37	5.70E-06	4.13E-07	5.36E-05
SR38	8.80E-06	6.35E-07	8.31E-05
SR39	5.23E-06	3.75E-07	4.96E-05
SR40	1.02E-05	7.35E-07	9.56E-05
SR41	2.20E-05	1.60E-06	2.06E-04
SR42	3.87E-06	2.82E-07	3.62E-05
SR43	3.17E-06	2.31E-07	2.98E-05
SR44	1.96E-06	1.42E-07	1.84E-05

Table B-2 **Maximum Predicted Annual Deposition for Project Case (Construction Phase)**

Receptor Location	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene
	Deposition Rate, Q (mg/100 cm²/yr)		
SR45	9.38E-07	6.77E-08	8.85E-06
SR46	7.47E-07	5.38E-08	7.07E-06
SR47	7.75E-07	5.58E-08	7.32E-06
SR48	4.98E-07	3.57E-08	4.73E-06
SR49	5.28E-07	3.79E-08	5.01E-06
SR50	1.30E-06	9.41E-08	1.23E-05
SR51	4.10E-06	2.98E-07	3.85E-05
SR52	8.25E-07	5.82E-08	7.94E-06
SR53	4.56E-07	3.27E-08	4.33E-06
SR54	4.44E-07	3.11E-08	4.29E-06
SR55	2.91E-07	2.03E-08	2.82E-06
SR56	1.99E-07	1.39E-08	1.93E-06
SR57	1.71E-06	1.21E-07	1.64E-05
SR58	2.41E-07	1.72E-08	2.29E-06

Table B-2 **Maximum Predicted Annual Deposition for Project Case (Construction Phase)**

Receptor Location	Indeno(1,2,3,c,d)pyrene	Anthracene	Fluorene
	Deposition Rate, Q (mg/100 cm²/yr)		
MPOI	0.00E+00	7.93E-04	6.32E-03
SR1	0.00E+00	1.33E-04	1.07E-03
SR2	0.00E+00	4.54E-05	3.63E-04
SR3	0.00E+00	4.11E-05	3.29E-04
SR4	0.00E+00	8.17E-05	6.54E-04
SR5	0.00E+00	8.11E-05	6.49E-04
SR6	0.00E+00	3.87E-05	3.10E-04
SR7	0.00E+00	2.81E-05	2.25E-04
SR8	0.00E+00	3.29E-05	2.64E-04
SR9	0.00E+00	8.91E-05	7.15E-04
SR10	0.00E+00	6.84E-05	5.50E-04
SR11	0.00E+00	1.11E-04	8.91E-04
SR12	0.00E+00	1.25E-04	1.00E-03
SR13	0.00E+00	1.10E-04	8.79E-04
SR14	0.00E+00	1.49E-04	1.19E-03
SR15	0.00E+00	1.54E-04	1.23E-03
SR16	0.00E+00	1.16E-04	9.26E-04
SR17	0.00E+00	4.21E-05	3.38E-04
SR18	0.00E+00	1.37E-04	1.09E-03
SR19	0.00E+00	3.00E-04	2.39E-03
SR20	0.00E+00	1.51E-04	1.22E-03
SR21	0.00E+00	5.53E-05	4.45E-04
SR22	0.00E+00	5.64E-05	4.54E-04
SR23	0.00E+00	5.13E-05	4.12E-04
SR24	0.00E+00	5.08E-05	4.07E-04
SR25	0.00E+00	1.88E-04	1.50E-03
SR26	0.00E+00	1.83E-05	1.48E-04
SR27	0.00E+00	1.73E-05	1.41E-04
SR28	0.00E+00	1.73E-05	1.41E-04
SR29	0.00E+00	1.84E-05	1.50E-04
SR30	0.00E+00	2.02E-05	1.64E-04
SR31	0.00E+00	2.02E-05	1.64E-04
SR32	0.00E+00	2.28E-05	1.85E-04
SR33	0.00E+00	2.56E-05	2.08E-04
SR34	0.00E+00	2.90E-05	2.36E-04
SR35	0.00E+00	2.90E-05	2.36E-04
SR36	0.00E+00	9.38E-05	7.51E-04
SR37	0.00E+00	5.08E-05	4.08E-04
SR38	0.00E+00	7.87E-05	6.34E-04
SR39	0.00E+00	4.70E-05	3.80E-04
SR40	0.00E+00	9.06E-05	7.28E-04
SR41	0.00E+00	1.95E-04	1.56E-03
SR42	0.00E+00	3.43E-05	2.75E-04
SR43	0.00E+00	2.82E-05	2.26E-04
SR44	0.00E+00	1.74E-05	1.40E-04

Table B-2 **Maximum Predicted Annual Deposition for Project Case (Construction Phase)**

Receptor Location	Indeno(1,2,3,c,d)pyrene	Anthracene	Fluorene
	Deposition Rate, Q (mg/100 cm²/yr)		
SR45	0.00E+00	8.38E-06	6.75E-05
SR46	0.00E+00	6.69E-06	5.39E-05
SR47	0.00E+00	6.93E-06	5.59E-05
SR48	0.00E+00	4.47E-06	3.62E-05
SR49	0.00E+00	4.74E-06	3.83E-05
SR50	0.00E+00	1.16E-05	9.34E-05
SR51	0.00E+00	3.65E-05	2.92E-04
SR52	0.00E+00	7.52E-06	6.14E-05
SR53	0.00E+00	4.10E-06	3.32E-05
SR54	0.00E+00	4.06E-06	3.32E-05
SR55	0.00E+00	2.67E-06	2.19E-05
SR56	0.00E+00	1.83E-06	1.50E-05
SR57	0.00E+00	1.55E-05	1.26E-04
SR58	0.00E+00	2.17E-06	1.76E-05

Table B-2 **Maximum Predicted Annual Deposition for Project Case (Construction Phase)**

Receptor Location	Phenanthrene	Pyrene
	Deposition Rate, Q (mg/100 cm²/yr)	
MPOI	1.02E-02	7.40E-04
SR1	1.73E-03	1.25E-04
SR2	5.89E-04	4.26E-05
SR3	5.33E-04	3.85E-05
SR4	1.06E-03	7.66E-05
SR5	1.05E-03	7.60E-05
SR6	5.02E-04	3.63E-05
SR7	3.65E-04	2.64E-05
SR8	4.27E-04	3.09E-05
SR9	1.16E-03	8.37E-05
SR10	8.91E-04	6.44E-05
SR11	1.44E-03	1.04E-04
SR12	1.63E-03	1.17E-04
SR13	1.42E-03	1.03E-04
SR14	1.93E-03	1.40E-04
SR15	2.00E-03	1.44E-04
SR16	1.50E-03	1.08E-04
SR17	5.47E-04	3.95E-05
SR18	1.77E-03	1.28E-04
SR19	3.87E-03	2.79E-04
SR20	1.97E-03	1.42E-04
SR21	7.21E-04	5.21E-05
SR22	7.35E-04	5.31E-05
SR23	6.68E-04	4.83E-05
SR24	6.59E-04	4.77E-05
SR25	2.43E-03	1.76E-04
SR26	2.40E-04	1.74E-05
SR27	2.28E-04	1.65E-05
SR28	2.28E-04	1.65E-05
SR29	2.42E-04	1.75E-05
SR30	2.66E-04	1.93E-05
SR31	2.66E-04	1.93E-05
SR32	3.00E-04	2.17E-05
SR33	3.37E-04	2.43E-05
SR34	3.82E-04	2.76E-05
SR35	3.82E-04	2.76E-05
SR36	1.22E-03	8.79E-05
SR37	6.62E-04	4.78E-05
SR38	1.03E-03	7.42E-05
SR39	6.15E-04	4.44E-05
SR40	1.18E-03	8.53E-05
SR41	2.53E-03	1.83E-04
SR42	4.45E-04	3.22E-05
SR43	3.66E-04	2.65E-05
SR44	2.26E-04	1.64E-05

Table B-2 **Maximum Predicted Annual Deposition for Project Case (Construction Phase)**

Receptor Location	Phenanthrene	Pyrene
	Deposition Rate, Q (mg/100 cm²/yr)	
SR45	1.09E-04	7.91E-06
SR46	8.74E-05	6.32E-06
SR47	9.06E-05	6.55E-06
SR48	5.86E-05	4.23E-06
SR49	6.21E-05	4.49E-06
SR50	1.51E-04	1.09E-05
SR51	4.73E-04	3.42E-05
SR52	9.94E-05	7.18E-06
SR53	5.37E-05	3.88E-06
SR54	5.38E-05	3.89E-06
SR55	3.55E-05	2.57E-06
SR56	2.43E-05	1.76E-06
SR57	2.05E-04	1.48E-05
SR58	2.85E-05	2.06E-06

Table B-2 Maximum Predicted Annual Deposition for Project Case (Construction Phase)

Receptor Location	Arsenic	Chromium	Manganese	Mercury	Nickel
	Deposition Rate, Q (mg/100 cm²/yr)				
MPOI	5.57E-05	1.14E-06	1.03E-04	1.11E-07	1.79E-04
SR1	1.44E-05	2.95E-07	2.67E-05	2.87E-08	4.65E-05
SR2	4.68E-06	9.55E-08	8.65E-06	9.28E-09	1.51E-05
SR3	4.30E-06	8.77E-08	7.95E-06	8.53E-09	1.38E-05
SR4	7.67E-06	1.57E-07	1.42E-05	1.52E-08	2.47E-05
SR5	7.30E-06	1.49E-07	1.35E-05	1.45E-08	2.35E-05
SR6	3.88E-06	7.93E-08	7.18E-06	7.71E-09	1.25E-05
SR7	2.81E-06	5.74E-08	5.20E-06	5.58E-09	9.05E-06
SR8	3.14E-06	6.41E-08	5.81E-06	6.24E-09	1.01E-05
SR9	1.35E-05	2.77E-07	2.50E-05	2.69E-08	4.36E-05
SR10	1.08E-05	2.21E-07	2.01E-05	2.15E-08	3.49E-05
SR11	1.48E-05	3.02E-07	2.73E-05	2.94E-08	4.76E-05
SR12	1.07E-05	2.19E-07	1.98E-05	2.13E-08	3.45E-05
SR13	9.65E-06	1.97E-07	1.79E-05	1.92E-08	3.11E-05
SR14	1.26E-05	2.57E-07	2.33E-05	2.50E-08	4.05E-05
SR15	1.20E-05	2.45E-07	2.22E-05	2.38E-08	3.86E-05
SR16	9.53E-06	1.94E-07	1.76E-05	1.89E-08	3.07E-05
SR17	3.63E-06	7.41E-08	6.71E-06	7.21E-09	1.17E-05
SR18	1.65E-05	3.36E-07	3.04E-05	3.27E-08	5.30E-05
SR19	3.48E-05	7.11E-07	6.44E-05	6.91E-08	1.12E-04
SR20	2.13E-05	4.35E-07	3.94E-05	4.23E-08	6.86E-05
SR21	1.02E-05	2.08E-07	1.89E-05	2.02E-08	3.28E-05
SR22	1.15E-05	2.34E-07	2.12E-05	2.28E-08	3.70E-05
SR23	1.09E-05	2.22E-07	2.01E-05	2.16E-08	3.50E-05
SR24	5.72E-06	1.17E-07	1.06E-05	1.14E-08	1.84E-05
SR25	2.39E-05	4.88E-07	4.42E-05	4.74E-08	7.69E-05
SR26	5.99E-06	1.22E-07	1.11E-05	1.19E-08	1.93E-05
SR27	5.94E-06	1.21E-07	1.10E-05	1.18E-08	1.91E-05
SR28	5.94E-06	1.21E-07	1.10E-05	1.18E-08	1.91E-05
SR29	6.08E-06	1.24E-07	1.12E-05	1.21E-08	1.96E-05
SR30	6.47E-06	1.32E-07	1.20E-05	1.28E-08	2.08E-05
SR31	6.47E-06	1.32E-07	1.20E-05	1.28E-08	2.08E-05
SR32	6.83E-06	1.39E-07	1.26E-05	1.35E-08	2.20E-05
SR33	6.94E-06	1.42E-07	1.28E-05	1.38E-08	2.23E-05
SR34	7.07E-06	1.44E-07	1.31E-05	1.40E-08	2.28E-05
SR35	7.07E-06	1.44E-07	1.31E-05	1.40E-08	2.28E-05
SR36	7.26E-06	1.48E-07	1.34E-05	1.44E-08	2.34E-05
SR37	1.06E-05	2.17E-07	1.97E-05	2.11E-08	3.43E-05
SR38	1.38E-05	2.81E-07	2.54E-05	2.73E-08	4.43E-05
SR39	1.20E-05	2.45E-07	2.22E-05	2.38E-08	3.87E-05
SR40	1.41E-05	2.87E-07	2.60E-05	2.79E-08	4.53E-05
SR41	2.50E-05	5.10E-07	4.62E-05	4.95E-08	8.03E-05
SR42	4.56E-06	9.31E-08	8.43E-06	9.05E-09	1.47E-05
SR43	3.45E-06	7.04E-08	6.38E-06	6.85E-09	1.11E-05
SR44	1.73E-06	3.53E-08	3.20E-06	3.43E-09	5.56E-06

Table B-2 Maximum Predicted Annual Deposition for Project Case (Construction Phase)

Receptor Location	Arsenic	Chromium	Manganese	Mercury	Nickel
	Deposition Rate, Q (mg/100 cm²/yr)				
SR45	1.06E-06	2.17E-08	1.96E-06	2.11E-09	3.42E-06
SR46	9.17E-07	1.87E-08	1.69E-06	1.82E-09	2.95E-06
SR47	9.16E-07	1.87E-08	1.69E-06	1.82E-09	2.95E-06
SR48	7.05E-07	1.44E-08	1.30E-06	1.40E-09	2.27E-06
SR49	7.31E-07	1.49E-08	1.35E-06	1.45E-09	2.35E-06
SR50	1.56E-06	3.17E-08	2.88E-06	3.09E-09	5.01E-06
SR51	4.41E-06	9.00E-08	8.15E-06	8.75E-09	1.42E-05
SR52	3.80E-06	7.77E-08	7.04E-06	7.55E-09	1.22E-05
SR53	7.66E-07	1.56E-08	1.42E-06	1.52E-09	2.47E-06
SR54	2.90E-06	5.92E-08	5.36E-06	5.76E-09	9.34E-06
SR55	2.31E-06	4.72E-08	4.27E-06	4.59E-09	7.44E-06
SR56	1.73E-06	3.54E-08	3.21E-06	3.44E-09	5.58E-06
SR57	5.37E-06	1.10E-07	9.93E-06	1.07E-08	1.73E-05
SR58	4.33E-07	8.83E-09	8.00E-07	8.59E-10	1.39E-06

Table B-3 Maximum Predicted Change in Soil Concentration

COPC	Maximum Predicted Change in Soil Concentration, Cs (mg/kg)		Background Concentration		Maximum Change	Health-based Screening Level	
	at MPOI	at Receptor	(mg/kg)	Reference	%	(mg/kg)	Reference
Carcinogenic PAHs							
Benzo(a)pyrene (TPE)	6.29E-04	2.38E-04	7.00E-02	a	1%	5.30E+00	a
Non-carcinogenic PAHs							
Anthracene	4.76E-03	1.80E-03	5.00E-02	b	10%	2.50E+00	a
Fluorene	3.79E-02	1.43E-02	5.00E-02	b	76%	1.54E+01	a
Phenanthrene	6.14E-02	2.32E-02	1.90E-01	b	32%	4.30E+01	a
Pyrene	4.44E-03	1.68E-03	1.90E-01	b	2%	7.70E+00	a
Metals							
Arsenic Compounds	3.34E-04	2.09E-04	6.93E+00	c	0%	1.70E+01	a
Chromium 6+	6.83E-06	4.26E-06	<0.3	d	0%	4.00E-01	a
Manganese Compounds	6.18E-04	3.86E-04	1.90E+03	b	0%	-	
Mercury	6.64E-07	4.14E-07	3.10E-02	c	0%	6.60E+00	a
Nickel Compounds	1.08E-03	6.72E-04	2.45E+01	c	0%	4.50E+01	a

References:

(a) Alberta Government. 2016. Tier I Soil and Groundwater Remediation Guidelines, Table A-2 (Health-based Screening Level) and Table C-9 (Background Concentration).

(b) Ontario Ministry of Environment. 2011. Rationale for the Development od Soil and Groundwater Standards for Use at Contaminated Sites in Ontario. Table 1, Agricultural (for PAHs) and Table 8.3b (Manganese)

(c) Maximum measured concentration in collected soil samples from PDA

(d) Millenium EMS Solutions. 2016. Best Practices - Evaluation of Background Metal Concentrations in Alberta Soil. Letter to Petroleum Technology Alliance Canada, dated August 16, 2016. File #15-00403.

Attachment C SAMPLE CALCULATIONS

Exposure Ratio

Exposure Ratio (ER) sample calculation for acute (1-hour) exposure to nitrogen dioxide (NO_2) at the maximum point of impingement for the Application Case during the Construction phase is provided below.

$$ER = \frac{C_{air}}{TRV}$$

Where

ER = Exposure ratio, unitless
C_{air} = Concentration in air, µg/m³
= 370 µg/m³ (see Table A-1)
TRV = Toxicological Reference Value, µg/m³
= 114 µg/m³ (see Table 4-1)

$$ER = \frac{370\ \mu g/m^3}{114\ \mu g/m^3} = 3.3$$

Soil Concentration

The soil concentration (Cs) sample calculation for maximum Project-related change in soil from arsenic deposition during the construction phase is provided below.

$$Cs = \frac{QT}{\rho \cdot Z_d} \times 10^6$$

Where

Cs = Predicted change in soil concentration, mg/kg
Q = Surface atmospheric deposition rate, g/cm²/yr
= 5.57E-10 g/cm²/yr (see Table B-2)
T = Time of deposition, yr
= 3 yr (based on 36 month construction period)
ρ = Bulk density of soil, g/cm³
= 1 g/cm³ (conservative, based on typical ranges of 1.0 to 1.8 g/cm³)
Z_d = Mixing depth, cm
= 5 cm (Health Canada, 2010a)
10^6 = Conversion factor (g/g to mg/kg)

$$Cs = \frac{(5.57E\text{-}10)(3)}{(1)\cdot(5)} \times 10^6 = 0.000334$$